Purpose and Scope

This document describes PG&E’s electric metering requirements for electric revenue metering applications for load-only entities and generators interconnecting to PG&E’s power system using wye-connected, revenue metering class, instrument transformers on three-phase, 3-wire transmission services.

General Information

1. The requirements in this document apply to three-phase, 3-wire transmission services (60 kV or above) with wye-connected, metering transformer installations. These requirements include:
   A. Grounding the neutral conductors of the wye-connected, metering transformer installations.
   B. The minimum distance from the metering transformers to the meter enclosure.
2. The grounding procedures in this document are different from the electric metering personal-safety grounding procedures that apply when certain revenue metering work is being performed.
3. These requirements apply to all “load-only” and generator customers being served and metered by PG&E. Metering requirements are as follows:
   A. Net Sale/Surplus Sale - Meter(s) will be installed to measure surplus power delivered to PG&E’s system.
   B. No Sale or Stand by Service Only - Meter will be installed to measure power delivered to customer. If the customer sells power to the California Independent System Operator (CAISO) grid, additional metering to satisfy CAISO’s revenue metering requirements shall be the responsibility of the customer.
4. Generators selling all their surplus energy to PG&E require additional metering to measure the generator output going back to the grid. Final determination of the additional metering shall be made by the metering group.

Metering Requirements

5. Metering requirements fall under PG&E’s approved tariffs. The electric revenue metering requirements depend on the type of service provided to the customer. This requires installing different types of meters to accurately measure/record energy provided to the customer.
6. For installations requiring communication circuits, the use of a regular voice-grade land-line or cell phone are decided on a case-by-case basis. For a substation-type environment, the use of a Positron-type electronic device may be required to offset the ground potential rise (GPR) which causes noise on the circuit.
7. The grounding source must be on or very close to the ground level and must be the effective ground as specified in the CPUC General Order (G.O.) 95. For PG&E-built substations, the grounding source is the ground grid, and the ground source inside the meter enclosure is Cadweld-connected to the substation ground grid.
8. Metering transformer neutral conductors must be insulated.
9. The potential-transformer (PT) neutral conductors must be grounded as follows:
   A. Ground the primary, PT neutral conductor at the base of the metering substructures.
   B. Ground the secondary, PT neutral conductor at the meter enclosure near the meter panel.
10. The PT and current transformer (CT) secondary neutral conductors shall be grounded to the grounding source and have only one ground point inside the meter enclosure (see Note 24NO TAG on Page NO TAG).
11. PT and CT secondary neutrals shall be on separate conductors and run from the metering transformers to the meter. The PT secondary neutral conductor is white with green stripes (W-Gs), and the CT secondary neutral conductor is solid white.

12. During testing or maintenance, **never** disconnect the neutral conductors from the ground source. During in-service testing, do not lift the neutral conductor for the potential.

13. Open the neutral blade #10 (far right) on the 10-pole test switch during wiring. Close the neutral blade #10 after the wiring is completed.

**Distance From Metering Transformers to the Meter Enclosure**

14. Table 1 provides a matrix for selecting a conductor size and distance “D” to achieve the CT accuracy of 0.3% or better. Distance “D” is defined as the length of the underground conduit of the PT and CT secondary conductors from the metering transformers to the meter enclosure. The resistance of the current circuit is shown in burden Ω and the circuit length equals approximately 2 “Ds”. Use the clear cells in this table with burdens less that 0.5 Ω (or CT accuracy better than 0.3%). **Do not** use the shaded cells with burdens greater that 0.5 Ω (or over the accuracy limit of 0.3%).

