BLACK HILLS POWER

Technical Requirements for Parallel Operation of Distribution Generation Facilities

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REVISIONS

Rev. No.	Date	Description	By	Approval
1.0	8/31/07	New Document	EE/JK	

TECHNICAL REQUIREMENTS FOR PARALLEL GENERATION SERVICE - SMALL (≤ 25 KW – SINGLE PHASE / ≤ 100 KW – THREE PHASE)

1. DEFINITIONS

Distributed Generation (DG) Equipment — Includes any distributed generation facility, small electric generation facility, or generation facility of a self-generator or customer generator.

Flicker —A variation of input voltage sufficient in duration to allow visual observation of a change in electric light source intensity.

Harmonic Distortion — Continuous distortion of the normal sine wave; typically caused by nonlinear loads or by inverters.

Networked System — One that is normally operated with more than one distribution feeder connected to a load. Examples are spot networks and secondary networks. Open loop underground residential distribution systems and open loop primary feeder systems are not considered networks in this context.

Point of Common Coupling — The point at which the DG facility is connected to the shared portion of the Company's system.

Radially Operated System — One that is normally operated with only one distribution feeder connected to a load at any one time.

Single Phasing Condition — Occurs when one phase of the three-phase supply line is disconnected.

Unintentional Island — An unplanned condition where one or more DG's and a portion of the electric utility grid remain energized through the point of Interconnection.

2. APPLICABILITY

These rules apply to Interconnection and parallel operation of DG (Distributed Generation) equipment that, in sum, is rated 25kW or smaller single phase and 100kW or smaller three phase on non-networked Company Distribution systems of 25kV or less.

3. CUSTOMER DESIGN REQUIREMENTS

For an interconnection to be safe to Company employees / equipment and to other customers, the following conditions are required to be met on DG equipment.

3.1. Interconnection Customer DG facilities must meet all applicable national, state, and local construction, operation and maintenance related safety codes, such as the American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE), National Electrical Code (NEC), National Electrical Safety code (NESC), Occupational Safety and Health Administration (OSHA), and Underwriters Laboratories (UL).

3.2. Interconnection Customer must provide the Company with a one-line diagram showing the configuration of the proposed DG system, including the protection and controls, disconnection devices, nameplate rating of each device, power factor rating, transformer connections, transformer impedance, and other information deemed relevant by the Interconnection Customer. If the proposed DG system does not pass the BHP Small

Generator Interconnection Procedures Fast Track Process, additional information may be necessary from the Interconnection Customer and Company facilities changes may be required.

3.3. DG Equipment must be equipped with adequate protection and control to trip[1] the unit off line during abnormal system conditions[2], according to the following requirements:

3.3.1. Undervoltage or overvoltage within the trip time indicated below. By agreement of both the Interconnection Customer and the Company, different settings maybe used for the undervoltage and overvoltage trip levels or time delays.

Voltage	**Maximum Trip Time**
Voltage < 50%	10 cycles
50% ≤ Voltage < 88%	120 cycles
110% < Voltage < 120%	60 cycles
Voltage ≥ 120%	6 cycles

3.3.2. Three-phase generation must disconnect from the Company's system for loss of balanced three-phase voltage or a single phasing condition within the trip times indicated in 3.3.1 when voltage on at least one phase reaches the abnormal voltage levels.

3.3.3. Underfrequency or overfrequency within the trip time indicated below: All DG shall follow the associated Company frequency within the range 59.3 Hz to 60.5 Hz. By agreement of both the Interconnection Customer and the Company, different settings maybe used for the under frequency and over frequency trip levels or time delays.

DG Size	**Frequency Range (Hz)**	**Clearing Time (cycles)**
≤ 25 kW	> 60.5	10
	< 59.3	10
> 25 kW	> 60.5	10
	< 59.8 – 57.0 (adjustable)	Adjustable (10 cycles to 300 sec.)
	< 57.0	10

3.4. The Company requires DG equipment to have the following additional protection to avoid damage to the Company's system during normal, as well as abnormal system conditions.

3.4.1. Synchronizing controls to insure a safe interconnection with the Company's distribution system. The DG equipment must be capable of Interconnection with minimum voltage and current disturbances. Synchronous generator installations, as well as other types of installations, must meet the following: slip frequency less than 0.2 Hz, voltage deviation less than ±10%, phase angle deviation less than ±10 degrees, breaker closure time compensation (not needed for automatic synchronizer that can control machine speed).

[1] To trip is to automatically (without human intervention required) open the appropriate disconnection device to separate the DG equipment from the power system.

[2] Abnormal system conditions include faults due to adverse weather conditions including but not limited to, floods, lightning, vandalism, and other acts that are not under the control of the Company. This may also result from improper design and operation of customer facilities resulting from non-compliance with accepted industry practices.

3.4.2. A disconnect switch to isolate the DG equipment for purposes of safety during maintenance and during emergency conditions. The Company may require a disconnect device to be provided, installed by, and paid for by the customer, which is accessible to and lock-able by Company personnel, either at the primary voltage level, which may include load-break cutouts, switches and elbows, or on the secondary voltage level, which may include a secondary breaker or switch. The switch must be clearly labeled as a DG disconnect switch.

3.5. DG equipment must have adequate fault interruption and withstand capacity, and adequate continuous current and voltage rating to operate properly[3] with the Company's system. A three-phase device shall interrupt all three phases simultaneously. The tripping control of the circuit-interrupting device shall be powered independently of the utility AC source in order to permit operation upon loss of the Company distribution system connection.

3.6. Test results shall be supplied by the manufacturer or independent testing lab that verify, to the satisfaction of the Company, compliance with the following requirements contained in this document[4]:

3.6.1. Over/Under Voltage Trip Settings
3.6.2. Over/Under Frequency Trip Settings
3.6.3. Synchronization
3.6.4. Harmonic Limits (tested at 25%[5] of full load rating or at a level as close to the minimum level of rated output the unit is designed to operate as practical and at a level as close to 100% of full load rating as practical)
3.6.5. DC Current Injection Limits
3.6.6. Anti-Islanding
3.6.7. Prevent Connection or Reconnection to De-energized System
3.6.8. Unbalance current Trip Settings (For three phase DG installations)
3.6.9. Primary fault Trip Settings
3.6.10. Secondary fault Trip Settings

If test results are acceptable to the Company and if requested by a manufacturer, the Company will supply a letter indicating the protective and control functions for a specific DG model are approved for Interconnection with the Company's distribution system, subject to the other requirements in this document.

The Interconnection Customer must provide the Company a reasonable opportunity to witness site testing of any other protective and control functions required in this document, but not listed above. The Interconnection Customer must provide the Company a reasonable opportunity to perform an inspection prior to the first paralleling of the generation equipment to install and/or verify correct protective settings and connections to the system.

3.7. Harmonics and Flicker: The DG equipment shall not be a source of excessive harmonic voltage and current distortion and/or voltage flicker. Limits for harmonic distortion (including

[3] Properly, in this context, means within the acceptable utility or applicable industry established practices.

[4] For photovoltaic systems, a certification that the testing requirements of UL 1741 have been met may be used in place of these tests.

