PART VIII

COGENERATION AND SMALL POWER PRODUCTION

For the safety of electric supply system personnel and the general public, no generation shall be parallel with an electric system WITHOUT THE PRIOR KNOWLEDGE AND WRITTEN APPROVAL of the Cooperative.

A. APPLICATION FOR SALE OF ENERGY

A Consumer Member desiring to install generation derived primarily from supplemental energy shall formally notify the Cooperative in writing of this intention. Included with the notification should be a complete set of electrical diagrams, a site plan showing the location of the facilities, a complete listing of the electrical parameters associated with the generator power conditioning equipment, a description of the protective functions of the facilities including hardware, a range of settings and fuse characteristics, maximum power rating, and expected kWh production from the generator. Any information on the expected use of the generator pertaining to its end use, seasonal availability patterns, or average monthly data that would be helpful in preparing load curves should also be provided.

The Cooperative will estimate the required modifications or additions to the distribution system that may be necessary to interconnect the member-owned generation. FERC regulation, 18 CFR 292 PART C, allows for billing of the small power producer for any interconnection costs. The Cooperative will include in the interconnection agreement provisions for the Consumer Member's installation of future modifications and additions as may be required with large penetrations of small power producers. Such future costs might include equipment for harmonic filtering, complex utility relaying schemes, power factor correction, and System Control and Data Acquisition (SCADA) Systems.

The electrical facility will be designed and installed in accordance with applicable portions of the latest edition of the National Electrical Safety Code (NESC) and the National Electrical Code (NEC), as appropriate.

B. INSURANCE

Because of the numerous liability issues that are involved with the interconnection of member-owned generation, the Consumer Member will be instructed to have his insurance company submit proof of the purchase of liability insurance coverage to the Cooperative, with renewal policies being provided annually. The Cooperative is to be notified immediately if there is any insurance cancellation.

C. TECHNICAL

No generators larger than 10 kw will be permitted on single-phase secondary services without the Cooperative first performing the necessary studies to ensure that adequate and reliable service to all Consumer Members may still be maintained due to possible phase unbalances and voltage flicker. Any approval must be in writing.

The electrical arrangement of the Consumer Member's service will be in accordance with the attached Drawing R-23. The Consumer Member should furnished the following equipment:

1. Two load break disconnect switches--a utility disconnect switch and a generator disconnect switch so that the responsibility for synchronizing the Consumer Member's generator is removed from the Cooperative's lineman as well as removing the Cooperative of the liability of operating the Consumer Member's equipment. (See number 3 below for further explanation.)

   Induction generators and line-commutated inverters are capable of self-excitation when isolated from the utility system and connected to small loads that possess a leading power factor. Disconnect switches must have load interrupting capability and provision for padlocking.

2. The Cooperative will determine which metering configuration will be best for the energy technology and the size of the unit being considered.

3. To ensure safety to utility personnel against self-excitation of induction machines and synchronous machines, provision for grounding the incoming line at the Consumer Member's transformer should be made.

The Consumer Member's system shall be equipped and constructed such that it will automatically disconnect from a de-energized or faulted utility line.

Minimum protection requirements will vary on different generator configurations and distribution system characteristics; however, the following protective functions should be supplied:

1. Overcurrent protection should be set as low as feasible, allowing for machine in-rush characteristics. Three-phase generators that can act as a ground source to the utility system should be equipped with a sensitive ground overcurrent relay when practical.

2. Over-under voltage protection and frequency protection functions should be supplied on generators that have the capability for isolated operation. The intent of requiring this protection is to prevent damage to the appliances of other Consumer Members on the same distribution line and to connected distribution system equipment. These protective functions are expected to be supplied on synchronous machines and self-commutated inverters. Induction generator systems which have frequency protection are the exception to the norm.

The Consumer Member should provide a generation facility that is self-protected from normal, abnormal, and system emergency conditions and should carry adequate liability insurance to protect against accidental damage to adjacent Consumer Members due to mis-operation of equipment. The Cooperative must be absolved from any liability for damages to the Consumer Member's facility.

The small power producer should not introduce harmonics into the Cooperative's power system that are excessive enough to affect other Consumer Members. ANSI C50-1936 requires that allowable distortion measured at the Consumer Member's meter not exceed 10 percent. Present industry practice for inverter equipment is to limit total harmonic distortion to less than 5 percent. Any interference on the electrical or communications systems (to include telephone, radio, television, carrier, etc.) resulting from the Consumer Member's equipment will be grounds for termination of the interconnection until the Consumer Member corrects the condition in its facilities to the satisfaction of the Cooperative.

The Consumer Member is advised that in the long term, the Cooperative may have to install a communication channel and remote terminal equipment for the purpose of supervisory control and data acquisition or to complete a protective relaying system.

The Cooperative further advises that the cost of the communications equipment and any necessary modifications to the Consumer Member's equipment may be the responsibility of the Consumer Member. This requirement will be included in the initial interconnection contract.

