Customer-Owned Generation Manual

Wisconsin Public Service

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1. General

Introduction

Within this manual, whenever “Company” is listed, it is in reference to We Energies or Wisconsin Public Service. These requirements are applicable to all customer-owned generation facilities at which Company supply lines are terminated. For questions of requirement intent, a Company Field Application Engineer will provide an interpretation/clarification and shall be solely responsible for final determination of compliance.

The Customer-Owned Generation Manual is a list of Company requirements, not a design guide. The requirements contained herein are exclusively those of the Company. However, additional requirements applicable to customer-owned generation are set forth in the applicable Wisconsin State Electrical Code, IEEE Standards, and other codes and ordinances. The Company should be consulted only on matters relative to its specific requirements. Customers and consultants are advised to communicate directly with appropriate code enforcement authorities for matters which pertain to requirements of the applicable Wisconsin State Electrical Codes, and other local codes or ordinances.

It is in the best interest of the customer to identify the Company’s requirements early in the design stage to avoid any unnecessary expenses or delays.

The Company does not assume responsibility for the protection of the customer’s generating equipment or for damage to any other customer equipment, and does not assume any liability or responsibility for customer-owned equipment through the generation approval process. The customer is solely responsible for protecting its equipment to prevent damage due to faults, line reclosing, imbalances or disturbances on the Company’s distribution system, as well as assuring that generation equipment is paralleled in synchronism with the Company’s distribution system. The customer is responsible for damage to property and/or injury to personnel of the Company or others when caused by customer’s generation facility because of malfunction, improper design, improper operation, human error, or other negligence of the customer or derived from the generation facility or controls.

General Requirements

1. The Company, in its review and inspection, may specify additional requirements relative to the equipment and general design of the customer-owned generation facility, as the Company in an emergency situation may be requested to act as the customer's contractor and operate the customer-owned generation equipment.
2. The customer shall obtain the acceptance of the Company before making any additions or material modifications to any existing customer-owned generation facility. A material modification is any modification to the equipment that deviates from the equipment shown on submitted documentation. After commissioning, any modification of AC interconnected generation and equipment that is involved in the islanding of the customer-owned generation facility will require re-commissioning of the facility.

3. By installing customer-owned generation, the customer and installer agree to address any existing code or safety issues with metering or service equipment to meet current requirements.
    a. This includes any clearance issues with natural gas equipment in proximity to electrical equipment.
4. Service/Metering installations that fail to meet acceptable electrical standards as determined by the Company shall be modified and/or updated as required.
5. Customers and installers are responsible for proper installation, operation and maintenance of customer-owned generation equipment in accordance with the products' listing and manufacturers' instructions.
6. Customers are responsible for the expense to make system improvements needed to handle your distribution connected generation facility, obtain any and all authorizations, permits and licenses required for construction and operation of your generating facilities.
7. Customers are required by law to maintain liability insurance (equal to or greater than amounts indicated in PSC 119) or to prove financial responsibility by another means agreeable to the Company.
8. When the customer is changing the ampacity of their service entrance equipment, they must meet the current State adopted version of the NEC and the current metering requirements of the Company.*
9. When the customer adds to or modifies their service entrance wiring and/or equipment in any way that requires them to adhere to the current State adopted version of the NEC, they shall also adhere to the current metering requirements of the Company.*
10. Moving or relocating service equipment to new or different location shall constitute an upgrade and they shall also adhere to the current metering requirements of the Company.*

    *Note: Any changes to the service will require a completed service change/modification/rewire/relocation application to be submitted to the Company.

11. Any documentation submitted as updated or new takes precedence over all previously submitted documentation and shall comply with current requirements.
12. A customer-owned generating facility is considered to be the building/structure that contains/supports the customer-owned generation system and all associated buildings/structures on the same parcel of land.
13. All customer-owned generation must be located at the customer of record's premise (parcel of land and all associated buildings/structures) and serving only the customer of record's premise.
14. Customer-owned generation is not permitted to be transmitted through distribution system equipment to offset the usage of other electrical services.
15. There are limited circumstances where the Company may allow a customer with multiple electrical services serving the same premise to offset the meters on that premise with one interconnected customer-owned generation system. These are generally limited to grandfathered installations and require additional review and special approval from the Company.
16. Customer-owned generation interconnected to the distribution system with a primary service (medium voltage) shall also meet the Company's requirements for customer-owned substations. Please reach out to the Company for specific requirements.
17. The total single phase generation at a site shall not exceed 150 kW.

2. Scope

This manual applies to all customer-owned generation facilities with a capacity of 15 megawatts (MW) or less that are interconnected, or whose owner seeks to have interconnected, to the Company's distribution system. This manual also defines the minimum requirements for safe and effective operation of the customer/the Company parallel interconnection. These requirements apply to those generation systems that have the capability to operate in parallel with the Company's distribution system, and that will not be intentionally operated in an islanded condition with the Company's distribution system. Exceptions may be made, following review by the Company, for infrequent momentary parallel operation of emergency stand-by generation*.

> ** PSC 119 currently defines "Parallel operation" as the operation for longer than 100 milliseconds of an on−site customer-owned generation facility while the facility is connected to the energized distribution system. This could be interpreted as implying that soft start emergency generators which may operate for short periods of time (less than five minutes) but longer than 100 milliseconds (ms) must follow all the provisions outlined in PSC 119. The Wisconsin Public Service Commission has subsequently stated that PSC 119 was not intended for these types of soft loading backup generators in spite of the 100ms definition. Although these types of installations are not required to follow PSC 119; they still must be reviewed and approved by the Company.*

Traditional backup systems with "break-before-make" style transfer switches are not considered to be operating in parallel with the Company's distribution system. Please contact the Company for questions regarding energy storage backup only systems and electric vehicle to home/building backup systems.

Some examples of customer-owned generation are below:

- Wind turbine
- Photovoltaic system (solar)
- Energy storage system
- Bio-gas
- Micro turbine
- Fuel cell
- Hydro
- Any combination of the above

Note: Some customer-owned generation rates are exclusive to renewable generation.

Facilities with a generation capacity less than or equal to 15 MW must comply with this manual and the Wisconsin State Legislature State Administrative Code: Chapter PSC 119 RULES FOR INTERCONNECTING DISTRUBUTED GENERATION FACILITIES.

All requirements laid out in the manual are designed to:

- Ensure the safety of customers, electric provider employees and the general public
- Maintain overall system reliability
- Protect distribution system facilities
- Avoid electrical interference problems

Typical Sequence of Events

1. Notification by the customer of record to the Company that they want to install customer-owned generation.
2. Interconnection application and associated paperwork is filled out by the customer and sent to the Company.
3. The Company reviews the customer-owned generation application.
4. The Company will make the determination if an engineering review and/or distribution system study are required and proceed with the additional reviews if required.
5. The Company will notify the customer of any construction or modification costs.
6. Once the customer has paid for any required costs to the Company the customer can install their customer-owned generation system.
7. Once all equipment (customer and Company) has been installed the system will be commissioned and the results will be shared with the customer.
8. After the system passes commissioning the customer will need to sign the required agreements.

3. Required Documentation

The completed documentation listed below is required before a customer-owned generation facility will be reviewed for acceptance.

- Wisconsin Standard Distributed Generation Application Form (Form 6031)
- Applicable Supplement Form(s)
  - Solar Photovoltaic Form
  - Wind Turbine Form
  - Generator Form
  - Energy Storage Form
- Application Review Fee based on PSC 119 Category
- Proof of Insurance based on PSC 119 Category
- Pictures of the existing metering equipment showing all sides of the metering equipment and the centerline height of the meter.
- One-line diagrams*
- Site plan*
- Technical documents of the customer-owned generation equipment*

Completed documentation after successful commissioning.

- Surplus Energy/Power Purchase Agreements (We Energies or Wisconsin Public Service)

* Please see additional requirements listed below.

One-line Requirements

- One-line must meet the minimum requirements of PSC119.10
- One-line must be computer generated, hand-drawn one-lines will not be accepted.
- List the AC system size based on the PSC 119 system size calculation
- List the equipment part numbers
- List the maximum continuous output power for each generator/energy storage device.
- List the amperage rating and fuse information of the interconnection/PV disconnect switch(es).
- Service Entry Equipment catalog number(s) and amperage rating
- Main Over Current Protection Device amperage rating
- Transfer Switch or Grid Isolation Relay manufacturer name and model number
- List the customer of record's name and address
- One-line must distinguish existing systems from new equipment
- One-line should show revision tracking with identification of changes shown on the one-line to expedite reviews.
- One-line must show all customer-owned generation systems on the same building/property.
- One-line must show any traditional backup generation including transfer equipment.
- One-line must show any Electric Vehicle (EV) Chargers including vehicle to home capable systems.

- If applicable, one-line submittal must note the resolution of any existing code violations or metering violations before approval.
- If applicable, Telemetry Equipment including enclosure catalog number, see Telemetry Equipment Requirements section for more information

Site Plan Requirements

- Site plan must meet the minimum requirements of PSC119.12
- Site plan must show the locations of the customer-owned generation system's components.
    - Metering equipment
    - Disconnects
    - System Placards
    - Generation equipment (inverter, wind turbine, solar panels, generator, etc.)
    - Energy storage equipment
    - Service equipment including microgrid interconnect devices, transfer switches, or similar
    - All buildings on the property
- Site plan must be computer generated, hand-drawn site plans will not be accepted.
- List the customer of record's name and address
- Site plan must distinguish existing systems from new equipment
- Site plan must show all customer-owned generation systems on the same building/property.
- Site plan should show revision tracking with identification of changes shown on the site plan to expedite reviews.
- If applicable, Telemetry Equipment, see Telemetry Equipment Requirements section for more information

Required Technical Documents

- Data sheets showing the product's ratings and listings for the generation equipment (inverter, energy storage system, microgrid interconnect device, transfer switch, disconnects, generator, etc.)
- Recommendation to provide documentation showing a high level sequence of events (how the system functions during an outage and restoration)

Onsite One-line Requirements

- Final interpretation of these requirements is determined by the Company Field Application Engineer.
- One-line must be computer generated, hand-drawn one-lines will not be accepted.
- One-line must be of weatherproof permanent construction and UV-resistant (permanent engraved/embossed placard or laminated paper in a holder)
- One-line must show the following electrical equipment and how it is electrically connected.
    - Generator, inverter, and/or energy storage
        - Generator - Solar panels, wind turbine, traditional generators, etc.
    - Metering equipment

    - Interconnection Disconnect/PV Switch(es)
    - Micro-grid interconnect device
- List the customer of record’s address
- One-line must show all customer-owned generation systems on the same building/property.
- One-line must show any traditional backup generation including transfer equipment.
- One-line must show any Electric Vehicle (EV) Chargers including vehicle to home capable systems.

4. System Sizing

Customer-owned generation will be sized based on the total amount of interconnected customer-owned generation at a given premise. A premise is considered the plot of land and all associated buildings/structures.

PSC 119 Sizing

The generator export capacity is either the nameplate rating or a limited amount if using an approved means. Currently the Company's only approved means to limit the generation facility's capacity, is with the use of an interlock system to physically and electrically limit the amount of generation that can be connected to the utility at a given time. In all other cases the nameplate rating will be used for sizing. Please submit documentation for any system that is designed to limit the export capacity for review and approval. Documentation must have sufficient detail to show how the system limits the export capacity and must also provide testing data showing the system is able to limit the export capacity of the system. Upon review of the provided documentation the Company will make the determination if the means of export capacity limitation is an approved means. Below are examples of NOT approved means of limitation:

- Load subtraction – using customer load as a means to limit the export capacity to the utility system.
- DC system limitations – limiting the inverter by having less than the nameplate capacity of DC energy sources connected.
- Electronic limiting – software change that will reduce the output rating of the inverter. The current version of SPS 316 requires the conductors to be sized for the maximum continuous output current of the inverter with no exceptions for electronic limiting of the inverter. If the inverter has a maximum continuous apparent power (kVA) rating the system size will be calculated assuming unity power factor.

The Company's definition of a non-exporting energy storage system is an energy storage system that is limited by an approved means from exporting power to the utility system. The Company does not currently have any approved means to limit the energy storage system from exporting power to the utility system. Please submit documentation for any energy storage system that is designed to prevent export for review and approval. Documentation must have sufficient detail to show how the system limits the export capacity and must also provide testing data showing the system is able to prevent export to the system. Upon review of the provided documentation the company will make the determination if the means of export limitation is an approved means.

