Section G5: ENERGIZATION AND SYNCHRONIZATION REQUIREMENTS FOR TRANSMISSION GENERATION ENTITIES

PURPOSE

The following is PG&E's procedure for performing pre-energization inspections, Generator Owner substation energization, permission to parallel for test purposes, and approving commercial operations. For PG&E to provide the Generator Owner with timely energization it is important that all requirements be met. It is the Generator Owner's or Transmission Owner's responsibility to ensure that any inspection required by local government agencies are complete, and permits signed off prior to the pre-energization inspection date, parallel inspections, and preparing to energize and synchronize the generator to the PG&E transmission system. All time requirements must be met for PG&E to provide the Generation Entity with timely service.

G5.1. TEST RESULTS AND/OR INFORMATION REQUIRED PRIOR TO PRE-PARALLEL INSPECTION (PPI)

All tests outlined through sections G5.1.1- G5.1.8. must be complete and an electronic or hard copy of the test reports submitted to a PG&E representative a minimum of thirty (30) business days and accepted ten (10) business days before the requested pre-parallel inspection date. All test reports require header information reflecting the equipment identification or apparatus identification matching the one or three-line diagrams.

Test reports shall be submitted separately according to the major equipment tested, i.e. Main Transformer Bank, Main Circuit Breaker. The Generator Owner shall submit the accepted DC schematics, one-line and three-line diagrams of the facility with the test reports. Pre-energization inspection dates shall be scheduled a minimum of ten (10) business days after all test reports are approved by PG&E and five (5) business days prior to the Generator Owner substation energization date. Failure to submit and gain acceptance of PG&E test requirements shall result in delay of the pre-energization inspection.

Notice to Interconnection Customer, submitting a clearance on the transmission system is typically a 120 days process to gain acceptance from CAISO. A transmission system clearance is required to energize the third-party substation. PG&E is responsible for submitting the transmission clearance requests on new interconnections.

G5.1.1. Proving Insulation

For any of the megger tests referred to below, follow IEEE 43, "Recommended practice for Testing Insulation Resistance of Electrical Machinery", Section 5.3, Table 1 – "Guidelines for direct voltages to be applied during insulation

resistance test". In most cases, a 5,000 volt DC megger or hi pot will be required.

- All transformers connected to the primary bus and the main transformer must be meggered winding to winding and each winding to ground. For purposes of this document, "primary bus" is defined as the source-side bus or conductor from the primary interrupting device to the generating plant.
- All circuit breakers and circuit switchers connected to the primary bus and at the interconnection point must be meggered in the following manner: Breaker open - each pole to ground, pole 1-2, pole 3-4, pole 5-6; breaker closed - pole 1-ground, pole 3-ground, pole 5-ground and if the poles are in common tank or cell, pole 1-3, pole 3-5, pole 5-1.
- All buses and cables shall be meggered phase-to-phase and phase-to-ground.
- The main transformer(s) and main breaker(s) shall have a dielectric test performed on the insulating medium (gas or oil). This does not apply to factory-sealed circuit switcher interrupters.
- The generator(s) must be meggered or hi-pot tested phase-to-phase and phase-to-ground.

G5.1.2. Proving Ratios

All ratios of transformers connected to the primary bus must be proven using either a turns ratio tester or a voltage ratios test. The main transformer must be tested on the final operating tap. This tap shall be recommended by PG&E to best match current transmission system operating voltages.

G5.1.3. Circuit Breakers and Circuit Switchers

- A minimum to trip at 70 percent or less of the nominal DC control voltage must be performed on all circuit breakers and/or circuit switchers that are operated by PG&E-required relays.
- A Micro-Ohm test must be performed on all circuit breakers and circuit switchers.
- A timing test showing the time from trip initiation to main poles opening is required.
- A timing test showing the time from close initiation to main poles closing is required.

G5.1.4. Current Transformers and Current Circuits

- A saturation check should be made on all current transformers (CTs) associated with the required PG&E relays. If this is not possible, a manufacturer's curve is acceptable.

- The connected ratio of all CTs must be proven either by using current (primary to secondary) or voltage (secondary to primary).
- CT circuits must be checked for proper connections and continuity by applying primary or secondary current and reading in the relays. Each test (primary or secondary) must be performed in all combinations to prove proper connections to all phase and ground relays. Current must be applied or injected to achieve a secondary reading of 5 amps in each relay to ensure that no loose wiring or parallel current paths exists.
- A single-phase burden check must be made on each phase of each current circuit feeding PG&E-required relays.
- A megger check of the total circuit with the ground wire lifted must be done to prove that only one ground exists.

