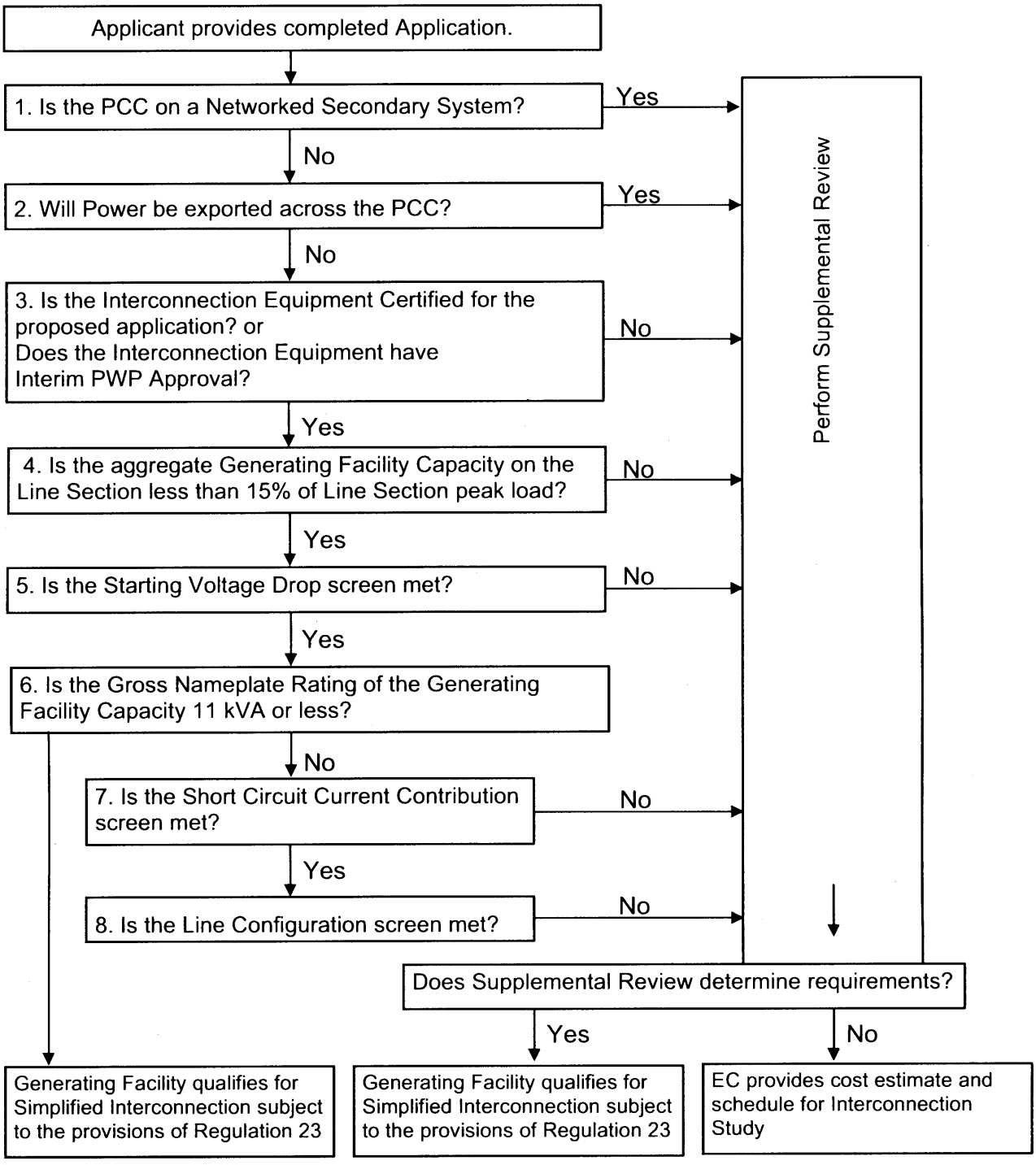
Initial Review Process Flow Chart



3. Initial Review Process Details

a. Screen 1: Is the PCC on a Networked Secondary System?

- If No, continue to next screen.
- If Yes, the Generating Facility does not qualify for Simplified Interconnection. Perform supplemental Review.

Significance:
Special considerations must be given to Generating Facilities proposed to be installed on networked secondary distribution systems because of the design and operational aspects of network protectors. There are no such considerations for radial distribution systems.

b. Screen 2: Will power be exported across the PCC?

