



Guidance No. 3 for Interconnection of Energy Storage Systems Operated on the DC Side of the Paired Onsite Renewable Generation Connected Under a Net Metering Tariff

Purpose

This document provides guidance for the interconnection of electric storage to operate in parallel with the utility and a customer's renewable generation. The energy storage is connected on the DC side of the onsite renewable generation in a net metering (NEM) arrangement.

Background

In Proceeding No. 15AL-0048, the Company agreed to terms guiding the installation of customer sited storage facilities. This guidance document addresses the term that states:

The Company will allow an energy storage system to be located on the same side of the production meter as a NEM eligible onsite renewable generator provided that the storage system is charged exclusively by the onsite renewable generation and that only the production recorded by the production meter will be eligible for REC incentives.¹

This guidance may be modified from time to time to be consistent with the Company's policies for interconnection and operation of customer-sited storage.

Exclusions

This guidance addresses configurations and requirements related to the term above. This guidance does not address non-renewable generation, non-net metered self-generation, stand-alone storage without generation, standby rates, buy-sell metering, or any tariffed rate where net metering Schedule NM is not applied.

Interconnection Reviews

All electrical sources, including storage, that operate in parallel with Xcel are required to have an interconnection review and an Interconnection Agreement to ensure safety, system reliability, and operational compatibility. For purposes of this guidance, a source is considered to be operating in parallel with the grid when it is connected to the

¹ Attachment A, Decision No. C16-1075, Pages 20-21.



distribution grid and can supply energy to the customer simultaneously with the Company supply of energy. Any source operating in parallel with the grid is required to have an interconnection agreement.

When a storage system is installed in conjunction with a renewable generation system, both may be reviewed at the same time and be included in one Interconnection Agreement.² When a storage system is installed after the renewable generation system, the review level will be based upon the combination of the onsite generation rated capacity and the storage nameplate capacity for the selected operating mode³ of the energy storage. When the energy storage and renewable generation share a common inverter, the review level will be based on the rating of the shared inverter. The operating modes will be part of the Interconnection Agreement requirements and any change in operating modes that impact the ability of the energy storage system to adhere to the settlement requirements may require another review of the facility and possibly mitigations. If the energy storage is installed at the same time as the renewable source, a combined review is to be encouraged as the total time and cost will be less than two separate reviews.

Telemetry and Control

Whenever an electric storage system is co-located on the same site with a NEM eligible generation system, its rated nameplate capacity will be included with the onsite generation for determining whether or not telemetry and/or remote separation control are needed⁴. When the energy storage and renewable generation share a common inverter, the telemetry level will be based on the rating of the shared inverter. This applies regardless if all sources are installed at the same time or at separate times. The determination is also based upon the selected operating modes of the energy storage as stated at the time of installation. Any change in operating modes that impact the ability of the energy storage system to adhere to the settlement requirements may require a change in telemetry functionality.

² Interconnections are reviewed based on the combined nameplate ratings of the sources that can actually be simultaneously supplied to the grid, such as two inverters. The ongoing operation capacity portion of the review is based on the actual simultaneous performance AC ratings. If the contribution of the energy storage to the total contribution is limited by programming or by some other on-site limiting element, the reduced ongoing capacity will be used.

³ Operating Modes includes such requirements as charging the energy storage only from an on-site renewable energy source that is net-metered, non-export requirements, or stand-alone storage systems.

⁴ Less than full nameplate will be considered if the added source is limited by programming or onsite equipment element rating.



Energy Storage Configurations

There are two basic energy storage configurations that are permitted under this guidance⁵. In the two configurations, the energy storage is assumed to be using a shared hybrid inverter along with the renewable generation. The Diagrams provided assume a Protected Load Panel would be connected on the renewable generation's side of the Production Meter, when a production meter is required or elected to be installed.

- Hybrid Inverter with a Protected Load Panel directly served by the hybrid inverter (Diagram No. 3a).
- Hybrid Inverter with a Transfer Switch (Diagram No. 3b).

Each diagram provides the representative configuration in principle and may have other features not reflected in the diagram but the operational principle shall be consistent with the operational principle demonstrated by the diagram. The desired functionality may be controlled by inverter or control system programming. The diagrams are attached at the end of the text and are considered a part of this guidance.

