Prepared by: MZGD

METHODS AND REQUIREMENTS FOR INSTALLING RESIDENTIAL UNDERGROUND ELECTRIC SERVICES 0 – 600 V TO CUSTOMER-OWNED FACILITIES

063927

Asset Type: Electric Distribution **Function:** Design

Issued by: Lisseth Villareal (LDV2) **Date:** 07–02–26

Rev. #28: This document becomes active on 09–02–26. For a description of the changes, see Page 8.

This document is also included in the following manual:

- *Electric and Gas Service Requirements (Greenbook)*
- *Electric Design Manual*

Purpose and Scope

This document shows the methods and requirements for installing PG&E-owned, underground service cables in customer-owned, residential, terminating facilities. See Greenbook Section 8, "Electric Metering Pedestals and Electric Switchboards for terminating underground services.

General Information

1. Underground electric service laterals are normally installed in a PG&E service trench or in a joint trench with natural gas and communication service facilities.
2. PG&E must review and approve all meter installations before the meters are installed. To determine the most satisfactory meter location and to ensure that all equipment clearance and working space requirements will be met, consult a PG&E project coordinator during the project preliminary planning stage.
3. When it is necessary to install a service 75 feet or longer, the applicant must contact PG&E before ordering the service riser, conduit, or termination enclosure. If the service riser and/or conduit specified in Table 3 on Page 6 of this document will not accept the cable required to meet flicker and/or voltage drop requirements, a larger conduit must be installed. This could require the installation of a larger termination enclosure.
4. Install a splice box whenever cable pulling tensions may be exceeded.
5. Ensure that any new installed secondary distribution cable is not smaller, either in size or in number of runs, than the largest new service that is on the load side of that new secondary system. For example, if the largest service cable required will be 1–350 Al, then the secondary distribution cable must be a minimum of 1–350 Al. The existing secondary distribution system can remain as is if it can adequately supports any new services without causing loading, voltage drop, and voltage flicker issues.

Residential Services Information

6. A "residential service" is a service supplying a single or multi-metered residential building. This document addresses services through 600 amp, single-phase for 120/240 V. For three-phase residential services or services larger than 600 amp, see Document 063928.
   A. Standard voltage for single metered residential building is 120/240 V.
   B. Rule 2 limits both residential and non–residential 120/208 V panels to a rating of 200 amps. But single–phase main service panels for 120/208 V rated 225 amps are commercially available. Therefore, 120/208 V panel with a rating of 225 amps are allowed for residential single–phase main service.
   C. All single-phase, 120/208 V services require full-sized neutral.
   D. 800 amp single phase services are not allowed. 800 amp rated services and larger must be three-phase, and terminate in pad-mounted switchgear.
7. Minimum service requirements.
   A. Install the number and size of conduits as shown in Table 3 on Page 6, based on the main service panel rating. No more than seven service conduits, of any size, will be supplied from any one transformer.

B. Install the number and size of conductors, as shown in Table 3 on Page 6, to meet the individual initial demand load. Take load characteristics and growth into consideration.

C. For 600 amp panels, it is permissible to install a smaller transformer and fewer conductors to serve a long term initial load with the intent of installing a larger transformer and additional conductors should future load increase occur.

D. For single phase services, it is not necessary to size the transformer to match the ultimate capability (in total kVA) of the customer's main switch panels being connected to the transformer and secondary system.

E. Vacant conduits, if any, are to be used to serve future load increases. Install detectable polyester pulling tape if there are only vacant conduits in the trench path. Refer to Document 038193 for installation instructions.

8. Residential design includes mobile home and mobile home parks parks that are individually metered and not master–metered. For mobile home park design requirements see Document 052521, "Electrical Service Requirements for Mobile Home Developments".

9. Conduit is required for residential services, including multi-metered residential buildings.

10. The applicant must provide the trench, conduit, and backfill in accordance with Electric Rule 16 and PG&E requirements. PG&E will furnish and install the service cables and make the connection at the point of service delivery in the applicant's service termination enclosure or meter panel.

