

7. SERVICES OVER 600 VOLTS

7.1 GENERAL

The Company shall always be consulted to obtain required design criteria where service is contemplated. Three (3) copies of the preliminary plans of the Customer shall be submitted for review before purchase of equipment or start of construction. Drawings submitted for review shall include (1) Plot Plan showing desired delivery point, (2) Service details (underground or aerial), (3) Service entrance equipment or structures, (4) Arrangement of service substation equipment, (5) Single Line Diagram, and (6) Load Information.

All facilities beyond the delivery point (except metering equipment) shall be furnished, installed, maintained and operated at the Customer's expense and shall be owned or leased by the customer. This includes necessary structures, foundations, enclosures, ground busses, and cautionary and designation markings. The National Electrical Code requires an enclosure for all electrical installations (Article 110B), unless acceptable tamper resistant equipment is used. Customers should provide regulating equipment if the voltage band for satisfactory operation of their load equipment does not fall within the voltage band of the Company service.

7.2 ACCEPTABLE HIGH VOLTAGE SERVICE EQUIPMENT

7.2.1 Ratings

All customer-owned service equipment shall be rated for the service voltage being supplied, and have adequate fault close and fault current interrupting ratings. Please refer to Table 7.01.

**Table 7.01
Service Equipment Ratings**

Service (kV) # Phase, # Wires	Equipment Voltage Class (kV)	Minimu m (BIL) (kV)	Max Fault Current Amps Sym	Recommended Transformer Primary Voltage & Winding Configuration
4.16 3 Ph, 4 wire	5	60	6,300	4,160 Delta
13.2 3 Ph, 3 or 4 wire	15	95	6,300	13,200 Delta
33, 3 Ph, 3 Wire *	34.5	200	**	33,000 Delta
33, 3 Ph, 4Wire *	34.5	150	**	33,000Y/19,050 * ***
69, 3 Ph, 4 Wire	72.5	350	**	69,000
138, 3 Ph, 4 Wire	145	750	**	138,000
230, 3 Ph, 4 Wire	242	900	**	230,000

* See Figure 12.08

** Consult New Business Customer Engineering

*** Transformers connected to 33,000 V, 3 Phase, 4 Wire circuits shall have grounded-wye primary and secondary winding configurations

7.2.2 Service Cable, Terminations and Splices

Company requirements for service cable, terminations, and splices are provided in Section 11.

7.2.3 Location of Disconnects

The service disconnect shall consist of one of the following: a removable circuit breaker, a circuit interrupter with visible 3 phase gang operated isolation switch, or a three phase, gang operated, load break switch and fuse assembly. The service disconnect may be located at any convenient location on the customer's property either indoor or outdoor. The location shall meet the requirements of the National Electrical Code. Open wire services over 500 feet long, or less where conditions warrant, require a service switch near the property line. Indoor type service control assemblies shall be installed in clean, dry locations and shall not be located in vaults with oil insulated transformers. Service equipment should not be installed in locations that are susceptible to flooding or where water supply or sewer piping failures may flood the room. An emergency exit shall be located near the service switch. Personnel shall be able to exit from the service switch without passing transformers.

7.2.3.1 Working Space

Front aisle space for metalclad switchgear shall not be less than the manufacturer's recommendations or the National Electrical Code, whichever is greater. For all new construction, aisle space, where the service cable and PECO metering compartment doors open, shall permit inspection of live parts while energized. Working space shall meet the dimensions specified in Table 110-34(a) of the National Electrical Code to accommodate this requirement. Front and rear aisles shall allow full opening of compartment doors, and shall not be less than 36 inches. For assemblies that do not require rear access, rear aisle space is not required. When in the open position, compartment doors shall allow occupants a safe, unobstructed exit from the electrical room or substation enclosure. Aisle space for replacement of damaged equipment shall be permitted to maintain pre-existing aisle clearances, subject to acceptance by the company and a listed electrical inspection agency (see Chapter 9).

7.2.3.2 Indoor Service Disconnect

The Customer's indoor service control units shall be of metalclad or metal enclosed switchgear construction. This equipment shall have drip proof indoor enclosures..

7.2.3.3 Outdoor Service Disconnect

Service equipment installed outdoors may be of weatherproof metal clad or metal enclosed switchgear or of pole type construction. Typical equipment configurations applicable to single service installations are shown in Figs. 12.06 12.07, and may also be applied in required combinations for dual service installations if acceptable facilities are incorporated to ensure that the two services cannot be in parallel and that the fuses will be accessible only when they are completely isolated.

7.2.4 Overcurrent Protection

PECO Energy High-Voltage customers shall install, own, operate and maintain overcurrent protection systems meeting National Electrical Code requirements, assure that the devices coordinate with PECO's distribution / transmission system protection, and meet PECO requirements for reliability and periodic testing.

7.2.4.1 Fuses

Fuses selected as service overcurrent protection shall be of a manufacturer, type, and size compatible with the Company's distribution system protection. A list of acceptable fuses and recommended maximum connected transformer capacities is found in Tables 10.20C, 10.21C & 10.22C. The fuse selected shall be rated for the Company's operating voltage and able to interrupt the maximum fault current available from the Company's system. The Customer shall select a fuse type and size that will properly protect the system, and does not exceed the maximum fuse sizes listed by the Company. A set of spare fuses shall be provided and stored in or near each service control assembly.

7.2.4.2 Circuit Breakers and Circuit Interrupters

Circuit breakers shall be installed as service disconnects where the load or connected transformer capacity exceeds the limit specified for switch and fuse application, or for other reasons where the requirements are unusual. Fixed circuit breakers shall have isolating switches to provide a lockable, visible break device for PECO or customer system maintenance and repair. Circuit interrupters may be installed for services rated 4,160 through 33,000 if a visible break device is provided for isolation. Circuit breakers shall be installed as service disconnects and overcurrent devices for all installations above 33,000 Volts. Refer to Tables 10.20A, 10.21A, and 10.22A for acceptable circuit breakers.

7.2.4.2.1 Overcurrent Relays

PECO Energy High-Voltage customers with circuit breaker or circuit interrupter service control, shall install, own, operate and maintain overcurrent relay systems that coordinate with PECO's distribution / transmission system protection and meet PECO requirements for reliability and periodic testing. PECO Energy technicians shall be responsible to verify the current transformer ratio and the integrity of the wiring from the CT to the relay devices by primary injection of current, and the initial settings of these relays.