All customers served under net metering, photovoltaic, or some standby services are required to have a Production Meter, with exception of on-site certified inverter based solar generation 10kW or less, unless otherwise installed under the provisions of PUC Rule 3664(e)(II). This provision allows for Company installation of a production meter for solar generation 10kW or less, with Customer consent, at the Company's expense or by Customer request at the Customer's expense.

On-site certified inverter based solar generation 10kW or less without a production meter, supplied by a branch circuit from the customer's panel, may omit the disconnect switch.

There may also be a configuration without a Protected Load Panel. This would be identical to Diagram No. 3b, but without a transfer switch or Protected Load Panel.

For configuration 3b, metering will be the standard service meter for NM and production meter for the residential and small commercial tariffs. For configuration 3a, the net meter will be the standard for service under NM. The Production Meter will be upgraded to a dual register bi-directional meter. The added protected load supply meter will be a standard load-only meter. At some future date, the meters may be upgraded to

⁵ Photovoltaics are typically installed taking service under the Net Metering Service tariff.



bi-directional meters.⁶ Large commercial and industrial customers will use bi-directional meters suitable for their rate class.

When a production meter is utilized for REC payments, the configurations under Guidance No. 3 will result in some loss of meter recorded RECs and corresponding payments for installations eligible for REC payments. Batteries consume some power for maintaining a charge. A discharge - charge cycle has turn-around energy losses. This is true whether the cycle occurs supporting the Protected Load Panel during an outage or for use of the energy storage to manage the customer's energy usage.

This guidance requires the energy storage to be charged with 100% renewable energy from the on-site eligible renewable generation source. The installation must be designed and programmed to comply with this condition. For inverters, the programming selected must be protected⁷ from modification so only the inverter manufacturer or installer can change the renewable only charging programming. The means of achieving this shall be provided as part of the Interconnection Agreement and Interconnection Application. Other means of securing the settings may be mutually agreed upon on a case-by-case basis. Xcel Energy reserves the right to conduct an inspection to verify compliance at a later date if problems arise or indications of possible non-compliance are present.

Hybrid Inverter with a Protected Load Panel directly served by the hybrid inverter (Diagram No. 3a)

When a Protected Load Panel is installed with the hybrid inverter and supplied through that inverter, a second uni-directional Load Meter must be installed between the hybrid inverter and the Protected Load Panel when a production meter is required or elected to be installed. The main Production Meter will be a dual-register bi-directional meter. These meters and the service meter must be able to be synchronized for the same time intervals. These three meters will enable the derivation of renewable production and load. The inverter software programming must be inaccessible and/or password protected.⁸

Hybrid Inverter with Transfer Switch (Diagram No. 3b)

If a Transfer Switch is used to supply the Protected Load Panel under normal conditions, when a production meter is required or elected to be installed, no power will

⁶ Meters may require upgrading due to changing metering standards, metering technology changes, or new system control installation.

⁷ Programming protection may be by means of password protection or making access physically inaccessible.

⁸ Inaccessible may include locks or other physical security. Inaccessible and/or password protection must be restricted to the manufacturer/developer/ installer.



flow in reverse through the Production Meter. This eliminates the need for the second Production Meter. The required Service Metering and Production Metering will be the standard meters for net-metered eligible generation. At some future date, the meters may be upgraded to bi-directional meters⁹. The inverter software programming must be locked down and password protected.

Illustrative diagrams of approved configurations are attached.