Tariff Sizing

The systems will continue to be sized based on the tariffs for each company to determine tariff eligibility. The max continuous output power listed on the generator/inverter nameplate, as shown below, will be used to calculate system size unless the system is configured such that the nameplate rating of the generating system does not accurately reflect the output of the system.

AC Generators (synchronous and asynchronous generators):

$$Total\ System\ Size\ =\ AC\ Generator\ Nameplate(s)$$

DC generation (solar and energy storage):

$$Total\ System\ Size = AC\ Inverter\ Nameplate(s) + AC\ Energy\ Storage\ Inverter\ Nameplate(s)$$

5. System Improvement

During the review of submitted plans and application for a customer-owned generation facility the distribution system will be studied to determine the need for any system improvements required to accommodate the addition of the facility.

Examples of (but not limited to) system improvement requirements:

- Customer plans indicate that a generation facility's export capacity is larger than the transformer serving the customer, the transformer will need to be changed out to avoid any overloading.
- Customer plans indicate the installation of a meter socket or main service panel breaker larger than the existing equipment, the customer's service conductors will need to be changed out to avoid any overloading.
- Customer plans indicate the use of a meter socket that is no longer approved, the customer must install metering equipment that is approved for the service size indicated to avoid any overloading.
- Customer-owned generation exceeds the ratings of the distribution equipment and/or substation equipment and requires upgrades.
- Customer-owned generation creates power quality issues for other customers so the customer may need a dedicated transformer.

Depending on the nature of the improvements required the customer/installer will be notified of the cost and rough timeline to make the improvements. If the customer decides to modify their customer-owned generating system in an attempt to reduce the system improvements that will restart the review process.

6. Equipment Requirements

Compliance with the following requirements shall be confirmed during evaluation of customer-owned generation system designs. The following listed requirements are the minimum and additional requirements may be added at time of review. Any revised design submitted must be in compliance with the current requirements.

Technical Requirements

Overvoltages

Due to the possibility of potentially damaging overvoltages during distribution system fault conditions when generation is present, steps must be taken in the design phase of a generation project to assure that overvoltages are limited to acceptable levels. The utility side of the customer's interface transformer must be effectively grounded to limit the Company's system and other customers' overvoltages if the generator interconnected to the distribution system is temporarily islanded from the Company's substation source. The preferred method to meet this requirement is through the use of an interface transformer connected grounded wye on the utility side. Distribution systems inherently operate with some system voltage imbalance, therefore, a generator with a grounded neutral connection may require an additional level of transformation between the generator and the point of service to limit generator neutral currents.

Interconnection Protection Requirements

Protection of the Company and customer generation interconnection is necessary to avoid unintentional islanding of the Company's distribution system during abnormal system conditions. Unintentional islanding of customer-owned generation where it supports a portion of the Company's distribution system must be avoided to ensure that other customers are supplied with a safe, reliable, and stable supply of electricity. Customer generation supporting only its own load under non-paralleled conditions is acceptable.

The purpose of interconnection relays is to (a) sense faulted conditions on, or the loss of, the Company's distribution system and (b) automatically disconnect the customer-owned generation from the Company's distribution system. The customer shall be responsible for the purchasing, setting, testing, operation, and maintenance of all interconnection relays. The interconnection relaying package must be reviewed and approved by the Company before the generation may be operated in parallel with the Company's distribution system.

As a minimum, the Company requires the following interconnection relays and settings be installed whenever customer-owned generation is capable of being operated in parallel with the Company's distribution system. Other schemes must provide the equivalent protection characteristics of these relays, and must be accepted by the Company.

Table 1

Minimum Interconnection Relay Requirements

Relay	IEEE Device No.	Pickup Setting	Time Delay (at pickup)
Under Voltage	**27**	**90% of nominal**	**1.0 Seconds**
Over Voltage	**59**	**110% of nominal**	**0.1 Seconds**
Under Frequency	**81U**	**59.5 Hz**	**0.5 Seconds**
Over Frequency	**81O**	**60.5 Hz**	**0.1 Seconds**

The Company must approve any deviation from the specific relay type or settings identified in Table 1 above. The relays identified in Table 1 reflect the minimum relay requirements which are satisfactory for most customer-owned generation installations. However, during the application process, the Company may determine that additional interconnection relaying requirements are necessary to ensure protection of the distribution system due to specific concerns associated with the type or location of the generator as well as the distribution system at the point of interconnection. Any additional interconnection relaying requirements will be identified by the Company during the Interconnection Study. The customer shall be responsible for the cost of any additional equipment.

Synchronism Check and Transfer Trip Protection

The relays identified in Table 1 may not guarantee against unintentional islanding for all customer-owned generation interconnections in all situations. If the Company were to reclose on that section of the energized islanded distribution system; it is likely that this would be out of synchronization with the customer-owned generation, which could damage the customer's generation equipment. The likelihood of the customer generation becoming islanded will vary greatly depending on: the type of generator; its control system; and the loading profile of the Company's feeder to which the generation is connected. It is the responsibility of the customer to evaluate this risk and determine whether or not the addition of utility relaying such as synchronism check or transfer trip relays to prevent an out of synchronism reclosing operation is warranted. During the application process, the Company will inform the customer of situations where the feeder load could closely match the generation output (i.e. where there is a greater chance of islanding) and provide the customer with the option of installing transfer trip and/or synchronous check functionality on the Company's upstream line protection device(s) at the customer's expense.

Relays required as part of PSC 119.25 that are not identified above are to be set based on the customer's facility specifics.

The customer is responsible for the determination of these settings. The Interconnection relay requirements discussed above are separate from and in addition to relays required for the protection of the customer's generation and electrical equipment. The customer is solely responsible for the design, installation, setting, operation, and maintenance of any relays necessary to protect its equipment.

Other Interconnection Design Considerations

The customer shall not energize the Company's de-energized circuit. The customer shall install the necessary sensing and control devices required to monitor voltage on all phases of the Company's supply circuit and prevent energizing where any phase voltage is outside the range specified in PSC 113.0702.

The customer must install a method of synchronizing its generation to the Company's distribution system. Connection of its generation to the Company's system may only be accomplished via synchronization. It is highly recommended that automatic synchronizing be used to minimize the potential for damage to customer-owned equipment.

The Company normally applies automatic reclosing to all distribution lines. The customer must ensure that its generation is automatically disconnected from the Company's distribution system prior to reclosing.

> The Company shall assume no responsibility for damage to customer's equipment due to out of-phase reclosing.

Typically, the Company's devices may have one or more recloses with the first set at a minimum of 1.0 second. There may be single phase protection devices installed between the Company's source substation and the customer. It is the responsibility of the customer to protect its three phase equipment for potentially damaging effect of the loss of one or two phases supplying that equipment. The Company's system voltage may vary at the interconnection point. The customer's generation and protective scheme must be able to operate at the normal and short term voltage variation outlined below in the System Voltages and System Voltage Imbalance sections.

It is the responsibility of the customer to ground the generator as necessary to protect its equipment. If the installation of generation equipment causes the Company's system design fault current limits to be exceeded, the customer must install equipment, at its expense, to limit the fault current on the Company's distribution system.

Design and Operating Requirements

The nature of the Company's distribution system is dynamic; therefore, source conditions may change. The customer should be aware that changes made to the local utility system, or addition of other customers with generation, may require that modifications be made to the customer interconnection protective devices to properly coordinate with the utility supply. If changes are necessary, the customer may be subject to future charges to facilitate the modifications. Operation of the customer generation system shall not adversely affect other customers or interfere with proper operation of the utility system. If the generation system adversely affects other customers, the customer generation equipment may be required to be disconnected until the problem is resolved. The customer-owned generation system owner must resolve the problem internally, if possible. The Company may make distribution system modifications to resolve the problem at the generation owner's expense, or the Company may disconnect service to the generation facility.

System Voltages

The Company's Distribution System operates at a nominal system steady-state voltage as required in PSC 113.0702. Customer's generation should be capable of operating within this range. The generation equipment should have the ability to ride through short-term system disturbances and operate without interruption to avoid excessive nuisance tripping. Inverters should sense abnormal voltages and respond to track and trip as appropriate.

System Voltage Imbalance

Due to constantly changing customer loads, the Company's voltage and voltage imbalance varies continuously. The customer's equipment must be capable of operating within the imbalance range at the location where the generation is being applied.

Power Factor

The customer power factor must be maintained between .90 leading and .90 lagging. If the generation facilities impose unusual reactive burden on the utility system (usually resulting from induction machines), the customer may have to install power factor correction equipment. The Company must be consulted prior to addition of power factor correction equipment, and must accept the power factor correction method or design. If the generation facilities cause an unacceptable increase in the Company's distribution system voltage, the customer may be required to operate at a specific power factor to reduce distribution system voltage. The Company will work with the customer to determine the specific power factor requirement.

Flicker

The customer shall not cause flicker in excess of 2% at the high side of the distribution transformer. If a dedicated transformer is not present, voltage flicker shall not exceed 3% at the low side of the transformer. If flicker complaints arise from other customers as a result of the generating equipment, the customer generation equipment may be required to be disconnected until the problem is resolved

Frequency

All customer-owned generating equipment shall maintain an output frequency of 60-hertz. The operating frequency of the customer's generating equipment shall not deviate more than 0.5 hertz from a 60-hertz base.

Harmonics

The customer's generating equipment shall not introduce excessive harmonics to the Company's system voltage and current waveforms per the latest revision of IEEE 519, "Recommended Practices and Requirements for Harmonic Control in Electric Power Systems". If harmonics complaints arise from other customers as a result of the generating equipment, the customer-owned generation equipment may be required to be disconnected until the problem is resolved. IEEE 519 will be used as a guide in resolving harmonic issues.

Voltage Transients (Impulses)

The magnitude of sub-cycle voltage transients (anywhere on the voltage waveform) caused by activation, deactivation, or operation of the customer generation shall not exceed twice the normal peak of the nominal voltage sine wave (e.g. 350 volts for a 120 volt rms system). No repetitive sub-cycle voltage transients causing false zero crossings of the voltage waveform will be allowed.

High Frequency Noise

The level of high frequency noise between 20kHz and 1MHz should not be increased by more than 0.5% of the nominal system voltage (e.g. 0.6 volts on a 120 volt system) when the customer-owned generation facility is operated.

Grid Reconnection (after an outage)

After an outage, generation should cease to operate until continuous system normal voltage and frequency has been maintained for a minimum of 5 minutes. Reconnection may be either automatic or manual.

Transfer Schemes

This paragraph applies to standby-by generation that is not operated in parallel with the Company's distribution system. Refer to the *Customer-Owned Backup Generation Requirements* document for additional requirements. Typically transfer between sources is accomplished through the use of an open transition (Break-Before-Make) transfer scheme. Closed transition (Make-Before-Break) transfer schemes are permitted only between two energized sources, which are in synchronism with each other. The transfer device shall be equipped with sensing to verify presence and adequacy of both sources before allowing the transfer to be made. If either source falls outside the synchronism requirements specified by the generation manufacturer, the transfer shall be prevented. The maximum allowable closed transition transfer time shall be no greater than 100 milliseconds. All other transfers shall be performed with open transition type (Break-Before-Make) equipment.

Access

Once the generation facility is interconnected with the Company's distribution system the customer grants the Company the right to inspect the facility at the Company's discretion.

Maintenance

All interconnection protective devices, including circuit breakers, relays, control batteries and communication equipment, owned by the customer shall be periodically maintained, tested and calibrated by qualified personnel at intervals specified by the device manufacturer, or in accordance with accepted industry practice. Copies of maintenance, testing and calibration logs and reports shall be made available to the Company upon request. The customer grants the Company the right to witness or verify on demand the calibration and operation of all interconnection protective equipment.

Generation Equipment Requirements

- Any inverter or microinverter installed shall be UL 1741 compliant and shall be installed in accordance with its listing.
- Any energy storage system installed shall be UL 9540 compliant and shall be installed in accordance with its listing.
- Installation of equipment that deviates from manufacturer's instructions/specifications voids these UL listings. (Installing equipment in areas that are not suitable for the environment, mix and match inverters outside of energy storage system's listing, available fault current exceeds equipment ratings, etc.)
    - Minimum temperature ratings for equipment installed outside
        - Southeast WI: -30°F (Sheboygan and Fond Du Lac Counties and south)
        - Northeast WI and Upper Michigan: -40°F (North of Sheboygan and Fond Du Lac Counties)
- Any single phase inverter or microinverter shall not be used on three phase systems.
- All equipment located upstream of the main service panel/disconnect shall be rated for the Guaranteed Available Short Circuit Current of the service.
    - All equipment shall be rated for the available fault current.
- All three-phase equipment should have loss of phase protection.
- The Company's meters will not be installed in any customer-owned meter collars and meter socket adapters.
- Meter collars and meter socket adapters installed downstream of Company metering equipment in customer metering equipment will be allowed provided they are Listed by a Nationally Recognized Testing Lab, and installed in accordance with its Listing and Manufacturer's Instructions.
    - Additional customer metering equipment shall not create additional neutral to ground bonds when installed in accordance with the meter socket's listing/instructions.
- Customer-owned generation installed on a building shall be interconnected to the electrical service of that building.
- Customer-owned generation equipment interconnected to the distribution system shall be installed with permanent wiring methods. Cord and plug connections will not be allowed.
- All three phase Enphase microinverters will be required to pass loss of phase testing.
    - It is recommended that a Three Phase Network Protection Relay or equivalent three phase interrupting device be installed to ensure adequate tripping during a loss of phase event.

