

APPENDIX Q

GENERATOR AUTOMATIC SYNCHRONIZERS

FOR GENERATION ENTITIES

PG&E INTERCONNECTION HANDBOOK

Q1.1 OPERATION AND PERFORMANCE REQUIREMENTS

Automatic synchronizers assure that a generator attempting to parallel with the utility electric system can do so without causing an electrical disturbance to other customers and facilities (present and future) connected to the same system. In addition, the auto-synchronizer device assures that the a generator attempting to parallel with the utility will itself not be damaged due to an improper parallel action. There are four types of synchronizing allowed.

1. **Automatic synchronizing:** The automatic synchronizer controls the generator voltage and speed to match the system conditions. The Automatic Synchronizer must meet the four operating parameters listed below and must meet PG&E-required specifications.
2. **Automatic synchronizing with a device not accepted by PG&E, supervised by an approved Synchronizing relay:** The Synchronizing relay must meet the four operating parameters listed below and must meet PG&E-required specifications.
3. **Manual synchronizing with supervision from a Synchronizing relay:** The Synchronizing relay must meet the four operating parameters listed below and must meet PG&E-required specifications.
4. **Manual synchronizing with Synch check supervision:** This option is only allowed for generators less than 1000 KW total. The relay must be acceptable to PG&E and must meet the first two operating parameters in the list of four bullet items below.

The following are the operating parameters for an automatic synchronizer and for a synchronizing relay:

- Voltage matching window of $\pm 10\%$ or less
- Phase angle acceptance window of ± 10 degrees or less
- Slip frequency acceptance window of 0.1 Hz or less



- Breaker closure time compensation¹

A field acceptance test must be performed on each synchronizing device to prove the operation of each function listed above. The test report must be legible and clearly list the actual operating values.

Note: The synchronizing relay activates a close signal output contact, or functionally equivalent feature, which in turn allows the breaker to close after all of the above conditions are met.

Auto synchronizers and synchronizing relays must meet the following specifications:

- The device must be utility grade for use in utility type environment and applications
 - ❑ The minimum and maximum operating temperatures are in the range of -40° to 70° C
 - ❑ Must meet Current Transformer (CT) and Potential Transformer (PT) circuit burden carrying requirements
 - ❑ Must be certified to meet [ANSI/IEEE C37.90](#) dielectric testing requirements
 - ❑ Must be certified to meet ANSI/IEEE 37.90.1 Surge Withstand Capability (SWC) and Fast Transient testing
 - ❑ Must be certified to meet the Radio Frequency Interference (RFI) withstand capability in accordance with ANSI/IEEE C37.90.2
 - ❑ Must meet [UL](#) and [FCC](#) test requirements as necessary
 - ❑ Output contact Load Break Capability – through an inductive network
 - ❑ Airborne Arcing Noise susceptibility
 - ❑ Must be certified for DC Hipot Test or Megger with no leakage or breakdown of the components.
 - ❑ Electrostatic Discharge Immunity (ANSI/IEEE C37.90)
 - ❑ Must be certified to meet [IEC](#) 60255-21-1 Class 1 Vibration test (sinusoidal) or equivalent tests. IEC 60255-21-2 Class 1 Shock and bump or equivalent tests.

Auto synchronizers and synchronizing relays that are on PG&E's list of approved devices already meet these specifications.

If the generator selects a synchronizing device that is not on PG&E's approved list, the Generation Entity or its representatives will be required to arrange for the device to be tested by a certified testing company. An [International Electric Testing Association](#) (NETA) certified testing company must provide the test results to PG&E for approval². The tests should be designed to confirm that the synchronizing device would only close, or permit closing of a circuit breaker within the tolerances given in the operating parameters above. The generator will also provide to PG&E a copy of the detailed manufacturers instruction manuals

In addition, the device should be checked for the following:

¹ When an automatic synchronizing device does not have a comparable feature, a more restricted setting will be required. The phase angle window (± 5 degrees) with a one second closing window time shall be used to achieve synchronization within a ± 10 degrees phase angle. Supervision by a PG&E-approved synchronizing device will be required if the relay settings range do not support the desired settings or when the measuring elements are not within specified tolerances.

² Some of the companies that manufacture high voltage test equipment may also provide equivalent testing services.



- Confirm voltage sensitivity and setting accuracy within $\pm 1\%$
- Confirm phase angle sensitivity and setting accuracy within $\pm 1\%$
- Confirm slip frequency response and setting accuracy within $\pm 1\%$
- Confirm breaker close time compensation accuracy within $\pm 1\%$