[5] If the device is not designed to operate at this level, then the test should be at the lowest level at which it is designed to operate.

inductive telephone influence factors) will be as published in the latest issues of ANSI/IEEE 519, “Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.” Flicker occurring at the point of common coupling shall remain below the Border Line of Visibility curve on the IEEE/GE curve for fluctuations less than 1 per second or greater than 10 per second. However, in the range of 1 to 10 fluctuations per second, voltage flicker shall remain below 0.4%. When there is reasonable cause for concern due to the nature of the generation and its location, the Company may require the installation of a monitoring system to permit ongoing assessment of compliance with these criteria. The monitoring system, if required, will be installed at the Interconnection Customer’s expense. Situations where high harmonic voltages and/or currents originate from the distribution system are to be addressed in the Interconnection Agreement.

3.8. DC Injection from inverters shall be maintained at or below 0.5% of full rated inverter output current into the point of common coupling.

3.9. The DG’s generated voltage shall follow, not attempt to oppose or regulate, changes in the prevailing voltage level of the Company at the point of common coupling, unless otherwise agreed to by the owners/operators of the DG and the Company. DG installed on the downstream (load) side of the Company’s voltage regulators shall not degrade the voltage regulation provided to the downstream customers of the Company.

3.10. System Grounding: The DG system should be grounded in accordance with ANSI/IEEE 142 “Grounding for Industrial and Commercial Power Systems. The DG grounding system shall be sized to handle the maximum available ground fault current and designed and installed to limit step and touch potentials to safe levels as set forth in ANSI/IEEE 80 “IEEE Guide for Safety in AC Substations Grounding.” All electrical equipment shall be grounded in accordance with local, state, and federal electrical and safety codes and applicable standards.

3.11. System Protection: The Interconnection Customer is responsible for providing adequate protection to Company facilities for conditions arising from the operation of generation under all Company distribution system-operating conditions. The Interconnection Customer is also responsible for providing adequate protection to their DG facility under any Company distribution system operating condition whether or not their DG is in operation. Conditions may include but are not limited to:

3.11.1. Loss of a single phase of supply,
3.11.2. Distribution system faults,
3.11.3. Equipment failures,
3.11.4. Abnormal voltage or frequency,
3.11.5. Lightning and switching surges,
3.11.6. Excessive harmonic voltages,
3.11.7. Excessive negative sequence voltages,
3.11.8. Separation from supply,
3.11.9. Synchronizing generation,
3.11.10. Re-synchronizing the Interconnection Customer’s generation after electric restoration of the supply.

Protective devices required to permit safe and proper operation of the DG system while interconnected with the Company’s distribution system are shown in figures at the end of this document.

3.12. Feeder Reclosing Coordination: In the case of a Company protection function initiating a trip of a Company protective device in reaction to a fault on the Company system, the DG unit protection and controls must be designed to coordinate with the Company reclosing practices of that protective device.

3.13. Unintentional islanding: For an unintentional island in which the DG and a portion of the Company's system remain energized through the point of common coupling, the DG shall cease to energize the Company's system within two seconds of the formation of an island.

3.14. The DG shall be designed to prevent the DG from being connected to a de-energized Company circuit. The Interconnection Customer should not reconnect DG to the Company's system after a trip from a system protection device, until the Company's system is re-energized for a minimum of five minutes. If the Interconnection Customer were to connect a backup generator, in the event to serve a critical load, they must open their main breaker or utilize a transfer switch prior to generator hook up, in order to ensure no back feed into the Company's distribution system. This is a critical safety requirement.

3.15. Voltage unbalance at the point of common coupling caused by the DG equipment under any condition shall not exceed 3% (calculated by dividing the maximum deviation from average voltage by the average voltage, with the result multiplied by 100).

3.16. Current unbalance at the point of common coupling caused by the DG equipment shall not exceed acceptable limits as determined by common utility practice.

3.17. Revenue Metering requirements will depend upon the type of generation and the type of Interconnection. Generally either a single bi-directional meter or two detented meters wire in series to capture energy flow in either direction will be installed by the Company. A dedicated, direct phone line may also be required to be supplied by the Interconnection Customer for Company use to read the metering. Additional monitoring may also be done through the meter and the dedicated, direct phone line. In some cases, the phone line requirement may be waived at the Company's discretion for smaller DG systems. The Company will supply, own, and maintain all the metering equipment necessary such as the voltage transformers, current transformers, by-pass switches, and meters.

3.18. Remote Monitoring requirements will depend upon the type and size of generation and the type of Interconnection. The remote monitoring can usually be done via direct phone line communication. The Company may also require a specific RTU and/or protocol to match their remote monitoring system.

3.19. Where DG design dictates Company changes; the complete cost of such changes will be borne by the Interconnection Customer. These changes could include, but are not limited to, the addition of reclosers, circuit breakers, capacitors, voltage regulators, or protective relaying equipment, depending on the DG size, location, and impact on the Company's system.

4. CUSTOMER OPERATING PROCEDURES

4.1. If high-voltage, low-voltage, or voltage flicker complaints arise from other customers due to the operation of Interconnection Customer's DG, the Interconnection Customer may be required to disconnect their generation equipment from the Company's system until the problem has been resolved.

4.2. The operation of the DG equipment must not result in harmonic currents or voltages at the point of common coupling that will interfere with the Company's metering accuracy and/or

proper operation of facilities and/or with the loads of other customers. Such adverse effects may include, but are not limited to heating of wiring and equipment, overvoltage, undervoltage, voltage flicker, communication interference, etc.

4.3. The Interconnection Customer must discontinue parallel operation when requested by the Company after reasonable prior notice except in an emergency, so that maintenance and/or repairs can be performed on the Company's facilities. In an emergency situation, the Interconnection Customer shall discontinue parallel operation as quickly as possible once directed to by the Company.

5. DG INTERFACE TESTING

5.1. Testing of the DG interfaces is important for the protection of the Interconnection Customer, the Company, and other customers.

5.2. This section describes two separate and distinct tests. The Manufacturer's tests and the Verification tests, together, ensure that a proposed system meets the necessary technical and functional requirements and that the proposed system has been installed so that it operates properly.

5.3. At the time of production, all interface equipment, including inverters and discrete relays, must meet or exceed the requirements of the following ANSI/IEEE standards: C37.90, C37.90.1, C37.90.2, C37.98, C37.2, and C62.41, as well as the following IEC standards: 255-21-1, 255-22-2, and 255-5.

5.4. Manufacturers Testing — Requires the testing of the specific generating unit and protective equipment. It also requires the testing of additional units over time to demonstrate that product quality has not declined. The results of manufacturers testing should be provided on an equipment certification, or a trusted equipment database. After review of manufacturers testing results, the Company reserves the right to refuse connection of such device to the Company's distribution system.

5.5. After review of the initial application, if the Company deems that sufficient information about the system has not been provided; Company may request that type testing be performed by an independent testing lab to verify system. The Company and manufacturer will agree upon type testing procedure and test.

5.6. Manufacturers may elect to have systems comprised of utility grade relays and other devices type tested as complete systems to avoid the required utility review if they are not used.