Metering Equipment Requirements

- Metering or service entry equipment shall be selected from the Company's metering manuals (We Energies or Wisconsin Public Service) and shall match the utility requested service size.
- Metering or service entry equipment that is a code violation or imposes a safety risk shall be updated to address the issue(s) and comply with current requirements listed in the Company's metering manuals.
    - One-line submittal must note the resolution of any code violations or metering violations before approval.

- Metering equipment that requires replacement to accommodate customer-owned generation
    - Round-ring sockets
        - Multi-position meter stacks with more than 2 meters are exempt from his requirement.
    - Rusted or damaged sockets or cabinets
        - This includes metering equipment with damaged fasteners and/or other internal components such as bypass levers.
    - Sockets or cabinets with inadequate internal or external clearances
    - Legacy service types (e.g., three-phase 3W or 4W Delta Services)
- Metering equipment that should be replaced to accommodate customer-owned generation
    - Meters without the ability to bypass.
    - Metering equipment for underground services without provisions for frost loops (conduit style meter sockets).
    - Legacy metering installations that are not listed in the Company's metering manuals.
- One-line diagrams shall be accessible near metering equipment and protected from the environment in a weather tight enclosure or mounted as a permanent placard.
- Splices and/or taps shall not be made inside metering/service termination equipment.
- Customer-owned generation conductors may be allowed to be connected to the metering/service termination equipment provided there are manufacturer provided provisions within the existing equipment to land the conductor on the bus/termination pads without modification and the following requirements are met.
    - All customer-owned wiring on the utility or source side of the metering/service termination equipment for parallel metering connections shall be made with lugged connections inside the termination/metering equipment.
    - If lug space is not available to accommodate the total number of utility service conductors (based on the service size) and new customer-owned generation wiring then the existing termination/metering equipment shall not be used.
- Once service entrance or similar customer-owned conductors exit the metering/service termination equipment they are not allowed to re-enter the metering/service termination equipment.

Disconnect Equipment Requirements

- Interconnection/PV disconnects shall be externally mounted and shall provide a visible open between its contacts.
    - Breakers, including breakers integrated in metering equipment, or air conditioner "pull out" disconnects are not acceptable.
    - It is the customer's responsibility to seal/secure the cover of the disconnect.
- Interconnection/PV disconnects shall have the ability to be locked in the OPEN position.
    - The disconnect shall not be locked in the closed position.
- Equipment connected downstream of the Interconnection/PV disconnect shall be rated for the maximum input fault current allowed by the upstream fuses.
- All single throw disconnect switches shall be connected such that their blades are de-energized when the switch is in the open position.
- Disconnects shall be installed with centerline between 30" and 72" above grade.

- Disconnects shall have a minimum of 6” vertical and horizontal separation from all other electrical equipment, non-electrical equipment, and all other obstructions.
- The interconnection disconnect should be within 10’ from metering equipment and within line of sight from the metering equipment.
    - Around the corner of a building, on the back side of a fence, or backside of a metering structure are not considered to be within line of sight from the metering equipment.
    - If the interconnection disconnect cannot be located within 10 feet of the utility electric meter, permanent placards shall be installed at the metering equipment and other disconnect locations indicating the locations of the interconnection/PV disconnect switch(es) and metering equipment.
        - Locating disconnect devices more than 10 feet away or out of line of site of metering equipment requires a written request for review and approval from the Company field application engineer. The intended placarding shall be submitted at the same time for review and approval.
- Systems where a feeder serves generation on another building shall have disconnects and location placards on any building where the system is present. Please see the most common example figures shown below with photovoltaic customer-owned generation.

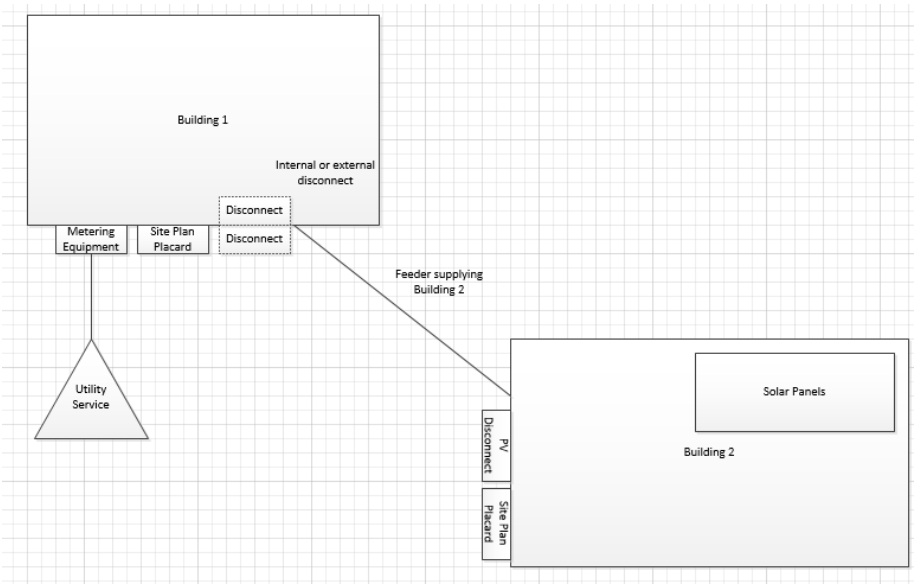


Figure 1: Building with customer-owned generation fed by another building

Note: The disconnect at building 1 in this example is not required to be located outside or be a visible break style disconnect.

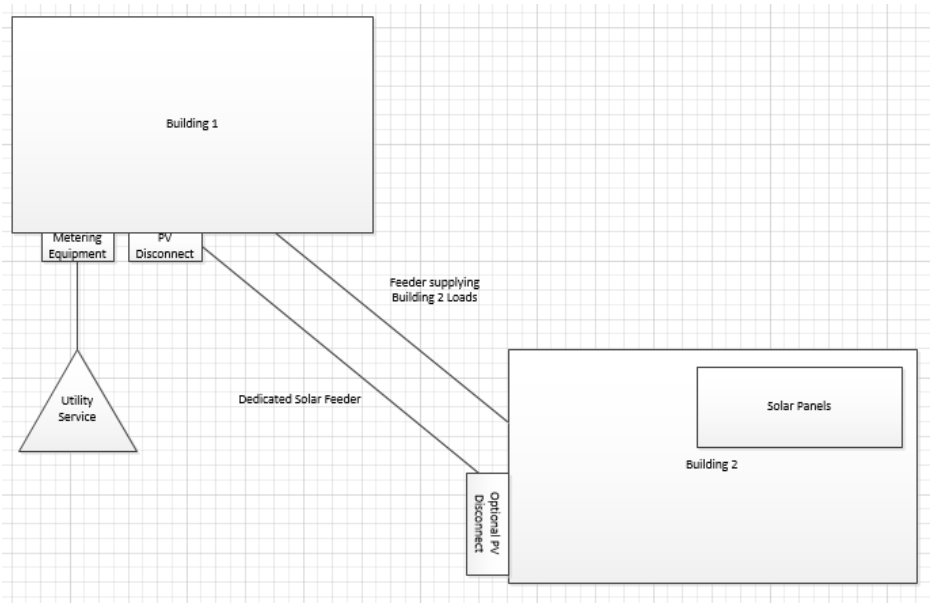


Figure 2: Building with customer-owned generation fed by another building with a dedicated solar feeder

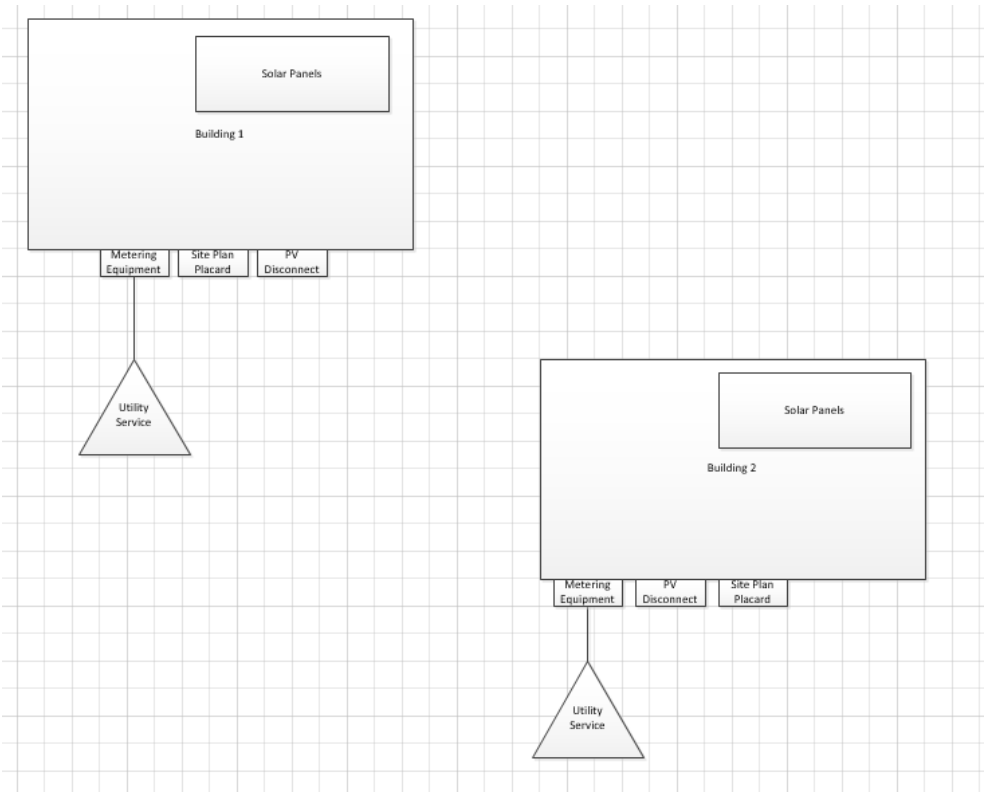


Figure 3: Two buildings with customer-owned generation on one premise.

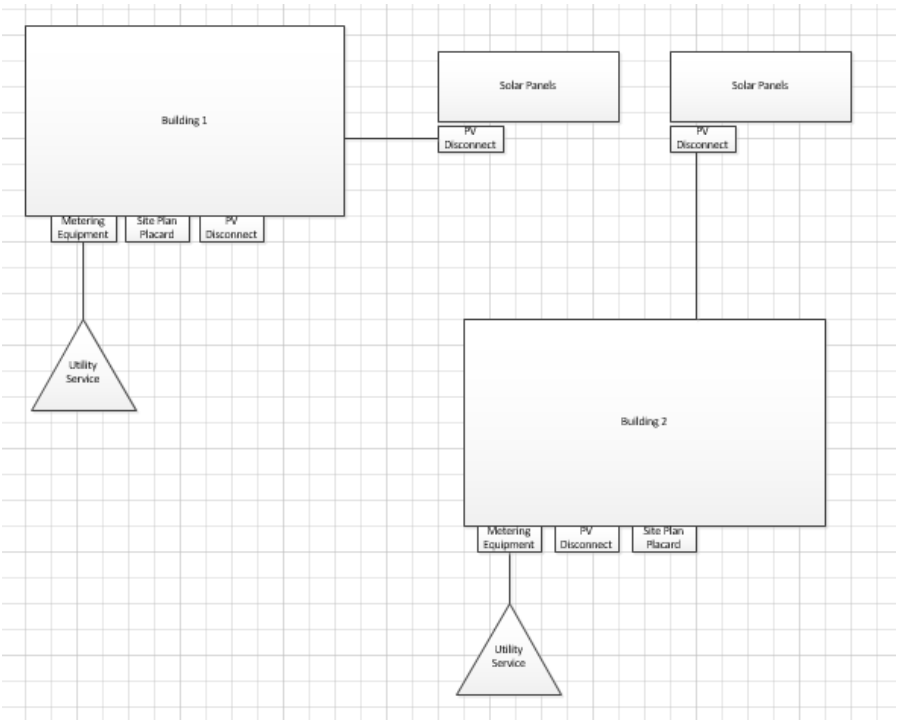


Figure 4: Two buildings on the same premise with multiple ground mounted customer-owned generation.

