

INTERCONNECTION STANDARDS  
FOR NET METERED GENERATING FACILITIES

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# TABLE OF CONTENTS

- SECTION I. INTERCONNECTION REQUIREMENTS FOR GENERATING FACILITIES 50kW AND UNDER..... 3
  - 1. GENERAL REQUIREMENTS ..... 3
    - 1.1 Size..... 3
    - 1.2 Location ..... 3
    - 1.3 Codes, Standards and Regulatory Agencies..... 4
    - 1.4 Protection of the Utility System..... 4
    - 1.5 Disconnection of Generators..... 6
    - 1.6 Protection ..... 6
    - 1.7 Inspection and Maintenance..... 7
  - 2. SPECIFIC REQUIREMENTS FOR INTERCONNECTION ..... 8
    - 2.1 Inverter Systems..... 9
    - 2.2 Synchronous Generators ..... 22
    - 2.3 Induction Generators..... 22
    - 2.4 Storage ..... 23
- SECTION II. INTERCONNECTION REQUIRMENTS FOR GENERATION OVER 50kW ..... 23
  - 1. GENERATING FACILITIES OVER 50kW ..... 23
- SECTION III. INSURANCE AND WARRANTY/PERFORMANCE REQUIREMNETS ..... 24
  - 1. LIABILITY INSURANCE REQUIREMENTS ..... 24
  - 2. WARRANTY/PERFORMANCE..... 24
- APPENDIX I - SUMMARY OF INTERCONNECTION PROCEDURE ..... 26
- APPENDIX II - GENERATING FACILITY DESIGN DATA REQUIREMENTS.....27
- APPENDIX III - SUMMARY OF CODES AND STANDARDS ..... 28
- APPENDIX IV - PROTECTIVE DEVICE DESCRIPTIONS ..... 30
- APPENDIX V DEFINITIONS ..... 31
- APPENDIX VI - ONE-LINE DIAGRAM .....32

## SECTION I. INTERCONNECTION REQUIREMENTS FOR GENERATING FACILITIES 50kW AND UNDER

The following interconnection requirements shall apply to all Generating Facilities connecting with La Plata Electric Association's ("LPEA") System.

### 1. GENERAL REQUIREMENTS

To ensure safe and reliable power system operation, protective equipment, meeting the standards in this document, must be installed at locations where the member wishes to operate generating facilities in parallel with LPEA's system. In addition, all applications will pass through an engineering review process. If the review finds that changes, such as revisions to the electrical system configuration and/or modifications to protective equipment at other locations, are needed, in order to accommodate parallel operation, those modifications will need to be made prior to interconnection. All costs associated with interconnection, necessary system additions, and modifications to accommodate the Generating Facility will be borne by the member.

LPEA requires that the member design, construct and operate their equipment in a manner which will not degrade the quality of service to other LPEA members. This requires that the Generating Facility's 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 member's equipment, installation and operation in any respect which affects safety, reliability or quality of service.

LPEA will not assume responsibility for protection of the members' Generating Facility or any other portion of the members' electrical equipment. The member is fully responsible for properly protecting their 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 member in determining conditions to which their equipment is likely to be subjected to as a result of probable system operation or disturbances, as much as possible to determine these conditions in advance.

#### 1.1 Size

LPEA requires that all proposed applications meet the current Net Metering Tariff requirements.

#### 1.2 Location

For interconnection of a Generating Facility to a radial distribution circuit, the aggregated generation, including the proposed Generating Facility, on the circuit shall not exceed LPEA's determination of the line sections balance of load to generation. A line section is that portion of LPEA's electric system connected to a member bounded by automatic sectionalizing devices or the end of the distribution line.

If the Generating Facility is to be interconnected on single-phase shared secondary, the aggregate generation capacity on the shared secondary, shall not increase voltage on other services over industry standards, (ANSI C84.1). If voltage exceeds 105% at the Point of Common Coupling the Generating Facility will be disconnected.

If the Generating Facility 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.

The above requirements for Generating Facilities assume a low density of parallel generation of members on the service circuit. LPEA may impose additional requirements if necessary, for safe, reliable service to other LPEA members.

### 1.3 Codes, Standards and Regulatory Agencies

The member must ensure that the Generating 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. The member agrees to hold LPEA harmless for any damage to person or loss to property arising out of the member's failure to comply with such codes or legal requirements. The member's installation must be inspected and certified by a Colorado State Electrical Inspector before the Generating Facility's 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". For a summary of applicable codes and standards, see Appendix III.

### 1.4 Protection of the Utility System

In order to be assured of continuing safe, reliable service to LPEA members, LPEA must be concerned with the manner in which the Generating Facility is connected to the existing LPEA system. LPEA's concerns are fourfold:

- 1) The Generating Facility must promptly disconnect from LPEA in the event of a utility system disturbance;
- 2) The Generating Facility must disconnect in the event of a malfunction or disturbance on the member's equipment;
- 3) The Generating Facility must not backfeed a de-energized LPEA line; and
- 4) The Generating Facility must not degrade the quality of service to other LPEA members.

#### 1.4.1 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 Generating Facility connected to this portion of line represents an additional source of power to energize the line. Thus, the member's equipment must also automatically act to disconnect the Generating Facility to avoid contributing to the severity of the fault, to avoid isolated operation and to protect the member's 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 Generating Facility, the voltage will collapse, and protective relays will take the Generating Facility off line. When the production 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 members, is likely to occur. 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 Generating Facility will not always be isolated with a sufficiently large load to prevent independent operation, LPEA requires inverters are IEEE 1547 compliant. 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.

#### *1.4.2 Disturbances*

To prevent loss of service to other LPEA members, the member must provide protective equipment to promptly disconnect the Generating Facility in the event of a fault or other disturbance on the member'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 member to properly coordinate the protective equipment.

#### *1.4.3 Backfeed to Utility System*

The Generating Facility provides an additional source of power for LPEA's network. The member must provide protective equipment sufficient to give positive assurance that the Generating Facility 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 requires an accessible disconnect device that is visibly marked "Generation Disconnect" and has the capability of isolating the energy produced by each Generating Facility. 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 Generating Facility.

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.

#### *1.4.4 Power Quality*

The Generating Facility will not be allowed to degrade the quality of power delivered to other LPEA members. The Generating Facility will be expected to operate within the limits on voltage, frequency and harmonic content as outlined in the codes and standards listed in ANSI C84.1.

