INTERCONNECTION STANDARDS

FOR

PARALLEL OPERATION OF

SMALL-SIZE GENERATING FACILITIES

GREATER THAN 100 KILOWATTS TO 2,000 KILOWATTS

IN THE STATE OF NEW JERSEY

January 1, 2005
Rockland Electric Company
390 West Route 59
Spring Valley, NY 10977

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I. INTRODUCTION

The interconnection standards set forth in this document ("Interconnection Standards") describe the minimum operating, metering and protective equipment which Rockland Electric Company ("RECO") requires for operation of its electric distribution system in parallel with a customer-generator facility with a total output greater than 100KW to 2,000KW. These Interconnection Standards have been established for the protection of life and property and are intended to assist owners of customer-generator facilities with a total output greater than 100KW to 2,000KW (referred to hereafter as the "Applicant") in evaluating their electrical generating system requirements.

A. Application Procedure

This application procedure is consistent with the requirements of the New Jersey Board of Public Utilities ("Board"), as set forth in the Board's regulations, N.J.A.C. 14:4-9.1 to 14:4-9.11, "Net Metering and Interconnection Standards for Class 1 Renewable Energy Systems." The Applicant should file the appropriate application form with RECO. Upon request, RECO shall meet or speak with the Applicant to assist preparing the application.

II. EQUIPMENT REQUIREMENTS

A. Metering

An Applicant desiring to sell power to RECO shall, subject to RECO approval, provide, install, own, and maintain all facilities necessary to accommodate RECO metering. Metering may include either standard watt-hour meters or time-of-delivery meters depending upon the contractual agreement. Meters may be equipped with detents to prevent reverse registration so that deliveries to and from the Applicant's equipment can be separately recorded and treated as separate transactions under the applicable rate of price schedule.

Metering requirements for the delivery of power to RECO fall under three general classifications, depending upon the contractual arrangements:

1. Net Metering. The Applicant's excess generation is delivered to the RECO electric distribution system after the Applicant first meets its own normal service requirements.

    (a) A customer-generator facility utilizing net metering shall be equipped with metering equipment that can measure the flow of electricity in both directions at the same rate. This is typically accomplished through use of a single bi-directional meter.

(b) A customer-generator may choose to use an existing electric revenue meter if the following criteria are met:

2. The meter is capable of measuring the flow of electricity both into and out of the customer-generator facility at the same rate;

3. The meter is accurate to within plus or minus five percent when measuring electricity flowing from the customer-generator facility to the electric distribution system.

(a) If the customer-generator's existing electric revenue meter does not meet the requirements at (b) above, RECO shall install a new revenue meter for the customer-generator, at RECO's expense. Any subsequent revenue meter change necessitated by the customer-generator, whether because of a decision to stop net metering or for any other reason, shall be paid for by the customer-generator.

(b) The customer-generator may request that RECO install a meter, in addition to the revenue meter addressed in (c) above, at the customer-generator's expense. In such a case, RECO shall charge the customer-generator no more than the actual cost of the meter and its installation.

4. Simultaneous Purchase and Sale. The entire net output of the Applican'ts generation facility is delivered to the RECO electric distribution system while RECO simultaneously supplies all of the Applicant's normal electric service requirement. Meter(s) will be required to measure the net generation to the RECO electric distribution system.

5. No Sale. Should the Applicant desire not to sell power to RECO but only to operate in parallel, the Applicant may do so under the terms of a special agreement. In such cases metering will not be required for the measurement of power delivered into the RECO electric distribution system.

Metering requirements for the delivery of power by RECO to the Applicant shall be in accordance with RECO's applicable electric tariffs on file with and authorized by the Board. For a simultaneous purchase and sale arrangement, auxiliary metering shall be required to measure energy supplied to the Applicant for its generator auxiliary load when its customer-generator facility is not operating and during periods of generator startup and shutdown.

B. Protective and Control Devices

1. Design Requirements

(a) Certified Equipment

A customer-generator facility must be certified as complying with the following standards, as applicable:

1. IEEE 1547, Standard for Interconnecting Distributed Resources with Electric Power Systems, as amended and supplemented ("IEEE Standard 1547"), which is incorporated by reference herein. IEEE Standard 1547 can be obtained through the IEEE website at www.ieee.org ; and

2. UL 1741, Inverters, Converters, and Controllers for Use in Independent Power Systems (January 2001), as amended and supplemented ("UL Standard 1741"), which is incorporated by reference herein. "UL Standard 1741" and other UL standards can be obtained through the Underwriters Laboratories website at www.ul.com.

