

Mixed Generation Interconnection, Metering & Settlement

Netmetering Eligible, Class 1 Renewable Energy
Generation
Combined with Other Distributed
Generation/Storage

1

System Impact Issues

Traditional Distributed Generation (DG)

- The EDCs will continue to analyze the impact of traditional DG operating in parallel with the EDC's distribution system, behind the same meter with new or existing Class 1 renewable generation in accordance with the regulations for a Level 3 application. Installations not combined with Class 1 renewable generation may be treated as a Level 1 or 2 application.
- These include both rotating equipment and inverter based generation which produce energy to offset retail customer usage in accordance with the netmetering regulations and/or deliver wholesale energy to the EDCs distribution system.

Note: Any interconnected generation capable of islanded (i.e., Stand Alone) operation, must separate from the EDCs electrical system prior to energizing the islanded portion of the customer's system.

2

System Impact Issues

Frequency Response Systems ("FR") - Voltage Impact

- **Each has Twice the Impact of an Equivalently Sized PV-Only System**
 - **Load change to Distribution System**
 - **PV System: 0 to Minus Inverter Rating**
 - **FR System: Plus inverter Rating to Minus Inverter Rating**
- **Multiple Systems Respond in Unison to PJM signal**
 - **Load Changes are Additive**
 - **No Diversity**
- **High Frequency of Operation**
- **Potential for Sustained High or Low Voltage**

3

System Impact Issues

FR Systems – EDC Maintenance Issues

- **Increased Wear on Voltage Regulation Devices**
 - **LTCs, Line/Bus Regulators/Switched Capacitors**
- **Not Designed for Frequent Changes**
- **Voltage Regulation Equipment is Designed with Intentional Time Delay to Prevent Premature Wear**
 - **May Contribute to Sustained High and Low Voltage without Preventative Controls**

4

System Impact Issues

Frequency Response Systems (“FR”) - Analysis Requirements

- **Interconnection Application Notification Mandatory**
 - **Request OCE Mandatory Requirement**
 - **Add to Interconnection Application**
 - **Need for Improved PJM Notification of Intended Application**
- **Systems Analyzed at Full Potential Load Swing**
 - **Not Less Than Twice Inverter Rating**
- **Multiple Systems on Distribution Circuit & Substation Must be Analyzed in Aggregate**
- **Analysis Must Include Flicker Curve Considerations**

5

System Impact Issues

Frequency Response Systems (“FR”) - Operational Requirements / Limitations & Conditions for Interconnection

- **Aggregated FR Will be Limited to an Amount Creating Voltage Fluctuations to Less Than ½ the Dead Band of Any Voltage Regulation Device.**
- **Presence of FR may significantly increase costs to reconfigure system to accommodate future load growth or inhibit/prevent system reconfiguration.**
 - **Additional costs to reconfigure system because of FR may be passed on to customer or**
 - **FR may be required to cease interconnected operations.**
- **FR Operation May Only be Permitted While System is Configured as Originally Studied (i.e., Not During Restoration / Maintenance)**
- **Maximum Ramp Rates & Staggered Responses May be Required**

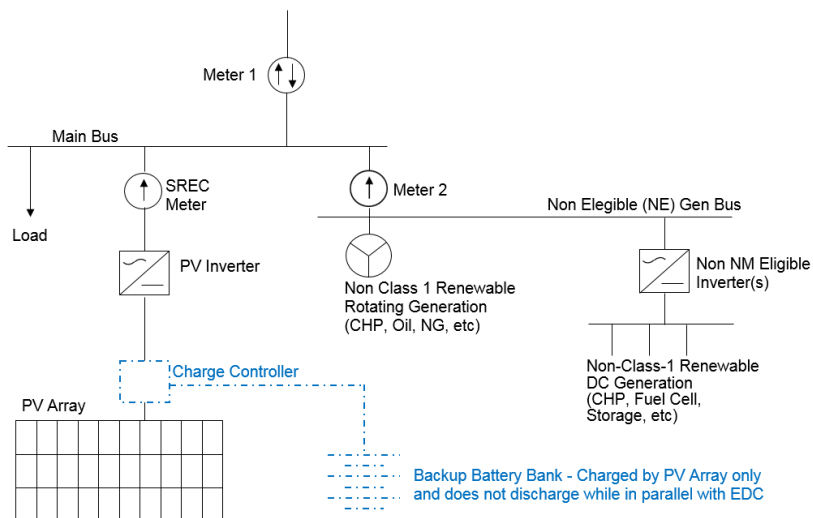
6

Metering

- **Additional metering will be installed, where necessary, at the customer's expense, to differentiate between Class 1 renewable energy which is eligible for net metering and other energy which is not.**
- **Metering requirements and configuration will be determined based on the type of generation, the intended purpose and operation of the of each of the generation systems and their source(s) of energy.**
- **While there may be some more unique situations, metering requirements will generally fall into one of three configurations that follow.**

