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Chapter 5 – General Specification for a Customer Owned 26.4 kV Substation with a Metal-Clad 26 kV Switchgear

1. Introduction

PSE&G is committed to providing a safe environment for our employees and safe, adequate and reliable electric service to our customers.

These General Specifications are provided to assist the customer and their agents in developing the necessary detailed substation specifications for acceptable operation on PSE&G's 26.4 kV electrical system.

The Addendum to these General Specifications show typical one-line substation configurations (Figure 5.1 through Figure 5.11) that are acceptable for operation on PSE&G's 26.4 kV electrical system. Not all configurations are available everywhere on the system nor is every possible configuration shown. Preliminary discussions with PSE&G are recommended to determine what is available to best serve the customer's requirements.

In accordance with Section 5.1 of the Standard Terms and Conditions of *PSE&G's Electric Tariff* B.P.U.N.J. No. 15, the customer's 26.4 kV bus is considered part of PSE&G's distribution system for operational purposes, and system power may flow through the customer's bus with no remuneration to the customer by PSE&G.

2. General

The following general requirements apply to customer substations:

1. PSE&G requires that all customer substations supplied from the 26.4 kV impedance grounded electrical system shall be designed for 34.5 kV operation and that all construction and equipment shall be rated and tested at a minimum of 38 kV voltage level classification, 150 kV BIL, unless otherwise specified.
2. All aspects of the Metal Clad / Metal-Enclosed Switchgear associated with Customer Owned Substations shall conform with the latest versions of American National Standards Institute (**ANSI**) / Institute of Electrical and Electronics Engineers (**IEEE**) Standards C37.20.3, C37.20.4 and C37.20.2.
3. The 26.4 kV system is resistance grounded through an 8 or 9 ohm neutral resistor that is installed in PSE&G's switching stations. Under certain conditions this neutral resistor may be bypassed, effectively grounding the system. During single phase Ground Fault events, the unfaulted phases may rise to 31 kV over ground potential. Maximum voltage as seen by switching and interrupting devices will not exceed 29.0 kV during ground faults. These effects should be considered in the design of the customer's relaying. PSE&G requires that all indoor customer substations supplied from the 26.4 kV impedance grounded electrical system shall be designed for 34.5 kV operation and that all construction and equipment shall be rated and tested at a minimum of 38 kV voltage level classification, 150 kV BIL, unless otherwise specified.
4. Prior to purchasing any equipment, PSE&G shall be contacted for details on types of equipment and relays suitable for the substation design selected by the customer.
5. Customer shall submit to the Division 26 kV Planner two copies of the conceptual one-line (electronic version in PDF format) as part of the first contact with PSE&G. The one line shall clearly indicate all proposed protection (function / make and model) and all equipment ratings. One copy shall be addressed to the Division 26 kV Planner and the other to the Electric Meter Supervisor.

3. Review and Approvals Required

The following are requirements for the review and approval of the customer's substation:

1. Five sets of the final substation plans, and an electronic version in PDF format, shall be submitted to PSE&G for its review so as to ensure that the design satisfies PSE&G's technical requirements. Such review must be completed prior to the fabrication of apparatus and the supporting structure.
2. Specifically, the drawings submitted should cover the following items:
   a. Single-line diagram of the substation including secondary connections to the main transformers, bus and feeder breaker arrangements and connections.
   b. Written procedure on how the customer substation will be operated.
   c. DC and AC schematic diagrams of the relaying and control of all 26.4 kV automatic apparatus.
   d. A plot plan showing the location of the substation with regard to all structures within 100 ft thereof.
   e. A manhole and conduit drawing representing incoming lines and instrument transformer secondary circuits used for revenue metering.
   f. Switchgear plans and elevation views showing at a minimum incoming terminations and revenue instrument transformer cubicles. These drawings will confirm clearances and how instrument transformers are installed.
   g. Substation plan and elevation views whether indoor or outdoor.
   h. A listing of the major equipment and materials, including their electrical characteristics and the manufacturer's description, unless these are detailed on the drawings.
   i. The location and arrangement of metering, indication and control panels. See Section 9. Number 7. for SCADA requirements and details.
   j. The substation grounding plans, details and calculations.
   k. System protection relay and instrumentation single-line diagram.
3. PSE&G's review of the above final plans and drawings is for general arrangement acceptance and to ensure conformity with PSE&G's technical requirements only, and does not indicate safe or faultless design. By review of the final plans or drawings, PSE&G is indicating that the design is compatible with PSE&G's equipment and service. Responsibility for proper design, operation, maintenance and safety of the customer's installation rests solely with the customer. In addition, all work and equipment must conform to municipal and all other applicable codes and requirements, including applicable provisions of the *National Electrical Code* (**NEC**) and the *National Electrical Safety Code* (**NESC**) in effect at the time of construction.

   Note

   PSE&G will not be liable for damages or for injuries sustained by customers or by the equipment of customers or by reason of the condition or character of customer's facilities or the equipment of others on customer's premises. PSE&G will not be liable for the use, care, or handling of the electric service delivered to the customer after same passes beyond the point at which PSE&G's service facilities connect to the customer's facilities.

4. Final acceptance by PSE&G before introducing service to the completed installation is dependent upon the customer obtaining approval from the electrical inspection authorities having jurisdiction, and provision by such inspection authority to the local Electric Distribution Division Wiring Inspection Department of an original cut-in card.

5. Unless otherwise specified, PSE&G requires a minimum of 3 weeks after notification of completion of the customer's work and its walk through or inspection of the customer's installation, to test and set relays, breakers, meters and/or other associated equipment, including developing final cut-over procedures or other documents or procedures required for the customer. Further, any corrective items noted by PSE&G during the final walk through or inspection of the customer's site must be completed prior to PSE&G beginning its final commissioning work noted above.

4. Frequency and Voltage Regulation

The following are general voltage and frequency conditions on PSE&G's system that the customer should consider in its substation design:

1. The frequency of PSE&G's system is normally regulated at 60 Hz (cycles per second) and under usual conditions the variations are limited to 0.1 cycle above or below 60 Hz.
2. The voltage of PSE&G's 26.4 kV system under normal conditions will be within a range of 105% to 98% of nominal voltage with a maximum variation of 6%. Under emergency conditions the voltage can be within a range of 105% to 95% of nominal voltage with a maximum variation of 8%. If this regulation is not satisfactory for the operation of the customer's plant, it is the customer's responsibility to install suitable voltage regulation equipment. It should be noted, that during fault conditions, short term voltage fluctuations may occur on PSE&G system which could result in abnormally low voltage and/or unbalanced voltages. In addition, operation of certain types of customer's utilization equipment will adversely affect the power quality of the supply voltage. If the customer has installed critical computer or electronic equipment requiring continuity of service or exceptional service quality, it is the customer's responsibility to install any necessary uninterruptible power supply and/or a power conditioning device that may be required for this application. All aspects of the Metal Clad/Metal-Enclosed Switchgear associated with Customer Owned Substations shall conform with the latest versions of ANSI / IEEE Standards C37.20.3, C37.20.4and C37.20.2
3. It is also recommended that time-delay protective devices be installed on important motors and other critical equipment. This will permit the customer to avoid unnecessary outages during faults or surges on PSE&G's system or from the customer's in-plant facilities.

5. Short Circuit Duty

The maximum available three-phase short circuit current on PSE&G's 26.4 kV system is 31.5 kA (Short Time Symmetrical 2 Seconds) / 50 kA (Momentary 10 Cycle Asymmetrical) / 80 kA (Peak). The construction of PSE&G's 26.4 kV system is dynamic and subject to change as required for the safe, adequate and reliable operation of the system. PSE&G requires that the customer design its substation for the maximum short circuit current available.

6. Circuit Breakers

The following are general requirements for circuit breakers:

1. All circuit breakers on the high-voltage side of the customer's transformers shall meet the most recent edition of ANSI Standard C-37 for 38 kV maximum rated voltage equipment. Line circuit breakers shall have a minimum of 1,200 A continuous current rating. Bus tie breakers may require higher current ratings depending on the substation configuration.
2. PSE&G requires all circuit breakers on the high-voltage side of the customer's transformers have a minimum short circuit interrupting duty of 31.5 kA (Short Time Symmetrical 2 Seconds) / 50 kA (Momentary 10 Cycle Asymmetrical) / 80 kA (Peak). The line side of the service entrance or transformer circuit breaker shall be provided with a bushing-type, five tap multi-ratio ANSI standard current transformer in each terminal. The current transformer shall be relaying accuracy class of C-400 or better on full tap, and its current rating shall be compatible to the continuous current rating of the breaker.
3. Applications that utilize fixed circuit breakers shall employ key interlocked isolation disconnect switches. The disconnects shall be interlocked so that they can only be opened if the circuit breaker is open/ripped.

7. Fuses

PSE&G's preference is for the use of circuit breakers, but in some cases fuses may be utilized on the high-voltage side of the customer's transformers in lieu of transformer primary circuit breakers. This is only allowable for transformers of up to 10 MVA rating. If fuses are used, the fuses shall be insulated at 38 kV, 150 kV BIL. The fuses shall be able to interrupt short circuits at voltages up to 29.0 kV and withstand voltages up to 38 kV after clearing the fault, voltage rating shall be 38 kV. The fuses shall meet the following requirements:

1. The fuses must be able to coordinate with PSE&G's source line(s) relaying and with the transformer secondary fuse, breaker or recloser. If the primary fuse is of the expulsion type, the minimum melting time shall be corrected for "preloading". The selection time between primary and secondary protection for a customer's transformers shall be a minimum of 0.5 seconds.
2. The fuses shall have an interrupting capacity equal to, or greater than, the maximum asymmetrical short circuit current available on the system, 50 KA.

   Note

   Only two known types of fuses are currently available for use on the PSE&G 26 kV System in Metal-Enclosed Switchgear. The 38 kV insulated S&C "Fault Fiter" (Electronic Fuse) has a max voltage rating of 29.0 kV and a continuous current rating of up to 1,200 A. The Cooper NX rated at 38 kV has a max continuous current rating of up to 100 A.

   S&C SM 5 and Cutler Hammer BA fuses have max short circuit clearing capabilities of less than 17 kA asymmetrical and are not acceptable.
3. The current rating of the fuse shall be greater than or equal to the transformer manufacturer's nominal nameplate full load emergency rating. The customer shall submit its proposed fuse type to PSE&G's System Protection Department for approval prior to energization of the substation.
4. The fuses shall meet the most recent requirements of IEEE Standards C37.46 and C37.48.

8. Battery

A storage battery, or other reliable direct current source, shall be provided to supply DC voltage for automatic tripping of the circuit breaker(s). The latest editions of IEEE Standards 484 and 485 provide guidance in calculating the appropriate battery size and for installation design and procedures. IEEE Std. C37.06 - 2009, Table 18 provides the control voltage range required at the circuit breaker(s).

The battery shall be equipped with an automatic charger, a voltmeter and a low voltage alarm. The low voltage alarm shall be either an audible alarm that will attract a response and a remote alarm to a manned location. Likewise, if another DC source is utilized, it shall be alarmed to indicate loss of voltage.

The battery shall be sized for minimum of an 8-hour discharge rate.

9. Relays and SCADA Interface

The following are general requirements for relaying and SCADA equipment:

1. Specific PSE&G requirements will be provided for relays and their associated equipment, as required for the operation of circuit breakers and/or motor-operated disconnecting switches. For the convenience of those customers who plan that their substations will utilize Automatic Sectionalizing or Transfer Schemes, sample relay and control diagrams have been included Section 25. “Standard Layouts” (Figure 5.1 - Figure 5.4). Some other typical substation configurations are shown in Figure 5.6 - Figure 5.11. Additionally, a list of recommended relays that may be used by the customer is included in Table 5-1. In the event that the customer chooses to use alternative relays, these relays must be approved by PSE&G, and the customer will be responsible for applying the relay settings provided by PSE&G using an approved third party testing company at the customer’s expense. Written relay test results must be provided to PSE&G for the initial installation, and every 4 years thereafter, when the settings are verified by an approved testing company.
2. All protective relays shall have provisions for isolating the relays for testing or replacement purposes while the equipment is in service. Relay isolation shall be accomplished by using switches such as the ABB FT-1. Test switches in AC current circuits shall be equipped with test jacks for test connections.
3. The current and potential transformers supplying the relays shall not be used for any other purpose.
   a. All Current Transformers (**CTs**) for relay protection shall adhere to ANSI/IEEE Standard MRCT, C400 class or better.
   b. 26 kV breakers shall be equipped with two sets of three-phase CTs on both sides to provide overlapping zones of protection for incoming PSE&G lines, and the customer’s 26 kV bus and 26 kV transformers, unless it is not possible to fit in two sets due to space limitations, in which case the relay and CT arrangement and accuracy class must be submitted to PSE&G for approval of the configuration.
   c. Each incoming 26 kV line shall be provided with three line-side single phase Voltage Transformers (**VTs**), with a 27,600-115 V ratio (240/1), wye-connected on both the primary and secondary sides with secondary winding isolation switches. All VTs shall be of 34.5 kV Nominal System Voltage.
4. It is recommended that the customer consider the installation of differential relaying for the protection of large power transformers.

   If differential relaying is installed, the over current relays associated with each service entrance breaker shall be connected to the bushing-type current transformers on the source side of each service entrance breaker. If CTs are not available on the source side of the entrance breaker, load side CTs may be used.