An equipment package shall be considered certified as complying with the above-referenced standards if it has been submitted by a manufacturer to a nationally recognized testing and certification laboratory, and has been tested and listed by the laboratory for continuous interactive operation with an electric distribution system in compliance with the applicable and standards listed above.

(b) Non-Certified Equipment

If the customer-generator facility is not certified per (A) above then utility grade relays approved by RECO, are required.

2. General Technical Requirements

The following general requirements are intended to be consistent with those contained in IEEE Standard 1547 and apply to all installations. The Applicant shall comply with the requirements set forth in IEEE Standard 1547 to the extent they go above and beyond those contained in these Interconnection Standards. Certified equipment will generally comply with these Interconnection Standards.

C. All generators must have:

1. A Disconnect Switch

A disconnect switch must be provided as means of electrically isolating the RECO electric distribution system from the customer-generator facility and to establish working clearance for maintenance and repair work in accordance with RECO safety rules and practices. This disconnect switch may be located in the main interconnection line or in the generator connecting line provided it is wired directly into the main interconnection line on the RECO side of the Applicant's main distribution bus. The disconnect switch will be installed by RECO at the Applicant's expense if it is to be located in RECO-owned wiring. If the switch is to be located in the Applicant's wiring, it must be furnished and installed by the Applicant.

In either case, the disconnect switch is subject to the following requirements:

(a) Only disconnect switches specifically approved by RECO for this purpose may be used.

(b) The disconnect switch shall be physically located for ease of access and visibility to RECO personnel. When installed in the Applicant's wiring, the disconnect switch shall normally be located in close proximity to the metering.

(c) RECO personnel shall inspect and approve the installation before parallel operation will be permitted.

(d) The disconnect switch enclosure and operating handle (when present) will be kept locked at all times with RECO padlocks.

(e) Only RECO personnel shall operate the switch.

(f) The Applicant is responsible for all labor and material costs to maintain, repair or replace the disconnect switch.

(g) A circuit breaker with overcurrent protection on each phase

A circuit breaker allows the Applicant's generation equipment to be separated from the RECO electric distribution system.

This circuit breaker must have sufficient interrupting capacity to interrupt maximum available fault current at its location.

(h) Over and under voltage protection

This protection is used to trip the circuit breaker when the voltage is above or below RECO's normal level. The settings shall be per the most current version of IEEE Standard 1547 unless RECO determines otherwise.

(i) Over and underfrequency protection

This protection is used to trip the circuit breaker when the frequency varies from the nominal of 60 Hz. The settings shall be per the most current version of IEEE Standard 1547, unless RECO determines otherwise.

(j) A dedicated transformer which serves only the Applicant

The impedance of the dedicated transformer limits the fault currents on the generator bus from the RECO electric distribution system and also limits fault currents on the RECO electric distribution system from the customer-generator facility. This requirement is site specific.

(k) A ground fault sensing scheme

This scheme detects ground faults and trips the circuit breaker, thus prohibiting the Applicant's customer-generator facility from continuously contributing to a ground fault. This scheme must be able to detect ground faults between the RECO electric distribution system side of the dedicated transformer and RECO's end of line. A transformer-connected delta on the customer-generator facility side and grounded wye on the electric distribution system side, with appropriate relaying equipment, would provide a means of detecting system ground faults.

2. All customer-generator facilities greater than 400KW must have an impedance relay or an overcurrent relay with voltage restraint.

   These relays are used to detect phase-to-phase and three-phase faults and initiate a generator circuit breaker trip. They must be located on the individual customer-generator feeder.

3. Induction Generators. Induction generation may be connected and brought up to synchronous speed (as an induction motor) if it can be demonstrated that the initial voltage drop measured at the RECO/customer interface is acceptable based on current inrush limits. The customer-generator shall submit the expected number of starts per specific time period and maximum starting KVA draw data to RECO to verify that the voltage dip due to starting is within the visible flicker limits as defined by IEEE Standard 519, Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.

   Starting or rapid load fluctuations on induction generators can adversely impact RECO’s electric distribution system voltage. Corrective step-switched capacitors or other techniques may be necessary. These measures can, in turn, cause ferroresonance and/or self-excitation. RECO will review these measures and may require the Applicant to conduct additional studies, tests and install additional equipment.

4. Synchronous Generators. Synchronous generation shall require synchronizing facilities. These shall include automatic synchronizing equipment or manual synchronizing with relay supervision, voltage regulator, and power factor control and/or as referenced in IEEE Standard1547.