Synchronous generation is expected to operate at as nearly unity power factor as is practical to prevent voltage flicker upon switching. The Generating Facility 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 the member's 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 members or interference with the operation of LPEA equipment occurs, LPEA will disconnect the member until such time as the problem is resolved.

#### *1.4.5 Protective Equipment*

The type and quality of protective equipment required will depend on the size and type of the member's equipment as well as the electrical characteristics of LPEA's interconnection. Additional equipment may be necessary for a given installation. 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 member installations.

### 1.5 Disconnection of Generators

#### *1.5.1 Emergency Disconnect*

LPEA may disconnect the Generating Facility, without prior notice to the member. LPEA shall notify the member of the emergency if circumstances permit;

- a. To eliminate conditions that constitute a potential hazard to LPEA personnel or the general public
- b. If pre-emergency or emergency conditions exist on the utility system
- c. If a hazardous condition relating to the Generating Facility is observed by a LPEA inspection
- d. If the member has tampered with any protective device

#### *1.5.2 Non-Emergency Disconnect*

LPEA may disconnect the Generating Facility, after notice to the responsible party has been provided and a reasonable time to correct, consistent with the conditions, has elapsed;

- a. The member has failed to make available records of verification tests and maintenance of the protective devices
- b. The Generating Facility interferes with utility equipment or equipment belonging to other members of the utility
- c. The Generating Facility adversely affects other member services
- d. The Generating Facility exports more power than approved for
- e. The Generating Facility fails to maintain voltage and frequency requirements
- f. The member installed a renewable system without approval from LPEA

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

### 1.6 Protection

The member is solely responsible for protection of their Generating Facility equipment. To facilitate the design, LPEA herein lists potential hazards to the member's 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 APPENDIX IV.

The member's equipment can be damaged by interconnection with LPEA's system if the voltage, phase sequence or phase angle of the Generating Facility does not match that of the system. For synchronous generators the member 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 member's equipment as a result of automatic reclosure unless proper protection is provided. LPEA's transmission and distribution lines are usually equipped with circuit reclosers 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 member's Generating Facility was not taken off-line when LPEA's circuit was opened, the Generating Facility 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 Generating Facility 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 Generating Facility. The cost of such modifications will be charged to the member.

Transient voltage surges may occur on LPEA lines due to switching operations or lightning strikes. The Generating Facility 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 APPENDIX IV.

## 1.7 Inspection and Maintenance

### 1.7.1 Inspection

The member shall not commence interconnected operation, until:

- 1) The member has supplied LPEA with a completed Application for Interconnection/Net Metering a form supplied by LPEA for review and acceptance
- 2) The member 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 Generating Facility

- 4) LPEA has inspected and tested the Generating Facility and certified, in writing, that the Generating Facility has complied with all requirements for interconnection; and
- 5) The member 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 member must notify LPEA prior to any modifications made to the Generating Facility or to the interconnection between the Generating Facility and LPEA. The member must receive approval from LPEA prior to proceeding with such modifications. The member 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 member.

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

#### *1.7.2 Maintenance*

The member shall operate and maintain Generating Facility equipment at their cost unless previous arrangements have been made with LPEA to maintain the Generating Facility equipment. In this case, LPEA will operate and maintain the Generating Facility equipment and bill the member for these services.

The member 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 Generating Facilities location, size, design, specific operating and system requirements, and the availability of materials needed to accomplish the interconnection.

Member's 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.

## **2. SPECIFIC REQUIREMENTS FOR INTERCONNECTION**

All Generating Facilities are required to:

- 1) Have a clearly displayed permanent and weather proof sign indicating the location of the Generation Disconnect.
- 2) Have an AMI meter installed at the member's service location prior to final inspection.
- 3) Have an accessible disconnect switch as specified in Section 1.4.3.;

- 4) Have a circuit breaker rated for the service to which it is applied;

In addition, the member should consider installation of:

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

In addition to the above requirements, LPEA has established guidelines for the protection and interconnection of parallel Generating Facilities by type. These guidelines represent the minimum requirements for interconnection and recommended practice for member's equipment protection. The member shall be the sole judge of what equipment is necessary to protect the Generating Facility and associated electrical equipment. LPEA shall be the sole judge of what equipment is necessary to ensure a safe and reliable interconnection with LPEA's system.

The types of Generating Facilities for parallel generation are:

- 1) Inverter Systems
- 2) Synchronous Generators
- 3) Induction Generators
- 4) Storage

## 2.1 Inverter Systems

The inverter requirements are intended to be consistent with UL 1741 - Supplement SA using this document as the source requirement document and ANSI/IEEE 1547 and 1547a Standard for Interconnecting Distributed Resources with Electric Power Systems (IEEE 1547 including amendment 1547a), where possible. In the event of conflict between this document, and UL 1741 - Supplement SA, and/or IEEE 1547-2003 or IEEE 1547a, this document shall take precedence.

### 1. GENERAL INTERCONNECTION AND PROTECTIVE FUNCTION REQUIREMENTS

The Protective Functions and requirements of this document are designed to protect La Plata Electric's Distribution and Transmission System and not the Generating Facility. The member shall be solely responsible for providing adequate protection for its Generating Facility and Interconnection Facilities. Generating Facilities Protective Functions shall not impact the operation of other Protective Functions on La Plata Electric's Distribution and Transmission System in a manner that would affect La Plata Electric's capability of providing reliable service to its customers.

a. **Protective Functions Required**

Inverters operating in parallel with La Plata Electric's Distribution or Transmission System shall be equipped with the following Protective Functions to sense abnormal conditions on La Plata Electric's Distribution or Transmission System and cause the Inverter to be automatically disconnected from La Plata Electric's Distribution or Transmission System or to prevent the Inverter from being connected to La Plata Electric's Distribution or Transmission System inappropriately:

- i. Over and under voltage trip functions and over and under frequency trip functions;
- ii. A voltage and frequency sensing and time-delay function to prevent the Inverter from energizing a de-energized Distribution or Transmission System circuit and to prevent the Inverter from reconnecting with La Plata Electric's Distribution or Transmission System unless La Plata Electric's Distribution System service voltage and frequency is within the ANSI C84.1-1995 Table 1 Range B voltage Range of 106 volts to 127 volts (on a 120 volt basis), inclusive, and a frequency range of 59.3 Hz to 60.5 Hz, inclusive, and are stable for at least 15 seconds; and
- iii. A function to prevent the Inverter from contributing to the formation of an Unintended Island and cease to energize La Plata Electric's Distribution System within two seconds of the formation of an Unintended Island.