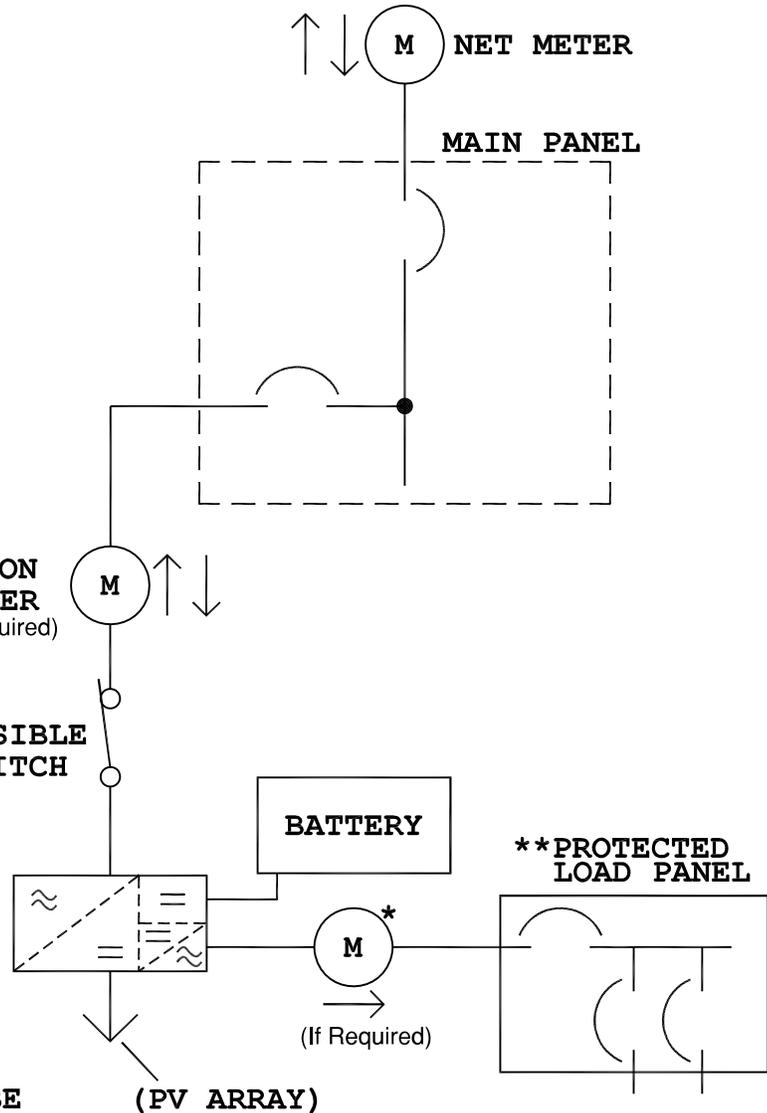
⁹ Meters may require upgrading due to changing metering standards, metering technology changes, or new system control installation.

FIGURE ILLUSTRATES REPRESENTATIVE CONCEPTS & INTENT. PACKAGED SYSTEMS MAY HAVE HYBRID INVERTERS WITH THESE FEATURES PROVIDED AS PART OF THE PACKAGE.

HYBRID EXAMPLE #3a METER OPTION

-BATTERY MAY EXPORT ONLY IF 100% CHARGED BY NEM ELIGIBLE GENERATION SOURCE

METERING MUST BE TIME SYNC



1. GRID FOLLOW
2. GRID FORM
3. CHARGER
4. TRANSFER
5. REQUIRED INVERTER PROGRAMMING MUST BE LOCKED DOWN
- *6. METER REQUIRED WHEN PROTECTED LOAD PANEL IS INSTALLED ON INVERTER SIDE OF PRODUCTION METER WHERE A PRODUCTION METER IS REQUIRED.

