


Prepared by: MZGD

	METHODS AND REQUIREMENTS FOR INSTALLING NON-RESIDENTIAL UNDERGROUND ELECTRIC SERVICES		063928
	0 – 600 VOLTS TO CUSTOMER-OWNED FACILITIES		
Asset Type: Electric Distribution	Function: Design and Construction		
Issued by: Lisseth Villareal (LDV2) <i>Lisseth Villareal</i>	Date: 06–30–23		
Rev. #27: This document replaces PG&E Document 063928, Rev. #26. For a description of the changes, see Page 9.			

This document is also included in the following manuals:

- [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 conductors in commercial buildings and three-phase multi-residential buildings. For agricultural underground service refer to [Document 054619](#)

General Information

1. See [Document 058817](#) for terminating underground electric service 0–600 V in customer owned facilities.
2. Single-phase main service switches must not exceed 200 amps for 120/208 V services or 600 amps for 120/240 V services. All single-phase, 120/208 V services require full-sized neutrals.
3. 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 required will be 1-350 Al, then the secondary must be a minimum of 1-350 Al. The existing secondary distribution system can remain as is if it can adequately support any new services without causing loading, voltage drop, and voltage flicker issues.

Customer Requirements

4. The applicant must provide trench 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. 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 the use in the trench. In new construction areas, the developer may be required to have a soil report available, which will assist in determining if import backfill is necessary. 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. Trenches that run across or along public roads and streets in the franchise areas must have soil compacted to a minimum of 95% density.
 - B. Trenches that run across private properties and in all other areas must have soil compacted to a minimum of 90% density.
 - C. A compaction test report may be required by PG&E. This report must include the testing company information: Name, Address, Contact Information.

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5. 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 on Page 8. The installation requirements and conduit types for PG&E 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. Galvanized rigid steel (GRS). 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.
6. To avoid cable insulation damage, the end of the conduit must be provided with a suitable termination fitting such as a bushing, hub, or end bell.
 - A. A riser conduit locking ring fitting is required on the inside of wall-mounted electric meter panels to secure the conduit to the panel.
7. 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 to the outside of the applicant's building. See Figure 4 on Page 8. See [Electric and Gas Service Requirements \(Greenbook\)Section 5.3.4](#) "Electric Meter Rooms".
8. State or local building codes require special conduit seals in certain locations, such as gasoline and hydrogen filling stations. If the underground service conduit runs within a 20' horizontal radius of a gas pump (from any edge of the dispenser enclosure), or within a 10' horizontal radius of an underground gas tank. Similarly, if the underground service conduit runs within a 5' horizontal radius of a hydrogen cooling block, dispenser, or storage, or within 15' horizontal radius of a hydrogen compressor, services should maintain the required clearances listed in this note all the way to the customer meter panel so the electric conduit and cable are designed per PG&E current requirements. Otherwise, the applicant is be responsible for meeting PG&E, the National Electric Code (NEC), Canadian Electric Code (CEC)/ or Local Authority Having Jurisdiction (AHJ) requirements listed in A–C below:
 - A. The type of conduit required from the meter termination point to the connection point with PG&E.
 - (1) Install PG&E approved secondary number 5 concrete box. See [Document 028028](#) for ordering information.
 - (2) Use approved secondary multi-ways tap slices for PG&E to join PG&E's secondary cable to customer owned cable. See [Document 036640](#) for ordering information.
 - B. The installation and maintenance of special fittings (explosion-proof) and sealing compounds at both ends.
 - C. The type of cable required from the meter termination point to the connection point with PG&E. This section of cable is customer owned, installed and maintained.
9. Prior to cable installation, prove all conduits free and clear by means of a mandrel PG&E approved. A PG&E-approved polyester, flat pulling tape, white with sequential footage markings every foot, and 2,500-pound minimum tensile strength (**Code M560154**), must be installed in all conduits and attached to an end cap.
10. Install a splice box whenever cable pulling tensions are exceeded.
11. Test bypass facilities are required for both single phase and three phase non-residential installations regardless of the panel ampacity.

PG&E Requirements

12. If PG&E service conductors are to be run in a multiple conduit system, all phases and the neutral must be installed in each conduit that is used.
13. PG&E will furnish and install the underground service conductors and make connections in the applicant's service termination enclosure.
14. Potential water intrusion into service conduits and meter termination facilities
 - A. 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.
 - B. [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."
 - C. 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](#).