7.2.4.2.2 Overcurrent Protection Scheme

Each service shall have four-element protection that senses overcurrent in each phase and the neutral of the relay CT circuit. Relays shall be of draw-out construction with internal current shorting contacts or have separate test switches, permitting removal of one relay without affecting the operation of the remaining relay(s).

The protection scheme shall be designed such that failure of any one protective device, shall still sense overcurrent in three of the four elements being protected. This is to guarantee that any type of fault can be detected when one protective device has failed. The protective devices shall be connected to a test switch that provides access to each phase and neutral current, voltage (when applicable), control power, and completely isolate tripping contacts for testing. Meter Devices, Superior, and GECO PK test plugs manufacture acceptable test switches. Relays equipped with internal GECO test plugs or ABB flexi-test switches are exempt from the external test switch requirement (i.e., GECO IAC, IFC, DIAC, MDP; ABB CO; and Basler 50/51B).

Discrete, individual phase and ground overcurrent relays are acceptable, without need for back-up overcurrent protection.

Microprocessor based overcurrent relays shall provide the following features:

1. A self-diagnostic failure feature, which provides an alarm contact to be used by the customer to enunciate the condition.
2. A power source that is not dependent on the primary service voltage during the time the relay is sensing a fault.
3. Multi-Function, digital and microprocessor based relays with 3 phase and neutral overcurrent protection in one enclosure are considered one protective device. A redundant relay with the same overcurrent protective characteristics shall be installed to meet PECO reliability requirements. Service control devices protected by only one microprocessor relay shall be limited to applications where PECO Energy can fuse the service connection according to its current service fusing standards.
4. Where the protective device provides additional functions beyond the overcurrent protection required by PECO Energy, the customer shall be responsible to program and or set all useable and desired functions of the relay. A copy of the relay's electronic setting file shall be submitted to New Business Customer Engineering for record purposes. PECO technicians will verify the overcurrent protection set point and time delay.

The relays acceptable to PECO Energy and their associated maximum settings are listed in table 7.02. Other types of relays and settings higher than those listed will be considered on a case-by-case basis.

TABLE 7.02 ACCEPTABLE SERVICE RELAYS

MANUFACTURER	TYPE	NOTE	PRIMARY PICK-UP CURRENT (AMPS)	NOTE	TIME DELAY IN CYCLES @ 400% P.U.
ABB Power T&D	CO-6		360		15
	CO-8		360		15
	CO-9		360		15
	DPU 2000	*	360	**	15
	ITE-51Y	*	360	**	15
	Micro-51		360	**	15
	MMCO	*	360	**	15
Basler	BE1-50/51B		360	**	15
	BE1-951	*	360	**	15
Cutler Hammer	DG 3000	*	360	**	15
	FP 5000	*	360	**	15
General Electric	IAC-IT		360		15
	IAC-VI		360		15
	IFC-53		360		15
	MDP	*	360	**	15
	DIAC		360	**	15
	Multilin SR750	*			
	Multilin SR735	*	360	**	15
			360		15
Schweitzer	351, 251, & 501	*	360	**	15
Siemens	7SJ 6	*	360	**	15

* Microprocessor Based Relay - see special requirements above

** Inverse TCC (equiv to C0-8 or IAC-53)

7.2.4.2.3 Service Relay Settings

The customer shall be responsible to determine the overcurrent protection settings of the relays used to protect the service entrance equipment. CT ratios shall be sized for the load not the substation capacity. Typical limit is 600/5, unless the facility's expected ½ hour electrical demand is above this rating. PECO Energy Co., New Business Customer Engineering, will review the CT ratio, relay type, model number, and the proposed setting submitted, for acceptance, and proper coordination to PECO Energy Co.'s distribution system

protection. PECO Energy Co. shall set, test, and seal the service entrance overcurrent relays prior to energizing the equipment.

Instantaneous elements may be made inoperative for the relays listed in table.

7.02. The maximum settings shown guarantee coordination with PECO Energy's station circuit breakers or circuit reclosers. The customer's designer shall assure that the setting meets the National Electric Code and any other standards concerning protection of the customer's service cable, switchgear, bus, or transformation.

The service protection scheme submitted for approval shall include the following relay information:

1. AC schematic (3 line)
2. Control schematic
3. Single Line Diagram
4. CT ratio
5. Relay manufacturer
6. Relay model numbers
7. Type of curves available (Inverse, Very Inverse, Extremely Inverse, etc)
8. Time element tap range
9. Instantaneous element tap range

The relay setting information for 3 phase and neutral overcurrent protection shall include:

1. Type of curve selected (Inverse, Very Inverse, Extremely Inverse, etc)
2. Time delay primary pick up current in amperes, CT ratio and pick up tap value
3. Time delay expressed as cycles at 400% of the relay pick up current. or time dial equivalent
4. Instantaneous element primary pick up current in amperes, CT ratio and tap selected.

7.2.4.2.4 Relay System Maintenance The customer shall be responsible to maintain the service overcurrent protection system. PECO Energy may check calibration of the relays and trip test the service breaker, at the customer's request, once every four years, or if a customer fault has resulted in a PECO line or circuit tripping. Equipment problems shall be reported to the customer for correction. PECO Energy reserves the right to disconnect service equipment that may jeopardize the reliability of PECO's transmission or distribution system.

Testing more frequently may be requested at the customer's expense. Protective relay systems should be tested every two years, including relay calibration, tripping power supply check, and a breaker trip test, per NFPA 70B - *Recommended Practice for Electrical Equipment Maintenance*, article 18-10.3.1. Customers may perform their own service relay calibration checks and breaker trip tests, provided that qualified technicians are contracted and the testing

company submits a certified test report to PECO Energy for review. The customer may not change the service relay settings without review and acceptance by PECO Energy.

7.2.5 Transformers

All customers with services over 600 volts are responsible to install, own, and operate all transformers. The transformer nominal voltage rating and primary winding configuration should meet the recommendations of Table 7.01. Transformers with reduced BIL ratings should have additional surge protection coordinated to the BIL selected and service voltage characteristics. Customer owned transformers should have 2 – 2 ½ % primary no load taps above and below the nominal voltage rating. Transformers supplied by 4,160 or 13,200 Volt services should be specified with delta primary windings, to be compatible with PECO 3 phase 3 wire and 4 wire distribution systems. Transformers supplied by 33 KV services shall be specified with grounded-wye primary and secondary windings. New Business Customer Engineering should be consulted before specifying delta connected 33 KV transformers.

