



## **Guidance No. 2 for Interconnection of Energy Storage Systems Operated on the AC 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 AC side of the onsite renewable generation and behind the utility's delivery meter in a net metering (NEM) arrangement. Energy storage connections on the DC side of the paired onsite renewable generation are covered in Guidance Document No.3.

### **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 that is paired with net energy metering ("NEM") eligible onsite renewable generation to be operated in parallel with the grid provided that (a) an interconnection review is completed; and either (b) the storage system is charged exclusively by the NEM eligible on-site generation, or (c) the customer can demonstrate the storage system will never export to the grid.<sup>1</sup>

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<sup>2</sup>, stand-alone storage without generation, standby rates, buy-sell metering, or any tariffed rate where net metering Schedule NM is not applied.

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<sup>1</sup> Attachment A, Decision No. C16-1075, Pages 20-21.

<sup>2</sup> Self-generation is a customer supplying part or their entire load from onsite generation with no intent of export or payment for export.



## **Interconnection Reviews**

All electrical sources, including energy 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 distribution grid and can supply energy to the customer simultaneously with the Company supply of energy. Any source operating in parallel to 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<sup>3</sup>. 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 mode<sup>4</sup> of the energy storage. The operating modes will be part of the Interconnection Agreement requirements and changes 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 needed.<sup>5</sup> 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. Change in operating modes that impact the ability of the energy storage system to adhere to the requirements may require a change in telemetry functionality.

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<sup>3</sup> 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.

<sup>4</sup> Operating Modes includes such requirements as charging the energy storage only from the renewable source, non-export energy management, or stand-alone.

<sup>5</sup> 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 three basic energy storage configurations that are permitted under this guidance<sup>6</sup>. The second configuration has three alternative arrangements:

- Standby Energy Storage Operation with NEM Eligible Onsite Renewable Generation (Diagram No 2a).
- Parallel Energy Storage Operation Charged 100% by NEM Eligible Onsite Renewable Generation (Diagram No. 2b).
- Parallel Energy Storage Operation Subject to No-export Restrictions (Diagram No. 2c).

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.

Metering will be the standard service NM and Production Meter for the residential and small commercial tariffs. At some future date, the meters may be upgraded to bi-directional meters.<sup>7</sup> Large commercial and industrial customers<sup>8</sup> will use bi-directional meters suitable for their rate class.

### **Standby Energy Storage Operation with Onsite Renewable Generation (Diagram No. 2a)**

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<sup>6</sup> Photovoltaics are typically installed taking service under Net Metering Service Tariff.

<sup>7</sup> Meters may require upgrading due to changing metering standards, metering technology changes, or new system control installation.

<sup>8</sup> "Large C & I customers" would generally be those customers served under rate schedules as SG, PG, etc.



Standby batteries may charge from the onsite renewable resource or the utility grid, but cannot discharge into the customer's main panel. Standby operation is applied to a Protected Load Panel in a manner consistent with National Electric Code Article 702. No change in metering is required for this arrangement. See Guidance No. 1 for standby energy storage interconnection with non-net-metered self-generation.

### **Parallel Energy Storage Operation Charged 100% from Onsite Renewable Generation (Diagram No. 2b)**

This configuration allows batteries that are 100% charged with onsite renewable generation to be connected in parallel to the grid on the AC side of the onsite renewable generation. The energy storage is connected on the AC side of the onsite renewable generation and a transfer switch<sup>9</sup> is provided to divert renewable AC power to the energy storage for charging. The inverter's software programming will control the appropriate charging, discharge, and bypass of the energy storage system. The inverter software programming must be inaccessible<sup>10</sup> and/or password protected.

This configuration shall use a separate inverter from the PV inverter.

### **Parallel Energy Storage Operation Subject to No-Export Restrictions (Diagram No. 2c)**

If the parallel energy storage can be charged by power from the utility via the main panel and thus is not charged from 100% renewable energy, the energy storage must not export to the grid. Subject to the Inadvertent Export provisions below, the energy storage may not cause an outward flow of power at the delivery point meter. Nothing in this guidance document shall be construed to limit the export of actual onsite renewable self-generation that is net metered.

