Electric Service Requirements

Commercial Distributed Generation with Optional Energy Storage Systems

Engineering Specification T015

February 2025

SMUD®

COMMERCIAL DISTRIBUTED GENERATION (DG) WITH OPTIONAL ENERGY STORAGE SYSTEMS (E.G., BATTERIES)

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1. Overview

This document is intended to present the Sacramento Municipal Utility District's (SMUD's) requirements for the establishment of connecting Small and Large Commercial Distributed Generation (DG) to SMUD's electric grid with the option to also install Energy Storage System (ESS) devices (e.g., batteries). For the purpose of this document, Small Commercial customers will be those that have installed Distributed Generation less than 500 kW. Large Commercial customers will be those Commercial customers installing DG equal to or greater than 500 kW. This document exists on SMUD.org – search for "Electric Service Requirements" or go to www.smud.org/construction.

If you are a Commercial Customer served via our Downtown Secondary Network, in addition to the requirements set forth in this document, you will also have to abide by the requirements of SMUD's GP-001, *Distribution Generation (DG) Interconnection Requirements on the Downtown Secondary Network System*.

If you are creating a Purchase Power Agreement (PPA), these are so complex that a generic explanation in an Electric Service Requirement (ESR) cannot cover all of the possibilities of such an installation. Please refer to SMUD's Policy and Procedure 11-01, *Interconnection Guideline,* for steps to submit the application.

All references to inverter-based DG and/or ESS system sizes will be based upon total nameplate AC rating of the inverter(s).

The requirements presented here are necessary for SMUD to supply uniform, satisfactory, and safe electrical connections between the Customer's DG and/or ESS, and SMUD's electrical system. It is necessary that all written material (this text, as well as all of the notes on the drawings) be carefully read.

The National Electric Code (NEC) and the County / City Electrical Inspector for your area may have requirements for your generation system that are beyond what SMUD requires. Please check with your local Inspector to make sure your plans meet their requirements.

SAFETY FIRST!! All materials used, and all work performed, on a Customer's premise (with the exception of the meter), shall conform with requirements of the local inspection authority, the National Electric Code, and all applicable safety orders, rules, and regulations of the State of California. Customer service switchboard equipment shall meet SMUD and EUSERC (The Electric Utility Service Equipment Requirements Committee) requirements and be UL approved. No DG and/or ESS can be connected unless approved by the County / City Electrical Inspector for your area (also referred to as the Authority Having Jurisdiction or AHJ). In order to provide a safe interconnection between the Commercial DG and/or ESS and SMUD's electrical system, a SMUD representative will also have to inspect and approve the DG and/or ESS installation.

2. General Requirements for Service

Portions of Sections 3 through 9 below are modified from EUSERC - The Electric Utility Service Equipment Requirements Committee.

3. Definitions

3.1. **Combiner / Sub-Panel:** An electrical panel where one or more feeds from Distributed Generation sources can be combined into one circuit to the Power Production Meter. If the Combiner / Sub-Panel has more than six (6) breakers, an additional Visible Disconnect Device will have to be installed between the Combiner / Sub-Panel and the Power Production Meter (2020 NEC 230.71(A) for Service Conductors and 240.92(D)2 for Feeder Conductors). Further, the Combiner / Sub-Panel shall be sized to only accommodate the DG and/or ESS breakers. No other loads can be connected between the Power Production Meter and the DG equipment. The allowed related loads include tracking motors, cooling fans, monitoring and metering, etc. Note: Generation connected between the meter and the main (Option 2) may only include monitoring and metering per 2020 NEC 230.82.

3.2. **Critical Load Sub-Panel:** An electrical panel where customer essential loads are connected, and which is served by an on-site Energy Storage System.

3.3. **Demarc/MPOE**: Demarcation point is sometimes abbreviated as demarc or DMARC, or **MPOE** (stands for Minimum Point Of Entry), and is used to describe the interface between customer premise and the telephone company wiring.

3.4. **DG (Distributed Generation):** Any type of Customer owned electric generator, static inverter, or generating facility that has the capability of being operated in parallel with SMUD's distribution system.

3.5. **Distribution System:** All electrical wires, equipment, and other facilities owned or provided by SMUD, including Interconnection Facilities, by which SMUD provides Distribution Service to a Customer.

3.6. **Energy Storage System:** A system that uses either chemical means (e.g., batteries) or mechanical means (e.g., flywheels) to store energy for later use. The system will include all necessary equipment necessary to convert the storage means into usable energy (e.g., wires, inverters, chargers, gearboxes, motor/gen set, etc.).

3.7. **EUSERC:** The Electric Utility Service Equipment Requirements Committee. Designation that metering equipment meets the requirements of the member utilities developed to promote safe and uniform electric service equipment requirements.

3.8. **Generating Facility:** All Generators, electrical wires, equipment, and other facilities, owned or provided by the facility owner, for the purpose of producing electric power.

3.9. **Interactive Static Inverter:** A power electronic device that converts Direct Current (DC) power to Alternating Current (AC) by means of electronic switching. The only static inverters acceptable for the interconnection of Customer owned equipment with SMUD are those inverters that are designed to automatically separate from SMUD's distribution system upon loss of voltage from SMUD and to reclose with SMUD only after SMUD's voltage has been restored.

3.10. **Medium Voltage:** voltages between 600 Volts and 34,500 Volts.

3.11. **Parallel Operation:** The simultaneous operation of a Generator with power delivered or received by SMUD while interconnected. Under SMUD's Rate Policy and Procedures Manual, No. 11-01, "Interconnection Guidelines", Parallel Operation includes only those generators that are so interconnected with the Distribution System for more than one second (60 cycles).

3.12. **Point of Common Coupling (PCC):** The transfer point for electricity between the electrical conductors of SMUD and the electrical conductors of the Generating Facility.

3.13. **Point of Interconnection (Delivery):** The electrical transfer point between a Generator or a Generating Facility and SMUD's electrical system. This may or may not be coincident with the Point of Common Coupling.

3.14. **Power Production Meter (PM):** The Meter located at the Generator panel, or otherwise located to record generation output without other unrelated Customer loads. Loads ancillary to the generation (e.g., solar tracker motors, engine cooling fans, pumps, etc.) are to be connected, to the extent practicable, so that these are metered with the generation by the Power Production Meter, i.e., the ancillary loads should be connected between the DG and/or ESS and the Power Production Meter. **All PM panels shall be of ring type.**

3.15. **PPA (Power Purchase Agreement):** This refers to a contract entered into by an independent power producer and SMUD. The PPA specifies the terms and conditions under which electric power will be generated and purchased. PPA's require the independent power producer to supply power at a specified price for the life of the agreement. While PPA's vary, their common elements include: specification of the size and operating parameters of the generation facility; milestones in-service dates and contract terms; price mechanisms; service and performance obligations; dispatchability options; and conditions of termination or default.

3.16. **Smart Contactor:** a device that will automatically disconnect an Energy Storage system from the host electric utility upon detection of the loss of voltage from the utility. Such functionality is often incorporated in an interactive or multimode inverter, ESS or similar device identified for interactive operation.

3.17. **Station Service:** Station service loads include all energy consumption necessary for the generation of electricity that can be supplied by the facility itself while it is generating electricity, and any loads not separately metered from any station service load. These include, but are not limited to, pumps, condensers, pollution controls, monitoring and control equipment, and any energy demand used in the operations of a facility that occur *only* in response to the operations or changes in operation of the facility itself. <u>This does not include any energy used at the facility that is needed **when the facility itself is not generating,** e.g., maintenance, vehicle transportation, cleaning, or other similar energy uses, unless these energy uses are not separately metered from a station service load.</u> Electricity used for station service, or parasitic load, is not eligible for California's Renewables Portfolio Standard.

3.18. **Utility Service Meter:** The Meter located in a Customer's main electrical panel. This meter is capable of separately recording power flow into, and power flow out of, a Customer's facility or premise.

3.19. **Visible Disconnect Device:** An electrical switching device that can separate the Generating Facility from SMUD's Distribution System and is designed to allow visible verification that separation has been accomplished. This requirement can be met by opening the enclosure to observe the contact separation. It will be used by SMUD and the Customer to establish an open point when working on either the Power Production Meter or the DG and/or ESS system. With the door open, the air gap shall be visible at the trailing edge of the movable disconnect blades when the switch is in the open position. It will completely isolate the Customer's generating facility from SMUD's distribution grid. The breakers(s) in a Combiner / Sub-Panel may be substituted for a Visible Disconnect.

4. Abbreviations

AC = Alternating Current	ESR = Electric Service Requirement
AHJ = Authority Having Jurisdiction	LEC = Local Exchange Carrier
CEC = California Electric Code	NEC = **2020** National Electric Code
CL = Critical Loads	NEM = Net Energy Metering
DC = Direct Current	PCC = Point of Common Coupling
DG = Distributed Generation	PM = Power Production Meter
ESS = Energy Storage System	VDD = Visible Disconnect Device

5. References – Latest Editions, Errata, Corrections, Bulletins, and Amendments

All Customer equipment shall conform to nationally recognized standards and recommended practices. These include, but are not limited to the following:

5.1. California Electrical Code (CEC)

5.2. IEEE 519 – Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems

5.3. IEEE 929 – Recommended Practice for Utility Interface of Photovoltaic (PV) Systems

5.4. IEEE 1547 – Standard for Interconnecting Distributed Resources with Electric Power Systems

5.5. IEEE 1547.1 – Standard for Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

5.6. NEMA C84.1 - Electric Power Systems and Equipment-Voltage Ratings (60 Hertz) {formerly ANSI C84.1}

5.7. NFPA 70 – 2020 National Electrical Code (NEC), especially Articles 690, 705, 706, 708, and 710.

5.8. OSHA 1910.145(F)(7)

5.9. UL 98 – UL Standard for Safety Enclosed and Dead-Front Switches

5.10. UL 1741 – UL Standard for Safety Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources

6. Design Review and Approval

6.1. Prior to *APPROVAL* of Customer interconnection facilities, the Customer shall submit through *PowerClerk Interconnection* system:

Document Type	Project Type / Equipment Size
Single Line	All Commercial
Site Plan	All Commercial
Elevation Drawing	All Commercial
Panel Cut Sheets	> 200 Amps
Panel Inspection	>600 Volts and on all projects ≥ 500 kW

6.1.1. Distributed Generation (DG) and/or Energy Storage System (ESS) interconnection on-line application for SMUD's review and written approval.

6.1.2. An electrical one-line or three-line diagram (Note: for retrofits, SMUD meter number for the utility service meter(s) is/are required on the diagram). For DG and/or ESS projects equal to or greater than 500 kW, SMUD will require a single line drawing and a conduit plan that shows the SMUD telemetry cabinet and the conduits to the Power Production Meter Panel. See Sections 11 and 12 for more information.

6.1.3. A site plan/layout showing the location of all electrical equipment from the inverter (including solar equipment or other generation equipment to be listed) and/or ESS back to the Main electric service panel.

6.1.4. Elevation drawing(s) showing the location of all electrical equipment to be mounted on the facility (with possible obstructions, e.g., gas meters, fences, etc.). For DG and/or ESS projects equal to or greater than 500 kW, SMUD will require an elevation drawing and a conduit plan that shows the SMUD telemetry cabinet and the conduits to the Power Production Meter Panel. See Sections 11 and 12 for more information.

6.1.5. Detailed panel (cut sheets) are required on generation and/or energy storage installations with meter panels rated greater than 200 amperes. **SMUD *shall review and approve the cut sheets before the customer orders the equipment.***

6.1.6. For projects with a meter panel rated greater than 600 Volts, SMUD also requires inspection of the meter panel once it is delivered to the job site.

