PECO REQUIREMENTS FOR PARALLEL OPERATION FOR CUSTOMERS WITH GENERATION NOT EXCEEDING 50kW

FOREWORD

This manual known as the "Yellow Book" ("Requirements for Parallel Operations for Customers with Generation Not Exceeding 50 kW") contains PECO's requirements for customers who wish to interconnect small Distributed Energy Resources ("DER"s) to PECO's electric distribution system.

The requirements published in this manual supersede any requirements that were published in its previous revisions. This manual will be updated from time-to-time. Please visit PECO's website to ensure use of the most recent version, as updates will be posted there when they become effective.

Equipment, regulatory changes, and other evolving issues may necessitate the implementation of changes prior to publication of the next revision of the manual. For this reason, customers should confer with PECO to ensure that they are planning their work in conformance with any recent changes that are not reflected in this edition of the Yellow Book.

Please contact the PECO Green Power Connect team with questions about this manual or for additional information about PECO services.

A. CUSTOMER ELIGIBILITY

Applicant must be a PECO customer with at least a 60 Amp, 120/240 Volt secondary service. This document only applies to locations where the total generation to be paralleled with the PECO system is limited to 50kW.

B. EQUIPMENT REQUIREMENTS

Figures 1 through 4 show examples of arrangements of equipment, although they are not intended to serve as design documents. The Interconnecting Customer ("IC") is responsible for designing, installing, operating, and maintaining its own equipment in accordance with interconnection agreements and applicable standards. The customer shall furnish, install and maintain the following equipment:

1. **COMPATIBLE EQUIPMENT:** The interconnection equipment (energy conversion facilities, generator and necessary interface equipment) is required to be successfully tested in accordance with IEEE Standard 1547 (as amended and supplemented). It must also comply with the appropriate codes and standards of UL Publication 1741 (as amended and supplemented) demonstrated through testing and certification by any OSHA's Nationally Recognized Testing Laboratory ("NRTL")

2. **NEC CONFORMANCE:** The service shall be modified per most recent National Electrical Code® ("NEC"), to accommodate an interconnected electric power production source.

3. **DISCONNECT SWITCH:** A readily accessible disconnect switch which is pad lockable in the open position and provides a visible break shall be installed between the AC output of the interconnected power source and its connection to the premises wiring system. For residential services, this switch shall be located outdoors, as close as practical to the utility meters. If this disconnect switch is not visible from the utility meters, a plaque shall be located at the utility meters indicating the presence and location of this disconnect switch. For commercial or industrial services, this switch may be located indoors only by special permission from PECO, and only where conditions of maintenance and supervision ensure that the customer can provide qualified persons, available 24/7, to service and operate the system as required by PECO.

4. **METERING OPTIONS:** All services shall be metered for registered kWh and/or kW usage as dictated by PECO's Electric Service Tariff as approved by the Pennsylvania Public Utility Commission ("PA PUC"). The qualifications for Net Metering are also listed in the PECO 'Rate RS-2 Net Metering' section of PECO's Electric Service Tariff. PECO will provide meters as described in the table below for customers electing a Net Metering option. Customers must provide and install the required meter sockets or metering transformer enclosures to contain the PECO metering equipment. **For residential**, all meters must be outdoors as indicated in Section 8 of PECO's Electric Service Requirements (Blue Book), with space for mounting a copy of the source directory required per NEC, Article 705.10, showing location of all electrical sources to the premises.

The various metering options available are indicated in the table below:

Option	Description	Meter Configuration	Notes
A	Net Metering	• 1 – IN/OUT (Bidirectional)	Residential Only. Customer billed monthly for net usage.
B	Net Metering	• 1 – IN • 1 – OUT (Two meter concept)	Non-Residential only. Customer billed monthly for net usage.
C	Single Meter, Detented	• 1 Meter IN only	Metering option only available when generation output does not exceed premise load. Customer does not expect to export power or Net Meter.
D	Virtual Net Metering[1]	• Any # of Meters IN • Any # of Meters OUT	Virtually net metered PECO accounts must be in the same customer's name. In addition, the meters must be located within two miles of the boundaries of the generating customer's property and within PECO's service territory.

