



Xcel Energy Requirements for DER Application Completeness Review

Applicable to Public Service Company of Colorado



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1.0 Scope

Outlined below are the engineering documents and associated minimum requirements for a Distributed Energy Resource (DER) interconnection application to be deemed complete. The requirements apply to all DER for the purpose of providing additional detail on how application completeness will be reviewed with respect to governing interconnection requirements. Interconnections using Energy Storage Systems must also follow the Xcel Energy Storage Interconnection Guidelines in addition to the below requirements. In the context of this document, “Dedicated Power Production Facility” refers to interconnections that connect directly to the Distribution System for the sole purpose of exporting energy to the distribution system and do not have electrical services associated with serving a customer load or premise.

2.0 Terms and References

Applicable terms and company/industry references are provided below.

2.1 Glossary

Distributed Energy Resource (DER): Distributed Energy Resources (DERs) include all sources, including energy storage systems. All sources interconnected in parallel with Xcel Energy’s system require an interconnection review.

Reference Point of Applicability: The location, either the Point of Common Coupling (PCC)¹ or the Point of DER Connection (PoC)², where the interconnection and interoperability performance requirements specified in IEEE 1547 apply. With mutual agreement, the Area Electric Power System (EPS) Operator³ and Customer may determine a point between the Point of Common Coupling and Point of Interconnection. See the PSCo DG Tech Manual for more information.

2.2 References

- Internal
 - [DG Tech Manual](#)
 - [Xcel Energy Standard for Electric Installation and Use](#)
 - [Interconnection of Electric Storage Guidance and Declaration Forms⁴](#)
 - [PSCo Approved List of Meter Collar Adaptors](#)

¹ PCC is the point where the Interconnection Facilities connect with the Area EPS Operator’s Distribution System. Also referred to as the Point of Interconnection (POI) in FERC SGIP and Colorado Rule 3852.

² PoC is the point where the individual DER is electrically connected in a Local EPS.

³ The Area EPS Operator is the entity responsible for designing, building, operating, and maintaining the Area EPS. Within Xcel Energy’s service territory, the Area EPS Operator is Xcel Energy.

⁴ See the “Energy Storage Systems” subsection under the “Technical Requirements and Documents” section on [Xcel’s Interconnection website](#).

- External
 - [National Electric Code](#)
 - [UL 1741](#)
 - [IEEE 1547](#)
 - [National Electric Safety Code](#)
 - [Applicable building codes and standards](#)

3.0 One Line Diagram

Important note: Ensure that data provided on the one-line is consistent with data provided on the interconnection application in the online portal.

One Line diagram, also known as a single-line diagram, showing the installation of the DER system and associated equipment shall be required with each interconnection application.

To reduce the chances of a delayed deemed-complete status by increasing the overall clarity of the one-line, it is strongly recommended to use a standard graphical symbol set, such as that found in IEEE 315, when such a standardized symbol exists.

One-line diagrams may consist of multiple pages.

The following information shall be clearly depicted on the one-line diagram:

Contact information and General

3.1 Customer name and premise address

Note: Ensure consistency of name and address between the one-line and the interconnection application.

Note: Proposed resources of new construction or off-site interconnections may not have a premise address at the time of application. After receiving a premise address, the customer must upload revised one-line diagrams into the online portal including the premise address.

3.2 Installer name and contact information. Contact information must include a phone number or email address.

3.3 Clearly identify the Reference Point of Applicability (RPA). This is the location that the DER system will meet the requirements of IEEE 1547 Section 4.2.

Note: For practical purposes, indicating the location that measurements will be taken as the "RPA" for the witness test is sufficient to satisfy this requirement in most cases. If measurements are being taken at a disconnect, it should be clear which side of the disconnect measurements are being taken.



Electrical Component Schematic

3.4 The electrical connections of all major components between the main service meter⁵ and the DER system

Note: Examples of major components include interconnection transformers, breakers, fuses, reclosers, meters, meter collars, current transformers⁶, potential transformers, and inverters.

Note: All customer equipment shall be located on the customer-side of the main service meter.

Note: All Dedicated Power Production Facilities require a dedicated transformer with no other associated load or DER interconnections.

3.5 Main service meter and main service panel

Note: Breakers serving only load do not need to be shown in detail, but some indication that load is served from the main service panel, or any other panel in the drawing, is requested. The presence of another breaker is enough to indicate to the reviewer that additional load is served from this panel.

Note: Off-site DER may exclude main service panel.

3.6 Main service protection between DER and the utility

Note: This protective device shall be provided immediately after the main service meter. Typical protective devices include circuit breakers and fuses. When connected behind a main service panel, the main service breaker will suffice as the protective device. Unfused AC disconnects do not serve as main service protection.