G5.1.5. Relays

All relays[1] must be field tested on site to their specified settings to verify the following:

- Minimum operating point at which relay picks up (minimum pickup).
- Time delay at three different current test points, in integral multiples of minimum pickup, that closely characterize the relay time-current curve.
- Phase angle characteristic of directional relay.
- Pickup points at maximum torque angle (MTA) and ±30 degrees of MTA on impedance relays using the approved settings.
- Slip frequency, voltage matching, phase angle acceptance and breaker compensation time on synchronizing relays.
- PG&E tolerances are listed below:
    - Current/Voltage/Time: ± 10 percent
    - Impedance/Phase Angle: ± 5 percent
    - Frequency: ± 0.05 Hz

If a pilot relay system is required by PG&E, signal level checks must be performed to PG&E standard.

G5.1.6. Primary Disconnect Switch

The primary disconnect switch at the point of interconnection shall be assigned a PG&E number by PG&E. The switch, platform, and switch number plate bracket must be constructed to PG&E's Engineering Standard 034851 and Engineering Design Standard 454092, see Appendix D. A switch number plate bracket shall be furnished by PG&E (Appendix D).

[1] Please see Section G-2 specifically Table G2-5 for information on relay requirements.

G5.1.7. RTU/RIG/DPU

The final RIG/DPG/RTU database shall be provided to PG&E at least 120 calendar days and accepted 60 calendar days prior to scheduled pre-energization inspection date.

G5.1.8. Station Battery

When a battery is installed, proof of discharge testing is required to ensure that the battery has the capacity to support the load and trip (see Appendix T).

G5.1.9. Telemetry/Relay Specifications

Device manufacturer specifications meet accuracy requirements defined in G1.3.3. and G2.

G5.1.10. Signage Requirements

Signage requirements are found in Appendix D – Engineering Numbered Documents, TD-1013B-005, “PG&E Substation Signage for 3rd Party Interconnections”.

G5.2. PRE-ENERGIZATION INSPECTION (PEI)

The Generation Owner is responsible for ensuring that all relays, data telemetry and other protective devices are adjusted and working properly, as accepted by PG&E, prior to the pre-energization inspection date. The relay settings submitted to and accepted by the PG&E Protection Engineer and must be demonstrated. If problems arise with equipment during inspection, the PG&E protection Test Inspector may elect to cancel the PEI and reschedule.

All pre-parallel inspections should be scheduled to begin at 8:00 AM and completed by 6:00 PM, Monday through Friday only. Functional tests shall be performed by the Generation Owner test technician representative and all tests shall be observed by PG&E as outlined below.. The Generation Entity shall provide all test equipment and qualified personnel to perform the required tests. PG&E recommends third party testers to be International Electrical Testing Association (NETA) certified. PG&E shall be there strictly as an observer. Form G5-1 shall be completed by the PG&E Test Inspector on site at the time of the pre-energization inspection.

G5.2.1. Requirements Prior to PG&E performing the Pre Energization Inspection

G5.2.1.1 Grid Operations Telemetry

- Communication circuits at Generator Owner’s substation meet Appendix F specifications and are functioning properly. EMS and SCADA links to

Vacaville Grid Control Center and Rocklin System Dispatch are operational.

- RIG/DPG/RTU data is mapped correctly to PG&E EMS and SCADA systems.
    - Scaling on all analog data points is correct.
    - Point to Point check on all status points is verified at PG&E electric control centers.

G5.2.1.2 Test Reports

- G5-1/PS-1 forms accepted from PG&E Protection Engineer
- Battery Discharge Test accepted from PG&E Project Engineer with Appendix T form
- Relay Test Reports accepted from PG&E Protection Engineer

G5.2.1.3 Contracts

- All necessary technical studies are complete
- All proper contracts and documents have been executed and are in place. This includes Material Modification Assessments.
- All necessary funds have been submitted to PG&E prior to performing the Inspection
- A Standby Service Agreement has been executed by the Generator Owner and PG&E Interconnection Management

G5.2.2. Pre Energization Inspection at Generator Owner Substation

Section G5.2.1 shall be completed a minimum 10 business days prior to the requested Pre Energization Inspection date. At the Pre Energization Inspection the PG&E Test Inspector shall conduct the following:

- Verify signage and grounding of switching platforms, fences and buildings are in accordance with Appendix D – Engineering Numbered Documents, TD-1013B-005, “PG&E Substation Signage for 3rd Party Interconnections”.
- Witness the Generator Owner’s remote operations can observe battery charger alarms by intentionally setting off alarms momentarily.
- The Generator Owner’s test technician representative shall demonstrate to the PG&E Protection Engineer accepted relay settings as shown in the G5 and PS-1 form are programmed appropriately in the station relays to the PG&E test Inspector.
- The Generator Owner’s test technician representative shall demonstrate DC power and trip circuits to the PG&E test Inspector.