- D. If the meter termination facilities are significantly lower than the source side facilities, use the Rayflute Duct Sealing System (RDSS) conduit sealing system listed in [Document 062288](#).
- E. The applicant is responsible for providing a means to prevent the accumulation of excess water pressure in the service conduit system. The horizontal layout of the conduits allows water to drain easier and service cable to pull throughout the drain box all the way to the service panel without splicing the service cable. This is accomplished by the following methods:
- (1) For wall-mounted service and metering equipment install an enclosure, outside, at the base of the riser to the meter panel, or at a maximum of 6 feet away from the meter panel along the service run.
 - (a) For 4" service conduit or smaller, install a 26" deep #2 enclosure, and enter through the short walls, making sure to maintain 18" minimum depth for existing installation and 24" for new installation from finish grade to top of the conduit. See Figure 1 below.
 - (b) For 5" service conduit (up to 3 conduits), install a 26" deep #3 enclosure, and enter through the short walls, making sure to maintain 18" minimum depth for existing installation and 24" for new installation from finish grade to the top of the conduit. See Figure 1 below.
 - (c) For either 14E(1)(a) or 14E(1)(b) box installation, install the enclosure 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 pull and install end bell fittings on all conduits.
 - (d) Seal both ends of the service conduit from the drain enclosure to the customer meter panel.

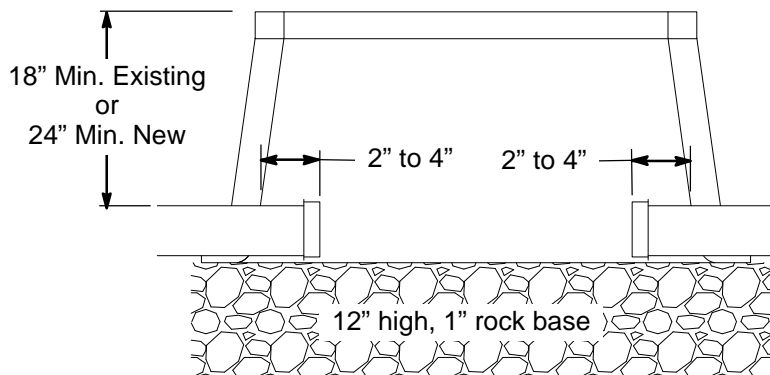


Figure 1
Conduit Installation in a Drain Box

- (2) For indoor electric meter rooms below grade level, a reliable method of water mitigation and drainage must be incorporated into the design of the meter room(s) to prevent the accumulation of water.
15. Once service termination connections are made at the customer termination can or pull section, 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.
16. Minimum service requirements
- A. Install the number and size of conduits as shown in Table 4 on Page 6 and Table 5 on Page 7, based on the main service panel rating. No more than seven conduits, of any size, may be installed into the secondary window of a pad-mounted transformer or into the secondary terminators of a subsurface transformer enclosure.
 - B. Install the number and size of conductors, as shown in Table 4 on Page 6, to meet the individual initial demand load. Take load characteristics and growth into consideration.
 - C. 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. Always size the transformer pad to accommodate the largest transformer size necessary to serve the combined ampacity of all services. Never exceed more than seven sets of conductors per transformer.
 - E. Vacant ducts, 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.

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17. Single main service panels fed by single transformer

Example 1

480 V, 4-wire, 1,600-amp rated main switch, initial demand load is 300 kVA. Install five 5-inch ducts, service size is 1,000 kcmil for phase and 350 kcmil for neutral. Only two sets of service conductors are required to meet initial loading. The remaining three ducts should be capped for future use.

18. Multiple main service panels fed by single transformer

Example 2

1,000-amp, 600-amp, and 400-amp mains to be served. The number of sets of conduits required are three, two, and one, respectively. A total of six conduits are needed to serve the three main switches. The three services can be served from one transformer.

19. Multiple main service panels fed by multiple transformers

Example 3

2,000-amp and 1,000-amp mains to be served. The number of sets of conduits required are seven and three respectively. A total of ten conduits are needed to serve the two main switches. The two services cannot be served from one transformer; they must be served from individual transformers.

Cover

20. A minimum of 24 inches of cover for secondary (0 – 750 V) electric service, or 36 inches minimum cover for primary (over 750 V) is required. Cover is the distance from the outer surface of an underground facility to the top of the final grade. The actual trench depth will be greater (approximately 30 inches or 42 inches minimum respectively) to accommodate the under ground facility, bedding, enclosures, riser sweeps, and joint trench installations with other utilities.