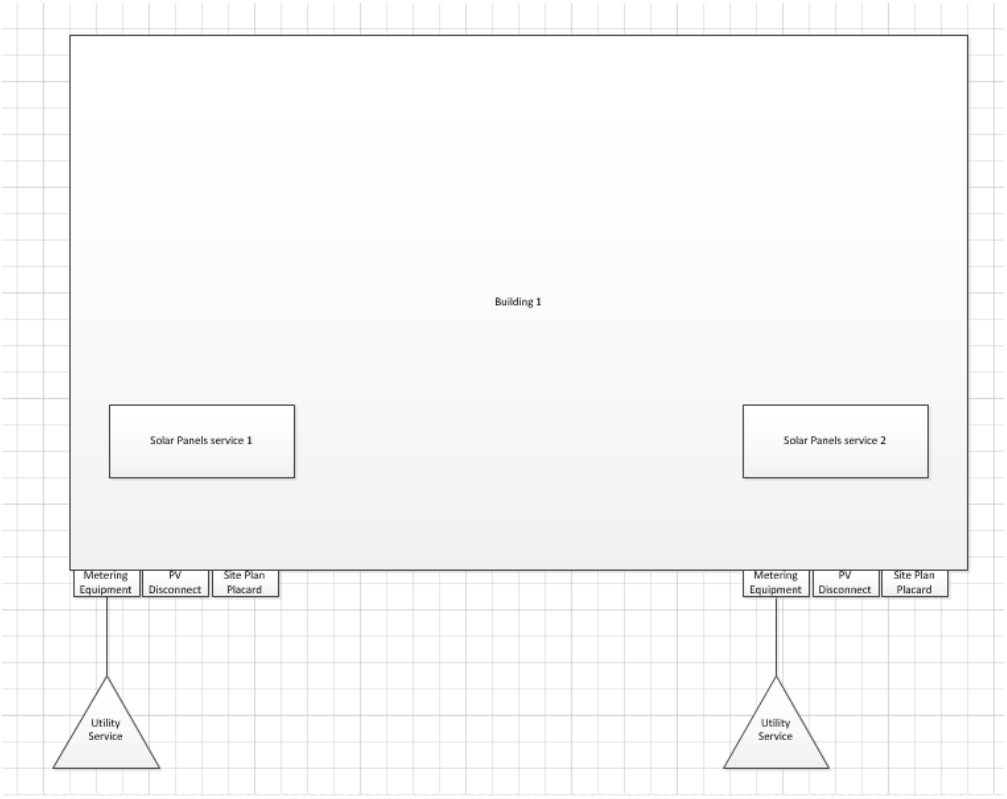


Figure 5: One large building with two services each with customer-owned generation interconnected.

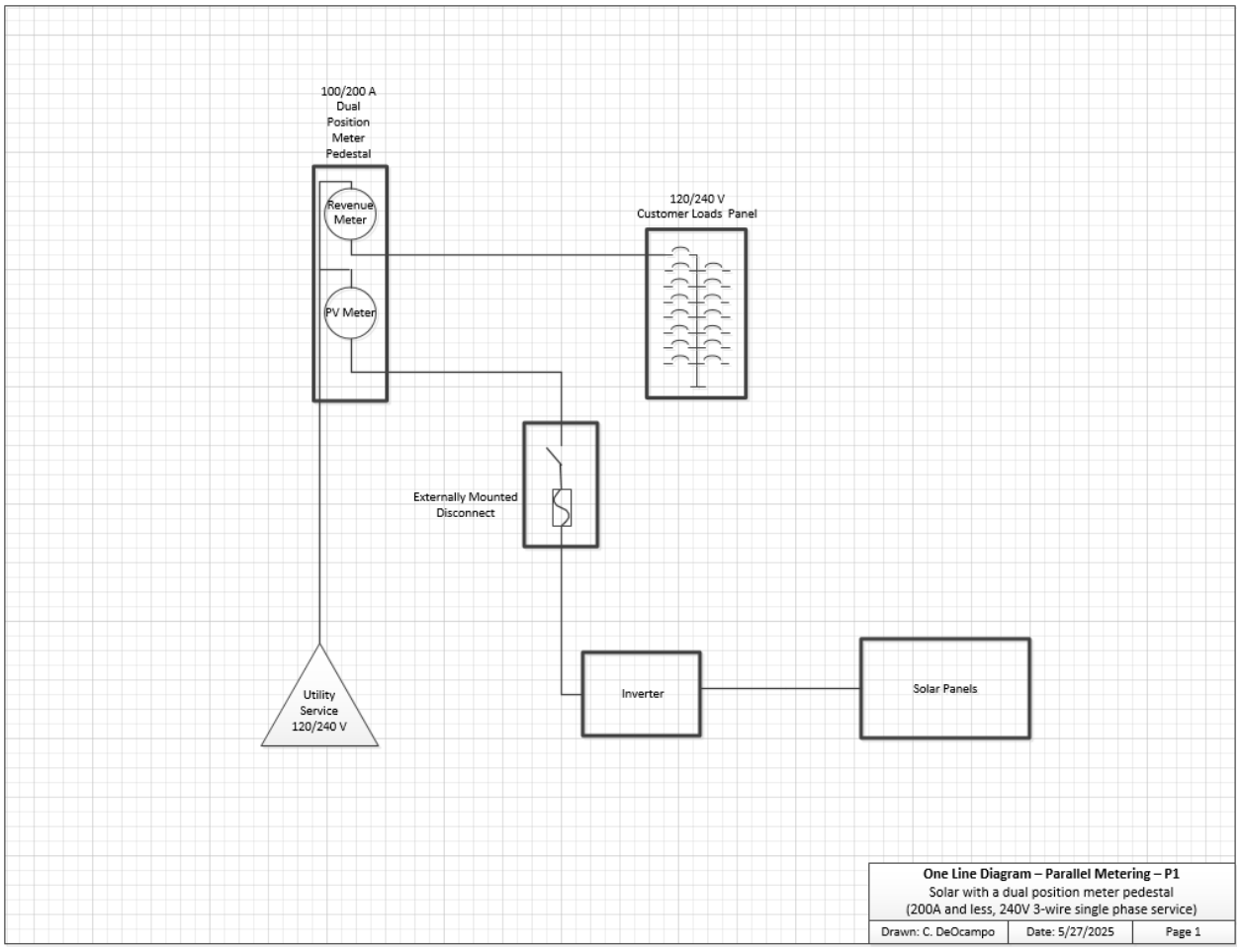
7. Reference One-Line Diagrams

The following one-line diagrams are not a substitute for your own design and are meant to be used as reference only. The following references do not cover all possible combinations of equipment and the minimum required disconnecting means are shown. The example one-lines below are shown with the most common form of customer-owned generation (photovoltaic and energy storage). If other types of generation are used these diagrams may be used as a starting point by substituting the generation shown below with another type of generation.

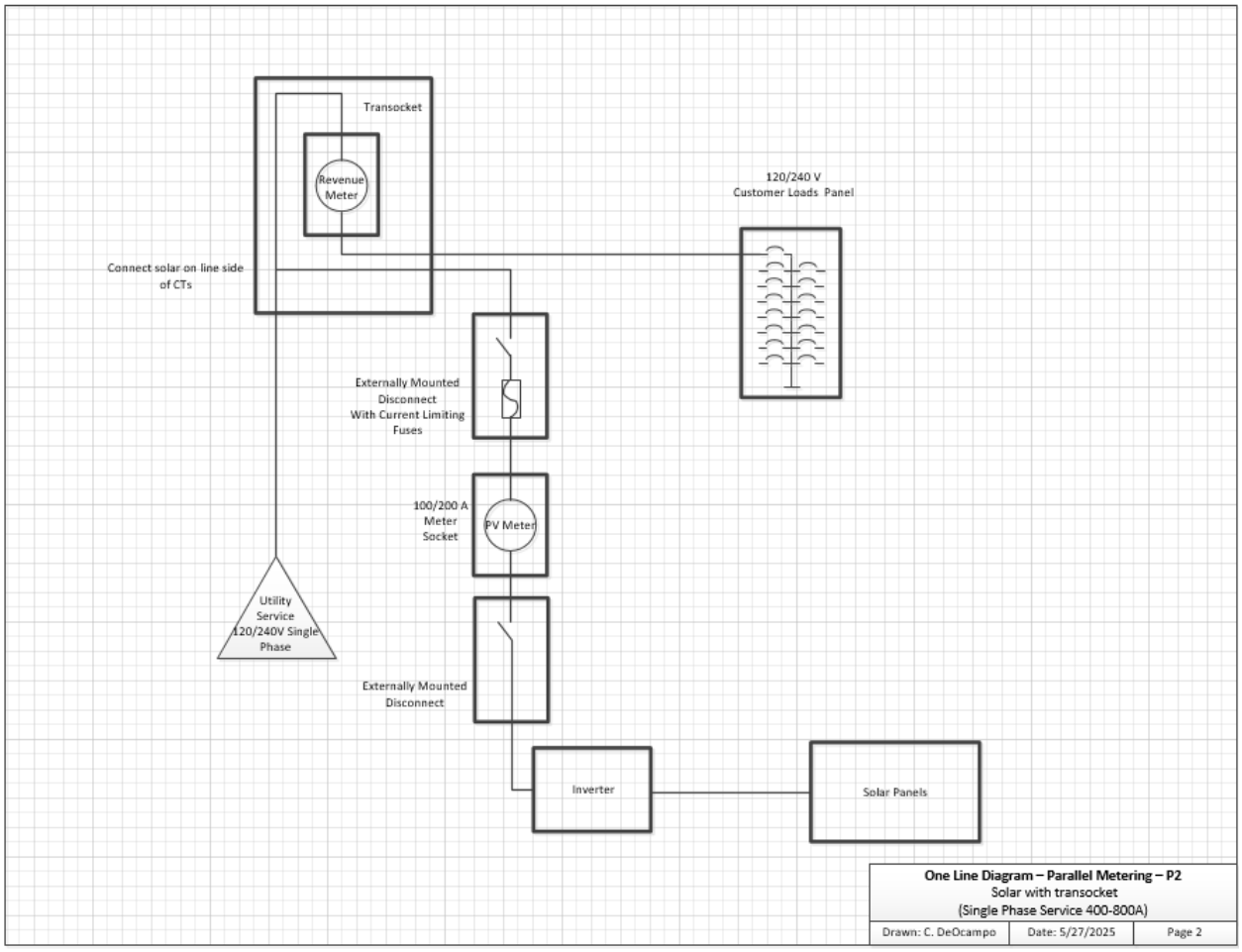
Parallel Metering

The one-line diagrams shown below are depicted with underground services. If the customer has an overhead service drop the one-lines need to be modified to reflect metering that is suitable for an overhead service.