3.7 The voltage and number of phases of the main service meter, production meter (if required) and inverters/DER system(s).

Note: The phase symbol "Φ" may be used to indicate phase.

Note: A note indicating that, "The main billing meter, DER/inverter(s), production meter (if required) are all 240VAC, 1-phase, 3-wire" is sufficient to address this requirement.

Note: All Xcel-owned production meters shall be installed at an Xcel Energy standard voltage and the voltage should be listed on the one-line.⁷

Note: If present, provide any transformer winding configuration and voltages. Please do not include any instrument transformer ratios.

Note: If a three-phase system is using single-phase inverters, indicate the quantity of inverters per phase.

⁵ Xcel Energy infrastructure is not required to be shown on the customer one-line. Any Xcel Energy equipment shown is subject to change at Xcel Energy's discretion and should not be used for planning/design purposes by the customer.

⁶ CT polarity should be clearly marked on the drawing.

⁷ Xcel Energy standard service voltages can be found on Pg. 24, section 3.1.1 of the Electric Standard for Electric Installation and Use. The inverter side of a step-up transformer may be a non-standard Xcel Energy voltage, provided that no Xcel Energy metering is located between the step-up transformer and the inverter.

- 3.8 DER system size(s):
- 3.8.1 The kW DC and kW AC nameplate ratings of each DER system
Note: Ensure consistency of system sizes (DC and AC) between the one-line and the interconnection application.
- 3.8.2 The aggregate kW AC nameplate rating
Note: For example, this would be the sum of all inverters present on a DER system.
- 3.9 When multiple DER units are existing or proposed on a single service, all DER systems shall be shown with proposed and existing marked and have ratings clearly labeled.
Note: Ensure accuracy in the online application portal by indicating the presence of an existing PV system and providing its kW AC value.
Note: If possible, provide one-lines of any existing DER systems. In the case that existing DER is poorly documented, effort should be made to include as much information as possible for all existing DER. At a minimum, inverter data (e.g., manufacturer/model and AC kW rating) is required.
- 3.10 The expected individual kW AC nameplate rating of each inverter of the system
Note: Effort should be made to include the most accurate inverter model at the time of application submission, as it adds greater clarity to the expected performance and operation of the system, reducing the likelihood of additional requests for information at the next step in the process. However, it is expected that designs may be non-materially modified after application submission and prior to commissioning. This includes the inverters models. Some flexibility will be provided for this requirement, but final one-lines will need final inverter makes and models prior to permission to operate being granted.
- 3.11 Ensure consistency of quantity and model of inverters and PV modules (arrays) between the one-line and the interconnection application.
- 3.12 Clearly indicate any inverter certifications other than UL 1741, i.e. UL 1741 CRD for PCS, UL 1741 SB.
Note: UL 1741 certification is assumed for all inverters unless indicated otherwise.
- 3.13 For Energy Storage Systems (ESS), the Configuration Mode⁸ being applied for shall be clearly indicated on the one-line.
- 3.14 ESS charge source(s) and indication of storage export must be accurately provided in the online portal.
- 3.15 An ESS declaration for the proposed Configuration Mode must be uploaded to the online portal. The declaration must be accurately filled out, dated, and signed.
- 3.16 If auxiliary DER equipment power is necessary, then the circuit for this auxiliary equipment shall be shown.
Note: Examples of auxiliary DER equipment include axis trackers, heaters, lighting, etc.

⁸ Configuration Modes can be found in Storage Guidance documentation (see References).



- 3.17 If used, indicate any control system, such as a power control system or plant controller. Provide a functional description of the control system.

Note: A description of the system should be provided to help the reviewer understand the goals or purpose of the control system. If the control system relies on additional sensors, such as CTs or PTs, these should be indicated and referenced in the description.

- 3.18 Settings for any protective relaying external to the inverter (if applicable)

Metering

- 3.19 PV Production meter, if applicable.⁹

Note: If production metering will be customer owned, include indication. Otherwise, utility ownership is assumed.

Note: If an existing DER system is present, the new system is treated as its own system when determining the need for a production meter. In other words, do not count the existing system towards the system size when determining the need for a production meter for the new DER system.

- 3.19.1 For single-phase installations, the meter shall be labeled as 1-phase, 3-wire (if not already done per requirement 3.7).

- 3.19.2 For three-phase installations, the meter shall be labeled as 3-phase, 4-wire.

Note: No loads shall be connected on the DER side of an Xcel Energy-owned production meter. Energy Storage Systems are permissible, provided they only charge from the DER, and not the grid, at any time. Indicate PV-only charging if this is the case.

- 3.19.3 Customer owned meters shall not be located on the DER side of the Xcel Energy production meter.