The Inverter shall cease to energize La Plata Electric's Distribution System for faults on La Plata Electric's Distribution System circuit to which it is connected (IEEE 1547-4.2.1). The Inverter shall cease to energize La Plata Electric's Distribution circuit prior to re-closure by La Plata Electric's Distribution System equipment (IEEE 1547-4.2.2).

b. **Momentary Paralleling Generating Facilities**

With La Plata Electric's approval, the transfer switch or scheme used to transfer member's loads from La Plata Electric's Distribution or Transmission System to member's Generating Facility may be used in lieu of the Protective Functions required for Parallel Operation.

c. **Suitable Equipment Required**

Circuit breakers or other interrupting equipment located at the Point of Common Coupling (PCC) must be Certified or "Listed" (as defined in Article 100, the Definitions Section of the National Electrical Code) as suitable for their intended application. This includes being capable of interrupting the maximum available fault current expected at their location. The member's Inverter and Interconnection Facilities shall be designed so that the failure of any single device or component shall not potentially compromise the safety

and reliability of La Plata Electric's Distribution and Transmission System. The Inverter paralleling-device shall be capable of withstanding 220% of the Interconnection Facility rated voltage (IEEE 1547- 4.1.8.3). The Interconnection Facility shall have the capability to withstand voltage and current surges in accordance with the environments defined in IEEE Std C62.41.2-2002 or IEEE Std C37.90.1-2002 as applicable and as described in L.3.e (IEEE 1547- 4.1.8.2).

d. **Visible Disconnect Required**

The member shall furnish and install a ganged, manually-operated isolating switch (or a comparable device mutually agreed upon by La Plata Electric and member) to isolate the Inverter from La Plata Electric's Distribution or Transmission System. The device does not have to be rated for load break nor provide over-current protection.

The device must:

- i. allow visible verification that separation has been accomplished. (This requirement may be met by opening the enclosure to observe contact separation.)
- ii. include markings or signage that clearly indicates open and closed positions.
- iii. be capable of being reached:
  - a. for Emergency purposes quickly and conveniently 24 hours a day by La Plata Electric personnel for construction, operation, maintenance, inspection, testing or to isolate the Inverter from La Plata Electric's Distribution or Transmission System without obstacles or requiring those seeking access to obtain keys, special permission, or security clearances.
- iv. be capable of being locked in the open position.
- v. be clearly marked on the submitted single line diagram and its type and location approved by La Plata Electric prior to installation. If the device is not adjacent to the PCC, permanent signage must be installed at a La Plata Electric approved location providing a clear description of the location of the device. If the switch is not accessible outside the locked premises, signage with contact information and a La Plata Electric approved locking device for the premises shall be installed.

e. **Meter Socket**

- i. Any empty meter socket is required between the generator and LPEA's meter. The meter socket needs to be in a convenient place

which is approved by LPEA for the metering of generation. See Appendix VI for additional layout information.

- ii. A production meter, capable of communicating with LPEA's metering system is required to be set in the meter socket. Contact LPEA to acquire the appropriate meter.

f. **Drawings Required**

Prior to Parallel Operation or Momentary Parallel Operation of the Inverter, La Plata Electric shall approve the members Protective Function and control diagrams. Generating Facilities equipped with Protective Functions and a control scheme previously approved by La Plata Electric for system-wide application or only Certified Equipment may satisfy this requirement by reference to previously approved drawings and diagrams.

g. **Generating Facility Conditions Not Identified**

In the event this document does not address the Interconnection conditions for a particular Inverter, La Plata Electric and member may agree upon other arrangements.

## 2. PREVENTION OF INTERFERENCE

The member shall not operate Inverters that superimpose a voltage or current upon La Plata Electric's Distribution or Transmission System that interferes with La Plata Electric operations, service to La Plata Electric Members, or communication facilities. If such interference occurs, the member must diligently pursue and take corrective action at its own expense after being given notice and reasonable time to do so by La Plata Electric. If member does not take corrective action in a timely manner or continues to operate the facilities causing interference without restriction or limit, La Plata Electric may, without liability, disconnect Generating Facilities from La Plata Electric's Distribution or Transmission System, in accordance with Section D of this document. To eliminate undesirable interference caused by its operation, each Inverter shall meet the following criteria:

i. **Voltage Regulation**

If approved by La Plata Electric, the Inverter may actively regulate the voltage at the PCC while in parallel with La Plata Electric's Distribution System. The Inverter shall not cause the service voltage at other customers to go outside the requirements of ANSI C84.1-1995, Range A (IEEE 1547-4.1.1).

ii. **Voltage Trip and Ride-Through Settings**

The voltage ranges in Table 1.1 define protective trip limits for the Protective Function and are not intended to define or imply a voltage regulation Function. Generating Facilities shall cease to energize La Plata Electric's Distribution System within the prescribed trip time

whenever the voltage at the PCC deviates from the allowable voltage operating range. The Protection Function shall detect and respond to voltage on all phases to which the Generating Facility is connected.

i. Inverters

Inverters shall be capable of operating within the voltage range normally experienced on La Plata Electric's Distribution System from plus to minus 5% of the nominal voltage (e.g. 114 volts to 126 volts, on a 120-volt base), at the service panel or PCC. The trip settings at the generator terminals may be selected in a manner that minimizes nuisance tripping in accordance with Table 1.1 to compensate for voltage drop between the generator terminals and the PCC. Voltage may be detected at either the PCC or the Point of Interconnection. However, the voltage range at the PCC, with the Generating Facility on-line, shall stay within +/-5% of nominal.

ii. Voltage Disturbances

Whenever La Plata Electric's Distribution System voltage at the PCC varies from and remains outside near Nominal voltage for the predetermined parameters set forth in Table 1.1, the Inverter's Protective Functions shall cause the Inverter(s) to become isolated from La Plata Electric's Distribution System:

1. The Inverter shall stay connected to La Plata Electric's Transmission or Distribution System while the grid remains within the "Ride-Through Until" voltage-time range and must stay connected in the corresponding "Operating Mode.
2. For voltage excursions beyond the near Nominal (NN) magnitude range and within the range of the HV1 or LV3 regions, the Inverter shall momentarily cease to energize within 0.16 seconds.
3. In the HV1 region, the Inverter is permitted to reduce power output as a function of voltage under mutual agreement between the Producer and La Plata Electric.
4. If the distribution system voltage does not exit the ride-through region and recovers to normal system voltage, the Inverter shall restore continuous operation within 2 seconds.
5. If La Plata Electric's Transmission or Distribution System voltage does not exit the ride-through region and returns from the LV3 region to the LV2 or LV1 region, the Inverter shall restore available current within 2 seconds.