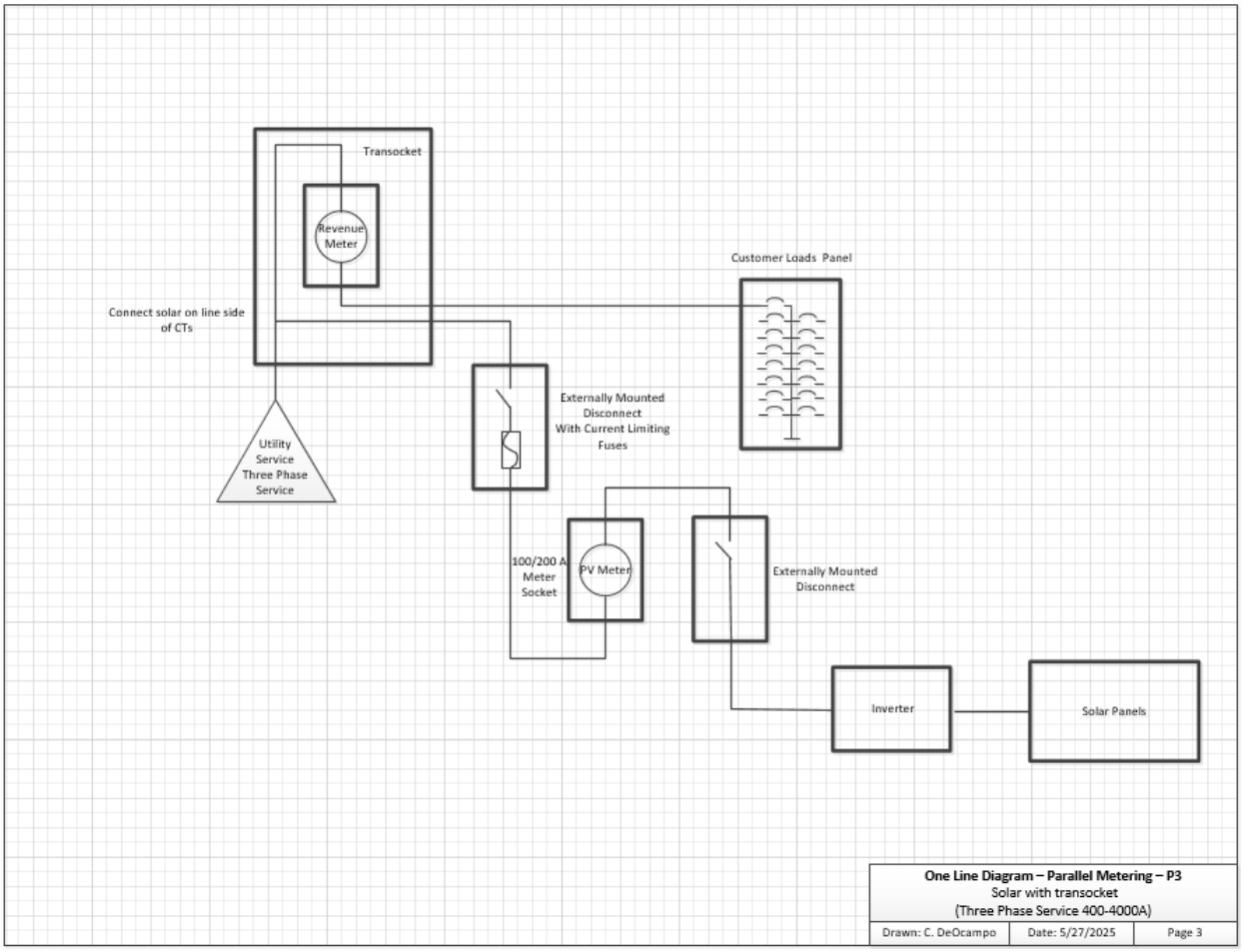
P1 100/200A Parallel



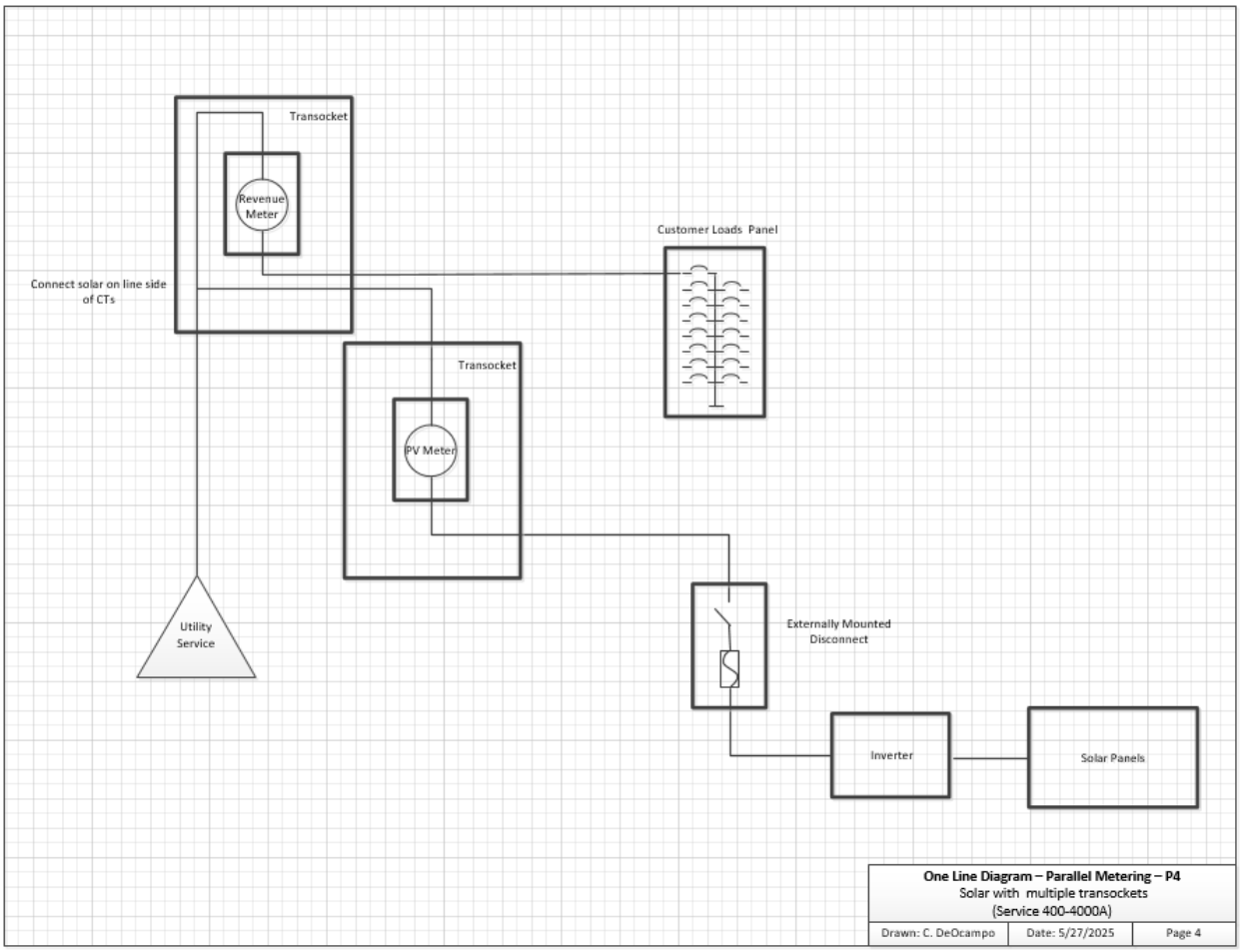
P2 400 – 800A Parallel (Solar with Transocket)



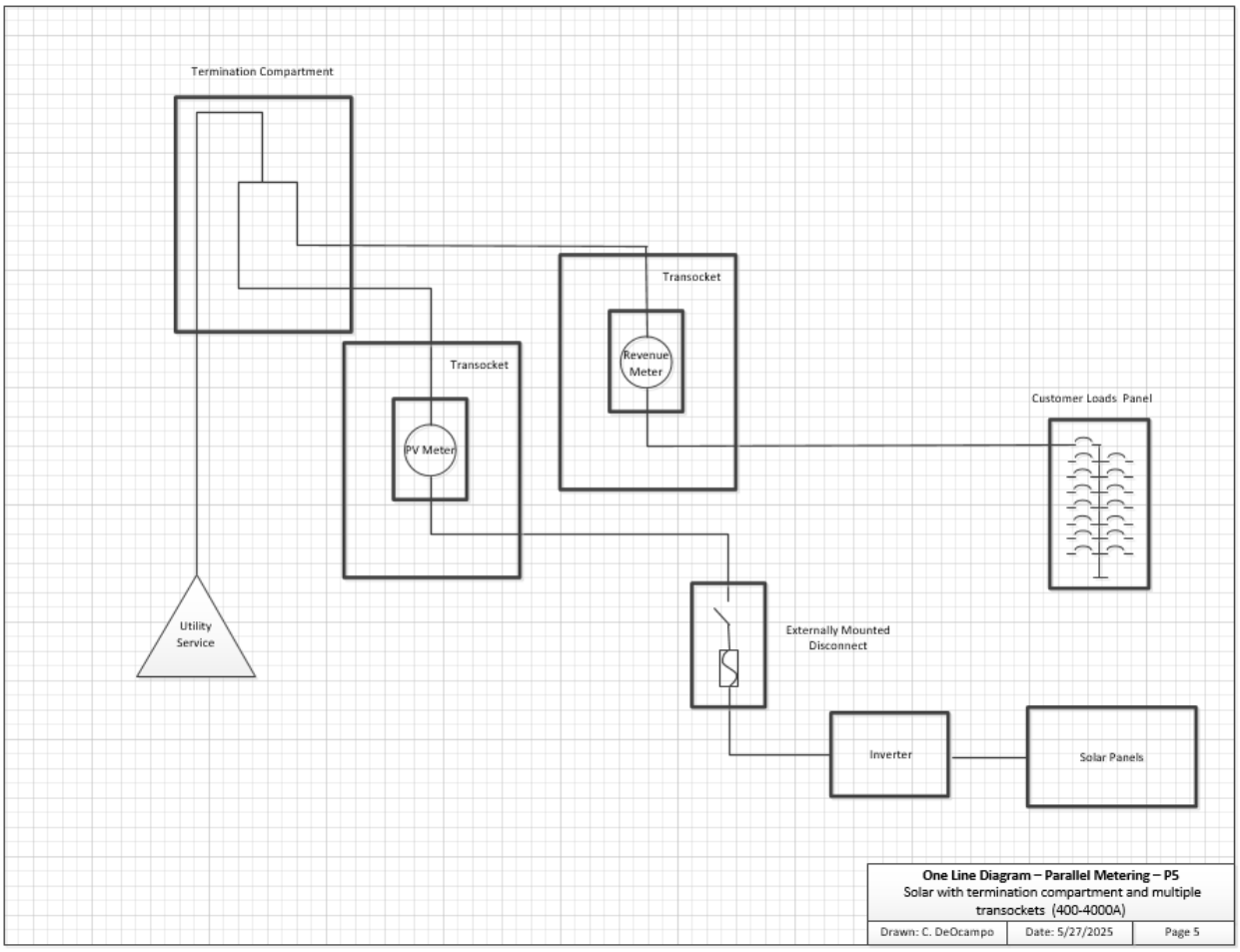
P3 400 – 4000A Parallel (Solar with Transocket)



P4 400 – 4000A Parallel (Solar with Multiple Transockets)



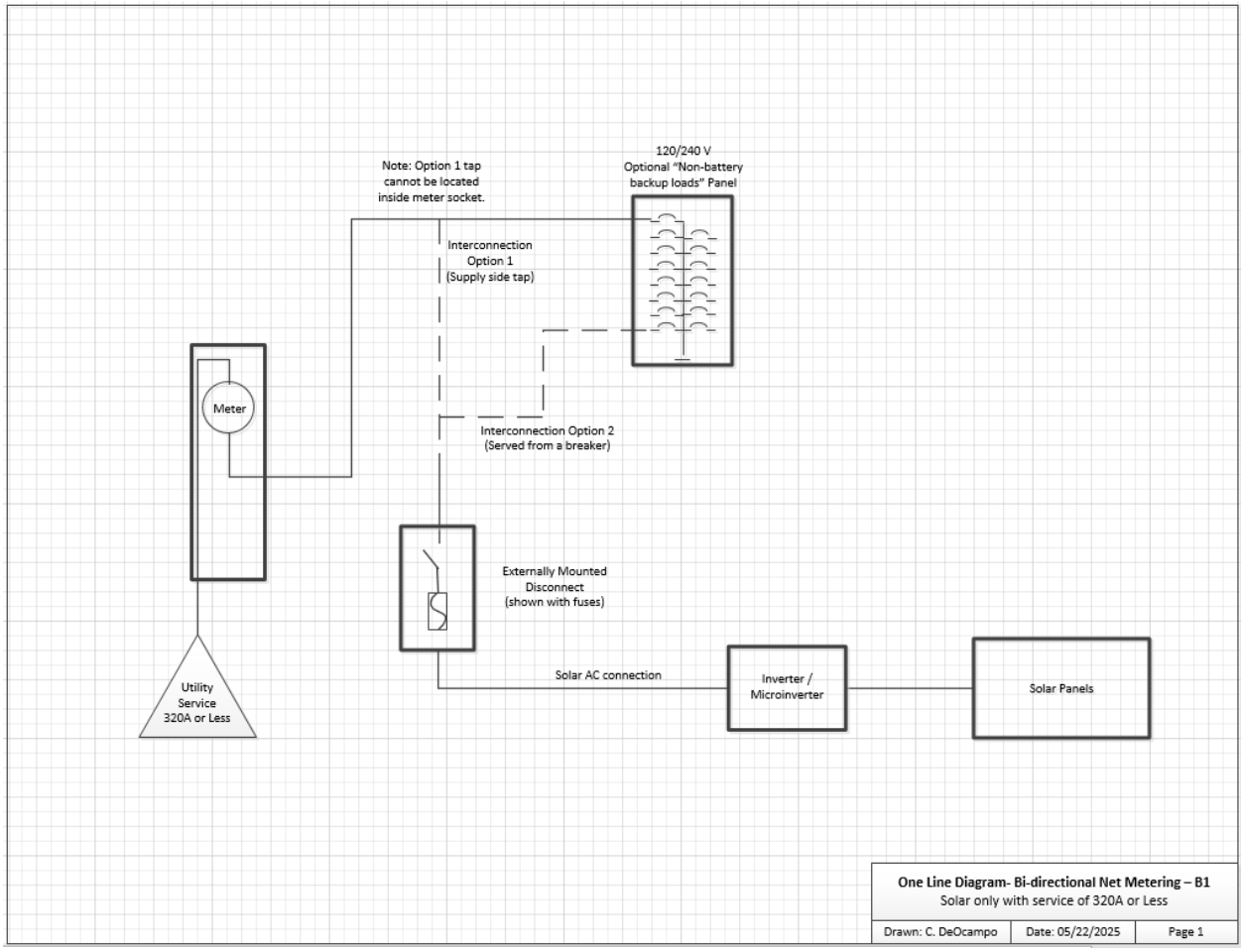
P5 400 – 4000A Parallel (Solar with Termination Compartment and Multiple Transockets)