6.1.7. For projects with DG and/or ESS equal to or greater than 500 kW, SMUD needs to review the *preliminary* conduit drawings for proper placement of conduits. SMUD does not allow communication conduits to be terminated in the high side of the switchgear cabinet.

6.1.8. ***SMUD will not be responsible for the costs incurred by the Customer for the relocation or replacement of any equipment installed by the Customer prior to SMUD's approval***.

6.2. All metering equipment shall meet requirements set forth by EUSERC; SMUD's ESR T004; SMUD Policy and Procedure 11-01, *Interconnection Guideline;* and to this ESR T015.

6.3. Changes or modifications to the approved design shall not be made without prior approval. If changes or modifications are desired, the Customer shall submit the revised plans including the changes or modifications for SMUD approval.

6.4. The accuracy of the Power Production Meter to monitor the true output of the DG system is very important to SMUD. Therefore, no other loads can be connected between the Power Production Meter and the DG equipment. The allowed related loads can include tracking motors, cooling fans, monitoring and metering, etc. Note: Generation connected between the meter and the main (Option 2) may *only* include monitoring and metering per 2020 NEC 230.82. Please reference on your design that the Combiner / Sub-Panel will be sized to only accommodate the DG and/or ESS breakers. The equipment needs to be called out on the drawing with the following text "DG load center sized for DG breakers only".

6.5. For installations that include ESS with DG, or have just standalone ESS, the metering requirements will depend upon the connection(s) to the critical loads.

7. SMUD Requirements

Power Production Meter (PM) is required for all Distributed Generation projects within SMUD service territory. PM for Energy Storage System (ESS) is not required. A Combiner / Sub-Panel can substitute for the Visible Disconnect Device for systems less than 600 VAC and 200 Amps or less. A disconnecting means shall be located such that the inverter(s) can be serviced without de-energizing the production meter. A Combiner / Subpanel's breakers or a Visible Disconnect Device are acceptable as this disconnecting means. Medium voltage systems will be on a case-by-case basis.

7.1. **Commercial – DG only, No ESS – Option 1:** Generation connected to a breaker position in Main panel located at the opposite end of the bus from the Main breaker or otherwise located per applicable NEC code.

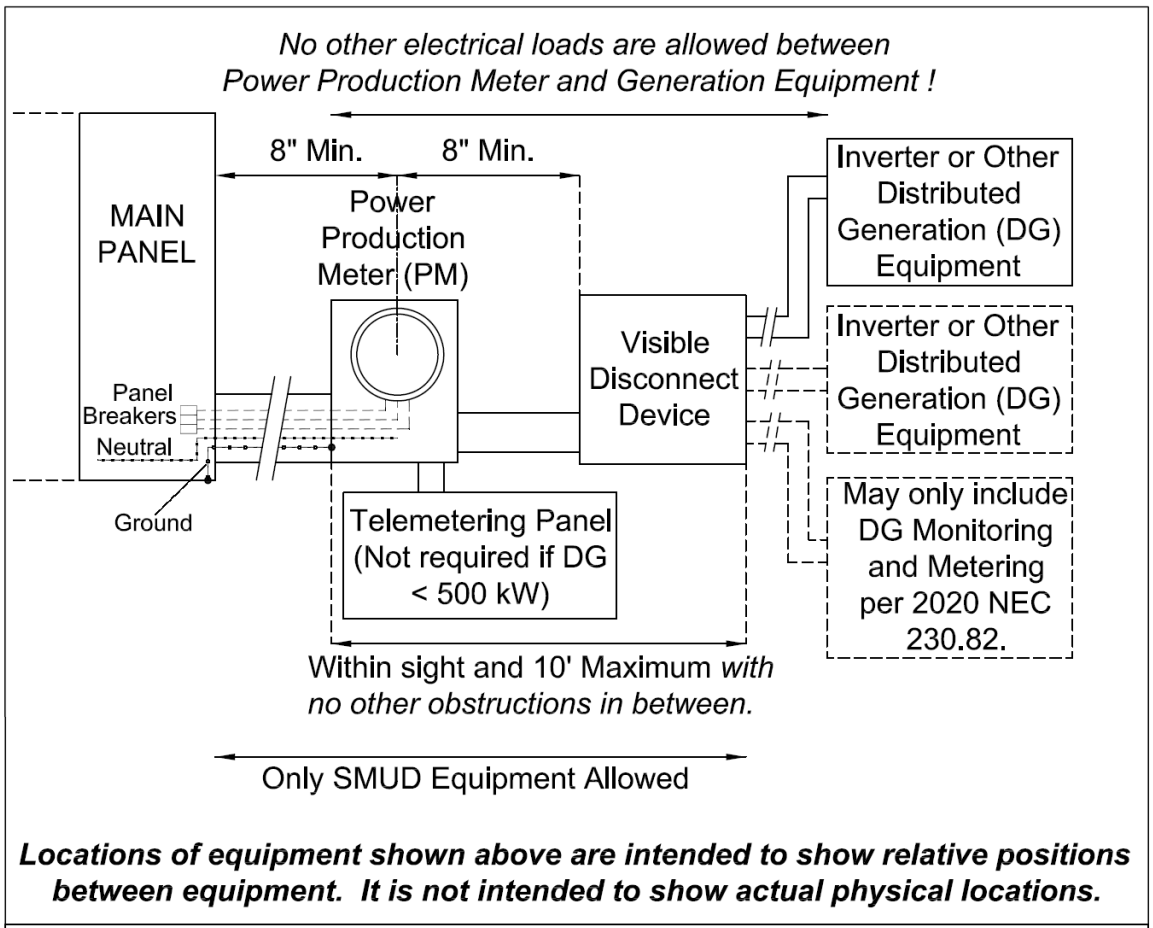

Figure 1: Commercial Distributed Generation Only - Option 1

Generation connected to Breaker Position in Main Panel
with VDD between Power Production Meter and Generation.

7.1.1. There are 2020 National Electric Code requirements that limit the breaker size in the Main panel that connects to the generation. Section 705.12(B)(3)(2) states that the maximum size of this breaker is limited by the size of the bus bar within the Main panel and by the size of the Main breaker. The size of the Main breaker plus the size of the breaker for the generation circuit cannot exceed 120% of the bus bar's ampacity rating.

- Example 1: for a bus bar rating of 1000 Amps and a Main breaker rated 1000 Amps, the maximum breaker size available for the generation is: (120%) x (1000 Amp bus bar) = 1200 Amps - 1000 Amp Main breaker = 200 Amps.
- Example 2: for a bus bar rating of 1600 Amps and a Main breaker rated 1000 Amps, the maximum breaker size available for the generation is: (120%) x (1600 Amp bus bar) = 1920 Amps – 1000 Amp Main breaker = 920 Amps.

This NEC section also has a requirement for the labeling of the breaker that connects to the generation source. The code requires a permanent warning label shall be applied to the distribution equipment adjacent to the back-fed breaker from the inverter that displays the following or equivalent wording:

WARNING:
POWER SOURCE OUTPUT CONNECTION -
DO NOT RELOCATE THIS OVERCURRENT DEVICE

7.1.2. 2020 NEC Section 705.12(B)(3)(3) provides an additional method to determine the maximum allowed size of the breaker serving the generation circuit. The sum of all ratings of the breakers in the panel (not including the Main breaker) cannot exceed the ampacity of the bus bar's rating. This section also requires that permanent warning labels shall be applied to distribution equipment that displays the following or equivalent wording:

WARNING:
THIS EQUIPMENT FED BY MULTIPLE SOURCES.
TOTAL RATING OF ALL OVERCURRENT DEVICES,
EXCLUDING MAIN SUPPLY OVERCURRENT DEVICE,
SHALL NOT EXCEED AMPACITY OF BUSBAR.

7.1.3. 2020 NEC Section 705.13 allows for the use of a Power Control System (PCS) to electronically control the output of the power production source(s), which will prevent the main bus from overloading. Battery backup installations can also use a smart contactor or other device (e.g., backup switch) in conjunction with the PCS.

7.1.4. The Power Production Meter (PM) socket and Visible Disconnect Device (VDD) shall be located within sight and within ten feet (10') of each other ***with no other obstruction(s) in between.*** Refer to Figure 1 for location requirements of devices.

7.1.5. It is highly desired that the breaker / disconnect in the inverter have the ability to be locked in the open position.

7.1.6. ***As mentioned earlier, the NEC and the County / City Electrical Inspector for your area may have requirements for your generation system that are beyond what is listed here. Please check with your local Inspector to make sure your plans meet their requirements.***

7.1.7. The Power Production Meter (PM) socket and a Visible Disconnect Device (VDD) need to be accessible 24 / 7 / 365 and located within sight and within ten feet (10') of each other ***with no other obstructions in between***. For meters 200 amps or smaller, there shall be a minimum of eight inches (8") between the centerline of the Power Production Meter socket and any obstruction. For meters greater than 200 amps, there shall be a minimum of eight inches (8") between the edge of the enclosure and any obstruction. A Combiner / Sub-Panel may be substituted for a VDD for systems under 200 Amps.

7.1.8. Small Commercial: If the Customer's DG is less than 500 kW (gross AC nameplate), the telemetering panel shown in Figure 1 will not be required.

7.1.9. Transformer Rated Metering: If the Customer's DG metering is transformer rated (>200 Amps), the DG breaker must be lockable in the off position, or an additional lockable AC disconnect is required between the Utility Service Meter panel and the Power Production Meter panel (within sight and 10' maximum with no other obstructions in between).

7.2. **Commercial – DG only, No ESS – Option 2:** Generation connected between Utility Service Meter and Main Breaker position as per applicable NEC code. A FUSED Disconnect Switch needs to be installed between the Main Panel and the Power Production Meter (2020 NEC 230). All other items from 7.1.2 through 7.1.6 apply.

Note: Energy Storage Systems (e.g., batteries) that charge from utility AC power are considered LOADS, and these loads are not included in those permitted by NEC 230.82(5). As such, these storage systems may ***NOT*** be connected in this location. Energy Storage Systems that are configured to only charge from some other source (such as the DC bus of a PV system) are considered generation, and may connect in this location per NEC 230.82(6).