5. To facilitate maintenance and eliminate the possibility of vibration damage / inadvertent operation, caution should be observed in the placement of relays for tripping high-voltage circuit breakers. If the protective devices being used are sensitive to vibration, consideration shall be given to not mounting relays in/on a compartment attached to the breaker but rather in/on a separate weatherproof enclosure or rack in the control house or control room.
6. Basic SCADA functionality should be considered for all customer subs. For small 26 kV customers a standard Mini SCADA box shall be used. The box has only dry contact inputs for indication enabled. Standard prints for this class and coded NEMA 4 Mini SCADA box are 311336, 311337, and 311338. This mini SCADA box is PSE&G class and coded with code W930001 and is usually kept in stock by PSE&G. Please contact PSE&G design group for standard prints to be used in designing point to point diagrams and review of proposed design. PSE&G Design should be contacted for direction and final review of the design.
    a. PSE&G shall designate, select, specify and purchase the equipment required for SCADA purposes. The applicant shall receive the devices from PSE&G and install the equipment at its facility. If necessary, PSE&G will install any other SCADA equipment required at its facilities, at the applicant's expense. The applicant shall pay PSE&G for all costs associated with SCADA equipment.
    b. PSE&G shall require approximately 48 in. x 48 in. of open wall space to install a mini SCADA RTU for monitoring of the station. The mini SCADA RTU dimension is approximately 30 in. H x 30 in. L x 12 in. D.
    c. The mini SCADA RTU shall be powered from 125 V DC station batteries as primary source.
    d. 120 V AC is required as a back-up source of power. This is also used for the heater and AC convenience outlet.
    e. This mini SCADA RTU takes up to 16 dry contact inputs and provides a wetting voltage to the field contact with the power supplied.
    f. A standard dial-up phone line, otherwise known as Plain Old Telephone Service (**POTS**) line and normally ordered and maintained by the customer, is to be terminated at the location of the mini SCADA RTU. The customer in agreement with the operating division shall define who orders and maintains the line.
    g. If a standard dial-up POTS line is not available from the telephone service provider, then a fiber optic or T1 connection shall be provided. The customer shall provide an uninterruptable power supply to the router or other interface device. The router or other interface device shall be powered in such a fashion, so that, if power to the facility goes down, the communications system shall be kept “live” for a minimum of at least 8 hours.
7. Recommended indications/alarms shall be as follows if available and should be wired in this order. If the specific alarm is not available, a spare input shall be left in its place. The points listed here are suggestions and of course every site will have slightly different points to be submitted and approved by the local operations and Relay groups. Specific text can be modified in the Master. As a rule of thumb, Station Alarm (as described elsewhere in the alarm bus portion of the spec.), Station Control handle in Auto, Breaker/motor operated disconnect indication, DC System trouble, Station L&P fail are the most basic. The customer must supply:
    a. Dry contact and wiring to the RTU cabinet for each available point.
    b. Common Station Alarm (If Available and Applicable)
    c. Station Control Handle (If Available and Applicable)

d. Fire Alarm (If Available and Applicable)
e. Station Battery System Trouble (If Available and Applicable)
f. Station Light and Power Fail
g. L1 Breaker Status (Any Line Breaker MOC “A” and TOC in Series)
h. Breaker Status (Any Line Breaker MOC “A” and TOC in Series)
i. SEC. 1-2 Breaker Status or Motor operated disconnects
j. Transfer Auto/Manual
k. SPARE
l. SPARE
m. SPARE
n. SPARE
o. SPARE
p. SPARE
q. SPARE

8. The presence of any type of generation running in parallel with the service may result in additional specific protection, SCADA, and ESOC RTU design requirements. The customer engineer is required to identify any generation and obtain direction and approval from PSE&G Design Group based on the specifics of planned installation.
9. Two copies of each relay instruction book for all line and bus relays shall be provided to PSE&G 2 months prior to the expected service date.
10. Note that some multifunction microprocessor relays may be used in lieu of the devices listed in the Acceptable Relay List attached to this document, with the prior approval of PSE&G’s System Protection Group.
11. When relays are required for the protection of a sub-transmission line or a transmission line, requirements covering that application are very specific and are based on the line configuration, etc. Those requirements are not in the scope of this document. The PSE&G System Protection Group in Newark must be contacted for specific recommendations. At that time, sample AC and DC schematics will be provided by PSE&G.
12. For other applications (i.e. bus differential protection discussed in number 4 above) the same System Protection Group in Newark must be contacted for specific relay recommendations.

10. Disconnecting / Load Interrupting Switches

The following are guidelines for Metal-Enclosed load interrupting disconnecting switches:

1. Guidelines for the application, installation, operation and maintenance of disconnecting switches are described in the latest editions of IEEE NESC C2-2012, Sections 173 and 216, as well as the latest editions of IEEE C37.20.4 and 37.22 2. All Metal-Enclosed Disconnect Switches shall be of 38 kV Class, 150 kV BIL and designed for operation at 34.5 kV unless otherwise noted.
2. The line disconnecting switches shall be three-pole gang-operated devices rated 1,200 A continuous with 1,200 A Minimum (56 MVA) load break capability if used for switching and be tested and capable of at least five full load interruptions at a minimum operating voltage of 29.0 kV. One three-pole, gang-operated line grounding switch shall be installed as a companion to each line disconnecting switch, and shall be mechanically interlocked in such a way that the line grounding switch cannot be closed when the line disconnecting switch is in the closed position, and the line disconnecting switch cannot be closed when the line grounding switch is in the closed position. The line disconnecting switches and the line grounding switches shall be so arranged that they can be padlocked in any position desired. The Ground Switch shall be of 38 kV Class, withstand 150 kV BIL in the open position and have a withstand rating of 31.5 kA (Short Time Symmetrical 2 Seconds) / 50 kA (Momentary 10 Cycle Asymmetrical) / 80 kA (Peak) and meet all applicable operational and test parameters for service in 34.5 kV systems.

   Note ANSI Standards do not require ground switches to have a fault close rating since proper operating practice requires the circuit be tested de-energized before closing the ground switch. It must have a momentary rating of 50 kA.

3. Line Disconnect Switches and Line Grounding Switches shall be housed in separate isolated cubicles whenever possible. Each switch shall be equipped with a mechanical position indicator, clearly visible from outside of the cubicle door. Line Disconnect Closed – Red, Line Disconnect Open – Green, Ground Open – Green, and Ground Closed – Red.
4. Disconnect switches shall have a Withstand / Fault Make – Latch rating of 31.5 kA (Short Time Symmetrical 2 Seconds) / 50 kA (Momentary 10 cycle Asymmetrical) / 80 kA (Peak).
5. Line disconnecting switches and any line breaker bus disconnecting switches or bus sectionalizing switches shall be rated 1,200 A Continuous. Bus sectionalizing switches may require higher current ratings, depending on the customer's substation configuration, with 1,200 A minimum (56 MVA) load break capability if used for switching and be tested and capable of at least 5 full load interruptions at an operating voltage of 29.0 kV minimum
6. Where a circuit breaker is not used as the primary side disconnecting means for a main power transformer, then the primary side disconnecting switch shall be capable of interrupting the magnetizing current of the transformer and be rated at least 600 A load break capability and be tested and capable of at least five full load interruptions at an operating voltage of 29.0 kV minimum.
7. Any disconnecting switch mounted vertically shall be hinged at the bottom to prevent accidental closing.
8. Any disconnect switches installed shall be oriented for front access, with the phases arranged 1-2-3 left-to-right, and not oriented as an end unit in a front-to-back configuration.
9. The incoming line compartment (cubicle with ground switch and arrestors) shall be designed to easily handle the pulling and termination of two 750 kcmil EPR type cables per phase.

10. Based on minimum spacing requirements outlined in Section 12. Number 5. and Figure 5.17, this incoming cable compartment shall be designed to be at least 60 in. wide and have a pad lockable hinged door to permit incoming cable access without unbolting and metal clad panels, only to PSE&G personnel.
11. Each incoming line compartment shall be equipped with a “View Port” that shall permit an operator to perform infrared scans and to visually determine the position of both disconnect devices without opening the cubicle door. The “View Port” shall be an engineered product that shall be UV, flash resistant and shatter proof. Fluke Series CLK or approved equal.
12. The incoming line compartment (cubicle with ground switch and arrestors) shall have sufficient clearance to safely permit the testing of the incoming line with a “Test Stick”.
13. The incoming line compartment (cubicle with ground switch and arrestors) shall also be equipped with three “Neon Glow Tubes” connected on the incoming line that shall be visible through the “View Ports” to give an indication of an energized line. “Neon Glow Tubes” shall be designed to permit easy replacement.

11. Revenue Metering Equipment

The following information pertains to revenue metering equipment:

1. PSE&G will furnish two VTs and two CTs for revenue metering, the secondary control cable and test switches for each metering point.
2. PSE&G will not permit the connection of any customer equipment to the metering transformers used for revenue metering. No device other than those used for automatic tripping, or those supplied or required by PSE&G, shall be placed on the line side of the billing meters. The revenue metering transformers shall be installed after main breaker(s) or disconnect(s). In stations with multiple incoming lines, the metering transformers shall be on the load side of the common bus.
    a. The customer shall install instrument transformers, wire the high-voltage side and the equipment ground connection. The instrument transformer equipment ground shall be 4/0 AWG minimum, copper wire or equivalent.
    b. The primary connections shall be made so that the VTs are connected on the line side of the CTs. These connections shall be direct and shall not be fused. 250 kcmil is the maximum size wire that can be terminated on the VTs, #2 AWG is the minimum size that may be used.
    c. The connections to the primary terminals of the CTs shall be designed so that either ABB KOR-20 or GE JKW-7 CTs may be bolted to the bus. (These CTs have different heights from the base plate to the primary terminal connection with the bus.). For details of current transformers see Figure 5.15 - Figure 5.16. CT primary terminals shall not be considered to be bus supports. The bus shall be designed to be properly supported and braced without the need for the CTs to be mounted in place. Polarity markings on CTs shall normally be on the line/utility side of the switchgear. Hardware which may be needed for the installation of alternative CTs shall be stored inside the instrument transformer compartment, preferably not in contact with the concrete pad.
    d. The mounting arrangement for the Potential transformers (**PTs**) shall be designed for GE JVW-7 PTs. For details of potential transformer see Figure 5.17.
    e. Connections to metering transformer secondary terminals, test switches, meter equipment and meters will be made by PSE&G.

3. VTs and CTs for metering shall be accessible at all reasonable times for the purpose of inspection, maintenance or change-out by PSE&G. If the VTs and CTs are enclosed in switchgear or a transformer cabinet, or compartment where visual inspection is impractical, access shall be limited only to PSE&G's personnel by a hinged door having provisions for PSE&G's pad-locks, or barrel locks and seals. Metering transformers, secondary wiring and unmetered primary conductors shall be visible for inspection when the compartments or cabinets are opened and energized.
4. Threaded rigid galvanized steel 2 in. conduit shall be used for the secondary control cable/wires from the switchgear cubical for metering transformers to the meter panel, and shall be supplied and installed by the customer.
    a. Conduits for metering transformers secondary connections shall be dedicated conduit that shall not pass through either trenches, hand holes or manholes. Metering conduits shall be inspected prior to backfill or pouring concrete.
    b. PSE&G shall furnish the secondary control cables/wires, and the customer shall pull them.
5. A meter panel with minimum dimensions of 36 in. wide x 36 in. high is to be supplied by the customer and installed at a height of no less than 24 in. and no more than 78 in. from the floor. However, if two sets or more of instrument transformers are used, this meter panel shall be 4 ft x 6 ft. Please discuss the meter panel layout with PSE&G's local Electric Distribution Division Metering Department. This panel shall be located adjacent to the metering transformers, but in no case shall the length of the secondary leads from the metering transformers to the revenue meters exceed 180 ft.
    a. The station ground shall be extended to the meter enclosure for grounding of the metering circuits and equipment.
    b. The meter panel and associated equipment shall be housed in a building or in a weatherproof, heated enclosure. A metering and control house for the metering equipment, relays, control equipment, telephone and storage battery is recommended. A door for entrance to this structure shall be equipped to take PSE&G's standard padlock, and access may be from outside the substation enclosure.
    c. Painted 3/4 in. thick plywood is recommended for the meter panel with a 1 in. air gap shall be provided behind the wood to enhance dryness. Alternative materials may be used for the meter panel with advanced PSE&G approval.
    d. Lighting must be available at indoor metering locations for meter readings and inspections.
    e. If the customer elects to house the meter panel in a heated outdoor metal enclosure, such structure requires specific PSE&G approval as to the size, layout and mounting location of the enclosure. A 120 V duplex outlet shall be provided on the meter panel.
    f. Drilling dimensions for the meter enclosure will be supplied by PSE&G's local Electric Distribution Division Metering Department personnel, as will specific details as to the type and size of metering transformers that will be furnished by PSE&G. Refer to figures at the back of this chapter for typical examples:
        - Figure 5.11 – Meter Panel for one set of metering instrument transformers
        - Figure 5.15 – Indoor Meter Panel for two sets of instrument transformers
        - Figure 5.16 – Outdoor Meter Panel for two sets of instrument transformers

g. PSE&G shall provide the revenue meter socket(s), relay enclosures, and any enclosures required for test switches. The customer shall mount this equipment on the meter panel, and provide the connecting conduits. PSE&G will connect the wiring to the test switches, meters and other associated equipment on the meter panel.

h. The customer shall provide a conduit of necessary size from the communication demarcation location to the meter panel. The customer shall install the communication circuits in the conduit. In case of phone cable used, one pair of wires shall be installed for each set of metering transformers, and Cat 5 cable shall be provided from the demarcation to the meter panel.

12. Insulators, Conductors, Clearances and Connections

The following are general requirements for insulators, conductors, clearances and connections:

1. Specific detail requirements for bus supports, insulators and clearances are described in the latest editions of IEEE Standards C37.20.2, C37.20.3, and ANSI/NEMA C29.8 and C29.9.
2. All 26 kV bus shall consist of rigid bus construction, and such bus and flexible connections shall be in accordance with the guidelines of the latest edition of ANSI/IEEE Standard 605.
3. All bus construction and clearances for energized parts must be certified and tested to meet 150 kV BIL at a minimum. In general, insulated bus is preferred.
4. Bus construction shall have 1,200 A capacity in the line positions and at least that much for the main bus in between depending on the customer's substation configuration, such as when it is designed to be a "flow-through" station.
5. The following clearances must be maintained for cable attachment points in the incoming cable compartments and the revenue instrument transformer compartment:

   a. Phase-to-Phase – 12 in. to 12-1/2 in. edge to edge.

   b. Phase-to-Ground – 10 in. to 12 in. edge to cubicle wall.

   Spacing must be rated for 150 kV BIL, at a minimum. The cable landing bus shall be 3 in. to 4 in. wide. Minimum Incoming Cable Cubicle width shall be 60 in. minimum. Also see Figure 5.16.
6. At locations where incoming overhead lines are to be terminated on the customer's structure, the customer shall have structural members drilled as shown on Figure 5.18.
7. For underground connections, see Figure 5.16.

13. Transformers

Transformers shall comply with the general requirements and installation guidelines of ANSI C57.

Transformers shall be Delta connected on the 26.4 kV side.

14. Surge Arresters

PSE&G recommends the installation of surge arresters. If surge arresters are to be installed, they shall meet the following requirements:

1. Surge Arresters shall be installed in accordance with the guidelines and standards of the latest edition of ANSI C62.
2. Single-phase, station class, Metal Oxide Varistor (**MOV**) type surge arresters shall be installed on the 26.4 kV side of each transformer and shall be readily disconnected for maintenance. The arresters for transformers of 34.5 kV class shall be rated at 36 kV and be designed for use on a resistance grounded system operating at a nominal maximum of 27.7 kV. Where dead front small transformers are used, dead front 36 kV class distribution class arresters may be used.
3. Single-phase MOV type surge arrester protection shall be installed on the line side of each line disconnecting switch. The arrestors shall be 36 kV station class arresters, and shall be readily capable of being disconnected for cable fault location purposes.

