



Xcel Energy Requirements for DER Application Completeness Review

Applicable to All Xcel Energy Operating Companies



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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.

Appendix A – Template for Notice of Incomplete Initial Application Materials provides a notification template for communicating with Interconnection Customers when their initial application cannot be deemed complete in accordance with this document.

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 or the Point of DER Connection, where the interconnection and interoperability performance requirements specified in IEEE 1547 apply. With mutual agreement, the Area EPS Operator and Customer may determine a point between the Point of Common Coupling and Point of DER Connection. See Minnesota DER Technical Interconnection and Interoperability Requirements for more information.

2.2 References

1. Colorado [Rule 3667](#)
2. Xcel Energy [Section 9 Tariff](#)
3. Xcel Energy [Section 10 Tariff](#)
4. New Mexico [Interconnection Manual](#)
5. South Dakota PUC Small Generator Facility Interconnection Rules [Section 20.10.36](#)
6. Xcel Energy [Standard for Electric installation and Use](#)
7. Xcel Energy [Storage Interconnection Guidelines](#)
8. [National Electric Code](#)
9. [UL 1741](#)



10. [IEEE 1547](#)

3.0 One Line Diagram

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

Contact information and General

- 3.1 Name of Customer who owns/will own service, the Xcel Energy “customer of record” for existing services
- 3.2 Application OID, SRC, or case number assigned to the project
- 3.3 Clearly identify the Reference Point of Applicability (RPA) and denote the RPA where test and verification features will be applied in the written test procedure
- 3.4 A note indicating that the design shall meet National Electric Code (NEC codes) requirements
- 3.5 For systems larger than 250 kW, a signature from a professional engineer licensed in Minnesota is required.

Electrical Component Schematic

- 3.6 Label and show the electrical layout of all equipment in-line between the main service meter and the DER system
 - 3.6.1 The equipment listed shall include, at a minimum, switches, breakers, fuses, junction boxes, combiner boxes, protective devices, etc.
 - 3.6.2 All customer equipment¹ shall be located on the customer-side of the main service meter
 - 3.6.2.1 Primary vs secondary interconnection shall be clearly noted and consistent with all other provided documentation
- 3.7 Main service meter and main service panel
- 3.8 Main service protection² between DER and the utility
 - 3.8.1 The protective device shall be provided immediately after the main service meter
- 3.9 Electrical ratings³ of all equipment
- 3.10 The aggregate AC capacity of each DER system
- 3.11 The electrical ratings of the DER shall be provided

¹ Xcel Energy infrastructure is not required to be shown on the customer one-line. Any Xcel Energy equipment shown is subject to change and should not be used for planning/design purposes by the customer

² For DER being installed on existing buildings, the main service breaker will typically be sufficient

³ Including, but not limited to, Volts, Amps, number of phases, kW, kVA, winding configurations



- 3.11.1 Voltage
- 3.11.2 Power Output (KVA or kW)
- 3.11.3 Phases (single or three-phase inverters)
- 3.12 Clearly note if inverter(s) are UL1741 certified
- 3.13 *When multiple DER units are existing or proposed on a single service:* all DER systems shall be shown with proposed and existing marked
- 3.14 *For energy storage systems:* the mode of operation⁴ being applied for shall be clearly indicated on the one-line
- 3.15 The circuit for auxiliary equipment power necessary to the operation of the DER shall be shown
- 3.16 The Reference Point of Applicability shall be indicated

Metering

- 3.17 Production meter, if applicable, with ownership noted (utility or customer)
 - 3.17.1 For single-phase installations, the meter shall be specified as 1-phase, 3-wire
 - 3.17.2 For three-phase installations, the meter shall be specified as 3-phase, 4-wire
 - 3.17.3 No loads or energy storage systems shall be connected on the DER side of the production meter.
 - 3.17.4 All Xcel-owned production meters shall be installed at an Xcel Energy standard voltage⁵
 - 3.17.5 Production Meter CT polarity should be shown on the drawing as facing the PV, i.e. H1 of the CT faces the inverter such that DER is seen by the production meter as kWh delivered
 - 3.17.6 When present, customer owned meters shall be clearly noted as “provided by customer”
 - 3.17.6.1 Customer owned meters shall not be located on the DER side of the Xcel Energy production meter⁶
- 3.18 *For systems with an output of 200 amps or more:* any Xcel-owned metering requiring PTs shall be shown with the PTs unfused