<table>
<thead>
<tr>
<th>Conductor Size and Type</th>
<th>Burden Ω of 2 “Ds” (2 “Ds” is the metering circuit length)</th>
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</thead>
<tbody>
<tr>
<td>12 Al</td>
<td>0.320 Ω</td>
</tr>
<tr>
<td>12 Cu</td>
<td>0.200 Ω</td>
</tr>
<tr>
<td>10 Al</td>
<td>0.200 Ω</td>
</tr>
<tr>
<td>10 Cu</td>
<td>0.120 Ω</td>
</tr>
<tr>
<td>8 Al</td>
<td>0.130 Ω</td>
</tr>
<tr>
<td>8 Cu</td>
<td>0.078 Ω</td>
</tr>
</tbody>
</table>

**Procedures**

15. Electric metering personnel are responsible for the technical specifications, evaluation, and availability of metering products.

16. The revenue metering scheme shall be submitted to PG&E during the early design phase of the project for review and approval. Failure to satisfy this requirement can result in a delay of the project.

**Wiring Diagram**

17. The following are color codes of metering conductors as shown in Figure 1 on Page 4 and Figure 2 on Page 5.

- B = Black
- LB = Light Blue
- O = Orange
- P = Purple
- R = Red
- W = White
- W-Gs = White with Green Stripes
- Y = Yellow

**PG&E-Provided Equipment**

18. PG&E owns, installs, maintains, operates, and reads its meters used for measuring the standby service load. These are PG&E-approved meters that are fully compatible with PG&E’s Meter Data Acquisition System (MDAS).
Customer-Provided Equipment

19. When the standby service is at the transmission voltage level (60 kV and above) or at the same service point as the generator’s interconnection, the generator shall provide the required combination metering units (PT/CT). Also, the secondary metering signals for PG&E’s standby meter shall be available at no cost to PG&E.

20. The customer is responsible for providing and maintaining the mounting structures for the PT/CT. Conduits, metering enclosure, meter socket(s), test switches, dedicated communication circuit, and other devices required for PG&E’s revenue meter installation are the responsibility of the customer. The use of flex conduits is not acceptable (see Figure 1 on Page 4).

21. When the generator requests PG&E to install non-PG&E standard metering (i.e., CAISO metering), PG&E will perform the work and charge the customer accordingly.

22. Analog outputs required by the customer require the use of a special type of revenue class meters. The use of these special meters will be for generator customer’s load rated 1 MW or greater.

23. Any other meter that will share the same metering circuit as the PG&E meter shall be a socket-based type meter.

General Notes

24. Requirements for grounding the neutral conductor of three-phase, wye-connected, revenue metering transformers are as follows:

   One Ground Point - Because different ground-potential rises within a substation can cause ground current to flow through the electric meter (which is a safety hazard and results in significant billing errors), there must not be more than one ground point for the PT and CT secondary neutral conductors.

25. Never use three-phase metering units.

26. The use of capacitively-coupled voltage transformers (CCVTs) for revenue metering applications is limited to 500 kV and above. Revenue metering applications involving installations served from 60 kV through 230 kV require the use of combination metering units (PT/CT).

27. In order to minimize the number of 90 degree bends (maximum of 3 per the Electric and Gas Service Requirements), the PT/CT units should be supported on a common structure as illustrated in Figure 1 on Page 4 and not on individual support structures.

28. The metering enclosure shall be sized accordingly if other equipment such as line protective relays, telecommunications, and/or EMS/SCADA equipment will be installed.

Ordering Meter Units

29. To order combination metering units (PT/CT), please call the senior meter engineer at extension 223-3389 (outside line 415-973-3389).

References

<table>
<thead>
<tr>
<th>Accessory Equipment For Revenue Metering Installations</th>
<th>Location</th>
<th>Document</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagram of Connections for Metering Polyphase Loads Using Self-Contained Meters</td>
<td>OH: Meters/UG: Services</td>
<td>028162</td>
</tr>
<tr>
<td>Diagram of Connections for Metering Polyphase Loads Using Transformer-Rated Meters</td>
<td>OH: Meters/UG-1: Services</td>
<td>028163</td>
</tr>
<tr>
<td>Revenue-Class Instrument Transformers 0–500 kV</td>
<td>Electric Metering</td>
<td>054340</td>
</tr>
<tr>
<td>Electric Revenue Meters</td>
<td>ELS</td>
<td>062208</td>
</tr>
</tbody>
</table>
Physical Connections at PT/CT Substructure for Three-Phase, 3-Wire, Transmission, Y-Connected, High Voltage Metering