- If Yes, the Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.
- If No, the Generating Facility must incorporate one of the following four options:

Option 1:
To insure power is never exported, a reverse power Protective Function must be implemented at the PCC.
Default setting shall be 0.1% (export) of transformer rating, with a maximum 2.0 second time delay.

Option 2:
To insure at least a minimum import of power, an under-power Protective Function must implemented at the PCC.
Default setting shall be 5% (import) of the Generating Facility Gross Nameplate Rating, with maximum 2.0 second time delay.

Option 3:
To limit the incidental export of power, all of the following conditions must be met:
The aggregate capacity of the Generating Facility must be no more than 25% of the nominal ampere rating of the ~~customer~~Producer's Service Equipment and;
The total aggregate Generating Facility capacity must be no more than 50% of the service transformer rating. (This capacity requirement does not apply to ~~customer~~Producers taking primary service without an intervening transformer);
The Generating Facility must be certified as Non-Islanding.

Option 4:
To ensure that the relative size (capacity) of the Generating Facility compared to facility load results in no export of power without the use of additional devices, the Generating Facility capacity must be no greater than 50% of the ~~customer~~Producer's verifiable minimum load over the last 12 months.

Significance:
- If it can be assured that the Generating Facility will not export power, PWP's Distribution System does not need to be studied for load-carrying capability or Generating Facility power flow effects on PWP voltage regulators as the Generating Facility will simply be reducing ~~customer~~Producer's load on PWP's Distribution System.
- Permits use of reverse-power relaying at the PCC as positive anti-islanding protection.

c. Screen 3: Is the Interconnection Equipment Certified for the Application or does the Interconnection Equipment have Interim PWP Approval?

- If No, the Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.
- If Yes, continue to next screen.

Significance:
If the Generating Facility has been Certified or previously approved by PWP, PWP does not need to repeat its review and/or test of the Generating Facility's Protective Functions scheme. Site Commissioning Testing may still be required to ensure that the system is connected properly and that the protective functions are working properly.

Certification indicates the following criteria have been tested and verified:
- Basic protective function requirements.
- Harmonic distortion limits.
- Synchronizing requirements.
- Power factor regulation requirements.
- Non-islanding requirements.
- If used, reverse power function requirement.
- If used, under-power function requirement.

d. Is the aggregate Generating Facility capacity on the Line Section less than 15% of Line Section Peak Load?

- If Yes, continue to next screen.
- If No, Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review to determine cumulative impact on Line Section.

Significance:
Low penetration of Generating Facility installations will have a minimal impact on Distribution System and load operation and power restoration.
The operating requirements for a high penetration of Generating Facilities may be different since the impact on PWP's Distribution System operation will no longer be minimal, therefore requiring additional study or controls.

e. Screen 5: Is the Starting Voltage Drop Within Acceptable Limits?

- If Yes, continue to next screen.
- If No, The Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review to determine cumulative impact on Line Section.

NOTICE: This screen only applies to Generating Facilities that start by motoring the Generator.

PWP has two options in determining whether Starting Voltage Drop could be a problem; which option to use is at PWP's discretion.

Option 1:

PWP may determine that the Generating Facility's starting Inrush Current is equal to or less than the continuous ampere rating of the ~~customer~~Producer's service equipment.

Option 2:

PWP may determine the impedances of the service distribution transformer (if present) and secondary conductors to ~~customer~~Producer's service equipment and perform a voltage drop calculation. Alternatively, PWP may use tables or nomographs to determine the voltage drop. Voltage drops caused by starting a Generating Unit as a motor must be less than 2.5% for primary interconnection and 5% for secondary interconnection.

Significance:

- This screen addresses potential voltage fluctuation problems for generators that start by motoring.
- When starting, a Generating Facility should have minimal impact on the service voltage to other PWP Customers.
- Passing this screen does not relieve ~~the customer~~Producer from ensuring that its Generating Facility complies with the flicker requirements of this Regulation, Section D.

f. Screen 6: Is the Gross Nameplate Rating of the Generating Facility 11kVA or less?

- If Yes, the Generating Facility qualifies for Simplified Interconnection. Skip remaining screens.
- If No, continue to next screen.

Significance:
The Generating Facility has minimal impact on fault current levels and any potential line overvoltages from loss of system neutral grounding.

g. Screen 7: Is Short Circuit Current Contribution Within Acceptable Limits?

- If No, the Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.
- If Yes, continue to next screen.