**Table 1.1:** Voltage Ride-Through Table

<b>Region</b>	<b>Voltage at Point of Common Coupling (% Nominal Voltage)</b>	<b>Ride-Through Until</b>	<b>Operating Mode</b>	<b>Maximum Trip Time</b>
<b>High Voltage 2 (HV2)</b>	$V > 120$			0.16 seconds
<b>High Voltage 1 (HV1)</b>	$110 < V < 120$	12 seconds	Momentary Cessation	13 seconds
<b>Near Nominal (NN)</b>	$88 < V < 110$	Indefinite	Continuous Operation	Not Applicable
<b>Low Voltage 1 (LV1)</b>	$70 < V < 88$	20 seconds	Mandatory Operation	21 seconds
<b>Low Voltage 2 (LV2)</b>	$50 < V < 70$	10 seconds	Mandatory Operation	11 seconds
<b>Low Voltage 3 (LV3)</b>	$V < 50$	1 seconds	Momentary Cessation	1.5 seconds

iii. **Paralleling**

The Generating Facility shall parallel with La Plata Electric’s Distribution or Transmission System without causing a voltage fluctuation at the PCC greater than plus/minus 5% of the prevailing voltage level of La Plata Electric’s Distribution or Transmission System at the PCC and meet the flicker requirements of Section 2.d. iv., Certification and Testing Criteria, provides technology-specific tests for evaluating the paralleling Function. (IEEE 1547-4.1.3)

iv. **Flicker**

The Generating Facility shall not create objectionable flicker for other customers on La Plata Electric’s Distribution or Transmission System. To minimize the adverse voltage effects experienced by other customers (IEEE 1547-4.3.2), flicker at the PCC caused by the Generating Facility should not exceed the limits defined by the "Maximum Borderline of Irritation Curve" identified in IEEE 519-1992 (IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, IEEE STD 519-1992). This requirement is necessary to minimize the adverse voltage affects experienced by other members on La Plata Electric’s Distribution or Transmission System. The Generating Facility may be connected and

brought up to synchronous speed (as an induction motor) provided these flicker limits are not exceeded.

v. **Integration with La Plata Electric's Distribution System Grounding**

The grounding scheme of the Generating Facility shall not cause over-voltages that exceed the rating of the equipment connected to La Plata Electric's Distribution System and shall not disrupt the coordination of the ground fault protection on La Plata Electric's Distribution System (IEEE 1547-4.1.2).

vi. **Frequency**

La Plata Electric controls system frequency, and the Generating Facility shall operate in synchronism with La Plata Electric's Distribution or Transmission System. Whenever La Plata Electric's Distribution or Transmission System frequency at the PCC varies from and remains outside normal (nominally 60 Hz) by the predetermined amounts set forth in Table 1.2, the Generating Facility's Protective Functions shall cease to energize La Plata Electric's Distribution or Transmission System within the stated maximum trip time.

i. **Frequency Ride-Through Requirements**

Inverter based systems shall remain connected to La Plata Electric's Distribution or Transmission System while the grid is within the frequency-time range indicated in Table 1.2 and shall disconnect from the electric grid during a high or low frequency event that is outside that frequency-time range. The frequency values are shown in Table 1.2. These values provide default interconnection system response to abnormal frequencies. The inverter shall disconnect by the default clearing times. In the high frequency range between 60.2 Hz and 61.5 Hz, or some other mutually agreed range, the Inverter is permitted to reduce real power output until it ceases to export power by 61.5 Hz, or other frequency value mutually agreed between the generating facility operator and La Plata Electric. Islands and microgrids may need different default frequency settings.

**Table 1.2:** Frequency Ride-Through and Trip Settings Table

System Frequency Default Settings (Hz)	Minimum Range of Adjustability (Hz)	Ride Through Until	Ride Through Operational Mode	Maximum Trip Time
<b>f &gt; 62</b>	62 - 64	No Ride Through	Not Applicable	0.16 seconds
<b>60.5 &lt; f &lt; 62</b>	60.1 - 62	299 seconds	Mandatory Operation	300 seconds
<b>58.5 &lt; f &lt; 60.5</b>	Not Applicable	Indefinite	Continuous Operation	Not Applicable
<b>57.0 &lt; f &lt; 58.5</b>	57 - 59.9	299 seconds	Mandatory Operation	300 seconds
<b>f &lt; 57.0</b>	53 - 57	No Ride Through	Not Applicable	0.16 seconds

**h. Harmonics**

When the Inverter is serving balanced linear loads, harmonic current injection into La Plata Electric’s Distribution or Transmission System at the PCC shall not exceed the limits stated in Table 1.3. The harmonic current injections shall be exclusive of any harmonic currents due to harmonic voltage distortion present in La Plata Electric’s Distribution or Transmission System without the Inverter connected (IEEE 1547-4.3.3.). The harmonic distortion of an Inverter shall be evaluated using the same criteria as for the Host Loads.

**Table 1.3** Maximum harmonic current distortion in percent of current (I) [1,2]

Individual harmonic order, h	h<11	11≤ h<17	17≤ h<23	23≤ h<35	35≤ h	Total demand distortion
Total demand (odd harmonics) [3] Max Distortion (%)	4.0	2.0	1.5	0.6	0.3	5.0

[1] – IEEE1547-4.3.3, [2] – I = the greater of the maximum Host Load current average demand over 15 or 30 minutes without the GF, or the GF rated current capacity (transformed to the PCC when a transformer exists between the GF and the PCC). [3] – Even harmonics are limited to 25% of the odd harmonic limits above.