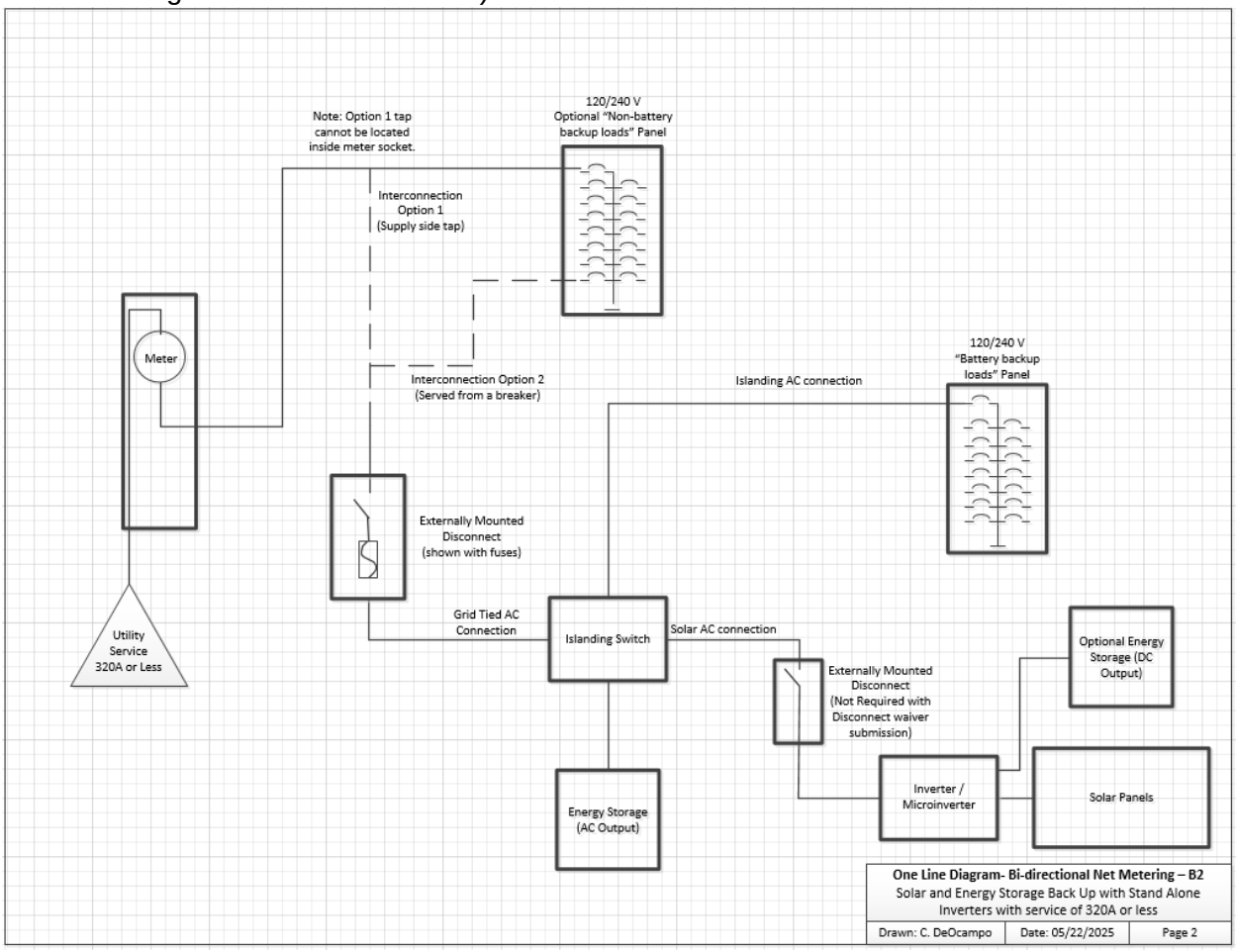
Bi-directional Metering

The one-line diagrams shown below are depicted with underground services. If the customer has an overhead service drop the one-lines need to be modified to reflect metering that is suitable for an overhead service. All metering equipment for bi-directional metering shall be labeled “Dual source” with a permanent sticker or placard.

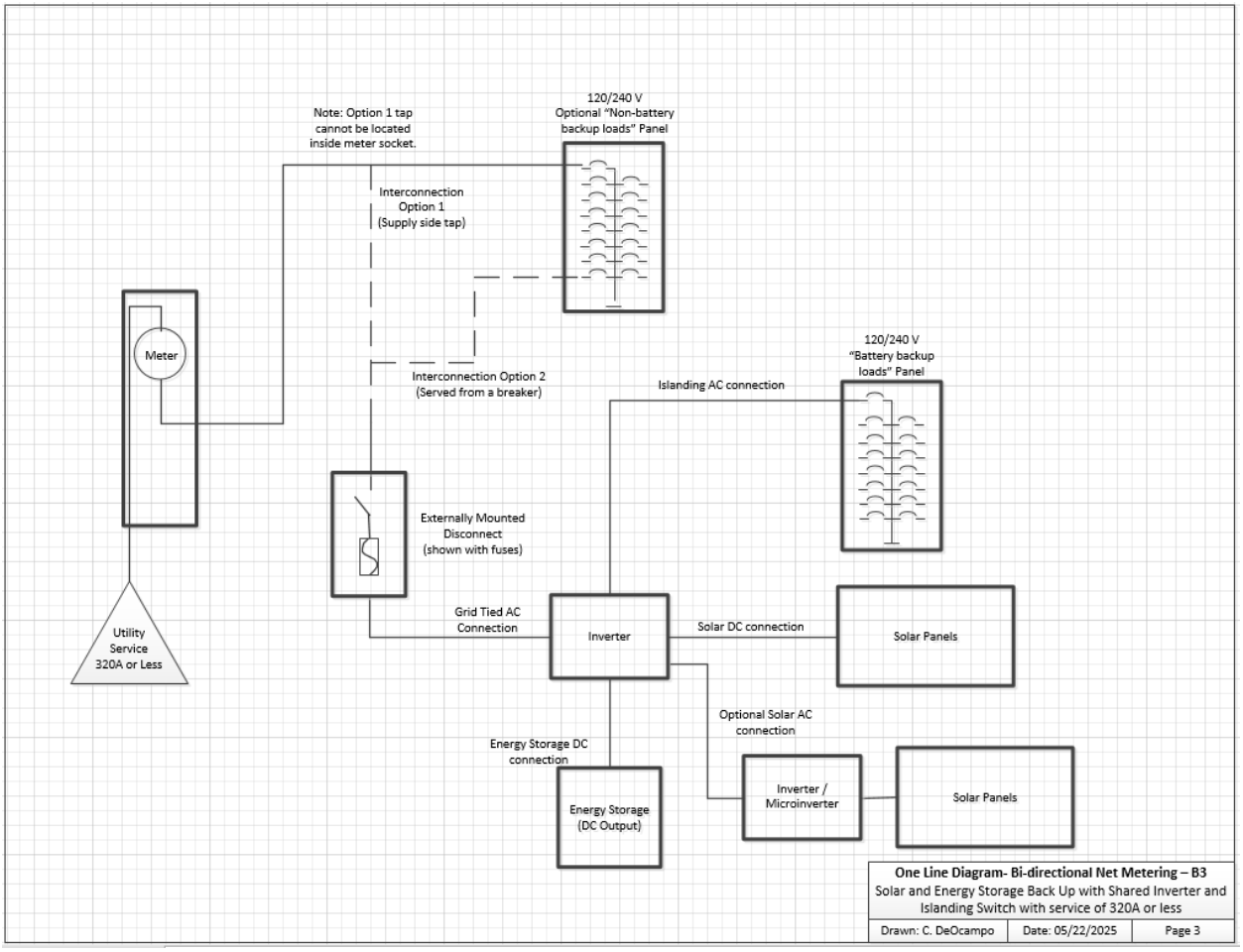
B1 320A and Less Single Meter (Solar Only)



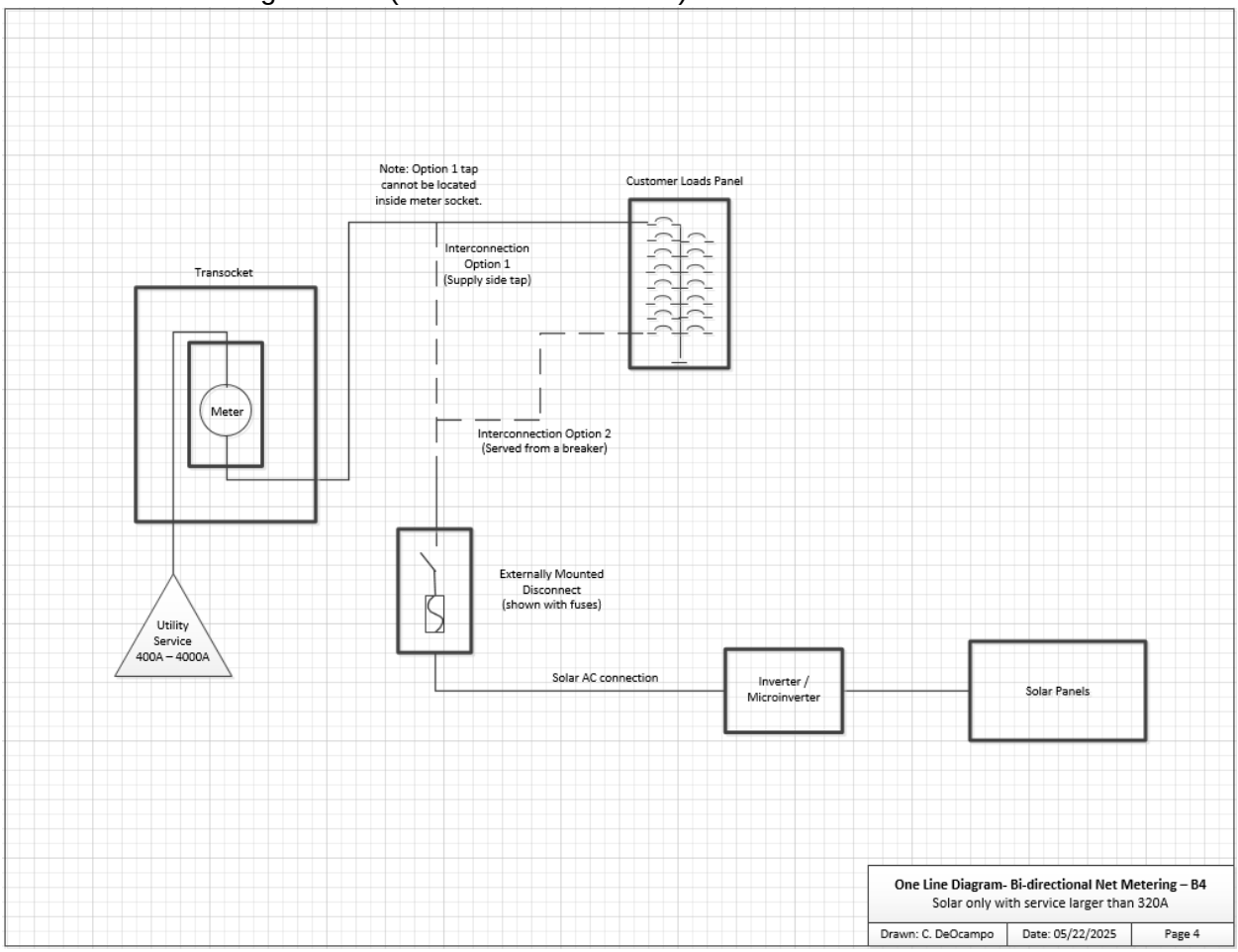
B2 320A and Less Single Meter (Solar with Energy Storage Back-up with dedicated Islanding Switch/Microgrid Interconnect Device)