- The Generator Owner's test technician representative and PG&E test inspector shall together perform direct transfer trip checks according to Section G5 and Appendix F.
- Check that each protective relay trips the appropriate generator breaker and/or main breaker. This may require injecting a signal. Jumpering the studs across contact on the back of the relay is not acceptable. This is done to prove that the relay will handle the trip current of the breaker,and also provides relay targeting according to the G5 form.
- Check Direct Transfer Trip or Special Protection Scheme (if applicable)

Typically, pre-parallel inspections can be performed within a normal working day. PG&E shall dedicate one full workday to observe the test. If a test cannot be completed by 6:00 PM, the PG&E representative may cancel the remainder of the test and reschedule it. In this case, the Generating Entity shall incur additional costs for the pre-parallel inspection.

G5.3. ENERGIZATION

If possible, initial energizing of all Generator Owner equipment shall be done with a proven PG&E breaker at the Point of Interconnection (POI). A test program outlining all steps taken energizing the Generator Owner equipment from the Transmission Owner high side voltage for the first time shall be written by a PG&E Test representative. This procedure shall be shared with the Generator Owner at the safety tailboard meeting onsite to the third-party substation on the day of the initial energization.

G5.3.1. Functional Tests

Following energizing the Generator Owner's substation for the first time the following functional tests shall be performed:

- Check that proper secondary potential is applied to all voltage and frequency relays.
- Check the synchronizing meter, synchronizing equipment and phasing panel (if used) with the paralleling breaker closed and the generator off-line. This typically requires lifting the generator leads. The equipment should show an "in-phase" condition. Note: This may not be applicable for inverter-based generation.

Check the generator phase rotation. (PG&E's phase rotation is A-C-B counterclockwise). All three phases must be checked using hot sticks with a phasing tool or a phasing panel provided by the Generation Owner. The synchronizing equipment typically checks one phase only. Any other method of demonstrating correct phasing and phase rotation shall be approved by PG&E in writing prior to conducting the test. Alternative methodologies to check phasing and phase rotations must be submitted to PG&E fifteen business days in advance of scheduled pre-energization inspection. PG&E must approve the methodology three business days in advance of pre-parallel test date. Note: This may not be applicable for inverter-based generation.G5.4. REQUIREMENTS FOR PARALLEL GENERATOR OPERATION

G5.4.1. Permission to Parallel for Testing Purposes Only

- A Permission to Parallel for Test Purposes letter shall be released from the PG&E Transmission Grid Operations department to the California Independent System Operator (CAISO) once all requirements have been met to satisfy the Transmission Owner responsibility acting on behalf of the CAISO. Parallelling is synonymous with synchronization to the electric grid. The letter shall be released after the PG&E test technician has successfully completed the energization of the third-party substation. Direct Transfer Trip or Special Protection Scheme shall be tested, and released for service prior to release of the Test Purposes letter.

G5.4.2. Notification of Parallel Operation (For Testing Purposes Only)

The Generating Entity must notify the Grid Control Center prior to paralleling generation for testing purposes. The Generator Owner will have to notify CAISO of their intentions to parallel and complete the new resource implementation (NRI) process. Once permission to parallel is granted, the unit is allowed to parallel with the system and complete the remainder of the tests listed below to achieve commercial operation or permission to operate (for Rule 21 projects). The generator may operate in accordance with the previously executed Generation Interconnection Agreement for a maximum of 90 days, or a period previously approved by PG&E.

G5.4.3. Impedance and Directional Relay Tests

After CAISO approval to the Generator Owner (GO) to Parallel Operation for Testing PG&E shall test all required impedance and directional relays by doing the following:

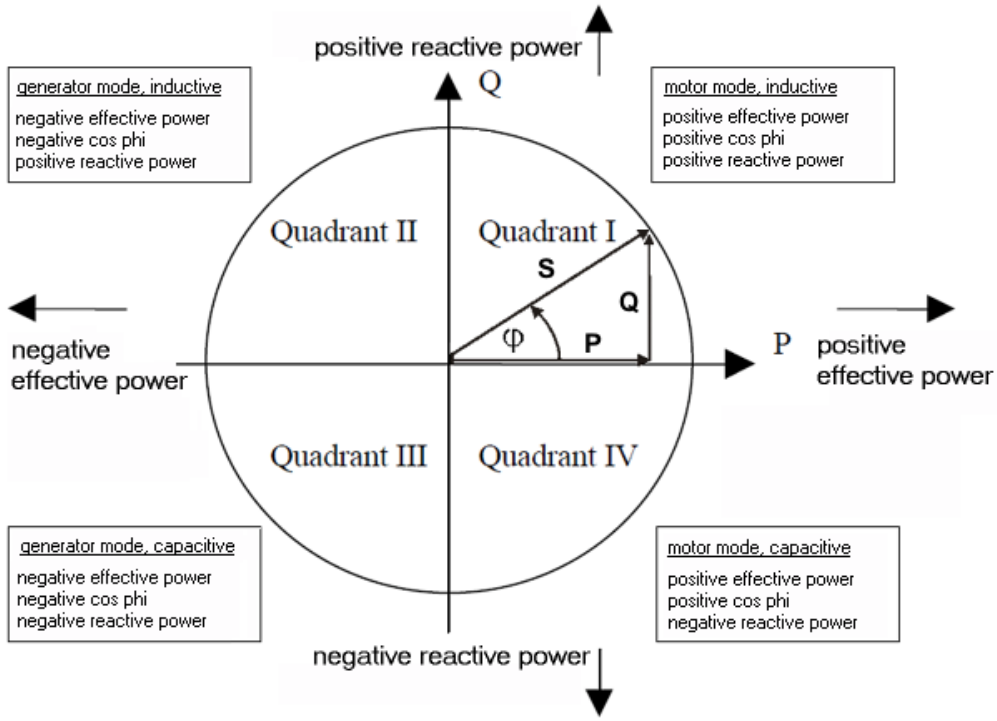
- Generator Owner shall bring up load on the plant and/or generator.
- The GO Test technician shall demonstrate power flow to PG&E test technician.
- The GO test technician shall measure the phase angle between the current and potential applied to the relay, while witnessed by the PG&E test technician.
- The GO test technician shall observe the current action of the directional contacts according to the direction of power flow. Reverse either the potentials or current to prove contact operation for reverse power flow, while witnessed by the PG&E test technician.

