



**INTERCONNECTION STANDARDS
FOR
PARALLEL OPERATION OF
SMALL-SIZE GENERATING FACILITIES
10 - 100 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 of 10 - 100KW. These Interconnection Standards have been established for the protection of life and property and are intended to assist owners of customer-generator facility with a total output of 10 - 100KW (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 in 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:
 - 1. The meter is capable of measuring the flow of electricity both into and out of the customer-generator facility at the same rate;
 - 2. The meter is accurate to within plus or minus five percent when measuring electricity flowing from the customer-generator facility to the RECO electric distribution system.
 - c. If the customer-generator's existing electric revenue meter does not meet the requirements of (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.
 - d. 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.
2. Simultaneous Purchase and Sale. The entire net output of the Applicant's generation facility is delivered to the RECO electric distribution system while RECO simultaneously supplies all of the Applicant's normal electric service requirements. Meter(s) will be required to measure the net generation to the RECO electric distribution system.
3. 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.

Figures 1 and 2 set forth below show typical metering for net metering and simultaneous purchase installations.

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 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.

The Applicant shall provide appropriate protection and control equipment, including an interrupting device that will disconnect the customer-generator facility in the event that the portion of the RECO distribution system that serves the customer-generator is de-energized for any reason or for a fault in the Applicant’s customer-generator facility. The Applicant’s protection and control equipment shall be capable of disconnecting the customer-generator facility upon detection of an islanding condition and upon detection of a utility system fault.

The Applicant’s protection and control scheme shall be designed to allow the customer-generator facility, at steady state, to operate only within the limits specified in these Interconnection Standards for frequency and voltage. Upon request from RECO, the Applicant shall provide documentation detailing compliance with the requirements set forth in these Interconnection Standards.

The specific design of the protection, control and grounding schemes will depend on the size and characteristics of the Applicant's customer-generator facility, as well the Applicant's load level, in addition to the characteristics of the particular portion of RECO's electric distribution system where the Applicant is interconnecting.

Minimum protection requirements are necessary for safe and reliable parallel operation of both the Applicant's customer-generator facility and RECO's electric distribution system. While most commercially available generators and inverters are equipped with some protective and control devices, additional equipment may be required to permit parallel operation with the RECO electric distribution system depending on the location, type and size of the customer-generator facility. See Figures 1 and 2 set forth below, for typical protection schemes.

a) All customer-generator facilities must have:

1. A Disconnect Switch

A disconnect switch must be provided as a 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. The disconnect switch must provide a visible air break.
- 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. The disconnect switch shall be clearly marked "Generator Disconnect Switch" with permanent 3/8-inch letters or larger.
- D. RECO personnel shall inspect and approve the installation before parallel operation will be permitted.
- E. The disconnect switch must be lockable in the open position with a standard RECO padlock with a 3/8-inch shank.
- F. The Applicant is responsible for all labor and material costs to maintain, repair, or replace the disconnect switch.

2. Interrupting Device

The customer-generator facility shall have, as a minimum, an interrupting device(s) sized to meet all applicable local, state, and Federal codes. The interrupting device shall be operated by the required over and under voltage and over and under frequency protection. All phases of a generator or inverter interface shall disconnect for a voltage or frequency trip on any phase. It is recommended the voltage protection be wired phase to ground.

3. Under and over 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.

4. Over and under frequency 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.

- B. Customer-generator facilities greater than 10KW may require a dedicated transformer which serves only the Applicant (i.e., no other customer served from this transformer). Upon approval by RECO after review of the project details, a customer-generator facility less than 10KW generating at a secondary voltage level may not require a dedicated transformer.

The dedicated transformer provides isolation between the Applicant's customer-generator facility and other RECO customers.

- C. In addition to the items listed above, all customer-generator facilities exceeding 40KW must have the following:

1. A ground fault sensing scheme.

This scheme detects system 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.