    Qualification of material for use as backfill is the responsibility of the job foreman or, in the case of contract work, the inspector or their designer. A visual inspection of the material is sufficient for evaluation of the material. The source of the backfill, native or import, is immaterial to the suitability of the backfill for use in the trench. In new construction areas, the developer may be required to have a soils report available, which will assist in determining if import backfill is necessary.

11. Soil compaction must meet PG&E's and any applicable federal, state, county, and local requirements. PG&E specific soil compaction requirements are as follows:

    A. Place the backfill in horizontal layers not to exceed eight-inch of loose thickness. Each layer must be thoroughly tamped and compacted with suitable compaction equipment to obtain the required density listed in 4.B. and 4.C. below.

    B. Trenches that run across or along public roads and streets in the franchise areas must have soil compacted to a minimum of 95% density.

    C. Trenches that run across private properties and in all other areas must have soil compacted to a minimum of 90% density.

    D. A compaction test report may be required by PG&E. This report must include the testing company information: Name, Address, Contact information.

12. Service conduits installed through or under the applicant's building foundation/slab must not exceed 20' past the outside wall of the building and must terminate into the electrical room. See Figure 4 in Page 8. The installation requirements and conduit types for PG&E's service conductors used in this application must be as indicated below;

    A. Conduits must not pass under or through one building to supply adjacent buildings.

    B. UL651 approved PVC Schedule 40 or 80.

    C. ANSI C80.1 approved Galvanized Rigid Steel (GRS).

13. GRS conduit is required when the conduit will be exposed and installed in locations such as along walls and low clearance ceilings that may be subject to damage from vehicles, machinery, or tools. The exposure of the electrical conduits to physical damage must be determined through discussion during the pre-construction meeting and assessing the field conditions during inspections.

14. To avoid cable insulation damage, the ends of conduits must be provided with a suitable fitting, such as a bushing, hub, or end bell.

    A. A threaded riser conduit and locking ring fitting is required on the inside of wall–mounted electric meter panels to secure the conduit to the panel.

15. When an applicant's main service panel is installed in an electric meter and service termination room, the room must be built with one wall and a door that leads directly to the outside of the applicant's building.
    See Greenbook Section 7.5.1 Meter Installation Locations.

16. Once service termination connections are made at the applicant's service termination and metering equipment, whether the service is left energized or de-energized, it is the responsibility of a PG&E crew or in the case of contract work, PG&E inspector to complete the tasks listed below.
    A. Cover and seal all meter sockets with an approved blank-off cover (Pie Plate) or set the electric meter(s). Material codes for electric meter socket covers are **M249425** and **M249559**.
    B. Seal all seal-able covers on the customer owned panel using PG&E approved seals.
17. Water intrusion into service conduits and meter termination facilities may occur if the source side of the service facilities (e.g., secondary splice box) is at an elevation greater than the meter termination facilities.
    A. CPUC General Order 128, Rule 31.6 requires "Lateral ducts for services to buildings, through which water may enter buildings, must be plugged or sealed at the customer meter panel and at the source end of the service conduit."
    B. When the intrusion of water into the service and metering equipment can be reasonably expected through lateral ducts, the conduits must be sealed at both ends using one of the PG&E approved sealing method shown in Document 062288.
    C. If the meter termination facilities are significantly lower than the source side facilities, use the Rayflate Duct Sealing System (RDSS) conduit sealing system listed in Document 062288.
    D. The applicant is responsible for providing a means to prevent the accumulation of excess water pressure in the service conduit system. This can be accomplished with the installation of a drain box. It is preferred that conduits are installed into the drain box horizontally. The horizontal layout of the conduits allows water to drain easy and service cables to be pulled through the drain box all the way to the service panel without splicing. Install a drain box according to the requirements listed below:
        (1) A drain box must not contain any straight and tap splices or multi-tap splices inside.
        (2) Working space for a drain box is the same as secondary splice box.
        (3) For outdoor pad-mounted switchboards and wall-mounted service and metering equipment install a box, outside, at the base of the riser to the meter panel, or at a minimum of 6 feet away or at a maximum of 15 feet away from the meter panel along the service run. Install drain box in customer property.
            (a) Install a 26" deep #2 box, and enter through the short walls making sure to maintain 18" minimum depth from finish grade to the top of the conduit. The horizontal layout of the conduits allows water to drain easier and service cables to pull throughout the drain box all the way to the service panel without splicing. See Figure 1 on Page 3 and Document 028028 for ordering the #2 box.
            (b) Install the box on a twelve-inch base of one-inch rock to aid in the drainage of the unwanted water, align the conduits at either end to achieve a nearly straight through pull and install end bell fittings on all conduits.
            (c) Seal both ends of the service conduit from the drain enclosure to the customer meter panel.

