

TRI-COUNTY RURAL ELECTRIC COOPERATIVE, INC.

Policy Bulletin No. 3-17

Appendix A

**SAFETY & INTERCONNECTION REQUIREMENTS FOR
ALTERNATE ENERGY PRODUCTION**

The Cooperative recognizes the various electric industry standards and safety codes as they pertain to Alternative Energy System (AES) or Qualifying Facilities (QF). The standards and codes to be followed include, but are not limited to: Institute of Electronic and Electrical Engineers (IEEE), the Mid-Atlantic Distributed Resource Initiative (MADRI), PJM Interconnection, National Electrical Safety Code (NESC), National Electrical Code (NEC), National Fire Protection Association (NFPA), Underwriters Laboratories (UL), state, and local entities. Any reference in this Policy to a code, standard, regulation, or guideline shall be construed to mean the then-current version of that document.

At a minimum, the Cooperatives require the use of AES/QF equipment that meets the intent of the IEEE 1547-2003, and/ or IEEE 929-2000, and/ or UL 1741-2001 Standards, and any other current industry standards.

GENERAL TECHNICAL REQUIREMENTS

Overview

The technical requirements for connection of AES/QF will be those necessary to assure the safety and integrity of the Cooperative's electric system, and to maintain the quality and reliability of service to the Cooperative's electrical system or to others connected thereto. If an adverse effect(s) occurs in the sole opinion of the Cooperative, the AES/QF Owner must discontinue operation and take corrective action.

Disconnecting Device

The technical requirements require a lockable disconnecting device, installed at a Cooperative approved location, with an appropriate control and protective scheme that automatically isolates the AES/QF from the utility system for, but not necessarily limited to, the following conditions:

- An electrical or mechanical fault on the AES/QF.
- An electrical or mechanical fault on the Cooperative's electrical system.
- An abnormal operating voltage and/or frequency on either system.
- A separation of the Cooperative's main system from the circuit that is interconnected with the AES/QF.

The reconnection of the AES/QF to the Cooperative distribution system shall not occur until normal system conditions are present. The cooperative will allow automatic reclosing of the interconnection device provided both the AES/QF and Cooperative facilities are energized and synchronize with one another .

Installation

The AES/QF units are to be installed in a workmanlike manner. Minimum Interconnection requirements will include, but may not be limited to, meeting or exceeding IEEE 1547-2003 and/ or UL 1741-2001 functionality requirements, or any other code or ordinance listed in this document. Facilities shall be installed to current NFPA 70-2005 codes or applicable electrical/ building codes. Additional operational or equipment requirements may be imposed on the AES/QF depending on the point of connection on the Cooperative's electrical facilities and the impact of the AES/QF on the Cooperatives' system. The Cooperative reserves the right to observe Generator start-up testing procedures to verify the proper system AES/QF interaction, or testing after modifications have been made to the Member's system.

Related Information

Depending on the size of the AES/QF, guidelines established by the PJM Interconnection L.L.C. will need to be followed. The PJM website at www.pjm.com contains details on IEEE 1547-2003, and other interconnection information.

If the electrical output of the AES/QF will be transmitted over the electric system of another entity, the AES/QF may need to meet additional requirements of that entity.

Assumptions and Limitations

IEEE 1547-2003 is not all-encompassing in its coverage of AES/QF interconnections. Limitations and assumptions affecting its application include:

- The assumption that the AES/QF operates at 60 Hz.
- The assumption that the aggregate capacity of the AES is 10 MVA or less at the point of common connection.
- The assumption that IEEE 1547-2003 is focused on the activities of a AES/QF on radial primary and secondary distribution systems.
- The limitation that IEEE 1547-2003 does not address the protection or operating requirements, planning, designing, or maintenance of the distribution system.

Monitoring Provisions / Other Communications / Control

Depending on the intended use and application of the AES/QF, monitoring provisions may be needed. Small units providing supplemental residential power likely will not need monitoring, whereas larger units generating power in excess of local use may require additional metering, or the use of an indicator sent either to the Cooperative or another entity controlling the electric system. The communication capabilities required to coordinate the AES/QF with protective or monitoring devices, may include but not be limited to, a Remote Terminal Unit (RTU), and shall be installed at the AES/QF Owners expense.

Net Metering will require the use of metering equipment, located between the Cooperative's source and the Owner's electrical load, that will measure the flow of electricity from the Cooperative to the Owner. The metering will also measure the flow of electricity supplied by the AES/QF Owner to the Cooperative. These independent meter registers will be used to determine the amount of energy provided to the Cooperative, and will be the basis for potential monthly billing credits.

SPECIFIC TECHNICAL REQUIREMENTS

- A. The interconnection equipment must be of a "fail safe" design to ensure, in the event of any electrical supply or equipment failure, that the AES/QF's and the Cooperative's electrical system will be physically separated automatically. The AES/QF will remain separated until the Cooperative's electrical system returns to its normal operating status. The AES/QF will synchronize with the Cooperative's electrical system only when the Cooperative electrical facilities' voltage and frequency are within acceptable industry tolerances. Adherence to IEEE 1547-2003 relaying guidelines is required.
- B. Fault protection can be provided by various methods, but must be capable of detecting and clearing faults that can occur in AES/QF and/or Cooperative facilities. Typical schemes are shown in, but are not limited to, Exhibit 1.
- C. Anti-islanding protection is required to immediately and automatically disconnect AES/QF generation from the Cooperative system upon the loss of Cooperative power.