- D. Induction generator installations may require capacitors to be switched on to correct the customer-generator facility's output to near unity power factor. Capacitors installed on the generator terminals may be acceptable; but caution should be used since this increases the possibility of the customer-generator facility becoming self-excited. Preferably, capacitors should be provided and installed by RECO on the RECO electric distribution system at the Applicant's expense.

- E. Synchronous generators and induction generators designed to operate similar to synchronous generators must also have manual synchronization with relay supervision to synchronize with the RECO electric distribution system. Synchro-check relays (such as G. E. Model IJS) normally used for checking two voltages between which there is no slip are not acceptable.
- F. It is recommended that the Applicant protect its three-phase equipment from negative sequence currents.
Certain conditions in the utility electric 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.
- G. To avoid out-of-phase reclosing, the design of the Applicant's protection and control scheme shall take into account RECO's practice of automatically reclosing the feeder without synchronism check as quickly as 20 cycles after being tripped.
- H. A failure of the Applicant's interconnection protection equipment, including loss of control power, shall open the interrupting device, thus disconnecting the customer-generator facility from RECO's electric distribution system. An Applicant's protection equipment shall utilize a non-volatile memory design such that a loss of internal or external control power, including batteries, will not cause a loss of interconnection protection functions or loss of protection set points.

C. 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 disturbances may result from the restoration of power by automatic equipment to a line energized by an Applicant's customer-generator facility.

Modifications will be required when the customer-generator facility 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 until five minutes after voltage and frequency have returned to normal.

D. Direct Telephone Service:

The Applicant shall provide 24-hour telephone contact(s) to RECO. This contact will be used by RECO to arrange access for repair, inspection or emergencies. RECO will make such arrangements (except for emergencies) during normal business hours.

E. Testing and Maintenance

Upon initial parallel operation of a customer-generator facility, or any time interface hardware or software is changed, verification testing must be performed. A qualified individual must perform verification testing in accordance with the manufacturer's published test procedure. Qualified individuals include professional engineers, factory-trained and certified technicians, and licensed electricians with experience in testing protective equipment. RECO reserves the right to witness verification testing or require written certification that the testing was successfully performed.

Verification testing shall be performed at least once every four years. All verification tests prescribed by the manufacturer shall be performed. If wires must be removed to perform certain tests, each wire and each terminal must be clearly and permanently marked. The Applicant shall maintain verification test reports for inspection by RECO.

Single-phase inverters and inverter systems rated 15 kVA and below may be verified upon initial parallel operation and once per year as follows: the Applicant or its agent shall operate the load break disconnect switch and verify the power producing facility automatically shuts down and does not restart for five minutes after the switch is closed. The Applicant shall maintain a log of these operations for inspection by RECO. Any system that depends upon a battery for trip power shall be checked and logged once per month for proper voltage. Once every four years the battery must be either replaced or a discharge test performed.

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' customer-generator facilities must conform to IEEE 519-1992, Recommended Practices for Harmonic Control in Electric Power Systems.

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. 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.