5.7. Verification Testing — Is used to prove to the Company, and Interconnection Customer that the equipment is installed correctly, and functioning properly in regards to the Company interface. The testing will proceed with an equipment inspection, to verify equipment is as shown on the application. All verification test 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. Verification testing shall be performed at least once every four years. The Interconnection Customer shall maintain copies of all verification tests reports for inspection by the Company.

5.8. Because the electrical characteristics of each generating unit are unique, the test results for one generating unit are not permitted to represent the characteristics of all generating units, should more than one unit with the same design characteristics be installed. It is necessary to verify the operational capabilities for each generating unit for testing purposes.

5.9. Qualified individuals including professional engineers, factory-trained and certified technicians, and Company approved individuals. The Company reserves the right to witness verification testing or require written certification that the testing was successfully performed.

5.10. After the initial inspection, if the DG unit is determined to meet the interconnection requirements, then live testing can begin. Live testing will start with testing on parts of the protective equipment being demonstrated, before the generation is brought on line. Then the generation will be brought online, and other parts of the protective equipment will be demonstrated. While the unit is online checks will be made to verify proper protective equipment measurement, and measurement sources.

5.11. A measurement is to be made at the time of commissioning, while the unit is generating at a level that is better than 25% of it's nameplate rating, and is to include voltage per leg, Current per leg, Real Power supplied per leg, Reactive Power supplied or taken per leg, and Power Factor per leg, on the generating unit, or each unit if more than one is installed. The measurements report must include the type of meter used to derive the measurements. A diagram of how the measurements are taken is suggested to speed the utilities acceptance. The power factor may be calculated based on same time readings of the Watts, and Vars. Watts and Vars are not to be calculated values. A copy of these measurements and testing report are to be delivered to the utility for review and acceptance. Should the testing procedure not follow the verification test procedure, or manufacturers verification test procedure, then a detailed explanation of reasoning must be included.

5.12. The acceptance of the verification testing gives the Interconnection Customer the approval of the Company for interconnection. It is not the acceptance of responsibility for the installation. It is a statement that the installation appears to be correctly installed. The Interconnection Customer is responsible for liability, and proper maintenance of the equipment.

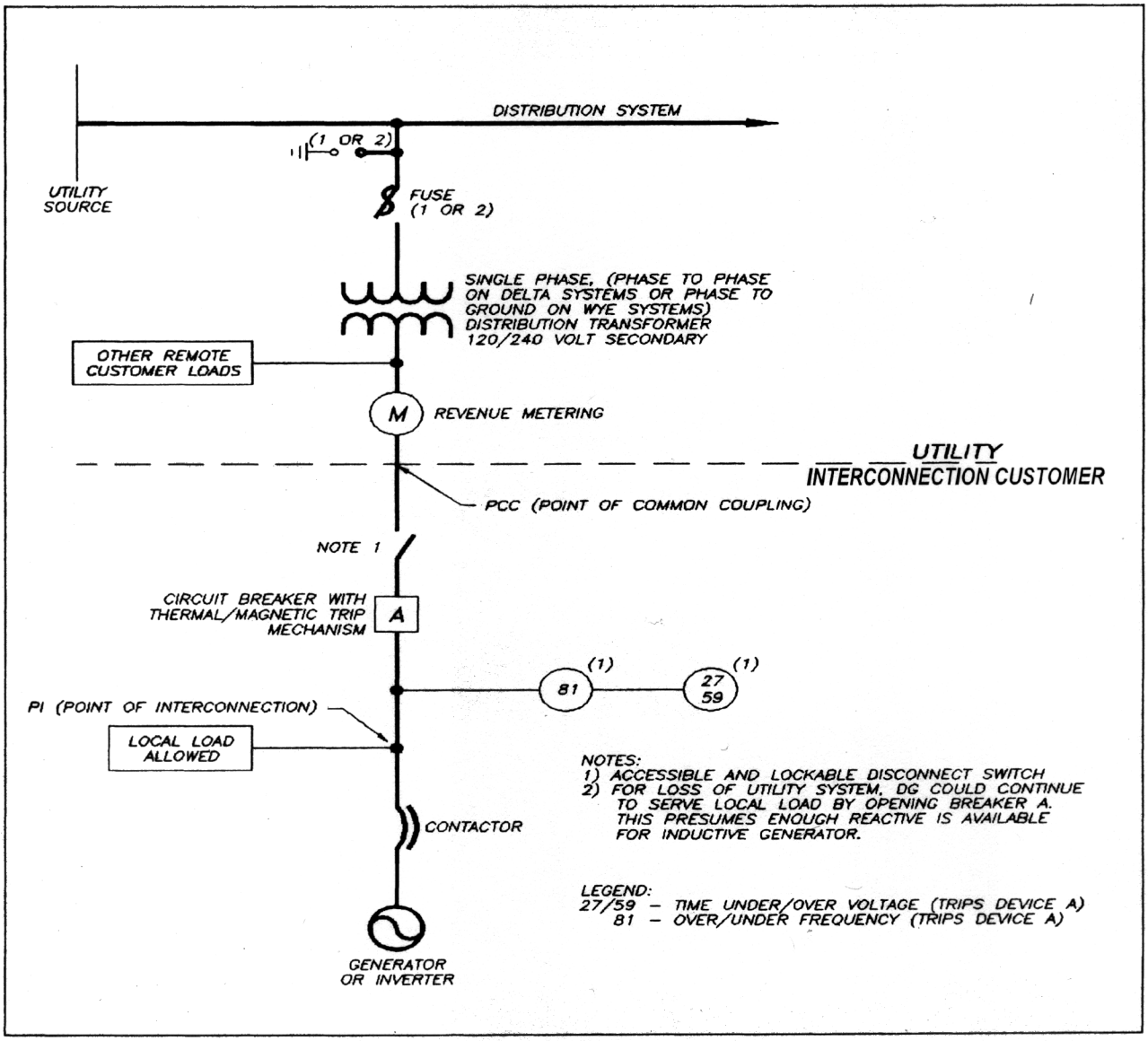
5.13. Verification testing is required if equipment is replaced, removed, added, damaged, programming is changed, or protective setting are altered in any way. Interconnection Customer shall notify the Company, in writing, prior to altering any equipment or settings. The Interconnection Customer shall also supply to the Company written documentation of the proposed changes as well as the newly completed verification tests.

5.14. All interface equipment must include a verification test procedure (unless otherwise noted in this document) as part of the documentation. Except for the case of small single-phase inverters as discussed later, the commissioning test must establish that the protection settings meet the interface requirements.

