



APPENDIX R

GENERATOR PROTECTIVE RELAY REQUIREMENTS

FOR GENERATION ENTITIES

PG&E INTERCONNECTION HANDBOOK

R.1 REQUIREMENTS

For third party generator interconnections, PG&E requires that the generator relays have the following features or setting elements:

- Overvoltage (59)¹ - On larger generators this is only required on the high side of the generator step-up transformer
- Undervoltage (27)
- Reverse Power (32) {for no-sale generators only }
- Voltage-Restrained Overcurrent (51V) or Distance Backup (21P)
- Underfrequency (81L)
- Overfrequency (81H)

One multifunction three-phase relay that provides all of the above function is **not** acceptable. Redundant relaying will be required. Refer to Section G2.2 of this handbook for more information. The relays must be capable of being set to meet the parameters specified in [Section G2](#). In addition, these relays must meet the following specifications:

- Relay 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

¹ Numbers in parenthesis are device numbers for respective functions and are based on the ANSI/IEEE C37.2-1970 standard.



- ❑ 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 Radio Frequency Interference (RFI) withstand capability in accordance with ANSI/IEEE C37.90.2
- ❑ Must meet [UL](#) and [FCC](#) test requirements as necessary
- ❑ Must be certified for output contact Load Break Capability tests – 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.

Relays on PG&E's list of approved relays already meet these specifications. If the generator selects a relay that is not on PG&E's approved list, the Generation Entity or its representative 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 generator will also provide to PG&E a copy of the detailed manufacturers instruction manuals.

The tests should be designed to confirm the following³:

- The contact outputs (programmable or fixed) shall be immune to 4 to 6 ms transient spikes at 60% of the station DC voltage.
- The relay must be D.C.-voltage operated
- Relay must perform under DC transients
- Confirm voltage pickup to drop out for overvoltage and undervoltage elements to be within tolerance
- Confirm current sensitivity within $\pm 10\%$. as required in Section G5.1.5 of the PG&E Interconnection Handbook.
- Confirm frequency response within $\pm 1\%$
- The relay shall have the following self-diagnostic alarms (solid state & microprocessor only). Any Self-Test, Non-Volatile Memory, EPROM data error, Watchdog error, Program error, Battery fail (if applicable), Firmware error, Unit-out-of-calibration (measuring elements are not within tolerance), DSP interrupt error.

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

³ A copy of the detailed manufacturers instruction manuals shall be provided to PG&E for all non PG&E approved protective devices and automatic controls.



- Pickup and dropout ratios of the protection setting elements within 1% or better accuracy of the measuring elements.

In addition, the generator should address the following:

- Description of the operating principals of the relay, including voltage input sensitivity and range, frequency setting elements and setting ranges.
- If the relay is on the generator side of the step up transformer, understanding of relay performance and function become more involved. For example, would external phase shift be required to the relay voltage inputs for conditions where transformer windings of the step-up transformer are not in phase, or would the relay makes the phase shift adjustment internally; similar to the SLY92 type device?
- For relays requiring external voltage input adjustments, how the under and overvoltage relay elements of the relay are set, detect, and operate correctly when the same overvoltage measuring element is used for overvoltage and the generator backup protection?
- For relays making voltage input adjustments internally, how are the under and overvoltage relay elements of the relay set and operate?
- The relay flexibility and sensitivity, in terms of range and function of elements, to be able to set for all applications with different generator and step-up transformer characteristics and / or under different system conditions.

Relay functionality as a result of loss of voltage, when used as distance backup. For example:

- Would the relay disable all tripping or just some elements?
- Would there be a backup relay element to provide temporary line protection when the relay is set to disabled, as a result of loss of voltage?
- How will concerns about the loss of potential (LOP) logic be addressed since we depend on one relay for multiple functions?
- How much protection is lost? Is the relay set to trip on LOP or block on LOP?
- How is the loss of voltage detected and alarmed, when the relay is used as voltage restraint overcurrent relay?
- The Loss of Potential (Device 60) function in both relays is designed to detect blown fuses and open potential circuits.

Both phase distance and the voltage restraint overcurrent relay features will need to be evaluated for features such as:

- Does the distance element have provisions for offset mho characteristics?
- How each relay would operate for the Delta-Wye configured step-up transformer, relative to the location of the voltage devices?
- Is a Y-T bank required with either of the two relays used as voltage restraint overcurrent?
- Would the loss of voltage input to either relay allow the relay to operate as overcurrent relay? etc.

It is the generators responsibility to not only set the relays but to understand the relays and settings that they are applying. They must be prepared to explain the settings and internal



relay logic and operating principles to PG&E if they chose to use products that are not on our approved list.