

## **REQUIREMENTS FOR PARALLEL OPERATION FOR CUSTOMERS WITH GENERATION NOT EXCEEDING 50 kW**

### **FOREWARD**

“Requirements for Parallel Operations for Customers with Generation Not Exceeding 50 kW” is intended to be used as a guide for customers with small generators who wish to interconnect to PECO electric distribution system.

For additional information about PECO services and future updates of this document please contact the PECO New Business office.

### **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 50 kW.

### **B. EQUIPMENT REQUIREMENTS**

Figures 1 through 4 show suggested arrangements of equipment, although they are not intended as design documents. Customers with Utility Interactive Inverter power system interfaces which meet current standards set forth in UL Publication 1741 and IEEE 1547 are eligible for an expedited review. The customer shall furnish, install and maintain the following equipment:

1. **COMPATIBLE EQUIPMENT:** Energy conversion facilities, generator and necessary interface equipment to match PECO service.
2. **NEC CONFORMANCE** The service shall be modified per the National Electrical Code® (NEC), to accommodate an interconnected electric power production source ( See Articles 690, 692, and 705)
3. **DISCONNECT SWITCH** A readily accessible disconnect switch which is pad lockable and provides a visible break shall be installed between the AC output of the interconnected power source and its connection to the premise 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, industrial, or multi-tenant facilities larger than 5 units, this switch may be located indoors, by special permission, 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 KW usage as dictated by the PAPUC tariff. The qualifications for Net Metering are listed in the PECO 'Rate RS-2 Net Metering' Tariff. PECO will provide the IN and OUT meters 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 the residential, two meter option, both sockets must be outdoors, 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

### METERING OPTIONS

Option	Description	Meter Configuration	Notes
A	Net Metering	<ul style="list-style-type: none"> <li>• 2 Meters</li> <li>• 1 – IN</li> <li>• 1 - OUT</li> </ul>	Two meters - Customer billed monthly for net usage.
B	Single Meter, Detented	<ul style="list-style-type: none"> <li>• 1 Meter IN only</li> </ul>	Generation output should not exceed premise load. Customer does not expect to export power or Net Meter.
C	Sale of Energy to Third Party	<ul style="list-style-type: none"> <li>• Separate Service to System</li> <li>• 2 Meters</li> <li>• PECO IN</li> <li>• Third Party OUT</li> </ul>	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.
D	Virtual Net Metering	<ul style="list-style-type: none"> <li>• Multiple IN meters</li> <li>• Multiple OUT meters</li> </ul>	Combined registration of multiple usage and source meters within 2 mile radius under the same ownership and PECO account name.

5. **ELECTRICAL INTERFACE PROTECTION** All interconnected power systems are required to monitor current, voltage and frequency and to disconnect the power source from the utility service, per IEEE 1547 protection levels and time delays, if the PECO supply is interrupted. Over/Under Voltage, and Over/Under Frequency protection shall meet the requirements of IEEE 1547. Manufacturer specifications for frequency and voltage protection schemes must be submitted to PECO for review. If this protection is not an integral part of a listed, manufactured power source interconnection system, 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 installed such as reverse power, reverse current, or out of step relaying, at the manufacturer's discretion. *Note:*

*Utility Interactive Inverters meeting the requirements of UL Publication 1741, and IEEE 1547 satisfy these interface protection requirements.*

**a. Overcurrent Protection - All Generation Types**

Circuit breakers or fuse elements sized in accordance with the 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 UL publication 1741, which requires 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 shall monitor the service voltage and frequency to detect utility service interruption, and disconnect the induction generator from the service.

**d. Synchronous Generators**

Synchronous generators produce power without the need of a utility source for excitation, and have the capability to supply loads independent of the utility electric supply. 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 “ $X_d$ ,  $X'_d$ , and  $X''_d$ ” impedance values for the generator being installed. A protective device meeting IEEE 1547 shall monitor the service voltage and frequency to detect utility service interruption and disconnect the generator from the electrical service. Frequency protection shall be set to trip the generator if less than 59.5 Hertz or greater than 60.5 Hertz. In addition, these sources must be interconnected to supply the phase to neutral loads on the service.