G5.4.4. Generator Load Tests

For generators, the following load tests shall be performed after the generator picks up load:

- For synchronous generators, verify operation of the generator at 90 percent lagging power factor and at 95 percent leading power factor at rated output measured at the generator terminals.
- For asynchronous generators, verify operation of the generating facility meets power factor requirements specified in the Interconnection Agreement (IA) and Section G3.1.
    - An exception can be made in the case of solar generation, where testing occurs during low sunlight situations (e.g. winter or cloudy day) such that the solar output cannot meet full nameplate MW rating. In this case, the generation facility must demonstrate it can deliver full nameplate MVAR ratings at the reduced total available MW output.
    - Example: Nameplate MW rating = 100 MW, and nameplate PF = 0.95, that calculates to MVAR output of 32.8 MVAR. The generator must demonstrate it can delivery 32.8 MVAR at the

fullest possible maximum MW output that day.



- For energy storage project, the power factor requirements shall be demonstrated in all modes of operation (full charge, standby, and full discharge)
- Verify functionality of operating schemes if applicable (e.g. export limiting scheme)
- Verify operation of the generator at 95 percent and 105 percent of per unit voltage while delivering rated output measured at the generator terminals or the low side of the GSU bank.
- Load check all PG&E required differential relays. The load current must balance to zero in all differential relays.
- Load check voltage restraint overcurrent relays to prove correct connection of currents and potentials (Form G5-2).

G5.4.5. Power System Stabilizer (PSS)

During the Parallel Operation for Testing period, the Power System Stabilizer shall be calibrated and tested in accordance with the latest WECC standard calibration and test procedures as outlined in Appendix H. The test report shall be submitted for review toAreaCoordinator@pge.com and TSOGEN@pge.com.

Adequate testing of the PSS can only occur on the generating unit(s) after pre-parallel inspection has been satisfactorily completed and the units are paralleled and supplying load. Official approval of PSS tuning comes from WECC. In

support of system reliability, PG&E will review the test report and provide comments to the Generation Entity.

Failure of the Generation Entity to maintain its PSS could adversely impact system operation. PG&E reserves the right either to disconnect from, or refuse to parallel with, any Generation Entity which does not operate and maintain its generator control systems in accordance with applicable reliability criteria.

The PSS Reports shall include a minimum of the following:

- Description of unit including ratings.
- Excitation system type and ratings.
- PSS type, inputs, and available setting ranges for adjustable parameters. Include description of failure detection system if provided.
- Modifications required to provide final settings.
- List of final settings, including:
    - Limit settings + and – gain.
    - Lead and lag time constants.
    - Washout time constant.
    - Any included filtering (fixed or settable).
- Models:
    - PSS model and parameters in GE PSLF format, using the latest WECC approved dynamic models.
    - Excitation model and parameters in GE PSLF format, using the latest WECC approved dynamic models.
- Bode plots:
    - Excitation response with unit connected to electrical system without PSS in service (See Figure 7 of Appendix H).
    - PSS response alone (See Figure 8 of Appendix H).
    - Excitation response with PSS in service and unit connected to electrical system. This plot can be either via test or calculated based on previous two plots.
    - If settings are developed through simulations, actual excitation response versus excitation model response used in simulation. (See Figure 3 of Appendix H).

- Time plots:
    - Step response showing generator terminal voltage, field voltage, field current, power, PSS output, AVR output with PSS in service and out of service. (See Figure 5 of Appendix H).

PG&E will not grant permission for a generating facility to commence commercial operations until PSS Test Reports have been submitted to PG&E for review.