**i. Direct Current Injection**

Inverter should not inject direct current greater than 0.5% of rated output current into La Plata Electric’s Distribution or Transmission System.

j. **Power Factor Producer**

The member shall provide adequate reactive power compensation on site to maintain the Inverter power factor near unity at rated output or a La Plata Electric specified power factor in accordance with the following requirements:

- i. Default Power Factor setting: Absorbing reactive power at 0.95 lagging power factor.
- ii. Aggregate generating facility is greater than 15 kW: 1.0 +/- 0.15 (0.85 Lagging to 0.85 Leading) down to 20% rated power based on available reactive power.
- iii. Aggregate generating facility is less than or equal to 15 kW: 1.0 +/- 0.10 (0.90 Lagging to 0.90 Leading) down to 20% rated power based on available reactive power.

k. **Dynamic Volt/VAR Operations**

The Inverter shall be capable of operating dynamically within a power factor range of +/- 0.85 PF for larger (>15 kW) systems, down to 20% of rated active power, and +/- 0.9 PF for smaller systems ( $\leq$ 15 kW), down to 20% of rated active power, based on available reactive power. This dynamic Volt/VAR capability shall be able to be activated or deactivated in accordance with La Plata Electric requirements.

La Plata Electric may permit or require the Inverter systems to operate in larger power factor ranges, including in 4-quadrant operations for storage systems with the implementation of additional anti-islanding protection as determined by La Plata Electric.

The Inverter shall be capable of providing dynamic reactive power compensation (dynamic Volt/VAR operation) within the following constraints:

- i. The Inverter shall be able to consume reactive power in response to an increase in line voltage and produce reactive power in response to a decrease in line voltage.
- ii. The reactive power provided shall be based on available reactive power, but the maximum reactive power provided to the system shall be as directed by La Plata Electric.

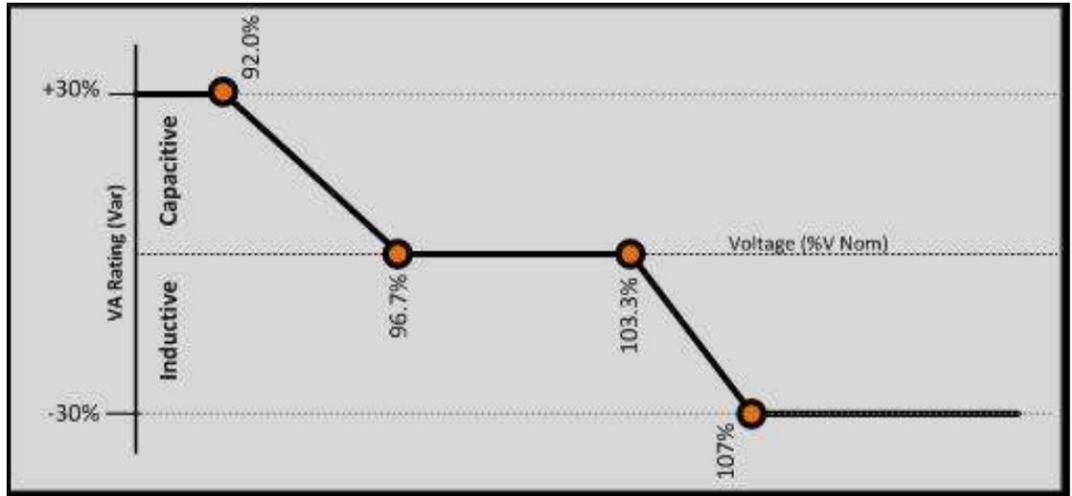
Table 1.4 and Figure 2.1 depict the default settings, which should be applied for all inverter sizes. Specific volt/var settings may be required for larger Generating Facilities (such as 100 kw or greater), or for specific areas with the Distribution Systems as determined by La Plata Electric.

Default Open Loop Response Time for volt/var operation should be five (5) seconds.

**Table 1.4:** Voltage and Reactive Default Settings

Voltage Setpoint	Voltage Value	Reactive Setpoint	Reactive Value	Operation
V1	92.0%	Q1	30%	Reactive Power Injection
V2	96.7%	Q2	0	Unity Power Factor
V3	103.3%	Q3	0	Unity Power Factor
V4	107.0%	Q4	30%	Reactive Power Absorption

**Figure 2.1:** Voltage and Reactive Default Settings



**1. Ramp Rate Requirements**

The Inverter is required to have the following ramp controls for at least the following four conditions. These functions can be established by multiple control functions or by one general ramp rate control function. Ramp rates are contingent upon sufficient energy available from the Inverter.

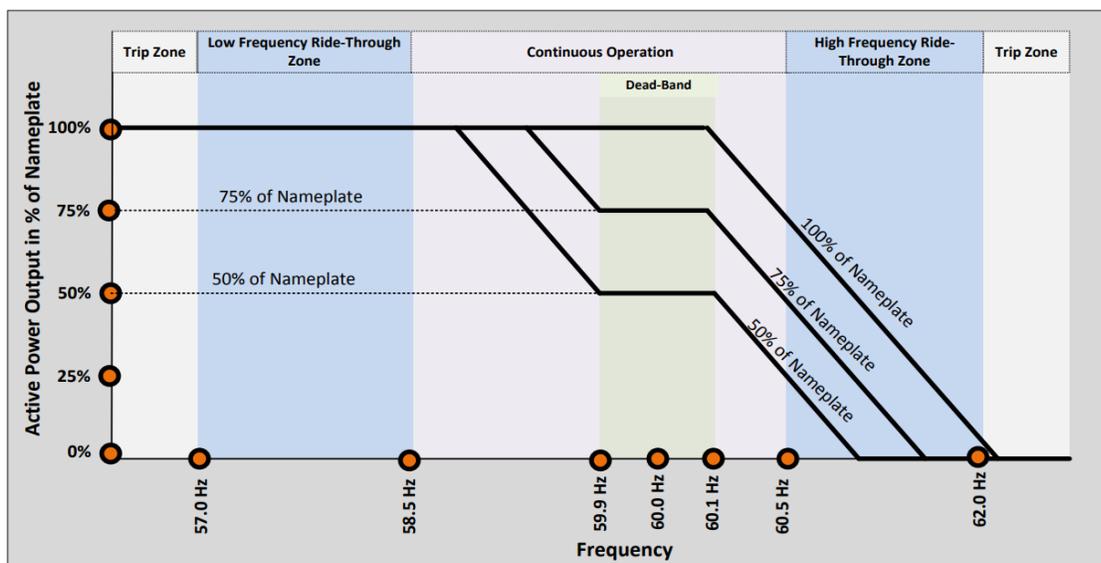
- i. Normal ramp-up rate: For transitions between energy output levels over the normal course of operation. The default value is 100% of maximum current output per second with a range of adjustment between 1% to 100%, with specific settings as mutually agreed by the Distributor Provider and the Generating Facility.
- ii. Connect/Reconnect Ramp-up rate: Upon starting to inject power into the grid, following a period of inactivity or a disconnection, the inverter shall be able to control its rate of increase of power from 1 to 100% maximum current per second. The default value is 2% of maximum current output per second, with specific settings as mutually agreed upon by La Plata Electric and the Generating Facility.