The customer is responsible for dynamically managing the energy storage operation so that these conditions are met regardless of the eligible renewable's output and any variations in the eligible renewable's output or the customer's load. The energy storage must be connected to the AC side of the onsite renewable generation and must not be on the DC side of the eligible onsite renewable generation.

The Production Meter will need to read the same values for the same intervals as the net meter. The no-export requirement does not allow compensation to be paid for exported energy storage power that is other than 100% eligible renewable energy.

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<sup>9</sup> The switch may be a built in part of the energy storage inverter package or functionally provided through internal programming.

<sup>10</sup> Inaccessible may include locks or other physical security. Inaccessible and/or password protection must be restricted to the manufacturer/developer/ installer.



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.

### **Inadvertent Export**

The requirement term “no export” allows occasional de minimis “inadvertent export” of power from the energy storage to the grid only. In all instances of this guidance references of “no export” or “inadvertent export” only applies to the energy storage power sent to the grid and does not apply to the power that may be exported to the grid by the onsite renewable generation. This recognizes that any parallel operation of a source with the utility may encounter brief upsets due to feeder or customer disturbances, sudden load changes, etc.

Inadvertent export is the unscheduled export of real power generated from a customer’s energy storage and delivered to the Company. The use of an internal transfer relay, energy management system, or other customer facility hardware or software system(s) intended to prevent the reverse power flow, or net export, from the customer’s energy storage across the point of interconnection is required. The magnitude of export shall be less than the energy storage’s nameplate rating (kW-gross)<sup>11</sup> and the duration of export of power from the customer’s energy storage shall be less than 30 seconds for any single event. There are no limits to the number of events.

The cumulative amount of energy from the customer’s energy storage and delivered to the Company in any calendar month shall be less than the customer’s energy storage’s nameplate rating (kW-gross)<sup>12</sup> multiplied by one (1) hour.

Any amount of export of real power across the point of interconnection lasting longer than 30 seconds for any single event shall result in a cease-to-energize or halt of energy production of the customer’s energy storage within two (2) seconds of exceeding the 30-second duration limit.

Where applicable, any failure of the Customer’s energy storage control system for thirty (30) seconds or more, resulting from loss of control signal, loss of control power or single component failure of the distributed energy resource (DER) or related control

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<sup>11</sup> The magnitude of export is based on the combined nameplate ratings of the sources that can actually be simultaneously supplied to the grid, such as storage and self-generation. 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.

<sup>12</sup> The magnitude of export is based on the combined nameplate ratings of the sources that can actually be simultaneously supplied to the grid, such as storage and self-generation. 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.



sensing of control circuitry, will cause the customer's energy storage to enter a non-export operational mode where no energy will be Inadvertently Exported to the grid.

