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

Asset Type: Electric Distribution  Function: Design and Construction
Issued by: Lisseth Villareal (LDV2)  Date: 12-17-20

Rev. #25: This document replaces PG&E Document 063928, Rev. #24. For a description of the changes, see Page 6.

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 conductors in commercial buildings and three-phase multi-residential buildings. For agricultural underground service refer to Document 054619

General Information
1. This document is also included in the Electric and Gas Service Requirements (Greenbook) and in Electric Design Manual. See Document 058817 for terminating service conductors.
2. Single-phase main service switches must not exceed 225 amps for 120/208 V services or 600 amps for 120/240 V services. All single-phase, 120/240 V services require full-sized neutrals.
3. Ensure that any installed secondary – distribution cable is not smaller, either in size or in number of runs, than the largest service that is on the load side of that 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.

Customer Requirements
4. The applicant must provide trench and backfill as specified by PG&E, service conduit in accordance with Table 2, Table 3, and Table 4 on Page 4 and a service termination enclosure as specified in Document 028028.
5. Conduit type for PG&E service conductors under the foundation up to 10’ past the outside wall of the applicant’s building must be as indicated below:
   A. Galvanized rigid steel or PVC coated rigid steel.
   B. UL approved Schedule 40 or 80 PVC.
   C. Note: Galvanized Rigid Steel (GRS) conduit is required when the conduit will be exposed, installed along walls and low clearance ceilings, and may be subject to damage such as vehicles, machinery or tools. To avoid cable insulation damage, the end of the conduit must be provided with a suitable termination fitting such as a bushing, nipple, end bell, or cable protector, etc. Conduits must not pass under or through one building to supply adjacent buildings.
6. 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 Electric and Gas Service Requirements (Greenbook)Section 5.3.4 “Electric Meter Rooms”.
7. 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, the applicant must be responsible for the requirements listed on A–C below. 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, the applicant must be responsible for the requirements listed on 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 062288 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.

8. 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 560154), must be installed in all conduits and attached to an end cap.

9. The installation of a splice box is required whenever cable pulling tensions are exceeded, or a change in cable or conduit size is required. The applicant must contact the local PG&E office to determine these requirements.

10. Test bypass facilities are required for both single phase and three phase installations regardless of the panel ampacity.

PG&E Requirements

11. 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.

12. PG&E will furnish and install the underground service conductors and make connections in the applicant’s service termination enclosure.

13. 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. However, 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. Also, the applicant is responsible for providing a means to prevent the accumulation of excess water pressure in the service conduit system. This is accomplished by the following methods:

(1) For wall-mounted service and metering equipment install a splice box, 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. Use a secondary #3 slice box instead of a secondary #5 slice box for drainage purpose. Table 1 footnote 5 shown in Document 028028 does not apply when the #3 slice box is used for drainage purpose.

(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.

14. Minimum service requirements

A. Install the number and size of conduits as shown in Table 2 on Page 4 and Table 3 on Page 5, based on the main service panel rating. No more than seven 5-inch service conduits will be supplied from any one transformer.

B. Install the number and size of conductors, as shown in Table 2 on Page 4, 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.

15. 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.
16. 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.

17. 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
18. 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 underground facility, bedding, enclosures, riser sweeps, and joint trench installations with other utilities.

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 for the new panel if both of the following are met:
   A. The maximum fill ratio is not exceeded.
   B. The calculated cable pulling tensions along the conduit route is within limits of the new cable.

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. Note 19 and Note 18 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.
   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 2 on Page 4 and Table 3 on Page 5. 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 2 on Page 4 and Table 3 on Page 5. For example, if the existing cable is #2 AWG aluminum and new upgraded panel requires 4/0 aluminum.

Temporary Service
22. 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”.

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### References

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<td>Multi-Tap Splice for 600-Volt Insulated Cables</td>
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### Table 1  Service Conduit Types Approved for Underground Applications With Prior PG&E Approval

<table>
<thead>
<tr>
<th>Type</th>
<th>Specification ¹ (must be marked on conduit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot-Dip, Galvanized, Rigid Steel</td>
<td>ANSI C80.1</td>
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<tr>
<td>PVC, Co-extruded Cellular Core PVC Schedule 40 or 80</td>
<td>UL 651, or ETL conforms to UL 651</td>
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</table>

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 2  Cable and Conduit Requirements for Single-Phase Commercial Services

<table>
<thead>
<tr>
<th>Main Service Panel Rating (amps) ¹</th>
<th>Conduit Size and Number</th>
<th>Cables Required to Serve Maximum Load ³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Aluminum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Per Phase</td>
</tr>
<tr>
<td>100</td>
<td>1−3&quot;</td>
<td>1−1/0</td>
</tr>
<tr>
<td>200</td>
<td>1−3&quot;</td>
<td>1−4/0</td>
</tr>
<tr>
<td>400 ²</td>
<td>1−4&quot;</td>
<td>1−750</td>
</tr>
<tr>
<td>600 ²</td>
<td>2−4&quot;</td>
<td>2−750</td>
</tr>
</tbody>
</table>

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 1/2 services.