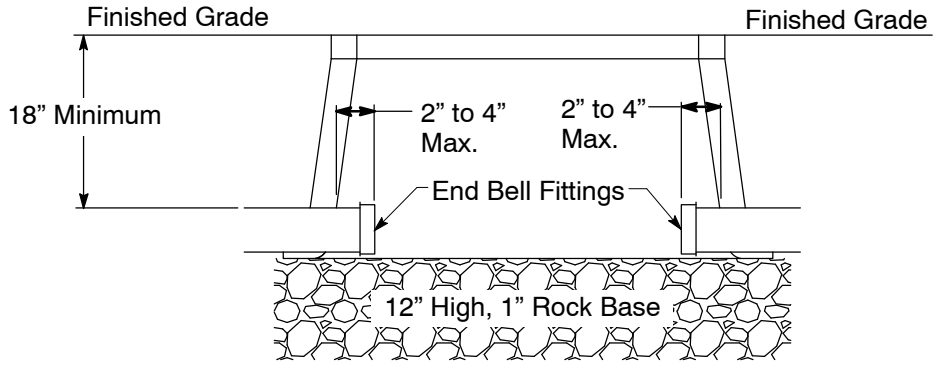


Figure 1
Conduit Installation in a Drain Box

        (4) For indoor electric meter rooms below grade level or at an elevation lower than the source side of the service facilities, a reliable method of water mitigation and drainage such as a sump pump must be incorporated into the design of the meter room(s) to prevent the accumulation of water.
18. Prior to cable installation, all conduits must be proven free and clear by means of a mandrel or other methods acceptable to PG&E. A polyester flat pulling tape, white with sequential footage markings every foot, 2,500 minimum tensile strength, and approved by PG&E (**Code M560154**), must be installed in all conduits and attached to an end cap (see Document 063928).

Upgraded Panel

19. For upgraded panels where the new specified size of service conductor will fit in the existing conduit, it is not necessary to upgrade the conduit to the currently specified size and number for the new panel if all of the following are met:

    A. The maximum conduit fill ratio is not exceeded.

    B. The calculated cable pulling tensions along the conduit route is within limits of the new cable.

    C. Copper or larger size of Aluminum cable is able to handle full load in existing number of conduits. See Table 1 below.

Table 1 Service Cable Size Allowed in Existing Conduit When Upgrading Panels

Existing Service Equipment Rating (amps)	New Upgrade Service Equipment Rating (amps)	Minimum Allowed Existing Conduit Number and Size	Aluminum or Copper Cable Required to Serve Maximum Load AWG or kcmil[1]	
			(Per Phase)	Neutral
100–125	200–225	1–2”	1–4/0 Al	1–1/0 Al
200–225	320	1–3”	1–350 Al	1–4/0 Al
320	400	1–3”	1–750 Al[3]	1–4/0 Al
400	600	1–4”	1–1000 Al[2]	1–350 Al