7

Figure 1 - Mixed Generation Connection & Metering Online without Frequency Regulation



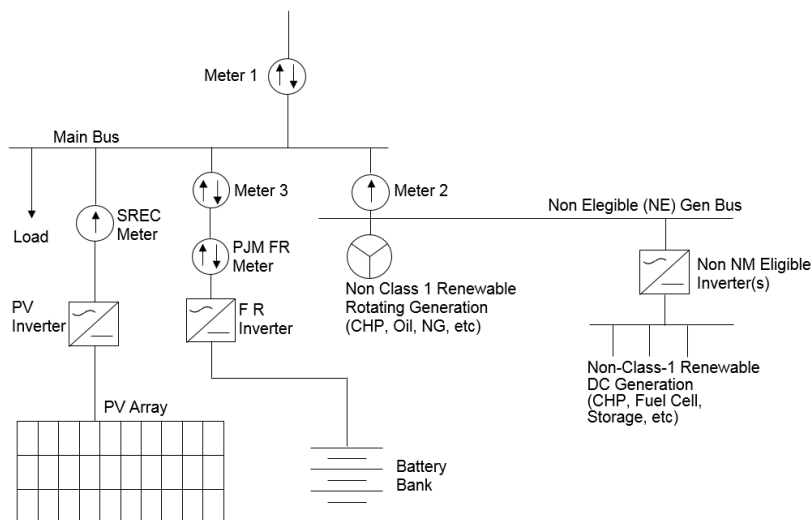
8

Figure 1 Legend

- **Meter 1 - Service Entrance Bidirectional Metering (kWh_{In} , kWh_{Out}):** Provided and installed at the EDC's expense based on the metering requirements of a comparable non generation Customer. Any upgrades (e.g. interval capability) are at the Customer's expense. Meter socket & installation by the Customer.
- **Meter 2 - Non Class 1 Renewable Generation Metering (kWh_{NE}):** Provided and installed by the EDC at the Customers expense. Meter socket & installation by the Customer.
- **SREC Meter - SREC Verification Metering:** Provided & installed by the Customer at the Customers expense.
- **Communications:** Where interval metering is required either for billing under the tariff rate schedule or at the request of the customer, the cost of the communications service and the installation of the communications medium are the responsibility of the Customer.

9

Figure 2 - Mixed Generation Connection & Metering Oneline with Frequency Regulation and Single Function Inverters



