2B.1—Cogeneration and Parallel Generation Interconnection Guide

1 Scope

This guideline is designed to assist company field engineers in interconnecting a cogenerator or parallel generator with the company's electrical distribution system. In those cases where a customer's facility cannot be adequately served by the distribution system, then the customer should consult with the company's Transmission Department.

This guideline also identifies the major requirements a customer must meet in order to interconnect his generating facility with the electrical distribution supply system. This guide is not intended to replace an evaluation of any special conditions made by the field engineer.

2 Cogeneration or Parallel Generation

Cogeneration or parallel generation is an option that many customers invest in to meet special requirements that they have. Customers may be using one of the following cogeneration processes:

1. Use the waste heat from the generator to run a manufacturing process;
2. Have access to heat they can use to generate electricity;
3. Use a generator interconnection to allow the full-load testing of their standby generator without having to cause themselves an outage.

3 Basic Interconnection Requirements

3.1 Power Quality

The generating facility must meet the power quality specifications as outlined in Engineering Handbook Section 1C, *Power Quality.* If the company determines that operation of the customer's generating facility adversely affects the power quality within the general area, then the customer must disconnect their equipment until the proper adjustments or corrections are made.

3.2 Metering

The customer must provide adequate space and equipment for the metering of the facility. Depending on the agreement between the customer and the company, the metering will either be single-direction or bi-directional. Single-direction metering will not provide payment to the customer for excess power generated on his site. Power generated or consumed, as well as vars consumed will be charged or reimbursed according to the current rate schedule or separate service agreement with the customer.

3.3 Protective Relaying

The customer shall soley be responsible for the protection of their equipment. Disturbances such as lightning, switching surges, voltage sags, line faults, line trips, line reclosures, over-frequency, under-frequency, high voltage and low voltage all occur within the electrical supply system and the customer must be prepared to deal with these events. Line reclosures will be done without regard to synchronous checking with the customer's generator unless special provisions are made with the company, usually at the customer's expense.

As a minimum, the customer needs to have protection for the following events: over-frequency, under-frequency, over-voltage, under-voltage, ground faults, phase-to-phase faults, reverse current relays for induction machines, and synchronous closing relays. Automatic line reclosing time delays on distribution lines can range from 0.3 seconds up through 90 seconds. Manual line reclosing will occur after the automatic line reclosing fails to restore electrical service.

3.4 System Compatibility

The interconnected generation system must not adversely affect the electrical supply system. Excessive voltage flicker and excessive voltage swings on the electrical system as described in Engineering Handbook Section 1C, must be minimized or not permitted.

Prior to construction, a system compatibility study must be done to ensure that the proposed generator will not adversely affect the system. During the generator compatibility study, if operation of the customer's generator under normal operating conditions does not raise the voltage of the system at the point of common coupling more than three percent, with the generator running at full output at unity power factor, then the generator is considered compatible with the system. If voltage swings will be in excess of three percent, then a separate and more extensive study must be done to determine its effects on the distribution system and what action, if any, needs to take place in order to make a compatible tie. These studies must be completed prior to the start of construction.

After the generator is constructed, it shall not be operated in such a way as to cause power quality or reliability problems to the system. The generator should limit itself to a three percent voltage shift on the system. Induction machines should be supplied with shunt capacitors to limit their var consumption on the system.

3.5 System Modifications

Any modifications that must be made to the company's system to accommodate the proposed generator must generally be paid for by the customer.

3.6 Visible Disconnect Switch

A visible and lockable disconnect switch for the generator that is accessible to the company is required unless this requirement is specifically waived by the company's local operations staff.

3.7 Code Compliance

The customer's facility must comply with all applicable sections of the National Electrical Code, the National Electrical Safety Code, IEEE 1547, *Distributed Resources Interconnected with Electric Power System*s, and the Electric Service Requirements Manual for that particular state. Photovoltaic systems must also comply with NEC Article 690.

4 Rotating Machine Driven System

This section applies to those systems that use a rotating machine to directly generate the ac power. It applies to both synchronous and induction systems. These systems are capable of generating high currents during a fault condition. Lacking any specific information, it is recommended that the customer use these settings on his protective relaying:

4. Over-frequency: 61 Hertz, 10 cycle time delay.
5. Under-frequency: 59 Hertz, 6 cycle time delay.
6. Over-voltage: 110% of nominal voltage, 1 to 5 second time delay.
7. Under-voltage: 90% of nominal voltage, 1 to 5 second time delay.
8. Ground faults, set to protect the generator.
9. Phase-to-phase faults, set to protect the generator.
10. Reverse current relays for induction machines, to protect motoring of the generator.
11. Synchronous closing relays.

For further information regarding generator protection, please refer to the General Electric "Gold" pamphlet, *Generator Protection GEK–75512A*.

5 Inverter Driven Systems

This section applies to systems up through 500 kW where dc-generated power is converted to ac power using an inverter. This includes photovoltaic systems, fuel cells, and dc generators that include an inverter for the final power conversion step. These systems must comply with IEEE 929, *Recommended Practice for Utility Interface of Photovoltaic (PV) Systems* and UL 1741, *Standard for Static Inverters and Charge Controllers*. The customer must utilize an automatic non-islanding inverter as defined by the above standards.

Issuing Department:	**Approvals and Authorization:**
Standards and Technical Support, PacifiCorp Engineering	This document was approved by the Distribution Engineering Standards Team.
Additional copies: 1407 West North Temple, Suite 330 Salt Lake City, UT 84140 Telephone: 801–220–2034; fax: 801–220–2258	Distribution Engineering Standards 1407 West North Temple, Suite 330 Salt Lake City, UT 84140 Telephone: 801–220–4517; fax: 801–220–2258

Approved: 

R. Dee Jones
Distribution Systems Engineering