**e. Self Commutating Inverters**

Self commutating inverters produce power without the need of a utility source for commutation, and have the capability to supply loads independent of the utility electric supply. PECO shall review these installations for their expected contribution to fault currents. The installer shall calculate 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.. A protective device meeting IEEE 1547 shall monitor the service voltage and frequency to detect utility service interruption and shut down the inverter. Frequency protection shall be set to shut down the inverter if less than 59.5 Hertz or greater than 60.5 Hertz. In addition, these sources must be interconnected to supply the phase to neutral loads on the service

### C. Requirements for Connection

1. The applicant shall submit the following to the appropriate PECO regional New Business office:
  - a. A Level 1, 2, 3, or 4 “INTERCONNECTION APPLICATION / AGREEMENT” application form
  - b. A PECO Service and Meter Application
  - c. Appropriate application fee

.Forms and fees are available on the PECO web site, [www.PECO.com](http://www.PECO.com), search “INTERCONNECTION”

#### APPLICATION LEVEL GUIDE LINE

Level	Size of Interconnected Power Source	Applicability
1	10 kW or Less	<ul style="list-style-type: none"> <li>• Power interface is inverter based.</li> <li>• Power interface with utility is pre-certified by a Listed testing agency to meet UL-1741 and IEEE 1547.</li> <li>• Exported power will be Net-Metered with PECO IN and OUT service meters, if the customer requests and meets the qualifications in the 'Rate RS-2 Net Metering' Tariff.</li> </ul>
2	>10 kW <= 50 kW	<ul style="list-style-type: none"> <li>• Power interface is inverter based.</li> <li>• Power interface with utility is pre-certified by a Listed testing agency to meet UL-1741 and IEEE 1547.</li> <li>• Exported power will be Net-Metered with PECO IN and OUT service meters, if the customer requests and meets the qualifications in the 'Rate RS-2 Net Metering' Tariff.</li> </ul>
3	<= 50 kW	<ul style="list-style-type: none"> <li>• Systems submitted as Level 1, 2, or 4 which were not approved</li> <li>• Systems which do not meet Level 1 or 2 criteria</li> <li>• Installation may require PECO system modifications to interconnect.</li> <li>• Non-Inverter based interface</li> <li>• Interface protection is not certified by a Listed testing agency to meet UL-1741 and IEEE 1547</li> <li>• Exported power will be Net-Metered with PECO IN and OUT service meters, if the customer requests and meets the qualifications in the 'Rate RS-2 Net Metering' Tariff.</li> </ul>
4	<= 50 kW	<ul style="list-style-type: none"> <li>• Systems submitted as Level 1 or 2 which were not approved</li> <li>• Export of power is not expected</li> <li>• Reverse power relays or other protection functions that prevent power flow onto the utility grid.</li> <li>• PECO service meter to be detented to register IN only</li> </ul>

2. A diagram, similar to Figures 1 thru 4, shall be submitted by the contractor indicating:
  - Where the electrical interconnection will be made with the premise wiring
  - List equipment ratings, conductor sizes, and fuse and breaker ratings

*Note: Transformer rated metering installations will require special review for modification to the meter board. This type of installation is not included in the Figures.*

3. Submit all available manufacturers' information concerning the system's electrical components.

*Note: not required for systems meeting IEEE Standard 1547, and UL Publication 1741.*

4. The installation must meet all local municipality building codes, the National Electrical Code, and the National Electrical Safety Code, and shall be inspected by an electrical underwriter listed in **PECO's Electric Service Requirements** handbook.
5. PECO will review the application per PAPUC PA Code Chapter 75 criteria. If the proposed installation is approved for connection to the PECO system, the results will be forwarded 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 shall be notified per section **D. Rearrangement Of PECO Distribution Facilities**, below.
6. Upon the completion of the interconnected power system's installation and any required PECO system and or metering upgrades, the applicant shall sign and submit PECO's *Certification of Completion* form and an electrical underwriter's inspection of the interconnected power system wiring, *The Certification of Completion*. is available on the PECO *Net Metering and Interconnection* webpage. PECO reserves the right to require a "witness test" of the system's protection scheme. Testing will be required for systems meeting the following criteria:
  - a. Any system which is not pre- certified by an independent testing laboratory (UL 1741).
  - b. Systems with field adjustable relays 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.