D. INSPECTION/TEST AND MAINTENANCE

Inspection and test shall include both an initial acceptance inspection and test and subsequent inspection and testing at regular intervals.

A complete set of drawings and equipment specifications must be available to the Consumer Member and the Cooperative. Initial acceptance and subsequent inspections must be witnessed by Cooperative personnel at agreed-upon times. Complete test records should be maintained. The type of test and required results will be specified by the Cooperative.

Inspection should include wiring and hookup compliance with:

1. National Electric Code (NEC)*
2. National Electrical Safety Code (NESC)*
3. Cooperative standards
4. City, county, and state electrical codes

* There are some conflicts between NEC and NESC codes, particularly in grounding requirements. In case of conflict, the most stringent requirement shall apply.

Test should include:

1. Relay settings and breaker actuation
2. Synchronization
   a. Frequency matching
   b. Phase angle
   c. Phase rotation
3. Voltage regulation
4. Harmonic output
5. Electromagnetic interference
6. Safety

The Cooperative must reserve the right to inspect on demand all protective equipment, including relays and circuit breakers at the interconnection. Inspection should include the tripping of the breaker by the protective relays.

No modifications or revision to the Consumer Member's installation will be made without prior notification and approval by the Cooperative.

The Cooperative reserves the right to interrupt the cogenerator or small power producer when deemed necessary by the Cooperative due to system emergencies or unsafe operating conditions.

Cooperative personnel will not assume responsibility for synchronizing member-owned generation to the utility system frequency. Restoration of electric service to a Consumer Member's load panel will be made by closing the utility disconnect switch only after the Consumer Member's generator disconnect switch has been opened.

The Consumer Member should have complete control of the generator disconnect except during the restoration procedure. No padlocks or other locking devices may be placed on the generator disconnect switch or on facilities that may restrict access to the switch.

The utility disconnect switch will be placed on the utility side of the meter and will have a load interrupting rating equivalent to the rating of the service. The utility disconnect switch shall not at any time be operated by the Consumer Member and shall be locked with a system padlock or locking device supplied by the Cooperative.

The Cooperative should adequately mark the location of member-owned generation by attaching caution signs for the benefit of operating personnel at the Consumer Member's transformer location and at the point where the spur or lateral joins the main feeder.

The Cooperative will revise circuit maps of the feeder when member-owned generation facilities are energized. Substation one-line diagrams will also be updated to indicate the number and aggregate rating of generators on a feeder. Feeders that have member-owned generation should bear a caution sign.

In accordance with Occupational Safety and Health Act (OSHA) requirements, all power sources should be removed from a feeder and the feeder grounded prior to commencing work on a line section. This means that each member-owned generating system will have to be disconnected and the feeder grounded at a point between the work area and the member-owned generator.

E. OPERATIONAL

If the Cooperative determines that it is necessary to do work on the Consumer Member's premises, an inspection of the work area and Consumer Member's generating facility will be made by Cooperative personnel to determine that the machine is inoperative. If hazardous working conditions are detected, the Consumer Member will be required to correct the unsafe condition before the work will be performed.

F. MAINTENANCE

The Cooperative shall be responsible for maintenance of all equipment supplied by the Cooperative. The Qualifying Facility owner has full responsibility for the maintenance of the QF generating and protective equipment. Complete maintenance records must be maintained by the QF and must be available for the Cooperative's review.

Failure of the QF to provide proper maintenance, which in the judgment of SMECO causes degradation of the Cooperative's system, will result in termination of parallel operation.

Both parties may find it advantageous for the QF owner to contract some or all of the QF maintenance to the Cooperative. Any such agreement could be separate from the basic interconnection agreement.

G. POWER FACTOR

The maintenance of a high power factor is of primary importance in the economic operation of the transmission and distribution system. It will be the responsibility of the QF to maintain the power factor at least 90 percent. Less than 90 percent power factor will cause a reduction in payment for energy in accordance with approved Tariff.

H. VOLTAGE REGULATION

For the purpose here, voltage regulation refers to the range of voltages supplied by the Cooperative at the Consumer Member's metering point.

The Cooperative designs the electric distribution system to economically provide individual Consumer Members with service voltages that are within specified maximum and minimum limits necessary for satisfactory operation of the Consumer Member's appliances and equipment.

For example, the most common type of electric service is 120/240 volts, single-phase. The acceptable limits for this particular type of service is 114-126/228-252 volts, but very few consumers, if any, ever experience this full range of acceptable voltage regulation. Consumer Members near the distribution substation are more likely to experience voltages in the upper half of this range, while those farthest away will be in the lower half of the range. However, plant investment costs are minimized by using the full range of acceptable voltages in the overall design of the distribution system.

The cost to correct unacceptable voltage regulation specifically caused by QFs is part of the total cost of service that the QF is responsible for.