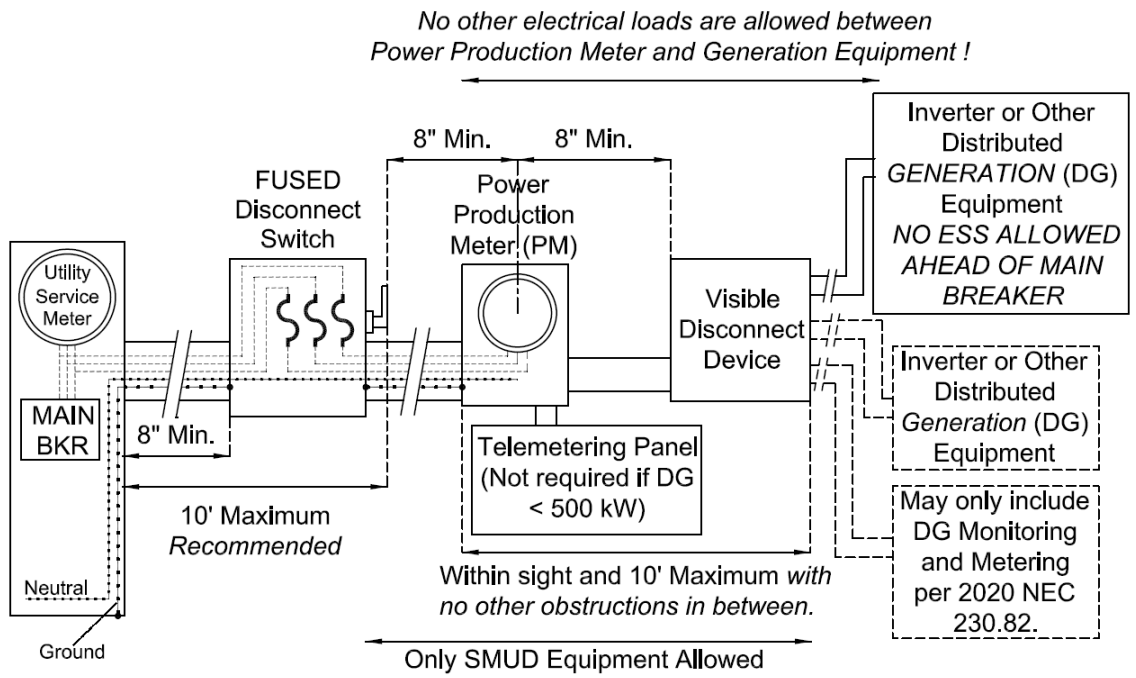

Figure 2: Commercial Distributed Generation Only - Option 2
Generation connected between Utility Service Meter and Main Breaker Position in Main Panel with VDD between Power Production Meter and Generation.

NO BATTERIES OR OTHER STORAGE DEVICES ALLOWED AHEAD OF MAIN BREAKER!

7.2.1. The FUSED Disconnect Switch should be as close as possible to the Main Panel, and it is recommended that it be within ten feet (10') of the Main Panel. Please consult with the AHJ as to the maximum distance allowed from the Main Panel.

7.2.2. 2020 NEC section 705.11(A) states "The sum of the source continuous current output ratings on a service, other than those controlled in accordance with 705.13, shall not exceed the ampacity of the service conductors."

7.3. **Commercial – DG and ESS – Option 3:** Generation connected to a breaker position in a Critical Load panel with an ESS connected to a separate breaker position in the Critical Load panel.

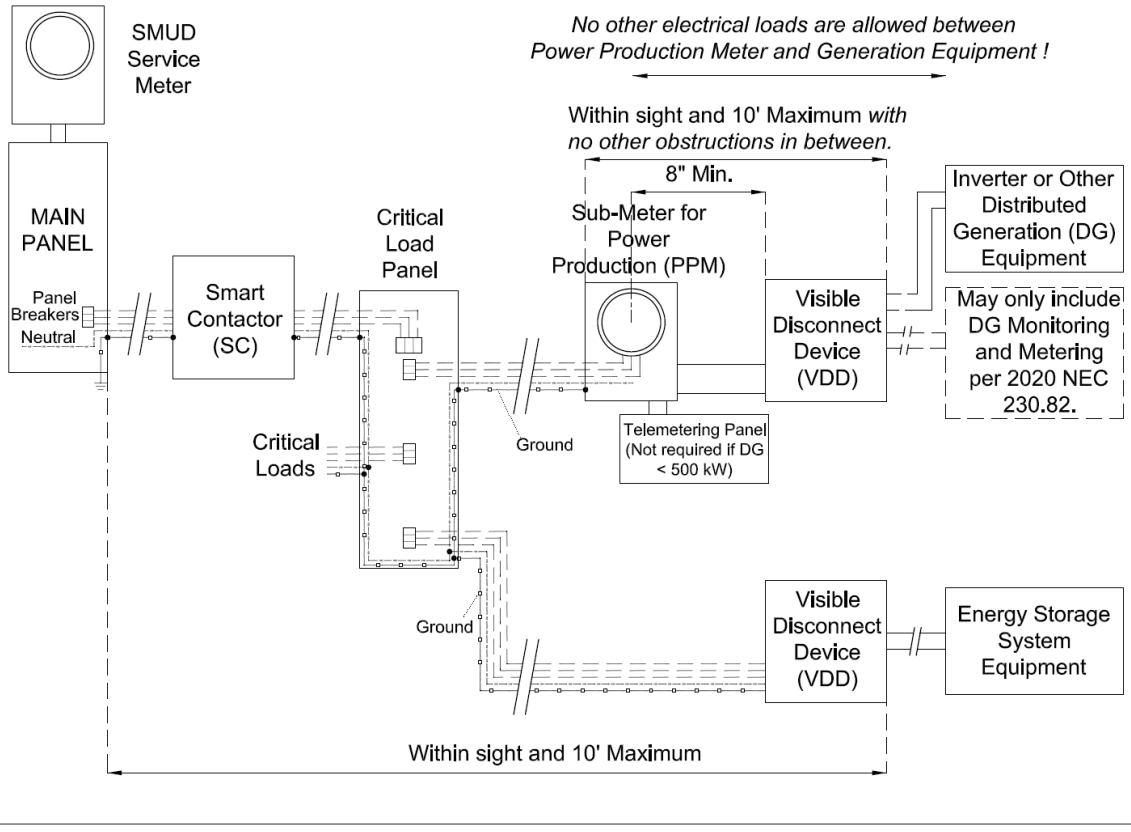

Figure 3: Commercial Distributed Generation with Energy Storage Equipment - Option 3

Generation connected to Breaker Position in Critical Load Panel
with ESS connected to a Different Breaker Position in Critical Load Panel.

7.3.1. As with previous options, there can be no other load between the Power Production Meter and the DG equipment, other than loads necessary for the monitoring and metering of the DG equipment.

7.3.2. A Smart Contactor needs to be installed between the Main Panel and the Critical Load Panel. This contactor will open and isolate the DG and ESS from the Utility System should the Utility System experience an outage. This will allow the DG and ESS to continue to power the Critical Loads.

7.3.3. All applicable NEC requirements mentioned in previous options still apply, in addition to the NEC requirements that apply to ESS.

7.3.4. Labeling is needed on the exterior of all panels and on the breaker in the Main Panel to the effect that DG and ESS are connected to them.

7.3.5. If the ESS is located greater than five feet (5') from the Critical Load Panel, or if the conductors pass through a wall panel, or if the ESS is out of sight from the Critical Load Panel, provisions 7.3.5.1 through 7.3.5.5 shall apply:

7.3.5.1 A disconnecting means and overcurrent protection shall be provided at the energy storage device end of the circuit. Fused disconnecting means or circuit breakers shall be permitted.

7.3.5.2 Where fused disconnecting means are used, the line terminals of the disconnecting means shall be connected toward the energy storage device terminals.

7.3.5.3 Overcurrent devices or disconnecting means shall not be installed in energy storage device enclosures where explosive atmospheres can exist.

7.3.5.4 A second disconnecting means located at the connected equipment shall be installed where the disconnecting means required by (7.3.5.1) is not within sight of the connected equipment.

7.3.5.5 Where the energy storage device disconnecting means is not within sight of the PV system AC and DC disconnecting means, geolocation placards or directories shall be installed at the locations of all disconnecting means indicating the location of all disconnecting means.

7.3.6. Per 2020 NEC 706.33(B)(3) (referred to from Article 690 Part VIII), ESS systems using interactive inverters to control energy storage state-of-charge by diverting excess power into an alternate electric power production and distribution system, such as utility system shall comply with 7.3.6.1 and 7.3.6.2 below:

7.3.6.1 These systems shall not be required to comply with NEC 706.33(B)(2).

7.3.6.2 These systems shall have a second, independent means of controlling the battery charging process for use when the alternate system is not available or when the primary charge controller fails or is disabled.

7.3.7. If your Critical Load Panel, or other storage equipment, is inaccessible (e.g., inside the garage, behind a locked fence, etc.) a SMUD employee will contact you to set up an appointment so that we may get access to the panel.

7.3.8. If the Critical Load Panel and ESS are located *inside* a garage (out of sight of the Main Service Panel), a second disconnect switch needs to be located between the Energy Storage System and the Critical Load Panel. This second disconnect switch needs to be ***OUTSIDE*** next to the Main Service Panel. The disconnects need to be labeled per NEC and EUSERC requirements.

7.3.8.1 The Disconnect for the ESS needs to be within ten feet (10') and within sight of the main panel.

7.3.8.2 One line drawings for ESS need to have labels of where the equipment is installed (e.g., inside garage).

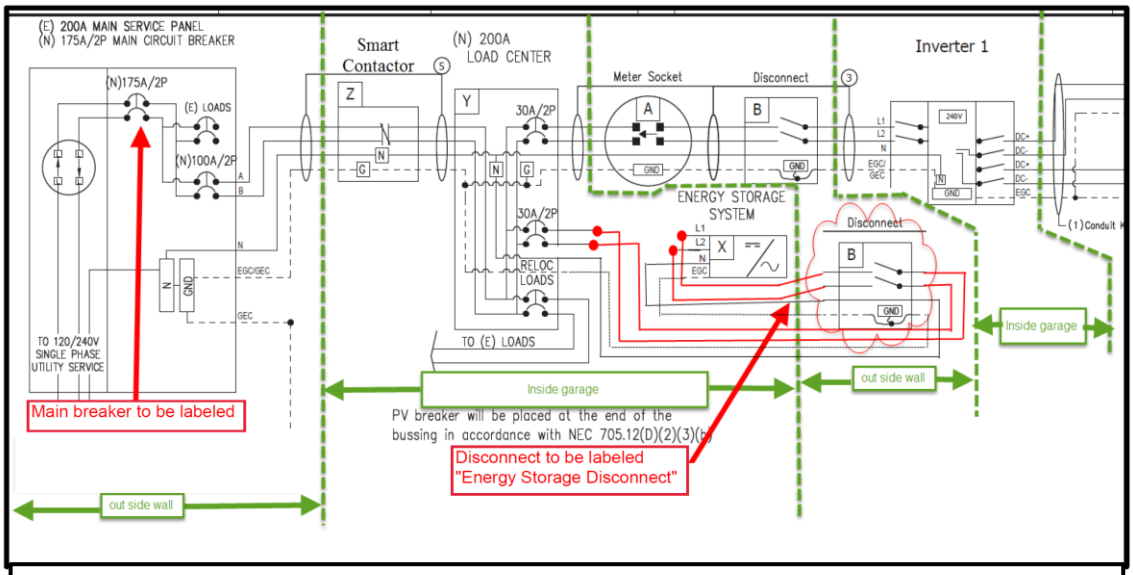

Figure 4 – The drawing above (from Tesla) shows an example of an additional disconnect, its location, and labeling, which would be required if the ESS is located in a garage.

7.4. **Commercial – DG and ESS – Option 4:** Generation and ESS connected to the DC section of the same inverter.