15. Grounding

The following are general requirements for grounding:

1. Specific detail requirements for grounding are described in the latest editions of the NEC, NESC and IEEE Guides 80 and 81. The station ground resistance shall be measured in accordance with Section 8 of IEEE Std.81-2012 “IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of the Grounding System” and Section 19.1 of IEEE Std. 80-2000 “IEEE Guide for Safety in AC Substation Grounding”. These guides provide procedures for measuring the earth resistivity, the resistance of the installed grounding system and the continuity of the grid conductors.
2. PSE&G will supply the following values:
   - Maximum ground fault current
   - Maximum fault clearing time
   - Split Factor, S_F
   - X/R Ratio
3. The Customer shall supply PSE&G with the following information:
   - Plans and details of the substation that indicate conductor size and typical grounding grid design
   - Calculations as described in IEEE Guide 80-2000, with special attention paid to step and touch potentials.

16. Location and Structural Arrangement

The following are general requirements for substation layouts:

1. At any location where the following actions may be performed there shall be adequate, safe space available for:
   - Inspection
   - Maintenance

- Routine removal or replacement of components
- Routine removal or replacement of power or control cable

2. The customer's substation site should be selected to provide adequate clearances from existing and future buildings. The clearance between energized equipment and other structures shall meet or exceed the latest requirements of NESC, NEC, and IEEE STD 1427.
3. In outdoor part of substation there should not be any building located within 15 ft of energized equipment (except the control house). Where necessary, a parapet guard shall be considered for installation along the building roof adjacent to the substation for safety of personnel.
4. The substation site shall be enclosed by a fence at least 7 ft high, (6 ft fence with 1 ft of barbed wire) as described in Section 110A of IEEE NESC C2-2012. Fences and gates shall be equipped with "Danger High Voltage" signs as required by the NEC and NESC.
5. Substation design should meet requirements of IEEE Std. 979-2014 "IEEE Guide for Substation Fire Protection" or National Fire Protection Association (**NFPA**) 850, 2015 Edition including as a minimum:
   a. Construction of oil spill containments for transformers filled with a mineral oil
   b. Separation of mineral oil containing transformers from each other and substation buildings by distances listed in Table 1 of IEEE Std. 979-2014 or Table 5.1.4.3 of NFPA 850, 2015 Edition. If these distances cannot be achieved, 2 h rated firewalls should be constructed designed in accordance with the above-mentioned standard.
6. Substation should have an adequate lightning protection in accordance with the latest revision of IEEE Std. 998 "Guide for Direct Lightning Stroke Shielding of Substations"
7. The switchgear shall be accessible to qualified personnel only. Any gate or doors must be provided with a means to allow independent access to PSE&G personnel.
8. For personnel safety, lighting shall be provided for walkways and operating areas as per NESC Section 111.
9. A telephone shall be provided in the area for the purpose of switching.

17. More Than One Source

Where the customer's load can be supplied from more than one source, such as the customer's own generation or a duplicate service from PSE&G, the entrance switchgear shall be provided by the customer with a sign stating "Caution – Multiple Power Sources".

Additional requirements may be specified by PSE&G depending upon the customer's equipment and/or arrangement.

18. Mimic Bus

A Mimic Bus or schematic representation, illustrating the arrangement of the devices and apparatus contained in the cubicles comprising the switchgear, shall be displayed on the front panels of the switchgear.

19. Operating Procedures

The following are standard operating procedures for the substation:

1. To provide for security of PSE&G's system and for the safety of PSE&G's and the customer's personnel, PSE&G requires operational control of the following devices at the customer's substation:
   - 26.4 kV line disconnecting switches
   - Line grounding switches
   - Line circuit breakers and their bus disconnecting switches
   - 26.4 kV bus sectionalizing switches and breaker(s), if provided

   A representative of PSE&G's local Electric Distribution Division office will operate these devices as directed by that Division's Service Dispatcher.
2. An authorized attendant of the customer may operate the 26.4 kV service entrance breaker(s), the breaker isolating switches and all equipment on the load side of the service entrance breaker(s) as desired. The customer's authorized attendant is never to operate the devices listed above in number 1.
3. In the event of an interruption to service, PSE&G will restore service as soon as possible without notification.
4. Specific operating instructions shall be provided to the customer prior to energization.

20. Other Requirements

"Danger High Voltage" signs shall be installed in accordance with applicable requirements of the NEC and the NESC in effect at the time of construction.

Approved "Lamicoid" (Engraved Laminated Plastic) tags shall be furnished by the customer on all switchgear compartments and panel-mounted components, and all circuit breakers, transformers and disconnect switches. Tag names shall be identical to the terminology used in the customer's drawings, or as specified by PSE&G at interface points. All tags shall be attached with either stainless steel pins or stainless steel machine screws.

21. Customer Responsibilities for Testing and Commissioning

Normal protocol would expect the following when installing and commissioning customer switchgear. This work is the responsibility of the Customer and is normally performed by the site Electrical Contractor and a Testing Contractor. Testing and commissioning must be performed by a certified National Electrical Testing Association (**NETA**) company.

1. Customer shall perform the following:
   a. Physical assembly of all shipping sections.
   b. Verify the weather tightness of the completed assembly.
   c. Tightening and torquing of all bolted electrical connections.
   d. Tie-in of all prefabricated wiring.
   e. Install and verify all external wiring.
   f. Complete testing of all protection and control circuits using the AC/DC schematics.

g. Hi-pot, Doble and Ductor testing of all circuit breakers.
h. Timing test for service entrance and bus tie circuit breakers.
i. Hi-pot and Doble testing of all bus work including arrestors. Ductoring of bus work is also recommended.
j. Operational verification of each circuit breaker – electrical, mechanical, safety interlocks.
k. Operational verification of each line disconnect and ground switch and keyed interlocks.
l. Operational verification of drawout fuse holders.
m. Ratio verification of potential devices.
n. "Megger" and ratio tests of all current transformers.
o. Set the ratio of all CTs as per protection requirements – Line Protection CTs shall be set by PSE&G.
p. Short all unused CTs and winding taps as necessary.
q. Calibration of all instruments.
r. Verify and adjust battery chargers as required – verify set points of all battery related alarms.
s. Verification and testing of all alarms to the annunciator.
t. Verify accuracy of Mimic Bus against the One Line.
u. Install and verify operation of telephone circuits for SCADA and metering.
v. Verify correct taps for transformers. Perform all necessary transformer tests before energizing (TTR, Doble, hi-pot, cooling system as required).

2. PSE&G shall:
   a. For service entrance and bus tie circuit breakers, perform operational checks and review results of ductor and timing tests performed by the Customer.
   b. Set line relays (bus differentials and breaker failure if used), verify associated instrumentation and perform operational / trip checks of service entry and bus tie breakers.
   c. Set and test the required ratio of CTs associated with the line relays.
   d. Verify operation of line disconnects, line grounds and keyed interlocks.
   e. Install and verify metering and SCADA equipment.

22. Construction in Flood Prone Areas

As part of the customer facility design process, the customer or customers engineer shall determine if the customer site is prone to flooding by reviewing the latest Federal Emergency Management Agency (**FEMA**) and New Jersey Department of Environmental Protection (**NJDEP**) Flood Maps. If flooding is a possibility, station equipment that may be impacted by flood waters shall be installed at least 1ft above the highest available design flood elevation as determined by:

1. FEMA 100-year Base Flood Elevation (**BFE**)
2. NJDEP Flood Hazard Area Limit (**FHAL**)

This will apply to but not limited to metal clad switchgear, circuit breakers, operating mechanisms for disconnects, transformers, batteries, relays, terminal blocks (especially those carry DC current) and other vulnerable electronic devices.

23. Animal Deterrent

It is required to mitigate interruptions and equipment damage resulting from animal intrusion into electric power supply substation by using the means of animal deterrent recommended by the latest IEEE Guide 1264.

24. Arc Flash Hazard Calculation Studies

It is required to performed Arc Flash Hazard Calculation Study in accordance with latest IEEE STD 1584 and NFPA 70E and reviewed by PSE&G.

The arc-flash study report should include the following information as a minimum:

1. Executive summary.
2. Narrative describing the scope and results of the study and the methodology used.
3. Description of modes of operation (power system) and details of the scenarios evaluated.
4. Results of short-circuit analysis listing equipment that is applied above its short-circuit current rating, and recommendations if appropriate.
5. Results and recommendations of time-current analysis, including time-current curves.
6. Arc-flash spreadsheet: A tabulated form including a listing of all equipment that had arc-flash hazard values calculated as part of the study. This listing should include the calculated three-phase bolted fault current, arcing fault current, identity of overcurrent protection device with its opening time, working distance, arc-flash protection boundary, and incident energy.
7. A tabulated form showing the worst case incident energy calculated for each bus and the associated mode of power system operation. Report may include incident energy calculated for each bus for each mode of operation.

Note This may be part of the arc-flash spreadsheet.

8. Documentation of all study input data, including utility available fault currents; cable sizes, types, and lengths; motor data; breaker types and settings; fuse sizes and types; etc.
9. Up-to-date single-line diagram(s).
10. Documentation of the software manufacturer, exact version of software used, and configuration settings used to do the study.
11. List of assumptions that were made for cable lengths, CT ratios, transformer impedances, etc.
12. Additional information may be included where it enhances understanding of the electrical system and arc-flash study.
13. Advisory statements covering the impact of changes to the power system, including overcurrent protective devices or system operation and potential impact on arc-flash incident energies.

25. Standard Layouts

Transfer and Sectionalizing Scheme Controls for Figure 5.1, Figure 5.2, Figure 5.3 and Figure 5.4.

1. For both Transfer and Sectionalizing Schemes, two selector switches should be provided to choose:
   a. Type of Scheme
      i. Sectionalizing
      ii. Line 1 Preferred
      iii. Line 2 Preferred
   b. Control Switch
      i. Automatic
      ii. Manual
2. Selectable time, delayed over a range of 0-30 seconds.
3. Transfer Scheme description:
   a. Preferred line loses potential
   b. *Time-delay times out
   c. Preferred motor operated disconnect (or breaker) opens
   d. Alternate motor operated disconnect (or breaker) closes
   e. Station restored
   f. To restore station to normal, switching must be done manually
4. Sectionalizing Scheme Description:
   a. Loss of line potential
   b. *Time-delay times out
   c. Both L1 and L2 motor operated disconnects (or breakers) open
   d. Return of potential on either L1 or L2 will result in the motor operated disconnect closing into the line with potential on it
   e. Station restored
   f. To restore station to normal, switching must be done manually

Note

* Time delay is necessary to coordinate with line reclosing.

Figure 5.1: Sectionalizing Scheme with Breakers

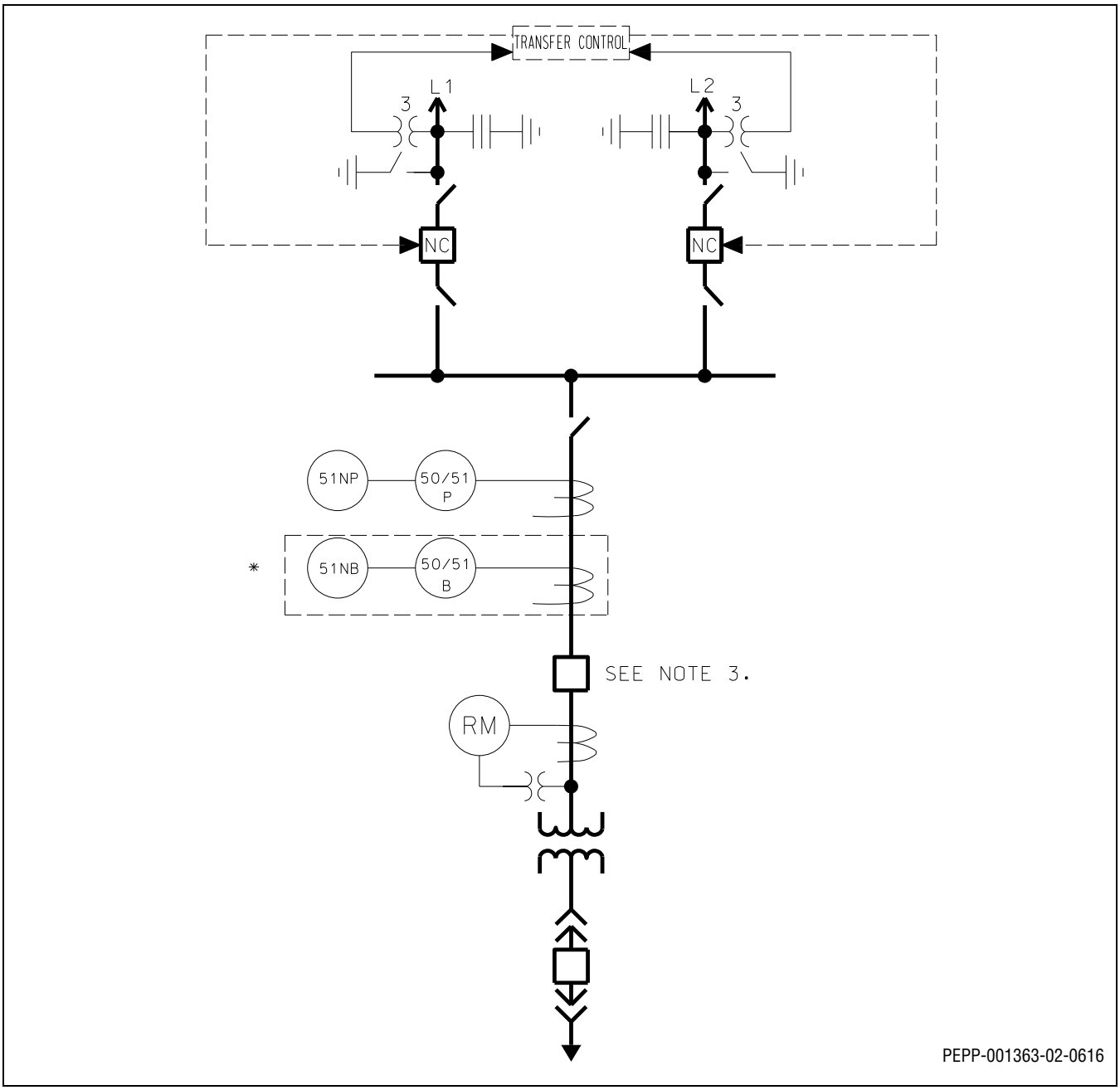


Figure 5.1 Notes*:

If Electromechanical relays are used, one set of relays is required.

If Microprocessor relays are used, customer choice to either:

1. Use just 50/51P, 51NP and relay must trip breaker on relay failure.
2. Use both 50/51P, 51NP and 50/51B, 51NB and single relay failure does not have to trip breaker.
3. Fuse protection in lieu of breakers is only allowable for transformers with a maximum rating of 10 MVA or less.