Transformers with grounded-wye primary and delta secondary windings are not recommended for connection to PECO Energy distribution services. This transformer-winding configuration provides ground fault current to PECO's system and can result in nuisance tripping of customer overcurrent protection or transformer failure. This configuration is recommended for customers planning to operate generators in parallel with PECO's system, and requires special overcurrent protection systems.

7.2.6 Grounding

Grounding of all electric services shall be according to the requirements of the National Electrical Code and current IEEE substation grounding standards. For services of 33 KV or less, grounding resistance shall be 25 ohms or less.

7.3 SERVICE REQUIREMENTS, 13 AND 33 KV

(For Services over 33 kV, consult New Business Customer Engineering.)

7.3.1 Single Service

The load controlled by all of the assemblies referred to below will be metered as a single load.

7.3.1.1 13kV Service

A maximum of one service control assembly consisting of a 3-phase gang operated switch and fuses, or a circuit breaker shall be permitted, per service. (See Tables 10.23P, 10.23S and 10.24).

Exception – Connections shall be permitted on the line side of the service disconnect to supply PECO accepted service assemblies for a fire pump supply. This fire pump connection shall meet the requirements of Section 7.4.

7.3.1.2 33kV Service

One main service control assembly consisting of a 3-phase gang operated switch and fuses is preferred. If the line exposure on the Customer's property is acceptable, the Company may permit the installation of not more than six individual switch / fuse feeders before requiring a main circuit breaker. A main service switch shall be required for three or more switch / fuse feeders, or where 33 KV primary metering is installed. (See Tables 10.29 A and 10.29 B).

Exception – Connections shall be permitted on the line side of the service disconnect to supply PECO accepted service assemblies for a fire pump supply. This fire pump connection shall meet the requirements of Section 7.4.

7.3.2 Dual Service

Dual service consists of two services, each of which is connected to a separate bus with approximately one half total load normally supplied by each service. Each service shall have separate, acceptable service disconnect and overcurrent devices. Primary transfer facilities may be omitted if transformers and secondary transfer facilities are provided which can supply the entire load from either service. The maximum facility load supplied by either service depends upon the rating of the PECO lines, and is typically 4 MVA per 13.2 kV service, and 11 MVA per 33 kV service. The transfer bus shall be on the load side of the service overcurrent devices. Only one service control assembly will be permitted for each 13.2 KV Service. (See Tables 10.25A, 10.25B, and 10.26).

Exception – Connections shall be permitted on the line side of each service disconnect to supply PECO accepted service assemblies for a fire pump supply. This fire pump connection shall meet the requirements of Section 7.4.

7.3.2.1 DUAL SERVICE AUTOMATIC TRANSFER REQUIREMENTS

7.3.2.1.1 Normal Operating Configuration

Normal configuration of the service equipment requires each service breaker to be closed and the tie breaker to be open. Both lines carry a portion of the total facility load (split as close to 50 - 50% as possible). Regular / reserve operation (one service breaker and tie breaker closed) may be permitted with PECO Energy's approval.

7.3.2.1.2 Required Features For Dual Service Circuit Breaker Assemblies

- a. The main and tie circuit breakers must be connected to a control power source that is available when all breakers are open, permitting operation of close coils, trip coils, and charging mechanisms. Acceptable systems include a station control battery or an AC source derived from the line VTs with a transfer switch (Dev 83) to select power from either line VT. Control Power Transformers (CPT) are not permitted to be connected on the line side of PECO Energy's metering transformers.
- b. Service overcurrent relays shall operate a lockout device, which shall trip the associated service breaker, and lockout (prevents closing) both main breakers and the tie breaker.

- c. The tie breaker shall not be tripped from the line overcurrent relays or their associated lockout relays. If tripping the tie breaker is a desired feature, a covered test switch must be provided on the tie breaker compartment to block tripping from each service overcurrent or lockout device. This is necessary to allow testing of each services' overcurrent relays with the tie closed and carrying load.
- d. An AUTO / MANUAL (Dev 43) selector switch shall be available to enable and disable the automatic transfer scheme.
- e. In MANUAL position
 - Automatic transfer is blocked
 - Breakers may be tripped and closed at will from their control switches, including paralleling of the main - tie - main breakers and closing on a de-energized line.
 - The customer may elect to install a permissive switch (Dev 69) to prohibit manual paralleling and closing on a de-energized line. This switch must have two positions NORMAL / PARALLEL and must **NOT** be key operated.
- f. In AUTO position
 - The transfer scheme will be operative
 - Paralleling of the mains and tie are prohibited. If the main-tie-main breakers are paralleled when Dev 43 is switched to the AUTO position, the tie breaker shall trip.
 - Main and tie breakers may be tripped from their control switch.
 - Tripping a main breaker from its control switch, with 43 in AUTO, will disable the auto transfer scheme. The breaker's associated lockout relay may be upset to accomplish this requirement.
 - Main and tie breakers may not be closed from their control switch
 - All loss of source transfers shall be OPEN transition (break before make).
 - Upon loss of voltage to either service, with a recommended 2 second time delay, the scheme shall:
 - Verify loss of voltage to the affected service
 - Verify acceptable voltage is available on the alternate service
 - Verify all lockout relays are reset
 - Trip the service breaker on the affected service and close the tie breaker
 - Upon return of acceptable voltage to the affected service, restoration to split load shall require a MANUAL operation.
 - Automatic "GOOD LINE SEEKING" is permitted after a transfer to one line (transferring the total load from one available line to another as needed to maintain service until normal operating configuration can be established). After a recommended 2-second time delay, the service breaker on the

affected line shall trip and the service breaker of the available line shall close, provided all lockout relays are reset. The tie breaker may remain closed during good line seeking operations.

- g. A means shall be provided to test the automatic transfer scheme by simulating loss of voltage
- h. Slip contacts (remain closed after trip or close) in the main and tie breaker control switches shall **NOT** be used in the breaker control scheme.