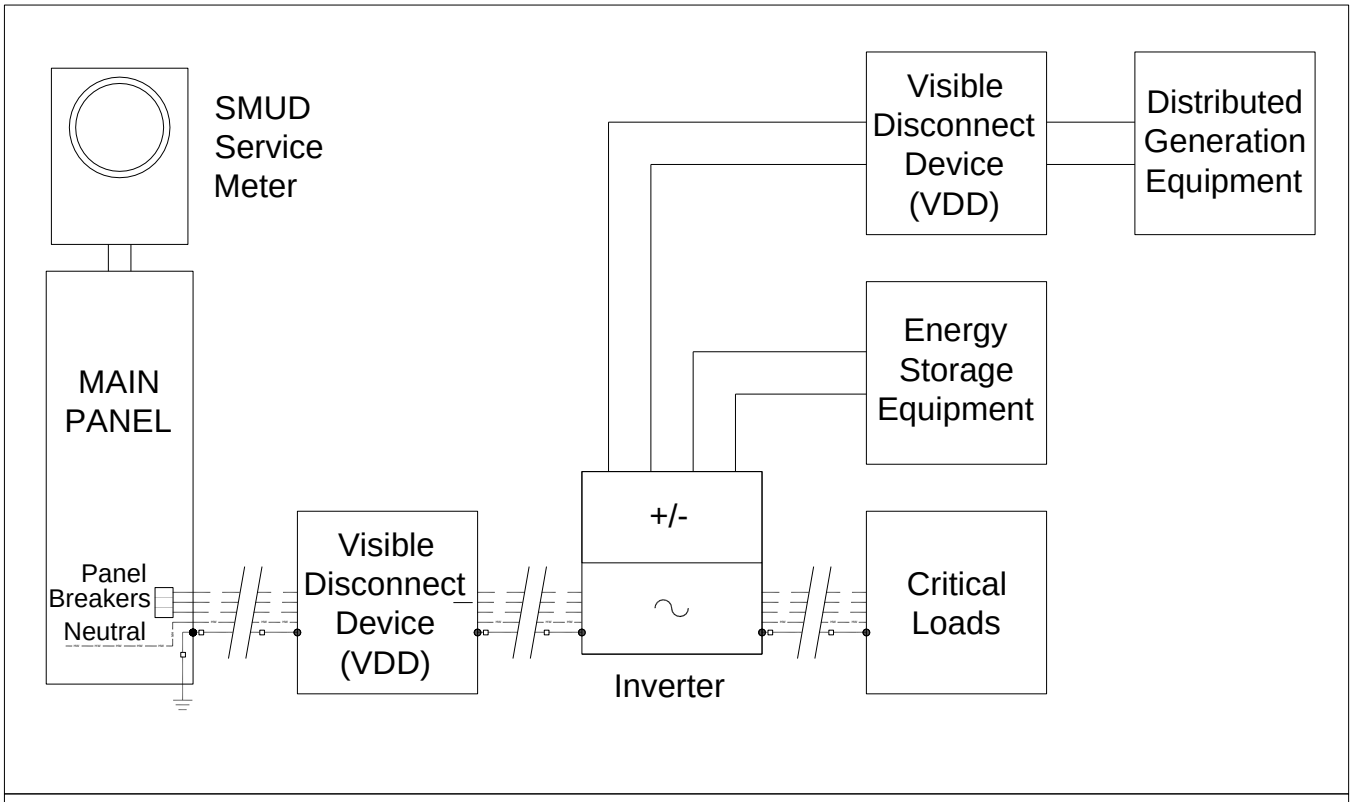

Figure 5: Commercial Distributed Generation with Energy Storage Equipment - Option 4

Generation and ESS directly connected to the Inverter's DC Section

7.4.1. Provisions in 7.3.1 through 7.3.8 above shall apply.

7.5. **Commercial – ESS only – Option 5:** No DG – only ESS connected to the DC section of the same inverter that is serving the Critical Loads.

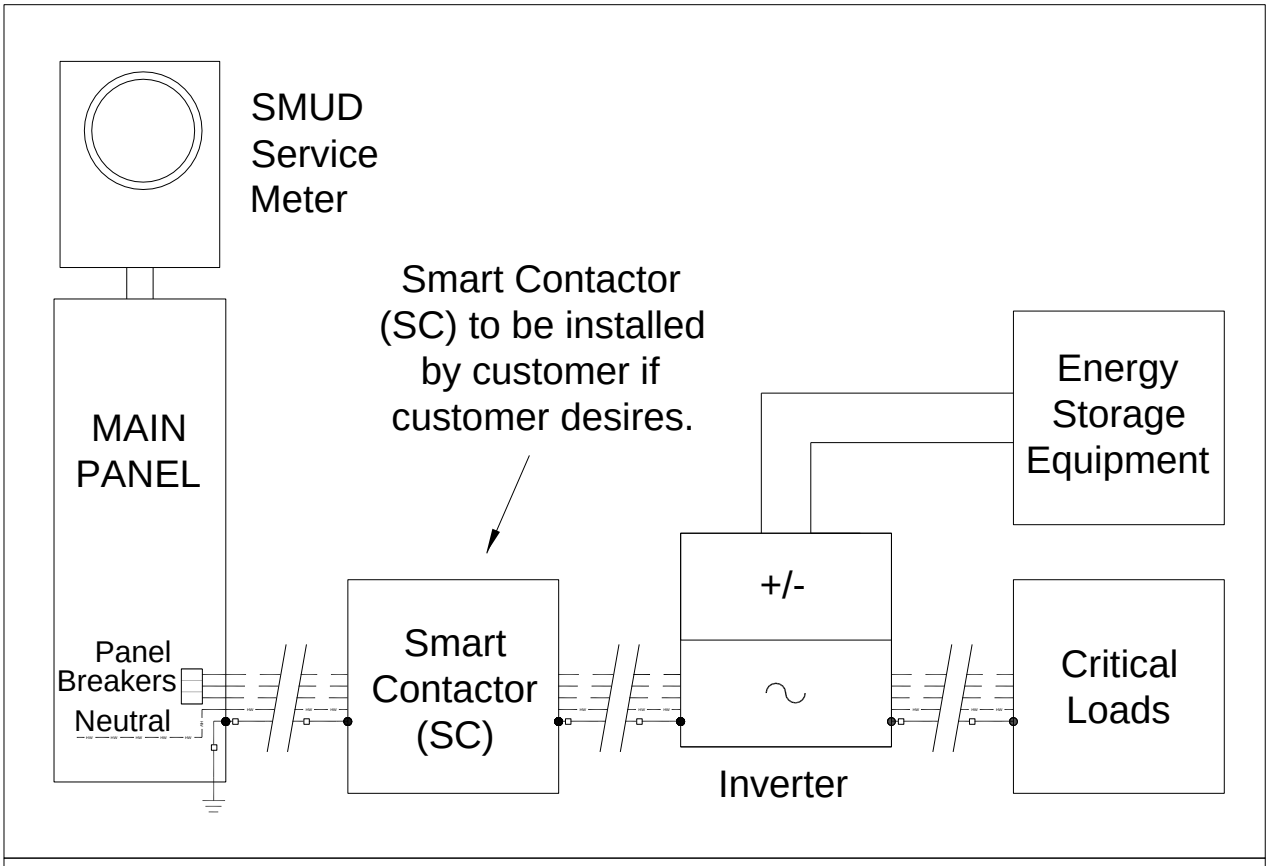

Figure 6: Commercial Energy Storage Equipment Only - Option 5

ESS Connected to Inverter that is serving Critical Loads.

7.5.1. A Smart Contactor may be installed to isolate the ESS and Critical Loads from the Utility System should the Utility lose power.