Figure 5.2: Sectionalizing Scheme with Motor Operated Load Break Type Disconnects

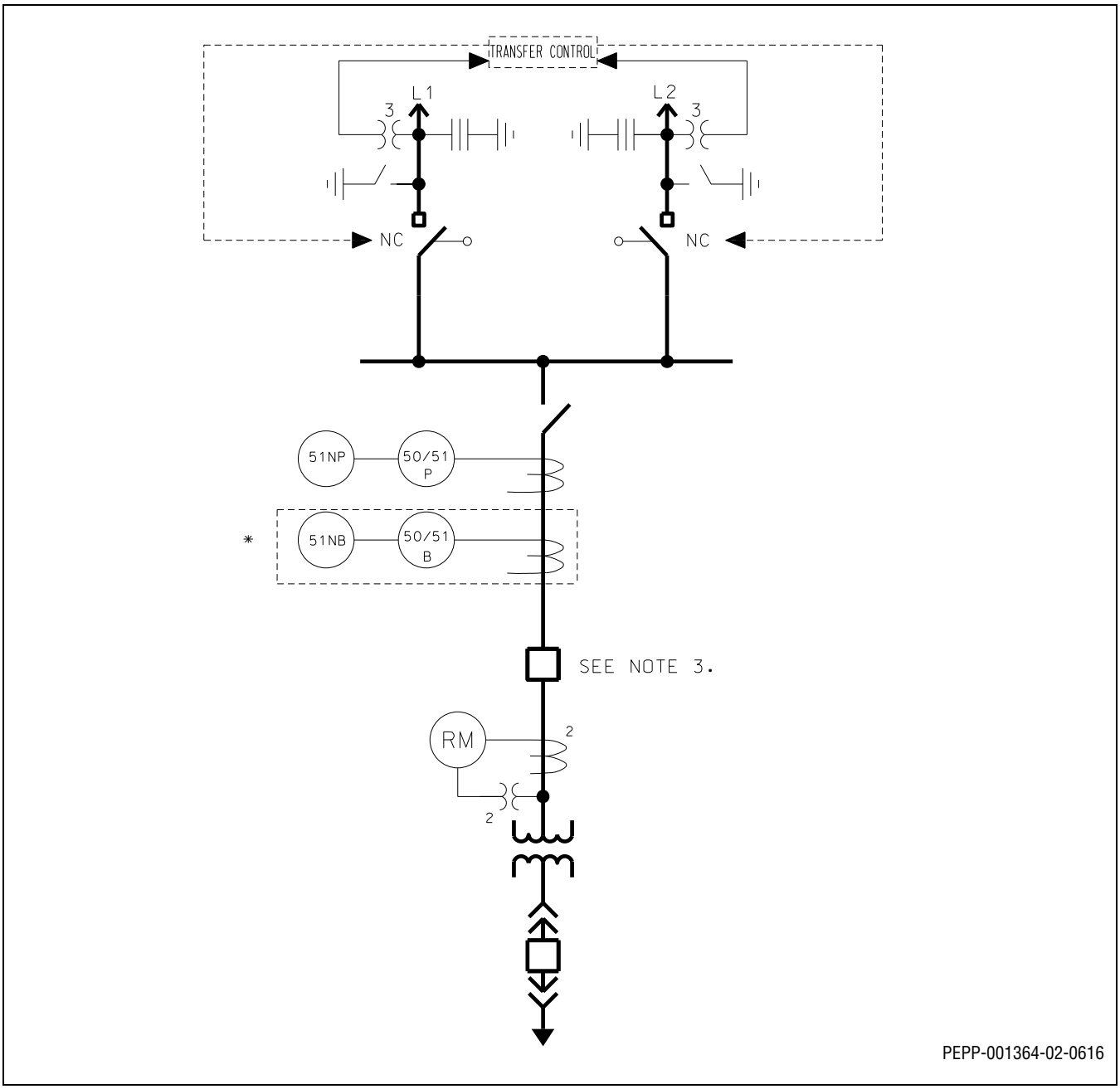


Figure 5.2 Notes*:

If Electro-mechanical relays are used, one set of relays is required.

If Microprocessor relays are used, customer choice to either:

1. Use just 50/51P, 51NP and relay must trip breaker on relay failure.
2. Use both 50/51P, 51NP and 50/51B, 51NB and single relay failure does not have to trip breaker.
3. Fuse protection in lieu of breakers is only allowable for transformers with a maximum rating of 10 MVA or less.

Figure 5.3: Transfer Scheme with Breakers – Transformer >10 MVA

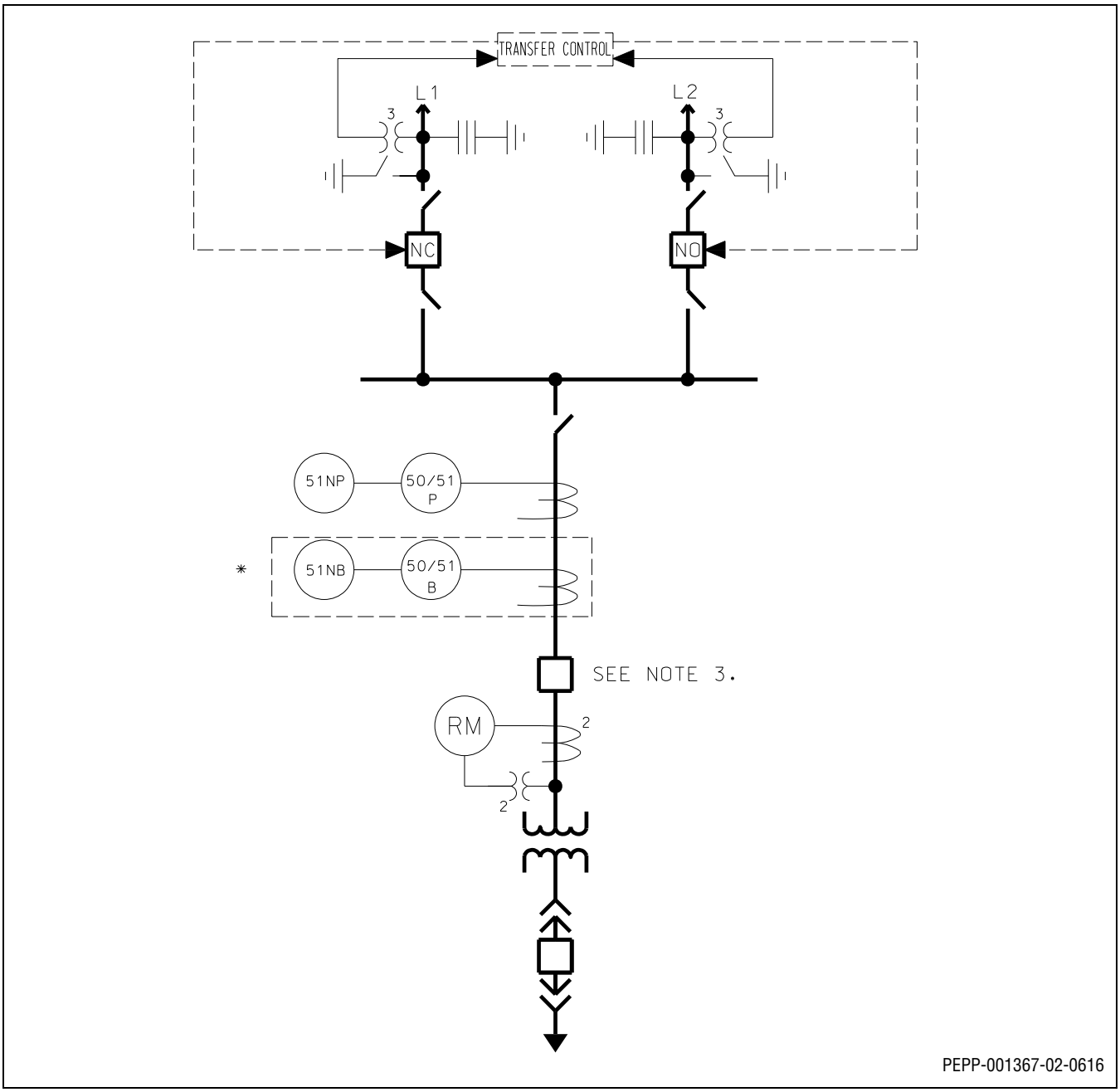


Figure 5.3 Notes*:

If Electromechanical relays are used, one set of relays is required.

If Microprocessor relays are used, customer choice to either:

1. Use just 50/51P, 51NP and relay must trip breaker on relay failure.
2. Use both 50/51P, 51NP and 50/51B, 51NB and single relay failure does not have to trip breaker.
3. Fuse protection in lieu of breakers is only allowable for transformers with a maximum rating of 10 MVA or less.

Figure 5.4: Transfer Scheme with Motor Operated Disconnects – Transformer >10 MVA

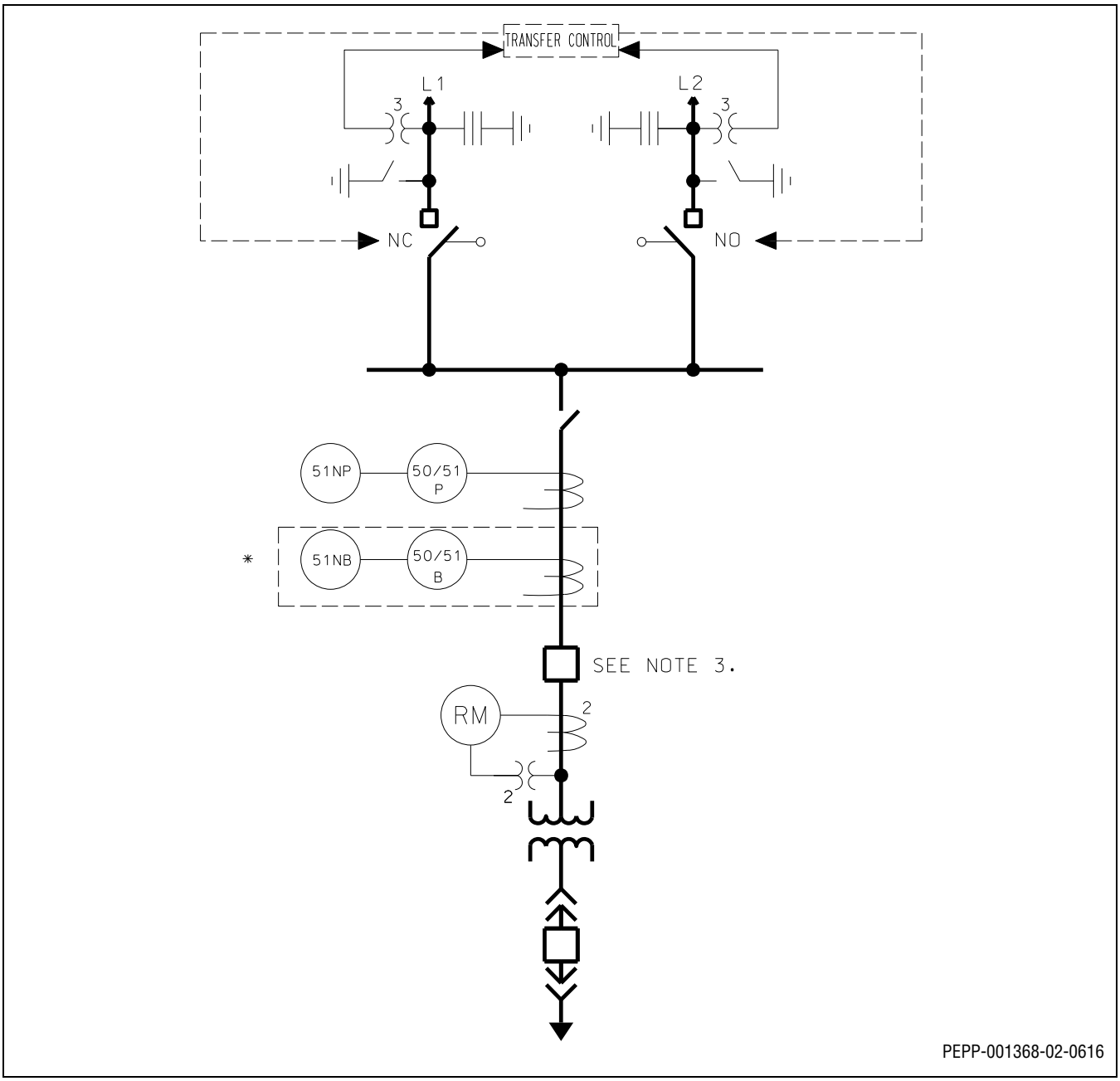


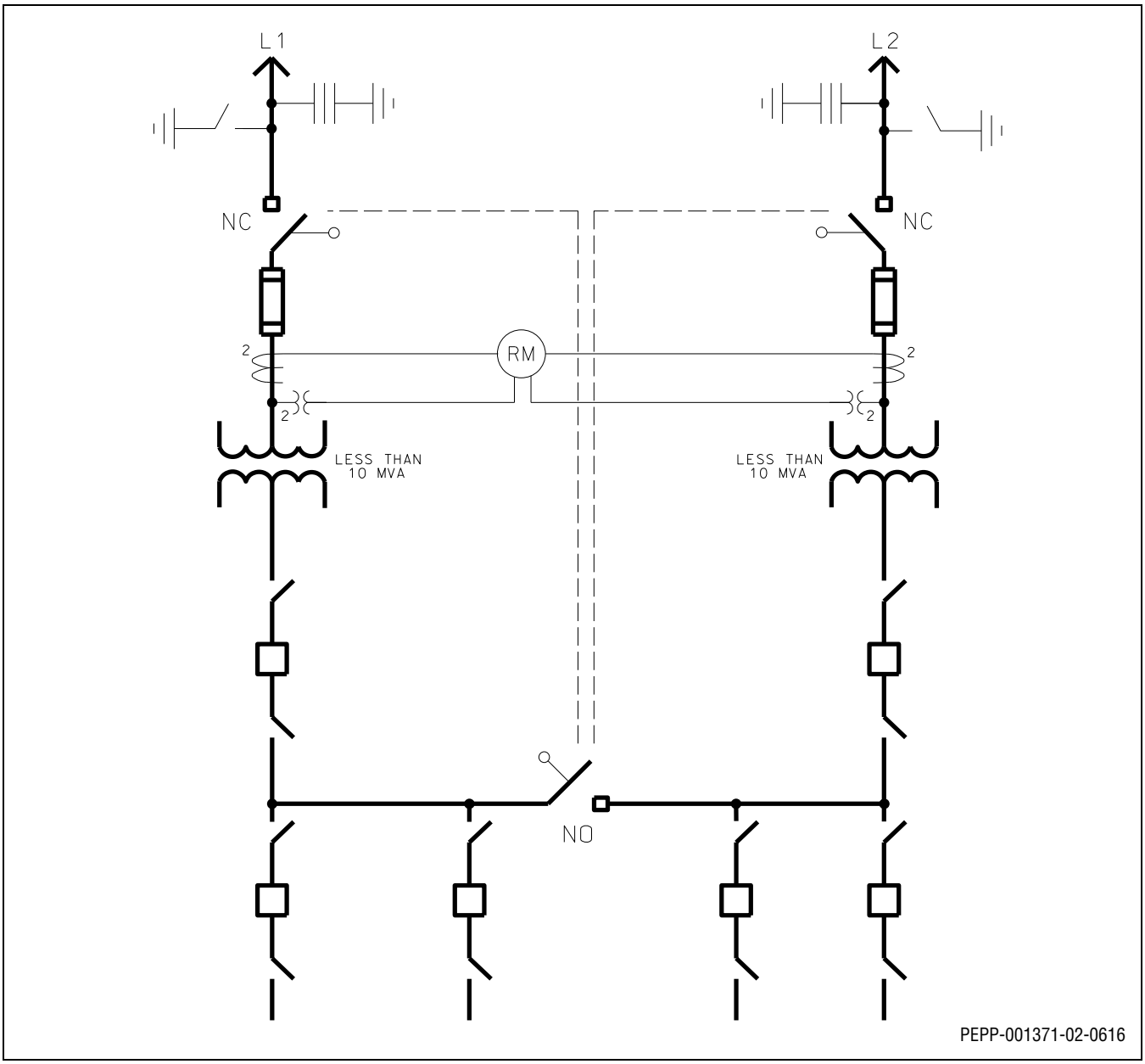
Figure 5.4 Notes*:

If Electromechanical relays are used, one set of relays is required.

