INTERCONNECTION STANDARDS
FOR DISTRIBUTED ENERGY RESOURCES

Revision 10

September 2022

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Revision Descriptions

Revision Description	Revised By	Approved
Revision 9		Kraig Bader 7/1/2011
Revision 10 • Completely revised to better align with advances in DER technology, updated industry standards, and modifications in FCU operating procedures and policies.	Kent Coldsnow Poorva Bedge Neal May	Kraig Bader Adam Bromley 9/16/2022

1 Scope and General Requirements

1.1 Scope and Intent

The requirements contained in this document apply to all Distributed Energy Resources (DER) that will operate, for sustained periods or momentarily, while electrically connected to the Fort Collins Utilities (FCU) distribution system. All connections to the FCU distribution system and any aspect of such connection are subject to FCU review and such connections shall not be permitted unless approved by FCU.

The operation and design of all DER shall meet requirements contained in this document, any written agreement between FCU and the DER Operator, as well as any applicable requirements contained in Chapter 26 of the Fort Collins Municipal Code and Fort Collins Utilities Electric Service Standards. Any source not explicitly described in this document will require study before it can be approved to interconnect to FCU.

The protection and safety devices required are intended to provide protection for the FCU utility workers, FCU customers, the general public, and the FCU distribution system. Protective devices installed on or with the DER system are designed to ensure that the fault current supplied by the DER will be interrupted in the event a fault occurs on the FCU distribution system.

Any location where the aggregate total interconnected DER capacity exceeds the FCU System Capacity Limitations described in Section 1.8 may require additional study by FCU. Studies will consider the specific feeder or affected portion of the electric distribution system where the DER is proposed to be connected.

1.2 Application of Policy

Requirements in this revision shall apply to all projects with a building permit application date and/or interconnection application date after the revision date of this document.

1.3 System Phase and Voltage

The DER may interconnect to the system at any service voltage available at the site. Additional voltages may be arranged with FCU on a case-by-case basis, subject to FCU approval. If the DER is interconnected through a three-phase transformer, the DER shall be a three-phase system. If a single-phase DER will be interconnecting at 120V, FCU review is required.

1.4 System Reclosing

Automatic reclosing is generally not utilized on the FCU distribution system to clear temporary faults; however, in the cases and locations where automatic reclosing is used, the DER shall be designed to ensure that the DER will disconnect from the distribution system in the event an automatic reclose occurs. Normally the DER shall not interfere with automatic reclosing where it exists; however, industry standards require that a DER must automatically disconnect from an islanded system within two seconds. If the existing reclosing interval is faster than two seconds, FCU will reset it to accommodate the DER.

1.5 Islanding

Islanding occurs when a DER becomes separated from the main generation source on a distribution system but continues to independently serve a portion of the distribution system. DER shall be equipped with protective devices and controls designed to prevent the DER from being connected to a de-energized distribution system. Islanding is not permitted on the FCU distribution system.

1.6 Synchronizing

Synchronization of the DER with the FCU system shall be done automatically. Any proposal to allow manual synchronization is subject to review and approval by FCU. All DER must use protective devices that prevent electrically closing a DER that is out of synchronization with the distribution system. FCU will under no circumstances be responsible or liable for any damage done due to an out of synchronization closure of a DER onto the system. The Operator is responsible and liable for any damage done to the FCU system by any type of improper closing onto the system.

1.7 Improper Operation of the DER

DER systems shall not adversely impact the operation of the FCU system in any way. Adverse impacts to the FCU system include but are not limited to the following:

a) Unbalanced currents or voltages
b) Voltages outside of acceptable ranges as described in section 5.2 of this document
c) Impact to bulk electric system frequency deviating from the normal 60 Hz
d) Injection of Direct Current (DC) or harmonics into the system beyond what is allowed by this document
e) Any operation that causes excessive operations of system voltage regulating devices such as load tap changers and voltage regulators
f) Any operation that affects system grounding or ground fault protection

FCU will not normally interfere with the operation of any DER. However, when requested by FCU by telephone, in person, or in writing, the Operator must immediately stop operation and not resume operation until cleared by FCU to do so. If the Operator begins to operate the DER out of the ranges or conditions listed herein, the Operator must agree to cease operation until such a time as the DER Operator can demonstrate to FCU that it has remedied the problem and can once again operate the DER in compliance with these requirements.

If usage of the DER causes unusual fluctuations or disturbances on, or interference with FCU's system or other FCU customers, FCU shall have the right to require the DER Operator to install supplemental DER devices to reasonably correct or limit such fluctuation, disturbance, or interference at no expense to FCU or other customers.

1.8 System Capacity Limitations

The equipment installed by FCU to distribute power is limited in size and is sized for safe and efficient delivery of power. When adding DER, proper system protection and voltage stability must be maintained. When system penetration levels of DER become large enough, accidental islanding of sections of the distribution system becomes possible, and additional protective devices or systems, such as transfer trip equipment, may be needed for safe operation of the FCU system.

Whenever one or more of the following limitations are exceeded, additional analysis is required. FCU may need to conduct a study and may require additional equipment and/or modifications to the DER system prior to approval.

a) After the addition of the **proposed DER**, the total rated DER kVA interconnected via the distribution transformer equals or exceeds 100% of the transformer's rating
b) After the addition of the **proposed single-phase, non-inverter connected DER**, the total rated non-inverter connected DER kVA interconnected via the single-phase transformer equals or exceeds 20kVA

c) After the addition of the **proposed DER**, the total rated DER kVA on the feeder or portion of the feeder equals or exceeds 100% of the previous year's minimum daytime (7am – 7pm) load on that feeder or feeder section
d) After the addition of the **proposed non-photovoltaic DER**, the total rated DER kVA on the feeder or portion of the feeder equals or exceeds 100% of the previous year's minimum load on that feeder or feeder section
e) After the addition of the **proposed single-phase DER**, an imbalance greater than 90kVA of single-phase DER export capacity exists between two phases of the feeder or portion of the feeder
f) The **proposed DER includes an induction machine** 300 kVA or greater, or an aggregate of 300 kVA of induction generators

1.9 Submittal Requirement

The Operator shall submit in a timely manner, sufficient design and specification information relating to the facilities to be installed by the Operator. FCU shall be entitled to review and approve or reject these facilities prior to their installation and energization. The Operator agrees to incorporate any reasonable design changes requested by FCU prior to, during, or after installation of the DER system. FCU's approval or acceptance of any design and specification information related to the DER to be installed shall not be construed as an endorsement of such engineering plans, specifications, or other information.