AC Disconnect

- 3.19 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
 - 3.19.1 Other AC Disconnects shall not be labeled or identified as a “Utility” AC Disconnect, if applicable

⁴ Reference the Xcel Energy Guidelines for Interconnection of Electric Energy Storage found on Xcel Energy’s website for the full requirements of Energy Storage applications

⁵ 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

⁶ Refer to applicable state interconnection tariffs and program rules to determine if production meters are applicable



- 3.19.2 If the AC disconnect is not located within 10 feet of the main service meter⁷, a label meeting all requirements of the “Label Details” section should be placed at the main service meter clearly showing the location of the AC Disconnect
- 3.19.3 For installations that require a Production Meter, the Utility AC Disconnect shall be located between the DER and production meter
- 3.19.4 For installations not requiring a Production Meter, the Utility AC Disconnect shall be located between the DER and main service
- 3.19.5 *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.

Ground Referencing (applies only to systems greater than 100 kW)

- 3.20 Ground referencing⁸ equipment shall be installed between the main service meter and production meter to provide a ground reference for the system
 - 3.20.1 Details of the ground reference equipment required on the one-line:
 - 3.20.1.1 Type/winding configuration of ground referencing equipment
 - 3.20.1.2 X_0 value
 - 3.20.1.3 X_0/R_0 ratio
 - 3.20.1.4 Neutral current rating
 - 3.20.1.5 Equipment fault withstand rating
 - 3.20.2 Loss of ground referencing equipment shall immediately trip the DER system offline
 - 3.20.2.1 The method of monitoring and tripping shall be shown on the one-line

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 Name of Customer who owns/will own the service, the Xcel Energy “customer of record” for existing services
- 4.2 Installation premise address
 - 4.2.1 Installation address shall match application address

⁷ This will be evaluated as an exception, which may or may not be approved based on the accessibility of the AC Disconnect or the clarity of the placard

⁸ See the “PV and Inverter-based DER Ground Referencing Requirements and Sample Calculations” document for ground reference requirements



- 4.2.2 Installation address shall match the premise address for existing customer/services
- 4.2.3 *For dedicated power production facility interconnection applications:* GPS Coordinates in WGS 94 decimal degrees, with municipality and county are acceptable in place of an address when one has not yet been established by the county
- 4.3 Installer name & contact information
- 4.4 Application OID, SRC, or case number assigned to the project
- 4.5 Building(s) and streets shall be labelled
 - 4.5.1 A minimum of one street should be included on the site plan, with the name, distance, and direction to the nearest cross street, if the nearest cross street is not shown
- 4.6 Compass direction (indicate North)
- 4.7 *For ground mounted systems:* an access road is required to all Xcel Energy equipment, including production metering and Utility AC disconnects. For systems smaller than 100 kW, an exception may be sought for this requirement, based on equipment location and accessibility.
 - 4.7.1 The width of this road shall be indicated and cannot be less than 12 feet wide
 - 4.7.2 The drawing shall show the route from a public road to the Xcel Energy equipment

Electrical Component Locations

- 4.8 Main service entrance, all meter locations, disconnects, transformers, proposed and existing DER systems
 - 4.8.1 Distance shall be noted between this equipment
 - 4.8.2 Primary vs secondary interconnection shall be clearly noted and consistent with all other documentation
 - 4.8.3 *For dedicated power production facilities:* 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'
- 4.9 The Production Meter and AC Disconnect should be located together in a readily accessible location within 10' of the main service meter
 - 4.9.1 If the AC disconnect or Production Meter is not located within 10 feet of the main service meter⁹, a label meeting all requirements of the "Label Details" section should be placed at the main service meter clearly showing the location of the AC Disconnect
- 4.10 24/7 unescorted keyless access shall be provided to all Xcel Energy equipment
- 4.11 Position, distance and clearance concerns of overhead electric service lines and/or other utilities in relation to the PV panels shall be noted

⁹ This will be evaluated as an exception, which may or may not be approved based on the accessibility of the AC Disconnect or the clarity of the placard