*Note: PECO net- meter billing will not become active until the "witness test" has been waived, or satisfied, the Certificate of Completion has been completed and signed by the applicant, and an electrical under writer inspection has been submitted.*

#### **D. Rearrangement Of PECO Distribution Facilities**

Where 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 system, the application will be returned to the applicant to be re-submitted as a Level 3 with appropriate Level 3 application fee. An explanation of the reason for the return will be indicated. The new Level 3 application will keep the queue position of the original application. A Level 3 review response may require the applicant to pay for an Interconnection Feasibility Study and or an Interconnection Impact Study, to determine the modifications to PECO's system required to accommodate the interconnection of the proposed power system. When the extent of PECO's system modifications have been determined, PECO will prepare an Interconnection Facilities Study to communicate the nature of the PECO system modifications, costs for engineering, procurement, construction, and overheads, as well as an estimated time to complete the construction associated with the modifications. The applicant must agree to pay for the modifications, in advance, before work begins.

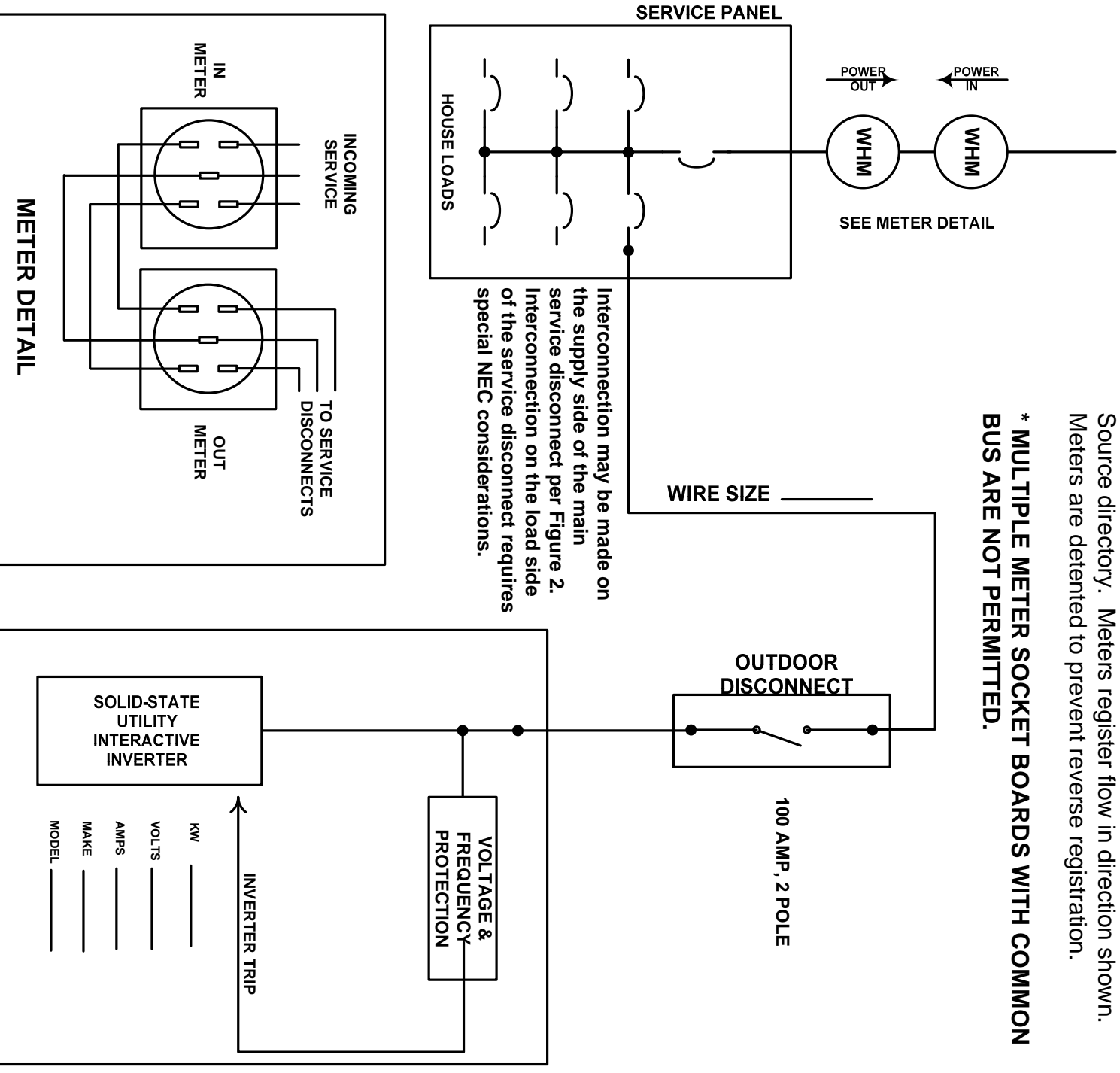
**FIGURE 1  
RESIDENTIAL NON-UTILITY GENERATION  
TYPICAL SERVICE & EQUIPMENT ARRANGEMENT  
PHOTOVOLTAIC / UTILITY INTERACTIVE INVERTER**