7.3.2.1.2 Required Features For Dual Service

Motor Operated Switch / Fuse Assemblies

- a. Switch assemblies for dual service shall include a manually operated main load break switch on the line side of the service fuse, and the motor operated switch on the load side of the fuse. The tie shall include a motor operated load break switch and a manually operated load break isolation switch for maintenance of primary devices.
- b. The motor operated switches shall be connected to a control power source that is available when all switches are open, permitting operation of close and open circuitry, and charging mechanisms. Acceptable systems include a station control battery or an AC source derived from the line VTs with a transfer switch (Dev 83) to select power from either line VT. Control Power Transformers (CPT) are not permitted to be connected on the line side of PECO Energy's metering transformers.
- c. The motor operated switches shall be electrically and mechanically interlocked to prevent paralleling of the services
- d. An AUTO / MANUAL (Dev 43) selector switch shall be available to enable and disable the automatic transfer scheme.
 - In **MANUAL** position
 - Automatic transfer is blocked
 - Switches may be opened and closed at will from their control switches.
 - In **AUTO** position
 - The transfer scheme shall be operable
 - Motor operated service and tie switches may be tripped from their control switches.
 - Tripping a main switch from its control switch, with 43 in AUTO, shall disable the auto transfer scheme. A lockout relay may be upset to accomplish this requirement.
 - Motor operated main and tie switches shall not be able to be closed from their control switches
 - All transfers shall be OPEN transition (break before make).

- Upon loss of voltage to either service, with a recommended 2 second time delay, the scheme shall:
 - Verify loss of voltage to the affected service
 - Verify acceptable voltage is available on the alternate service
 - Verify all lockout relays are reset
 - Open the service switch on the affected service and close the tie switch
 - Upon return of acceptable voltage to the affected service, restoration to split load shall require a MANUAL operation.
 - Automatic "GOOD LINE SEEKING" is permitted after a transfer to one line (transferring the total load from one available line to another as needed to maintain service until normal operating configuration can be established). After a recommended 2 second time delay, the motor operated service switch on the affected line shall open and the motor operated service switch of the available line shall close, provided all lockout relays are reset. The tie switches may remain closed during good line seeking operations.
- e. A means shall be provided to test the automatic transfer scheme by simulating loss of voltage for each service
- f. Slip contacts (remain closed after trip or close) in the motor operated main and tie switch control switches shall **NOT** be used in the control scheme.

7.3.3 Regular-Reserve Service

Regular-Reserve service consists of two services connected directly to a common bus. Each service shall have separate, acceptable service disconnect and overcurrent devices. The bus will be supplied normally from only one service. The other service will be used as a reserve in the event the normal service is interrupted or disconnected. The "NORMAL" line shall be designated by PECO, and may change with notice to the customer. The transfer bus shall be on the load side of the service overcurrent devices. (See Tables 10.27 and 10.28).

Only one service control assembly shall be permitted for each service.

Exception – Connections shall be permitted on the line side of each service disconnect to supply PECO accepted service assemblies for a fire pump supply. This fire pump connection shall meet the requirements of Section 7.4.

7.3.3.1.1 Required Features For Regular/Reserve Circuit Breaker Assemblies

- a. The main breakers must be connected to a control power source that is available when all breakers are open, permitting operation of close coils, trip coils, and charging mechanisms. Acceptable systems include a station control battery or an AC source derived from the line VTs with a transfer switch (Dev 83) to select power from either line VT. Control Power Transformers (CPT) are not permitted to be connected on the line side of PECO Energy's metering transformers.
- b. Service overcurrent relays shall operate a LOCKOUT (Dev 86) relay for the associated service. This device shall trip the associated service breaker and lockout (prevent closing) both service breakers.
- c. An AUTO / MANUAL (Dev 43) selector switch shall be available to enable and disable an automatic transfer scheme.
 - In **MANUAL** position
 - Automatic transfer shall be disabled.
 - Breakers shall be permitted to be tripped and closed at will, including paralleling of the main breakers and closing on a de-energized line.
 - The customer may elect to prohibit manually paralleling and closing on a de-energized line, however this feature must be defeatable through a permissive switch (Dev 69). This switch must have two positions NORMAL / PARALLEL and must NOT be key operated.
 - In **AUTO** position
 - The transfer scheme shall be operable
 - Service breakers may not be closed from their control switches
 - Paralleling of the mains is prohibited. If the main breakers are paralleled when Dev 43 is switched to the auto position, one of the service breakers shall trip.
 - Main breakers may be tripped from their control switch, which must also disable the auto transfer scheme. The breaker's associated lockout relay may be upset to accomplish this requirement. Slip contacts in the control switch may not be used to disable the auto scheme.
 - The control scheme shall NOT determine which service is to be considered the normal supply.
 - Upon loss of voltage to the connected service, and voltage is available on the alternate source, the associated breaker shall trip, after a pre-set time delay (2 seconds recommended). The alternate breaker shall close after verifying that the service voltage on the connected line has been lost, the connected service breaker has opened, and voltage on the alternate line is available.

- Upon restoration of voltage to the previously connected service, no further breaker operations shall occur.
 - Reconnecting to the previously connected service shall be a manual operation.
 - The scheme shall automatically "seek a good line", as needed, to maintain service to the facility.
- d. Slip contacts (remain closed after trip or close) in the main breaker control switches shall **NOT** be used in the breaker control scheme.
- e. A means shall be provided to test the automatic transfer scheme by simulating loss of voltage for each service

7.3.3.1.2 Required Features For Regular/Reserve Motor Operated Switch / Fuse Assemblies

- a. Switch assemblies for Regular/Reserve service shall include a manually operated main load break switch on the line side of the service fuse, and the motor operated switch on the load side of the fuse.
- b. The motor operated switches shall be connected to a control power source that is available when all switches are open, permitting operation of close and open circuitry, and charging mechanisms. Acceptable systems include a station control battery or an AC source derived from the line VTs with a transfer switch (Dev 83) to select power from either line VT. Control Power Transformers (CPT) are not permitted to be connected on the line side of PECO Energy's metering transformers.
- c. The motor operated switches shall be electrically and mechanically interlocked to prevent paralleling of the services
- d. An AUTO / MANUAL (Dev 43) selector switch shall be available to enable and disable an automatic transfer scheme.
- In **MANUAL** position
 - Automatic transfer is blocked
 - Switches may be opened and closed at will from their control switches.
 - In **AUTO** position
 - The transfer scheme shall be operable
 - Motor operated service switches may be tripped from their control switches.
 - Tripping a main switch from its control switch, with 43 in AUTO, shall disable the auto transfer scheme. A lockout relay may be upset to accomplish this requirement.