1 Mixing Aluminum and Copper cable runs for the same service is not allowed.

2 Center conduit underneath middle hot leg to allow flexibility to terminate the conductor.

3 Although percent fill is less than 55%, it could be difficult to pull 750 kcmil triplex in 3” conduit as the length and number of bends in the conduit run increases. Before designing a job to pull 750 triplex in existing 3” conduit Estimating must perform cable pulling tension calculation as well as reaching out to local maintenance and construction (M&C) to confirm the job site is favorable for a successful cable pull. If the 750 tpx cable fails to pull; it is the customer responsibility to replace the existing 3” conduit with approved 4” conduit and pull in new 750 tpx cable in it.

20. If the new panel is able to accommodate it, the existing service conductor may be reused provided it meets the load, voltage drop, and flicker requirements of the new load. If the service conductor size must be upgraded, the existing conduit must be proofed with a mandrel.

21. For existing panels rated up to 200 amps that do not meet all of the gas clearance requirements described in Greenbook Section 7, or for the existing panels without gas clearance issues that are being relocated, it is allowed to use the existing service conduit and extend new conduit of the same size and material to a new panel location that meets the gas clearance requirements, as long as all the parameters listed in Notes 19, 20, 21, and 22 are met.

    A. For service runs that approach the front of the existing panel, directly or at an angle, the new conduit will need to start back along the existing conduit and far enough away from the new panel location to minimize additional bends in the conduit system.

    B. The new total number of bends must be within the maximum 315° allowed for service conduit run. For further information refer to Document 038193.

    C. The new panel must be relocated no more than 20’ away from the existing panel.

22. For upgraded panels, splice boxes are not allowed on private property to accommodate customers’ existing services. Service cable needs to be brought up to our current standard conduit service size from the customer meter to PG&E point of secondary distribution.

23. Existing direct buried and CIC service cables must be replaced with approved service cable and installed in approved service conduit for upgraded service panels with rating over 125 amps.

    A. Existing service panels upgraded up to 125 amps can be served using existing direct buried or CIC service cables.

    B. Splice boxes between the customer panel, with existing DB or CIC cable, and PG&E secondary distribution system are not allowed. See Note 22 above.

24. Notes 19, 20, 21, and 22 do not apply if any of the following conditions exist:

    A. New upgraded panels with a Service Equipment Rating (amps) that is more than one upgraded size than the existing panel, as specified in Table 3 on Page 6. For example, if an existing panel less than or equal to 100 amps is upgraded to a 400 amp panel instead of a 200 amp panel.

    B. If the existing cable size is more than one size smaller than the cable required to serve maximum load for the new panel, as specified in Table 3 on Page 6. For example, if the existing cable is #2 AWG aluminum and new upgraded panel requires 4/0 aluminum.

        (1) 1/0 Al triplex cable is acceptable as the minimum size cable for any panel upgrade to 200 amps depending on the demand load. Refer to Document 050166 for cable ampacity.

        (2) Exception to notes 23.C. and 23.D. When upgrading from a 200–225 amp meter panel with existing 4/0 Al cable to a 400 amp termination enclosure, 750 Al triplex cable is required to be installed to meet the new total load, voltage drop and flicker requirements. 750 Al triplex cable is allowed to replace existing 4/0 triplex cable in existing 3” conduit. If 750 Al triplex cable fails while pulling into existing 3” conduit, it is the customer responsibility to replace the existing 3” conduit with new approved 4” conduit and pull new 750 Al triplex cable in it.

Cover and Trench Depth

25. A minimum of 24 inches of cover for secondary (0 - 750 V) electric service, or 30 inches minimum cover for primary (over 750 V) electric service is required. Cover is the distance from the outer surface of an underground facility to the top of the final grade.

    A. The cover for all trenches (electric and joint) located in the franchise (public) area is 30 inches.

    B. The actual trench depth will be greater (approximately 30 inches or 42 inches minimum respectively) to accommodate the underground facility, bedding, enclosures, riser sweeps, and joint trench installations with other utilities.