- 3.20 When a PV production meter is required, include the following standards references:

- 3.20.1 The PV production metering shall follow the most recent revision of the Xcel Energy Standard for Electric Installation and Use (Blue Book).

3.20.1.1 Reference Section 4.11 for self-contained metering.

3.20.1.2 Reference Sections 4.10.7 and 4.12 for transformer-rated metering.

- 3.20.2 Self-contained PV production metering will be required to have the PV generation wired to the line side terminals (top of meter block).

Note: Depicting the PV generation wired into the top of the meter block, adding a note stating the line side will be wired to the PV generation, or including a LINE and LOAD label on the meter block are acceptable ways to meet this requirement.

- 3.20.3 The meter socket for the PV production meter shall be marked with a stamped brass, aluminum, or stainless-steel tag, indicating the address including the unit, typically "PV PROD" in accordance with the requirements for "Meter Identification" in Section 4.14.4 of the Blue Book.

⁹ Refer to Section 6.2 of the DG Manual to determine if production metering is required, e.g., DER sizes greater than 10 kW DC. DER of 10.000 kW DC or less do not require production metering.



- 3.21 If two or more production meters are being requested, Xcel Energy will require a letter or email from the customer of record to be added to the application documents stating they understand the need for the two production meters and that there may be additional monthly charges for the two production meters.
- 3.22 If the application is in the Mountain Division, the production meter is not allowed to be placed on the drip side of the house. A picture of the proposed production meter location must be shown on the one line. See Section 4.2 of the Blue Book for a list of areas in the Mountain Division.
- 3.23 For dedicated power production facilities only (also known as primary metering), the following notes are required on the one line:
- 3.23.1 The primary metering will be installed in accordance with Section 4.13.
 - 3.23.2 Company-owned OH primary metering will be installed in accordance with drawing PM-10.
 - 3.23.3 Company-owned UG pad-mounted primary metering will be installed in accordance with drawing PM-40.
 - 3.23.4 The customer's load side conductors shall match Xcel Energy standard conductor sizes.
Note: No exceptions are allowed for non-standards conductor sizes.
 - 3.23.5 Customer-owned primary metering requires Meter Engineering review & approval which must be documented in the online portal.
- 3.24 Secondary DER systems greater than 250kW AC require transformer-rated metering (instead of self-contained) due to telemetry requirements.

Meter Collars

- 3.25 The meter collar manufacturer name and model number.
- 3.25.1 Meter collar manufacturer name and model number must also be listed in the online portal.
 - 3.25.2 A meter collar consent form must be filled out and uploaded to the online portal.

AC Disconnect

- 3.26 When required¹⁰, a visible-open type, lockable, and readily accessible AC disconnect for purposes of isolating the DER from the utility source labeled "Utility AC Disconnect," "Photovoltaic Utility AC Disconnect," or similar shall be shown.
- 3.26.1 Other AC disconnects shall not be labeled or identified as a "Utility" AC Disconnect, if applicable.
 - 3.26.2 Provide a note that the Utility AC Disconnect is "visible-open type, lockable, and readily accessible."
Note: Xcel Energy will assume that the Utility AC Disconnect is accessible to Xcel Energy's personnel 24/7 without escort, hindrance, or delay.
Note: Rack-out/draw-out breakers¹¹ do not qualify as a "Utility" AC Disconnect.

¹⁰ Utility AC Disconnects are required for DER that include ConnectDER meter collars or require production metering.

¹¹ Xcel Energy crews do not operate customer rack-out/draw-out breakers and would require customer's personnel to operate to create a visible-open, which causes hindrance and delay that is not acceptable for the "Utility" AC Disconnect.

- 3.26.3 For installations that require a production meter, the Utility AC Disconnect shall be located between the DER and the production meter.¹²

Note: If the design includes an AC combiner panel with breakers, then a fusible AC disconnect used in conjunction with a line-side tap may serve as the Utility AC Disconnect. Otherwise, a second AC disconnect must be located between the DER and the production meter and serve as the Utility AC Disconnect.

Note: For systems 10 kW DC or less with a breaker back feed from the customer's panel, Xcel will not be enforcing any requirements for any associated AC Disconnect means.

- 3.26.4 When multiple DER units are existing or proposed on a single service, if a single Utility AC Disconnect cannot be used to disconnect all DER, all Utility AC Disconnects should include numerical identification such as "Utility AC Disconnect 1 of 2" or similar. The number of disconnects required to be operated to isolate the DER from the utility should be clear.

Placards

- 3.27 Reference to a utility-required yellow with black lettering "PHOTOVOLTAIC SYSTEM CONNECTED" placard at the main billing meter.
- 3.28 When a Utility AC Disconnect is required, reference to a yellow with black lettering "UTILITY PV AC DISCONNECT" placard at the Utility AC Disconnect.