The following drawings and other documents shall be submitted to FCU for approval prior to any construction.

a) Single-line diagram of the facility showing the sizes of all equipment and the system protection planned
b) Cut sheets on all equipment planned including inverters, generators, fuses, circuit breakers, switches, etc.
c) Capability curves on all synchronous and doubly-fed induction generators
d) Short circuit calculations

2 Standards and Definitions

2.1 Standards

Unless otherwise specified in this standard, the current edition of the following standards should be referred to in design of the power plant, choice of equipment, and interconnection design.

ANSI C84.1 American National Standard for Electric Power Systems and Equipment- Voltage ratings (60 Hertz)

IEEE 18 IEEE Standard for Shunt Capacitors

IEEE 32 IEEE Standard Requirements, Terminology, and Test Procedures for Neutral Grounding Devices

IEEE 141: IEEE Recommended Practice for Electric Power Distribution for Industrial Plants

IEEE 142: IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

IEEE 242: IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

IEEE 519: Recommended Practices and Requirements for Harmonic Control in Electric Power Systems

IEEE 665: IEEE Standard for Generation Station Grounding

IEEE 1015: IEEE Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems

IEEE 1036: IEEE Standard for Application of Shunt Power Capacitors

IEEE 1547 IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power System Interfaces

IEEE 1547.1 IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems

IEEE 1547.2 IEEE Application Guide for IEEE Std. 1547, IEEE Standard for Interconnecting Distributed Resources with Electric Power Systems

IEEE 1547.7 IEEE Guide for Conducting Distribution Impact Studies for Distributed Resource Interconnection

IEEE C2: National Electrical Safety Code

IEEE C37.06: IEEE Standard for AC High-Voltage Circuit Breakers rated on a Symmetrical Current Basis-Preferred Ratings and Required Capabilities.

IEEE C37.012: IEEE Application Guide for Capacitor Current Switching for AC High-Voltage Circuit Breakers

IEEE C37.66: IEEE Standard Requirements for Capacitor Switches for AC Systems (1kV thru 38kV).

IEEE C37.90 IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus

IEEE C37.90.1 IEEE Standard for Surge Withstand capability (SWC) Tests for Relay and Relay Systems Associated with Electric Power Apparatus.

IEEE C37.90.2 IEEE Standard for Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers

IEEE C37.90.3 IEEE Standard Electrostatic Discharge Tests for Protective Relays

IEEE C37.95 IEEE Guide for Protective Relaying of Utility-Consumer Interconnections

IEEE C37.102 IEEE Guide for AC Generator Protection

IEEE C62.41: IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

NERC PRC-024-1: Generator Frequency and Voltage Protective Relays

NFPA 70: National Electrical Code

UL 1741: Inverters, Converters, Controllers and Interconnection System Equipment for use with Distributed Energy Resources

2.2 Acronyms

ANSI	American National Standards Institute
FCU	Fort Collins Utilities
DER	Distributed Energy Resource

EPS	Electric Power System
IEEE	Institute of Electrical and Electronics Engineers
kVA	Kilovolt Amperes
MVA	Megavolt Amperes
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NRTL	Nationally Recognized Testing Laboratory
PCC	Point of Common Coupling
PoC	Point of Connection
PV	Photovoltaic
TRD	Total Rated Current Distortion
UL	Underwriters Laboratories
VAR	Volt-Amperes Reactive

2.3 Definitions

Area EPS: Electric power system owned and operated by the utility

Cease to Energize: Terminate active power generation and limit reactive power exchange. A momentary cessation may occur if abnormal voltage and/or frequency conditions return to acceptable levels within required time limits and the DER restores output. A cease to energize condition may also precede a trip.

Clearing Time: The time between the start of the abnormal condition and the DER ceasing to energize the Area EPS. It is the sum of the detection time, any time delay, and operating time and arcing time of the interrupting device(s) used to interconnect the DER with the Area EPS.

Continuous Operation: Exchange of current between the DER and an EPS within prescribed behavior while connected to the Area EPS and while the system voltage and frequency is within specified parameters

Distributed Energy Resource: A source of electric power, including both generators and energy storage technologies, capable of exporting active power to an EPS

Distributed Energy Resource Unit: An individual DER device inside a group of DER that collectively form a system

Enter Service: Begin operation of the DER with an energized Area EPS.

Generation: The production of electric energy or the release of stored electric energy from an energy storage system.

Islanding: A condition in which a portion of an Area EPS is energized solely by one or more local EPSs through the associated PCCs while that portion of the Area EPS is electrically separated from the rest of the Area EPS on all phases to which the DER is connected

Local EPS: Electric power system contained entirely within a single premises or group of premises that is not owned or operated by the utility

Mandatory Operation: Required continuance of active current and reactive current exchange of DER with Area EPS as prescribed, notwithstanding disturbances of the Area EPS voltage or frequency having magnitude and duration severity within defined limits

Operator: Distributed Energy Resource owner and/or their operator, successors, heirs, agents, employees, and assigns

Permissive Operation: Operating mode where the DER performs ride-through either in mandatory operation or in momentary cessation, in response to a disturbance of the system voltages or frequency.

Point of Common Coupling: The point of connection between the Area EPS and the Local EPS, equivalent in most cases to “service point” as specified in the NEC

Point of Connection: The point where a DER unit is electrically connected in a Local EPS

Production Meter: Utility-provided meter used to measure the total energy output of a DER prior to any load consumption

Revenue Meter: Utility-provided bi-directional electric meter used to measure the energy consumed by customer loads and the net excess energy supplied from customer generation to the utility

Restore Output: Return operation of the DER to the state prior to the abnormal excursion of voltage or frequency that resulted in a ride-through operation of the DER

Return to Service: Enter service following recovery from a trip

Ride-Through: Ability to withstand voltage or frequency disturbances inside defined limits and to continue operating as specified

Trip: Inhibition of immediate return to service

2.4 DER Categories

Different types of DER have varying capabilities and are expected to respond differently when experiencing certain conditions, both normal and abnormal. Some requirements set forth in this standard differ based on the type of DER.

Category A1

This category is adequate for applications where the DER penetration is lower and where the DER power output is not subject to frequent, large variations. Operational requirements closely align with those described in IEEE 1547-2018 as Category A, related to reactive power capability and voltage regulation performance, and Category I, related to abnormal operating performance.