If Microprocessor relays are used, customer choice to either:

1. Use just 50/51P, 51NP and relay must trip breaker on relay failure.
2. Use both 50/51P, 51NP and 50/51B, 51NB and single relay failure does not have to trip breaker.
3. Fuse protection in lieu of breakers is only allowable for transformers with a maximum rating of 10 MVA or less.

Figure 5.5: Dual Supply, Low Side Transfer with Motor Operated Load Break Type Disconnects – Transformers < 10 MVA



Protection Description for Figure 5.6

The two supplies are generally sourced from separate lines and, in some cases, these lines may even originate from different switching stations. Closure of the normally-open tie-disconnect may result in excessive circulating currents through the transformers and supply lines, if the line disconnects are also closed. This looped condition must be minimized and only used when transferring feeder loads to alternate transformers.

When transferring from a de-energized supply line, the respective line disconnect must be opened before the tie-disconnect switch is closed into the live section.

All disconnects shall be load break type.

Figure 5.6: Dual Supply – Dual Transformers with Line Breakers

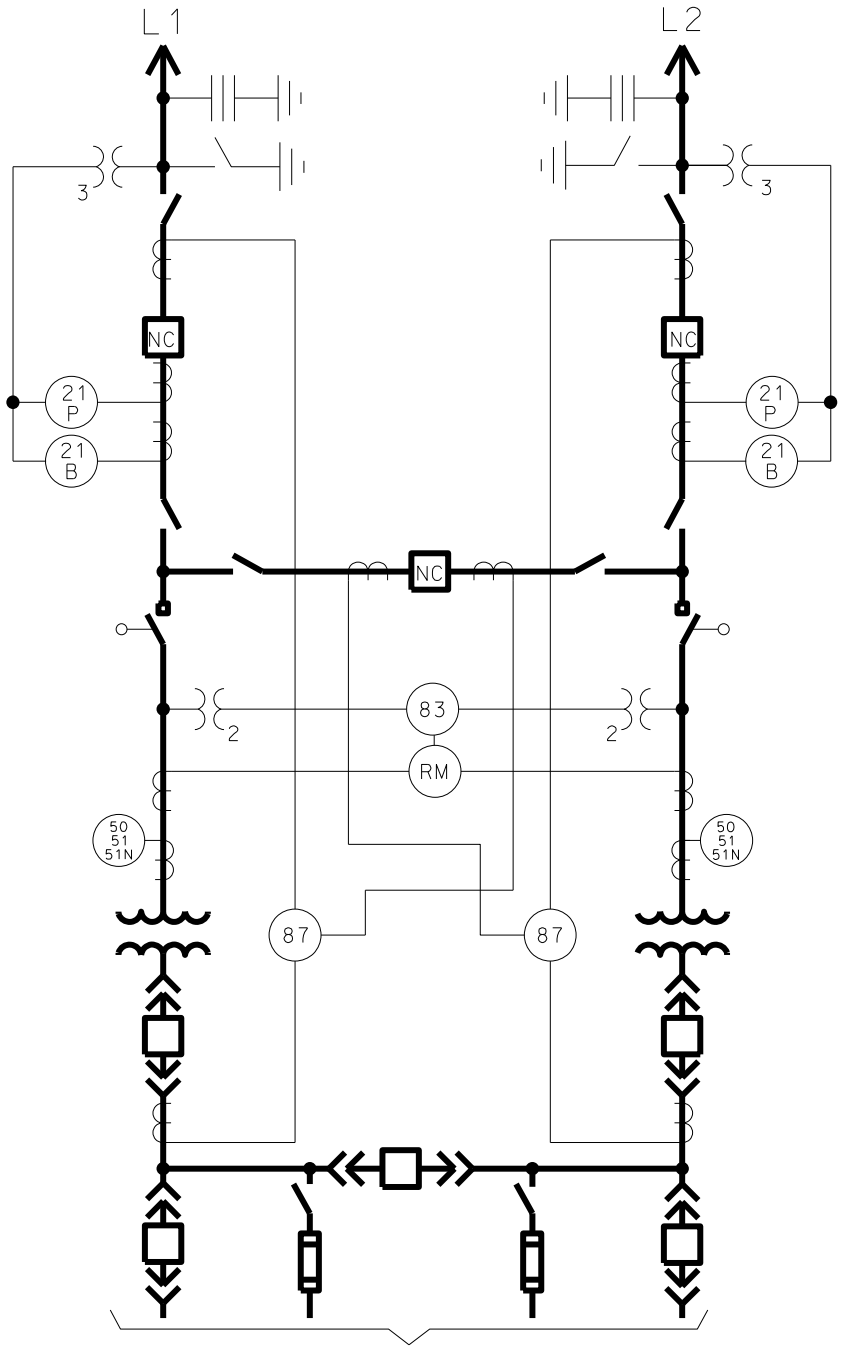
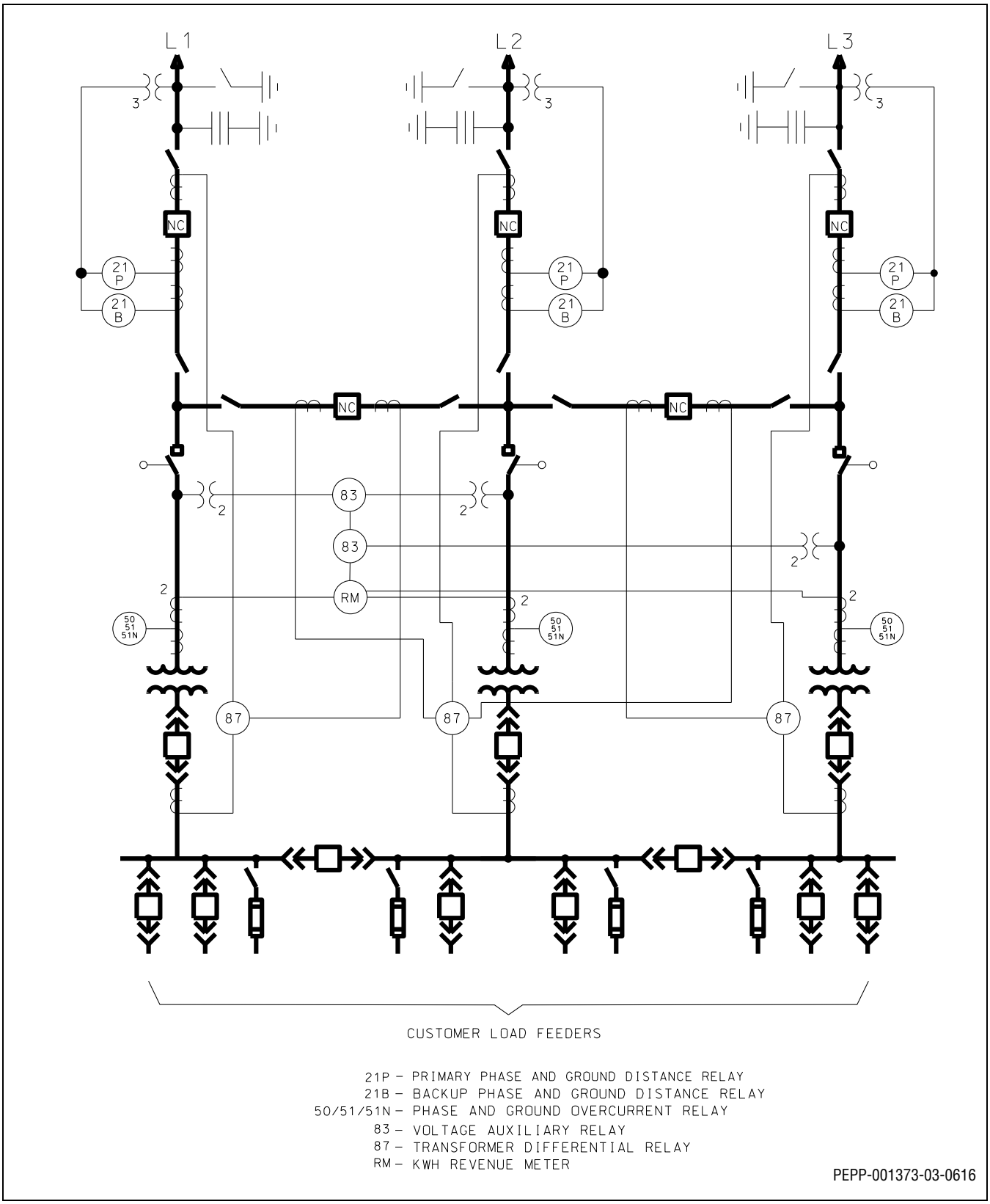


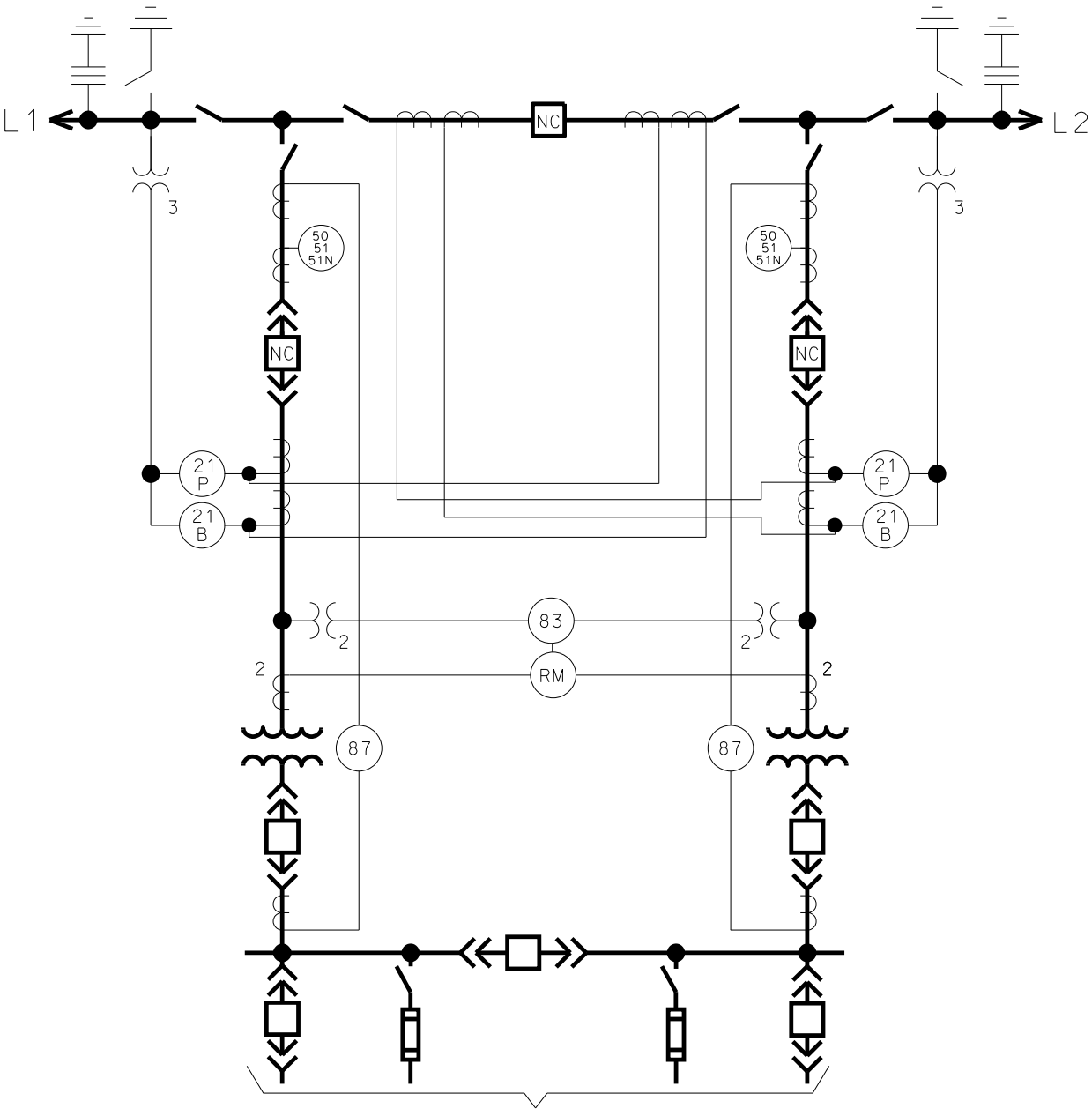
Figure 5.7: Multiple Supply – Multiple Transformers with Line Breakers



Protection Description for Figure 5.6 and Figure 5.7:

1. Each 26 kV feeder is protected by 21-primary, 21-back-up distance relays, and a 67N directional ground over current relay. The 67N ground over current relay is torque controlled by over current relay 50N.
2. Depending on the customer's location within the network, and its proximity to PSE&G substations, a communications circuit and associated equipment may be required for feeder protection.
3. Each 26 kV bus section will be protected with an 87 (differential) relay. The customer's transformer may or may not be included in the differential zone. If the transformer is not included in the differential zone, time over current relays 51 and 51N will be required for the transformer over current protection.
4. The 50N and 67N relays are only required if the 21B or 21P devices cannot perform these functions.
5. All transformer disconnects should have at least 600 A load break capabilities.