Upgraded Panel

21. 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 Aluminum cable can handle full load in existing number of conduits. See Table 1 and Table 2 below.

Table 1 Service Cabled Size Allowed in Existing Conduit When Upgrading Single Phase Panels

Existing Service Equipment Rating (amps)	New Upgrade Service Equipment Rating (amps)	Minimum Allowed Existing Conduit Size and Number	Aluminum or Copper Cable Required to Serve Maximum Load AWG or kcmil ¹	
			(Per Phase)	Neutral
100	200	1–3"	1–4/0 Al	1–1/0 Al
200	400	1–3"	1–750 Al ⁴	1–4/0 Al
400	600	1–4"	1–1000 Cu ^{2,3}	1–250 Cu

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

² Limited to 50 feet of cable between the transformer secondary spades and the customer's gear connection point. For greater distances, an appropriately rated PG&E approved pad-mounted termination enclosure is allowed if installed per the requirements listed in the Greenbook. For either type of installation, the PG&E installed cable length must not exceed 50 feet.

³ Center conduit underneath middle hot leg to allow flexibility to terminate the conductor.

⁴ Although percent fill is less than 55%, it could be difficult to pull 750 kcmil triplex in 3" conduit.

Table 2 Service Cable Size Allowed in Existing Conduit When Upgrading Three Phase Panels

Existing Service Equipment Rating (amps)	New Upgrade Service Equipment Rating (amps)	Minimum Allowed Existing Conduit Size and Number	Aluminum or Copper Cable Required to Serve Maximum Load AWG or kcmil	
			(Per Phase)	Neutral
100	200	1–3"	1–4/0 Al	1–1/0 Al
200	400	1–3"	1–750 Al ⁴	1–4/0 Al
400	600	1–5"	1–1000 Cu ^{2,3}	1–250 Cu
600	800	2–5"	2–750 Al	2–4/0 Al
800	1000	2–5"	2–1000 Cu ²	2–250 Cu
1000	1200	3–5"	3–750 Cu	3–250 Cu
1200	1600	4–5"	4–750 Cu	4–250 Cu
1600	2000	5–5"	5–1000 Cu ²	5–250 Cu
2000	2500	7–5"	7–1000 Cu ²	7–250 Cu

- ¹ Mixing Aluminum and Copper cable runs for the same service is not allowed.
- ² Limited to 50 feet of cable between the transformer secondary spades and the customer's gear connection point. For greater distances, an appropriately rated PG&E approved pad-mounted termination enclosure is allowed if installed per the requirements listed in the Greenbook. For either type of installation, the PG&E installed cable length must not exceed 50 feet.
- ³ Center conduit underneath middle hot leg to allow flexibility to terminate the conductor.
- ⁴ Although percent fill is less than 55%, it could be difficult to pull 750 kcmil quad in 3" conduit.
22. 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.
23. For existing panels that are less than 36" horizontally away from the gas service riser; 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 is 36" or more away from the gas riser as long as all the parameters listed in Notes 21, 22 and 23 are met. This note only applies to panels that requires a total number of two service conduits.
- 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.
24. Notes 21, 22 and 23 above do not apply to the following conditions.
- A. Direct buried or Cable-In-Conduit (CIC) service cables. Direct buried and CIC service cables must be replaced with approved service cable and installed in approved service conduit.
- (1) Splice boxes between the customer panel, with existing DB or CIC cable, and PG&E secondary distribution system are not allowed. Service cable needs to be brought up to our current standard conduit service system from the customer meter to PG&E point of secondary distribution.
- B. Upgraded electric meter panels that are within 36 inches of the gas service riser. The clearance requirements in [Electric and Gas Service Requirements \(Greenbook\) Section 5.4.3](#), "Meter Set Clearance Requirements," must be met for upgraded and relocated meter panels.
- C. New upgraded panels with a Service Equipment Rating (amps) that is more than one upgraded size than the existing panel, as specified in Table 4 on Page 6 and Table 5 on Page 7. 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.
- D. 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 4 on Page 6 and Table 5 on Page 7. For example, if the existing cable is #2 AWG aluminum and new upgraded panel requires 4/0 aluminum.

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Temporary Service

25. 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 [Electric and Gas Service Requirements \(Greenbook\) Section 5.9.1.](#), "Temporary Service Using Permanent Service Panels".