E	Sale of Energy to Third Party	• Separate Service to System
		• 2 Total Meters
		  ○ 1 – IN PECO
		  ○ 1 – OUT Third Party
			PECO meter reads IN only. Customer is billed for all registered usage. Third party agreement through PJM to purchase energy. OUT meter and communications to meet requirements of PJM.

a. **METER COLLARS:** The list below provides the manufacturers for devices that have been reviewed by PECO and are accepted for use. This list may be updated at PECO's discretion as additional models/manufacturer's equipment are requested and accepted. Installing multiple meter collars on the same meter base/socket is prohibited.

i. ConnectDER Solar

a) The ConnectDER Solar meter collar enables rapid connection of grid-ready distributed energy resources ("DERs"), especially solar photovoltaic systems, by creating a connection point to a collar that installs between a residential electric meter and a meter socket.

b) All guidelines, restrictions, and general operating procedures regarding installation and operation set forth by the manufacturer shall be followed.

5. **ELECTRICAL INTERFACE PROTECTION:** All interconnected power systems are required to monitor current, voltage, and frequency.

In the event PECO supply is interrupted, the interconnected power system must disconnect from the utility service in accordance with IEEE 1547 (as amended and supplemented) protection levels and time delays unless directed otherwise.

[1] Virtual net metering (also known as virtual meter aggregation) is the combination of meter readings and billing for multiple meters, regardless of rate class, on properties owned or leased and operated by the same customer solely by means of the Company's billing process.

Proof of certified compliance with IEEE 1547 (as amended and supplemented) must be submitted to PECO for review. If the interconnected power system is not certified to IEEE 1547 (as amended and supplemented), manufacturer specifications for frequency and voltage protection schemes must be submitted to PECO for review and shall only be interconnected at PECO's discretion.

Additionally, PECO shall have the right to require testing of the protection device systems at the customer's expense. Minimum protection requirements are dependent on the type of generation source as listed below. Additional protection may be required as deemed necessary by PECO.[2]

a. Overcurrent Protection - All Generation Types
Circuit breakers or fuse elements sized in accordance with the recent NEC must be present in the circuit interconnecting the generation source to the premise electrical system.

b. Utility Interactive Inverters
Utility Interactive Inverters shall meet IEEE 1547 (as amended and supplemented) and UL Publication 1741 (as amended and supplemented), which require monitoring the service voltage and frequency to detect utility service interruption and shut down the inverter operation upon loss of utility supply.

c. Induction Generators
A protective device meeting IEEE 1547 (as amended and supplemented) shall monitor the service voltage and frequency to detect utility service interruption and disconnect the induction generator from the grid.

d. Synchronous Generators
A protective device meeting IEEE 1547 (as amended and supplemented), shall monitor the service voltage and frequency to detect utility service interruption and disconnect the synchronous generator from the grid. PECO shall review these installations for their expected contribution to fault currents. The installer shall calculate the fault contribution of the synchronous generator at the service voltage, and submit to PECO the steady state, transient and sub transient impedance values (X_d, X'_d and X''_d) of the generator being installed. In addition, the installer must interconnect the source to supply the phase to neutral loads on the electrical service.

e. Self-Commutating Inverters
A protective device meeting IEEE 1547 (as amended and supplemented), shall monitor the service voltage and frequency to detect utility service interruption and disconnect the Self Commutating Inverter from the

[2] Utility inverters meeting the requirements of UL Publication 1714 and IEEE 1547 (as amended and supplemented) satisfy the interface protection requirements in this section.

electrical service. PECO shall review these installations for their expected contribution to fault currents. The installer shall calculate and provide to PECO the steady state fault current contributions of a self-commutating inverter to a single-phase fault on the service, and or a three-phase fault where appropriate. In addition, the installer must interconnect the source to supply the phase to neutral loads on the electrical service.

C. REQUIREMENTS FOR CONNECTION

1. The applicant shall submit the following online:
    a. An interconnection application
    b. A Service and Meter Application
    c. Appropriate application fee

    Interconnection levels and the related application fee structure are available on the PECO website.