### m. Recommended Frequency-Watt Settings

The Inverters, which have this optional function available, may enable this function with the following recommended settings. Inverters with different frequency-watt capabilities may be enabled with La Plata Electric concurrence.

- i. When system frequency exceeds 60.1Hz, the active power output produced by the Inverter shall be reduced by 50% of real power nameplate rating per hertz (5% of real power nameplate rating reduction per 0.1 hertz)
- ii. When system frequency moves under 59.9Hz, the active power output produced by the Inverter shall be increased by 50% of real power nameplate rating per hertz (5% of real power nameplate rating increase per 0.1 hertz) when inverter is capable of increasing real power production.
- iii. The default dead-band should be +/- 0.1 Hz from 60 hertz (59.9Hz to 60.1Hz). When the system frequency is in range of 59.9Hz and 60.1Hz, the Inverter is not required to increase or decrease power as a function of system frequency.
- iv. Open loop response time for Frequency –Watt shall be 5 seconds.

**Figure 2.2:** Active Power as a Function of System Frequency 60.1 Hz



### n. Voltage-Watt Default Settings Requirements

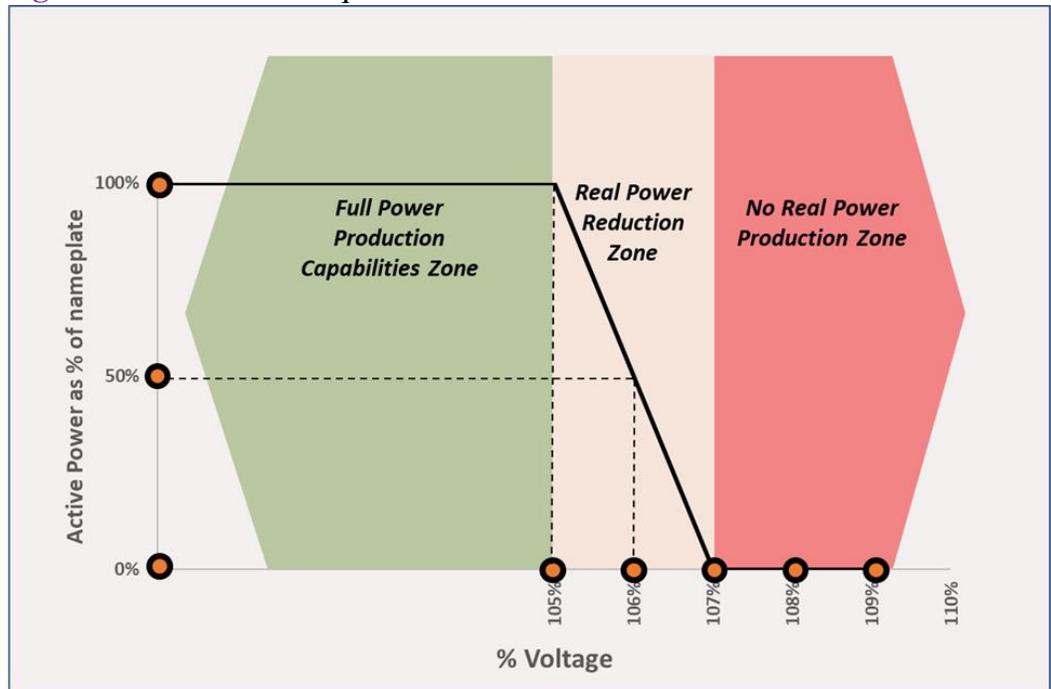
Inverters shall reduce their real power production as a function measured voltage at the inverter terminal or at the Generating PCC in accordance with the following:

- i. When the measured voltage is greater than 105% of nominal voltage (Example: 126 volts on 120 volts nominal), the active power output

produced by the Inverter shall be reduced at a rate of 50% of real power nameplate rating per one percent of nominal voltage. Figure 2.3 Volt-Watt Requirements illustrate the required rate of reduction.

- ii. When the measured voltage is greater than 107% of nominal voltage (Example: 128.4 volts on 120 volts nominal), the active power output produced by the Inverter shall be reduced to 0 watts.

**Figure 2.3: Volt-Watt Requirements**



**o. Default Activation States for Phase 1 Function**

Unless otherwise provided by La Plata Electric, the default settings will be as follows:

- Anti-islanding – activated
- Low/High Voltage Ride-Through – activated
- Low/High Frequency Ride-Through – activated
- Dynamic Volt/VAR operations – activated
- Ramp rates – activated
- Fixed power factor – deactivated
- Reconnect by “soft-start” methods – activated
- Frequency-Watt (Optional) – Implemented when available
- Volt/Watt – activated

These default activation states may be modified by mutual agreement between La Plata Electric and the member.

p. **Load Shedding or Transfer**

The voltage and frequency ride-through requirements of Table 1.2, Section 2.a. and Section 2.f.i shall not apply if either:

- i. The real power across the Point of Common Coupling is continuously maintained at a value less than 10% of the aggregate rating of the Inverters connected to the Generation Facility prior to any voltage disturbance, and the Generation Facility disconnects from La Plata Electric's T&D system, along with Generation Facility load, such that the net change in real power flow from or to La Plata Electric is less than 10% of the aggregate Inverter capacity; or
- ii. Generation Facility load real power demand equal to 90% to 120% of the pre-disturbance aggregate Inverter real power output is shed within 0.1 seconds of Inverter disconnection.

3. **TECHNOLOGY SPECIFIC REQUIREMENTS**

Grid-interactive inverters do not require separate synchronizing equipment. Non-grid-interactive or "stand-alone" inverters shall not be used for Parallel Operation with La Plata Electric's Distribution or Transmission System.