Short Circuit Current Contribution Screen
The Short Circuit Current Contribution Screen consists of two criteria; both of which must be met when applicable:

1) At primary side (high side) of the Dedicated Distribution Transformer, the sum of the Short Circuit Contribution Ratios (SCCR) of all Generating Facilities on the Distribution System circuit may not exceed 0.1.
2) At secondary (low side) of a shared distribution transformer, the short circuit contribution of the proposed Generating Facility must be less than or equal to 2.5% of the interrupting rating of ~~the customer~~Producer's Service Equipment.

Significance:
No significant Generating Impact on:
(1) Distribution System's short circuit duty
(2) Distribution System fault detection sensitivity
(3) Distribution System relay coordination
(4) Distribution System fuse-saving schemes

If the Generating Facility passes this screen it can be expected that it will have no significant impact on PWP's Distribution System's short circuit duty, fault detection sensitivity, relay coordination or fuse-saving schemes.

h. Screen 8: Is the Line Configuration Acceptable for Simplified Interconnection?

- If No, then the Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.
- If Yes, the Generating Facility qualifies for Simplified Interconnection

Line Configuration Screen:
Identify primary distribution line configuration that will serve the proposed Generating Facility. Based on the type of Interconnection to be used for the Generating Facility, determine from the following table if proposed Generating Facility passes the screen.

Primary Distribution Line Type	Type of Interconnection to Primary Distribution Line	Result/Criteria
Three-phase, three wire	Any	Pass screen
Three-phase, four wire	Single-phase, line-to-neutral	Pass screen
Three-phase, four wire (For any line that has such a section OR mixed 3 wire & 4 wire)	All others	To pass, aggregate Generating Facility Capacity must be less than or equal to 10% of Line Section Peak Load.

Significance:
If the primary distribution circuit serving the Generating Facility is of a three-wire type, or if the Generating Facility's Interconnection transformer is single-phase and connected in a line-to-neutral configuration, then there is no concern about overvoltages to PWP's, or other ~~customer~~Producer's equipment caused by loss of system neutral grounding during the operating time of anti-islanding protection.

J. TESTING AND CERTIFICATION CRITERIA

1. **Introduction.** This Section describes the test procedures and requirements for equipment used for the Interconnection of a Generating Facility to PWP's Distribution System. Included are Type Testing, Production Testing, Commissioning Testing, and Periodic Testing. The procedures listed rely heavily on those described in applicable Underwriters Laboratory (UL), Institute of Electrical and Electronic Engineers (IEEE), and International Electrotechnical Commission (IEC) documents—most notably UL 1741 and IEEE 929—as well as the testing described in the New York State Public Service Commission's Interconnection requirements[1]. These procedures and requirements were

1 "New York State Standardized Interconnection Requirements, Application Process, Contract & Application Forms For New Distributed Generators, 300 Kilovolt - Amperes or Less, Connected In Parallel with Radial Distribution Lines", November 9, 2000.

developed prior to the completion of IEEE P1547. *Standard for Distributed Resources Interconnected with Electric Power Systems*, and should be revisited once that standard is published. The tests described here, together with the technical requirements in Section D of this Regulation, are intended to provide assurance that the Generating Facility's equipment will not adversely affect PWP's Distribution System and that a Generating Facility will cease providing power to PWP's Distribution System under abnormal conditions. The tests were developed assuming a low level of Generating Facility penetration. At high levels of Generating Facility penetration, other requirements and corresponding test procedures may need to be defined.

This test specification also provides a means of certifying equipment. Once a Generating Unit or device has been Certified per this Certification Process, it may be considered to be suitable for use as part of a Generating Facility interconnected with PWP's Distribution System. Subject to the exceptions described in this Section, PWP will not require a ~~customer~~Producer to repeat the design review or test the Protective Functions of equipment that has been Certified. It should be noted the Certification process is intended to facilitate Generating Facility interconnections. Certification is not a prerequisite to interconnect a Generating Facility. The use of non-certified equipment may be acceptable subject to testing and approval by PWP as discussed below.

2. **Certification Criteria.** Equipment tested and approved (e.g. listed) by a NRTL as having met both the Type Testing and Production Testing requirements is considered to be Certified Equipment for purposes of Interconnection with PWP's Distribution System. Certification may apply to either a pre-packaged system or an assembly of components that address the necessary functions. Type Testing may be done in the factory/test lab or in the field. At the discretion of the testing laboratory, field-certification may apply only to the particular installation tested. In such cases, some or all of the tests may need to be repeated at other installations.