² Require transformer rated meter.

³ Cable size shown in Table 2 is the minimum size cable that must be used.
Table 3  Cable and Conduit Requirements for Three-Phase Commercial Services

<table>
<thead>
<tr>
<th>Main Service Panel Rating (amps) ²</th>
<th>Conduit Size and Number</th>
<th>Cables Required to Serve Maximum Load ⁶</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Aluminum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Per Phase</td>
</tr>
<tr>
<td>100</td>
<td>1–3”</td>
<td>1–1/0</td>
</tr>
<tr>
<td>200</td>
<td>1–3”</td>
<td>1–4/0</td>
</tr>
<tr>
<td>400</td>
<td>1–5”</td>
<td>1–750</td>
</tr>
<tr>
<td>600</td>
<td>2–5”</td>
<td>2–750</td>
</tr>
<tr>
<td>800</td>
<td>2–5”</td>
<td>2–750</td>
</tr>
<tr>
<td>1,000</td>
<td>3–5”</td>
<td>3–1,000</td>
</tr>
<tr>
<td>1,200 ³</td>
<td>4–5”</td>
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<tr>
<td>1,600 ³</td>
<td>5–5”</td>
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<tr>
<td>2,000 ³</td>
<td>7–5”</td>
<td>7–1,000</td>
</tr>
<tr>
<td>2,500 ³, ⁴</td>
<td>7–5”</td>
<td>NA</td>
</tr>
<tr>
<td>3,000</td>
<td>Bus Duct</td>
<td>NA</td>
</tr>
<tr>
<td>3,500 ⁵</td>
<td>Bus Duct</td>
<td>NA</td>
</tr>
<tr>
<td>4,000 ⁵</td>
<td>Bus Duct</td>
<td>NA</td>
</tr>
</tbody>
</table>

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 between the transformer secondary spades and the customer's gear connection point. For greater distances, a bus duct is preferred, but one subsurface or pad-mounted enclosure is allowed if installed per the requirements listed in Document 028028 or Document 063929 respectively.
⁵ Panels rated over 3000 amps cannot be served at 120/208 V.
⁶ Cable size shown in Table 3 is the minimum size cable that must be used.

Table 4  Minimum Bend Radius for New Construction

<table>
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<tr>
<th>Conduit Diameter</th>
<th>Vertical Radius</th>
<th>Horizontal Radius</th>
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<tbody>
<tr>
<td>2”</td>
<td>24”</td>
<td>36”</td>
</tr>
<tr>
<td>3”</td>
<td>24”</td>
<td>36”</td>
</tr>
<tr>
<td>4”</td>
<td>36”</td>
<td>36”</td>
</tr>
<tr>
<td>5”</td>
<td>36”</td>
<td>60”</td>
</tr>
</tbody>
</table>

Service Installation

Note

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.
2. The conduit end must extend at least 12 inches beyond 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.
**Figure 1**
Recessed-Mounted Service Termination Enclosure

To Customer’s Indoor Termination Enclosure up to 10” Beyond the Building Outside Wall

- Final Grade
- 48” Min.
- 66” Preferred
- 75” Max.

- 24” Min.
- 12” Min.
- Alternate for Apartment Installations Only
- Building Foundation

**Figure 2**
Surface-Mounted Combination Meter Socket Panel

To Customer’s Indoor Termination Enclosure up to 10” Beyond the Building Outside Wall

- See Note 7 on Page 1
- Conduit strap installed at mid distance from bottom of termination enclosure and final grade
- 48” Min.
- 66” Preferred
- 75” Max.

- Final Grade
- 24” Min.
- 12” Min.
- Alternate
- Building Foundation

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**Revision Notes**

Revision 25 has the following changes:

1. Added Note 3 on Page 1.
2. Revised Note 5C and Note 7A on Page 1.
5. Added new section named Cover on Page 3.
6. Revised Table 1 on Page 3.
7. Added table footnote 3 and 6 to Table 2 and Table 3 on Page 3 and 4 respectively.
8. Revised table footnote 4 to Table 3 on Page 4.
9. Added Note 4 and Note 5 on Page 5.