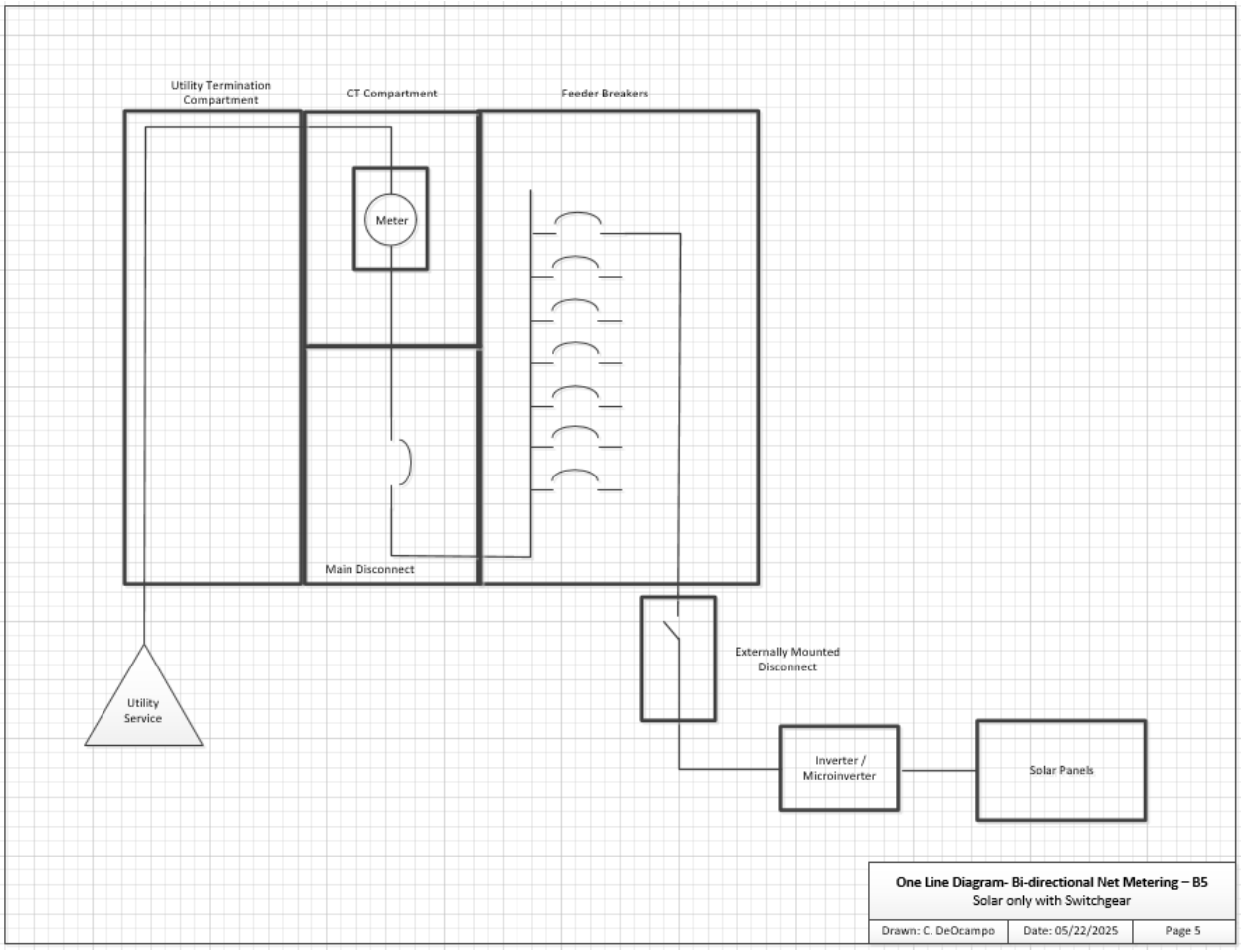
B3 320A and Less Single Meter (Solar with Energy Storage Back-up with Inverter with integrated Islanding Switch/Microgrid Interconnect Device) Shown with underground service in meter pedestal.



B4 400 – 4000A Single Meter (Solar with Transocket)



B5 Switchgear Single Meter (Solar with Switchgear)

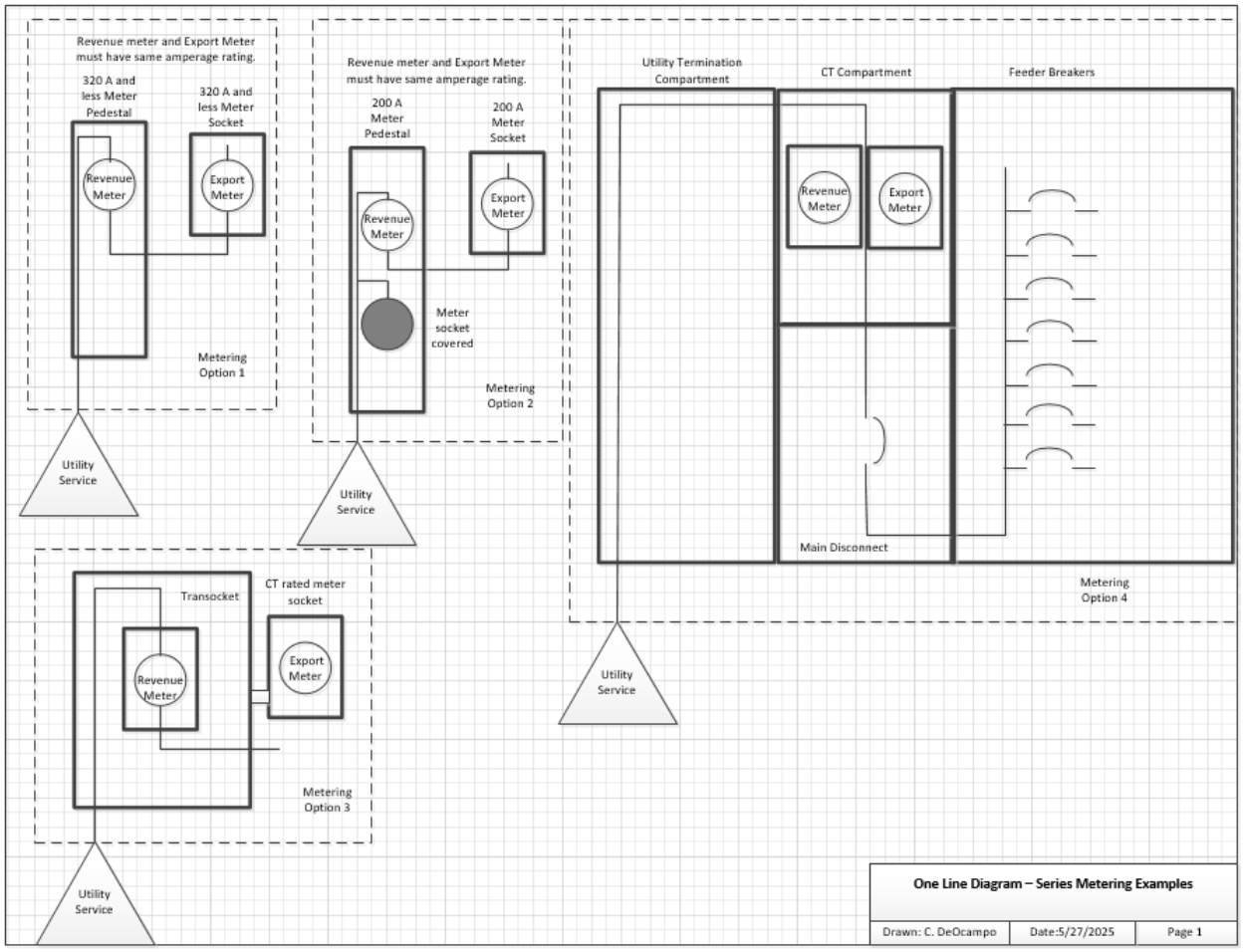


Single Meter for Non-purchase Metering

Customer-owned generation that will be on a non-purchase rate will use the same one-line diagrams as the Bi-directional metering shown above.

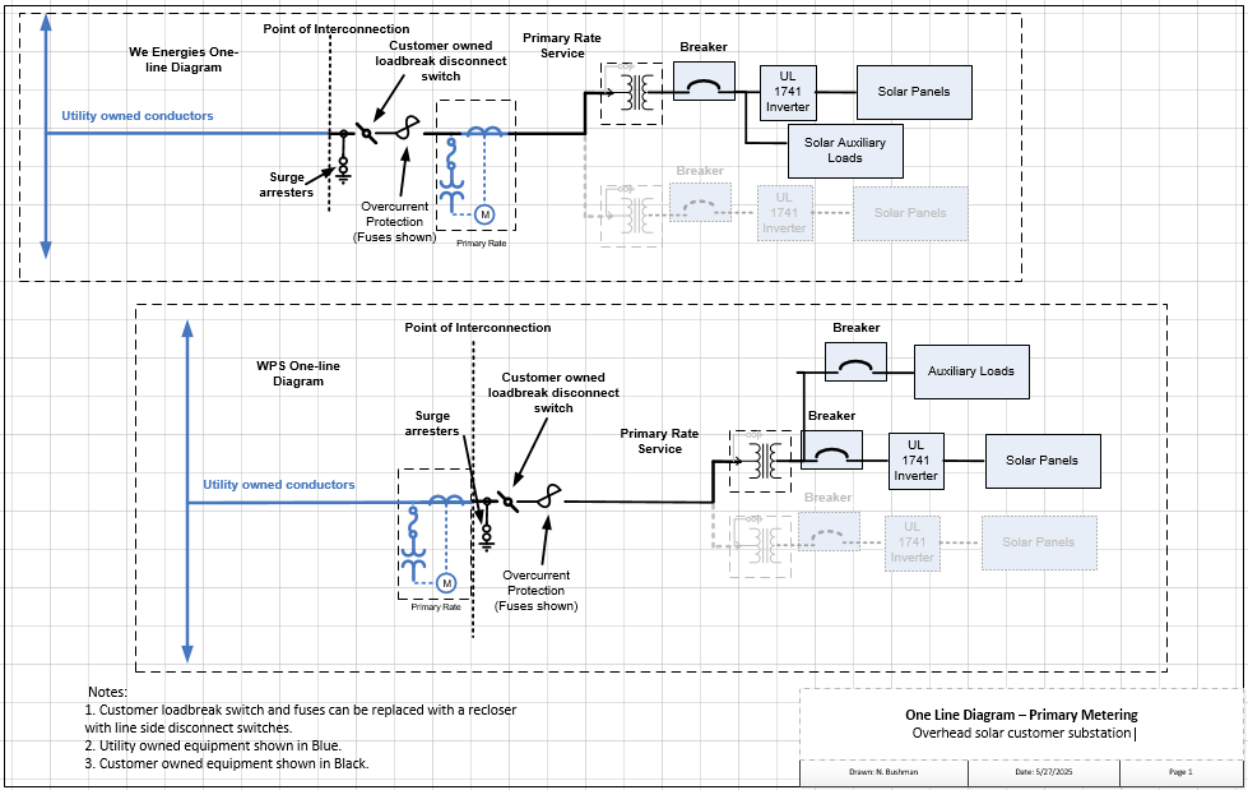
Series Metering

Series Metering with a dedicated revenue meter and dedicated export meter is not preferred and may only be allowed for existing systems. The Company strongly recommends the customer pursues bi-directional metering rather than series metering. Series metering one-lines will be similar to bi-directional metering with the below series metering substituted for the single bi-directional meter. The series metering example diagrams shown below are depicted with underground services. If the customer has an overhead service lateral the one-lines need to be modified to reflect metering that is suitable for an overhead service.



Primary Metering

The one-line diagrams shown below are depicted with overhead primary services with overhead customer-owned substations. If the customer has an underground primary service and associated padmounted customer-owned substation the one-lines need to be modified. The customer-owned substation shall comply with the Company's requirements for customer-owned substations.