Temporary Service

26. The policy of using permanent service panels to supply temporary power is expanding. Schedule 40 or 80 PVC riser conduit may be damaged by staples and nails, and this has resulted in damage to service cables. Therefore, for those locations where cable will be installed or that will be energized prior to completion of the wall, the conduit must be Schedule 40, rigid steel conduit, to protect the service cables from damage caused by siding nails, etc. Refer to Greenbook Section 5.4, “Temporary Service Using Permanent Service Panels”.

Table 2 Service Conduit Types Approved for Underground Application

Type	Specification [1] (must be marked on conduit)
Hot-Dip, Galvanized, Rigid Steel	ANSI Spec. C80.1
PVC, Co-extruded Cellular Core PVC, Schedule 40 or 80	UL 651, or ETL conforms to UL 651

[1] The entire “conduit system” must meet the specifications listed above. The conduit system includes conduits, conduit bends, conduit fittings or couplings and all related components (e.g., end bells and cable protectors) that are needed to install PG&E cables and conductors.

Table 3 Service Conduit Types Approved for Underground Application Cable and Conduit Requirements for Residential Services

New Service Equipment Rating (amps) [1]	Conduit Number and Size[2]	Elbow Minimum Vertical Radius	Elbow Minimum Horizontal Radius	Aluminum Cable Required to Serve Maximum Load AWG or kcmil [6]	
				(Per Phase)	Neutral
100–125	1–2”	24”	36”	1–1/0	1–#2
200–225	1–3”	24” [7]	36”	1–4/0	1–1/0
320 [3]	1–3”	24” [7]	36”	1–350	1–4/0
400 [4, 5]	1–4”	24” [7]	36”	1–750	1–4/0
600 [4, 5]	2–3”	24” [7]	36”	2–350	2–4/0

1 Service rating must be the termination section, pullcan, service section, or main service switch continuous current rating, whichever is greater.
2 See Note 3 on Page 1 for size and distance limitations, Note 12 on Page 2 for conduit type allowed on or within buildings, and Table 2 above for conduit type allowed underground.
3 Require manual bypass facilities.
4 Require transformer rated meter.
5 Requires two bolt terminations and cable to spade connectors. Lay-in lugs are not allowed.
6 Cable size shown in Table 3 is the minimum size cable that must be used.
7 Available only on 90 degree bends.

Service Installation

27. A Vertical 90° manufactured elbow is required to be installed to meet trench grade. The riser conduit must not protrude away from the wall or mounted panel.
28. Couplings on the riser conduit installed inside the building foundation must be no higher than flush with the top of the concrete.
29. Couplings installed outside building foundation must be installed a minimum of 6” below or above final grade.
30. The conduit end must extend at least 12 inches away from the foundation. Install the elbow in the direction of the service trench. If a deeper trench is required, the elbow must extend to the same depth as the conduit in the trench.
31. A minimum of 24 inches of cover must be maintained from the top of conduit to final grade.
32. See Greenbook Section 7.5.1 for Meter Installation Locations.
33. See Greenbook Section 3 for establishing PG&E and applicants underground electric service responsibilities.

