



Xcel Energy Requirements and Assumptions 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.

Energy Storage System (ESS): Any commercially available, customer-sited system or utility-sited system, including batteries and batteries paired with on-site generation, that does not generate energy, that is capable of retaining, storing, and delivering electrical energy by chemical, thermal, mechanical, or other means.

Reference Point of Applicability (RPA): 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.

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.



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](#)

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

3.0 One-Line Diagram Requirements

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

If any of the assumptions made by Xcel Energy as noted are not accurate and are not indicated as such on the documents, there may be a delay in granting permission to operate for the proposed interconnection resources until the issue/discrepancy is resolved.

A 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. Any existing DER equipment should also be included on the one-line diagram.

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.

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



The following information shall be clearly depicted on the one-line diagram, unless Xcel Energy assumes as noted:

General

3.1 The customer name provided in the interconnection application in the online portal is assumed to be accurate unless noted otherwise on the submitted documents.

3.2 Premise address must be shown on the one-line.

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.

3.3 Xcel Energy assumes the installer name and contact information listed in the online portal is accurate for the application unless noted otherwise on the submitted documents.

3.4 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: There must only be one RPA per DER system ('DER system' in this case includes all existing and proposed DER).

Note: For most interconnection resources, Xcel Energy assumes the RPA is located at the customer side of the Utility AC Disconnect unless indicated otherwise. If the design includes an AC combiner panel with breakers (and a fusible AC disconnect used in conjunction with a line-side tap) serving as the Utility AC Disconnect, then Xcel Energy assumes the RPA is located at the AC combiner panel unless indicated otherwise. For interconnection resources without a Utility AC Disconnect, Xcel Energy assumes the RPA is located at the AC side of the inverter unless indicated otherwise.

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

3.5 The electrical connections of all existing and proposed major components between the main service meter⁵ and the DER system must be shown on the one-line.

Note: Examples of major components include interconnection transformers (provide winding configuration and voltages), breakers, fuses, reclosers, meters, meter collar adaptors, 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.

Note: If there is existing DER equipment at the premise, ensure all equipment is marked as existing versus proposed (or new) appropriately. If possible, provide one-lines of any existing DER systems.

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.



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), production meter (if applicable), and Utility AC disconnect (if applicable) is required.

Note: If there is an existing DER system at the premise, ensure consistency with the online application portal by indicating the presence of the existing DER equipment and providing its kW AC value.

3.6 Main service meter and main service panel must be shown on the one-line.

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 the main service panel.

3.7 Main service protection between the DER and the utility must be shown on the one-line.

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.

Note: Unfused AC disconnects do not serve as main service protection.

3.8 The proposed DER system size in both kW DC and kW AC units must be shown on the one-line. Also, if there is an existing DER system on the same service that the proposed DER is interconnecting to, the existing DER system size in both kW DC and kW AC units must be shown on the one-line.

Note: If existing or proposed ESS is present, the ESS 'max continuous real power' inverter rating using kW AC units must be included on the one-line.

3.9 The voltage and phasing for the main billing meter, DER/inverter(s), and production meter (if required) other than 240VAC, 1-phase, 3-wire must be shown on the one-line.

Note: Xcel Energy assumes the main billing meter, DER/inverter(s), and production meter (if required) are all 240VAC, 1-phase, 3-wire unless noted otherwise.

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

Note: All Xcel-owned production meters shall be installed at an Xcel Energy standard voltage. Xcel Energy assumes this is the case unless noted otherwise.

Note: If a three-phase system is using single-phase inverters, Xcel Energy assumes an equal number of inverters per phase will be used unless noted otherwise.

3.10 Ensure consistency of quantity and model of inverters (PV and ESS) and PV modules (arrays) between the one-line and the online interconnection application.



3.11 The expected individual nameplate rating (using kW AC units) of each inverter chosen in the online portal must be shown on the one-line unless the inverter nameplate ratings for the equipment on the one-line match the ratings provided in the portal.

Note: Xcel Energy assumes the expected individual kW AC nameplate rating of each inverter that is chosen in the online portal accurately represents the one-line equipment unless indicated otherwise.

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.

3.12 Clearly indicate any inverter certifications other than UL 1741, i.e., UL 1741 CRD for PCS, UL 1741 SB on the one-line.

Note: UL 1741 certification is assumed for all inverters unless indicated otherwise.

3.13 For ESS, the Configuration Mode⁷ being applied for shall be clearly indicated on the one-line.

3.14 The ESS storage charge source(s) and indication of storage export must be accurately provided in the online portal.

3.15 An ESS declaration for the proposed ESS 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 on the one-line.

Note: Examples of auxiliary DER equipment include axis trackers, heaters, lighting, etc.