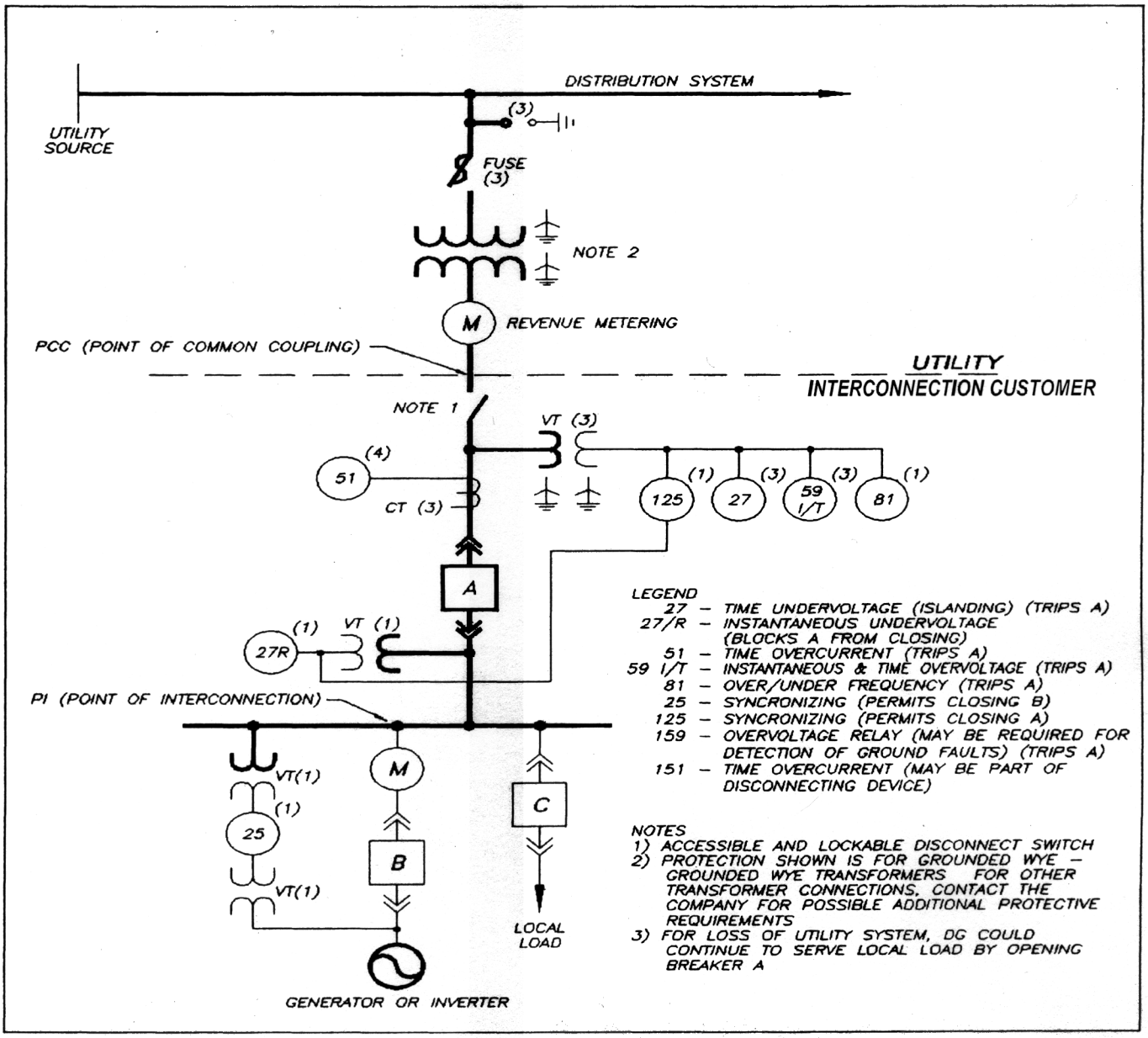
5.15. Single-phase inverters and inverter systems rated 25kVA and below may be verified upon initial parallel operation and once per year as follows: the Interconnection Customer shall operate the load break disconnect switch and verify the power producing facility automatically shuts down and does not restart for five minutes after the switch is closed. The Interconnection Customer shall maintain a log of these operations for inspection by the connecting utility. Any system that depends upon a battery for trip power shall be checked and logged once per month for proper voltage. Once every four (4) years the battery must be either replaced or a discharge test performed.

SMALL FACILITY INTERCONNECTION FIGURES

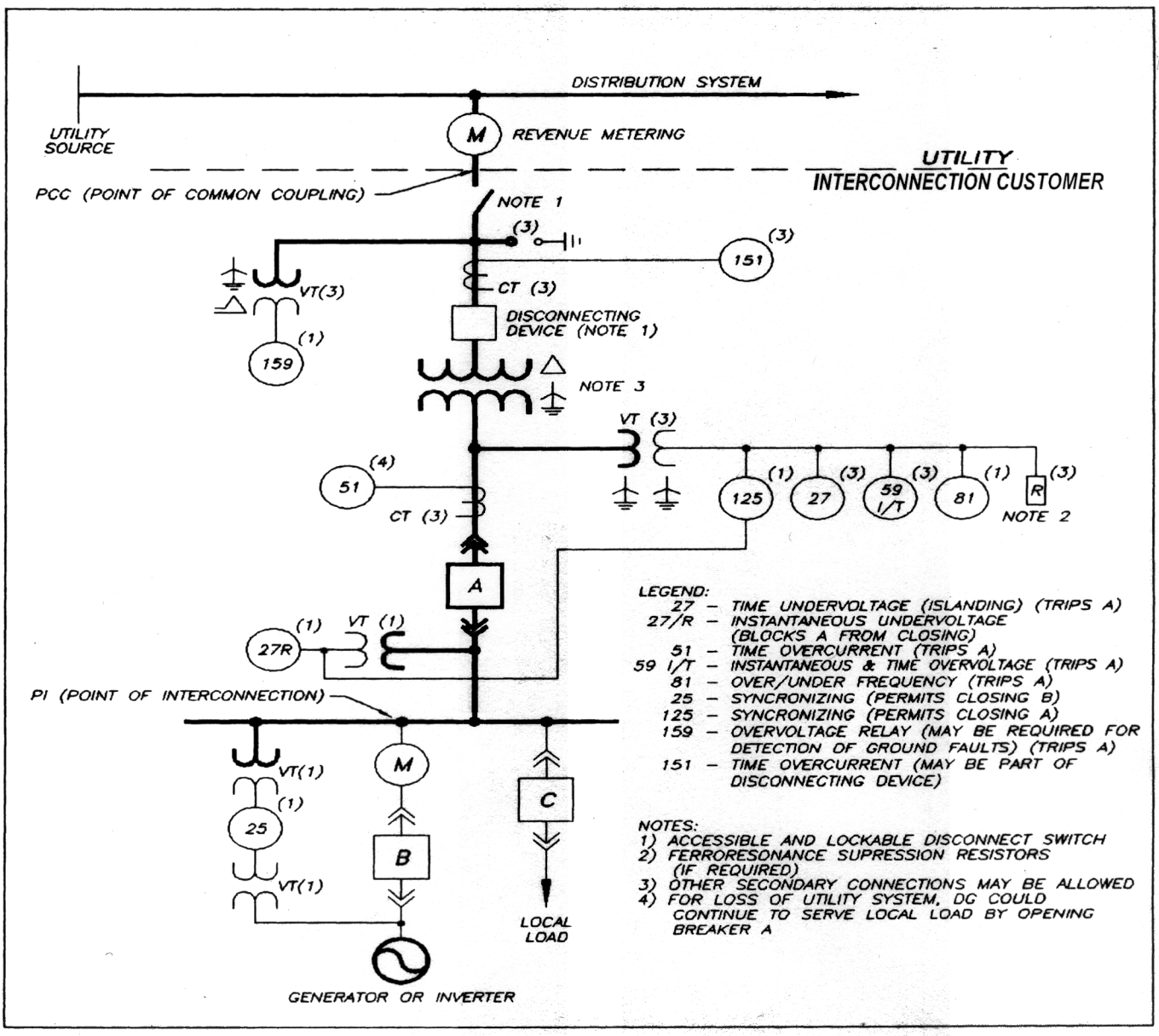
SMALL (≤25 KW) SINGLE PHASE INDUCTION GENERATOR OR INVERTER



SMALL THREE PHASE GENERATOR/INVERTER (≤100 KW) WITH GROUNDED-WYE TRANSFORMERS 12.47 KV AND BELOW SYSTEMS



SMALL THREE PHASE GENERATOR / INVERTER (≤100 KW) WITH DELTA / GROUNDED-WYE TRANSFORMERS 24.9 KV SYSTEMS



TECHNICAL REQUIREMENTS FOR PARALLEL GENERATION SERVICE - LARGE (> 25 KW – SINGLE PHASE / > 100 KW – THREE PHASE)