- Motor operated switches shall not be able to be closed from their control switches
 - All transfers shall be OPEN transition (break before make).
 - The control scheme shall not determine which service is to be considered the normal supply.
 - Upon loss of voltage to the connected service, and voltage is available on the alternate source, the associated service motor operated switch shall open, after a pre-set time delay (2 seconds recommended). The alternate service motor operated switch shall close after verifying that the service voltage on the connected line has been lost, the connected service switch has opened, and voltage on the alternate line is available.
 - Upon restoration of voltage to the previously connected service, no further switch operations shall occur.
 - Reconnecting to the previously connected service shall be a manual operation.
 - The scheme shall automatically "seek a good line", as needed, to maintain service to the facility.
- e. Slip contacts (remain closed after trip or close) in the main breaker control switches shall **NOT** be used in the breaker control scheme.
- f. A means shall be provided to test the automatic transfer scheme by simulating loss of voltage

7.3.4 Parallel Operation of Services

Paralleling of services is not permitted except as listed in 7.3.4.1, 7.3.4.2, and 7.3.4.3 All fused services, 13 kV and higher, shall have interlock facilities that prevent paralleling All circuit breaker services 13 kV and above shall not have interlocks that prevent paralleling in the MANUAL operating mode.

7.3.4.1 Momentary Paralleling Momentary paralleling of primary services with circuit breakers rated 13 kV and above is permitted only upon notification to the Company and if transfer facilities accepted for the purpose have been provided by the Customer.

7.3.4.2 Automatic Closed Transition Transfers for Dual and Regular/Reserve Services

Customers with circuit breaker primary service control assemblies may specify incorporation of automatic closed transition, (make before break) transfers for scheduled switching, to restore to normal configuration or to transfer load from one line to another as needed for PECO or customer equipment maintenance. These schemes must have the following features:

- Device 43 must be in the MANUAL position
- Must include a permissive device (69) which has an OFF position, and positions to pre-select which breaker shall trip when the parallel is completed
- Verify normal 3-phase voltage is available on both services.
- Verify all service lockout Relays are reset
- Notify PECO Operation Control Center prior to initiation
- Must be manually initiated and fully automated to completion.
- Initiation shall be either by closing the open breaker by its control switch, or through a spring return or push button switch that initiates the sequence, and seals in until complete.

7.3.4.3 Continuous Paralleling

Continuous paralleling of services, 13 kV and above, with circuit breakers, may be accepted in rare cases, where the customer's operating requirements are unusual, and with special permission by the Company. The Company's distribution infrastructure and the customer's service facilities shall be designed for continuous parallel operation, including installation of circuit breakers and relays, designed for continuous parallel operation. Note: The restriction on paralleling also applies at utilization voltage levels derived from high voltage services unless special permission is granted by the Company.

Fire Pump Connections

7.4.1 2,400 2 Phase, 4,160, 13,200 and 33,000 Volt 3 Phase Single Services

PECO Energy shall permit fire pumps to be connected to services over 600 Volts on the line side of the service disconnects, in compliance with National Fire Protection Association life safety and National Electrical Code requirements. The installation shall also meet local building and fire code requirements. The fire pump connection shall have its own acceptable service assembly and transformer meeting the service ratings in table 7.01. The service cable may terminate in the fire pump service assembly, and be extended to the main service assembly or tapped in an acceptable splice box. Accepted modular "T" splices may be used to make the service tap.

7.4.2 2,400 2 Phase, 4,160, 13,200 and 33,000 Volt 3 Phase Dual and Regular/Reserve Services

Fire pumps supplied by dual or regular reserve services shall have the capabilities of transferring to either service, or have a back-up supply acceptable to the NEC Authority Having Jurisdiction. PECO may interrupt either service for extended periods to repair, maintain, or connect other customers to its distribution system. Switch and fuse fire pump service assemblies shall assure isolation of either supply for maintenance of PECO's supplies and or the customer's service fuses.

7.4.3 Fire Pump Metering Requirements

All fire pumps and their associated equipment loads shall be metered. Primary or compensated secondary metering shall be permitted. PECO Energy shall provide the necessary metering voltage and current transformers for the customer to install in an acceptable enclosure. The customer shall make all primary connections and provide secondary conduit per Section 8 in this manual, between the meter transformer enclosure and the meter instrument panel. The fire pump meter shall be located on or adjacent to the main service meter panel. PECO Energy shall make the secondary connections and install the meter on the mounting equipment installed by the customer.

7.5 Customer Substation Maintenance, and Operating Responsibilities

Customers with services over 600 Volts shall maintain their service equipment and substations to assure safe and reliable operation. The customer shall provide trained operating personnel to operate service equipment as requested by PECO Energy system operators. Substations shall be secured to prevent unqualified personnel from entry into energized compartments, and maintained to assure safe egress of personnel for inspection and operation. Services may be terminated if customer substations jeopardize PECO Energy system reliability or present a safety hazard to operators or the general public.

7.6 Customer Substation Access

In the event of an emergency or for normal access a 24 hour-7 day a week contact phone number and the name of the responsible person shall be provided to PECO Energy Co. If in an emergency contact cannot be made with the responsible person of record at the designated contact phone number, PECO Energy Co. reserves the right to break and enter the property to gain access to the high voltage equipment in order to secure the emergency and facilitate repairs. PECO Energy Co. will secure the property and have local law enforcement agency on site during the break and entry process. PECO Energy Co. will make every attempt to notify the customer after a break entry has occurred.

NOTE: Any reference in this section to Figures or Tables 8.??, 10.?? or 12.?? can be found in Sections 8, 10 or 12, of this book, titled "Metering", "Accepted Equipment" and "Illustrations" respectively

CHAPTER 7 APPENDIX A

PECO ENERGY COMPANY MEDIUM VOLTAGE METAL ENCLOSED OR METALCLAD SERVICE SWITCHGEAR REQUIREMENTS FOR HIGH-TENSION CUSTOMERS

1.0 General

- 1.1 The customer's high-tension switchgear shall be built in accordance with this specification. All equipment and tests shall conform to the latest applicable approved standards of the Institute of Electrical and Electronics Engineers (IEEE), the National Electrical Equipment Manufacturers Association (NEMA), and the American National Standards Institute (ANSI).
- 1.2 Acceptance of electrical equipment; switches, circuit breakers, fuses, relays, etc., for use as service entrance, shall be dependent upon the Company's receipt and acceptance of the manufacturers' specifications and designs and the manufacturer's certification of the testing procedures used to ensure that the equipment conforms to applicable standards.
- 1.3 Acceptance of switchgear assemblies for service entrance and metering will be dependent upon a review of the manufacturer's specifications and drawings plus physical inspections of the equipment.
- 1.4 Accepted service entrance equipment components are listed in Chapter 10 of the Company's Electric Service Requirements (ESR). This document is available on the Company's web site: http://www.exeloncorp.com/peco/cbs/epc_cbs_resources.shtml. Listing by the Company shall not relieve the manufacturer of responsibility for the sufficiency of its design or the performance of the equipment.
- 1.5 PECO Energy sign requirements are in addition to any signs required by NEMA, ANSI, IEEE, or the National Electrical Code. These signs shall have one inch black lettering on white background unless specifically noted other wise. The word "DANGER" shall meet ANSI Z535.