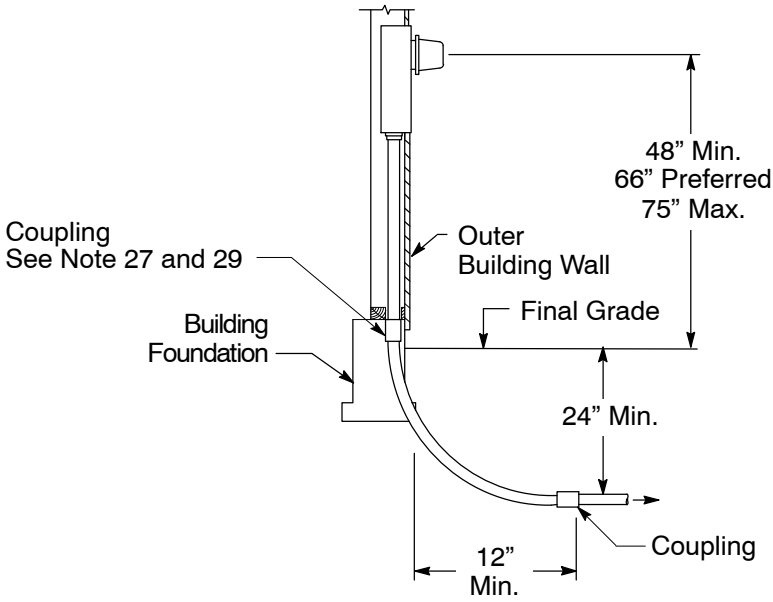


Figure 2
Recessed-Mounted Service Termination Enclosure

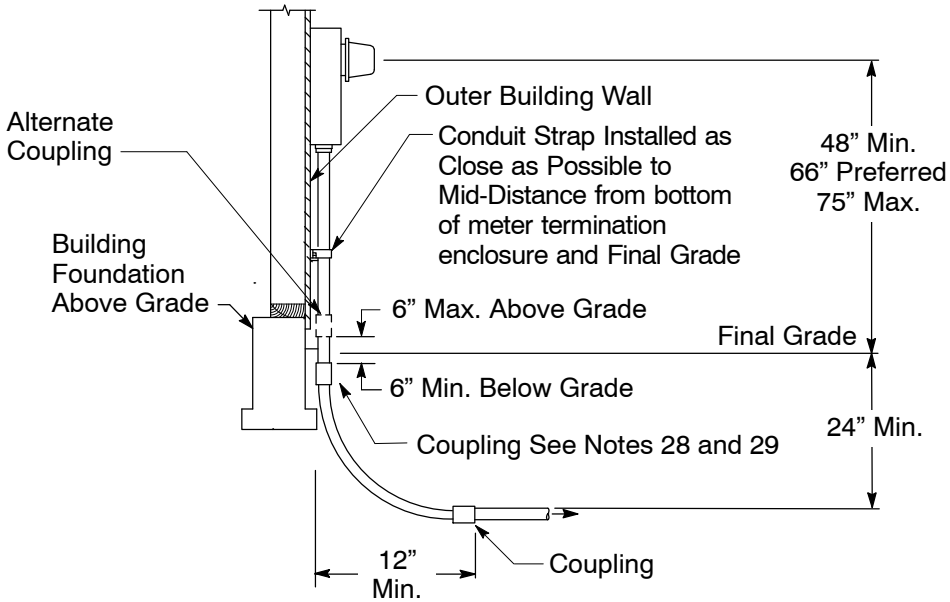


Figure 3
Surface-Mounted Service Termination Enclosure

Service Installation (Continued)