7.5.2. Provisions in 7.3.1 through 7.3.8 above shall apply.

7.6. **Commercial – Virtual Net Energy Metering (VNEM)**

7.6.1. For underground service multi-meter panels, an acceptable point of connection is,

7.6.1.1 Inside the main switch section with approval from the local AHJ, or

7.6.1.2 Install a sealable SMUD approved termination enclosure. See Figure 7

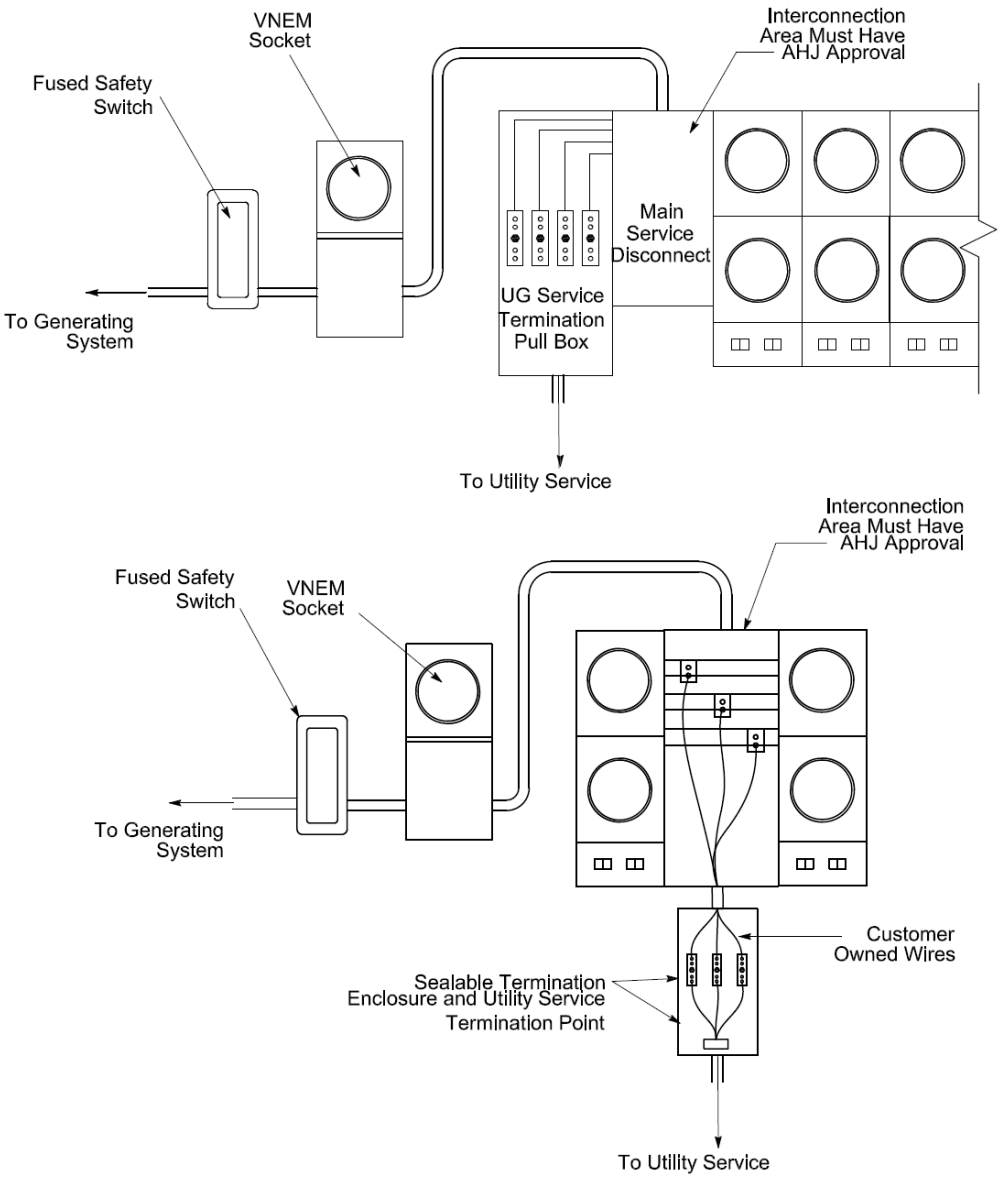

Figure7: Point on Connection: Underground Service Wall-Mounted Equipment

7.6.2. For overhead service multi−meter panels, an acceptable point of connection is

7.6.2.1 Inside the main switch section, with approval from the local AHJ, or

7.6.2.2 Install a sealable wiring gutter with approval from the local AHJ. See Figure 8

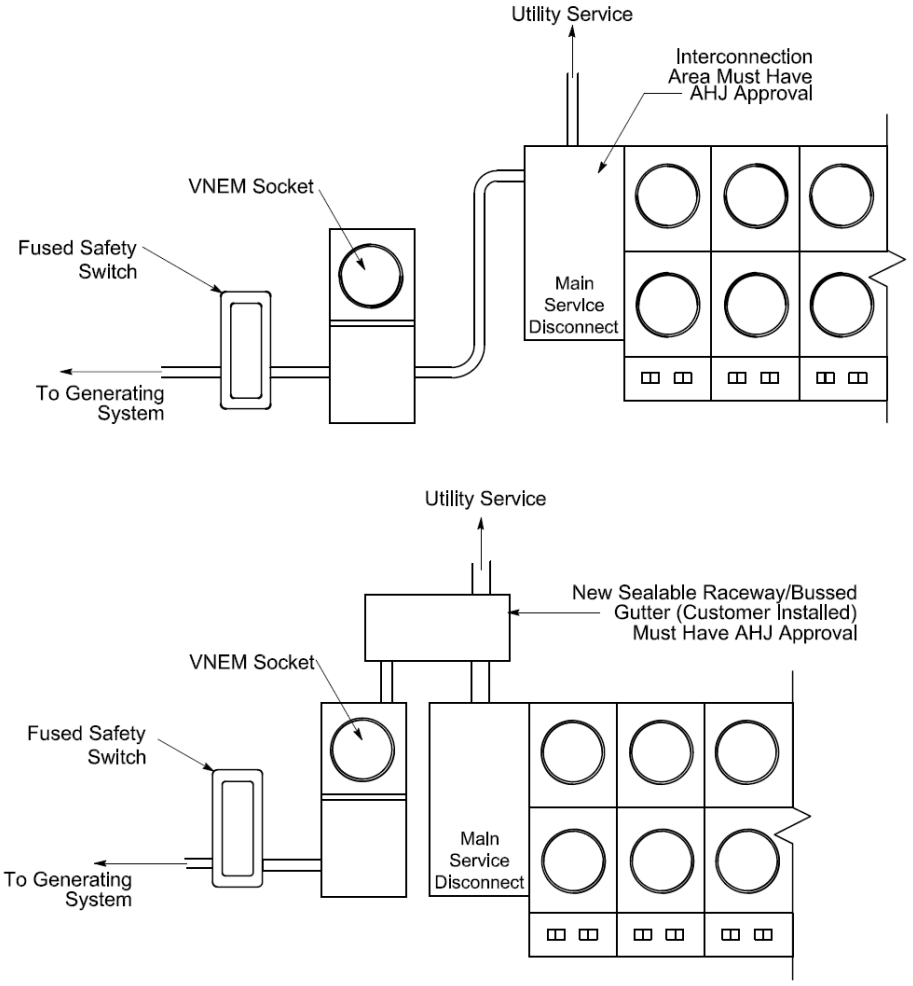

Figure8: Point on Connection: Overhead Service Wall-Mounted Equipment

7.6.3. For Multi-Meter Switchboards

7.6.3.1 Single metered switchboards with the SMUD service termination below the metering current transformer (CT) section cannot be used for any DG interconnections.

7.6.3.2 The SMUD service termination must be in a separate enclosure/section adjacent to the metering CT section. In addition, the SMUD service termination section must have clear separation between the SMUD service conductors and conductors to the CT section. See Figure 9.

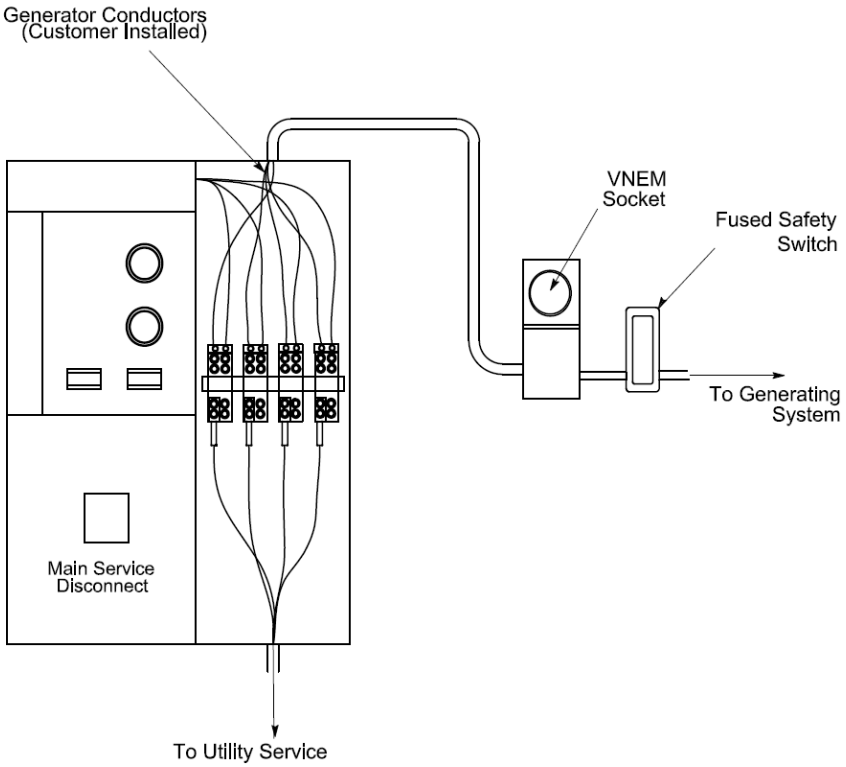

Figure 9: Point on Connection: Floor-Standing Switchboards

8. Power Production Metering Requirements - General

8.1. Pursuant to 7.1.4, the Customer shall provide and install the necessary metering socket and cabinet(s) as required by SMUD, in locations approved by SMUD. SMUD will furnish and install the Power Production Meter at no cost.

8.2. The Power Production Meter socket shall be wired so the output from the Customer's DG Source will be properly measured by the meter. Therefore, the DG shall be wired to the top clips of the PM. All phase conductors, one grounded conductor (neutral), and one grounding conductor (case ground) shall enter the Power Production Meter socket and they shall be labeled to differentiate between SMUD and DG Source.

8.3. The Power Production Meter, Visible Disconnect Device, and Telemetering Panel (if required) will be installed in a location readily accessible by SMUD 24 / 7 / 365 and in keeping with SMUD's metering requirements in T004.

8.4. A Visible Disconnect Device should be located such that the Power Production Meter remains energized from the Main Panel during Inverter replacements or during maintenance on the DG and/or ESS equipment.

8.5. Under no circumstances shall any metering enclosure be used as a conduit or raceway for any conductors. Only the phase conductors terminated in the meter socket and the associated grounded conductor (neutral) and grounding conductor (equipment ground) are allowed.

8.6. Arrangement and Location - The Power Production Meter shall be located within sight and 10 feet of a Visible Disconnect Device ***with no other obstruction(s) between them***. Where physical limitations prohibit this, alternate arrangements shall be made and approved by SMUD (e.g., installation of additional Visible Disconnect Device(s), labeling as per NEC and Authority Having Jurisdiction, etc.).

8.7. Equipment Protection and Grounding - All related metering enclosures and equipment shall be grounded in compliance with the NEC and the local Authority Having Jurisdiction.

8.8. All equipment shall be approved by a National Recognized Testing Laboratory (NRTL).

8.9. **After installation, SMUD employees will not energize the DG and/or ESS system. This will be the responsibility of the Customer / Contractor. It will also be the responsibility of the Customer to monitor the production of the DG and/or ESS system.**

8.10. For Power Production Metering over 600 volts (these requirements are in addition to the general Power Production Metering requirements):

8.10.1. There shall be an eight-foot (8') clearance from the utility CT section to any other obstruction.

8.10.2. Two Visible Disconnect Devices need to be installed – one on each side of the Power Production Meter.

8.10.3. All equipment shall meet EUSERC requirements.

8.10.4. Where possible, metering can be done with a pole-mounted rack.

8.10.5. For telecommunication equipment, clearance to high voltage equipment shall be maintained at all times from the high voltage bus support.

8.11. For Projects Equal to or Greater than 500 kW:

8.11.1. The Facility Owner will need to provide a 13-point socket in the switchgear.

8.11.2. The SMUD Power Production Meter and the Telemetry cabinet will require auxiliary power, ranging from 120 VAC to 277 VAC (120 VAC preferred), to be installed into the Utility Meter section. This circuit should not be fed from the generation circuit.

8.11.3. If the Facility Owner would like to install metering equipment for their own need, the Facility Owner is responsible for purchase and installation of its own separate metering equipment and will install it in their section of the switchgear. The Facility Owner cannot attach their metering equipment to the SMUD metering equipment.

8.11.4. For Net Energy Metering installations, the SMUD Power Production Meter shall be the closest meter to the DG and/or ESS source.

8.12. Curtailable Power Purchase Agreement (PPA) or Feed In Tariff (FIT)

8.12.1. Some DG and/or ESS installations may be required to have the option of being curtailed by SMUD. This will be determined by the PPA agreement.

8.12.2. The Facility Owner will run conduits from the meter and curtailment device to the telecommunications enclosure. SMUD will install wireless equipment to stream production data to SMUD's Energy Management System.

8.12.3. SMUD requires the first section of the metal enclosed switchgear (closest to the substation bank) to be the SMUD Power Production Metering Section. SMUD doesn't want any load losses between the Power Production Meter and the PCC.

8.12.4. The Power Production Meter requires DNP3 communication protocol between the plant controller and the RTU.

9. AC Disconnects

The Disconnect Device(s) will isolate all ungrounded (hot) conductors of the generating facility and/or ESS from SMUD's distribution system. The switch/breaker shall be a gang-operated, and load-break rated. A Combiner / Sub-Panel can substitute for the Visible Disconnect Device.

10. Labeling

Labels shall conform to the current California Electric Code, NEC, and Authority Having Jurisdiction.

11. Minimum Telemetry & Metering Requirements – Nameplate rating or facility aggregate 500 kW – 999 kW - Net Energy Metering (NEM) only

(If your nameplate rating or facility aggregate is one (1) MW or greater NEM or greater than 500 kW non-NEM, please refer to Section 12, this document.)

This is in compliance with revisions to SMUD Interconnection Guideline 11-01 approved by the Rates Department and management.

11.1. ***Facility Owner*** is responsible for the following: (SMUD shall provide a stipend to offset some of these costs):

11.1.1. Install Power Production Meter panel or provide Power Production Meter section in existing switchgear per SMUD and EUSERC metering standards, which may include relocation of disconnects. This is required for installation of the Power Production Meter.

Please refer to your *Power Clerk Interconnect* application for appropriate stipend amount.

11.1.2. Install and properly ground a separate lockable telemetry cabinet, which will be provided by SMUD (32" wide by 40" tall by 15" deep, rated NEMA 3R). The Facility Owner will also provide facilities to bring two power feeds {single phase as required (120 VAC preferred), 15 Amps capacity – one feed for telecommunications and one for the meter} to the telemetry cabinet and Power Production Meter. *The location of the cabinet shall be approved by SMUD prior to the Facility Owner installing it. Facility Owner is responsible for termination of power, neutral, and grounding cables.*

11.1.3. Facility owner will pull two CAT5e shielded cables from the meter to the telemetry cabinet in conduit. Note: Customer shall provide conduit plan drawing before installation of conduit.

11.1.4. SMUD will contribute an additional $6,000 paid to the Facility Owner or in the form of a credit toward other work that may be billable to the Facility Owner. SMUD, in its discretion, may adjust this contribution amount in the future. This amount is based on SMUD's estimated average cost for telemetry equipment, labor, and materials.