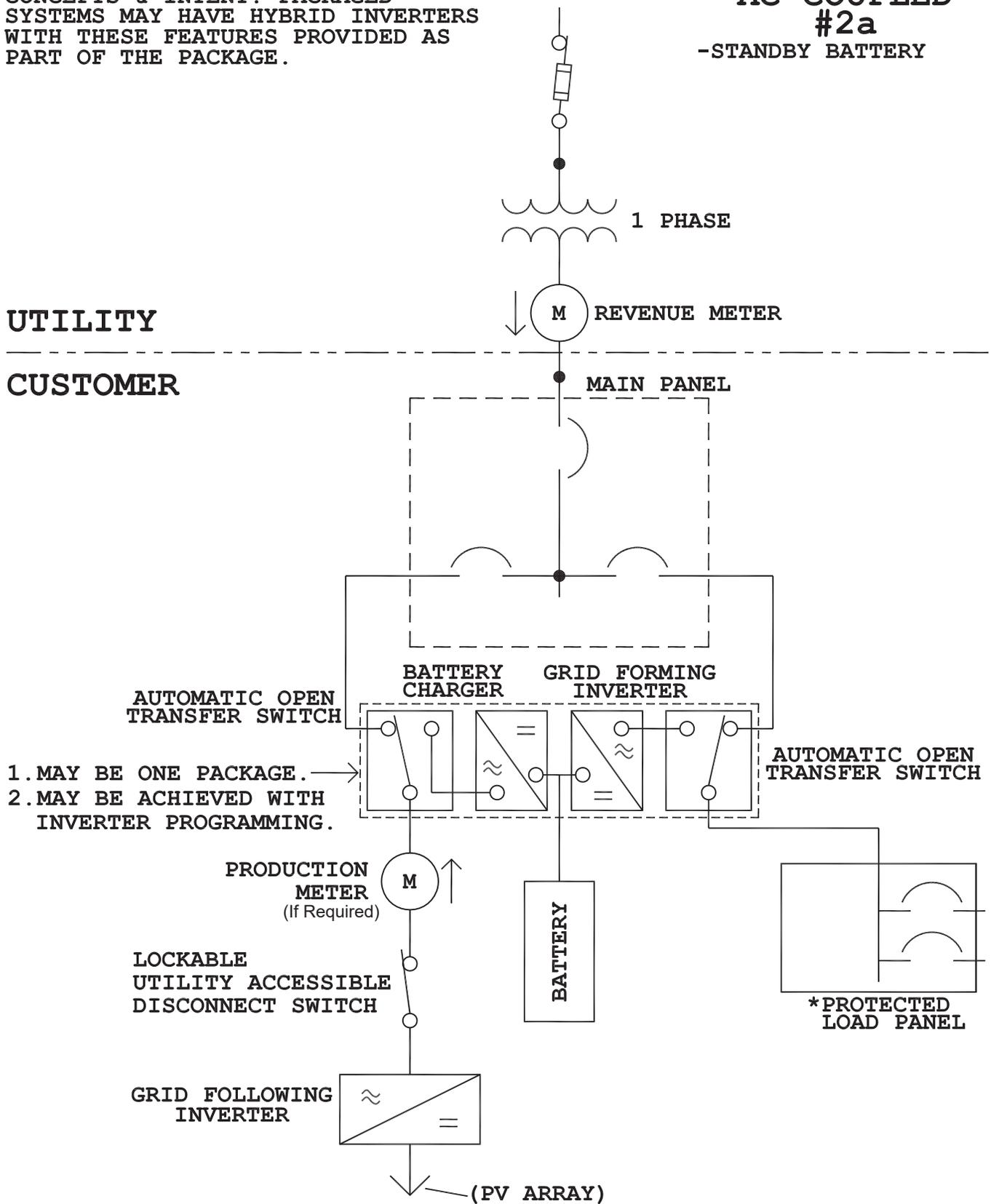
***Illustrative diagrams of approved configurations are attached.***

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

**AC COUPLED  
#2a**  
-STANDBY BATTERY

**UTILITY**

**CUSTOMER**



- 1. MAY BE ONE PACKAGE.
- 2. MAY BE ACHIEVED WITH INVERTER PROGRAMMING.

\*3. THE PROTECTED LOAD PANEL COULD BE A SEPARATE LOAD PANEL AS SHOWN IN THE DIAGRAM OR COULD BE THE ENTIRE MAIN PANEL.