G5.4.6. Model Testing and Validation Report

Following WECC guidelines, generation equipment shall be tested to verify that data submitted for steady-state and dynamics modeling in planning and operating studies is consistent with the actual physical characteristics of the equipment. The data to be verified and provided shall include generator gross and net dependable capability, gross and net reactive power capability, voltage regulator controls, speed/load governor controls, and excitation systems.

G5.4.7. Signage Requirements

Signage requirements are found in Appendix D – Engineering Numbered Documents, TD-1013B-005, “PG&E Substation Signage for 3rd Party Interconnections”.

G5.4.8. Stand Alone Testing (IBR Units)

Inverter based projects shall not be capable of stand-alone operation and must be demonstrated by the operation of the undervoltage relay or onboard inverter protection operation.

G.5.4.9 IBR Verification Methods Matrix

Table G5-1 below specifies the verification methods that are required to confirm compliance of IBRs to the requirements set forth by this Interconnection handbook and IEEE 2800-2022 Section 12.

Table G5-1

Verification and Testing matrix for IBRs

	IBR plant-level verifications at the RPA	Pre-commissioning (As-built stage)	Commissioning
1	Measurement accuracy as per Section G1.3.3 of TIH and Section 4.4 of IEEE 2800-2022	R	NR
2	Isolation device	R	R
3	Reactive power capability as per section G3.1.2 of TIH and Section 5.1 of IEEE 2800-2022	R	R

4	Voltage and reactive power control modes as per section G3.1.2 of TIH and Section 5.2 of IEEE 2800-2022	R	R
5	Voltage disturbance ride-through requirements as per Section G2.5.2 of TIH and section 7.2.2 of IEEE 2800-2022	R	NR
6	Frequency ride-thru requirements as per section G2.5.3 of TIH and section 7.3.2 of IEEE 2800-2022	R	NR
7	Transient overvoltage ride-through requirements as per Section G2.11 of TIH and Section 7.2.3 of IEEE 2800-2022	R	NR
8	AC overcurrent protection requirements as per Section G2.5.4 of TIH and section 9.4 of IEEE 2800-2022.	R	NR
9	Frequency protection as per section G2.10 of TIH and section 9.1 of IEEE 2800-2022	R	R
10	Voltage protection as per section G2.10 of TIH and section 9.3 of IEEE 2800-2022	R	R

Abbreviations:

NR Verification step is not required.

R Verification step is required.

G5.5. PERMISSION TO COMMENCE COMMERCIAL OPERATION

Written permission for commercial operation shall be sent to the Generation Owner and CAISO via U.S. First Class Mail, and carbon copy (cc) Generator Owner's main points of contact. The letter shall be issued after PG&E has verified the following:

- The pre-parallel test reports have been reviewed and approved by PG&E.
- The pre-parallel inspection (PPI) has been completed.
- EMS and SCADA links to Vacaville Grid Control Center and Rocklin System Dispatch are operational.
- Power factor and AVR testing – The power factor test results have been accepted by PG&E based on system conditions at the time of testing.
- If applicable, the Power System Stabilizer tests and calibration have been completed.
- All other outstanding issues have been resolved, including rights-of-way, deeds of conveyance, insurance verification and operating agreements.

- PG&E has received final copies of the single line diagram and elementary diagrams that show "As-Built" changes made during construction, as well as a completed finalized generator data sheet (Appendix M).

G5.6. GENERAL NOTES

- The PG&E system has A-C-B counterclockwise rotation.
- Any changes to PG&E required protection equipment or major equipment (transformer, breaker, generator, etc.) must be submitted to the PG&E representative for review and approval by the appropriate PG&E engineer prior to the changes being made. In order to energize new equipment, the Generation Entity must follow the pre-parallel inspection process.
- Protective Relays: Routine maintenance on PG&E required protective relays, batteries and breaker(s) must meet PG&E's maintenance and test practices. After completion of these tests, test reports must be submitted to the PG&E protection specialist for review and approval by the appropriate PG&E engineer. A PG&E technical representative may come to the customer's facilities and verify the settings.
- Customers who's load changes due to economic market conditions or any other related condition are still required to maintain their protective devices and can be subject to a pre-parallel inspection upon request by PG&E.
- **Idle Facilities** - If customers are idle for an extended period of time and do not maintain proof of maintenance for their applicable protective equipment they will be required to separate from PG&E and lock the high side disconnect with a PG&E lock. Prior to restoration of transmission service, the customer will must complete a PPI and/or any applicable transmission load reviews deemed required by PG&E.