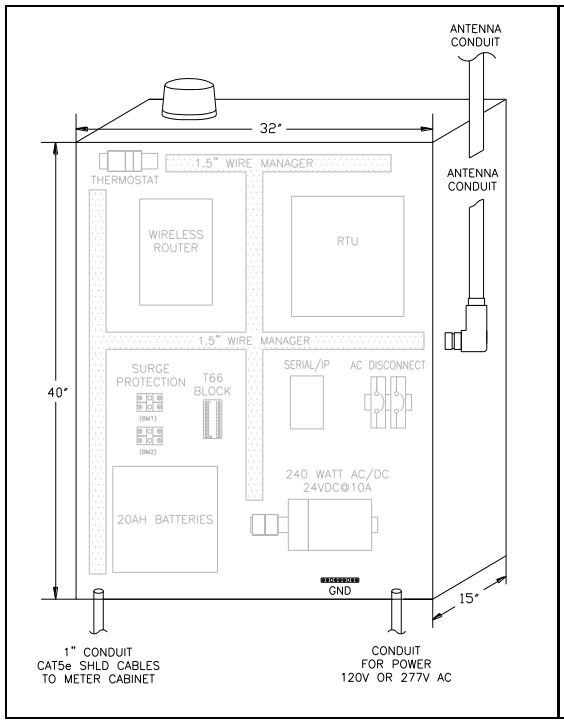

Figure 7 - Equipment Layout (SMUD will install the equipment)

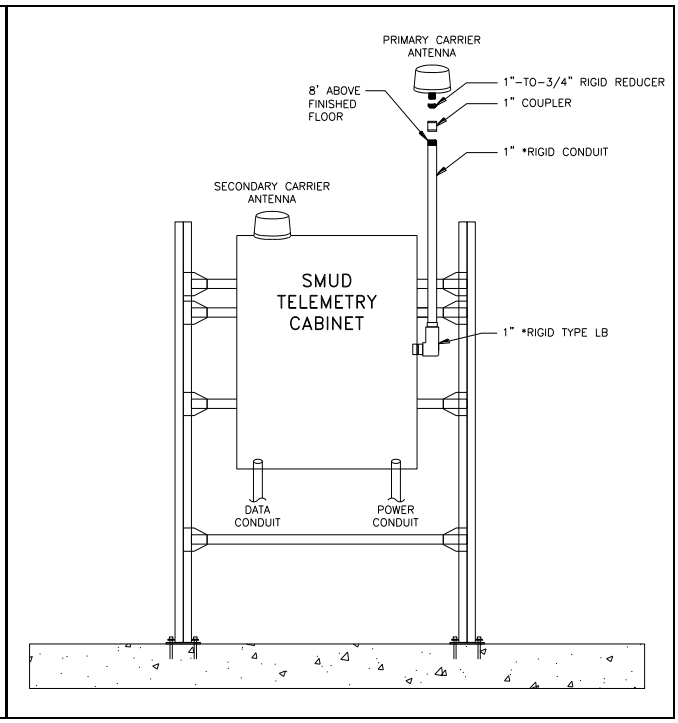

Figure 7a- Physical Cabinet Elevation

11.2. ***SMUD*** is responsible for the following telemetry labor and material costs:

11.2.1. Furnish and install all materials and labor associated with the installation of Power Production Meter(s) to read energy generated by the generation facility, including metering transformers if necessary.

11.2.2. Pay for all materials and labor costs associated with Energy Management System programming and testing.

11.2.3. Pay for all interconnection project management time.

11.2.4. If primary metering associated with telemetry is to be pole mounted, construction costs associated with the Power Production Metering will be provided by SMUD.

12. Minimum Telemetry & Metering Requirements – Nameplate rating or facility aggregate of

- **1 MW or greater Net Energy Metering (NEM) and**
- **all non-NEM equal to or greater than 500 kW.**

This is in compliance with revisions to SMUD Interconnection Guideline 11-01 approved by the Rates Department and management.

12.1. **Facility Owner** is responsible for all telemetry labor and material costs incurred by SMUD:

12.1.1. Install and pay for SMUD Power Production Meter section in switchgear cabinet per SMUD Power Production Metering standards, which may include relocation of disconnects. This is required for installation of the Power Production Meter. When 69 kV connections are required, the Facility Owner incurs the cost associated with purchasing the metering transformers (PT's / CT's) per SMUD approval.

12.1.1.1 Pay for, install, and properly ground, a separate lockable telemetry cabinet, which will be provided by SMUD (32" wide by 40" tall by 15" deep, rated NEMA 3R). The Facility Owner will also provide facilities to bring two power feeds (120 VAC to 277 VAC single phase as required (120 VAC preferred), 15 Amps capacity – one feed for telecommunications and one for the meter) to the telemetry cabinet and Power Production Meter. *The location of the cabinet shall be approved by SMUD prior to the Facility Owner installing it. Facility Owner is responsible for termination of power, neutral, and grounding cables.*

12.1.1.2 Please refer to Figure 7 on page 21 above for cabinet layout.

12.1.1.3 Facility owner will pull two CAT5e SHLD cables from the meter to the telemetry cabinet in conduit. **Note: Customer shall provide conduit plan drawing before installation of conduit**.

12.1.2. Pay for all materials and labor associated with installation of Power Production Meter(s) to read energy generated by the generation facility.

12.1.3. Pay for all materials and labor costs associated with Energy Management System installation, programming, and testing.

12.1.4. Pay for all interconnection project management time.

12.1.5. The Facility Owner is responsible for all labor and material costs including line work associated with all metering requirements (refer to SMUD Interconnection Guideline 11-01 for details).

13. Data from ESR T004 – Page A-27 (Reference page numbers refer to drawings in T004)

TYPE OF SERVICE	REF. PAGE NO.	MAIN SIZE AMPS.	METER	METER SOCKET	METERING AND TRANSFORMERS	TEST BYPASS
2W-1 PHASE 120V	A-21	100	CL. 100 120V 2W 1 PHASE	100A 4 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
3W-1 PHASE 120/240V	A-21	0-100	CL. 200 240V 3W 1 PHASE	100A-200A 4 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
3W-1 PHASE 120/240V	A-22	101-200	CL. 200 240V 3W 1 PHASE	200A 4 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
3W-1 PHASE 120/240V	A-6, A-7, A-8, A-9, A-13	201-400	CL. 20 240V 3W 1 PHASE	COMB. CAN / SWITCHBOARD 6 POINT	2-2W SEE NOTE 3	7 POLE TEST SWITCH SEE NOTE 2
4W-3 PHASE 120/240V	A-21	0-100	CL. 200 240V 4W DELTA 3 PHASE	100A 7 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
4W-3 PHASE 120/240V	A-22	101-200	CL. 200 240V 4W DELTA 3 PHASE	200A 7 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
4W-3 PHASE 120/240V	A-6, A-7, A-9, A-14	201-400	CL. 20 240V 4W 3 PHASE	COMB. CAN / SWITCHBOARD 13 POINT	3-2W SEE NOTE 3	10 POLE TEST SWITCH SEE NOTE 2
4W-3 PHASE 120/240V	A-6, A-7, A-9, A-14	401-800	CL. 20 240V 4W DELTA 3 PHASE	COMB. CAN / SWITCHBOARD 13 POINT	3-2W SEE NOTE 3	10 POLE TEST SWITCH SEE NOTE 2
4W-3 PHASE 120/240V	A-10, A-11, A-12, A-14, A-15, A-16, A-17, A-18	801-4000	CL. 20 240V 4W DELTA 3 PHASE	SWITCHBOARD 13 POINT	3-2W SEE NOTE 3	10 POLE TEST SWITCH SEE NOTE 2

NOTES:

1. Check with SMUD'S Engineering Designer for availability of 3-phase delta service.
2. Test switch provided by SMUD.
3. Metering current transformers provided by SMUD.

14. Data from ESR T004 – Page A-28 (Reference page numbers refer to drawings in T004)

TYPE OF SERVICE	REF. PAGE NO.	MAIN SIZE AMPS.	METER	METER SOCKET	METERING AND TRANSFORMERS	TEST BYPASS
2W-1 PHASE 120V	A-21	30	CL. 100 120V 2W 1 PHASE	100A 4 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
3W-1 PHASE 120/208V	A-22	0-200	CL. 200 120V 3W 1 PHASE	100A-200A 5 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
4W-3 PHASE 120/208V	A-21	0-100 UNDER 30KW	CL. 200 120V 4W 3 PHASE	100A 7 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
4W-3 PHASE 120/208V	A-22	101-200 UNDER 30KW	CL. 200 120V 4W 3 PHASE	200A 7 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
4W-3 PHASE 120/208V	A-21	0-100 OVER 30KW	CL. 200 120V 4W 3 PHASE	100A 7 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
4W-3 PHASE 120/208V	A-6, A-7, A-8, A-9	201-400	CL. 20 120V 4W 3 PHASE	COMB. CAN 13 POINT	3-2W SEE NOTE 3	10 POLE TEST SWITCH SEE NOTE 2
4W-3 PHASE 120/208V	A-6, A-7, A-9, A-10, A-14	401-800	CL. 20 120V 4W 3 PHASE	COMB. CAN / SWITCHBOARD 13 POINT	3-2W SEE NOTE 3	10 POLE TEST SWITCH SEE NOTE 2
4W-3 PHASE 277/480V	A-21	0-100 UNDER 30KW	CL. 200 277V 4W 3 PHASE	100A 7 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
4W-3 PHASE 277/480V	A-22	101-200	CL. 200 277V 4W 3 PHASE	200A 7 POINT CONTINUOUS DUTY RATED		SEE PAGE A-23
4W-3 PHASE 277/480V	A-6, A-9, A-10, A-14	201-400	CL. 20 277V 4W 3 PHASE	CT CABINET 13 POINT	3-2W SEE NOTE 3	10 POLE TEST SWITCH SEE NOTE 2
4W-3 PHASE 277/480V	A-6, A-9, A-10, A-14	401-800	CL. 20 277V 4W 3 PHASE	CT CABINET 13 POINT	3-2W SEE NOTE 3	10 POLE TEST SWITCH SEE NOTE 2
4W-3 PHASE 277/480V	A-14, A-15, A-16, A-17, A-18	801-4000	CL. 20 277V 4W 3 PHASE	SWITCHBOARD 13 POINT	3-2W SEE NOTE 3	10 POLE TEST SWITCH SEE NOTE 2

NOTES:

1. Any wye meter service over 200A, single phase, 120/208, is not available.
2. Test switch provided by SMUD.
3. Metering current transformers provided by SMUD.

Examples of panel types *

	Eaton/B-Line (catalog #)
Commercial < 200 amps	100 A = "117TB" 200 A ="127TB"
Commercial >200-800 amps 120-240V Service	122013
Commercial >200-800 amps 277-480V Service	363611 HRTCT plus CT mounting base i.e. 6067 HEEL (or similar)
Commercial > 800 amps	Ground Mounted Switchboard

* or similar from another manufacturer. Please note that Catalog # changes with the number of clips in socket.