The types of DER included in Category A1 include, but are not limited to:

- Engine or turbine-driven synchronous generators
- Synchronous hydro-generators
- Other synchronous generators, excluding those used in wind turbines

Category B2

This category typically includes DER where the power output is subject to frequent, large variations. Operational requirements closely align with those described in IEEE 1547-2018 as Category B, related to reactive power capability and voltage regulation performance, and Category II, related to abnormal operating performance.

The types of DER included in Category B2 include, but are not limited to:

- Inverters sourced by solar PV
- Inverters sourced by energy storage, including Vehicle-to-Grid (V2G) capable electric vehicles
- Inverters sourced by fuel cells
- Other inverter applications
- Wind turbines (all types)
- Induction generators
- Doubly-fed induction generators

3 DER Equipment and Installation Requirements

3.1 General Requirements

The installation of any DER shall meet the relevant requirements of the National Electrical Code (NEC) and the National Electrical Safety Code (NESC). Where required by the municipality, the Operator cleared to move forward with the installation must obtain all necessary building permits, pass all applicable building department inspections, and meet other applicable requirements including but not limited to the Fort Collins Municipal Code and Fort Collins Utilities' Electric Service Standards.

Unless otherwise modified in this document, the interconnection must meet the requirements of IEEE 1547. Where the requirements of this document vary from the requirements of IEEE 1547, this document governs.

The Operator shall be solely responsible for protecting the DER and all associated equipment from abnormal distribution system conditions such as outages, short circuits, voltage and frequency variations, and other disturbances. FCU will not install equipment for the protection of the DER or other equipment.

The DER equipment shall be designed and operated so that it is capable of properly synchronizing the DER to the Area EPS, maintaining safe operation of the generation equipment, detecting any unusual operating condition, and disconnecting the DER from the system anytime damage to the DER or other equipment may occur. The equipment protection provided by the Operator shall prevent the DER from adversely affecting the FCU distribution system's capability of providing reliable service to FCU customers.

Interconnections within FCU sealed compartments are not permitted.

No DER equipment used in the DER system shall be manufactured by any company on the United States Bureau of Industry and Security's Entity List (Supplement No 4 to Part 744).

3.2 Interconnection Disconnect Switch

Each DER installation shall include a manually operated, lockable, disconnect switch with a visual break. The disconnect switch shall be visible, located near the FCU electric meter, and accessible at all times by FCU personnel to allow the DER to be disconnected safely during maintenance or outage conditions. The disconnect switch shall be rated to interrupt the maximum output of the DER, shall be rated for the voltage and fault current requirements of the DER, and shall meet all applicable NEMA, UL, ANSI, IEEE, and NEC standards as well as local and state electrical codes.

The disconnect switch shall be permanently labeled with text indicating that the switch is for the DER. The labeling shall also clearly indicate the open and closed position of the switch. The disconnect switch must be located on the output or load side of the DER such that the entire DER can be isolated from FCU distribution system.

If the site contains more than one DER unit or system (e.g. PV and battery), a single disconnect switch may be used providing its rating is sufficient for all DER and opening it produces a visible open point between all DER and the FCU system. If more than one disconnect is used, each must meet the requirements in this section, be located near the FCU electric meter, and be labeled to clearly indicate multiple disconnects are used to isolate the DER system(s) at the site.

Other devices such as circuit breakers or fuses may be considered as a substitute for a disconnect switch under the following conditions:

a) If a circuit breaker is used, it shall be draw-out and capable of being locked into the disconnected position
b) If a fuse is used, it shall be capable of being removed from the bus to provide a visual open point
c) The Operator or Operator's agents are available at all times to disconnect and lock-out breaker or remove and tag the fuses whenever requested by FCU

3.3 Transformer

The transformer supplied (whether supplied by FCU or Operator) to interconnect a three-phase DER to the FCU system is required to be a grounded-wye to grounded-wye transformer. Any three-phase step-up or step-down transformer connected in the DER installation shall be a grounded-wye to grounded-wye connection.

DER shall not be permitted to interconnect through transformer banks made up of two or more single phase transformers.

3.4 Dedicated Transformer and Additional Primary Protection

A synchronous generator of any size may need to be required to be connected to the FCU system by a dedicated transformer, pending the results of an engineering analysis. Any inverter-based DER over 50 kVA may also be required to be connected to the FCU system by a dedicated transformer, pending the results of an engineering analysis. In cases where the customer owns the primary electric system and is served behind a primary metering point, the customer-owned transformer must meet FCU standards and design criteria and must be labeled according to FCU practices.

Most interconnecting transformers on the FCU system are protected with fuses. However, if a DER is rated at 1000 kVA or above, FCU may determine the fuse protection is insufficient to properly protect the FCU system. In this case, FCU may require a dedicated, three-phase interrupting device be added to the transformer high-voltage side along with necessary relaying.

3.5 Interruption Devices

Circuit breakers or other interrupting devices located at the Point of Common Coupling (PCC) must be certified or "Listed" (as defined in Article 100, the Definitions Section of the National Electrical Code) as suitable for their intended application. This includes being capable of interrupting the maximum available fault current expected at their location. The Operator's DER system and associated interconnection equipment must be designed so that the failure of any single device will not potentially compromise the safety and reliability of FCU's distribution system.

3.6 System Protective Functions

The protective functions and requirements contained in this document are designed to protect FCU's distribution system and not specifically the Operator's DER. The Operator is solely responsible for providing adequate protection for the DER and all associated equipment. The Operator's protective devices must not

impact the operation of other protective devices utilized on the FCU distribution system in a manner that would affect FCU's ability to provide reliable service to its customers.

The DER's protective functions must sense abnormal conditions and disconnect the DER from the FCU distribution system when those abnormal conditions occur. All DER must be capable of sensing line-line-line, line-line, and line-ground faults, and loss of source voltage on any one or all three phases of the FCU distribution feeder supplying the DER. In any of the above abnormal conditions, the DER must disconnect from the utility system to protect both the line and the DER from damage due to excessive currents or unusual voltages.

The minimum protective functions and other requirements for system protection for various categories of DER are shown below. Unless otherwise specified, each DER shall be protected by an electronic relay and shall coordinate protection with FCU upstream protective devices; documentation (i.e. TCC curve) demonstrating coordination of devices shall be submitted to FCU for review. All relay settings and test reports shall be submitted to FCU for review and FCU will determine whether an on-site inspection is required to observe calibration and testing of the relay and/or inverter functions. Any DER system that is not included in one of the following categories must be individually considered by FCU.