- 4.12 A separate Detail View or Plan View may be required to clearly show location of meters, main service and AC disconnect, when the site layout is unclear or illegible when printed on an 11"x17" sheet

5.0 Label Details

- 5.1 Labels shall be weatherproof, durable and permanently mounted
- 5.2 Labels shall demonstrate or state compliance with NEC 690
- 5.3 A label shall be included on Main Service Meter with the text "Generation System Connected", or similar
 - 5.3.1 When an Energy Storage System (ESS) is present, include a label stating that an ESS is present and equipped with an auto-transfer switch
- 5.4 Include label "Utility AC Disconnect", or similar
 - 5.4.1 When multiple DER units are present, 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.
- 5.5 *When multiple DER units are existing or proposed on a single service:* equipment for each system shall be uniquely identified through labelling (i.e. "PV Unit 1 of 2" or similar)

6.0 Test Procedure

A test procedure that will be used to verify the DER to grid interface protection and operation of the DER system shall be submitted to Xcel Energy for approval. The procedure shall include an open-phase test (for three phase systems) and an unintentional island detection test (for all systems) to verify the system ceases generating in parallel with the Xcel Energy distribution system when the Utility source is lost. Each system is unique and will require a custom test procedure based on the DER¹⁰. In addition to the manufacturer's recommendations, the following steps or notes shall be included:

Contact Info and General

- 6.1 Name of Customer who owns service, the Xcel Energy "customer of record" for existing services
- 6.2 Installation premise address shall match application address
 - 6.2.1 Address shall match the premise address for existing customer/services
- 6.3 Application OID, SRC, or case number assigned to the project
- 6.4 A note stating "All testing shall be performed by qualified personnel"

¹⁰ DER Owners may wish to consult with the Manufacturer regarding considerations specific the DER unit of interest.



Testing Applicable to all DER

- 6.5 The procedure shall provide steps to verify fixed power factor settings for each inverter meet the project requirements
- 6.6 The unintentional islanding test shall at minimum contain the following steps:
 - 6.6.1 Steps that verify DER system is ready to be energized
 - 6.6.2 Steps to verify labeling for the Main Service Panel, DER Protection, DC Disconnect, AC disconnect, Utility AC disconnect, Production Meter (when applicable) and other relevant labelling and signage
 - 6.6.3 Steps to energize the DER system
 - 6.6.4 While in normal operation, steps to verify the voltages at the DER AC terminals are within 5% of the combined DER AC voltage ratings and all LEDs, alarms, and/or LCD codes are “normal”
 - 6.6.5 While in normal operation, steps to verify that all DER units are operational and producing power
 - 6.6.6 Steps to simulate the loss of utility source¹¹ for the unintentional islanding test shall be listed
 - 6.6.6.1 Clearly identify the disconnection device being used to simulate this utility power outage
 - 6.6.7 Using a voltmeter, verify the voltage at the inverter side of the AC disconnect has dropped to zero
 - 6.6.7.1 Only customer-owned equipment shall be used for this verification. Xcel Energy will not provide special equipment for this verification. Xcel Energy provided meters shall not be used for this verification.
 - 6.6.8 Using an ammeter or the DER’s display/metering, verify the DER has ceased to energize within two seconds. For three phase systems, three phase monitoring may be required.
- 6.7 Verify DER LEDs, alarms, and/or LCD codes are appropriate for loss of Utility source
- 6.8 Steps to restore the lost Utility source shall be listed
- 6.9 A step to verify that the inverter system delays five (5) minutes before resuming power output after the Utility source is restored shall be listed

Testing Applicable only to Three-Phase systems

- 6.10 For three-phase systems, steps to simulate an open phase condition from the utility shall be included. The device used to create an open phase shall be clearly identified in the procedure.
 - 6.10.1 If ground referencing equipment is present, the open point must occur upstream of this device (upstream meaning in the direction of the utility source)

¹¹ This typically involves opening an AC disconnect.



6.10.2 If the protection scheme used to detect the open phase uses devices other than the inverter (for instance, separate relaying to trip a VFI or breaker), the installer must provide an engineering analysis that demonstrates a non-detection zone does not exist when the output of the DER is 5% or greater of the aggregate inverter AC nameplate rating in the open-phase detection schemes. A step will be required to disable this setting during testing if an acceptable engineering analysis cannot be provided.