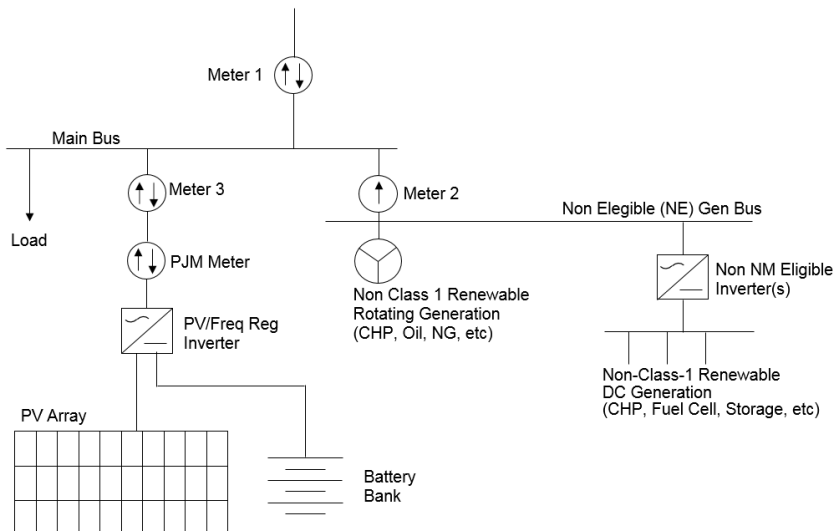
10

Figure 2 Legend

- **Meter 1 - Service Entrance Bidirectional Metering (kWh_{In} , kWh_{Out}):** Provided and installed at the EDC's expense based on the metering requirements of a comparable non generation Customer. Any upgrades (e.g. interval capability) are at the Customer's expense. Meter socket & installation by the Customer.
- **Meter 2 - Non Class 1 Renewable Generation Metering (kWh_{NE}):** Provided and installed by the EDC at the Customers expense. Meter socket & installation by the Customer.
- **Meter 3 - Battery Storage Bidirectional FR System Meter (kWh_{Chg} , kWh_B):** Provided and installed by the EDC at the Customers expense. Meter socket & installation by the Customer.
- **PJM FR Meter - PJM Frequency Regulation Performance Metering:** Provided & installed by the Customer at the Customers expense.
- **SREC Meter - SREC Verification Metering:** Provided & installed by the Customer at the Customers expense.
- **Communications:** Where interval metering is required either for billing under the tariff rate schedule or at the request of the customer, the cost of the communications service and the installation of the communications medium are the responsibility of the Customer.

11

Figure 3 - Mixed Generation Connection & Metering Online with Frequency Regulation and Multi Function Inverter



12

Figure 3 Legend

- **Meter 1** - Service Entrance Bidirectional Metering (kWh_{In} , kWh_{Out}): Provided and installed at the EDC's expense based on the metering requirements of a comparable non generation Customer. Any upgrades (e.g. interval capability) are at the Customer's expense. Meter socket & installation by the Customer.
- **Meter 2** - Non Class 1 Renewable Generation Metering (kWh_{NE}): Provided and installed by the EDC at the Customers expense. Meter socket & installation by the Customer.
- **Meter 3** - PV / Battery Bidirectional SREC Meter (kWh_{Chg} , kWh_{PV-B}): Provided and installed by the EDC at the Customers expense. Meter socket & installation by the Customer. Note: the energy flowing into the PV/FR inverter will be used as a surrogate for the energy produced by the batteries.
- **PJM Meter** - PJM Regulation Performance Metering: Provided & installed by the Customer at the Customers expense.
- **Communications**: Where interval metering is required either for billing under the tariff rate schedule or at the request of the customer, the cost of the communications service and the installation of the communications medium are the responsibility of the Customer.

13

Metering

Conceptual Energy Differentiation Process

- In any interval of measurement (monthly or hourly), subtract the non-NM eligible energy from the total exported in that interval.
- If the remainder is positive, that positive amount of energy is eligible for treatment under the netmetering regulations.
 - The remainder of the exported energy in the interval is treated as wholesale or by some other mechanism.
- If zero or negative, all of the energy exported in the interval is treated as wholesale or by some other mechanism.
- For hourly metered customers, all of the NM eligible interval values and all of the non NM eligible interval values are added separately for appropriate processing.

14

Billing & Settlement

Netmetering Eligible Energy

- The amount of energy received by the EDC from Class 1 Renewable resource, equivalent to the amount the EDC would have received absent any additional generation will be treated in accordance with the Netmetering regulations; either used to offset energy consumed during the month or banked for later usage during the annualized period.

Energy Produced by Qualifying Facilities (QFs)

- Energy received from traditional DG which are QFs will be compensated in accordance with the EDC's policy for purchasing such energy.

Energy Produced by Non-Qualifying Facilities (Non-QFs)

- An EDC may chose to purchase such energy but is under no obligation to purchase energy from non-QF DG. Non QF energy may be sold to a qualified wholesale market participant or directly to PJM. The EDCs will provide reasonable assistance to the customer generator in pursuing wholesale market sales.

15

Billing & Settlement

Energy Into and Out of a Frequency Regulation System

- Inverter based systems previously approved for use in a PV system do require additional analysis when used for FR. Such systems need more analysis in order to mitigate potential problems on the EDC's distribution system, power quality concerns and potential harm to customer's equipment.
- The energy produced by FR systems is not derived from Class 1 renewable resources and increases the amount of energy produced from fossil fueled generation.
- FR systems do not qualify for treatment under the netmetering regulations.

16

Billing & Settlement

Energy Into and Out of a Frequency Regulation System (continued)

- The EDCs plan to assess retail charges for the use of the distribution system, based on analysis to date, potentially in some combination of:
 - A contract demand adder based on the maximum load requirements of the FR system
 - Retail energy rates for energy consumed by the FR system and wholesale rates for sales into the market for energy produced by the system.
 - Netting the generation at the wholesale level produced and consumed by the FR system with a retail energy delivery charge for the energy consumed by the FR system.
 - Additional retail statement/settlement preparation charge.
- The EDCs are continuing to develop appropriate charges compatible with their rate structures which may be unique to each EDC. These concepts represent the general discussions amongst the EDCs. Each EDC reserves the right to take individual positions in current and future proceedings, as it deems appropriate.

17