Ground Referencing

- 3.29 Ground referencing is required for all front-of-the-meter inverter-based DER systems 100 kW and greater.
- 3.30 Ground referencing may be required for behind-the-meter inverter-based DER systems 100 kW and greater pending a screen¹³ by the reviewer.
- 3.31 Ground referencing equipment shall be installed between the main service meter and Xcel Energy-owned production meter to provide a ground reference for the system.
- 3.31.1 Details of the ground reference equipment required on the one-line:
- 3.31.1.1 Type/winding configuration of ground referencing equipment
 - 3.31.1.2 X_0 value
 - 3.31.1.3 X_0/R_0 ratio
 - 3.31.1.4 Neutral current rating
 - 3.31.1.5 Equipment fault withstand rating
- 3.31.2 A note stating, "Loss of ground referencing equipment shall immediately trip the DER system offline."
- 3.31.2.1 The method of monitoring and tripping shall be shown on the one-line.

¹² Refer to the Blue Book for Cold Sequence Requirements. Refer to the DG Manual for Manual Disconnect Switch Requirements.

¹³ See the DG Manual for ground referencing requirements and BTM inverter-based screening criteria.



4.0 Site Plan

Site Plan or location plan identifying location of equipment noted on the one line shall show the following information:

Contact Information and General

4.1 Customer name and premise address

Note: Ensure consistency of name and address between the one-line and the interconnection application.

Note: Proposed resources of new construction or off-site interconnections may not have a premise address at the time of application. After receiving a premise address, the customer must upload revised one-line diagrams into the online portal including the premise address.

4.2 Installer name and contact information. Contact information must include a phone number or email address.

4.3 Building(s) and street(s) shall be labelled.

Note: A minimum of one street must be included on all site plans.

Note: Proposed resources of new construction or off-site interconnections must also include the name, distance, and direction to the nearest cross street, if the nearest cross street is not shown.

4.4 Compass direction (indicate North)

Electrical Component Locations

4.5 Main service entrance, all meter locations, disconnects, transformers, proposed and existing DER systems.

4.5.1 Distance shall be noted between metering and disconnects.

Note: The Utility AC Disconnect and production meter shall be located together in a readily accessible location within 10' of the main service meter.

Note: Exact distances between electrical equipment are not required, and a general statement indicating general proximity may be acceptable. For example, "The Utility AC Disconnect and production meter (if required) shall be located together in a readily accessible location within 10' of the main service meter."

Note: If the Utility AC Disconnect or production meter is not located within 10' of the main service meter, provide a depiction of a placard that shall be placed at both the main service meter and production meter clearly showing the location of all meters and the Utility AC Disconnect(s).

Note: Main billing meters and Xcel Energy-owned production meters are not allowed to be indoors in an enclosed area.

If the existing main billing meter is located within an indoor location such as an electrical room, then the PV production can be located within the same electrical room or on the exterior of the building/structure. If a customer wants to install



indoors at a different location than the main billing meter, then it needs to be proposed on the site plan which will trigger a site meeting to evaluate with the local meter shop.

- 4.6 For dedicated power production facilities only:
 - 4.6.1 When an overhead primary service interconnection is used, the customer pole shall be no less than 25' from the Xcel Energy meter pole. Typical acceptable distance from the Xcel Energy meter pole to the customer pole is 40'.
 - 4.6.2 Ensure ownership of equipment is clearly shown (customer versus Xcel Energy-owned). The equipment ownership that needs to be shown includes, but is not limited to, feeder, recloser, meter and switches.
- 4.7 Provide a note indicating that, "24/7 unescorted keyless access shall be provided to all Xcel Energy equipment."
- 4.8 Indicate any overhead clearance issues:
 - 4.8.1 If DER facilities are near overhead electric service lines, then position, distance, and clearance concerns in relation to facilities must be noted.
 - 4.8.2 If DER facilities are not near overhead electric services lines, then provide a note indicating, "No overhead clearance issues."
Note: All customer facilities are subject to NESC clearance requirements in relation to Xcel Energy owned facilities. Therefore, lack of adequate clearance concerns noted on the site plan may delay permission to operate proposed interconnection resources.



Revision History

Revision	Date	Prepared By	Approved By	Notes
2.0		JCH		Converted to standard format/layout, added several sections.
4.0	07/01/2022	TAD	TAD	Revised the MN CRR for CO.
5.0	01/01/2023	TAD	TAD	Revised for common rejections.
6.0	09/01/2023	TAD	TAD	Revised for further clarifications & consolidated some requirements.