Notes
1. The use of flex conduit is not acceptable.
2. For proper spacing and clearances of PT/CTs, please consult PG&E.
3. The secondary terminals of current transformers are short-circuited at the factory prior to shipment. These short circuits should remain in place until the secondary connections are made. If connections are not made to one or more secondary windings at the time the transformer is placed in service, keep the short circuits on unused secondaries since they will have no effect on the accuracy of the other independent secondary windings. When not connected into a circuit, it is a good practice to ground the current transformer secondary windings. This applies only where separate secondary windings are on separate cores and does not apply to tapped portions of windings on a single secondary core.
4. On Haefely Trench voltage transformers, the secondary should never be short-circuited. It is a good practice to ground one side of each secondary winding whether that winding is used or not. Make sure the neutral bushing is securely connected to the base ground. These units are designed to be installed on systems having a solidly grounded neutral. The ground connection of the neutral (H₂) bushing must be in place when the transformer is energized.

Figure 1
Preferred/Recommended Wiring and Construction
Wiring for Three-Phase, 3-Wire, Transmission, Y-Connected, High-Voltage Metering

Figure 2
Preferred/Recommended Wiring and Construction

Note
1. One-point grounding at meter enclosure, same grounding wherein the potentials are not stacked up on top of one another.

Requirements:
• Two (2) neutrals (1 PT-neutral and 1 CT-neutral)
Wiring Diagram #1 for Three-Phase, 4-Wire, Primary Metering
(past wiring practices not recommended)

Figure 3
Two (2) Common Neutrals
(1 PT-neutral and 1 CT-neutral)
Wiring Diagram #1 for Three-Phase, 4-Wire, Y-Connected, Transmission Metering
(past wiring practices not recommended)

PTs, CTs, and 10-Pole Test Switch #1 at PT/CT Substructure

Not Used

O LB PW

3-Pole 60 A Potential Safety Disconnect Switch

Figure 4
One (1) Common Neutral for Both PT and CT
Typical Connection of a Non-Utility Generator

Note: For an installation rated 1 kVA or less (i.e., solar), a disconnect switch is not required.
Common Wire Customer Installation - Transmission Voltages 60 kV Through 230 kV When PG&E Owns Transformer and High-Side Breaker for Bundled Customers

Figure 7
Small Power Producers and Co-Generators
ISO Metering With Standby Service

To Transmission System (60 kV and above)

Disconnect Device (operated by PG&E)

PG&E Test Switch

CAISO Test Switch

PG&E/CAISO Master Test Switch

Analog Phone Line to MV-90

Transformer

Generator

Note: Usage of another type of meter can affect actual field wiring.

Figure 8
Connection Diagram Showing a CAISO Meter and a PG&E Standby Meter

Notes
1. This is a typical connection of a generator selling power to the CAISO, that includes a PG&E meter to measure standby power.
2. Combination metering units (PT/CT) specified by PG&E and purchased by the customer (generator).
3. For detailed requirements, please refer to PG&E’s Distribution Interconnection Handbook.
ISO Metering Showing Primary and Backup Metering

Figure 9
Connection Diagram Showing PG&E Meter Coupled To Primary and Backup CAISO Meters

* This test switch is optional.
** Use of a third test switch is no longer recommended.
ISO Metering

Figure 10
Connection Diagram Showing PG&E Meter and One CAISO Meter

* This test switch is optional.
** The use of a third test switch is no longer recommended.
ISO Metering (continued)

Figure 11
Connection Diagram Showing PG&E Meter and One ISO Meter

* This test switch is optional.
Revision Notes

Revision 02 has the following changes:

1. There are major revisions throughout the document.