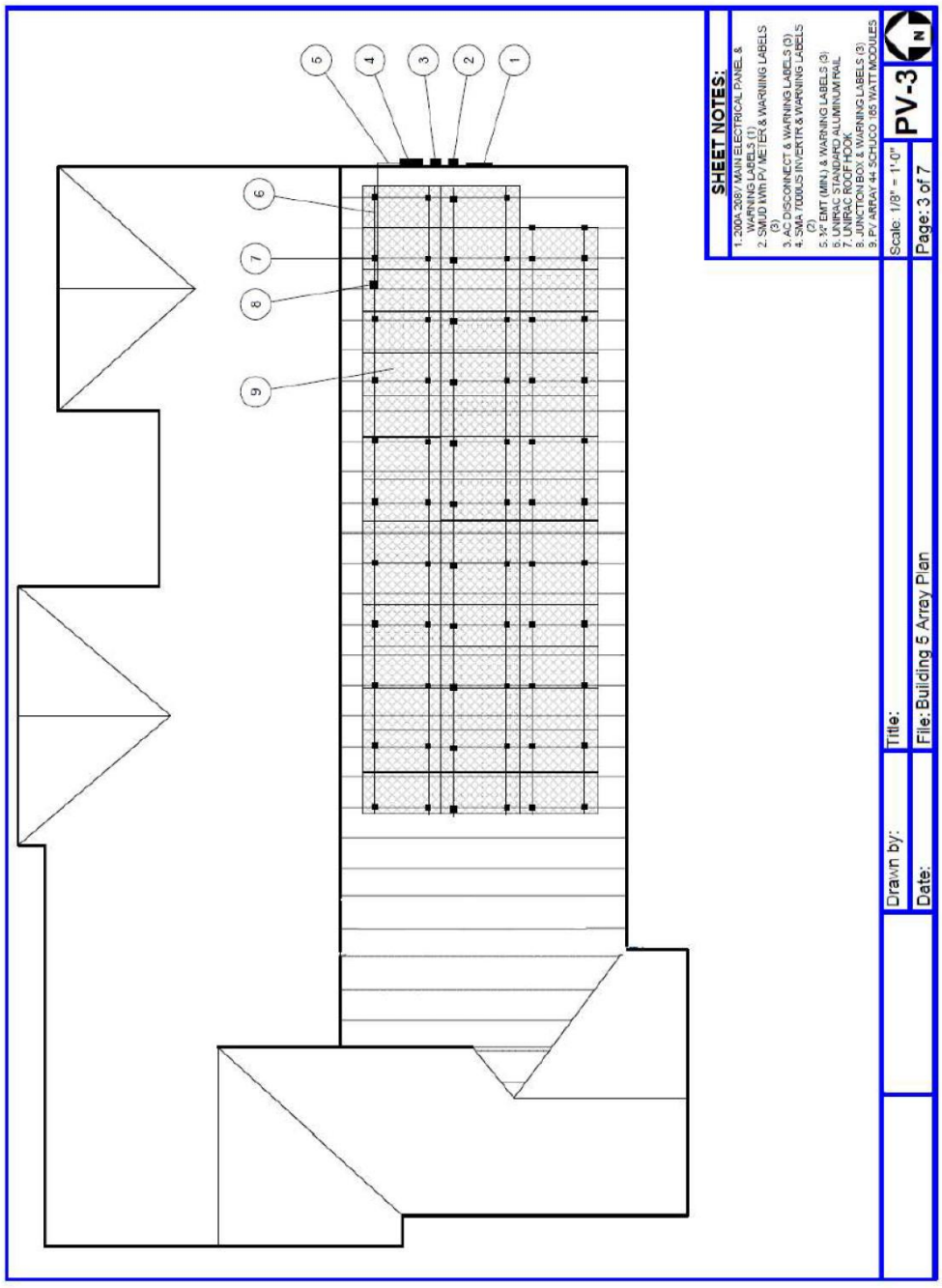

Figure 8- Sample Site Plan

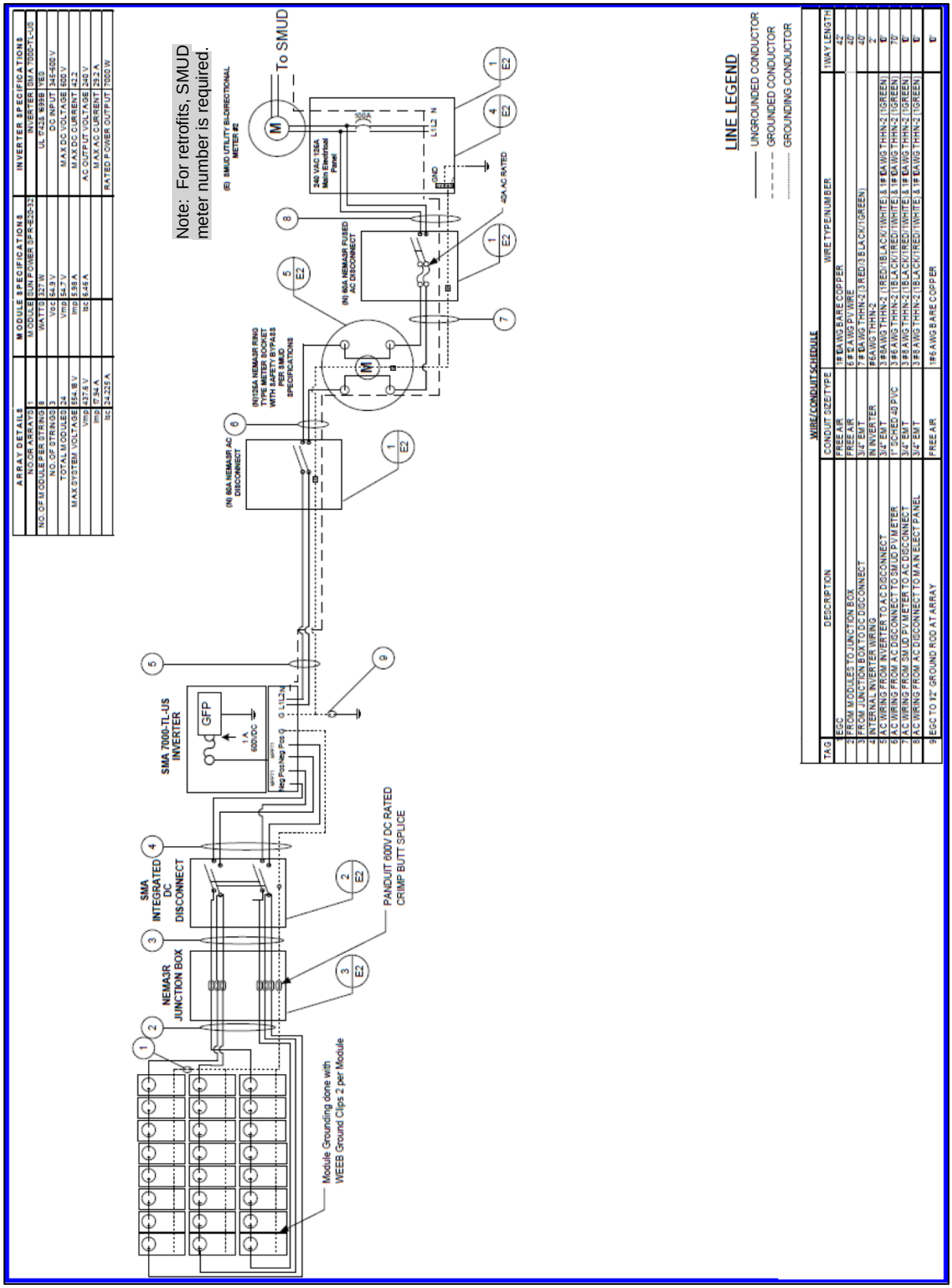

Figure 9 - Sample Single Line Drawing (refer to Section 6.1.2) of PV Connected Between Meter and Main Breaker.

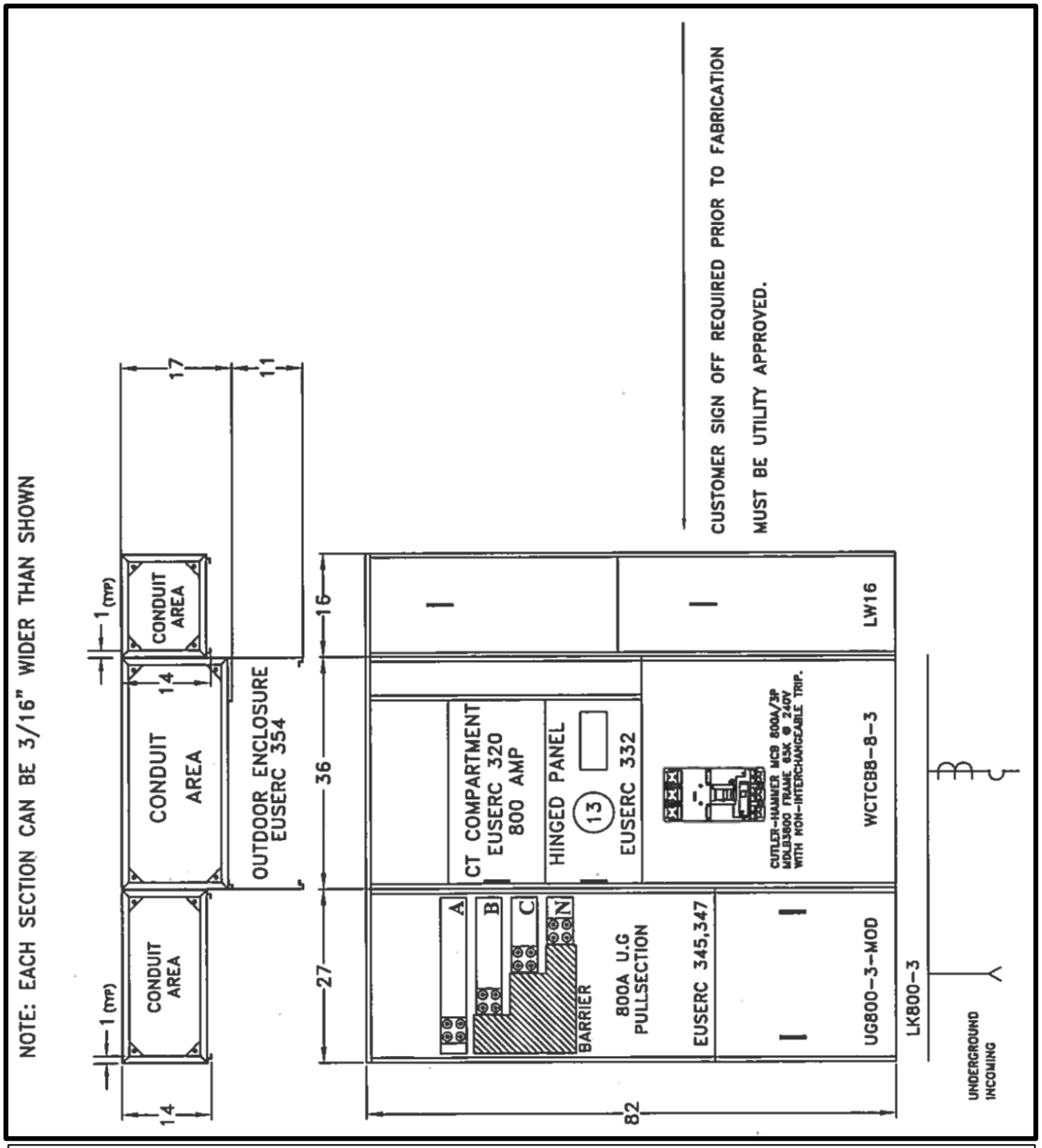

Figure 10 - Sample Cut Sheet - 800 Amp Breaker. Refer to Section 6.1.5.