1. DEFINITIONS

Distributed Generation (DG) Equipment — Includes any distributed generation facility, small electric generation facility, or generation facility of a self-generator or customer generator.

Flicker —A variation of input voltage sufficient in duration to allow visual observation of a change in electric light source intensity.

Harmonic Distortion — Continuous distortion of the normal sine wave; typically caused by nonlinear loads or by inverters.

Networked System — One that is normally operated with more than one distribution feeder connected to a load. Examples are spot networks and secondary networks. Open loop underground residential distribution systems and open loop primary feeder systems are not considered networks in this context.

Point of Common Coupling — The point at which the DG facility is connected to the shared portion of the Company's system.

Radially Operated System — One that is normally operated with only one distribution feeder connected to a load at any one time.

Single Phasing Condition — Occurs when one phase of the three-phase supply line is disconnected.

Unintentional Island — An unplanned condition where one or more DG's and a portion of the electric utility grid remain energized through the point of Interconnection.

2. APPLICABILITY

These rules apply to Interconnection and parallel operation of DG (Distributed Generation) equipment that, in sum, is rated greater than 25kW single phase and 100kW three phase on non-networked Company Distribution systems of 25kV or less. Special applications of single-phase systems greater than 50 kW will be considered on a case-by-case basis.

3. CUSTOMER DESIGN REQUIREMENTS

For an Interconnection to be safe to Company employees / equipment and to other customers, the following conditions are required to be met on DG equipment.

3.1. Interconnection Customer DG facilities must meet all applicable national, state, and local construction, operation and maintenance related safety codes, such as the American National Standards Institute (ANSI), Institute of Electrical and Electronics Engineers (IEEE), National Electrical Code (NEC), National Electrical Safety code (NESC), Occupational Safety and Health Administration (OSHA), and Underwriters Laboratories (UL).

3.2. Interconnection Customer must provide the Company with a one-line diagram showing the configuration of the proposed DG system, including the protection and controls, disconnection devices, nameplate rating of each device, power factor rating, transformer connections, transformer impedance, and other information deemed relevant by the Interconnection Customer. If the proposed DG system does not pass the Parallel Generation

Screening Process, additional information may be necessary from the Interconnection Customer and Company facilities changes may be required.

3.3. DG Equipment must be equipped with adequate protection and control to trip[6] the unit off line during abnormal[7] system conditions, according to the following requirements:

3.3.1. Undervoltage or overvoltage within the trip time indicated below. By agreement of both the Interconnection Customer and the Company, different settings maybe used for the undervoltage and overvoltage trip levels or time delays.

Voltage	**Maximum Trip Time**
Voltage < 50%	10 cycles
50% ≤ Voltage < 88%	120 cycles
110% < Voltage < 120%	60 cycles
Voltage ≥ 120%	6 cycles

3.3.2. Three-phase generation must disconnect from the Company's system for, loss of balanced three-phase voltage or a single phasing condition within the trip times indicated in 2.3.1 when voltage on at least one phase reaches the abnormal voltage levels.

3.3.3. Underfrequency or overfrequency within the trip time indicated below: All DG shall follow the associated Company frequency within the range 59.3 Hz to 60.5 Hz. By agreement of both the Interconnection Customer and the Company, different settings maybe used for the under frequency and over frequency trip levels or time delays.

DG Size	**Frequency Range (Hz)**	**Clearing Time (cycles)**
≤ 25 kW	> 60.5	10
	< 59.3	10
> 25 kW	> 60.5	10
	< 59.8 – 57.0 (adjustable)	Adjustable (10 cycles to 300 sec.)
	< 57.0	10

3.4. The Company requires DG equipment to have the following additional protection to avoid damage to the Company's system during normal, as well as abnormal system conditions.

3.4.1. Synchronizing controls to insure a safe interconnection with the Company's distribution system. The DG equipment must be capable of Interconnection with minimum voltage and current disturbances. Synchronous generator installations, as well as other types of installations, must meet the following: slip frequency less than 0.2 Hz, voltage deviation less than ±10%, phase angle deviation less than ±10 degrees, breaker closure time compensation (not needed for automatic synchronizer that can control machine speed).

3.4.2. A disconnect switch to isolate the DG equipment for purposes of safety during maintenance and during emergency conditions. The Company may require a

[6] To trip is to automatically (without human intervention required) open the appropriate disconnection device to separate the DG equipment from the power system

[7] Abnormal system conditions include faults due to adverse weather conditions including but not limited to, floods, lightning, vandalism, and other acts that are not under the control of the Company. This may also result from improper design and operation of customer facilities resulting from non-compliance with accepted industry practices.

disconnect device to be provided, installed by, and paid for by the customer, which is accessible to and lock-able by Company personnel, either at the primary voltage level, which may include load-break cutouts, switches and elbows, or on the secondary voltage level, which may include a secondary breaker or switch. The switch must be clearly labeled as a DG disconnect switch.

3.5. DG equipment must have adequate fault interruption and withstand capacity, and adequate continuous current and voltage rating to operate properly[8] with the Company's system. A three-phase device shall interrupt all three phases simultaneously. The tripping control of the circuit-interrupting device shall be powered independently of the utility AC source in order to permit operation upon loss of the Company distribution system connection.

3.6. Test results shall be supplied by the manufacturer or independent testing lab that verify, to the satisfaction of the Company, compliance with the following requirements contained in this document[9]:

3.6.1. Over/Under Voltage Trip Settings
3.6.2. Over/Under Frequency Trip Settings
3.6.3. Synchronization
3.6.4. Harmonic Limits (tested at 25%[10] of full load rating or at a level as close to the minimum level of rated output the unit is designed to operate as practical and at a level as close to 100% of full load rating as practical)
3.6.5. DC Current Injection Limits
3.6.6. Anti-Islanding
3.6.7. Prevent Connection or Reconnection to De-energized System
3.6.8. Unbalance current Trip Settings (For three phase DG installations)
3.6.9. Primary fault Trip Settings
3.6.10. Secondary fault Trip Settings

If test results are acceptable to the Company and if requested by a manufacturer, the Company will supply a letter indicating the protective and control functions for a specific DG model are approved for Interconnection with the Company's distribution system, subject to the other requirements in this document.