Table 3 Service Conduit Types Approved for Underground Applications With Prior PG&E Approval

Type	Specification ⁵ (must be marked on conduit)
Hot-Dip, Galvanized, Rigid Steel	ANSI C80.1
PVC, Co-extruded Cellular Core PVC Schedule 40 or 80	UL 651, or ETL conforms to UL 651

⁵ 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 4 Cable and Conduit Requirements for Single-Phase Commercial Services

Main Service Panel Rating (amps) ¹	Conduit Size and Number	Cables Required to Serve Maximum Load ³			
		Aluminum		Copper	
		Per Phase	Neutral	Per Phase	Neutral
100	1-3"	1-1/0	1-#2	NA	NA
200	1-3"	1-4/0	1-1/0	NA	NA
400 ²	1-4"	1-750	1-4/0	NA	NA
600 ²	2-4"	2-750	2-4/0	NA	NA

¹ Service rating must be the termination section, pullcan, service section, or main service switch continuous current rating, whichever is greater. See Note 2 on Page 1 for 100-600 amp 1Ø services.

² Require transformer rated meter.

³ Cable size shown in Table 4 is the minimum size cable that must be used.

Table 5 Cable and Conduit Requirements for Three-Phase Commercial Services ¹

Main Service Panel Rating (amps) ²	Conduit Size and Number	Cables Required to Serve Maximum Load ⁶			
		Aluminum		Copper	
		Per Phase	Neutral	Per Phase	Neutral
100	1-3"	1-1/0	#2	NA	NA
200	1-3"	1-4/0	1-1/0	NA	NA
400	1-5"	1-750	1-4/0	NA	NA
600	2-5"	2-750	2-4/0	NA	NA
800	2-5"	2-750	2-4/0	NA	NA
1,000	3-5"	3-1,000	3-350	NA	NA
1,200 ³	4-5"	4-1,000	4-350	NA	NA
1,600 ³	5-5"	5-1,000	5-350	NA	NA
2,000 ³	7-5"	7-1,000	7-350	NA	NA
2,500 ^{3, 4}	7-5"	NA	NA	7-1,000	7-250
3,000	Bus Duct	NA	NA	NA	NA
3,500 ⁵	Bus Duct	NA	NA	NA	NA
4,000 ⁵	Bus Duct	NA	NA	NA	NA

- ¹ 3,000-, 3,500-, and 4,000-amp service rated panels require using a bus duct.
- ² Service rating must be the termination section, pullcan, service section, or main service switch continuous current rating, whichever is greater.
- ³ Requires termination provisions (i.e., longer bolts) that allow connectors to be stacked when needed.
- ⁴ Limited to 50 feet of cable between the transformer secondary spades and the customer's gear connection point. For greater distances, a bus duct is preferred, but a PG&E approved pad-mounted termination enclosure 2,500-Amps rated is allowed if installed per the requirements listed in [Document 063929](#). For either type of installation, the PG&E installed cable length must not exceed 50 feet.
- ⁵ Panels rated over 3000 amps cannot be served at 120/208 V.
- ⁶ Cable size shown in Table 5 is the minimum size cable that must be used.

Table 6 Minimum Bend Radius for New Construction

Conduit Diameter	Vertical Radius	Horizontal Radius
2"	24"	36"
3"	24" ¹	36"
4"	36"	36"
5"	36"	60"

¹ Only available in 90° bends.

Service Installation

Notes

- 1. A Vertical 90° manufactured sweep is required to be installed to meet trench grade. The riser conduit must not protrude away from the wall or mounted panel.
 - A. Couplings on the riser conduit installed inside the building foundation must be no higher than flush with the top of the concrete. Couplings installed outside building foundation must be installed a minimum of 6" below final grade.
- 2. The conduit end must extend at least 12 inches away from the foundation. Install the sweep in the direction of the service trench. If a deeper trench is required, the sweep must extend to the same depth as the conduit in the trench.
- 3. A minimum of 24 inches of cover must be maintained from the top of conduit to the final grade.
- 4. See [Electric and Gas Service Requirements \(Greenbook\)Section 5.4.3](#) for electric and metering requirements.
- 5. See [Electric and Gas Service Requirements \(Greenbook\)Section 3.2.2](#) for establishing PG&E and applicants underground electric service responsibilities.