2.0 Service Equipment Review

- 2.1 The manufacturer shall furnish two copies of its drawings for the Company's acceptance or comment (In the alternative, a single copy may be transmitted electronically in Adobe Acrobat portable document format). These drawings are to be sent to the New Business Customer Engineering address listed in Section 1.9. Drawings shall include a single line diagram, sections and elevation views, and AC and control schematics for circuit breaker designs.
- 2.2 The submitted drawings shall include a list of major equipment and ratings.
- 2.3 To be listed as an accepted assembly in figures 10.23P through 10.33 in the ESR, the manufacturer shall assign a permanent standard number to drawings submitted for review. Upon acceptance of the design, **one** copy of the drawing shall be provided to PECO in Adobe Acrobat portable document format (pdf).

- 2.4 The manufacturer of accepted assemblies shall supply two copies of accepted assemblies for each individual customer location at the time of installation.

3.0 Construction Features

3.1 Service Cable Compartment

- 3.1.1 The service cable termination compartment shall be a separate compartment and isolated with grounded steel barriers. The following equipment shall be permitted to be located in this compartment: service cable, terminations, surge arresters, current transformers for relay protection, insulator supported bus, and connections to voltage transformers.

Exception: When a design has been accepted where the service switch occupies the same compartment as the service entrance cables, the switch shall be oriented such that the blade is connected to the service cable terminations and the required phase bus ground stabs. This hot blade orientation is required to limit exposure to a possible back feed while applying safety grounds to the service cables.

- 3.1.2 The service cable compartment shall not be used for installing metering transformers, service fuses, load cables or storage.
- 3.1.3 The service cable compartment door shall be hinged and bolted or latched shut, and shall have provisions for padlocking. It shall NOT be interlocked with the service switch.
- 3.1.4 3 Bus Phase Markings - Mark the appropriate phase letters "A", "B", "C" or "1", "2", "3" on the bus or on the steel work near the bus to identify the expected phase connections.
- 3.1.5 Service equipment installed outdoors shall have rainproof outdoor enclosures. Service equipment installed indoors shall have drip proof enclosures.
- 3.1.6 Bus installed on the source side of the service overcurrent device shall be supported on insulators rated for full phase-to-phase voltage, or Company accepted equal.
- 3.1.7 The service compartment shall provide sufficient vertical clearance from the incoming service cable conduit to the incoming cable connectors on the bus for termination of the service cable. The minimum vertical clearance shall be 36 inches.
- 3.1.8 Where opening the service compartment door exposes unshielded conductors or insulated bus operating above 600 Volts, the compartment shall have an inner barrier, hinged and bolted closed, labeled with a danger sign and the highest voltage present. The inner barrier shall provide the ability to inspect the compartment without opening the barrier. An expanded metal barrier is recommended.
- 3.1.9 Terminations, Safety Grounds, or Isolation Provisions – The service cables may terminate with live front cable terminations or insulated elbow connectors per the following requirements in 3.1.9.1 through 3.1.9.3:

3.1.9.1 Live Front Terminations

3.1.9.1.1 Provide long barrel, compression terminal connectors for all terminations, except clamp type terminal connectors may be supplied for dry indoor locations with copper conductors. Circumferential type compression lugs are required for aluminum conductors.

3.1.9.1.2 Each phase bus shall be equipped with provisions to attach a temporary ground clamp, consisting of a round copper or silver-plated copper bar with a 3/8 inch minimum diameter. The grounding provisions shall provide a 1-1/2 inch wide, round, horizontal surface for attachment of the clamp jaw, with a minimum 2-1/2 inch clearance to the attached bus, and must be accessible from the opened service cable door. Cable terminations, surge arresters and other auxiliary equipment permitted in the compartment shall not obstruct the grounding device. A similar grounding provision shall be attached to the switchgear ground bus in the service cable compartment, readily accessible from the rear door opening. These grounding provisions shall be positioned to support the weight of the clamp while being tightened.

EXCEPTION: Where the customer provides electrical maintenance personnel trained in medium voltage switchgear operation, an acceptable ground and test device may be provided to replace the phase ground stabs.

3.1.9.1.3 An inner barrier meeting section 3.1.8 is required.

3.1.9.2 Load Break Elbow Connectors

3.1.9.2.1 Ports for Load Break Elbows, rated 200 Amps, shall be of an acceptable manufacturer and type as listed in Chapter 11 of PECO Energy's ESR. Elbow connectors shall be fully insulated, rated 15 KV for 13.2 KV services and 35 KV for 33 KV services.

3.1.9.2.2 Provisions shall be made to connect elbow style surge arresters on the line side of the service switch. A separate port or T style surge arrester is acceptable. Surge arresters shall be rated as listed in section 3.2.

3.1.9.2.3 Load break service cable elbows must have a parking station available for PECO crews to disconnect the elbow and secure it in a parking device for line work isolation.

3.1.9.3 Dead Break Elbow Connectors

3.1.9.3.1 Ports for Dead Break Elbows, rated up to 600 Amps, shall be of an acceptable manufacturer and type as listed in Chapter 11 of PECO Energy's ESR. Elbow Connectors shall be fully insulated, rated 15 KV for 13.2 KV services and 35 KV for 33 KV services.

3.1.9.3.2 Dead Break Elbow installations shall provide a means to ground the service cable without removing the elbow from the port. Any of the following in a) or b) are acceptable:

a) An internal grounding switch where the following items are satisfied:

1) Provide a visible verification of position.