4. **SUPPLEMENTAL INVERTER REQUIREMENTS**

a. **Fault Detection**

A Inverter with an SCCR exceeding 0.1 or one that does not cease to energize La Plata Electric's Distribution or Transmission System within two seconds of the formation of an Unintended Island shall be equipped with Protective Functions designed to detect Distribution or Transmission System faults, both line-to-line and line to-ground, and cease to energize La Plata Electric's Distribution or Transmission System within two seconds of the initiation of a fault.

b. **Transfer Trip**

For a Generating Facility that cannot detect Distribution or Transmission System faults (both line-to-line and line-to-ground) or the formation of an Unintended Island and cease to energize La Plata Electric's Distribution or Transmission System within two seconds, La Plata Electric may require a Transfer Trip system or an equivalent Protective Function.

c. **Reclose Blocking**

Where the aggregate Generating Facility, capacity exceeds 15% of the peak load on any automatic reclosing device, La Plata Electric may require additional Protective Functions, including, but not limited to reclose-blocking on some of the automatic reclosing devices.

## 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. Generators 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 member's 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 I.2 by class of generator.

The generator, 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 Common Coupling.

The generator, 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 generator 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 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.

## 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 members 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 members. 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 member. All such modifications will be made at the expense of the member.

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 members. 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 member.

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

## 2.4 Storage

Energy storage systems that are capable of supplying power onto LPEA's System shall:

- Obtain an interconnection review by LPEA for a specific meter location. (Mobile storage systems must be approved for all points of common connection with LPEA's system where power will flow onto LPEA's system.)
- Shall never export more power than approved.
- Shall comply with the requirements in Section 2.1, 2.2 and/or 2.3 as applicable.

## SECTION II. INTERCONNECTION REQUIRMENTS FOR GENERATION OVER 50kW

### 1. GENERATING FACILITIES OVER 50kW

Generating Facilities over 50kW are required to undergo a more extensive engineering review, than Generating Facilities in the previous section. LPEA will require that the design is furnished with drawings approved by a Professional Engineer (PE). Depending on the size, additional metering, and contracts may be needed to interconnect the generator. Please contact LPEA's engineering department for details on interconnection.

## SECTION III. INSURANCE AND WARRANTY/PERFORMANCE REQUIREMENTS

### 1. LIABILITY INSURANCE REQUIREMENTS

Member agrees to maintain in effect at all times comprehensive bodily injury and property damage insurance coverage of at least the following amounts to protect LPEA and the public from damage attributable to a Generating Facility:

- 1.1 For systems of 10 kW or less, the member, at its own expense, shall secure and maintain in effect while interconnected personal liability insurance with a combined single limit for bodily injury and property damage of no less than \$300,000 for each occurrence.
- 1.2 For systems above 10 kW and up to 500kW, the member, at its own expense, shall secure and maintain in effect during the term of the agreement general liability insurance with a combined single limit for bodily injury and property damage of no less than \$1,000,000 for each occurrence.
- 1.3 For systems above 500kW and up to 2 MW, the member, at its own expense, shall secure and maintain in effect during the term of the agreement general liability insurance with a combined single limit for bodily injury and property damage of no less than \$2,000,000 for each occurrence.
- 1.4 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.

Certificates of Insurance evidencing the requisite coverage and provision(s) shall be furnished to LPEA prior to the Date of Interconnection of the Generating Facility. The Generating Facility will not be allowed to commence or continue interconnected operations unless evidence is provided that satisfactory insurance coverage is in effect at all times. LPEA reserves the right to request an updated insurance document for verification purposes.

The cost of the required insurance may be a factor in a member's decision to become a Generating Facility and, if so, whether to sell its power to LPEA or produce solely for its own use. We recommend that the member consult their insurance agent at an early stage of planning so that this cost may be properly incorporated into their project.

### 2. WARRANTY/PERFORMANCE

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 Generating Facility. The owners of the Generating Facility are solely responsible for determining and ensuring the adequacy and safety of all plans, specifications, sites, installations and other characteristics of the Generating Facility.

Members acknowledge and understand modifying their system settings on the inverter may void any manufacture's warranties. Member agrees that it will indemnify and hold LPEA harmless for any losses, liability or damages sustained by Member or any third-parties as a result of modifying the system settings on the inverter.

Member acknowledges and understands the voltage and frequency settings may cause tapering and result in less production than would otherwise be generated.

## APPENDIX I - SUMMARY OF INTERCONNECTION PROCEDURE

- 1) Members with a potential Generating Facility contacts LPEA and obtains an Application for Interconnection/Net Metering.
- 2) The member submits a completed Interconnection/Net Meter Application, One-Line Diagram and Site Plan to LPEA.
- 3) Within 10 business days LPEA evaluates the Interconnection/Net Meter Application and supporting materials for completeness and obtains pre-inspection for requested Generating Facility. LPEA will notify the member if the application and supporting materials are not in order upon review.
- 4) Within 15 business days, LPEA conducts preliminary engineering studies, to determine the effect the Generating Facility might have on existing LPEA members and equipment.
- 5) Provided all the criteria in the Interconnection Standards for Net Metered Generation are met, unless LPEA determines and demonstrates that the Generating Facility cannot be interconnected safely and reliably, LPEA approves and executes the Interconnection/Net Meter Application and returns it to the member.
- 6) Should an interconnection need established, or modified, LPEA designs and constructs the interconnection and modifies the existing LPEA network as necessary to accept the Generating Facility.
- 7) The member must install a production meter between the Generating Facility and the members utility meter. The production meter must be installed prior to final inspection.
- 8) The Generating Facility must have an accessible disconnect for emergency and non-emergency disconnect purposes.
- 9) The member provides notice of insurance coverage, which meets the insurance requirements based on the size of the Generating Facility, see Section III. The member should investigate liability insurance coverage early in the planning stage.
- 10) After installation, the member returns the Certificate of Completion to LPEA. Prior to parallel operation, LPEA will inspect the Generating Facility for compliance with standards within ten business days of the receipt of the Certificate of Completion. LPEA will inspect the Generating Facility for compliance with standards, and may schedule appropriate metering replacement, if necessary.
- 11) LPEA notifies the member in writing or by e-mail that interconnection of the Generating Facility is authorized within five business days. If the witness test is not satisfactory, LPEA has the right to disconnect the Generating Facility. The member has no right to operate in parallel until an approved witness test has been performed.