** 7. THE PROTECTED LOAD PANEL COULD BE A SEPARATE LOAD PANEL AS SHOWN IN THE DIAGRAM OR COULD BE THE ENTIRE MAIN PANEL.



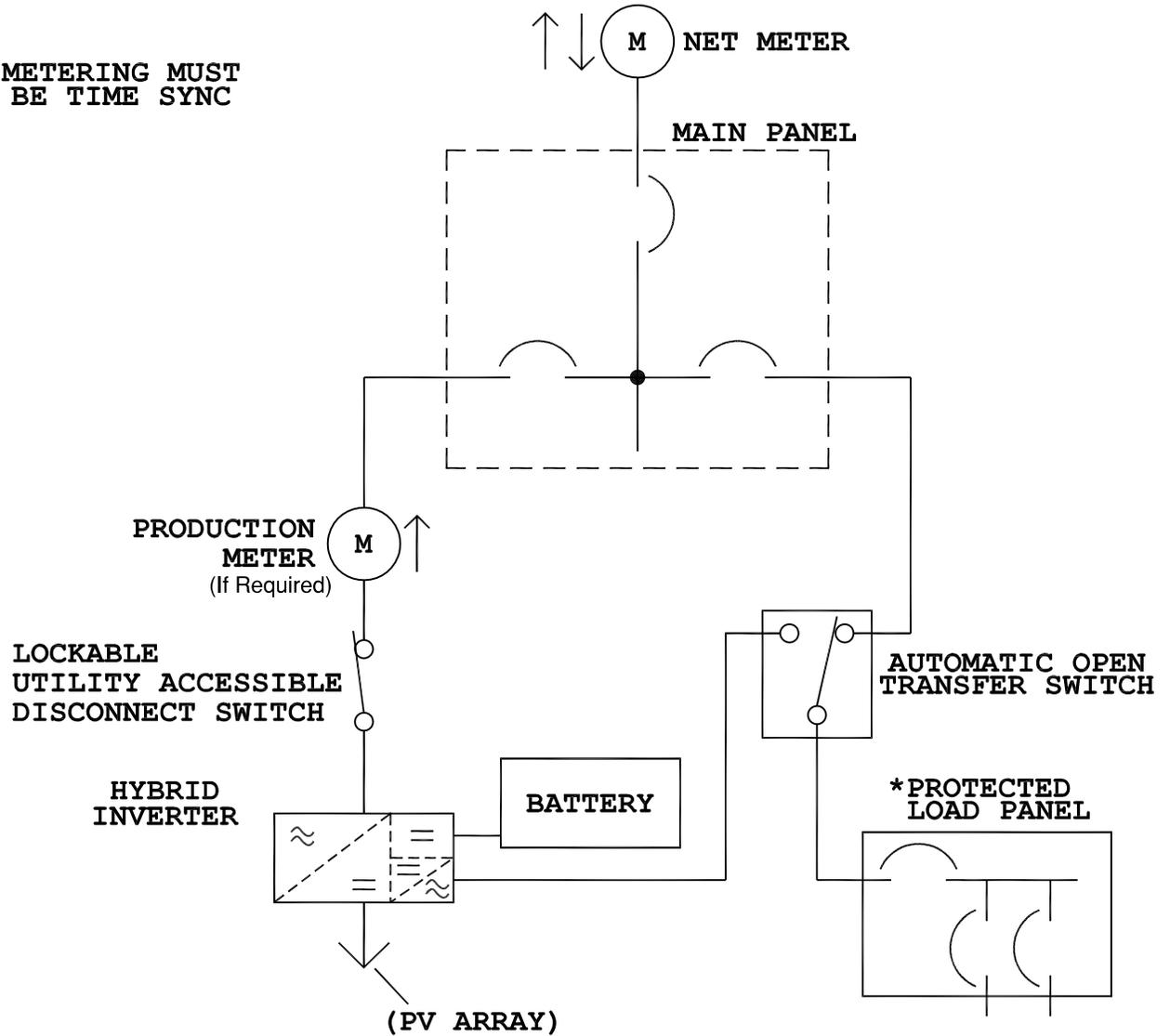
PSCO ONLY - 10/05/17

FIGURE ILLUSTRATES REPRESENTATIVE CONCEPTS & INTENT. PACKAGED SYSTEMS MAY HAVE HYBRID INVERTERS WITH THESE FEATURES PROVIDED AS PART OF THE PACKAGE.

HYBRID EXAMPLE #3b TRANSFER OPTION

-BATTERY MAY EXPORT ONLY IF
100% CHARGED BY NEM ELIGIBLE
GENERATION SOURCE

METERING MUST
BE TIME SYNC



1. GRID FOLLOW
2. GRID FORM
3. CHARGER
4. TRANSFER
5. REQUIRED INVERTER PROGRAMMING MUST BE LOCKED DOWN.
- *6. THE PROTECTED LOAD PANEL COULD BE A SEPARATE LOAD PANEL AS SHOWN IN THE DIAGRAM OR COULD BE THE ENTIRE MAIN PANEL.



PSCO ONLY - 10/05/17

PV + BATTERY CONFIGURATION