3.6.1 Category A1

a) Over and under voltage functions (27/59)
b) Overcurrent trip functions
    1) If less than 100kVA, overcurrent trip function (50/51) which may be included in a breaker trip-unit or a fuse
    2) If 100kVA or greater, voltage restrained overcurrent trip function (50/51V)
c) Ground fault protection (50/51G)
d) Over and under frequency functions (81O/U)
e) Sync Check (25)
f) Phase-sequence or negative sequence voltage (47)
g) A function to prevent the DER from contributing to the formation of an unintended island and to prevent the DER from reconnecting with the distribution system under abnormal conditions is required.
h) If 100kVA or greater:
    1) Interrupting devices shall be 3-phase circuit breakers with electrical operation.
    2) All relays shall be utility grade (must meet IEEE Std. C37.90, C37.91, C37.92, and C37.93) and shall be independent from the generator control devices.
    3) Reverse power (32)
i) If 1MVA or greater:
    1) Negative sequence current (46)
    2) Loss of field (40)

3.6.2 Category B2

a) Inverter-connected systems
    1) Inverters must be tested to meet IEEE 1547, IEEE 1547.1, and UL1741 including UL1741-SA. If the inverter does not carry a UL sticker, FCU must be supplied with certification from a Nationally Recognized Testing Laboratory (NRTL) stating the inverter has been tested to and meets the above IEEE and UL standards.
    2) Overcurrent trip function (50/51)
        i) Overcurrent trip function may be included in a breaker trip-unit or a fuse. This device shall be separate from the inverter control system and internal disconnect device.

3) If total system capacity is 1MVA or greater:
    i) Ground fault protection (50/51G) which may be included in a breaker trip-unit. This device shall be separate from the inverter control system and internal disconnect device.
    ii) Over/Under frequency (81O/U). This device shall be separate from the inverter control system and internal disconnect device.
    iii) Over/Under voltage (27/59). This device shall be separate from the inverter control system and internal disconnect device.

b) Non-inverter systems
1) Over and under voltage functions (27/59)
2) Overcurrent trip functions (50/51) which may be included in a breaker trip-unit or a fuse
3) Ground fault protection (50/51G) which may be included in a breaker trip-unit or a fuse
4) Automatic speed matching to within 5% (15) prior to closing associated breaker
5) Phase-sequence/negative sequence voltage (47)
6) If the generator is capable of self-excitation, the DER shall include a function to prevent the DER from contributing to the formation of an unintended island and to prevent the DER from reconnecting with the distribution system under abnormal conditions. If the generator is incapable of self-excitation, evidence must be provided to FCU proving that this is the case and anti-islanding protection is not required. If such evidence does not meet FCU approval, anti-islanding protection is required.
7) If 100kVA or greater:
    i) Interrupting devices shall be 3-phase circuit breakers with electrical operation
    ii) All relays shall be utility grade (must meet IEEE Std. C37.90, C37.91, C37.92, and C37.93) and shall be independent from the generator control devices.
    iii) Negative sequence current (46)
    iv) Over and under frequency (81O/U)
    v) Reverse power (32)

3.7 Momentary Paralleling Power Systems

Some backup power systems only operate parallel to the FCU system momentarily (normally less than 0.1 seconds). With FCU's approval, the transfer switch or system used to transfer the Operator's loads between FCU's distribution system to the Operator's DER may be used in lieu of the protective functions required for parallel operation. In this scenario, all transfer schemes and electrical drawings shall be provided to FCU for review and FCU will determine if an on-site inspection is required to observe the functionality of the transfer switch or system.

3.8 Meter Collar Adapters

Meter collar adapters may be used as a means of DER interconnection in locations that meet the criteria below:

a) Meter socket is not part of a meter bank
b) Meter socket is a ring type
1) New meter socket installations for use with meter collar adapters shall be a ring type with link bypass. A variance from the FCU Electric Service Standards ringless meter socket requirements will be granted for the purpose of interconnecting DER via a meter collar adapter.
2) Existing ring type meter sockets in good condition may be used without a link bypass.

The meter collar adapter model shall be on the list of approved devices, found in FCU Interconnection Standards Annex D.

Meter collar adapters containing an Automatic Transfer Switch (ATS) will require testing the operation of the electric meter disconnect functionality during the commissioning test, found in FCU Interconnection Standards Annex B. DER battery backup systems using meter collar adapters containing an internal ATS may not function when the visible-break disconnect switch is opened by L&P crews during outages.

4 Facility Grounding

The DER grounding system must not adversely impact FCU grounding or ground fault protective relaying. The DER grounding shall not cause high voltages to occur under any condition, either during normal operating conditions or during a system fault (e.g. single-line-to-ground fault).

4.1 Equipment Bonding Conductor

The Operator shall install an equipment-grounding conductor in addition to the ungrounded conductors and grounded conductor (neutral) between the DER and the distribution system. The grounding conductor shall be permanent, electrically continuous, and capable of safely carrying the maximum fault current that could be imposed on it by the systems to which it is connected. Additionally, the equipment-grounding conductor must be of sufficiently low impedance to facilitate the operation of overcurrent protection devices under fault conditions. All conductors shall comply with the National Electrical Code (NEC). The DER shall not be designed or implemented such that the earth becomes the sole fault current path.

4.2 Surge Protection

The DER Operator is responsible for providing surge or transient protection of the DER equipment.

4.3 System Grounding

FCU maintains an effectively grounded distribution system and requires that all DER be designed to contribute to an effectively grounded system. Effective grounding prevents the occurrence of excessively high voltages during ground faults and protects existing FCU equipment. Effective grounding of the DER may desensitize existing FCU ground fault protection, which could require FCU ground fault relay settings changes or modifications in the design of the DER.

The transformer supplied to interconnect three-phase DER to the FCU system will normally be a grounded-wye to grounded-wye transformer. This connection will not provide a grounding source by itself and will not provide an effectively grounded system from the DER side of the interconnection unless effective grounding of DER is implemented. When designing the grounding system for the DER, the designer should consider the condition that will result when a ground fault occurs on the line serving the DER. This ground fault would be cleared on the FCU side of the line by opening a substation breaker or a downstream interrupter or fuse. This will result in momentarily islanding the line on the DER until it trips. Under this condition, where the line is islanded and being supplied by the DER, the system must remain effectively grounded.