The Interconnection Customer must provide the Company a reasonable opportunity to witness site testing of any other protective and control functions required in this document, but not listed above. The Interconnection Customer must provide the Company a reasonable opportunity to perform an inspection prior to the first paralleling of the generation equipment to install and/or verify correct protective settings and connections to the system.

3.7. Harmonics and Flicker: The DG equipment shall not be a source of excessive harmonic voltage and current distortion and/or voltage flicker. Limits for harmonic distortion (including inductive telephone influence factors) will be as published in the latest issues of ANSI/IEEE 519, "Recommended Practices and Requirements for Harmonic Control in Electrical Power

[8] Properly, in this context, means within the acceptable utility or applicable industry established practices.

[9] For photovoltaic systems, a certification that the testing requirements of UL 1741 have been met may be used in place of these tests.

[10] If the device is not designed to operate at this level, then the test should be at the lowest level at which it is designed to operate.

Systems." Flicker occurring at the point of common coupling shall remain below the Border Line of Visibility curve on the IEEE/GE curve for fluctuations less than 1 per second or greater than 10 per second. However, in the range of 1 to 10 fluctuations per second, voltage flicker shall remain below 0.4%. When there is reasonable cause for concern due to the nature of the generation and its location, the Company may require the installation of a monitoring system to permit ongoing assessment of compliance with these criteria. The monitoring system, if required, will be installed at the Interconnection Customer's expense. Situations where high harmonic voltages and/or currents originate from the distribution system are to be addressed in the Interconnection Agreement.

3.8. DC Injection from inverters shall be maintained at or below 0.5% of full rated inverter output current into the point of common coupling.

3.9. The DG's generated voltage shall follow, not attempt to oppose or regulate, changes in the prevailing voltage level of the Company at the point of common coupling, unless otherwise agreed to by the owners/operators of the DG and the Company. DG installed on the downstream (load) side of the Company's voltage regulators shall not degrade the voltage regulation provided to the downstream customers of the Company.

3.10. System Grounding: The DG system should be grounded in accordance with ANSI/IEEE 142 "Grounding for Industrial and Commercial Power Systems. The DG grounding system shall be sized to handle the maximum available ground fault current and designed and installed to limit step and touch potentials to safe levels as set forth in ANSI/IEEE 80 "IEEE Guide for Safety in AC Substations Grounding." All electrical equipment shall be grounded in accordance with local, state, and federal electrical and safety codes and applicable standards.

3.11. System Protection: The Interconnection Customer is responsible for providing adequate protection to Company facilities for conditions arising from the operation of generation under all Company distribution system-operating conditions. The Interconnection Customer is also responsible for providing adequate protection to their DG facility under any Company distribution system operating condition whether or not their DG is in operation. Conditions may include but are not limited to:

3.11.1. Loss of a single phase of supply,
3.11.2. Distribution system faults,
3.11.3. Equipment failures,
3.11.4. Abnormal voltage or frequency,
3.11.5. Lightning and switching surges,
3.11.6. Excessive harmonic voltages,
3.11.7. Excessive negative sequence voltages,
3.11.8. Separation from supply,
3.11.9. Synchronizing generation,
3.11.10. Re-synchronizing the Interconnection Customer's generation after electric restoration of the supply.

Protective devices required to permit safe and proper operation of the DG system while interconnected with the Company's distribution system are shown in figures at the end of this document. In general, and increased degree of protection is required for increased DG size. This is due to the greater impact to system stability from these installations. Larger DG systems will require more sensitive and faster protections schemes to limit the damage and ensure safety.

3.12. Feeder Reclosing Coordination. In the case of a Company protection function initiating a trip of a Company protective device in reaction to a fault on the Company system, the DG unit protection and controls must be designed to coordinate with the Company reclosing practices of that protective device.

3.13. Unintentional islanding: For an unintentional island in which the DG and a portion of the Company's system remain energized through the point of common coupling, the DG shall cease to energize the Company's system within two seconds of the formation of an island.

3.14. The DG shall be designed to prevent the DG from being connected to a de-energized Company circuit. The Interconnection Customer should not reconnect DG to the Company's system after a trip from a system protection device, until the Company's system is re-energized for a minimum of five minutes. If the Interconnection Customer were to connect a backup generator, in the event to serve a critical load, they must open their main breaker or utilize a transfer switch prior to generator hook up, in order to ensure no back feed into the Company's distribution system. This is a critical safety requirement.

3.15. Voltage unbalance at the point of common coupling caused by the DG equipment under any condition shall not exceed 3% (calculated by dividing the maximum deviation from average voltage by the average voltage, with the result multiplied by 100

3.16. Current unbalance at the point of common coupling caused by the DG equipment shall not exceed acceptable limits as determined by common utility practice.

3.17. Revenue Metering requirements will depend upon the type and size of generation and the type of Interconnection. Generally either a single bi-directional meter or two detented meters wire in series to capture energy flow in either direction will be installed by the Company. A dedicated, direct phone line may also be required to be supplied by the Interconnection Customer for Company use to read the metering. Additional monitoring may also be done through the meter and the dedicated, direct phone line. In some cases, the phone line requirement may be waived at the Company's discretion for smaller DG systems. The Company will supply, own, and maintain all the metering equipment necessary such as the voltage transformers, current transformers, by-pass switches, and meters.

3.18. Remote Monitoring and/or SCADA requirements will depend upon the type and size of generation and the type of Interconnection. Generally this will be determined by the need of the Company's System Operator to have the necessary information for the reliable and safe operation of the Company's distribution system. Some remote monitoring can be done via direct phone line communication on smaller DG systems. For the larger DG systems, the monitoring must be through the Company's SCADA system that will require a continuous communication medium. When this type of communication system is required the Interconnection Customer must provide the communication medium that is compatible with the Company's SCADA system. The Company may also require a specific RTU and/or protocol to match their SCADA or remote monitoring system.

3.19. Where DG design dictates Company changes; the complete cost of such changes will be borne by the Interconnection Customer. These changes could include, but are not limited to, the addition of reclosers, circuit breakers, capacitors, voltage regulators, or protective relaying equipment, depending on the DG size, location, and impact on the Company's system.

4. CUSTOMER OPERATING PROCEDURES

4.1. If high-voltage, low-voltage, or voltage flicker complaints arise from other customers due to the operation of Interconnection Customer's DG, the Interconnection Customer may be required to disconnect their generation equipment from the Company's system until the problem has been resolved.

4.2. The operation of the DG equipment must not result in harmonic currents or voltages at the point of common coupling that will interfere with the Company's metering accuracy and/or proper operation of facilities and/or with the loads of other customers. Such adverse effects may include, but are not limited to heating of wiring and equipment, overvoltage, undervoltage, voltage flicker, communication interference, etc.

4.3. The Interconnection Customer must discontinue parallel operation when requested by the Company after reasonable prior notice except in an emergency, so that maintenance and/or repairs can be performed on the Company's facilities. In an emergency situation, the Interconnection Customer shall discontinue parallel operation as quickly as possible once directed to by the Company.