3.17 If used, indicate any control system, such as a power control system or plant controller, on the one-line.

Note: Depending on the control system's complexity, a description of the system may be requested by Xcel Energy to help the reviewer understand the goals or purpose of the control system. If the control system relies on additional sensors, such as currents transformers or potential transformers, these should be indicated on the one-line and referenced in the description.

3.18 The settings for any protective relaying external to the inverter must be shown on the one-line (if applicable).

⁷ Configuration Modes can be found in Storage Guidance documentation (see References).



Metering (applies to existing and proposed facilities)

3.19 PV Production meter(s), if applicable⁸, must be shown on the one-line.

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.

3.20 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 as the ESS charge source in the online portal if this is the case.

3.21 Customer owned meters shall not be located on the DER side of the Xcel Energy production meter(s).

When a PV production meter is required, include the following standards reference on the one-line:

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

3.22.1 Reference Section 4.11 for self-contained metering.

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

3.22.2.1 Secondary DER systems greater than 250kW AC require transformer-rated metering (instead of self-contained) due to telemetry requirements.

3.23 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.

3.24 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.

3.25 If two or more production meters are being requested by the customer but more than one is not required by Xcel Energy, Xcel will require a letter or email from the customer of record to be added to the application documents in the online portal stating they understand that there may be additional monthly charges for the two production meters.

⁸ Refer to Section 6.2 of the DG Manual to determine if production metering is required, e.g., DER sizes >10 kW DC. DER ≤10.000 kW DC do not require production metering unless the application is part of the Solar Rewards program or if the design includes a Connect DER meter collar adaptor.



3.26 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.

Note: See Section 4.2 of the Blue Book for a list of areas in the Mountain Division.

3.27 For primary-metered facilities only, the following notes are required on the one-line:

3.27.1 The primary metering will be installed in accordance with Section 4.13 of the Blue Book.

3.27.2 Company-owned OH primary metering will be installed in accordance with drawing PM-10.

OR

Company-owned UG pad-mounted primary metering will be installed in accordance with drawing PM-40.

Note: Customer-owned primary metering requires Meter Engineering review & approval which must be documented in the online portal.

3.28 The customer's load side conductors shall match Xcel Energy standard conductor sizes.

Note: No exceptions are allowed for non-standards conductor sizes.

Meter Collars Adaptor (applies to existing and proposed DER with meter collar adaptors)

3.29 The meter collar adaptor manufacturer name and model number must be listed in the online portal and must be an approved type for PSCo.

3.30 The meter collar adaptor manufacturer name and model number must be shown on the one-line.

Note: Xcel Energy assumes the meter collar adaptor manufacturer and model name in the online portal represents the meter collar adaptor on the one-line unless indicated otherwise.

3.31 A meter collar adaptor consent form must be filled out and uploaded to the online portal.

AC Disconnect

3.32 When required⁹, a visible-open type, lockable, and readily accessible Utility AC disconnect for purposes of isolating the DER from the utility source labeled "Utility AC Disconnect," "Photovoltaic Utility AC Disconnect," or "PV Utility AC Disconnect" must be shown on the one-line.

3.33 Other AC disconnects shall not be labeled or identified as a "Utility" AC Disconnect if other AC disconnects are present (unless Requirement 3.34 applies).

⁹ Utility AC Disconnects are required for DER that include ConnectDER meter collar adaptors, are part of the Solar Rewards program, or require production metering.



3.34 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.

Note: The number of disconnects required to be operated to isolate the DER from the utility should be clear.

Note: Ensure placarding in Requirement 3.1.34 addresses all Utility AC disconnects if there is more than one.

3.35 All Utility AC Disconnects must be labeled as “visible-open type, lockable, and readily accessible” on the one-line.

Note: Rack-out/draw-out breakers¹⁰ do not qualify as a “Utility” AC Disconnect.

3.36 For installations that require a production meter, the Utility AC Disconnect shall be located between the DER and the production meter.¹¹

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.

Placards (applies to existing and proposed facilities)

3.37 Reference to a yellow with black lettering “PHOTOVOLTAIC SYSTEM CONNECTED” placard at the main billing meter. A depiction of the placard is acceptable as long as there’s an indication as to its installation location.

3.38 When a Utility AC Disconnect is required by Xcel, reference to a yellow with black lettering “UTILITY PV AC DISCONNECT” placard at the Utility AC Disconnect. A depiction of the placard is acceptable as long as there’s an indication as to its installation location.