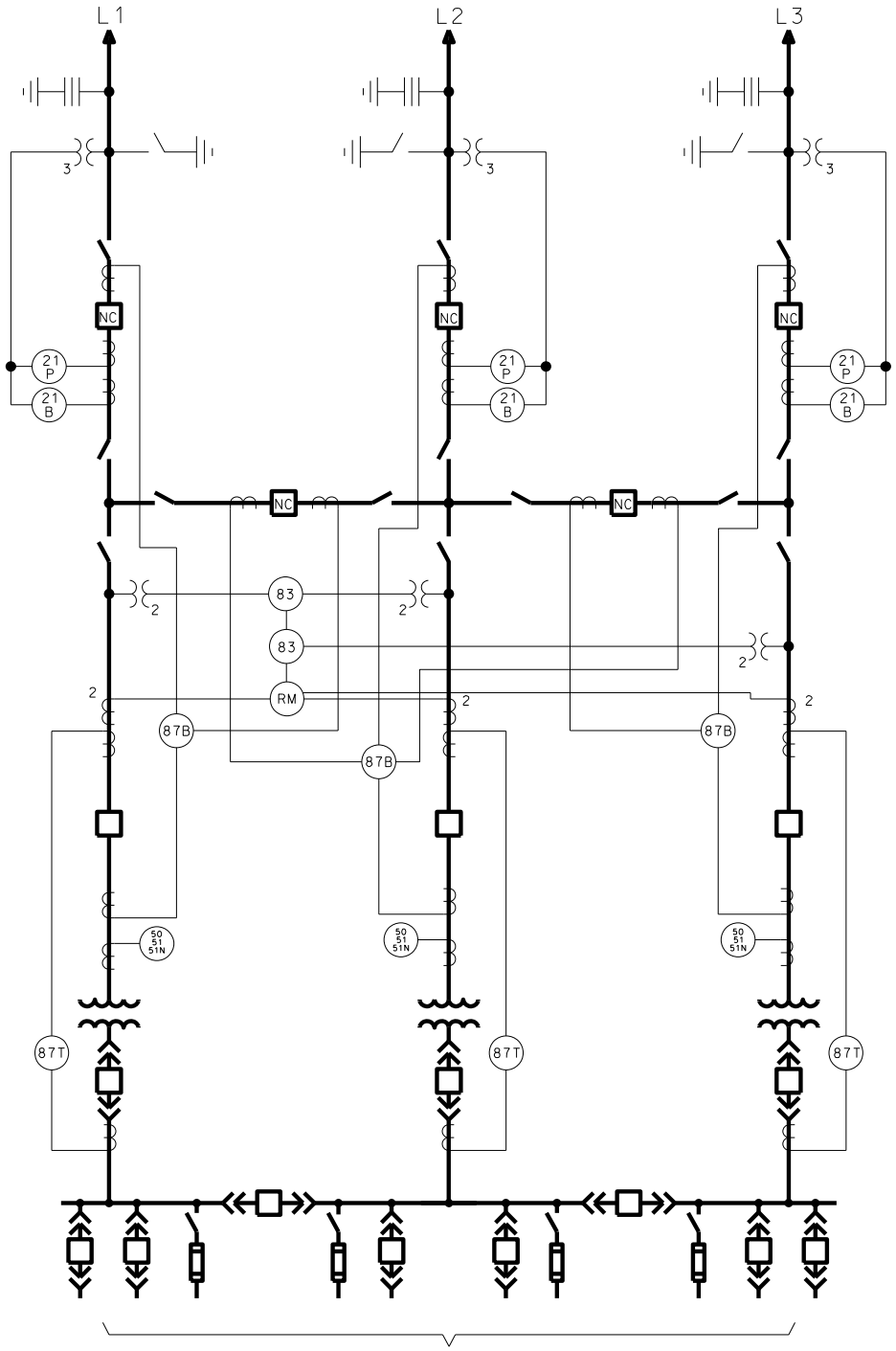
Figure 5.8: Dual supply – Dual Transformers with Transformer Breakers



Protection and Operating Requirements for Figure 5.8

Line relaying is required, and the customer should contact PSE&G for recommended relay types. The low-side bus tie breaker must be operated in a normally open position. Interlocks are required between the low-side transformer main breakers and the bus tie such that the bus tie breaker cannot be closed at the same time that both Main breakers are closed. Additionally, 26 kV transformer circuit breakers are required, along with over current protection. Transformer differential protection relaying is recommended as well, but not required by PSE&G. The customer may opt to select a relay capable of both over current and differential functions in one microprocessor-based package. Contact PSE&G for recommended relay types. Depending on the customer's location within the network, and proximity to substations, a communications circuit and associated equipment may be required for line protection.

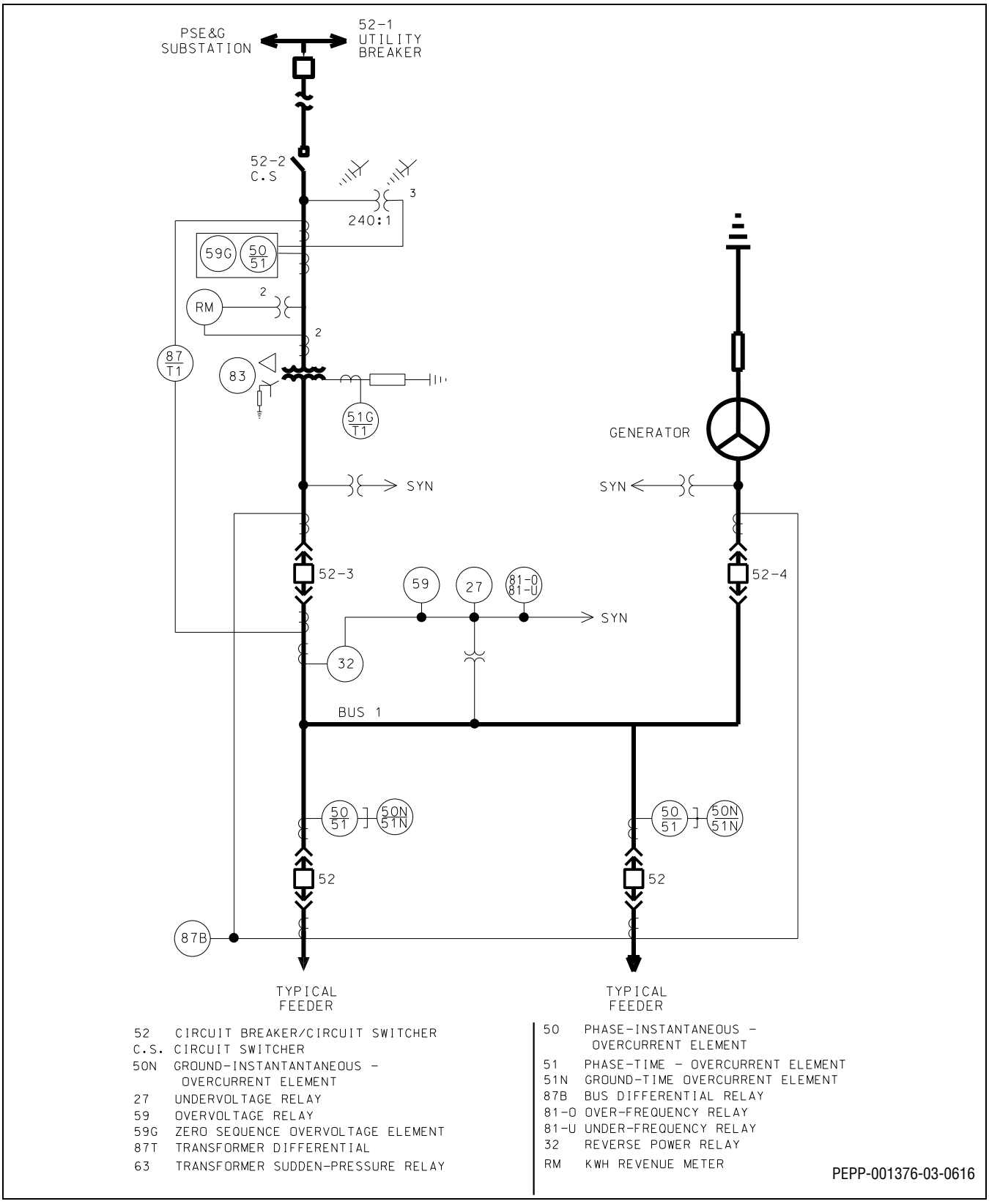
Figure 5.9: Multiple Supply – Multiple Transformers with Line and Transformer Breakers



Protection Description for Figure 5.9:

1. Each 26 kV feeder is protected by 21-primary, 21-back-up distance relays, and a 67N directional ground over current relay. The 67N ground over current relay is torque controlled by over current relay 50N.
2. Depending on the customer's location within the network, and its proximity to PSE&G substations, a communications circuit and associated equipment may be required for feeder protection.
3. Each 26 kV bus section will be protected with an 87 (differential) relay.
4. Each customer's transformer will be protected with a 87T (differential) relay. Time overcurrent relays 51 and 51N may be required for the transformer overcurrent protection.
5. The 50N and 67N relays are only required if the 21B or 21P devices cannot perform these functions.

Figure 5.10: Supply to Remote Non-Utility Substation with Generation (Non-Export)



Protection and Operating Requirements for Figure 5.10 Non-Exporting Generator Substation Scheme

Figure 5.10 depicts a typical one-line relay protection schematic of a customer-owned substation with a non-exporting generator installed. Variations from this substation design are permissible with prior approval from PSE&G. The required relay protection schemes will depend on the actual substation design that is chosen. The customer must contact PSE&G as early as possible in the design phase to establish the type of station design, operational requirements and relay protection logic and type selection to be utilized. See Chapter 6, Figure 6.1 for a schematic for an exporting system.

Note

Multifunction microprocessor relays may be used with the approval of PSE&G's System Protection Group.

When relays are required for the protection of a sub-transmission line or a transmission line, requirements covering that application are very specific and are based on the line configuration, etc. Those requirements are not in the scope of this document. The PSE&G System Protection Group in Newark must be contacted for specific recommendations. At that time, sample AC and DC schematics will be provided by PSE&G.

For other applications (i.e., bus differential), the same System Protection Group in Newark must be contacted for specific recommendations.

Table 5-1: Acceptable Relay List

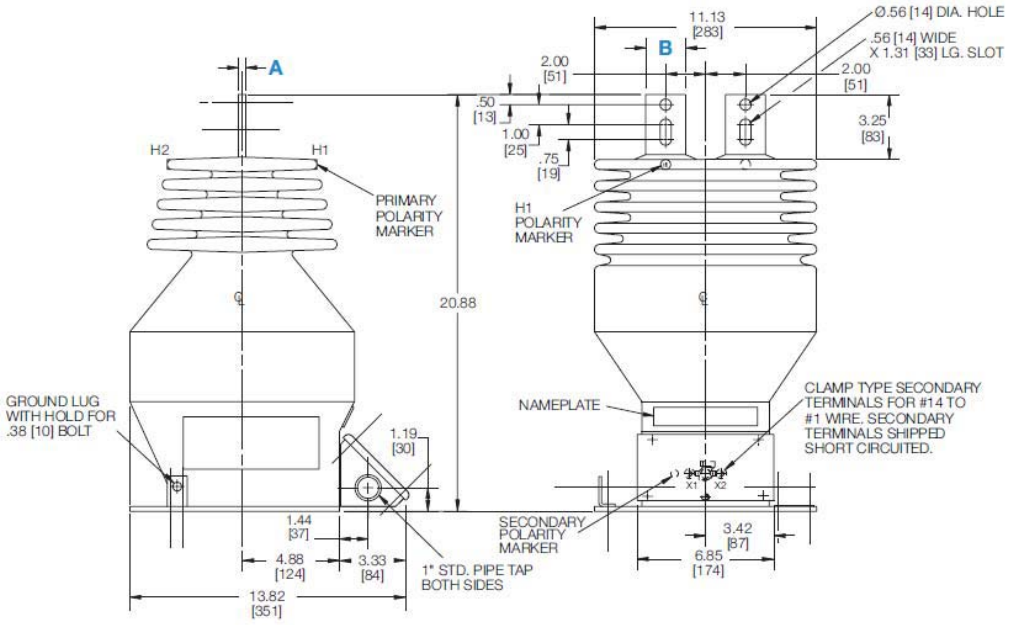
Code	Relay or Device Type
50/51/50N/51N	SEL-351
87 (Transformer)	SEL-387
87/21P	SEL-311L (Contact PSE&G for Style Number and Design Details)
87/21B	L-90 (Contact PSE&G for Style Number and Design Details)
87B (BUS)	SEL-587Z
59 N, G	SEL-351

Note

1. Existing Microprocessor Relays can be used to provide protective functions not listed above. All proposed relay designs and relay type selections must be approved by the PSE&G System Protection Department.
2. System Protection Relay and Instrumentation Diagrams, including relay types and a Tripping Table, must be approved by PSE&G prior to construction.
3. For any applications not shown in this document, the System Protection Group in Newark must be contacted for specific recommendations.

Figure 5.11: Details of ABB Metering Current Transformer KOR-20

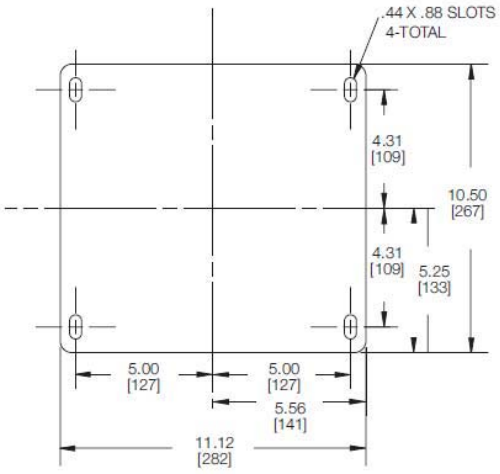
Dimensions



Type KOR-20

Bar dimensions

Primary ampere rating	A (in)	A (mm)	B (in)	B (mm)	Weight (lb)	Weight (kg)
5 - 100	0.25	6	1.5	38	112	51
150 - 1200	0.375	10	2.0	51	120	54