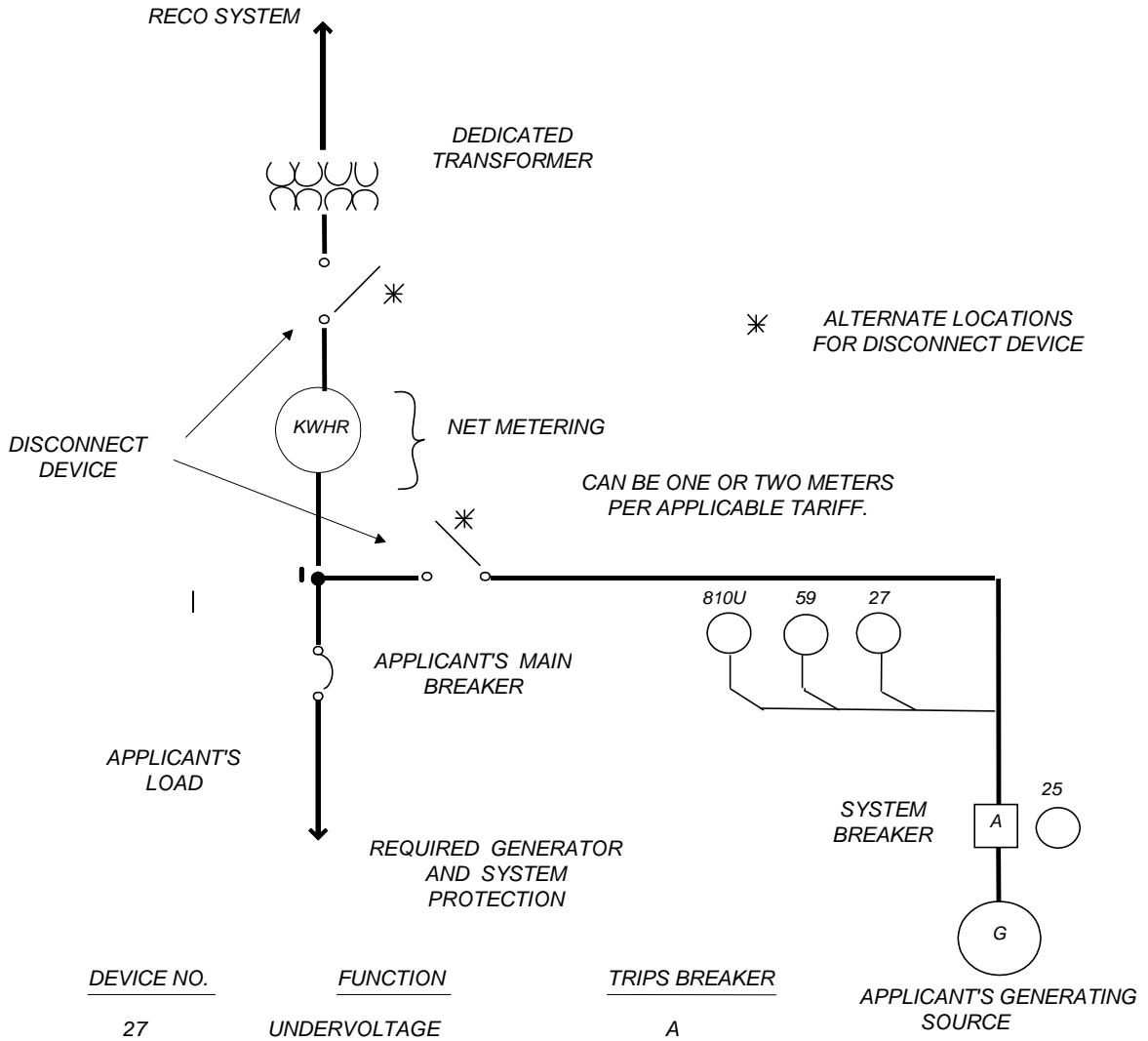
IV. OPERATING AND MAINTENANCE PROCEDURES

A. All Customer-Generators Must Have an Operations Log:

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

TYPICAL
PROTECTION & NET METERING INSTALLATION
FOR
ELECTRIC POWER PRODUCING FACILITIES
10 - 100 KILOWATTS

FIGURE 1



<u>DEVICE NO.</u>	<u>FUNCTION</u>	<u>TRIPS BREAKER</u>
27	UNDERVOLTAGE	A
51G	GROUND OVERCURRENT	A
59	OVERVOLTAGE	A
810U	OVER & UNDER FREQUENCY	A

FIGURE 2

TYPICAL
 PROTECTION AND METERING INSTALLATION
 FOR ELECTRIC POWER PRODUCING FACILITIES
 10 - 100 KILOWATTS
 FOR SIMULTANEOUS PURCHASE AND SALE