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

## AC COUPLED #2b

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

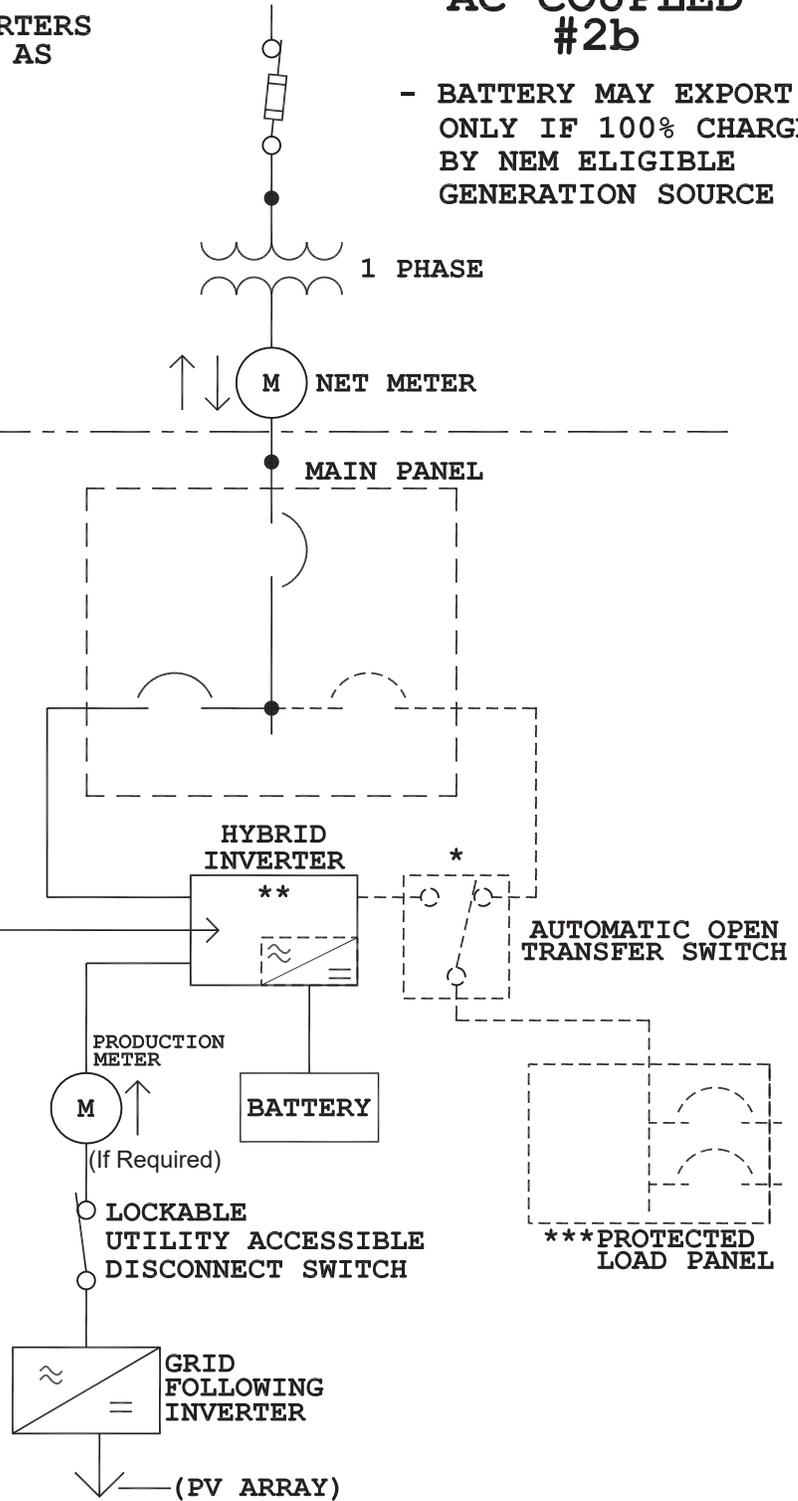
UTILITY

CUSTOMER

METERING MUST BE TIME SYNC

CONTROLLED BY INVERTER PROGRAMMING:

1. PV BYPASS BATTERY WHEN BATTERY FULLY CHARGED.
2. BATTERY CHARGED BY PV ONLY.
3. BATTERY DISCHARGE TO MAIN PANEL OR PROTECTED LOAD PANEL ONLY.
- \*4. OPTIONAL - ATS MAY BE OMITTED IF INVERTER CAN DELIVER UTILITY SIDE POWER WHILE BATTERY 100% CHARGED BY NEM ELIGIBLE GENERATION SOURCE.
- \*\*5. OTHER CONFIGURATIONS MAY BE USED THAT SATISFY THE BATTERY BEING 100% CHARGED BY NEM ELIGIBLE GENERATION SOURCE.
6. REQUIRED INVERTER PROGRAMMING MUST BE LOCKED DOWN.
- \*\*\*7. THE PROTECTED LOAD PANEL COULD BE A SEPARATE LOAD PANEL AS SHOWN IN THE DIAGRAM OR COULD BE THE ENTIRE MAIN PANEL.