   The use of Certified Equipment is not a requirement for interconnection. However, the use of Certified Equipment will simplify the interconnection approval process by reducing Commissioning and additional test requirements. For non-certified equipment, some or all of the tests described in this document may be required by PWP for each Generating Facility. The manufacturer or a laboratory acceptable to PWP may perform these tests. Test results for non-certified equipment must be submitted to PWP as part of the application process for PWP's review and approval under the Supplemental Review. Approval by PWP for equipment used in a particular application does not guarantee PWP approval for use in other applications or by other California electric utilities.

   When equipment is Certified by a NRTL, the NRTL shall provide to the manufacturer, at a minimum, a Certificate with the following information for each device:

a. Administrative:

1) Effective Date of certification or applicable serial number (range or first in series), other proof that certification is current

2) Equipment model number(s)

3) Software version, if applicable

4) Test procedures specified (including date or revision number)

5) Laboratory accreditation (by whom and to what standard)

b. Technical (as appropriate):

1) Device Rating (kW, kVA, V, A, etc.)

2) Maximum available fault current, A

3) In-rush current A

4) Trip points, if factory set (trip value and timing)

5) Trip point and timing ranges for adjustable settings

6) Nominal power factor or range if adjustable

7) If the device/system is certified for non-export and the method used (reverse power or under power)

8) If the device/system is certified non-islanding

It is the responsibility of the equipment manufacturer to ensure that certification information is made publicly available by the manufacturer, the testing laboratory, or by a third party. A sample certification information form is provided in Appendix 1.

3. Type Testing. Type testing provides a basis for determining that equipment is designed appropriately and meets the specifications for being designated as Certified Equipment under this Regulation. The requirements described in this section cover only issues related to Interconnection and are not intended to address device safety or other issues outside the needs of the relationship between PWP and the ~~customer~~Producer operating a Generating Facility.

The following table defines the test requirements by technology. Test References that are preceded by "UL 1741" refer to the section numbers of the document that describe the test requirements[2] While UL 1741 was written specifically for photovoltaic inverters, the requirements are readily adapted to inverter-based Generating Facilities, synchronous machines, induction machines, as well as single/multi-function controllers and protection relays. Until a standardized test procedure is specified, PWP or NRTL shall adapt the procedures referenced in

2 UL 1741, *Inverters, Converters and Charge Controllers for use in Independent Power Systems,* Revised January 2001

the following table as appropriate and necessary for a machine's performance and its control and protection system functions.

Type Tests and Requirements for Interconnection Equipment Certification

Type Test	Reference [1]	Inverter	Synchronous Machine	Induction Machine
Utility Interaction	UL 1741 – 39	X	X	X
DC Isolation	UL 1741 - 40.1	X	---	---
Simulated PV Array (Input) Requirements	UL 1741 - 41.2	X	---	---
Dielectric Voltage Withstand	UL 1741 – 44	X	X	X
Power Factor	UL 1741 - 45.2.2	X	X	X
Harmonic Distortion	UL 1741 - 45.4	X	X	X
DC Injection	UL 1741 - 45.5	X	---	---
Utility Voltage and Frequency Variation	UL 1741 - 46.2	X	X	X
Reset Delay	UL 1741 - 46.2.3	X	X	X
Loss of Control Circuit	UL 1741 - 46.4	X	X	X
Short Circuit	UL 1741 - 47.3	X	X	X
Load Transfer	UL 1741 - 47.7	X	X	X
Surge Withstand	J.3.a	X	X	X
Anti Islanding	J.3.b	(2)	(2)	(2)
Non-Export	J.3.c	(3)	(3)	(3)
In-Rush Current	J.3.d	(4)	(4)	(4)
Synchronization	J.3.e	(5)	X	---

Notes: X = Required; – = Not required;

Table Notes:

(1) Reference refers to section number in either UL 1741 or this Regulation. References within UL 1741 to "photovoltaics" or "inverter" may have to be interpreted by the testing laboratory to appropriately apply the tests to other technologies.
(2) Required only if Non-Islanding designation is desired
(3) Required only if Non-Export designation is desired.
(4) Required for devices that use PWP power to motor to speed
(5) Required for all synchronous machines as well as inverters that operate as voltage sources when connected to PWP.

a. **Anti-Islanding Test.** Devices that are tested to and pass the Anti-Islanding test procedure described in UL 1741 Section 46.3 will be considered Non-Islanding for the purposes of these interconnection requirements. This test is required only for devices for which a certified Non-Islanding designation is desired.

b. **Non-Export Test.** Devices that pass the Non-Export test procedure described in Section J.7.a. will be considered Non-Exporting for the purposes of these interconnection requirements. This test is required only for devices for which a certified Non-Export designation is desired.