Form G5-1

(Page 1 of 9)

Rev. 01-04/27/2017

Date Approved _____

PG&E Approving Engineer _____

PG&E LOG _____

JOB ORDER _____

D&C _____

PACIFIC GAS AND ELECTRIC COMPANY
GENERATION PRE-PARALLEL INSPECTION

Name of Project: _____

Location: _____

PM# _____

Transmission Line No. _____

Distribution Circuit No. _____

1. Maintenance Data:

   Generation Customer's Maintenance Chief _____

   Telephone Number _____

   Generation Customer's Regular Maintenance Interval _____

   Electrical Contractor _____

2. Test Reports Attached: Yes _____ No _____

   If not, who has the reports: _____

3. Generation Facility Manual Disconnect Device for PG&E Line Clearances:

   Manufacturer _____

   Model Number _____

   PG&E Device Number _____

4. Designated PG&E Electric Control Center _____

5. PG&E Inspector _____

   NAME PHONE NO.

   Date Inspection Performed (Witness Testing/PPI): _____

   Date Load Checks Performed (Energization): _____

   Date Facility Placed on 30 Day Test Released (Permission to Parallel for Test Purposes): _____

   Date Facility Completed Operational Testing: _____

Distribution:

PG&E Designated Electric Control Center (1)
Division Project Coordinator (1)
Marketing Services (1)
Power Contracts (1)
GM&C Area Engineering (1)
System Dispatch (1)

Form G5-1(Synchronous / Induction Generators)

PG&E LOG _____
JOB ORDER _____
D&C _____

PACIFIC GAS AND ELECTRIC COMPANY
GENERATION PRE-PARALLEL INSPECTION

1a. Generator Nameplate: _____ kW _____ Volts _____ Pf _____ 1ϕ _____ 3ϕ

b. Generator Type:
_____ Synchronous
_____ Induction

Synchronizing:
_____ Auto
_____ Manual w/ Relay

Connection:
_____ WYE-Ground
_____ WYE-Ungrounded
_____ Delta

Manufacturer _____ Serial No. _____

c. Generator Prime Mover:

Steam _____ Water _____

Other, specify _____

d. Generator Breaker or Contactor:

Manufacturer _____ Serial No. _____

_____ Thermal/Magnetic Overcurrent
_____ Undervoltage Release (optional under 40kW)
_____ DC Shunt Trip (required over 40kW) w/battery _____ Capacitor Trip _____
_____ Control Voltage (Not acceptable for use)

2. Dedicated Transformer: Yes _____ 3ϕ _____ 1ϕ _____ 3-1ϕ _____
No _____ Bank of 3-1ϕ _____

Customer owned _____ PG&E owned _____
Bank Rating: _____ KVA Transformer % _____ MVA Base

Transformer Connection: Primary _____ volts
Secondary _____ volts

Protected by: Fuse Size _____ Amps _____ Other _____

3. Ground Protection Required: Yes _____ No _____

If Yes, type of ground detection (check type):
_____ Ground Bank with overcurrent relay.
_____ Broken Delta Ground Bank with low pick up overvoltage relay.
_____ Ground Overcurrent relay in neutral or dedicated transformer.
_____ Low voltage pick-up overvoltage relay in elevated neutral of dedicated transformer.
Other

Form G5-1 (Wind Turbine Generators)

(Page 3 of 9)

PG&E LOG _____
JOB ORDER _____
D&C _____

PACIFIC GAS AND ELECTRIC COMPANY
GENERATION PRE-PARALLEL INSPECTION

1a. Generator Nameplate: _____ kW _____ Volts _____ Pf _____ 1ϕ _____ 3ϕ

b. Wind Generator Type:
_____ Type II
_____ Type III
_____ Type IV

Synchronizing:
_____ Auto
_____ Manual w/ Relay

Generator Connection:
_____ WYE-Ground
_____ WYE-Ungrounded
_____ Delta

Manufacturer _____ Model _____

d. Generator Breaker or Contactor at the Interconnection:

Manufacturer _____ Serial No. _____

_____ Thermal/Magnetic Overcurrent
_____ Undervoltage Release (optional under 40kW)
_____ DC Shunt Trip (required over 40kW) w/battery _____ Capacitor Trip _____
_____ Control Voltage (Not acceptable for use)
_____

2. Collector / Unit Transformer: Yes _____ 3ϕ _____ 1ϕ _____ 3-1ϕ _____
No _____ Bank of 3-1ϕ _____ Quantity _____

Bank Rating: _____ KVA Transformer % _____ MVA Base _____

Transformer Connection: Primary _____ volts
Secondary _____ volts

3. Dedicated / Interconnecting Transformer: Yes _____ 3ϕ _____ 1ϕ _____ 3-1ϕ _____
No _____ Bank of 3-1ϕ _____

Customer owned _____ PG&E owned _____

Bank Rating: _____ KVA Transformer % _____ MVA Base _____

Transformer Connection: Primary _____ volts
Secondary _____ volts

Protected by: Fuse Size _____ Amps _____ Other _____

4. Inverter Details (for Type IV Wind turbines)

Manufacturer: _____ Model: _____ kW: _____ Quantity: _____

Firmware: _____ Max. fault current:_____

5. Capacitors (if any)

kVARs: _____ Quantity: _____

6. Grounding Bank (if any)

Bank rating (kVA): _____ % Impedance: _____ Base MVA: _____

7. Ground Protection Required: Yes _____ No _____

If Yes, type of ground detection (check type):