Effective grounding shall be defined by IEEE 142 which states that to be considered effectively grounded both of the following two conditions must be met:

a) The ratio of zero-sequence reactance to positive-sequence reactance (X0/X1) must be positive and three or less.
b) The ratio of zero-sequence resistance to positive-sequence reactance (R0/X1) must be positive and less than 1.

The DER system equivalent (Thevenin equivalent) impedance shall meet the criteria for effective grounding stated above. The networks used in determining this impedance, and other fault current calculations for the

plant, will include the positive, negative, and zero sequence networks of the step-up transformer connected to the FCU system, all other transformers between the DER and the point of common coupling, the DER subtransient, positive, negative and zero sequence values, the neutral grounding device for the DER, the grounding transformer and neutral grounding device (if used) and any significant cable runs. The DER shall maintain an effectively grounded system under normal operating conditions while operating connected to the FCU system.

The short circuit contribution ratio (SCCR) of the DER is defined as the ratio of the DER short circuit contribution to FCU's contribution to a short circuit (IscDER/IscFCU) for either a three-phase or single-line-to-ground fault measured at the high voltage side of the transformer stepping up from the generation voltage to the FCU voltage.

The DER shall be grounded in such a way that the SCCR for a line-ground fault calculated at the high voltage side of the transformer connecting the DER to FCU is less than 3% while still achieving effective grounding as defined above. If this SCCR ratio is greater than 3% FCU must do a study to determine if re-setting ground fault relays on the existing FCU system is required. In rare cases connecting a certain DER to a particular feeder may not be practical due to protection issues or special protection techniques may be needed to make the connection safe.

Proper grounding of the DER can be achieved in a number of ways. FCU may at its discretion accept any of the following methods:

a) Solidly grounding the DER or installing a solidly grounded grounding transformer (zig-zag or grounded wye-delta transformer). While a solidly grounded DER is acceptable to FCU if all other requirements are met, it must be used with care. ANSI standards generally require that for a synchronous generator the ground fault current must be limited to the three-phase fault current. This usually requires a resistance or reactance be used for grounding the DER neutral. Also, a solidly grounded DER may conduct large amounts of harmonic currents. There may be some unbalanced voltage at the terminals of the DER. This can cause circulating current through the DER system if it is solidly grounded which may make de-rating of the DER necessary. If a solidly grounded system is used the designer must consider and plan for all issues that may result.
b) Resistance grounding. A resistance grounded DER or grounding transformer with a resistance placed between neutral and ground may be used if it meets the requirements of effective grounding.
c) Reactance grounding. A reactance grounded DER or grounding transformer with a reactor between the transformer neutral and ground may be used if it meets the requirements of effective grounding.
d) Other methods may be suggested for consideration by FCU.

If the Operator desires to generate at the FCU primary voltage and to connect the DER directly to the FCU system without the use of an interconnecting transformer, a study of the connection is required. The study will determine the grounding and other requirements necessary for this type of connection.

5 DER Operation

The Operator shall not operate the DER in any way that causes a system disturbance or that imposes a voltage or current upon FCU's distribution system that results in interference with FCU operations, service to FCU's customers, or other FCU equipment and facilities.

When FCU suspects that interference with electric service to other FCU customers is occurring, and such interference exceeds FCU Standards, FCU reserves the right at its expense to install test equipment as may be required to perform a disturbance analysis and monitor the operation of the DER to evaluate the quality of power produced. If the DER is demonstrated to be the source of the interference, and it is demonstrated that the interference produced exceeds FCU Standards or generally accepted industry standards, FCU may, without liability, disconnect the DER from the FCU distribution system. It shall be the

responsibility of the Operator to eliminate any interference caused by the DER and the Operator must diligently pursue and take corrective action, at the Operator's own expense, to eliminate undesirable interference caused by the DER. The DER will be reconnected to the FCU system only after the Operator demonstrates to the satisfaction of FCU that the cause of the interference has been remedied.

The Operator's protective devices shall prevent the DER from contributing to an island. If the portion of the FCU system the DER is connected to becomes islanded for any reason, the DER shall detect the island, cease to energize, and trip within 2 seconds of the formation of the island.

Three-phase DER shall be able to detect an open-phase condition, cease to energize, and trip within two seconds of the event.

DER systems are not permitted to enter service or return to service until Area EPS conditions have been maintained within the normal range for a minimum of five (5) minutes.

5.1 Voltage Regulation

The DER shall not actively regulate the voltage at the point of common coupling (PCC) unless the effects of this are first reviewed and approved by FCU. If FCU that determines it is advantageous for a DER to actively control its voltage, FCU will inform the Operator and the Operator will be required to control the DER's terminal voltage.

5.2 System Voltage

The voltage operating range limits for DER shall be used as a protection function that responds to abnormal conditions on FCU's distribution system. The FCU voltage operating range is normally 95% to 105% of the nominal voltage at the PCC, and 90% to 105% of nominal voltage at the utilization point, as required by ANSI C84.1 Range A. Occasional excursions outside this range may occur, and the DER shall respond as required in this section.

5.2.1 Shall Trip Voltage Limits

When the voltage at the PCC is above the Over Voltage (OV) limits or below the Under Voltage (UV) limits in this section, the DER shall cease to energize and trip within the clearing time indicated.

5.2.1.1 Category A1

Table 5-1: A1 Shall Trip Voltage Settings
(Reproduced from IEEE 1547-2018)

Shall trip function	Voltage at PCC (p.u. of nominal voltage)	Clearing Time (s)
OV2	1.20	0.16
OV1	1.10	2.00
UV1	0.70	2.00
UV2	0.45	0.16

5.2.1.2 Category B2

Table 5-2: B2 Shall Trip Voltage Settings (Reproduced from IEEE 1547-2018)

Shall trip function	Voltage at PCC (p.u. of nominal voltage)	Clearing Time (s)
OV2	1.20	0.16
OV1	1.10	2.00
UV1	0.70	10.00
UV2	0.45	0.16

5.2.2 Ride Through Voltage Requirements

Voltage ride through requirements are not applicable if frequency is greater than 62Hz or less than 57Hz.