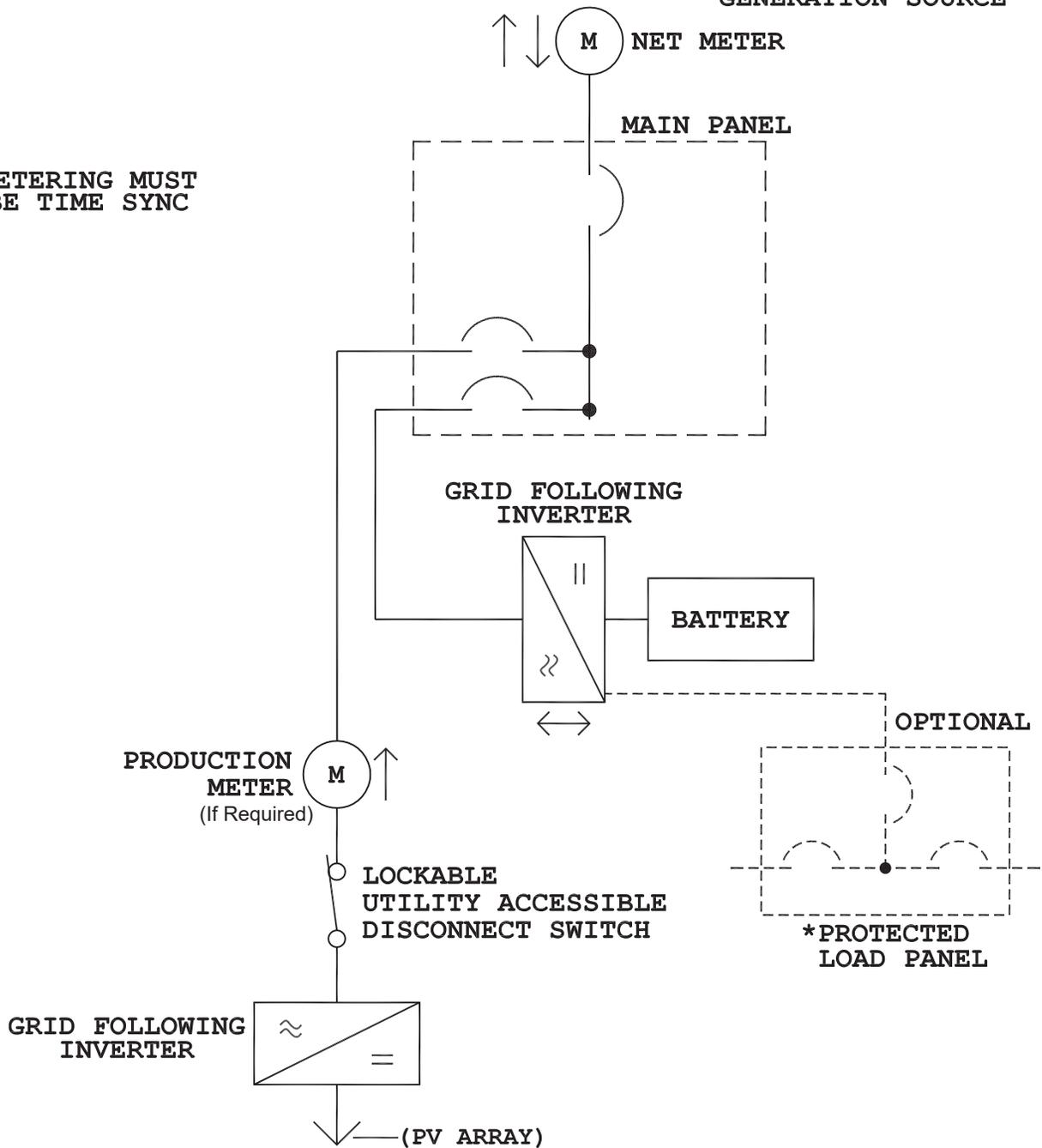
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FIGURE ILLUSTRATES REPRESENTATIVE CONCEPTS & INTENT. PACKAGED SYSTEMS MAY HAVE HYBRID INVERTERS WITH THESE FEATURES PROVIDED AS PART OF THE PACKAGE.

## AC COUPLED #2c

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

METERING MUST BE TIME SYNC



1. BATTERY INVERTER PROGRAMMING MUST BE LOCKED DOWN.
2. BATTERY INVERTER MAY BE CONNECTED TO PROTECTED LOAD PANEL IF THE INVERTER CAN PROVIDE TRANSFER SWITCH FUNCTION.

\*3. THE PROTECTED LOAD PANEL COULD BE A SEPARATE LOAD PANEL AS SHOWN IN THE DIAGRAM OR COULD BE THE ENTIRE MAIN PANEL.



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