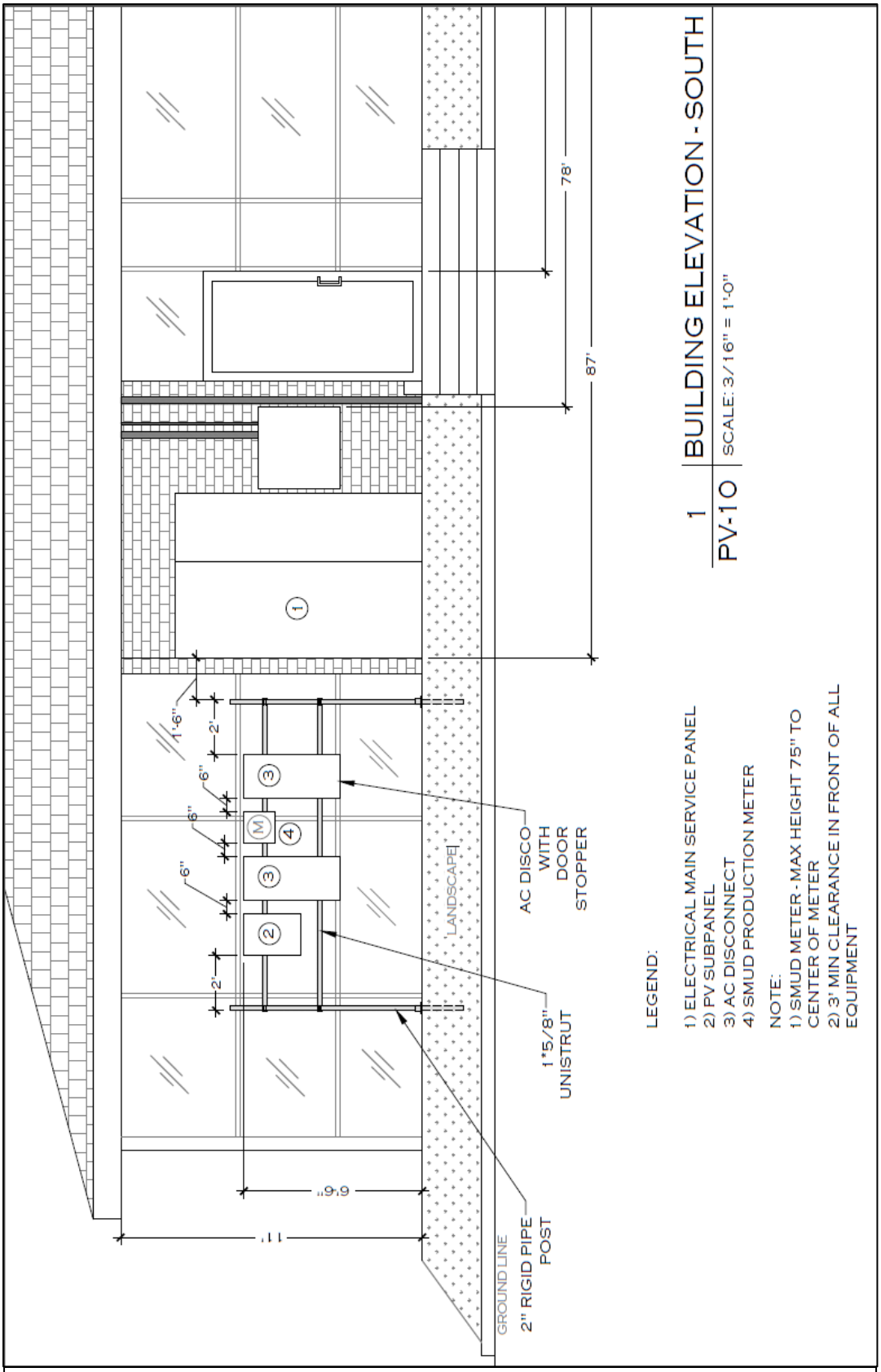

Figure 11 - Sample Elevation Drawing

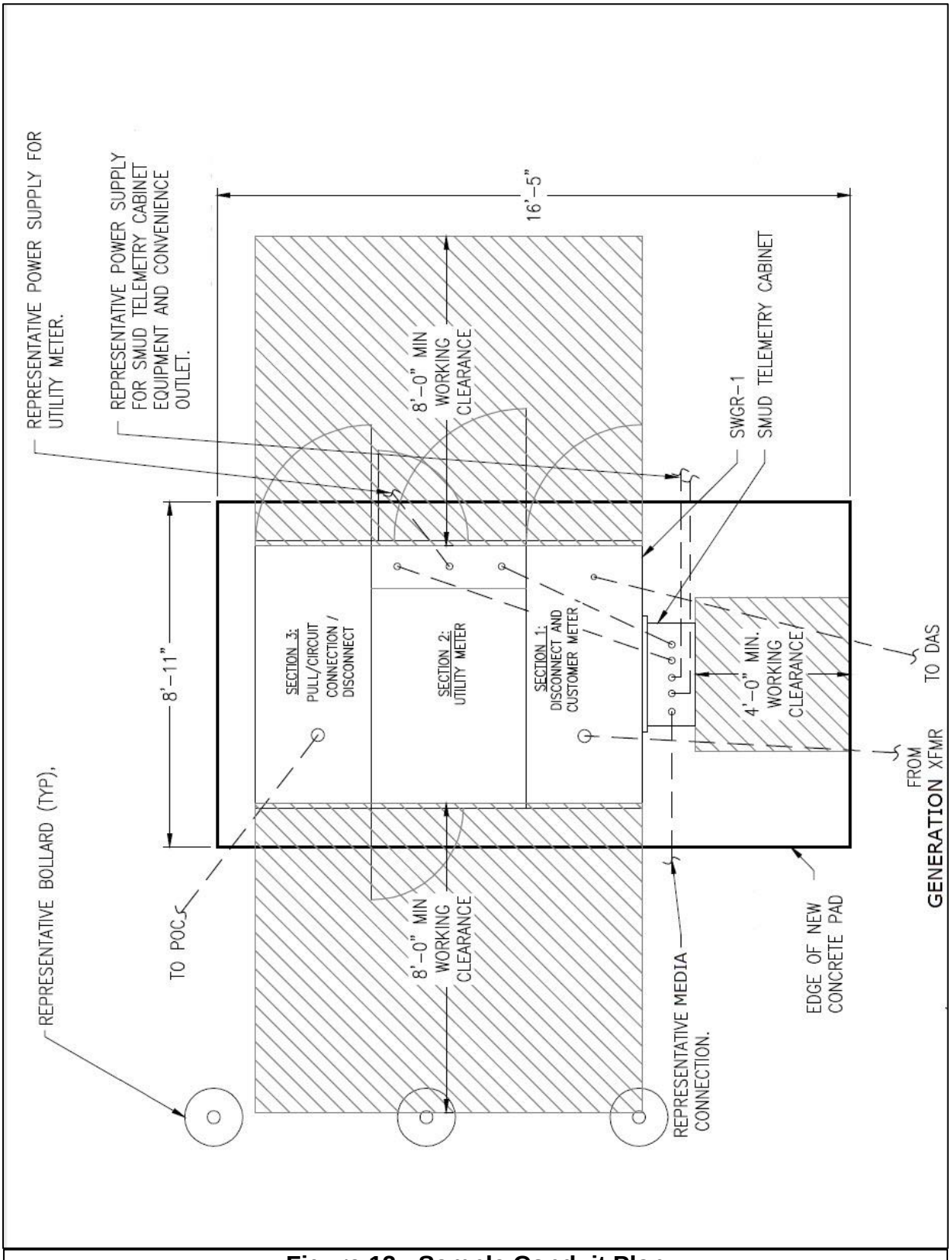

Figure 12 - Sample Conduit Plan

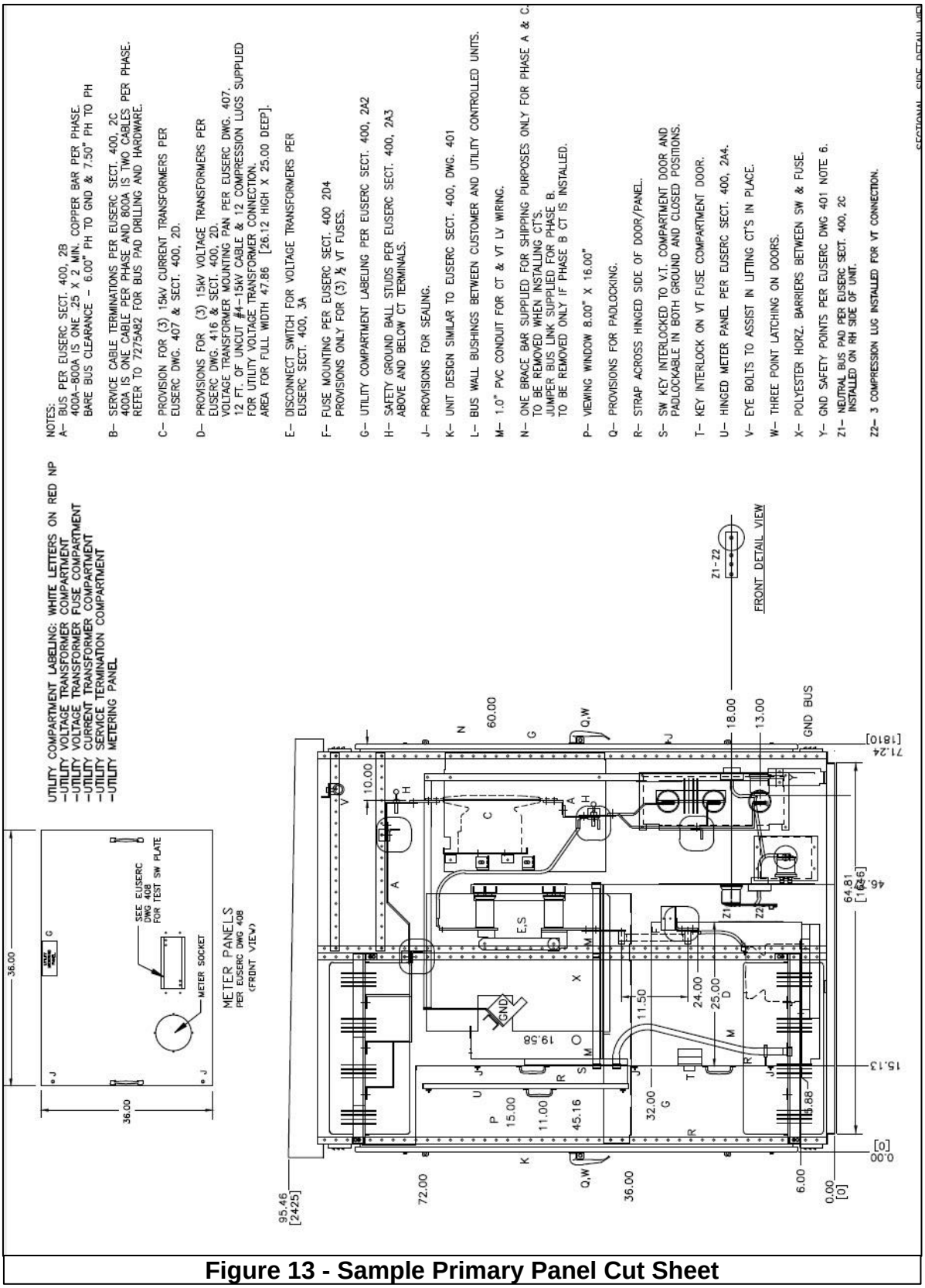

Figure 13 - Sample Primary Panel Cut Sheet