Ride-through requirements in sections 5.2.2.1 and 5.2.2.2 are not applicable if either of the following conditions is satisfied:

a) The net active power exported across the PCC into the Area EPS is continuously maintained at a value less than 10% of the aggregate rating of the DER connected to the Local EPS prior to any voltage disturbance, and the Local EPS disconnects from the Area EPS, along with the Local EPS load to intentionally form a Local EPS island.
b) An active power demand of the Local EPS load equal or greater than 90% of the pre-disturbance aggregate DER active power output is shed within 0.1s of when the DER ceases to energize the Area EPS and trips.

5.2.2.1 Category A1

Table 5-3: A1 Ride Through Voltage Settings (Reproduced from IEEE 1547-2018)

Voltage range (p.u.)	Operating Mode / Response	Minimum ride-through time (s)	Maximum Response Time (s)
V > 1.20	Cease to Energize	N/A	0.16
1.175 < V ≤ 1.20	Permissive Operation	0.2	N/A
1.15 < V ≤ 1.175	Permissive Operation	0.5	N/A
1.10 < V ≤ 1.15	Permissive Operation	1	N/A
0.88 ≤ V ≤ 1.10	Continuous Operation	Infinite	N/A
0.70 ≤ V < 0.88	Mandatory Operation	Linear slope of 4 s/1 p.u. voltage starting at 0.7 s @ 0.7 p.u.	N/A
0.50 ≤ V < 0.70	Permissive Operation	0.16	N/A
V < 0.50	Cease to Energize	N/A	0.16

5.2.2.2 Category B2

Table 5-4: B2 Ride Through Voltage Settings (Reproduced from IEEE 1547-2018)

Voltage range (p.u.)	Operating Mode / Response	Minimum ride-through time (s)	Maximum Response Time (s)
V > 1.20	Cease to Energize	N/A	0.16
1.175 < V ≤ 1.20	Permissive Operation	0.2	N/A
1.15 < V ≤ 1.175	Permissive Operation	0.5	N/A
1.10 < V ≤ 1.15	Permissive Operation	1	N/A
0.88 ≤ V ≤ 1.10	Continuous Operation	Infinite	N/A
0.65 ≤ V < 0.88	Mandatory Operation	Linear slope of 8.7 s/1 p.u. voltage starting at 3 s @ 0.65 p.u.	N/A
0.45 ≤ V < 0.65	Permissive Operation	0.32	N/A
0.30 ≤ V < 0.45		0.16	N/A
V < 0.30	Cease to Energize	N/A	0.16

5.3 System Frequency

The DER shall operate in synchronism with the FCU distribution system. Whenever FCU's distribution system frequency at the PCC varies from nominal (60 Hertz) by the amounts as set forth in Table 5-5, the DER system's protective functions shall disconnect the DER from the FCU distribution system with delay times no longer than those shown.

Unless some other anti-islanding scheme is employed, the DER shall disconnect due to low frequency resulting from islanding the feeder load on the DER. The frequency settings must be adjusted to ensure that, during the lowest loading level on the feeder, the resulting frequency change of the DER when it is islanded with those feeder loads, should cause the under frequency protection to disconnect the DER within two seconds.

5.3.1 Shall Trip Frequency Limits

When the frequency at the PCC is above the Over Frequency (OF) limits or below the Under Frequency (UF) limits in this section, the DER shall cease to energize and trip within the clearing time indicated.

5.3.1.1 Category A1 and B2

Table 5-5: Shall Trip Frequency Settings (Reproduced from IEEE 1547-2018)

Shall trip function	Frequency (Hz)	Clearing Time (s)
OF2	62.0	0.16
OF1	61.2	300.00
UF1	58.5	300.00
UF2	56.5	0.16

5.3.2 Ride Through Frequency Requirements

Frequency ride-through requirements are not applicable if voltage is outside of voltage ride-through ranges specified in Section 5.2.2.1 for DER in Category A1 or Section 5.2.2.2 for DER in Category B2.

Ride-through requirements in Section 5.3.2.1 are not applicable if either of the following conditions is satisfied:

a) The net active power exported across the PCC into the Area EPS is continuously maintained at a value less than 10% of the aggregate rating of DER connected to the Local EPS prior to any frequency disturbance, and the Local EPS disconnects from the Area EPS, along with Local EPS load to intentionally form a Local EPS island.
b) An active power demand of the Local EPS load equal or greater than 90% of the pre-disturbance aggregate DER active power output is shed within 0.1s of when the DER ceases to energize the Area EPS and trips.

5.3.2.1 Category A1 and B2

Table 5-6: Ride Through Frequency Settings (Reproduced from IEEE 1547-2018)

Frequency range (Hz)	Operating Mode	Minimum ride-through time (s)
f > 62.0	No ride-through requirements apply to this range	
61.2 < f ≤ 61.8	Mandatory Operation	299
58.8 ≤ f ≤ 61.2	Continuous Operation	Infinite
57.0 ≤ f < 58.8	Mandatory Operation	299
f < 57.0	No ride-through requirements apply to this range	

5.4 Synchronization

Synchronous machine automatic synchronizers and sync-check relays shall be set as shown in Table 5-7.

Table 5-7: Synchronization/Sync Check Relay Settings (Reproduced from IEEE 1547-2018)

Aggregate rating of DER units (kVA)	Maximum Frequency Difference (Hz)	Maximum Voltage Difference (%V)	Maximum Phase Angle Difference (deg.)
0-500	0.3	10	20
>500-1,500	0.2	5	15
>1,500	0.1	3	10

5.5 Flicker

Any voltage flicker at the PCC caused by the DER shall not exceed the limits defined by the “Maximum Borderline of Irritation Curve” identified in IEEE 519, IEEE 141, and IEEE 1453. This limit is shown in Figure 5-1. This requirement is necessary to minimize the adverse voltage effects which may be experienced by other customers on the FCU distribution system due to the operation of the DER. Induction generators may only be connected to the system and brought up to synchronous speed (as an induction motor) if these flicker limits are not exceeded.