2. The applicant's contractor shall submit a diagram, based on the templates provided in Figures 1 through 4, that includes at least the following:
    a. A specific location identifying where the point of electrical interconnection will be made with the premise wiring.
    b. A list of equipment ratings, conductor sizes and lengths, as well as fuse and breaker ratings.[3]

3. The applicant must utilize equipment that is certified to comply with the appropriate codes and standards of both UL Publication 1741 (as amended and supplemented) and IEEE Standard 1547 (as amended and supplemented). For certified inverters, the applicant must submit a specification sheet. For non-certified inverters, the applicant must submit all available manufacturers' information concerning the system's electrical components for PECO's review and consideration.

4. The installation shall be inspected by an electrical underwriter listed in PECO's Electric Service Requirements (Blue Book). The inspection must indicate that the system complies with all local municipality building codes as well as with recent versions of both the NEC and the National Electrical Safety Code. PECO will review and consider the application per PA Code Chapter 75 criteria. If the proposed installation is approved for connection to the PECO distribution system, PECO will forward the results to the submitter with instructions to modify PECO's metering installation. If PECO distribution facilities must be modified to meet the Chapter 75 criteria, the submitter will be notified per Section D ("Rearrangement of PECO Distribution Facilities") below. PECO will advise the contractor about the modified metering specification if needed.

[3] Transformer-rated metering installations will require special review for modification to the meter board. Figures 1 through 4 do not include this type of installation.

5. Upon the completion of the interconnected power system's installation and any required PECO system and or metering upgrades, the applicant shall complete each of the following: [4]
    a. Sign and submit PECO's *Certification of Completion* form prior to the interconnection application expiration timeframes outlined in the "Interconnection Expiration" section on Page No. 56 of PECO's current Electric Service Tariff.
    b. Submit an electrical underwriter's inspection of the interconnected power system wiring. The *Certification of Completion*. is available on the PECO *Net Metering and Interconnection* website.
    c. If required by PECO, satisfy PECO's requirement for a witness test. PECO will require testing of the system's protection scheme for systems meeting the following criteria:
        i. Any system which is not pre-certified by an independent testing laboratory as compliant with UL 1741 (as amended and supplemented).
        ii. Systems with field adjustable relays, which will require calibration by an independent testing service. A trip test shall be witnessed by a PECO representative. In addition, a test report of the relay calibrations shall be submitted to PECO for review.

D. REARRANGEMENT OF PECO DISTRIBUTION FACILITIES

When the review of a Level 1, 2, or 4 application determines that PECO facilities must be modified to accommodate the connection of the applicant's proposed system, the application will be returned to the applicant in order for the applicant to re-submit it as a Level 3 application and will be assessed a Level 3 application fee. An explanation of the reason for the return will be provided. The new Level 3 application will retain the queue position of the original application as applicable. Certain Level 3 projects may require additional reviews for which the applicant would be required to initiate and pay for an Interconnection Study in order to determine the modifications to PECO's system required to accommodate the interconnection of the proposed power system. After PECO determines which system modifications are necessary, PECO will prepare a Construction Agreement to communicate the nature of the required PECO system modifications, including costs (for engineering, procurement, construction, and overheads) and an estimated construction timeframe for completion of the modified project design. The applicant shall pay for any required modifications, in advance, prior to the commencement of any construction.

[4] PECO will **not** issue Permission To Operate ("PTO") until confirming that each of the following conditions has been met: (1) The Certificate of Completion has been completed and signed by the applicant; (2) The results of an electrical underwriter inspection have been submitted to PECO; and (3) The witness test has been either satisfied or waived.

FIGURE 1
RESIDENTIAL NON-UTILITY GENERATION
TYPICAL SERVICE & EQUIPMENT ARRANGEMENT

- All equipment shown, except for watt-hour meters (WHM), are owned, operated and maintained by the customer. Both breakers and switch/ fuse equipment may be interchanged. Symbols were selected for convenience only.
- Include all lengths, types of conductors, and types of conduit for each segment from generator and/or inverter(s) to the meter or main distribution panel
- Include all technical nameplate information for any inverter(s) and/or generator(s)