## APPENDIX II - GENERATING FACILITY DESIGN DATA REQUIREMENTS

La Plata Electric Association, Inc. (LPEA), reviews all proposals for interconnection of a Generating Facility 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 a facility's design until a complete design package is submitted. A complete design package upon request includes:

- (1) A complete site plan, detailing physical locations of all equipment to be installed from LPEA's supply line to the Generating Facility. 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 and provisions for grounding of the Generating Facility.
- (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 Generating Facility 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 Generating Facilities until a design review is completed and LPEA gives final written design approval.

## APPENDIX III - 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)

### 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

- Generator shall not cause loss of service to other members.

#### 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
- HOA Permitting

## APPENDIX IV - 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

## APPENDIX V - DEFINITIONS

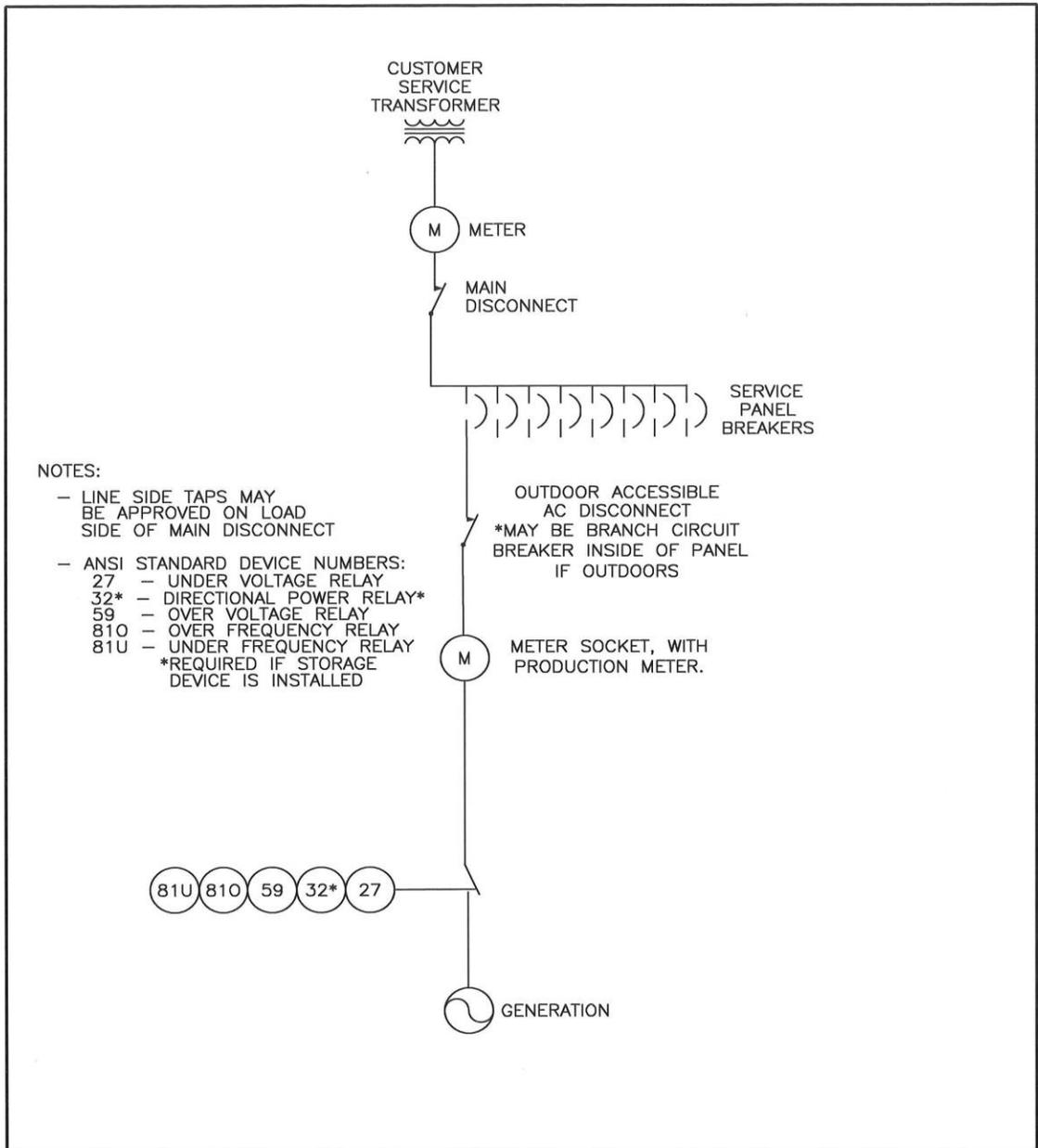
**Point of Interconnection** – The point where the Generating Facilities connect with LPEA’s distribution or transmission system. This may or may not be coincident with the Point of Common Coupling.

**Point of Common Coupling (PCC)** – The transfer point for electricity between the electrical conductors of LPEA and the electrical conductors of the member.

**Generating Facility** – All generators, electrical wires, equipment, and other facilities, excluding Interconnection Facilities, owned or provided by member for the purpose of producing electric power, including storage.

**Interconnection Facility** – The electrical wires, switches and related equipment that are required in addition to the facilities required to provide electric distribution service to a member to allow interconnection. Interconnection Facilities may be located on either side of the Point of Common Coupling as appropriate to their purpose and design. Interconnection Facilities may be integral to a Generating Facility or provided separately. Interconnection Facilities may be owned by either the member or LPEA.

# APPENDIX VI - ONE-LINE DIAGRAM



**NOTES:**

- LINE SIDE TAPS MAY BE APPROVED ON LOAD SIDE OF MAIN DISCONNECT
- ANSI STANDARD DEVICE NUMBERS:  
 27 - UNDER VOLTAGE RELAY  
 32\* - DIRECTIONAL POWER RELAY\*  
 59 - OVER VOLTAGE RELAY  
 810 - OVER FREQUENCY RELAY  
 81U - UNDER FREQUENCY RELAY  
 \*REQUIRED IF STORAGE DEVICE IS INSTALLED

				<p>La Plata Electric Association, Inc.          A Touchstone Energy Cooperative </p> <p>PO Box 2750          Durango CO 81302-2750          COLORADO 32 LaPLATA</p>	DRAWN MAF CHECKED JW APPROVED JW DATE 10/21/2016 FILE NAME NET METER	<b>GENERATION UNDER 50kW</b> SCHEMATIC DRAWING	SCALE NONE	DRAWING NUMBER <b>NET METER</b>
NO.	DATE	REVISIONS	APP'D					