Acceptable voltage regulation should be supplied for all loads, including those of QFs when their generation is inoperative. The extent to which a QF may adversely affect voltage regulation will, therefore, depend on the size of the QF load as well as the type and capacity of the generating unit. The need for additional plant investment to improve voltage regulation specifically because of a QF is not likely to be a problem for individual QFs less than 100 kw.

Voltage regulation problems associated with the different types of QFs will be evaluated in detail when operating characteristics for them become available.

If, under any circumstances, unacceptable voltage regulation is expected to occur or does occur specifically because of the QF, the QF will be disconnected, or not allowed to be connected, until unacceptable voltage is corrected.

I. VOLTAGE FLICKER

Voltage flicker is a term commonly used to describe a significant fluctuation of consumer voltage caused by a rapidly fluctuating load. The largest flicker occurs at the point where the fluctuating load is being supplied. However, this fluctuating load can cause excessive voltage flicker in adjacent facilities, depending on the magnitude of the load and the electrical characteristics of the utility system.

The most objectionable effect of voltage flicker for residential and commercial consumers is the visible flickering of incandescent lamps. (Light intensity varies with the square of the voltage.) Shrinking and expanding pictures on television screens is the second most objectionable result. Very severe voltage flicker can affect the operation of some electrical equipment, but the visible effects seen by consumers have been the dominant factor in establishing maximum acceptable voltage flicker limits in distribution system facilities.

The control of voltage flicker is a matter of economics, but excessive voltage flicker cannot be completely eliminated without disconnecting the fluctuating load. Usually, the Cooperative can reduce flicker to an acceptable level by increasing the capacity or changing the design of selected facilities. In some cases, the offending consumer is required to take corrective action.

The exact level where the visual effect of voltage flicker becomes objectionable is difficult to establish. It is a function of how often voltage fluctuations occur, the amount of voltage change, and an individual's psychological tolerance to the effects of voltage flicker. Unfortunately, a few people are much more sensitive to voltage flicker than others.

Also, in recent years, some computers and electronic control equipment have experienced problems with even low levels of voltage flicker. These exceptions to otherwise acceptable voltage flicker levels are unpredictable, and it is generally economically prohibitive to design electrical facilities to avoid all such voltage flicker complaints.

To this point, the discussion of voltage flicker has related to the quality of electric service to all Consumer Members supplied from residential substations. Voltage flicker problems that occur in industrial substations require special analysis. If not properly controlled, fluctuating industrial loads, such as arc furnaces, can cause objectionable voltage flicker to all other Consumer Members supplied from the same subtransmission system.

New technology and new concepts are being used in the design of generation units available to QFs. It is, therefore, logical to assume that voltage flicker may be a problem.

If QF capacity does not exceed the QF's peak load, it is unlikely that an additional expenditure will be required by the Cooperative to limit voltage flicker. However, the Co-operative may not always be able to identify the need for such an expenditure before the QF is placed in operation.

Present voltage flicker limits that will be provided by the Cooperative should be adequate in designing the QF interconnection facilities unless the QF itself is more sensitive to voltage flicker. The QF must consult the Cooperative before adding intermittent or fluctuating loads or voltage sources. The Cooperative may require the Consumer Member to provide suitable equipment to reasonably limit voltage fluctuations caused by the proposed QF, and/or may require special metering and billing procedures to help ensure that adequate revenue is received if the Cooperative is to be responsible for voltage correction action or equipment.

J. HARMONICS

Harmonics are waveforms whose frequencies are multiples of the fundamental (60 hertz) waveform. The combination of harmonics and fundamental waveforms causes a nonsinusoidal, periodic wave (Fourier series). Harmonics in power systems are the result of rapidly changing loads and nonlinear effects. Typically, harmonics are associated with retifiers and inverters and power switching circuits, such as variable speed motor drives, arc furnaces, arc welders, and transformer magnetizing current.

There are voltage and current harmonics, each requiring separate analysis. The effects are dependent on the magnitude and frequency of the harmonics and the characteristics of the electrical system. Some of the possible problems associated with harmonics are:

1. Capacitor bank overloading
2. Over voltages such as those due to ferroresonance
3. Excessive currents
4. Dielectric instability of insulated cables
5. Torque disturbance and overheating of synchronous machines
6. Electronic control and computer system problems
7. Communication (telephone) interference

The complexity and number of unknowns about harmonics and about the characteristics of some QFs prevent developing specific standards based on a complete analysis of harmonic effects. However, the Cooperative will require that the QF shall not adversely affect other Consumers Members; and if a problem occurs, the QF will be disconnected until the Consumer Member corrects the problem.

K. CONTRACT

A contract agreement covering all the various aspects of parallel operation and purchase of the electrical energy must be signed by the Cooperative and the Consumer Member proposing to install and operate a Qualifying Facility.

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