c. **In-rush Current Test** will be tested using the procedure defined in Section J.7.b. to determine the maximum current drawn during this startup process. The resulting in-rush current is used to estimate the starting voltage drop.

d. **Surge Withstand Capability Test.** Interconnection equipment shall be tested for surge withstand capability (SWC), both oscillatory and fast transient, in accordance with the test procedure defined in IEEE/ANSI C62.45 using the peak values defined in IEEE/ANSI C62.41 Tables 1 and 2 for location category B3. An acceptable result occurs even if the device is damaged by the surge, but is unable to operate or energize PWP's Distribution System. If the device remains operable after being subject to the surge conditions, previous type tests related to PWP protection and power quality will need to be repeated to ensure the unit will still pass those tests following the surge test.

e. **Synchronization Test.** This test verifies that the unit synchronizes within the specified voltage/frequency/phase angle requirements. It is applied to synchronous generators and inverters capable of operating as voltage-sources while connected to PWP. This test is not necessary for induction generators or current-source inverters.

The test will start with only one of the three parameters--voltage difference between Generating Facility and PWP Distribution System, frequency difference, or phase angle--outside of the synchronization specification. Initiate the synchronization routine and verify that the Generating Facility is brought within specification prior to synchronization. Repeat the test five times for each of the three parameters.

For manual synchronization with synch check or manual control with auto synchronization, the test must verify that paralleling does not occur until the parameters are brought within specifications.

4. **Production Testing.** As a minimum, the Utility Voltage and Frequency Variation Test procedure described in UL1741 under Manufacturing and Production Tests, Section 68 shall be performed as part of routine production (100 percent) on all equipment used to interconnect Generating Facilities to PWP's Distribution System. This testing may be performed in the factory or as part of a Commissioning Test (Section J.5).

5. **Commissioning Testing.** Commissioning Testing, where required, will be performed on-site to verify protective settings and functionality. Upon initial Parallel Operation of a Generating Facility, or any time interface hardware or software is changed that may affect the functions listed below, a Commissioning Test must be performed. An individual qualified in testing protective equipment (professional engineer, factory-certified technician, or licensed electrician with experience in testing protective equipment) must perform commissioning testing in accordance with the manufacturer's recommended test procedure to prove the settings and requirements of this Regulation.

PWP has the right to witness Commissioning Tests as described below, or to require written certification by the installer describing which tests were performed and their results.

Functions to be tested during commissioning, particularly with respect to non-certified equipment, may consist of the following:

- Over-and under-voltage
- Over and under-frequency
- Anti-Islanding (if applicable)
- Non-Export (if applicable)
- Inability to energize dead line
- Time delay restart after utility source is stable
- Utility system detection (if used)
- Synchronizing controls (if applicable)
- Other interconnection protective functions that may be required as part of the Interconnection Agreement

Other checks and tests that may need to be performed include:

- Verifying final protective settings
- Trip test
- In-Service Test

a. **Certified Equipment.** Generating Facilities qualifying for Simplified Interconnection incorporate Certified Equipment that have, at a minimum, passed the Type Tests and Production Tests described in this document, are judged to have little or no potential impact on PWP's Distribution System. For such Generating Facilities, it is necessary to perform only the Facilities qualifying for Simplified Interconnection incorporate Certified Equipment that have, at a minimum, passed the Type Tests and Production Tests described in this document, are judged to have little or no potential impact on PWP's Distribution System. For such Generating Facilities, it is necessary to perform only the following tests following tests:

   1) Protection settings that have been changed after factory testing will require field verification. Tests will be performed using injected secondary voltages and currents, applied waveforms, a test connection using a generator to simulate abnormal utility voltage or frequency, or varying the set points to show that the device trips at the measured (actual) utility voltage or frequency.

   2) Non-Islanding function, if included, will be checked by opening a load break disconnect switch to verify the interconnection equipment ceases to energize the line and does not re-energize for the required time delay after the switch is closed.

3) Non-Export function, if included, will be checked using secondary injection techniques. This function may also be tested by adjusting the Generating Facility output and local loads to verify that the applicable non-export criteria (i.e., reverse power or under power) are met.