Baseplate dimensions

PEPP-010207-01-06

Figure 5.12: Details of GE Metering Current transformer JKW-7

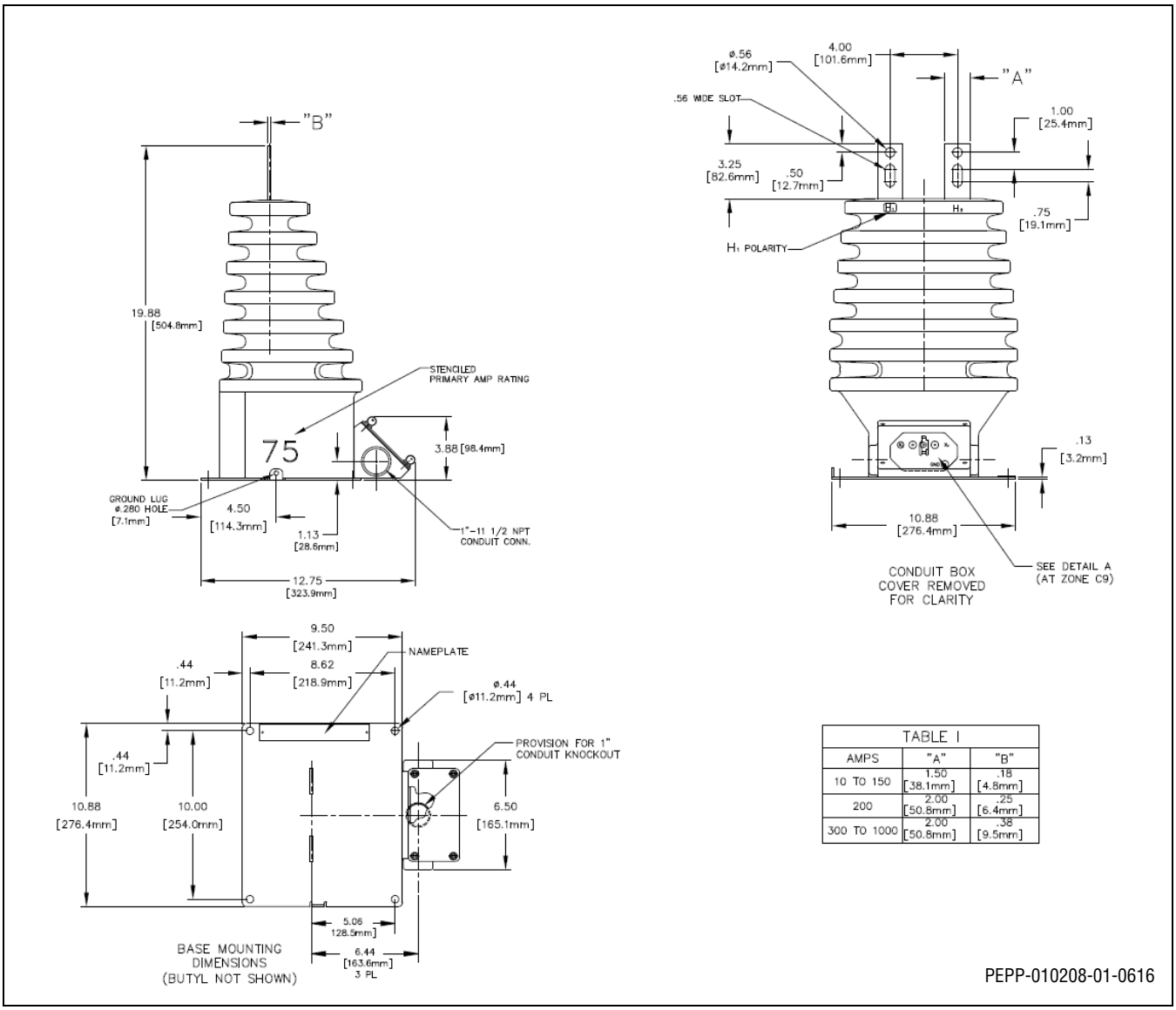
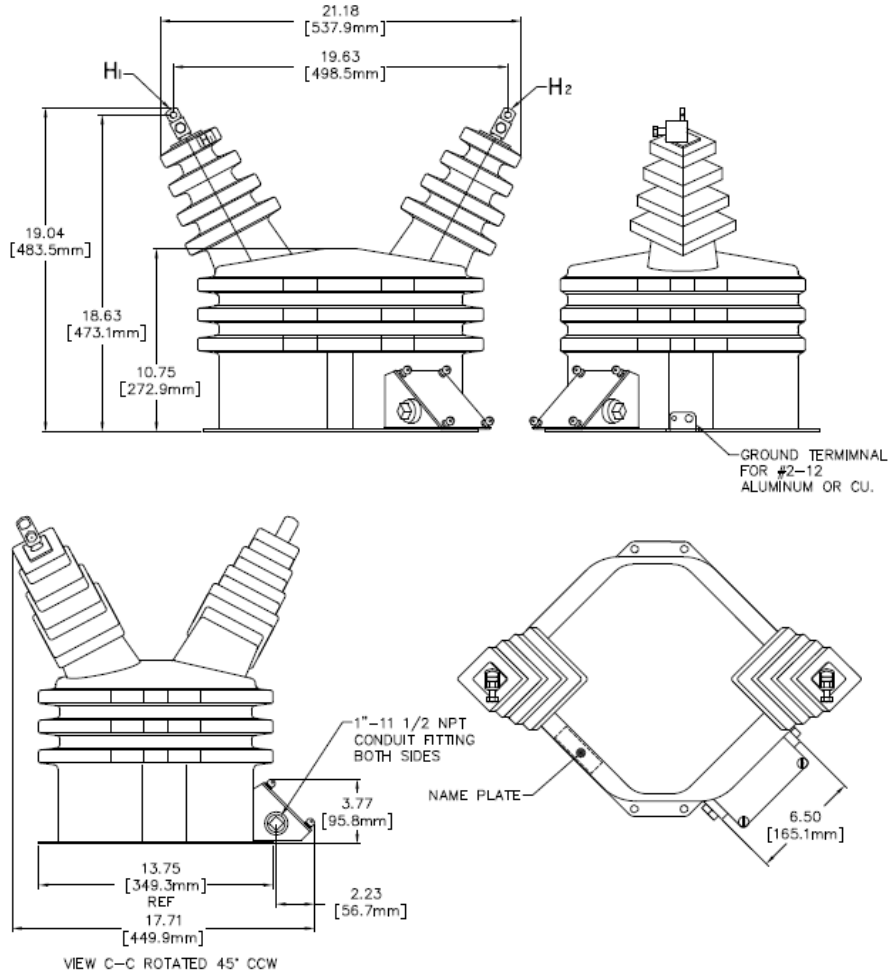
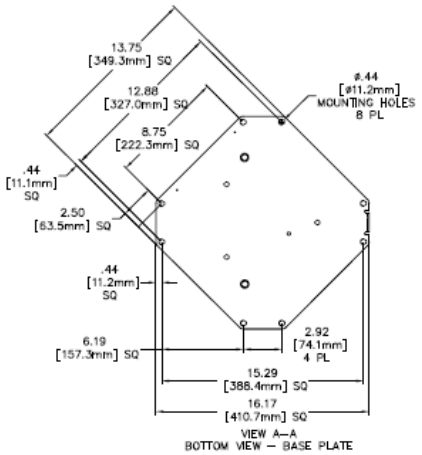


TABLE I		
AMPS	"A"	"B"
10 TO 150	1.50 [38.1mm]	.18 [4.8mm]
200	2.00 [50.8mm]	.25 [6.4mm]
300 TO 1000	2.00 [50.8mm]	.38 [9.5mm]

Figure 5.13: Details of GE Voltage Transformer JVW-7



MOUNTING PLATE DRAWING



PEPP-010209-01-0616

Figure 5.14: Meter Panel – Single Metering Point

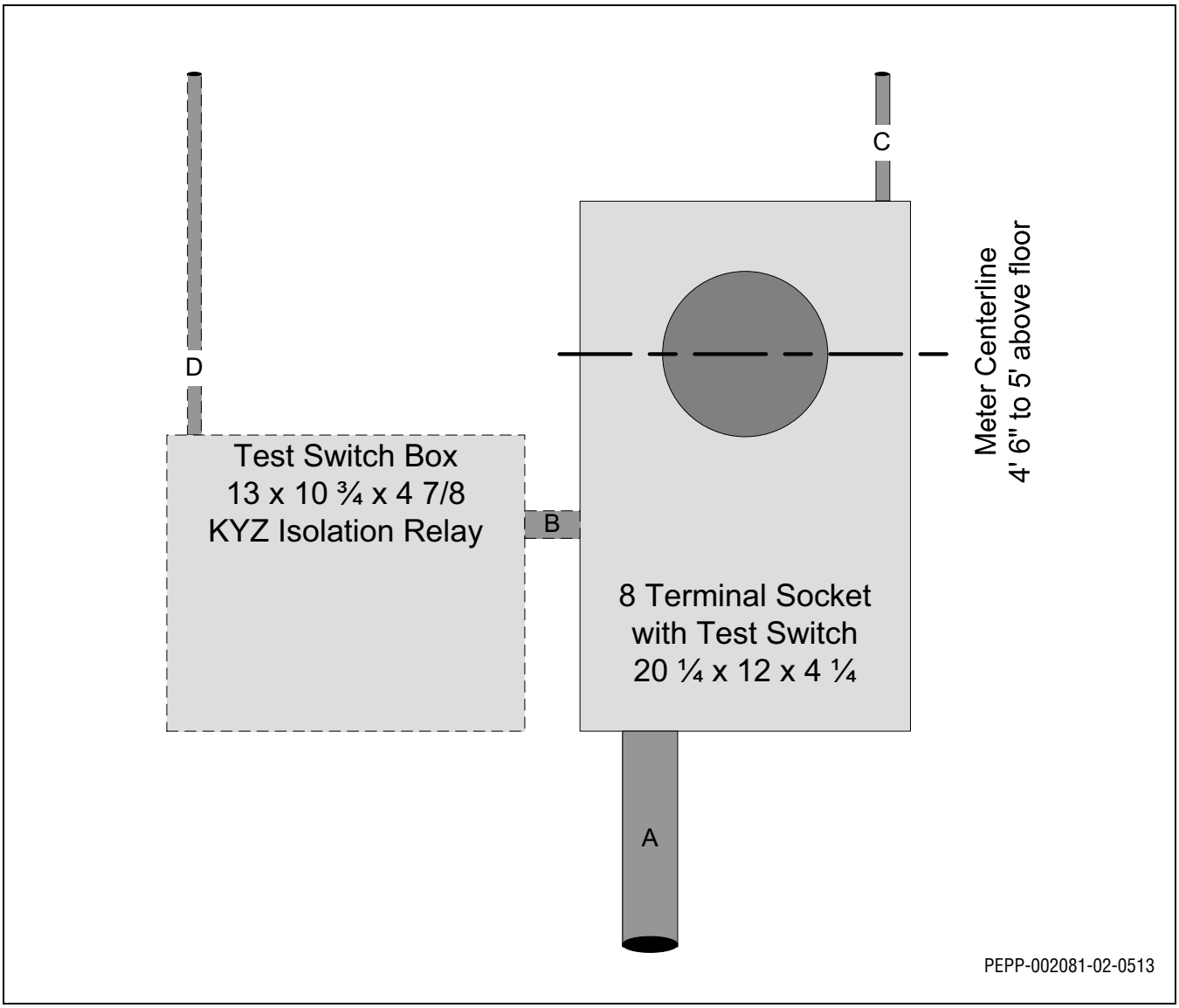


Figure 5.11 Notes:

Note	Conduit	Comment
A	2 in. RGS	For Instrument Transformer Secondary Connections
B	1 in. RGS nipple	With lock nuts and grounding bushings or use lock nuts with piercing screw and plastic bushing, 2 in. min length.
C	1/2 - 1 in. EMT, PVC or RGS	Phone line (POTS) – Suggest 4 pair Cat 5
D	1/2 - 1 in. EMT, PVC or RGS	Optional KYZ to Customer Suggest < 10 ohm loop resistance
Equipment to be mounted on 36 in. x 36 in. x 3/4 in. minimum painted plywood attached to the wall to provide an air space behind plywood.		

Figure 5.15: Meter Panel – Indoor – Two Metering Points

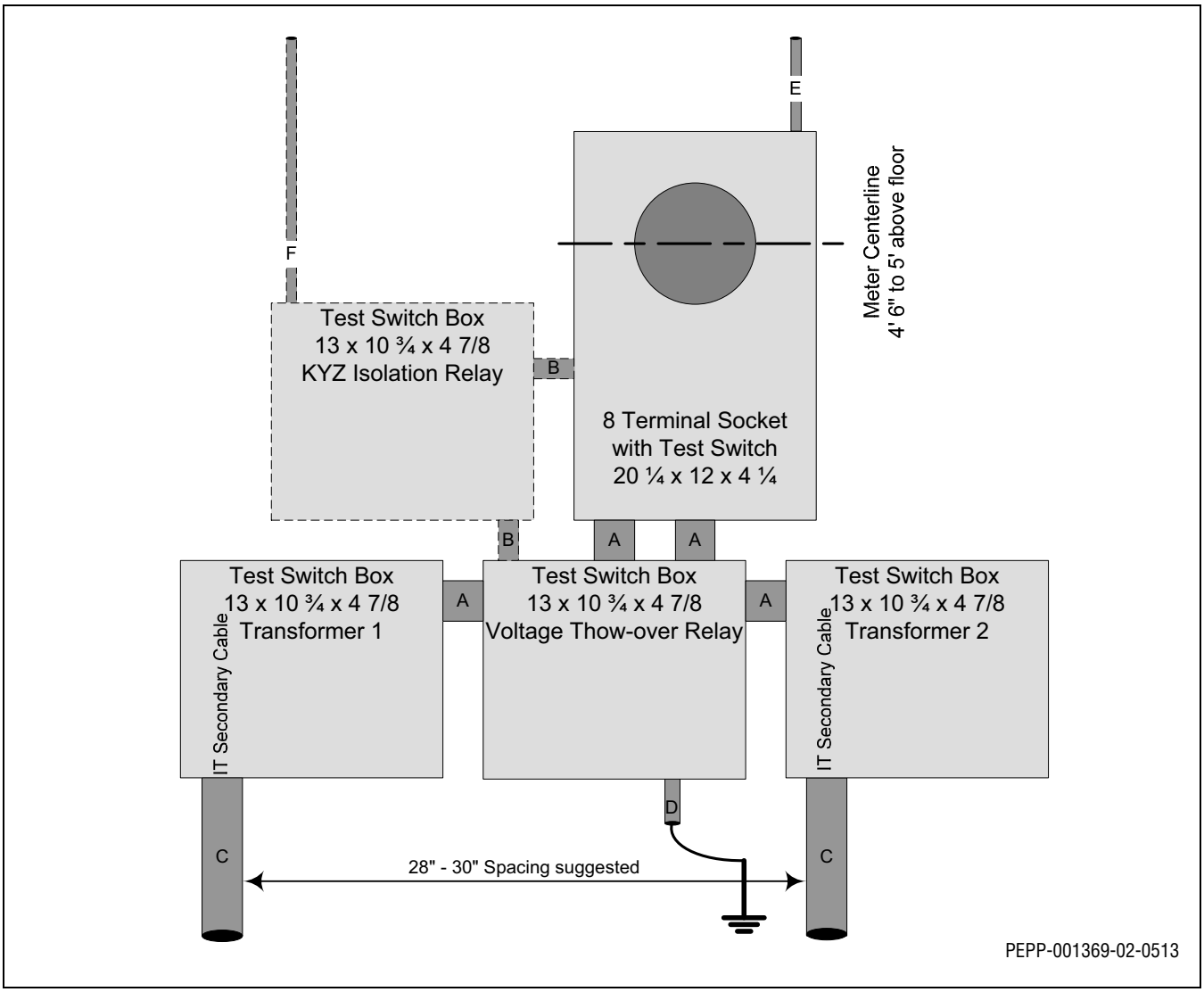


Figure 5.15 Notes:

Note	Conduit	Comment
A	2 in. RGS nipple	With lock nuts and grounding bushings or use lock nuts with piercing screw and plastic bushing, 2-1/2 - 3 in. long.
B	1 in. RGS nipple	With lock nuts and grounding bushings or use lock nuts with piercing screw and plastic bushing
C	2 in. RGS	For Instrument Transformer Secondary Connections
D	3/4 in. – 1 in. EMT or PVC	Ground Connection #8 or larger connection to ground bus
E	1/2 - 1 in. EMT, PVC or RGS	Phone line (POTS line) – Suggest 4 pair Cat 5
F	1/2 - 1 in. EMT, PVC or RGS	Optional KYZ to Customer Suggest < 10 Ω loop resistance
Equipment to be mounted on 48 in. x 72 in. x 3/4 in. minimum painted plywood attached to the wall to provide an air space behind plywood. Boxes shall be mounted and connected to allow doors and covers to open without binding on adjacent boxes.		