**PECO RESIDENTIAL  
SERVICE  
120/240 VOLTS  
1 PHASE 3 WIRE  
FORM 2S**

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.

**\* MULTIPLE METER SOCKET BOARDS WITH COMMON BUS ARE NOT PERMITTED.**



**FIGURE 2**  
**RESIDENTIAL NON-UTILITY GENERATION**  
**TYPICAL SERVICE & EQUIPMENT ARRANGEMENT**  
**SYNCHRONOUS OR INDUCTION GENERATOR**  
**AND PHOTOVOLTAIC / UTILITY INTERACTIVE INVERTER**

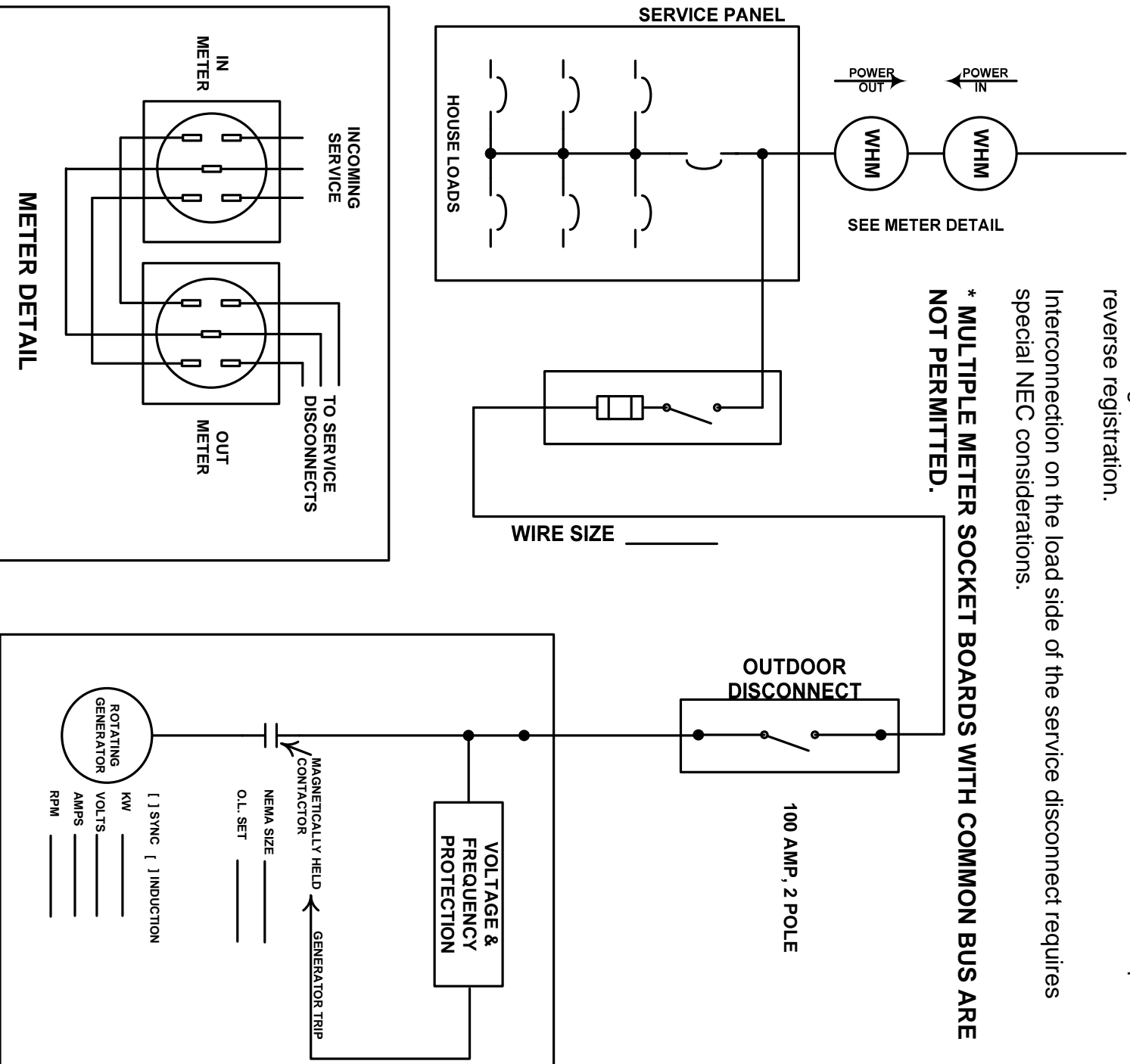
All equipment shown, except for watt-hour meters (WHM), are owned, operated and maintained by the customer. Both breakers and switch/fuse equipment may be interchanged. Symbols were selected for convenience only.

**PECO RESIDENTIAL SERVICE**  
**120/240 VOLTS**  
**1 PHASE 3 WIRE**  
**FORM 2S**

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.

Interconnection on the load side of the service disconnect requires special NEC considerations.