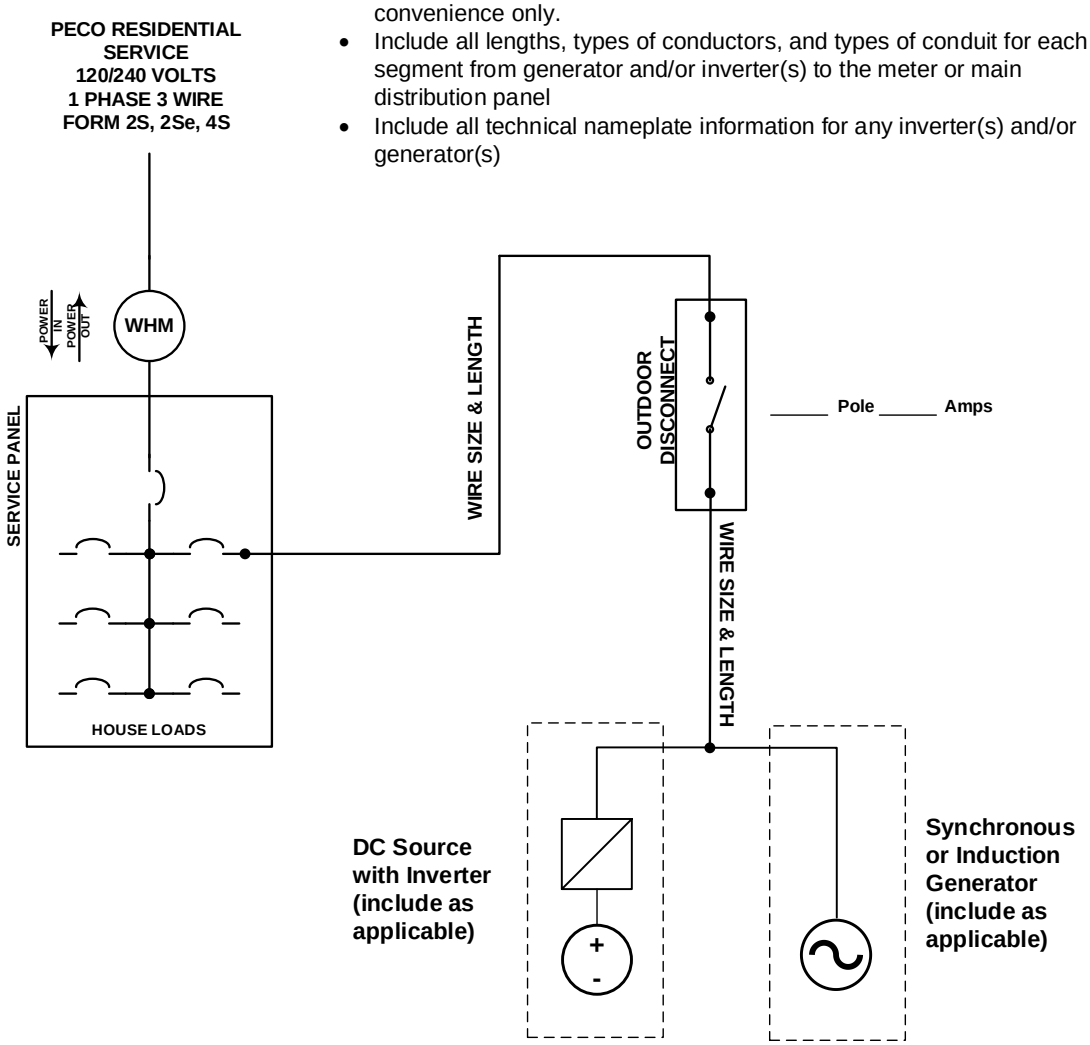


FIGURE 2
RESIDENTIAL NON-UTILITY GENERATION
TYPICAL SERVICE & EQUIPMENT ARRANGEMENT
WITH SUPPLY SIDE INTERCONNCETION

- All equipment shown, except for watt-hour meters (WHM), are owned, operated and maintained by the customer. Both breakers and switch/ fuse equipment may be interchanged. Symbols were selected for convenience only.
- Include all lengths, types of conductors, and types of conduit for each segment from generator and/or inverter(s) to the meter or main distribution panel
- Include all technical nameplate information for any inverter(s) and/or generator(s)
- Interconnection on the load side of the service disconnect requires special NEC considerations.