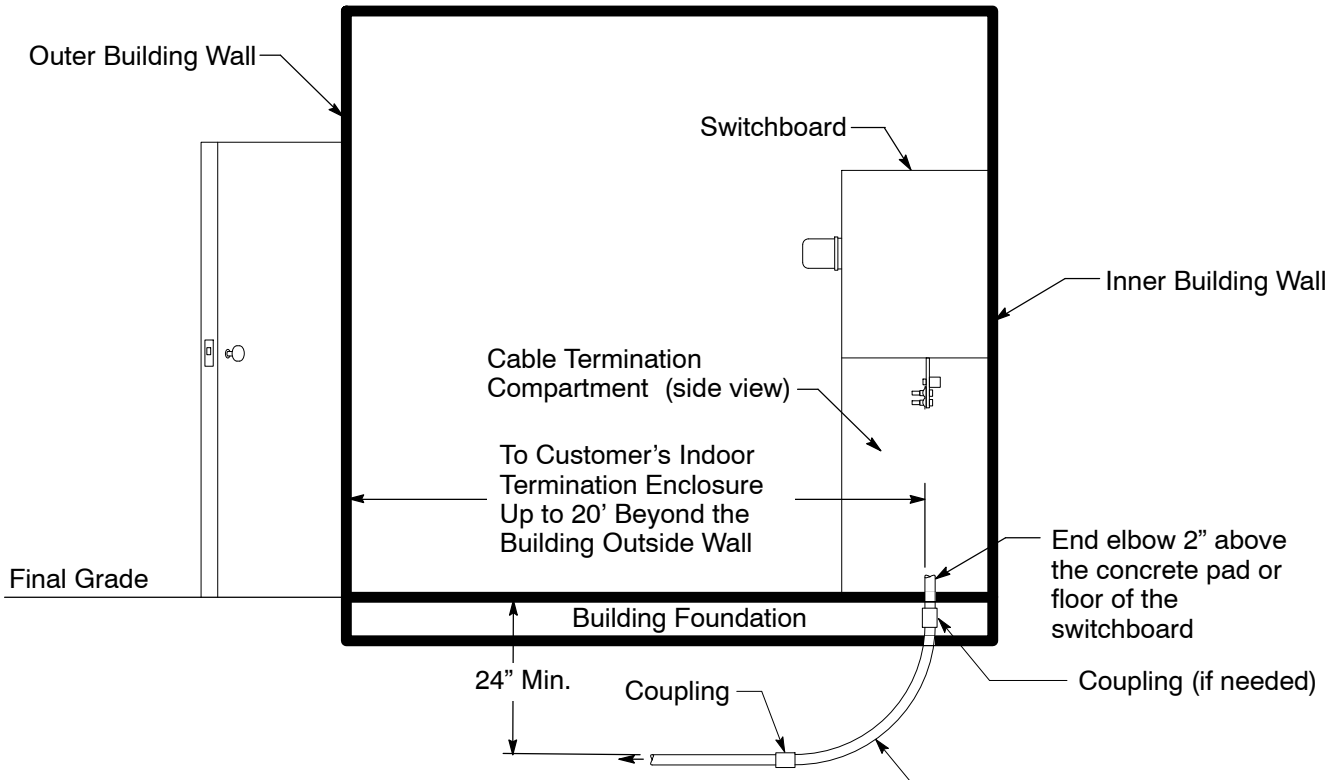


Figure 4
Indoor Service Termination and
Metering Enclosure in Electric Room

References	Location	Document
Secondary Electric Underground Enclosures	UG-1: Enclosures/Greenbook	028028
Minimum Requirements for the Design and Installation of Electric Conduit, Insulated Cable, and Facilities	UG-1: General/Greenbook	038193
Ampacity of Underground Distribution Insulated Aluminum Cables	UG-1: Cable/EPM	050166
Electrical Service Requirements for Mobile Home Developments	Greenbook/EMWP	052521
Underground Conduits	UG-1: Conduits/Greenbook	062288
Methods and Requirements for Installing Non-Residential Underground Electric Services 0–600 Volts to Customer-Owned Facilities	UG-1: Services/Greenbook	063928

Revision Notes

Revision 28 has the following changes:

1. This document replaces PG&E Document 063927, Rev. #27.
2. Updated Greenbook links shown in the Purpose and Scope Section on Page 1 and Note 15 on Page 2.
3. Added sump pump as an example to mitigation water into customers electric meter room to Note 17D(4) on Page 3.
4. Made changes to Notes 21, 23 and 24 under the Upgraded Panel Section to align with Greenbook new requirements on Page 5 and Page 6.
5. Revised Note 25 under Cover and Trench Section to clarify trench depth when located in a franchise area on Page 6.
6. Updated Greenbook links in Note 26, Note 31 and Note 32 on Page 6 and Page 8.
7. Changed requirement for the 4" minimum elbow vertical radius from 36" to 24" in Table 3 on Page 6.