5. DG INTERFACE TESTING

5.1. Testing of the DG interfaces is important for the protection of the Interconnection Customer, the Company, and other customers.

5.2. This section describes two separate and distinct tests. The Manufacturer's tests and the Verification tests, together, ensure that a proposed system meets the necessary technical and functional requirements and that he proposed system has been installed so that it operates properly.

5.3. At the time of production, all interface equipment, including inverters and discrete relays, must meet or exceed the requirements of the following ANSI/IEEE standards: C37.90, C37.90.1, C37.90.2, C37.98, C37.2, and C62.41, as well as the following IEC standards: 255-21-1, 255-22-2, and 255-5.

5.4. Manufacturers Testing — Requires the testing of the specific generating unit and protective equipment. It also requires the testing of additional units over time to demonstrate that product quality has not declined. The results of manufacturers testing should be provided on an equipment certification, or a trusted equipment database. After review of manufacturers testing results, the Company reserves the right to refuse connection of such device to the Company's distribution system.

5.5. After review of the initial application, if the Company deems that sufficient information about the system has not been provided; Company may request that type testing be performed by an independent testing lab to verify system. The Company and manufacturer will agree upon type testing procedure and test.

5.6. Manufacturer may elect to have systems comprised of utility grade relays and other devices type tested as complete systems to avoid the required Company review if they are not used.

5.7. Verification Testing — Is used to prove to the Company, and Interconnection Customer that the equipment is installed correctly, and functioning properly in regards to the Company interface. The testing will proceed with an equipment inspection, to verify equipment is as shown on the application. All verification test 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. Verification testing shall be performed at least

once every four years. The Interconnection Customer shall maintain copies of all verification tests reports for inspection by the Company.

5.8. Because the electrical characteristics of each generating unit are unique, the test results for one generating unit are not permitted to represent the characteristics of all generating units, should more than one unit with the same design characteristics be installed. It is necessary to verify the operational capabilities for each generating unit for testing purposes.

5.9. Qualified individuals including professional engineers, factory-trained and certified technicians, and Company approved individuals. The Company reserves the right to witness verification testing or require written certification that the testing was successfully performed.

5.10. After the initial inspection, if the DG unit is determined to meet the Interconnection requirements, then live testing can begin. Live testing will start with testing on parts of the protective equipment being demonstrated, before the generation is brought on line. Then the generation will be brought online, and other parts of the protective equipment will be demonstrated. While the unit is online checks will be made to verify proper protective equipment measurement, and measurement sources.

5.11. A measurement is to be made at the time of commissioning, while the unit is generating at a level that is better than 25% of it's nameplate rating, and is to include Voltage per leg, Current per leg, Real Power supplied per leg, Reactive Power supplied or taken per leg, and Power Factor per leg, on the generating unit, or each unit if more than one is installed. The measurements report must include the type of meter used to derive the measurements. A diagram of how the measurements are taken is suggested to speed the utilities acceptance. The power factor may be calculated based on same time readings of the Watts, and Vars. Watts and Vars are not to be calculated values. A copy of these measurements and testing report are to be delivered to the utility for review and acceptance. Should the testing procedure not follow the verification test procedure, or manufacturers verification test procedure, then a detailed explanation of reasoning must be included.

5.12. The acceptance of the verification testing gives the Interconnection Customer the approval of the Company for Interconnection. It is not the acceptance of responsibility for the installation. It is a statement that the installation appears to be correctly installed. The Interconnection Customer is responsible for liability, and proper maintenance of the equipment.

5.13. Verification testing is required if equipment is replaced, removed, added, damaged, programming is changed or protective setting is altered in any way. Interconnection Customer shall notify the Company, in writing, prior to altering any equipment or settings. The Interconnection Customer shall also supply to the Company written documentation of the proposed changes as well as the newly completed verification tests. Because the electrical characteristics of each generating unit are unique, the test results for one generating unit are not permitted to represent the characteristics of all generating units, should more than one unit with the same design characteristics be installed. It is necessary to verify the operational capabilities for each generating unit for testing purposes.

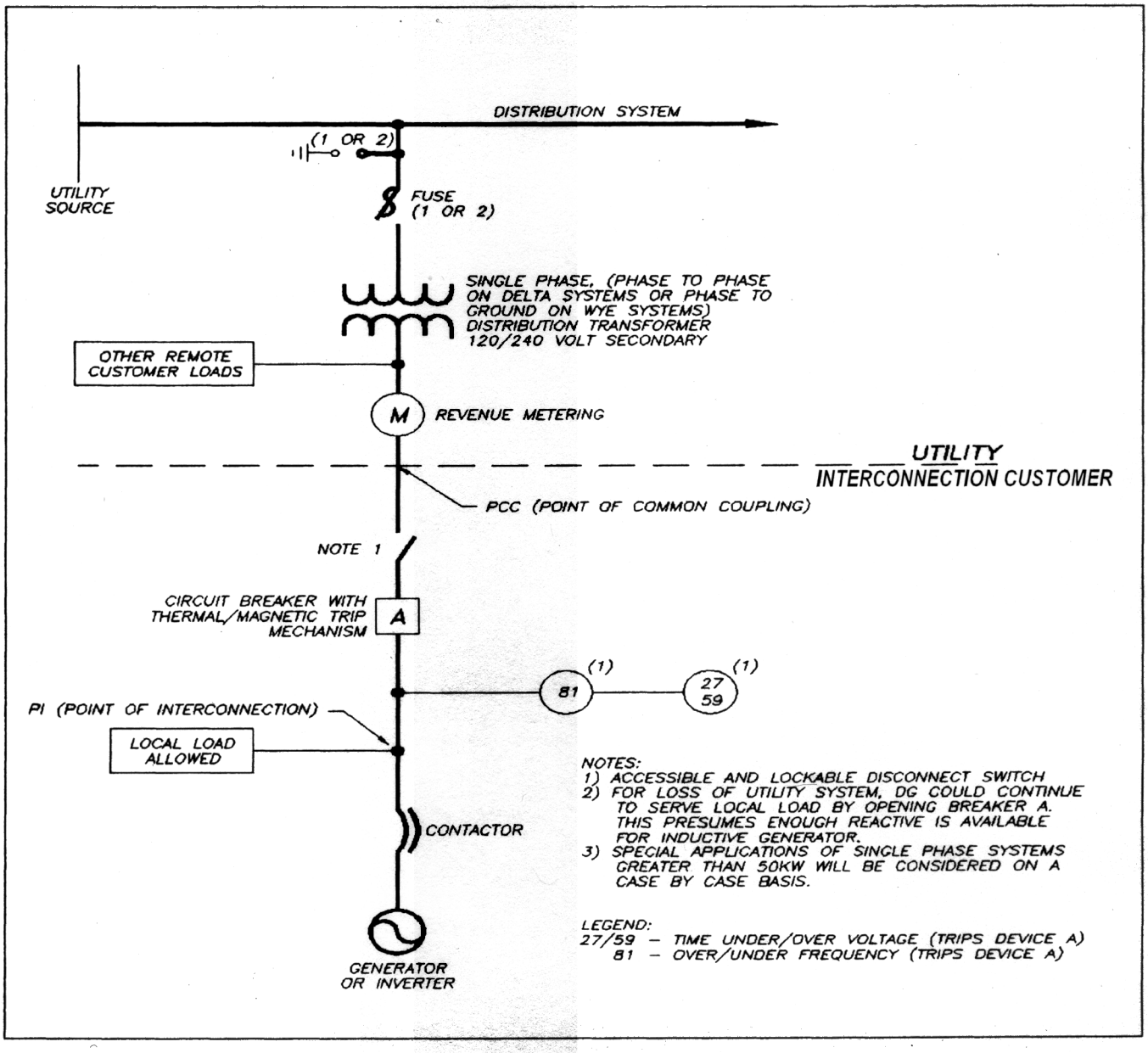
5.14. All interface equipment must include a verification test procedure (unless otherwise noted in this document) as part of the documentation. Except for the case of single-phase inverters as discussed later, the commissioning test must establish that the protection settings meet the interface requirements.