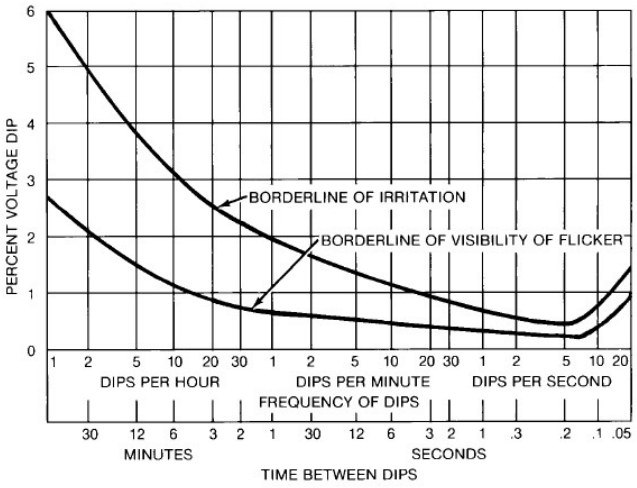


Figure 5-1: Allowable voltage flicker vs. time (Reproduced from IEEE 141)

5.6 Harmonics

Harmonic distortion measured at the PCC must be in compliance with IEEE 519 and IEEE 1547. Harmonic current injection limits are shown in Table 5-8 and Table 5-9.

Table 5-8: Maximum odd harmonic current distortion in percent of rated current at the PCC (Reproduced from IEEE 1547-2018)

	Individual Harmonic Order h (Odd Harmonics Only)					
	h<11	11≤h<	17≤h<	23≤h<	35≤h<	TRD
Percent (%)	4.0	2.0	1.5	0.6	0.3	5.0

Table 5-9: Maximum even harmonic current distortion in percent of rated current at the PCC (Reproduced from IEEE 1547-2018)

	Individual Harmonic Order h (Even Harmonics Only)			
	h=2	h=4	h=6	8≤h<50
Percent (%)	1.0	2.0	3.0	Associated rage specified in Table 5-8

DER shall not inject direct current greater than 0.5% of the full rated output current into the FCU distribution system.

5.7 Power Factor

The power factor at the PCC shall always remain within 0.95 lagging (VARs consumed by the site) to 0.95 leading (VARs supplied by the site), unless otherwise approved by FCU.

Inverter-connected DER systems shall be set to operate in a constant power factor mode with a power factor of 1. FCU may require modifications to the power factor settings described in this section if it is determined to be beneficial to the Area EPS.

Synchronous generators shall be capable of operating at any point within a power factor range of 0.95 leading (i.e. VARs absorbed by generator, capacitive, -0.95) to 0.95 lagging (i.e. VARs supplied by the

generator, inductive, +0.95). Synchronous generators should automatically control power factor and should be set to deliver VARs to the system as needed to keep the power factor at the PCC within the range required by this section.

For non-inverter generators other than synchronous generators, operation outside this power factor range is acceptable provided the cumulative power factor of the customer's entire facility, measured at the PCC, is kept within the range noted. This may be done using capacitor banks, adding static VAR compensators (SVC) or synchronous condensers, or other means agreeable to both the DER and FCU. If capacitor banks are used, they shall be sized and installed per IEEE Stds. 18, 1036, C37.012, C37.06, C37.66, and 1015. Capacitors may need to be stepped and switched to meet the power factor requirements above. Before the addition of capacitors, the Operator should completely study the effects of the capacitor additions on the resonance conditions and harmonic values that will result. If the addition of capacitors causes adverse resonance or harmonics effects on FCU's system, the Operator shall be required to pay for any modifications needed to mitigate the problem.

5.8 Disconnect Switch Operation

FCU operational procedures require line crews to create a visible break in the circuit between themselves and all potential sources of generation when working on deenergized equipment. The visible break disconnect switch will be used for this purpose during both planned outage work and unplanned outage restoration.

Under no circumstances shall the Operator tamper with or attempt to close a disconnect switch that has been open and locked out/tagged out by FCU personnel.

6 Monitoring Provisions

The following monitoring and metering requirements must be met by any Operator connecting a DER to the FCU system.

6.1 Metering

Unless otherwise required by a feed-in tariff rate scenario, shared energy system installation, or by a stipulation in a customer's interconnection agreement, all DER shall be net-metered and will not require the use of a generation production meter.

All DER installations, including primary metered DER installations, shall meet the requirements contained within the FCU's Electric Service Standards. All revenue meters will be supplied by FCU.

6.2 Monitoring and Control Requirements

Each non-inverter connected DER with a generation capacity of 100 kVA or larger and each inverter-connected DER with a capacity of 250kVA or larger aggregated at the PCC shall be required, at the discretion of FCU, to have FCU-supplied equipment that will be used for monitoring and control of the facility.

The Operator shall be responsible for all hardware, software, and any installation costs of FCU provided equipment associated with the DER installation. FCU will provide a remote monitoring and control equipment enclosure containing the following or similar equipment as approved by FCU at the Operator's expense:

- 900 MHZ spread spectrum radio or optical network terminal
- SEL 351 relay

- Terminal blocks as required
- Various control switches, CT blocks, etc. as required
- UPS battery backup

The Operator shall be responsible for mounting the equipment enclosure.

A YAGI antenna will be provided if necessary and shall be installed by the Operator at a location designated by FCU. The Operator will be responsible for installing the antenna coaxial cable specified by FCU. The Operator must use a certified installer to terminate the coaxial cable.

The monitoring and control system shall be designed to allow FCU to perform the following:

- Trip the DER system breaker for unstable system conditions such as frequency, voltage, and fault conditions
- Place a **hotline tag** on the DER breaker relay that would block the breaker's closing circuit to prevent operation
- Allows for future power dispatching by FCU through SCADA, provided an agreement to do so exists between FCU and DER Operator
- Real time monitoring of the following data points:
    - Active (Real) power
    - Reactive power
    - Current on each phase
    - Neutral current
    - Voltage
    - Frequency
    - Operational state
    - Connection status
    - Alarm status
    - Operational state of charge for storage systems
    - Solar irradiance for PV systems (W/m^2)
    - System breaker or operation status to determine if the system is on or offline
    - Others as required by FCU

The Operator shall provide all the necessary interface design to accomplish the functions listed above. The Operator must submit drawings of the proposed design to FCU for review and approval.

7 Testing

7.1 Commissioning Tests

In addition to any commissioning tests required by the Operator or manufacturer of equipment installed, some or all of the following inspections and tests are required by FCU before operation of the DER:

- Visual inspection of distribution transformer
- Visual inspection of the DER
- Visual inspection of the disconnect switches
- Visual inspection of the breaker
- Visual inspection of the fuses
- Operation test of the disconnect switch
- Phasing test
- Sync test

- Phase loss test
- Phase absent test
- Anti-islanding test
- Power quality test

Test applicability and testing procedures can be found in FCU Interconnection Standards Annex B for single-phase DER systems and FCU Interconnection Standards Annex C for three-phase DER systems.