**\* MULTIPLE METER SOCKET BOARDS WITH COMMON BUS ARE NOT PERMITTED.**



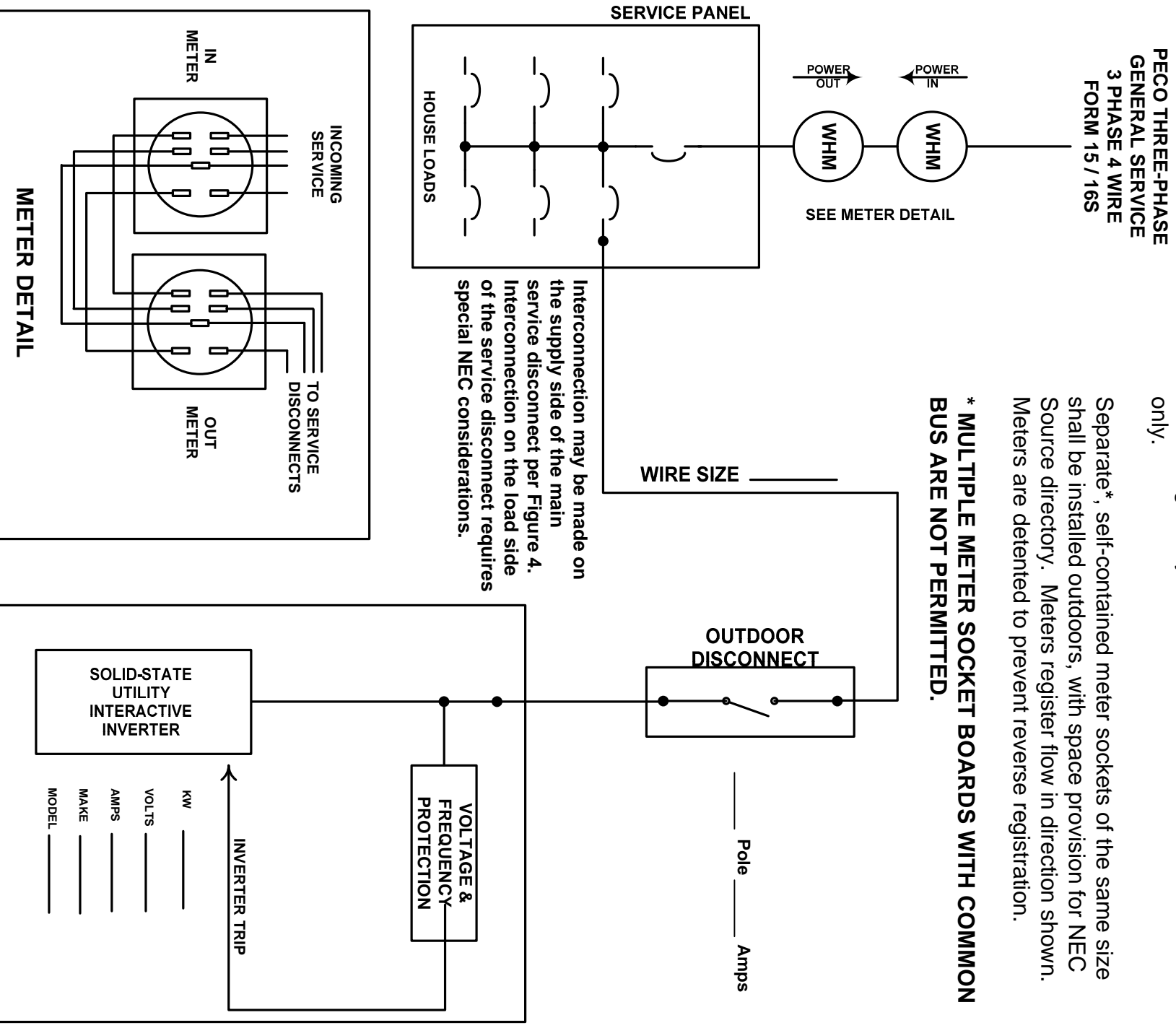


**FIGURE 3  
THREE-PHASE GENERAL SERVICE METER SOCKET  
NON-UTILITY GENERATION  
TYPICAL SERVICE & EQUIPMENT ARRANGEMENT  
PHOTOVOLTAIC / UTILITY INTERACTIVE INVERTER**

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.

**\* MULTIPLE METER SOCKET BOARDS WITH COMMON BUS ARE NOT PERMITTED.**



**FIGURE 4  
THREE-PHASE GENERAL SERVICE METER SOCKET  
NON-UTILITY GENERATION  
TYPICAL SERVICE & EQUIPMENT ARRANGEMENT  
SYNCHRONOUS OR INDUCTION GENERATOR  
AND PHOTOVOLTAIC / UTILITY INTERACTIVE INVERTER**

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.

PECO  
THREE-PHASE  
GENERAL SERVICE  
3 PHASE 4 WIRE  
FORM 15 / 16S

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.

Interconnection on the load side of the service disconnect requires special NEC considerations.

**\* MULTIPLE METER SOCKET BOARDS WITH COMMON BUS ARE NOT PERMITTED.**