8. Telemetry Equipment Requirements

The Company may require Telemetry equipment to be installed on all systems 300kW or larger. The need for Telemetry will be confirmed during the engineering review. It should be assumed that telemetry equipment is needed for any system 300kW or larger. The goal of the telemetry equipment is to quantify the hidden load due to a DG system by capturing the true output of the DG system. The customer is responsible for the cost of the telemetry equipment.

Customer Installed Equipment

The customer is responsible for installing an enclosure and conduit for the telemetry equipment. The enclosure shall be installed near the main DG disconnect. The Main DG disconnect shall have all generation running through it with no load tapped off between the generation and the disconnect. If a single main DG disconnect is not achievable contact the company with your plans so that the location for the telemetry equipment can be determined.

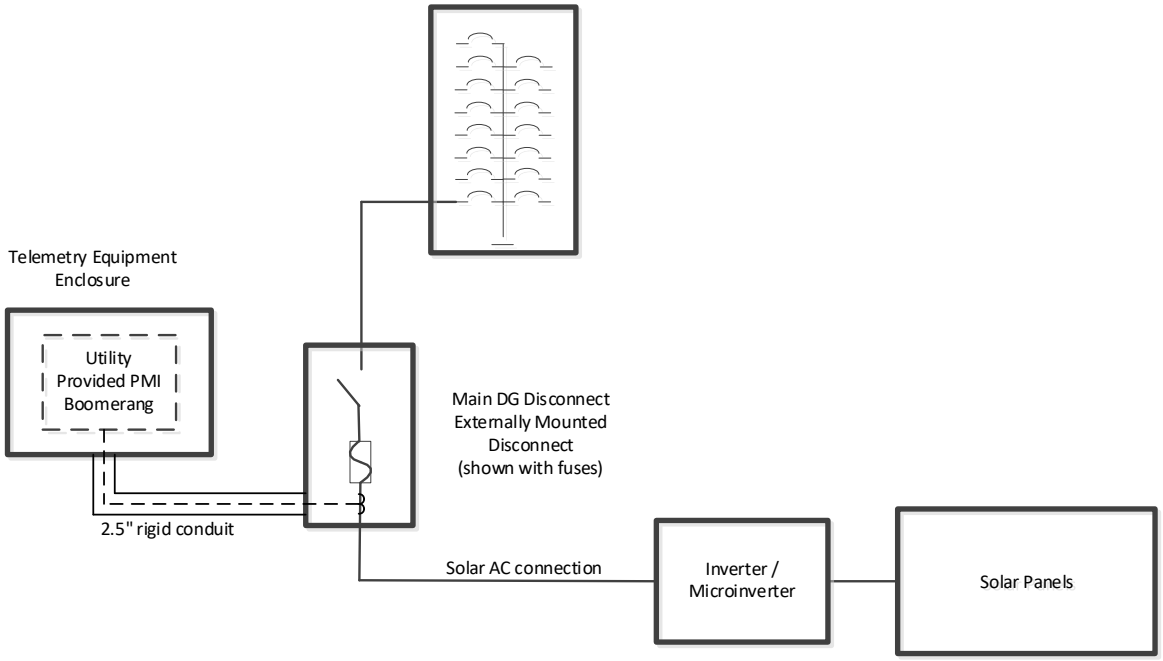
The enclosure shall meet the following general requirements.

1. The Company will specify the exact requirements based on project details.
2. General requirements:
    a. Voltage input for meter 120-300V
    b. Minimum of a 12”x12”x6” (LxWxD) wall mounted NEMA 3R box with a hinged door and locking hasp.
        i. Enclosure shall be located directly next to the DG disconnect
        ii. Minimum of a 2 ½” chase/conduit between enclosure and DG disconnect.
        iii. Telemetry meter box shall have a ½” (NPT) strain relief mesh cord grip installed in the bottom of the box to allow for antenna cord installation.

Utility Installed Equipment

The Company will install a PMI Boomerang/Seeker for telemetry metering. The Company will install the telemetry metering in the customer provided enclosure and will install the clamp on CTs and voltage leads through the customer provided conduit in the main DG disconnect. The company will need approximately 1 hour to install the telemetry equipment. In most cases, an outage would not be required for the installation of the telemetry equipment.

Example One Line



Example Installation Pictures

9. Commissioning Procedure and Expectations

Expectations

Approval of the facility documentation is the prerequisite to scheduling of final testing. Testing must be completed and passed in order to obtain permission to operate. The following guidelines are meant to ensure the commissioning is a timely and safe process. Failure to comply with the guidelines will result in a failed commissioning and a recommissioning fee charged to the installer.

- The facility shall be ready for testing no later than 10 minutes after the scheduled commissioning start time.
    - Ready for testing is defined as the facility producing significant output current.
    - Weather that significantly limits the facility from operating near rated capacity will require rescheduling of commissioning.
- The installer shall have access to the building(s) and all electrical equipment required for commissioning.
- The installer will remove all access panels necessary to allow access for commissioning measurements if required.
- The installer will have the tools and equipment with them required to perform the voltage and current measurements for verification of system operation if required.
    - Computer software connected to inverter is not an acceptable means of showing voltage or current measurements
- Other than the disconnecting device, Company personnel cannot operate customer-owned facilities such as breakers or inverter during the commissioning process, so the system needs to be left in a state that it will operate by closing the disconnect.
- If the customer is unable to have commissioning performed during normal business hours (Monday-Friday, 7 AM to 3 PM), the Company may be able to accommodate commissioning during non-business hours at the applicable billing rate.
- The Company reserves the right to reschedule commissionings on short notice due to elevated outage activity or other unavoidable Company resource constraints.
- All labels shall be installed prior to commissioning.
    - The labeling on the disconnect shall indicate power source(s) of the disconnect (Solar/PV and/or energy storage).
- Other than for testing purposes, the disconnecting device shall be left in the open position until commissioning has been completed. The installation should be tested prior to commissioning to confirm all components are operating properly. After the system has been tested, the disconnecting device shall be left in the open position until the commissioning is completed.

Commissioning Procedure

Commissioning begins with verification of equipment matching the submitted documentation. If any equipment installed differs from submitted documentation, the equipment will be reviewed to see if it will be acceptable and as-built documentation must be submitted after. The system cannot be operated until the as-built is submitted, reviewed, and accepted by the Company.

If the equipment that was installed is not acceptable the customer will need to either replace the equipment to match the accepted one-line or submit a new one-line for review and acceptance.

The Company will make the determination if a generation facility passes or fails the commissioning tests.

Performing the unintentional islanding test typically requires operation of disconnects to create an outage to the customer-owned generation and/or generation facility.

1. The generation facility is verified to be functioning at as close to rated output as possible.
2. The generation facility is intentionally islanded from the utility system to simulate a utility outage.
3. The generation facility is monitored to ensure it automatically disconnects/stops generating within two seconds of the intentionally islanding.

For customer-owned generation that utilizes automatic reconnecting to the distribution system (solar/energy storage systems) a grid reconnection test is also required and described below.

1. The generation facility is reconnected to the distribution system.
2. The generation facility is monitored to ensure it does not start producing power until a minimum of five minutes of stable voltage from the distribution system.

For generation facilities interconnecting to a three-phase voltage that has high complexity (as determined by the Company), utilizes Enphase microinverters, or is greater than 200kW, loss of phase testing shall be added to the commissioning process as described below. Installation of temporary disconnects for loss of phase testing is not an acceptable configuration, the system must be in final working condition.

1. The Company shall repeat the unintentional islanding and grid reconnection tests but rather than creating an outage that affects all phases of the generation facility only one phase will be opened to create an outage.
2. This test is repeated on each phase until all three phases are tested.
3. A failure of any test will result in the system failing commissioning.

Customers shall take any provisions necessary to protect their equipment during the loss of phase testing. The Company assumes no liability for damage to the customer's equipment during the loss of phase testing.

Approval/Pass

If the system passes, the job owner shall provide a written statement of final acceptance to the customer and installer.

Rejected/Failed

If the system fails, the job owner shall provide a written statement of failure to the customer and installer.

The installer shall take corrective action to fix the system, and the system shall be retested for proper operation.

10. Decommissioning

Scope

The owner of property chooses to discontinue generation or because of an Act of God or customer choice, they choose to no longer maintain or repair.
OR
The customer of record elects not to sign an Interconnection Agreement, Surplus Energy Agreement, or provide Proof of Insurance.

Process

- **Notification from Customer**
  - Customer submits notification to discontinue customer-owned generation.
- **Customer Responsibilities**
  - Customer to hire electrician to disconnect customer-owned generation.
  - Customer (or their electrician) to work with the municipality to coordinate an inspection prior to reenergizing.
  - Customer to remove all customer-owned generation equipment downstream of the metering.
    Note: when wired in series the additional meter socket must be removed. Bypasses will not be permitted to be installed to eliminate the need to remove the series meter socket.
  - Customer will continue to be charged the metering fee if they fail to remove the equipment.
- **Company Field Application Engineer or Company Representative**
  - Meets with the customer to verify customer-owned generation system is disconnected and removed.
  - Notifies Job Owner of status of customer-owned generation system (disconnect/removal).

11. Example Approval Letter

Template:

Subject: *ADDRESS* COGS Formal Review WR*XXXXXXXX*

ADDRESS WR*XXXXXXX*

Customer-Owned Generation Facility Type:

☐ Photovoltaic Array ☐ Energy Storage System ☐ Other:_____

Tariff System Size: *XX.XX kW*

PSC System Size: *XX.XX kW*

☐ Category 1 (20kW or less) ☐ Category 2 (>20 kW to 200 kW)

☐ Category 3 (>200 kW to 1 MW) ☐ Category 4 (>1 MW to 15 MW)

I have reviewed the customer-owned generation application for the above address. New equipment shall be installed per the current metering requirements of the Company. For existing equipment, I have conducted a preliminary exterior inspection of the metering equipment with the photos provided in the application. This review did not show changes or updates would be required to the metering equipment however, it is possible there could be a hazard or unsafe condition identified once our metering team arrives onsite to install/exchange the meter. If a hazard or unsafe condition is found the customer will need to make modifications to eliminate the hazard or unsafe condition before commissioning can occur.

The customer-owned generation application is APPROVED based on the adherence to the requirements laid out in the Customer-Owned Generation Manual.

Any deviations from the approved documentation of the customer-owned generation facility will require re-review, approval, and commissioning.

System Improvement Requirements before commissioning?	*Customer Obligated*
☐ Service conductor replacement	☐
☐ Service transformer replacement	☐
☐ Service relocation	☐
☐ Distribution improvements	☐
☐ Other: _____	☐

Loss of Phase Testing Required? ☐ YES ☐ NO

Please contact JOB OWNER when system is ready to be commissioned per commissioning guidelines laid out in the Customer-Owned Generation Manual.

Signed,

Engineer of Review

Example:

Subject: *1896 Generation Way, Milwaukee* COGS Formal Review WR*1234567*

Body:

1896 Generation Way, Milwaukee WR*1234567*

Customer-Owned Generation Facility Type:

☒ Photovoltaic Array ☐ Energy Storage System ☐ Other

Tariff System Size: *13 kW*

PSC System Size: *11.5 kW*

☒ Category 1 (20kW or less) ☐ Category 2 (>20 kW to 200 kW)

☐ Category 3 (>200 kW to 1 MW) ☐ Category 4 (>1 MW to 15 MW)

I have reviewed the customer-owned generation application for the above address. New equipment shall be installed per the current metering requirements of the Company. For existing equipment, I have conducted a preliminary exterior inspection of the metering equipment with the photos provided in the application. This review did not show changes or updates would be required to the metering equipment however, it is possible there could be a hazard or unsafe condition identified once our metering team arrives onsite to install/exchange the meter. If a hazard or unsafe condition is found the customer will need to make modifications to eliminate the hazard or unsafe condition before commissioning can occur.

The customer-owned generation application is APPROVED based on the adherence to the requirements laid out in the Customer-Owned Generation Manual.

Any deviations from the approved documentation of the customer-owned generation facility will require re-review, approval, and commissioning.

System Improvement Requirements before commissioning?	*Customer Obligated*
☐ Service conductor replacement	☐
☐ Service transformer replacement	☐
☐ Service relocation	☐
☐ Distribution improvements	☐
☐ Other	☐

Loss of Phase Testing Required? ☐ YES ☒ NO

Please contact JOB OWNER when system is ready to be commissioned per commissioning guidelines laid out in the Customer-Owned Generation Manual.

Signed,

Engineer of Review