- 2) Provide a direct read voltage test port to verify de-energized service cables before closing the ground switch.
 - 3) A padlock provision to prevent customer operation of the ground switch.
- b) Provide a separate, 200 Amp load break port and cover for voltage testing and insertion of three ground cables terminated with 200 Amp Load Break Elbows. The ground cables shall be provided with the equipment and stored in the service cable compartment. An elbow arrester port may be substituted for a separate port.

3.2 Surge Arresters

- 3.2.1 Surge arresters may be distribution, intermediate, or station class. They shall have a minimum Duty-Cycle Voltage Rating of 15 kV for 13.2 kV services, 27 kV for 33 kV services with 3 phase, 4 wire, solidly grounded supplies, or 36 kV, intermediate class for 33 kV services with 3 phase, 3 wire supplies.
- 3.2.2 Surge arresters with disconnectors or external gaps are not acceptable for installation in switchgear.
- 3.2.3 Surge arresters shall be directly connected to the switchgear ground bus. The connections to the surge arresters shall be equivalent to No. 6 copper wire or larger and as short and straight as practicable, avoiding sharp bends.
- 3.2.4 A barrier shall be installed between the arresters and the service cable and between the arresters and the service switch for protection from an arrester failure. Arresters acceptable to PECO Energy of a non-porcelain material design may be installed without the barriers.
- 3.2.5 Surge arresters shall be installed on the line side of the service switch or circuit breaker.

3.3 Line Voltage Transformers

- 3.3.1 Voltage transformers rated up to 2000 VA may be connected on the line-side of PECO's metering or the service-disconnecting device to monitor the incoming service voltage.
- 3.3.2 Provisions shall be installed to electrically isolate line VTs from the service cable. Isolation switches for this purpose shall provide a visible break and be lockable in the open position. Draw-out VTs shall include provisions for disconnecting primary and secondary connections, be lockable in the draw-out position only, and be of dead front design.
- 3.3.3 The line VT shall not supply power to heaters or other auxiliary equipment.
- 3.3.4 Control power transformers (CPT's), in excess of 2,000 VA shall be connected on the load-side of the PECO Energy metering transformers.

3.4 Metering Compartment

- 3.4.1 The metering compartment door shall be hinged with provisions for padlocking. It shall not be interlocked with the service switch. The compartment shall have an inner barrier,

hinged and bolted closed, labeled with the highest voltage present, and provide the ability to inspect the compartment without opening the barrier. An expanded metal barrier is recommended

- 3.4.2 Facilities shall be provided for mounting and wiring the metering transformers (supplied by the Company), in accordance with the latest revisions of the Company's drawings (MF641 – 5 kV class, MF544 – 15 kV class, and MF902 – 34.5 kV class).
- 3.4.3 Whenever a metering voltage transformer (VT) is mounted in an inverted position, the support bracket shall be designed so that the VT is supported in a trough or rack before the mounting bolts are secured.
- 3.4.4 A 6 x 6 x 4 inch junction box shall be provided for metering secondary connections.
- 3.4.5 Rigid steel conduit, intermediate metal conduit, or electrical metal tubing one-inch minimum diameter, shall be extended from the junction box to the vicinity of the secondary terminals of the metering transformers. NOTE: Larger conduit will be required if both the VT and CT secondary conductors are in the same conduit. The conduit shall be secured at locations that will maintain correct minimum electrical clearance within the switchgear. Proper fittings shall be installed to ground the conduit.
- 3.4.6 Metering voltage transformers shall be connected on the source side of the current transformers.
- 3.4.7 Metering transformers shall be arranged so that they can be safely and easily replaced. Isolation from service cables shall be provided by an open service switch or circuit breaker.
- 3.4.8 The Company's metering Voltage Transformers (VT's) at 2.4, 4.16, 13.2 kV and 33 kV require transformer fuse protection. 2.4, 4.16 and 13.2 kV VT's shall be supplied by PECO with external clip mountings and fuses. 33 kV VTs shall require self-supported, free standing fuse clips for GECO EJO-1, 38 kV current limiting fuses rated 2E and shall be installed by the equipment supplier as part of the switchgear. PECO Energy shall provide the 2E fuse refills
- 3.4.9 Adequate electrical clearance shall be maintained to all energized parts of metering transformers. VTs and fuses shall have adequate phase to ground clearance. Where phase-to-phase clearances are less than adequate, inter-phase insulator barriers shall be installed between VT connectors or fuse clips. Where CT connection clearances are less than adequate, high voltage tape or insulating boots may be applied to the CT connections. The CT primary polarity mark shall not be covered.
- 3.4.10 Bus Phase Markings - Mark the appropriate phase letters "A", "B", "C" or "1", "2", "3" on the steel work near the meter transformers so that the transformers and conductors are identified and coordinate with the service compartment phase markings.

3.5 Heaters

- 3.5.1 Heaters adequate to prevent condensation shall be provided in outdoor switchgear.
- 3.5.2 Heaters shall be supplied from a metered electric circuit.

- 3.5.3 Heaters shall NOT be controlled by a thermostat, humidistat, or local switch.
- 3.5.4 When heaters are located where they may be hazardous to personnel, they shall be provided with protective covers.

3.6 **Miscellaneous**

- 3.6.1 Bare energized parts shall maintain the clearances specified in Table **490-24** of the National Electrical Code, or be tested and certified by the manufacturer in accordance with accepted national standards.
- 3.6.2 The manufacturer's nameplate shall include the voltage class, BIL, continuous current rating, fault close rating and interrupting ratings.
- 3.6.3 Adequate provisions shall be provided for grounding of all non-current-carrying parts of the switchgear.
- 3.6.4 Any automatic service transfer scheme shall conform to the PECO Electric Service Requirements, "**Automatic Service Transfer Facilities.**"

3.7 **Air Interrupter Switches and Fuse Assemblies**

- 3.7.1 The switch shall be equipped with a gang-operated quick-make and quick-break operating mechanism.
- 3.7.2 The switch-operating handle shall be in the upper position when the switch is closed, and lower position when the switch is open. The switch handle height shall conform to National Electric Code section 404.8.
- 3.7.3 The switch compartment shall be equipped with a safety glass viewing window to allow positive determination of the switch position.
- 3.7.4 The assembly shall include a switch position indicator.
- 3.7.5 The switch handle shall have provisions for padlocking in the open position.
- 3.7.6 The interrupter switch handle shall be attached to the switch in such a manner that it cannot be readily removed.
- 3.7.7 The operating handle and the fuse compartment door shall be interlocked to prevent the opening of the fuse compartment door unless the switch is open, and to prevent closing the switch unless the fuse compartment door is closed and locked.
- 3.7.8 For dual and regular-reserve service equipment, non load-break isolating switches shall be interlocked to prevent operation unless an associated load-break switch is locked open. The fuse compartment door shall be interlocked with both the load-break switch and the isolator switch, requiring both switches to be locked open to gain access to the fuse.
- 3.7.9 For dual and regular-reserve service equipment, interlock facilities shall be provided to prevent paralleling of the services.