6.11 Steps to verify voltage and current are to be listed for the open-phase test. Location of measurement points shall be identified.

7.0 FERC SGIP-Based Interconnection Process Track Eligibility Determination

For those states and Operating Companies using interconnection procedures based on the FERC Small Generator Interconnection Process (SGIP), it is necessary to verify an Interconnection Customer has correctly selected the appropriate interconnection application review process. Process tracks are tied to application fees and review timelines.

7.1 Simplified Process

To qualify for the simplified interconnection process, the proposed DER must utilize a certified inverter based equipment package. Compliance with the UL1741 certification is likely indicated by the Interconnection Customer on the application form, but shall still be verified by an engineering review of the provided documentation.

Simplified process thresholds are as follows for SGIP based states:

- 7.1.1 Colorado: 10kW or less
- 7.1.2 Minnesota: 20kW or less
- 7.1.3 New Mexico: 10kW or less
- 7.1.4 South Dakota: 10kW or less

7.2 Fast Track Process

Interconnection applications for the fast track process may utilize certified or non-certified equipment. Process thresholds vary by state as follows:

- 7.2.1 Colorado: Maximum DER size is no larger than two (2) MW. Also note the proposed DER shall meet the codes, standards, and certification requirements as noted in the rules.
- 7.2.2 Minnesota: Section 3.1 of the Minnesota Interconnection Procedures (MIP) provides detail around fast track process thresholds. Note that synchronous and induction machines are always limited to two (2) MW or less in order to be fast track eligible. For inverter-based generation, use information available in GIS to determine feeder line voltage and distance in line miles to the appropriate substation, then input those values



into Table 1. For process eligibility, the mainline should be considered to be the main trunk of the circuit protected from a substation protective device.

Fast Track Eligibility for Distributed Energy Resources		
Line Voltage	Fast Track Eligibility¹² Regardless of Location	Fast Track Eligibility for certified, inverter-based DER on a Mainline¹³ and ≤2.5 Electrical Circuit Miles from Substation¹⁴
<5 kV	≤500 kW	≤500 kW
≥5 kV and <15 kV	≤1 MW	≤2 MW
≥15 kV and <30 kV	≤3 MW	≤4 MW
≥30 kV and ≤69 kV	≤4 MW	≤5 MW

Table 1 - Process Eligibility Determination

- 7.2.3 New Mexico: Maximum DER size is no larger than two (2) MW. Also note the proposed DER shall meet the codes, standards, and certification requirements as noted in the state interconnection manual.
- 7.2.4 South Dakota: Maximum DER size is no larger than two (2) MW. Additional considerations are outlined in the Tier 2 and Tier 3 process requirements.

7.3 Study Process

Interconnection requests not meeting eligibility requirements of the simplified or fast track processes will typically require a more detailed engineering study. Subject to the limits in 7.3.1 to 7.3.4, these projects will follow their respective state rules and tariffs for interconnection technical review.

- 7.3.1 Colorado: For DER interconnections between two (2) MW and no larger than ten (10) MW, and any interconnection application that fails the review screens of Level 1 or Level 2 processes.
- 7.3.2 Minnesota: For DER applications up to ten (10) MW that do not qualify for simplified or fast track processes, or that fail the initial and supplemental review screens.

¹² Synchronous and induction machines eligibility is limited to no more than 2MW even when line voltage is greater than 15 kV.

¹³ For purposes of this table, a Mainline is the three-phase backbone of a circuit. It will typically constitute lines with wire sizes of 4/0 American wire gauge, 266 kcmil, 336.4 kcmil, 397.5 kcmil, 477 kcmil and 795 kcmil.

¹⁴ An Interconnection Customer can determine this information about its proposed interconnection location in advance by requesting a pre-application report pursuant to MIP Section 1.4.



7.3.3 New Mexico: For DER interconnections up to ten (10) MW that either do not qualify for or fail the initial review screens contained in simplified and fast track processes.

7.3.4 South Dakota: For DER interconnections up to ten (10) MW that do not qualify for or fail the initial review screens of the Tier 1, 2, or 3 processes.