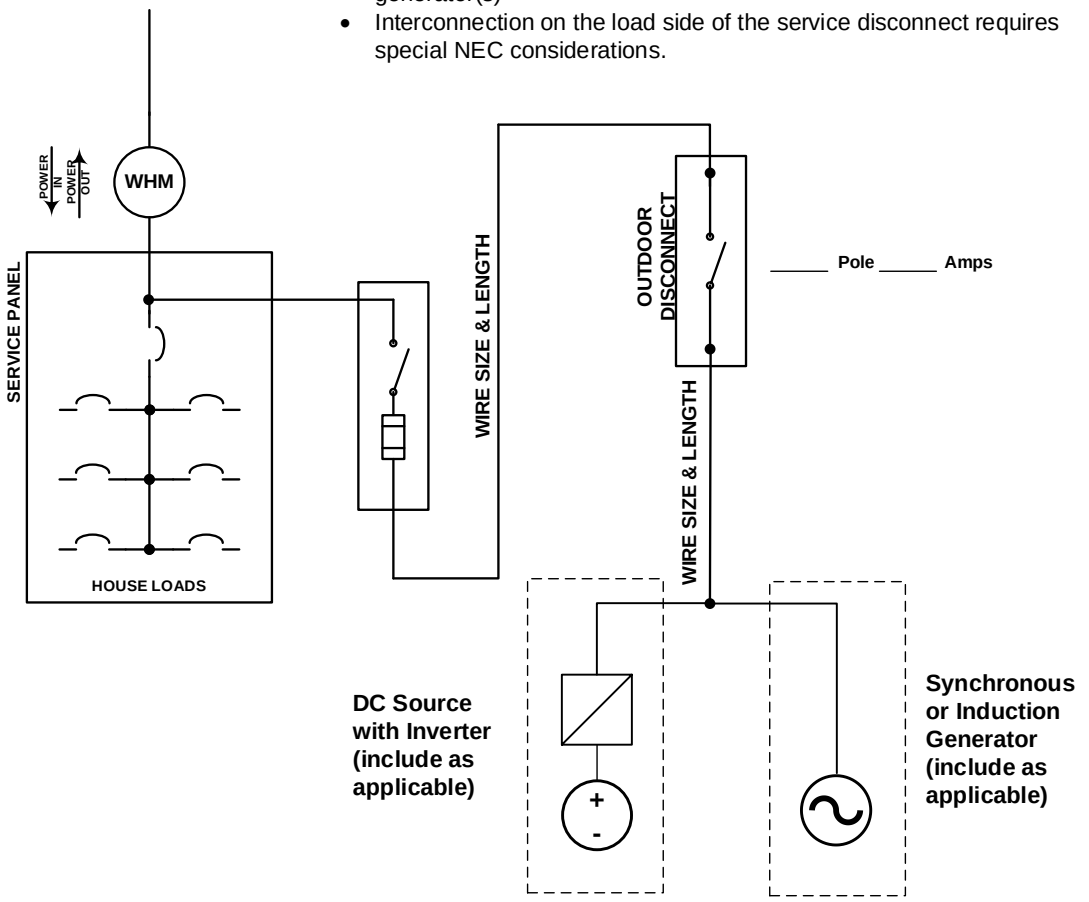


FIGURE 3
THREE-PHASE GENERAL SERVICE METER SOCKET
NON-UTILITY GENERATION
TYPICAL SERVICE & EQUIPMENT ARRANGEMENT

- All equipment shown, except for watt-hour meters (WHM), are owned, operated and maintained by the customer. Both breakers and switch/fuse equipment may be interchanged. Symbols were selected for convenience only.
- Separate*****, self-contained meter sockets of the same size shall be installed outdoors, with space provision for NEC Source directory. Meters register flow in direction shown. Meters are detented to prevent reverse registration
- Include all lengths, types of conductors, and types of conduit for each segment from generator and/or inverter(s) to the meter or main distribution panel
- Include all technical nameplate information for any inverter(s) and/or generator(s)

*** NO DEVICE, SUCH AS, BUT NOT LIMITED TO A LOAD SIDE DISCONNECT IS PERMITTED BETWEEN THE "IN" AND "OUT" METERS. METER BOARDS CANNOT BE MODIFIED TO ACCOMMODATE THE ADDITIONAL BOARD**