_____ Ground Bank with overcurrent relay.
_____ Broken Delta Ground Bank with low pick up overvoltage relay.
_____ Ground Overcurrent relay in neutral or dedicated transformer.
_____ Low voltage pick-up overvoltage relay in elevated neutral of dedicated transformer.
_____ Other _____

Form G5-1 (Solar / Battery / Fuel Cells)

(Page 5 of 9)

PG&E LOG _____
JOB ORDER _____
D&C _____

PACIFIC GAS AND ELECTRIC COMPANY
GENERATION PRE-PARALLEL INSPECTION

1a. Generator Nameplate: _____ kW _____ Volts _____ Pf _____ 1ϕ _____ 3ϕ

b. Generator Type:

Solar _____
Battery Energy Storage Systems (BESS) _____
Solar / BESS DC coupled _____
Fuel Cells _____
Others

Generator Connection

WYE-Ground: _____
WYE-Ungrounded:_____
Delta: _____

Manufacturer _____ Model _____

d. Generator Breaker or Contactor at the Interconnection:

Manufacturer _____ Serial No. _____

_____ Thermal/Magnetic Overcurrent
_____ Undervoltage Release (optional under 40kW)
_____ DC Shunt Trip (required over 40kW) w/battery _____ Capacitor Trip _____
_____ Control Voltage (Not acceptable for use)

2. Collector / Unit Transformer: Yes _____ 3ϕ _____ 1ϕ _____ 3-1ϕ _____
No _____ Bank of 3-1ϕ _____ Quantity _____

Bank Rating: _____ KVA Transformer % _____ MVA Base _____

Transformer Connection: Primary _____ volts
Secondary _____ volts

3. Dedicated / Interconnecting Transformer: Yes _____ 3ϕ _____ 1ϕ _____ 3-1ϕ _____
No _____ Bank of 3-1ϕ _____

Customer owned _____ PG&E owned _____

Bank Rating: _____ KVA Transformer % _____ MVA Base _____

Transformer Connection: Primary volts

Secondary _____ volts

Protected by: Fuse Size _____ Amps _____ Other _____

4. Inverter Details

Manufacturer: _____ Model: _____ kW: _____ Quantity: _____

Firmware: __ _____ Max. fault current:_____

5. Capacitors (if any)

kVARs: Quantity:

6. Grounding Bank (if any)

Bank rating (kVA): % Impedance: Base MVA:

7. Ground Protection Required: Yes _____ No _____

If Yes, type of ground detection (check type):

_____ Ground Bank with overcurrent relay.
_____ Broken Delta Ground Bank with low pick up overvoltage relay.
_____ Ground Overcurrent relay in neutral or dedicated transformer.
_____ Low voltage pick-up overvoltage relay in elevated neutral of dedicated transformer.
_____ Other _____

Form G5-1

(Page 7 of 9)

GENERATION PRE-PARALLEL INSPECTION

PROTECTIVE DEVICES:

RELAY	Standard Device Number	Required Yes/No (Will be filled in by PG&E)	Mfr and Model	Settings	Specific Breaker Tripped	Lockout Relay Required	Date of Function Test	PG&E Inspector Initials
Zone 1 Distance	21Z1							
Zone 2 Distance	21Z2							
Directional Phase O.C.	67							
Directional Ground O.C.	67N							
Non-directional O.C.	50/51							
Ground or Neutral O.C.	50/51N							
Overvoltage Ground	59N							
Overcurrent with voltage restraint	51V / 51C							
Underfrequency	81U							
Overfrequency	81O							
Synchronizing	25							
Auto Synchronizing	15/25							
Undervoltage	27							
Overvoltage	59							
Transfer Trip From:								
Reclose Block at:								
Required Interlock								
Block Close								
ATS Proper Operation Open Transition								
Closed Transition ATS Protections								

Event recording					

Form G5-1

(Page 8 of 9)

GENERATION PRE-PARALLEL INSPECTION

SPECIAL INSTRUCTIONS and/or VARIANCES:

(A). Additional information needed for testing: PG&E inspector initials _____

(B). Additional information needed for testing: PG&E inspector initials _____

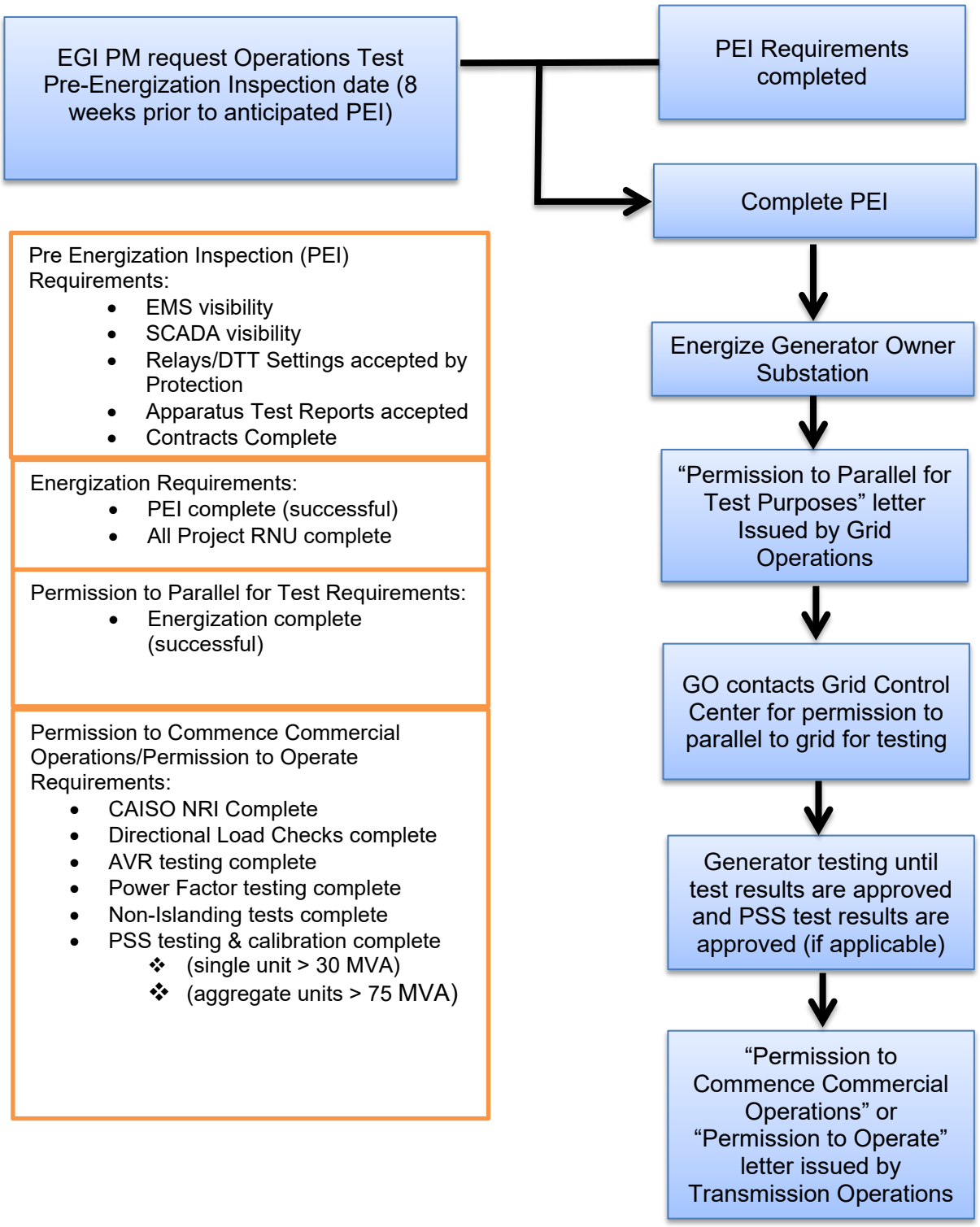
(C). Additional information needed for testing: PG&E inspector initials _____

GENERATORS OPERATION[1]:

(A)	Verify POI Protection is Cut-in and operating properly (Verify at Energization): PG&E inspector initials	
(B).	Verify Phase and Rotation, prior to Permission to Parallel (non-inverter): PG&E inspector initials	
(C).	Verify Generator Protection is Cut-in and operating properly (Verify at first Sync): PG&E inspector initials	
(D).	Verify proper load checks, at ½ amp secondary current: PG&E inspector initials	
(E).	Verify operation of the generator(s) at 0.90 (or applicable) P.F. lag and at 0.95 P.F. lead, while delivering rated output: PG&E inspector initials	
(F).	Verify operation of the generator(s) at 1.05 per unit voltage, while delivering rated output: PG&E inspector initials	
(G).	Verify generators with active anti-islanding enabled properly performs anti-islanding operations, in less than 2 seconds: PG&E inspector initials	

[1] See Section G5.3.3, “Generator Load Tests”

(H)	Verify that inverter based generation is not capable of standalone operation: PG&E inspector initials	
(I)	Verify the default settings for Inverter Based Generation as per Table G2-5: PG&E inspector initials	

Figure G5-1

SIMPLIFIED FLOW CHART OF ENERGIZATION TEST PROCEDURE