The supplemental Review or an Interconnection Study may impose additional components or additional testing.

b. **Non-Certified Equipment.** Non-certified equipment shall be subjected to the appropriate tests described in Type Testing (Section J.3.) as well as those described in Certified Equipment (Section J.5.a.). With PWP approval, these tests may be performed in the factory, in the field as part of commissioning, or a combination of both. PWP, at its discretion, may also approve a reduced set of tests for a particular application or, for example, if it determines it has sufficient experience with the equipment.

c. **Verification of Settings.** If the testing is part of the commissioning process, then, at the completion of such testing, ~~the customer~~Producer shall confirm all devices are set to PWP-approved settings. This step shall be documented in the Commissioning Test Certification.

d. **Trip Test.** Interconnection protective devices (e.g. reverse power relay) that have not previously been tested as part of the interconnection system with their associated interrupting devices (e.g. contactor or circuit breaker) shall be trip tested during commissioning. The trip test shall be adequate to prove that the associated interrupting devices open when the protective devices operate.

Interlocking circuits between protective devices or between interrupting devices shall be similarly tested unless they are part of a system that has been tested and approved during manufacture.

e. **In-Service Test.** Interconnection protective devices that have not previously been tested as part of the interconnection system with their associated instrument transformers or that are wired in the field shall be given an in-service test during commissioning. This test will verify proper wiring, polarity, CT/PT ratios, and proper operation of the measuring circuits. The in-service test shall be made with the power system energized and carrying a known level of current. A measurement shall be made of the magnitude and phase angle of each ac voltage and current connected to the protective device and the results compared to expected values.

For protective devices with built-in metering functions that indicate current and voltage magnitudes and phase angles, or magnitudes of current, voltage, and real and reactive power, the metered values may be used for in-service testing. Otherwise, portable ammeters, voltmeters, and phase-angle meters shall be used.

6. **Periodic Testing.** Periodic Testing of Interconnection-related Protective Functions shall be performed as specified by the manufacturer, or at least every four years. All periodic tests prescribed by the manufacturer shall be performed. ~~The customer~~Producer shall maintain periodic test reports or a log for inspection by PWP. Periodic Testing conforming to PWP test intervals for the particular line section may be specified by PWP under special circumstances, such as high fire hazard areas.

   A 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.

7. **Detailed Type Test Procedures and Requirements.** This section describes the additional Type Test procedures necessary to qualify a device as Certified, for use on the PWP Distribution System. These Type Tests are not contained in Underwriters Laboratories UL 1741 Standard *Inverters, Converters and Controllers for Use in Independent Power Systems,* or other referenced standards.

   a. **Non-Export Test Procedure.** The non-export test is intended to verify the operation of relays, controllers and inverters designed to limit the export of power and certify the equipment as meeting the requirements of Screen 2, Options 1 and 2, of the Initial Review Process. Tests are provided for discrete relay packages and for controllers and inverters that include the intended function.

      1) **Reverse Power Relay Test.** This version of the Non-Export test procedure is intended for stand-alone reverse power and under power relay packages provided to meet the requirements of Options 1 and 2 of the Non-Export Screen. It should be understood that in the reverse power application, the relay will provide a trip output with power in the export (toward PWP system) direction.

         Step 1: Power Flow Test at Minimum, Midpoint and Maximum Pickup Level Settings
         Determine the appropriate secondary pickup current for the desired export power flow of 0.5 secondary watts (the agreed-upon minimum pickup setting assumes 5 Amp and 120V CT/PT secondary). Apply nominal voltage with minimum current setting at 0 degrees in the trip direction. Increase the current to pickup level. Observe the relay's (LCD or computer display) indication of power values. Note the indicated power level at which the relay trips. The power indication should be within 2 percent of the expected power. For relays with adjustable settings, repeat this test at the midpoint, and maximum settings.
         Repeat at phase angles of 90, 180 and 270 degrees and verify that the relay does NOT operate (measured watts will be zero or negative).

         Step 2: Leading Power Factor Test

Apply rated voltage with a minimum pickup current setting (calculated value for system application) and apply a leading power factor load current in the non-trip direction (current lagging voltage by 135 degrees). Increase the current to relay rated current and verify that the relay does NOT operate. For relays with adjustable settings, this test should be repeated at the minimum, midpoint, and maximum settings.

Step 3: Minimum Power Factor Test
At nominal voltage and with the minimum pickup (or ranges) determined in Step 1, adjust the current phase angle to 84 or 276 degrees. Increase the current level to pickup (about 10 times higher than at 0 degrees) and verify that the relay operates. Repeat for angles 90, 180 and 270 degrees and verify that the relay does NOT operate.

Step 4: Negative Sequence Voltage Test
Using the pickup settings determined in Step 1, apply rated relay voltage and current at 180 degrees from tripping direction, to simulate normal load conditions (for 3-phase relays, use I_a at 180, I_b at 60 and I_c and 300 degrees). Remove Phase-1 voltage and observe that the relay does not operate. Repeat for phase-2 and 3.