Service Installation (Continued)

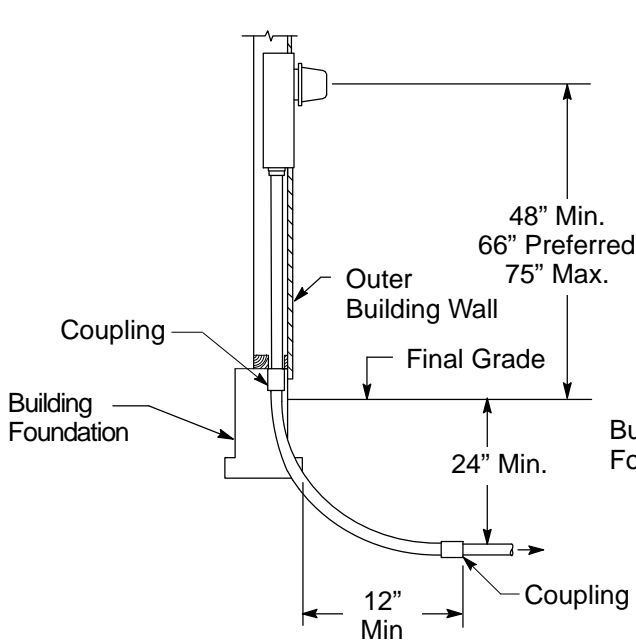


Figure 2
Recessed-Mounted Service Termination Enclosure

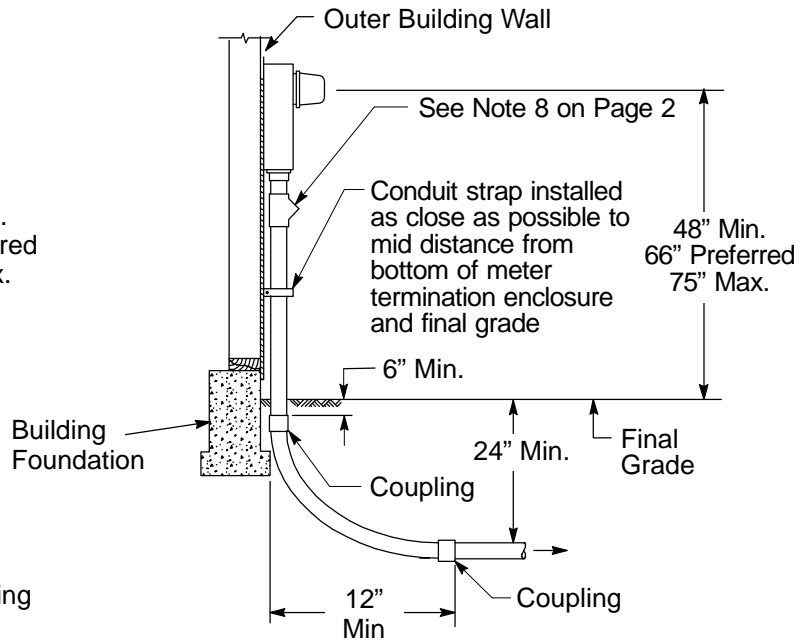


Figure 3
Surface-Mounted Combination Meter Socket Panel

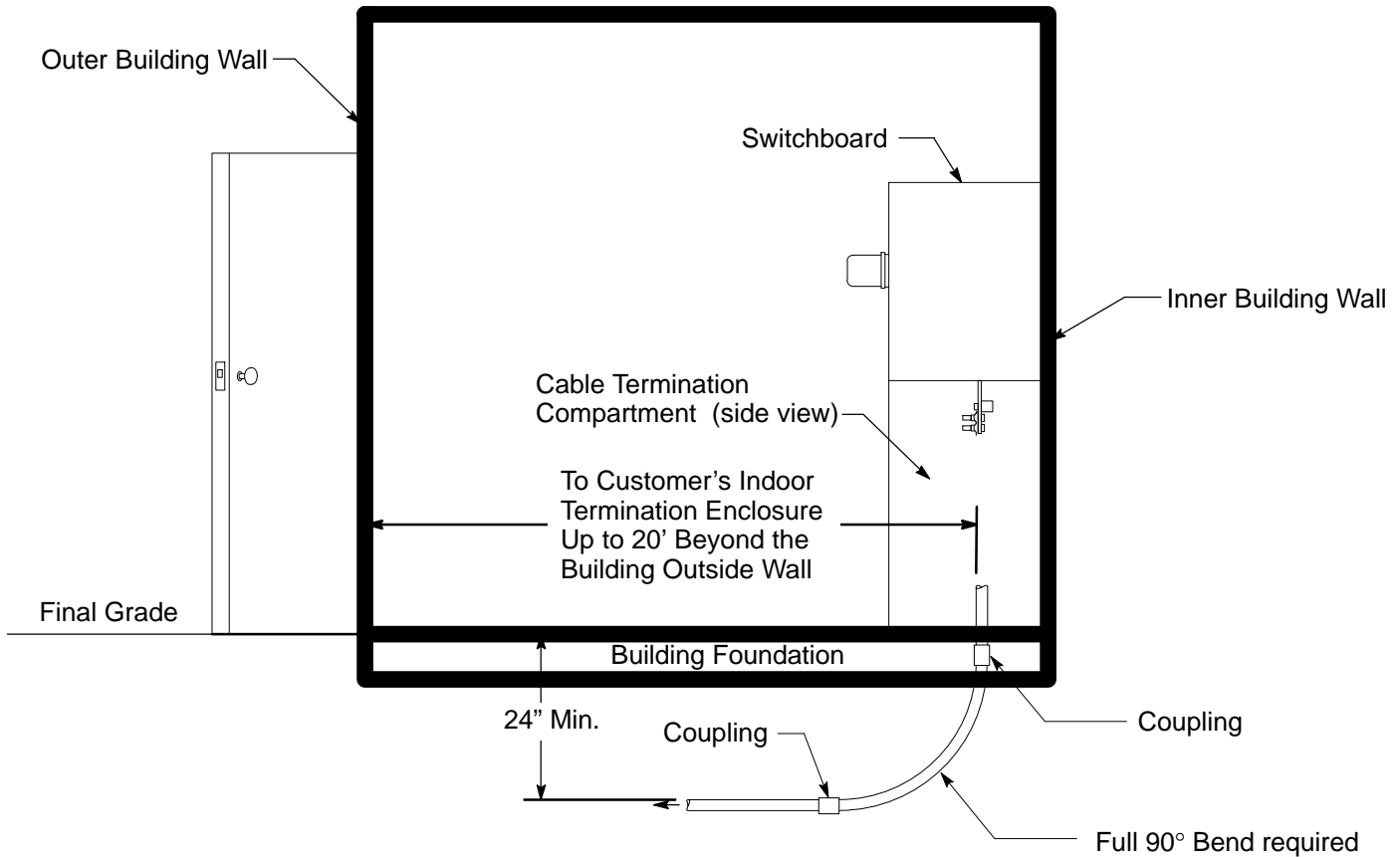


Figure 4
Indoor Service Termination and Metering Enclosure in Electric Room

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References	Location	Document
<u>Methods and Requirements for Installing Commercial Underground Electric Services 0 – 600 Volts to Customer-Owned Facilities</u>	<u>UG-1: Enclosures/Greenbook</u>	<u>028028</u>
<u>Multi-Tap Splice for 600-Volt Insulated Cables</u>	<u>UG-1: Splices</u>	<u>036640</u>
<u>Minimum Requirements for the Design and Installation of Electric Conduit, Insulated Cable, and Facilities</u> ..	<u>UG-1: General/Greenbook</u>	<u>038193</u>
<u>Agricultural Underground Service 500 HP or Less</u>	<u>UG-1: Services/Greenbook/EMWP</u>	<u>054619</u>
<u>Terminating Underground Electric Services 0-600 Volts in Customer-Owned Facilities</u>	<u>UG-1: Services/Greenbook</u>	<u>058817</u>
<u>Underground Conduits</u>	<u>UG-1: Conduits/Greenbook</u>	<u>062288</u>
<u>Requirements for Bus Duct Entrance Termination Unit for Use with Pad-Mounted Transformers</u>	<u>UG-1: Services/Greenbook</u>	<u>063929</u>

Revision Notes

Revision 27 has the following changes:

1. Revised Note 5C on Page 2.
2. Added new Note 6A on Page 2.
3. Revised Note 14E, 14E.1.a and revised text on Figure 1 on Page 3.
4. Revised Note 15 on Page 3.
5. Revised Notes 16A and 16E on Page 3.
6. Added Table Footnote 4 to Table 1 on Page 4 and to Table 2 on Page 5.
7. Adjust requirement for conduit strap installation. See Figure 3 on Page 8.