This protection generally can be accomplished by either a synchronous inverter used in DC generation or by applying the following isolation relays:

1. Undervoltage relay which may be time-delayed and instantaneous overvoltage relay.
2. Underfrequency relay where generators equal to or greater than 100 kW are utilized.
3. Overfrequency relay on certain installations.
4. In some cases direct transfer trip of the AES/QF generation from the upstream Cooperatives protective device may be required.

Typical protection schemes are illustrated in Figures 1 through 5 of Exhibit 1.

- D. AES/QF fault protection must coordinate with Cooperative system protective devices for faults in AES/QF equipment. The Cooperative will provide the characteristics of the protective device with which the AES/QF must coordinate.
All required protection design and associated settings must be provided to and approved formally by the Cooperative prior to connecting AES/QF equipment to the Cooperative system. The following information must be supplied to the Cooperative:
1. One-line relay application diagram.
 2. Three-line diagram.
 3. Connection diagrams showing all external connections to individual components of the protective scheme.
 4. Instruction manuals for all protective components. Component specifications and internal wiring diagrams must be provided, if not included in manuals.
 5. Generator data - equivalent impedances, time constants, etc. required to analyze fault contributions and load current flows.
 6. All protective equipment ratings.
- E. All relay settings for isolation protection must be coordinated and consistent with Cooperative equipment.
- F. Maintenance for required fault and isolation protection must be performed and documented by the AES/QF Owner at intervals specified by the Cooperative.
- G. A lockable, manually operable, visible load-break disconnecting device is required for all AES/QF interconnections. The device will be installed at a Cooperative-approved and accessible location.
- H. A UL approved, ringless type meter base, suitable for outdoor installation shall be provided for the purpose of metering the AES/QF generation output. The cooperative shall install its revenue meter in the meter base.
- I. The AES/QF will contain or employ a disconnecting device to automatically isolate the AES/QF generation from the Cooperative system when the Cooperative's circuit is either partially energized or fully de-energized. The disconnecting device also must be blocked from closing in on a partially energized or a de-energized Cooperative circuit.
- J. The Cooperative has the right, as required, to inspect all required protective equipment associated with the AES/QF interconnection.
- K. The AES/QF is responsible for properly synchronizing the Facility's generation with the Cooperative system.

- L. The AES/QF is responsible for providing a phase protection device on three-phase generators that will prevent damage to the generator or the Cooperative's system or Cooperative Members' equipment due to the loss of energy in any phase of a poly-phase system.
- M. The AES/QF electrical system should be able to withstand any and all electrical transients that occur on Cooperative's electrical distribution and transmission systems, including but not limited to, voltage surges, sags, swells, and outages. For instance, fuse coordination and operation of Cooperative reclosers should not cause damage that would require repair of the AES/QF's electrical system. Manual or automatic reset of system protective devices, either by the Cooperative or the AES/QF Owner, is acceptable.
- N. It is acknowledged that AES/QF technologies, such as fuel cells and wood powered steam turbines, continue to evolve. While the latest industry standard may not be specifically listed in this document, the Cooperative expressly reserves the right to use the latest industry standards in the interconnection evaluation process for any AES/QF technology.
- O. The AES/QF must be installed to meet the C2-2002 National Electrical Safety Code (NESC) or other applicable code requirements for clearances from the nearest Cooperative electric facility, or such other distance as the Cooperative deems necessary for safety or electric operation-related reasons.
- P. Additional resources on protection systems:
- ANSI/IEEE Std 1001-1988 "IEEE Guide for Interfacing Dispersed Storage and Generation Facilities with Electric Power Systems."
 - PJM "Small Generator (2 MW or less) Technical Requirements and Standards."
 - NFPA 70-2005 National Electrical Code. *Note: Attention is directed to Article 250 – Grounding and Bonding.*
 - IEEE Green Book – ANSI C114.1-1973/IEEE Std 142-1972 "IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems."
 - IEEE Orange Book – ANSI/IEEE Std 446-1980 "IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications."

PROJECT REVIEW

Additionally, to ensure that other Cooperative Members' electric service is not negatively affected by one (or more) operating AES/QF units, the Cooperative will perform a technical review of the AES/QF unit. The review process is intended to reveal potential problems prior to the operation of the AES/QF, as well as provide a cost estimate for the necessary work to interconnect AES/QF generation. Any cost of studies associated with

the proposed installation of a AES/QF shall be borne by the AES/QF Owner. The AES/QF owner shall also bear all costs associated with upgrades to the Cooperatives distribution that are necessary to accommodate the AES/QF.

The Cooperative, however, reserves the right to reevaluate the continued operation of the AES/QF if any actual or potential safety, quality, or reliability issues arise or occur. Any corrective actions recommended by the Cooperative or its agent must be implemented at the AES/QF Owner's expense. This may include termination of the operation of one or more AES/QF units interconnected on the same line section.

RESPONSIBILITY

It shall be the responsibility of the AES/QF Owner to design and operate a system adequate to meet the technical requirements generally set forth above and to assure reliability of the protection scheme as predicated by the design and location of Member generation. In addition, this protection must be compatible with Cooperative system protective devices. Paralleling Member generation with the Cooperative system will be permitted only upon obtaining formal Cooperative approval in advance.

The AES/QF Owner is solely responsible for providing adequate protection for his equipment.

EXHIBIT 1

GENERAL PROTECTION REQUIREMENTS

Figure

- 1 Protection for a single-phase inverter
- 2 Protection for a three-phase inverter
- 3 Protection for a single-phase induction generator
- 4 Protection for a three-phase induction generator
- 5 Protection for a three-phase synchronous generator