Step 5: Load Current Test
Using the pickup settings determined in Step 1, apply rated voltage and current at 180 degrees from the tripping direction, to simulate normal load conditions (use I_a at 180, I_b at 300 and I_c at 60 degrees). Observe that the relay does NOT operate.

Step 6: Unbalanced Fault Test
Using the pickup settings determined in Step 1, apply rated voltage and 2 times rated current, to simulate an unbalanced fault in the non-trip direction (use V_a at 0 degrees, V_b and V_c at 180 degrees, I_a at 180 degrees, I_b at 0 degrees, and I_c at 180 degrees). Observe that the relay, especially single phase, does not misoperate.

Step 7: Time Delay Settings Test
Apply Step 1 settings and set time delay to minimum setting. Adjust the current source to the appropriate level to determine operating time, and compare against calculated values. Verify that the timer stops when the relay trips. Repeat at midpoint and maximum delay settings

Step 8: Dielectric Test
Perform the test described in IEC 414 using 2 kV RMS for 1 minute.

Step 9: Surge Withstand
Perform the surge withstand test described in IEEE C37.90.1.1989 or the surge withstand test described in Section J.3.g.

2) **Under Power Relay Test.** In the underpower application, the relay will provide a trip output when import power (toward the ~~customer~~Producer) drops below the specified power level.

Note: For an underpower relay, pickup is defined as the highest power level at which the relay indicates that the power is *less* than the set setting.

Step 1: Power Flow Test at Minimum, Midpoint and Maximum Pickup Level Settings
Determine the appropriate secondary pickup current for the desired power flow pickup level of 5% of peak load (the agreed-upon minimum pickup setting). Apply rated voltage and current setting at 0 degrees in the direction of normal load current. Decrease the current to pickup level. Observe the relay's (LCD or computer display) indication of power values. Note the indicated power level at which the relay trips. The power indication should be within 2 percent of the expected power. For relays with adjustable settings, repeat the test at the midpoint, and maximum settings.

Repeat at phase angles of 90, 180 and 270 degrees and verify that the relay operates (measured watts will be zero or negative).

Step 2: Leading Power Factor Test
Using the pickup current setting determined in step 1, apply rated voltage and rated leading power factor load current in the normal load direction (current leading voltage by 45 degrees). Decrease the current to 145% of the pickup level determined in Step 1 and verify that the relay does NOT operate. For relays with adjustable settings, repeat the test at the minimum, midpoint, and maximum settings.

Step 3: Minimum Power Factor Test
At nominal voltage and with the minimum pickup (or ranges) determined in Step 1, adjust the current phase angle to 84 or 276 degrees. Decrease the current level to pickup (about 10% of the value at 0 degrees) and verify that the relay operates. Repeat for angles 90, 180 and 270 degrees and verify that the relay operates for any current less than rated current.

Step 4: Negative Sequence Voltage Test
Using the pickup settings determined in Step 1, apply rated relay voltage and 25% of rated current in the normal load direction, to simulate light load conditions. Remove Phase-A voltage and observe that the relay does not operate, repeat for phase-B and C.

Step 5: Unbalanced Fault Test
Using the pickup settings determined in Step 1, apply rated voltage and 2 times rated current, to simulate an unbalanced fault in the normal load direction (use V_a at 0 degrees, V_b and V_c at 180 degrees, I_a at 0 degrees, I_b at 180 degrees, and I_c at 0 degrees). Observe that the relay, especially single phase, operates properly.

Step 6: Time Delay Settings Test
Apply Step 1 settings and set time delay to minimum setting. Adjust the current source to the appropriate level to determine operating time, and compare against calculated values. Verify that the timer stops when the relay trips. Repeat at midpoint and maximum delay settings.

Step 7: Dielectric Test
Perform the test described in IEC 414 using 2 kV RMS for 1 minute.

Step 8: Surge withstand
Perform the surge withstand test described in IEEE C37.90.1.1989 or the surge withstand test described in Section J.3.g.

3) **Functional Test for Inverters and Controllers.** Inverters and controllers designed to provide reverse or under power functions shall be tested to certify the intended operation of this function. Two methods are provided.

Method 1: If the controller utilizes external current/voltage measurement to determine the reverse or underpower condition, then the controller shall be functionally tested by application of appropriate secondary currents and potentials as described in the Reverse Power Relay Test, Section J.7.a.(1) of this Regulation.