   For all synchronous generators sufficient reactive power capability shall be provided by the customer-generator to withstand normal voltage changes on RECO’s electric distribution system. The generator voltage VAR schedule, voltage regulator, and transformer ratio settings shall be jointly determined by RECO and the customer-generator to ensure proper coordination of voltages and regulator action. Customer-generators shall have synchronous generator reactive power capability to withstand voltage changes up to 5% of the base voltage levels.

A voltage regulator must be provided and be capable of maintaining the generator voltage under steady state conditions within plus or minus 1.5% of any set point and within an

Customer-generators shall adopt one of the following grounding methods for synchronous generators:

(a) Solid grounding;

(b) High- or low-resistance grounding;

(c) High- or low_reactance grounding; or

(d) Ground fault neutralizer grounding.

5. Single-phase generators must be connected in multiple units so that an equal amount of generation capacity is applied to each phase of a 3-phase circuit.

6. All customer-generator facilities shall comply with 1977 ANSI Standards C50.10 and C50.13 dealing with waveform and telephone interference.

7. It is recommended that the Applicant protect his three-phase equipment from negative sequence currents. Certain conditions in the RECO distribution system may cause negative sequence currents to flow. It is the sole responsibility of the Applicant to protect his equipment from excessive negative sequence currents.

D. **RECO System Modifications:**

RECO will provide equipment and labor necessary to perform all system modifications at the Applicant's expense under the terms of a special facilities agreement. The following modifications are required as noted:

For synchronous generators or other generators designed to operate similarly, RECO's automatic restoration equipment will be prevented from operating until all generation on the Applicant side of the restoration equipment is off line.

Generator damage and system disturbance may result from the restoration of power by automatic restoration equipment to a line energized by an Applicant's customer-generator facility.

Modifications will be required when the customer-generator facilities have the capability of energizing a line when the RECO electric distribution system is disconnected. The Applicant's customer-generator facility will not be allowed to automatically re-energize RECO's facilities.

E. Direct Telephone Service:

The Applicant shall provide 24-hour direct telephone service to RECO so that operating instructions from RECO can be given to the Applicant or any designated operator of the customer-generator facility.

III. PERFORMANCE CRITERIA

A. Harmonic Requirements:

The harmonic content of the voltage and current waveforms in the RECO electric distribution system must be restricted to levels which will not cause interference or equipment operating problems for RECO or its customers. All applicants generating facilities must conform to IEEE Standard 519. There are many methods that may be used to restrict harmonics. The preferred method is to install a transformer with at least one delta connection between the customer-generator facility and the RECO electric distribution system. This transformer significantly limits the effect of voltage and current harmonics on RECO's electric distribution system.

Any harmonic problems will be handled on a complaint basis. A customer-generator facility causing harmonic interference is subject to being disconnected from the RECO electric distribution system until the condition has been corrected. If the cause of the problem is traceable to the Applicant's customer-generator facility, all costs associated with determining and correcting problems will be at the Applicant's expense.

B. Governor Recommendation:

It is recommended that synchronous generator prime movers have a Governor and that its characteristics be set to provide a five percent droop characteristic (i.e., 0.15Hz change in the governor speed will cause a five percent change in the generator load). Governors must be operated unrestrained to regulated system frequency.

C. Power Factor Requirements:

All generation sources must be capable of operating continuously at any power factor between 90 percent lagging and 95 percent leading with a voltage level at any point within $\pm$ 5.0 percent or rated voltage. The value and the extent of the ability to vary the power factor is dictated by the system requirements at the location of the generation source. Applicant shall provide this information to RECO.

D. Generator Connection to the RECO System:

Connecting a customer-generator facility to the RECO electric distribution system must not cause harmful voltage fluctuations. A customer-generator facility causing such harmful voltage fluctuations is subject to being disconnected from the RECO electric distribution system until the condition has been corrected.

IV. OPERATING AND MAINTENANCE PROCEDURES

A. All Generators Must Have:

1. A customer-generator must maintain a daily operations log that includes information on unit availability, maintenance outages, circuit breaker trip operations requiring a manual reset, relay targets and unusual events. RECO shall have the right to review these logs, especially in analyzing system disturbances.

2. Operating schedules:

   The voltage-VAR schedule, voltage regulator settings and transformer ratio tap settings will be supplied to the Applicant by RECO.

   This information is necessary to ensure proper coordination of voltages and regulator action.