Figure 5.16: Meter Panel – Outdoor – Two Metering Points

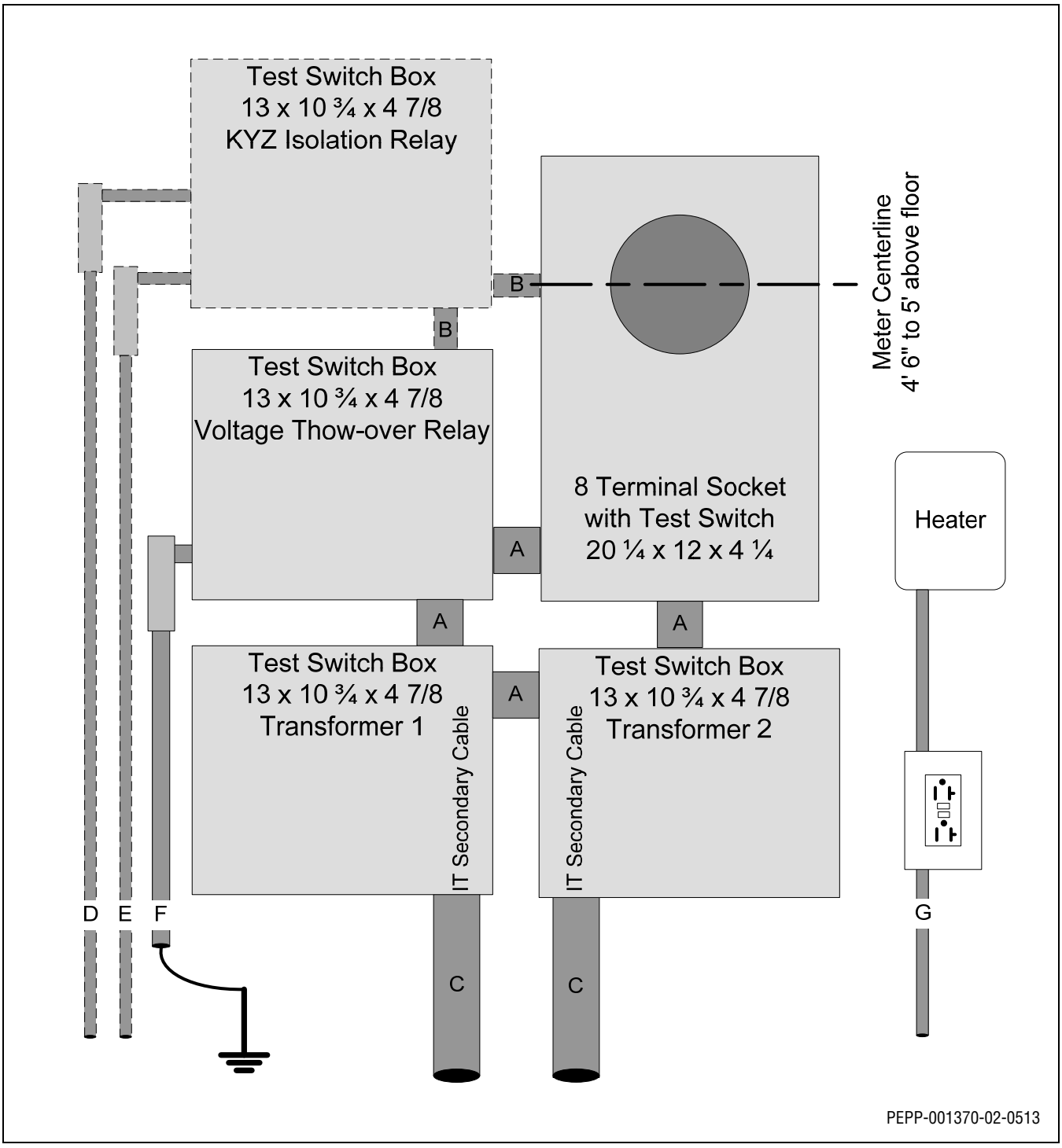
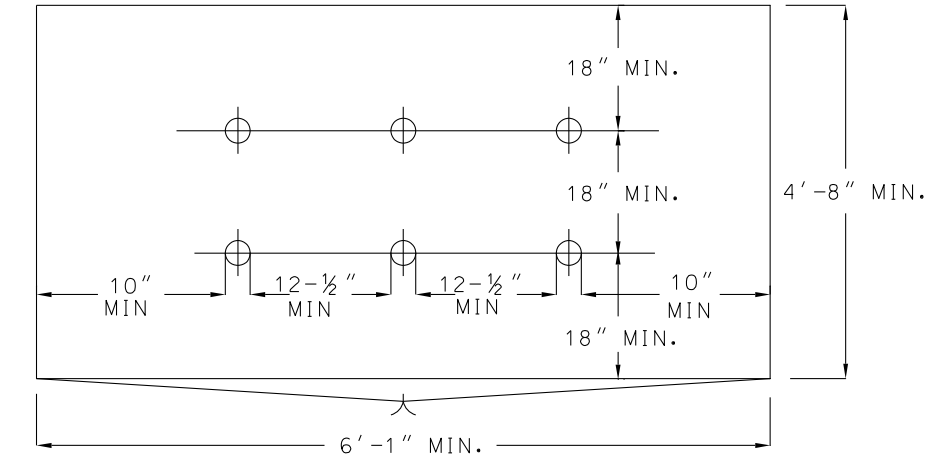


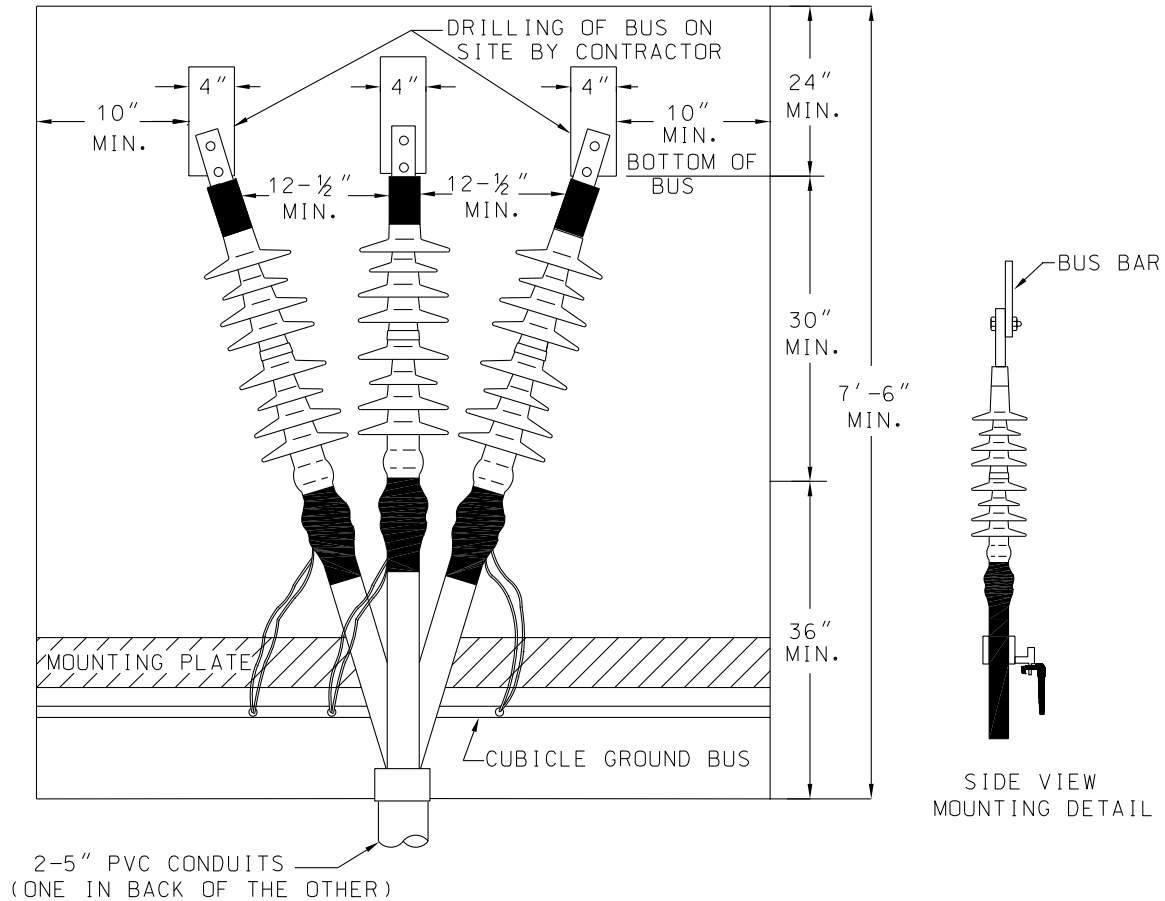
Figure 5.16 Notes:

Note	Conduit	Comment
A	2 in. RGS nipple	With lock nuts and grounding bushings or use lock nuts with piercing screw and plastic bushing, 2-1/2 - 3 in. long
B	1 in. RGS nipple	With lock nuts and grounding bushings or use lock nuts with piercing screw and plastic bushing
C	2 in. RGS	For Instrument Transformer Secondary Connections
D	1/2 - 1 in. EMT, PVC or RGS	Phone line (POTS line) – Suggest 4 pair Cat 5
E	1/2 - 1 in. EMT, PVC or RGS	Optional KYZ to Customer Suggest < 10 Ω loop resistance
F	3/4 – 1 in. EMT or PVC	Ground Connection #8 or larger connection to ground bus
G	1/2 - 1 in. EMT or PVC	120 V AC, 20 A Station Power
Equipment to be mounted on 36 in. x 36 in. x 3/4 in. minimum painted plywood attached to the wall to provide an air space behind plywood. Boxes shall be mounted and connected to allow doors and covers to open without binding on adjacent boxes.		

Figure 5.17: Typical Entrance Cubicle Arrangement using 26 kV EPR Cable



PLAN VIEW



ELEVATION VIEW

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Figure 5.18: Disc Insulator Assembly Dead-End on Customer's Structure

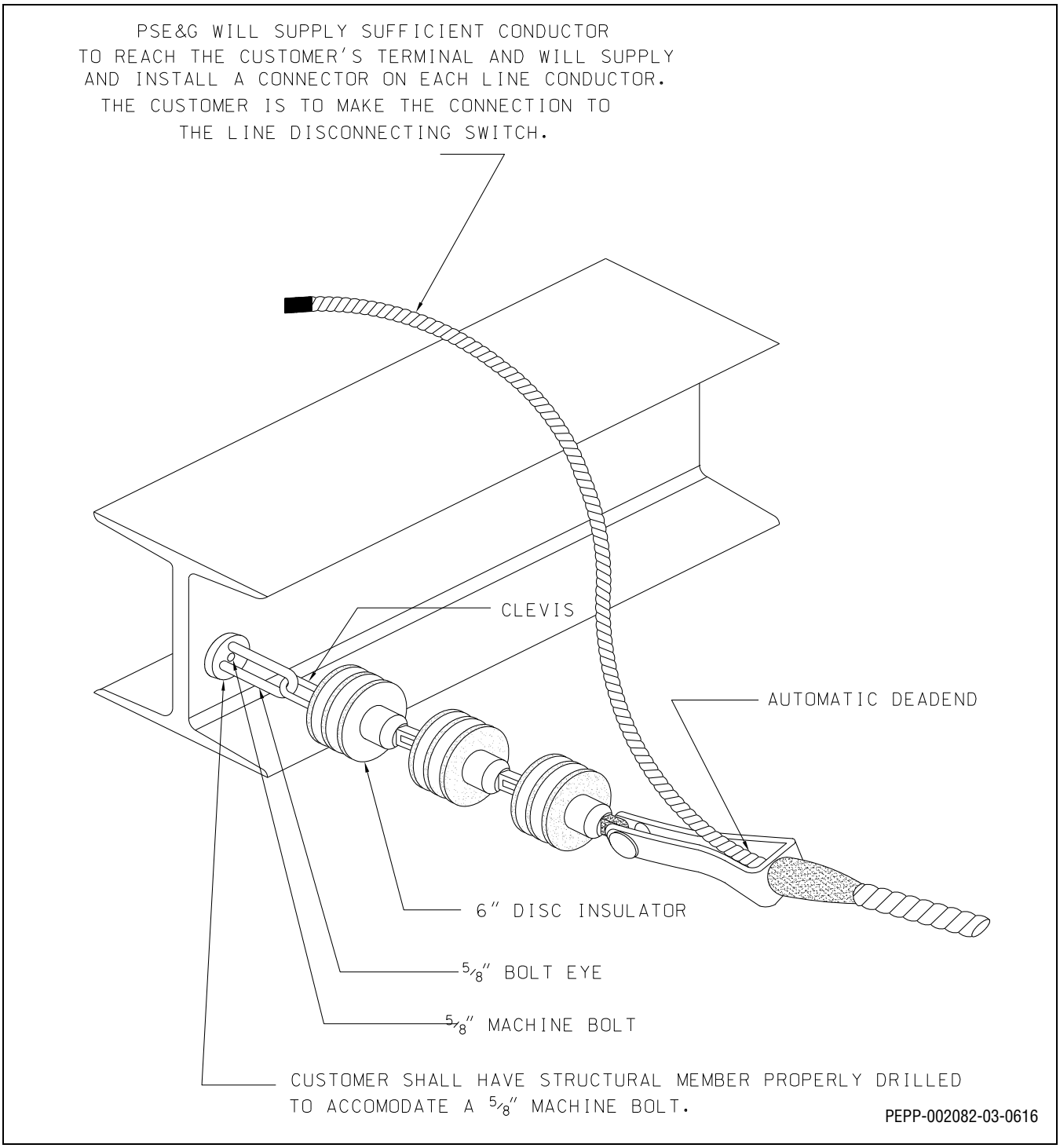

Figure 5.18 Note:

All line termination insulators and hardware will be provided and installed by PSE&G.