8.0 FERC SGIP-Based Interconnection Process Material Modification Determination

For those states and Operating Companies using interconnection procedures based on the FERC Small Generator Interconnection Process (SGIP), it is necessary to determine whether changes to a DER proposed by an Interconnection Customer constitute a Material Modification. Material Modifications encompass any changes to an interconnection application which has been deemed complete that alter machine data, equipment configuration, or site layout. Specifically, such changes must have a material impact on cost, timing, or design of interconnection facilities¹⁵ or upgrades¹⁶ on the project under consideration or any later queued project. Material Modifications may also impact the safety or reliability of the Company's system. Material Modifications apply to DER units after they are granted permission to operate.

A Material Modification shall include:

- 1) Changes the physical location of the point of common coupling; such that it is likely to have an impact on technical review;
- 2) Increases the nameplate rating or output characteristics of the Distributed Energy Resource;
- 3) Changes or replaces generating equipment, such as generator(s), inverter(s), transformers, relaying, controls, etc., and substitutes equipment that is not like-kind substitution in certification, size, ratings, impedances, efficiencies or capabilities of the equipment;
- 4) Changes transformer connection(s) or grounding; and/or
- 5) Changes to a certified inverter with different specifications or different inverter control settings or configuration.

¹⁵ **Interconnection Facilities** – The Company's Interconnection Facilities and the Interconnection Customer's Interconnection Facilities. Collectively, Interconnection Facilities include all facilities and equipment between the DER and the Point of Common Coupling, including any modification, additions or upgrades that are necessary to physically and electrically interconnect the DER to the Company's System. Some examples of Customer Interconnection Facilities include: supplemental DER devices, inverters, and associated wiring and cables up to the Point of DER Connection. Some examples of Company Interconnection Facilities include sole use facilities; such as, line extensions, controls, relays, switches, breakers, transformers and shall not include Distribution Upgrades or Network Upgrades.

¹⁶ **Upgrades** – The required additions and modifications to the Company's Transmission or Distribution System at or beyond the Point of Interconnection. Upgrades may be Network Upgrades or Distribution Upgrades. Upgrades do not include Interconnection Facilities.



A Material Modification shall NOT include:

- 1) Changes the ownership of a Distributed Energy Resource;
- 2) Changes the address of the Distributed Energy Resource, so long as the physical point of common coupling remains the same;
- 3) Changes or replaces generating equipment such as generator(s), inverter(s), solar panel(s), transformers, relaying, controls, etc. and substitutes equipment that is a like-kind substitution in certification, size, ratings, impedances, efficiencies or capabilities of the equipment; and/or
- 4) Increases the DC/AC ratio but does not increase the maximum AC output capability of the Distributed Energy Resource in a way that is likely to have an impact on technical review.



9.0 Revision History

Revision	Date	Prepared By	Approved By	Notes
2.0		JCH		Converted to standard format/layout, added several sections

10.0 Document Dependencies

10.1 Internal Documents

1. Colorado Rule 3667
2. Xcel Energy Section 9 Tariff
3. Xcel Energy Section 10 Tariff
4. New Mexico Interconnection Manual
5. South Dakota PUC Small Generator Facility Interconnection Rules Section 20.10.36
6. Xcel Energy Standard for Electric installation and Use
7. Xcel Energy Storage Interconnection Guidelines

10.2 External Documents

1. National Electric Code
2. UL1741



Appendix A – Template for Notice of Incomplete Initial Application Materials

If a DER interconnection application is incomplete, complete the form on the following page and provide a copy to the responsible Program Manager. The Program Manager will then communicate with the Interconnection Customer to address any issues within the required timeframe. Save a copy of this form in the appropriate engineering folder for the project.



July 19, 2019

To Whom it May Concern:

Regarding your DER interconnection request for application number(s):

in the state of _____, we are writing to inform you that one or more aspects of your application are not complete and require action to update before we can proceed with more detailed engineering reviews. Missing information is noted below under the relevant section heading.

Section 3.0 One Line Diagram

Section 4.0 Site Plan

Section 5.0 Label Details



Section 6.0 Test Procedure

Section 7.0 FERC SGIP-Based Interconnection Process Track Eligibility Determination

Are provided UL1741 certification documents sufficient: Yes No

Please update your relevant application documents and resubmit for Xcel Energy review in accordance with the governing interconnection process timelines.