Method 2: If external secondary current or potential signals are not used, then unit-specific tests must be conducted to verify that power cannot be exported across the PCC for a period exceeding two seconds. These tests may be factory tests, if the measurement and control points are part of a single unit, or may be provided for in the field.

b. In-Rush Current Test. This test will determine the maximum in-rush current drawn by the unit.

1) **Locked-Rotor Method.** Use the test procedure defined in NEMA MG-1 (manufacturer's data is acceptable if available).

2) **Start-up Method.** Install and setup the Generating Facility equipment as specified by the manufacturer. Using a calibrated oscilloscope or data acquisition equipment with appropriate speed and accuracy, measure the current draw at the Point of Interconnection as the Generating Facility starts up and parallels with PWP's Distribution System. Startup shall follow the normal, manufacturer-specified procedure.

Sufficient time and current resolution and accuracy shall be used to capture the maximum current draw within five percent. In-rush current is defined as the maximum current draw from PWP's Distribution System during the startup process, using a 10-cycle moving average. During the test, the utility source, real or simulated, must be capable of maintaining voltage within +/- five percent of rated at the connection to the unit under test. Repeat this test five times. Report the highest 10-cycle current as the in-rush current.

A graphical representation of the time-current characteristic along with the certified in-rush current must be included in the test report and made available to PWP.

Appendix 1

Utility Interconnection Equipment Certification Form

Utility Interconnection Equipment Certification

The information on this form is provided to indicate the compliance of the generation equipment listed below with the utility interconnection certification requirements defined in this Regulation.

Certifying Laboratory *The information on this form is provided by the following Nationally Recognized Test Laboratory:*

Laboratory:_____

Contact Name:_____ Phone: _____E-mail: _____

Address:_____

City: _____ State: _____ Zip: _____

Accredited by: _____Date: _____

Accredited to (test standards)[1]: _____

Equipment Specification *The information on this form applies to the following equipment:*

Equipment Manufacturer: _____

Address:_____

City: _____ State: _____Zip: _____

Model Number(s): _____

Software Version(s): _____

Effective[2]:_____

Device Description[3]:_____

_____

_____

_____

_____

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Test Results [4]

Mark the box next to each requirement that has been met and each test that has been performed and successfully passed. Provide an explanation of any exceptions or omissions on a separate sheet. List additional test documents used on a separate sheet.

UL 1741: (Section number listed)

☐-39 ☐-40.1 ☐-41.2 ☐-44 ☐-45.2.2 ☐-45.4 ☐-45.5
☐-46.2 ☐-46.2.3 ☐-46.4 ☐-47.3 ☐-47.7 *Optional:* ☐-*46.3*

☐-IEEE/ANSI C62.45/C62.41 (location Category B3)

California Regulation 21: ☐-J.3.e Non-export ☐-J.3.f In-Rush Current ☐-J.3.h Synchronization

Device Rating:[5] _____

Maximum available fault current, A _____

In-rush current[6], A _____

Trip settings[7]:

		Setting 1	Setting 2	Setting 3	Setting 4	Setting 5	Factory Settings [8]
Fast Over Voltage	Setting						
	Measured						
Fast Over Voltage	Setting						
	Measured						
Fast Over Voltage	Setting						
	Measured						
Fast Over Voltage	Setting						
	Measured						
Fast Over Voltage	Setting						
	Measured						
Fast Over Voltage	Setting						
	Measured						

Nominal Power Factor (Range, if adjustable) _____

Non Islanding: Yes___ No___ Maximum trip time: _____

Non Export: Yes___ No___ Method: _____

Other[8]: _____

_____

_____

_____

NOTES

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1 Accreditation must apply to test standards listed herein

2 Note here the date of certification, applicable serial number (range or first in series), or other information that indicates which units the certification applies to.

3 List appropriate functions, capabilities, applications, limitations, etc. Use additional sheets as necessary.

4 List all test documents (i.e. UL 1741, IEEE C62.45) and specific procedures (i.e. .UL 1741 Sec 39.1 – 39.5, etc.) used to evaluate device's suitability for utility interconnection

5 kW, kVA, V, A, etc as appropriate

6 For devices that use grid power to motor to speed

7 Trip value (Voltage in volts or frequency in Hz) and timing (in cycles). Devices with adjustable settings shall provide test results over the range of settings. For each test setting provide the setting values in the upper box and measured results in the lower box. List device ranges, if adjustable.

8 Provide any additional information that may be useful in evaluating these results such as test configurations, device settings used to meet requirements, etc. Use additional sheets if necessary.

~~Appendix 2~~

~~Energy Interconnection and Metering Agreement~~