Ground Referencing

3.39 Ground referencing equipment is required for all front-of-the-meter inverter-based DER systems 100 kW and greater AND for all inverter-based DER systems $\geq 1\text{MW}$ regardless of interconnection type.

3.40 Ground referencing equipment may be required for behind-the-meter inverter-based DER systems 100 kW and greater pending a screen¹² by the reviewer.

Note: The ground referencing screen shall include all aggregate (existing & queued) DER for the premise or feeder section (if applicable).

¹⁰ 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.

¹¹ Refer to the Blue Book for Cold Sequence Requirements. Refer to the DG Manual for Manual Disconnect Switch Requirements.

¹² See the DG Manual for ground referencing requirements and BTM inverter-based screening criteria.



- 3.41** 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.
- 3.42** Details of the ground referencing equipment required to be shown on the one-line regardless of ground reference equipment type are as follows:
 - 3.42.1** Type/winding configuration of ground referencing equipment
 - 3.42.2** X_0 value in Ohms
 - 3.42.3** R_0 value in Ohms and X_0/R_0 ratio
 - 3.42.4** Neutral current rating in Amps
 - 3.42.5** Equipment fault withstand rating in Amps
- 3.43** Details of the ground referencing equipment required to be shown on the one-line for wye-grounded:delta grounding transformers only are as follows:
 - 3.43.1** Wye-grounded:delta transformer size in kVA
 - 3.43.2** Wye-grounded:delta transformer impedance in %Z
- 3.44** Details of the ground referencing equipment required to be shown on the one-line for neutral grounding reactors only are as follows:
 - 3.44.1** Interconnection transformer (aka step-down transformer) impedance in %Z
 - 3.44.2** Neutral grounding reactor impedance in Ohms
- 3.45** A note stating “Loss of ground referencing equipment shall immediately trip the DER system offline” must be shown on the one-line.
- 3.46** The method of ground referencing equipment monitoring and tripping shall be shown on the one-line.



4.0 Site Plan Requirements

Important note: Ensure that data provided on the site plan is consistent with data provided on the interconnection application in the online portal.

If any of the assumptions made by Xcel Energy as noted are not accurate and are not indicated as such on the documents, there may be a delay in granting permission to operate for the proposed interconnection resources until the issue/discrepancy is resolved.

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

General

- 4.1 The customer name provided in the interconnection application in the online portal is assumed to be accurate unless noted otherwise on the submitted documents.**
- 4.2 Premise address must be shown on the site plan.**
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 site plans into the online portal including the premise address.
- 4.3 Xcel Energy assumes the installer name and contact information listed in the online portal is accurate for the application unless noted otherwise on the submitted documents.**
- 4.4 When multiple buildings (e.g., dwelling, detached garage, shop, etc.) are present at the proposed interconnection resource location, buildings and street(s) must be labelled on the site plan.**
Note: A minimum of one street must be included.
- 4.5 Proposed resources of new construction or Off-site interconnections must include the name, distance, and direction to the nearest cross street, if the nearest cross street is not shown.**
- 4.6 Compass direction (indicating North) must be shown on the site plan.**

Electrical Component Locations

- 4.7 The main service entrance, all meter locations, main service panel, disconnects, transformers, and proposed and existing DER systems must be shown on the site plan.**
Note: Off-site DER may exclude the main service panel.
Note: If module-integrated microinverters are shown on the one-line, Xcel Energy assumes they will be installed as such even if they are not explicitly shown on the site plan.
- 4.8 Distance shall be noted between metering and Utility AC disconnect(s).**
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', or within line of sight, 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).

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

Note: 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 the new PV production meter indoors at a different location than the main billing meter, then it needs to be proposed and noted as such on the site plan which will trigger a site meeting to evaluate with the local meter shop.

4.10 For dedicated power production facilities only:

4.10.1 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'.

4.10.2 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.

4.11 Provide indication that 24/7 unescorted, keyless access shall be provided to all Xcel Energy equipment on the site plan.

Note: A general statement indicating access may be acceptable. For example, "24/7 unescorted, keyless access shall be provided to all Xcel Energy equipment."

Note: Xcel Energy assumes there will be 24/7 unescorted, keyless access provided to all Xcel Energy equipment unless noted otherwise.

4.12 Indicate any overhead clearance issues on the site plan.

Note: Xcel Energy assumes there are no overhead clearance concerns unless noted otherwise. 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.



5.0 Revision History

Revision	Date	Prepared By	Approved By	Notes
1.0	4/1/2024	TD		Converted document from "Completeness Review Requirements" document to "Completeness Review Requirements and Assumptions"