3.7.10 Opening the fuse compartment door shall not expose energized terminals of the switch. Barriers shall be provided where necessary to prevent exposure to energized parts.

3.7.11 One set of spare fuse refills shall be provided with suitable storage facilities mounted on the inside of the fuse compartment door.

3.8 Circuit Breaker Assemblies

3.8.1 Circuit breaker assemblies may be a draw-out or stationary type.

3.8.1.1 Equipment with stationary breakers shall have the following features in **a)** through **c)** below:

- a) An isolating switch shall be installed ahead of the breaker to provide a visible break.
- b) For dual services isolating switches are required on the line and load side of the CB.
- c) Non load-break isolating switches or disconnects shall be interlocked to the CB such that they are opened after the CB is opened, and closed before the CB is closed.

3.8.1.2 Equipment with draw-out type CB's shall have the following features in **a)** through **c)** below:

- a) Apparatus required to remove the breaker(s) from their compartments shall be provided and stored in the switchgear room. Outdoor installations require an outdoor storage facility for this equipment.
- b) Breakers shall have a disconnect position for testing the breaker and its associated controls
- c) Breakers shall have a racked out or disconnected position, with provisions for padlocking in this position.

3.9 Tamper Resistant Equipment

3.9.1 Equipment to be installed where accessible to unauthorized persons shall be tamper resistant. To meet these criteria the manufacturer's drawings shall state "Tamper Resistant" and indicate the following features.

3.9.2 Enclosures shall prevent entry of foreign objects that would interfere with the operation or function of the equipment, touch energized parts, or create a safety hazard.

3.9.3 All exposed bolts shall be carriage-head type or require a special tool for removal. When a special tool is required, one shall be supplied to the customer.

3.9.4 Lockable cover(s) are required for key-interlock systems, switch handles (in both the open and closed positions), and the switch viewing windows.

- 3.9.5 All hinge pins shall be concealed.
- 3.9.6 Each exterior door shall be equipped with a captured, recessed, penta-head bolt (1/2 inch).
- 3.9.7 Padmount transformers shall have a captured, recessed, penta-head bolt and provisions for padlocking.

CHAPTER 7 APPENDIX B

PECO ENERGY COMPANY **MEDIUM VOLTAGE SERVICE SUBSTATION SIGNS**

The rate HT electric service agreement between the PECO ENERGY Company its customer states, among other things, that the customer must provide necessary designation signs in the high-tension substation. The recommendations given here are the minimum that will meet the Company's requirements. Additional signs may be required by the authorized inspection agency or to meet specific conditions.

All signs must comply fully with "American National Standards Specifications for Accident Prevention Signs" Z535-4, "Safety Color Code for Marking Physical Hazards" Z 535-4, and OSHA Section 1910.145.

All letters shall be 1 inch in height, except where noted.

1. **13,200 and 33,000 Volt Service Control Units**

On the front door, mark:

LINE CIRCUIT BREAKER
13,200 (33,000) VOLTS

Or

LINE LOAD BREAK SWITCH
13,200 (33,000) VOLTS

For Dual or Regular / Reserve service, mark:

SERVICE No. 1

(on the left unit facing the front of the equipment)

SERVICE No. 2

(on the right unit facing the front of the equipment)

2. **Service Cable Compartment Door**

On the door of the compartment containing the incoming cable terminations, mark with 1 ½ inch lettering:



For Dual or Regular / Reserve service, mark:

SERVICE No. 1

(on the left unit facing the front of the equipment)

SERVICE No. 2

(on the right unit facing the front of the equipment)

On the steel work supporting the incoming service termination's, mark phase letters "A", "B", "C" or "1", "2", "3"

3. **Circuit Breaker Compartment in Metalclad Switchgear**

On or near the metal shutters which cover the station primary circuit breaker terminals, mark phase letters "A", "B", "C" or "1", "2", "3" left to right when facing the shutters. Also mark "Bus" and "Line" near the appropriate edge of the shutters.

4. For Regular / Reserve or dual service with main line load switch and a transfer switch which also provides isolation to maintain the fuses, mark:

**ISOLATING SWITCH
13,200 (33,000) VOLTS**

SERVICE No. 1

(on the left unit facing the front of the equipment)

SERVICE No. 2

(on the right unit facing the front of the equipment)

5. **13,200 and 33,000 Volt Bus Tie Units**

On the front door, mark:

**BUS TIE CIRCUIT BREAKER
13,200 (33,000) VOLTS**

Or

**BUS TIE INTERRUPTER SWITCH
13,200 (33,000) VOLTS**

6. **13,200 and 33,000 Volt PECO Meter Compartments**

Where access to PECO metering transformers is from a single compartment door, the outer door shall be marked:

**PECO METER TRANSFORMERS
13,200 (33,000) VOLTS**

For Regular / Reserve or dual service mark:

SERVICE No. 1

(on the left unit facing the front of the equipment)

SERVICE No. 2

(on the left unit facing the front of the equipment)

Where access to the current transformers and voltage transformers is not from the same compartment door, each outer door shall be marked to indicate the PECO metering equipment contained therein, and marked as follows:

**PECO METERING
CURRENT TRANSFORMERS
13,200 (33,000) VOLTS**

**PECO METERING
VOLTAGE TRANSFORMERS
13,200 (33,000) VOLTS**

On the steel work supporting the bus in the metering compartment, mark phase letters "A", "B", "C" or "1", "2", "3", as appropriate.

7. **Ground and Test Device for Metalclad Switchgear**

On the portable grounding device, mark "**LINE**" and "**BUS**" in such a manner that the position being grounded is obvious. If the grounding device is to be used in feeder units, it should be marked to show that "**LINE**" refers to the outgoing feeder.

The grounding device is not to be used in bus tie units.