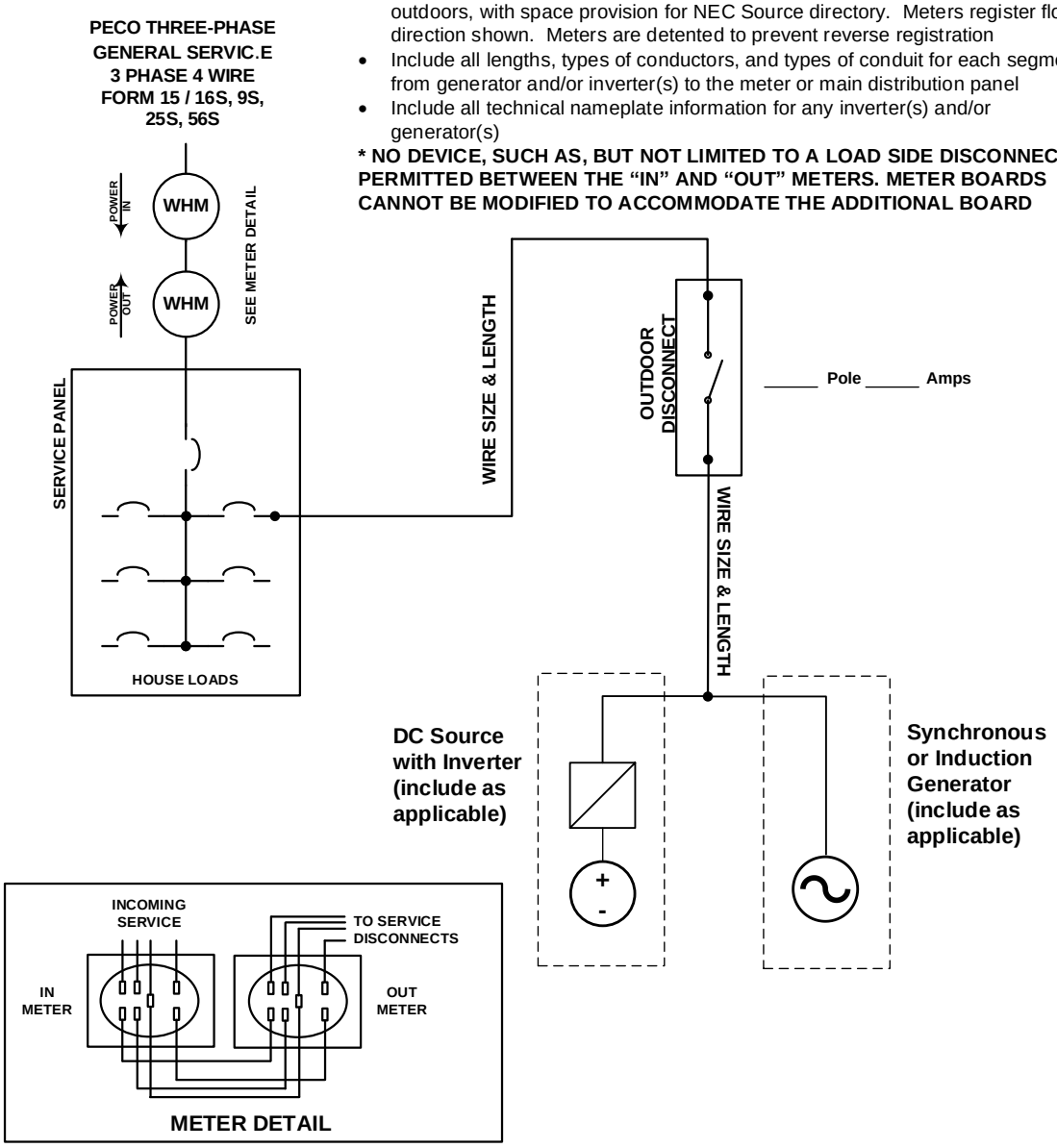


FIGURE 4
THREE-PHASE GENERAL SERVICE METER SOCKET
NON-UTILITY GENERATION
TYPICAL SERVICE & EQUIPMENT ARRANGEMENT
WITH SUPPLY SIDE INTERCONNCETION

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