5.15. Inverter systems must be verified upon initial parallel operation and once per year as follows: the Interconnection Customer 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 Interconnection Customer shall maintain a log of these operations for inspection by the connecting utility. Any system that depends upon a battery for trip power shall be checked and logged once per month for proper voltage. Once every four (4) years the battery must be either replaced or a discharge test performed.

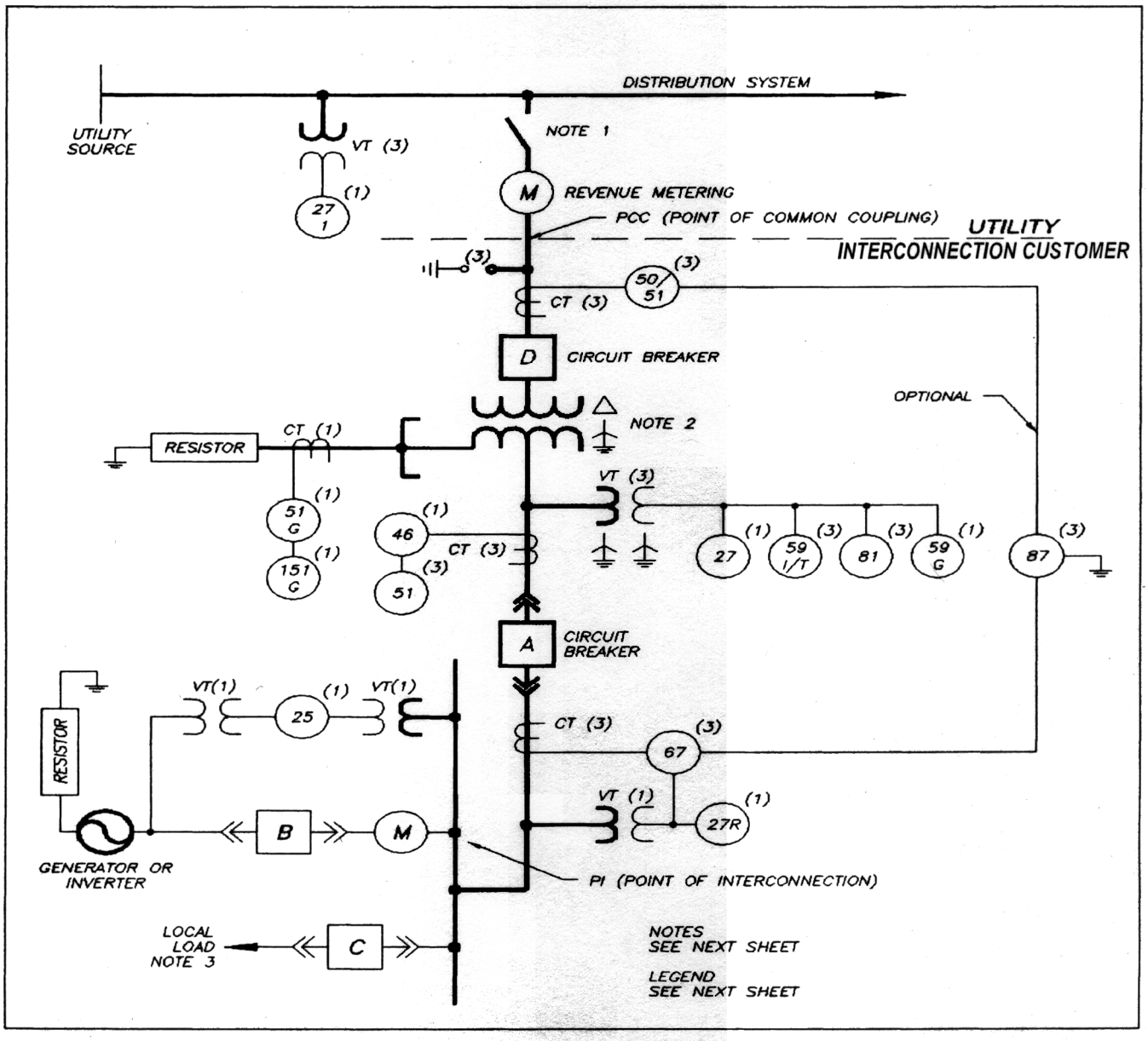
LARGE FACILITY INTERCONNECTION FIGURES

LARGE (> 25 KW) SINGLE PHASE INDUCTION GENERATOR OR INVERTER



LARGE (> 25 KW) THREE PHASE INDUCTION GENERATOR OR INVERTER

SHEET 1 OF 2



LARGE (> 25 KW) THREE PHASE INDUCTION GENERATOR OR INVERTER

SHEET 2 OF 2

LEGEND:

67	–	DIRECTIONAL OVERCURRENT (TRIPS A)
27	–	TIME UNDERVOLTAGE (ISLANDING) (TRIPS A OR D)
27/1	–	INSTANTANEOUS UNDERVOLTAGE FOR PRIMARY GROUND FAULT (TRIPS A OR D)
27/R	–	INSTANTANEOUS UNDERVOLTAGE (BLOCKS A FROM CLOSING)
50/51	–	INSTANTANEOUS & TIME OVERCURRENT (TRIPS A & D)
51	–	TIME OVERCURRENT (TRIPS A)
51/G	–	TIME OVERCURRENT (GROUND) (TRIPS A)
151/G	–	TIME OVERCURRENT (GROUND) (TRIPS D)
59 I/T	–	INSTANTANEOUS & TIME OVERVOLTAGE (TRIPS A OR B OR D)
81	–	OVER/UNDER FREQUENCY (TRIPS A OR D)
87	–	TRANSFORMER DIFFERENTIAL (TRIPS A & D)
59G	–	ZERO SEQUENCE OVERVOLTAGE (TRIPS A OR B OR D)
25	–	SYNCHRONIZING (PERMITS CLOSING B)
46	–	NEGATIVE SEQUENCE OVERCURRENT (TRIPS A OR D)

NOTES:
1) ACCESSIBLE AND LOCKABLE DISCONNECT SWITCH
2) OTHER TRANSFORMER SECONDARY CONFIGURATIONS ARE POSSIBLE.
3) FOR LOSS OF UTILITY SYSTEM, DG COULD CONTINUE TO SERVE LOCAL LOAD BY OPENING BREAKER A