The Operator must notify FCU two weeks in advance of the time of the testing so that FCU representatives may observe the tests required by FCU. If the phase loss or phase absent testing is required, FCU will schedule a line crew to perform the switching on the Area EPS.

Prior to performing the commissioning tests, the installation is required to be inspected and approved by City of Fort Collins Building Services.

7.2 Periodic Maintenance Tests and Inspections

FCU reserves the right to inspect any DER equipment interconnected to the FCU distribution system.

An Operator must maintain the DER equipment in good order and in compliance with all manufacturer's suggested periodic maintenance. If it is discovered that an Operator is not properly maintaining the equipment, FCU may disconnect the DER until such time that the Operator can prove that they have provided all required maintenance needed to allow the DER to operate properly and safely.

Functional testing must be performed every year to prove the proper operation of the isolation device and all breakers and relays. For all DER consisting of synchronous machines with aggregate ratings of larger than 1000kVA, no less than once every three years all protective functions must be re-tested and calibrated to prove their operation complies with the requirements contained in this document. The Operator must maintain written records of these tests and these records shall be made available to FCU on request.

Battery systems used for DER control or protective relaying must be maintained and periodically tested as suggested by the battery manufacturer.

7.3 Qualified Personnel

All testing and calibration shall be done by qualified personnel licensed with the City of Fort Collins.

8 DER System Modifications

After the DER begins operation any design changes, such as the addition of more generation capacity, must be submitted to FCU for review. Protective devices or any other requirements listed in this document must not be modified or their settings changed without approval of FCU.

9 Liability and Insurance

In no event shall FCU be held responsible for the safety, reliability, design, or protection of the DER. Compliance with these interconnection standards does not mean the DER is safe to operate and the Operator is solely responsible for making a determination about whether the DER is safe to operate.

Nothing herein shall be construed to create any duty to, any standard of care with reference to, or any liability to any person who is not a party to an arrangement or agreement between FCU and the Operator

pursuant to these requirements. FCU is not liable for damages caused to the facilities, improvements or equipment of the Operator by reason of the operation, faulty operation or non- operation of FCU facilities.

To the extent permitted by law, the Operator shall be solely responsible for and shall defend, indemnify and hold FCU harmless from and against any and all claims or causes of action for personal injury, death, property damage, loss or violation of governmental laws, regulations or orders, which injury, death, damage, loss or violations occurs on or is caused by operation of equipment or facilities on the Operator's side of the point of connection. Notwithstanding the above and to the extent permitted by law, the Operator shall be solely responsible for and shall defend, indemnify and hold harmless FCU from and against any and all claims or causes of action for personal injury, death, property damage or loss or violation of governmental laws, regulations or orders, wherever occurring, which injury, death, damage, loss or violation is due solely to the acts of omissions of such Operator, including but not limited to the use of defective equipment or faulty installation or maintenance or equipment by such party. However, nothing contained in this section shall be construed as relieving or releasing either party from liability or personal injury, death, property damage or loss, or violation of governmental laws, regulations or orders, wherever occurring, resulting from its own negligence or the negligence of any of its officers, servants, agents or employees. In the event of concurrent negligence, liability shall be apportioned between the parties according to each party's respective fault. Neither the Operator nor FCU shall be liable to the other or any other third party, in contract or in tort or otherwise, for loss of use of equipment and related expenses, expense involving cost of capital, claims of customers of FCU or the Operator, as applicable, loss of profits or revenues, cost of purchase or replacement power, or any indirect, incidental or consequential loss or damage whatsoever.

The Operator shall pay all costs that may be incurred by FCU in enforcing the indemnity described herein. Each party's liability to the other party for any loss, cost, claim, injury, liability, or expense, including reasonable attorney's fees, relating to or arising from any act or omission in its performance of this agreement, shall be limited to the amount of direct damage actually incurred. In no event shall either party be liable to the other party for any indirect, incidental, special, consequential, or punitive damages of any kind whatsoever.

For systems of 40 kVA or more, the Operator, at its own expense, except when the Operator is a governmental entity that self-insures in accordance with Colorado law, shall secure and maintain in effect during connection of its DER to the FCU system, liability insurance with a combined single limit for bodily injury and property damage of not less than $300,000 (Three Hundred Thousand Dollars) each occurrence. Such liability insurance shall not exclude coverage for any incident related to the subject DER or its operation. Except when the Operator is a governmental entity that self-insures in accordance with Colorado law, FCU shall be named as an additional interest under the liability policy. For systems above 500 kVA and up to one megawatt, the Operator, at its own expense, except when the Operator is a governmental entity that self-insures in accordance with Colorado law, shall secure and maintain in effect during connection of its DER to the FCU system, liability insurance with a combined single limit for bodily injury and property damage of not less than $2,000,000 (Two Million Dollars) for each occurrence. Insurance coverage for systems greater than one megawatt shall be determined on a case-by-case basis by FCU and shall reflect the size of the installation and the potential for system damage. Any insurance policy required herein shall include that written notice be given to FCU at least 30 days prior to any cancellation or reduction of any coverage. Such liability insurance shall provide, by endorsement to the policy, that FCU shall not by reason of its inclusion as an additional interest incur liability to the insurance carrier for the payment of premium of such insurance. A copy of the liability insurance certificate must be received by FCU prior to DER operation. Certificates of insurance evidencing the requisite coverage and provision(s) shall be furnished to FCU prior to date of interconnection of the generation system. FCU shall be permitted to periodically obtain proof of current insurance coverage from the Operator in order to verify proper liability insurance coverage. The Operator will not be allowed to commence or continue interconnected operations unless evidence is provided that satisfactory insurance coverage is in effect at all times.

10 Variance and Appeals

10.1 Variance from FCU Interconnection Standards

Whenever there are practical difficulties involved in carrying out the requirements described in this document, a Utilities official shall have the authority to grant modifications for individual cases, upon application of the developer, provided such Utilities official finds that the proposed design plan is in compliance with the intent and purpose of the FCU Interconnection Standards and that such modification does not lessen health, accessibility, life and fire safety, or reliability. The details of actions granting or denying modification requests shall be recorded and entered in the Utilities department files.

10.2 Appeals

The Light & Power Deputy Director is authorized to hear and decide appeals of decisions made by the Utilities official relative to the application and interpretation of the requirements contained within the FCU Interconnection Standards.

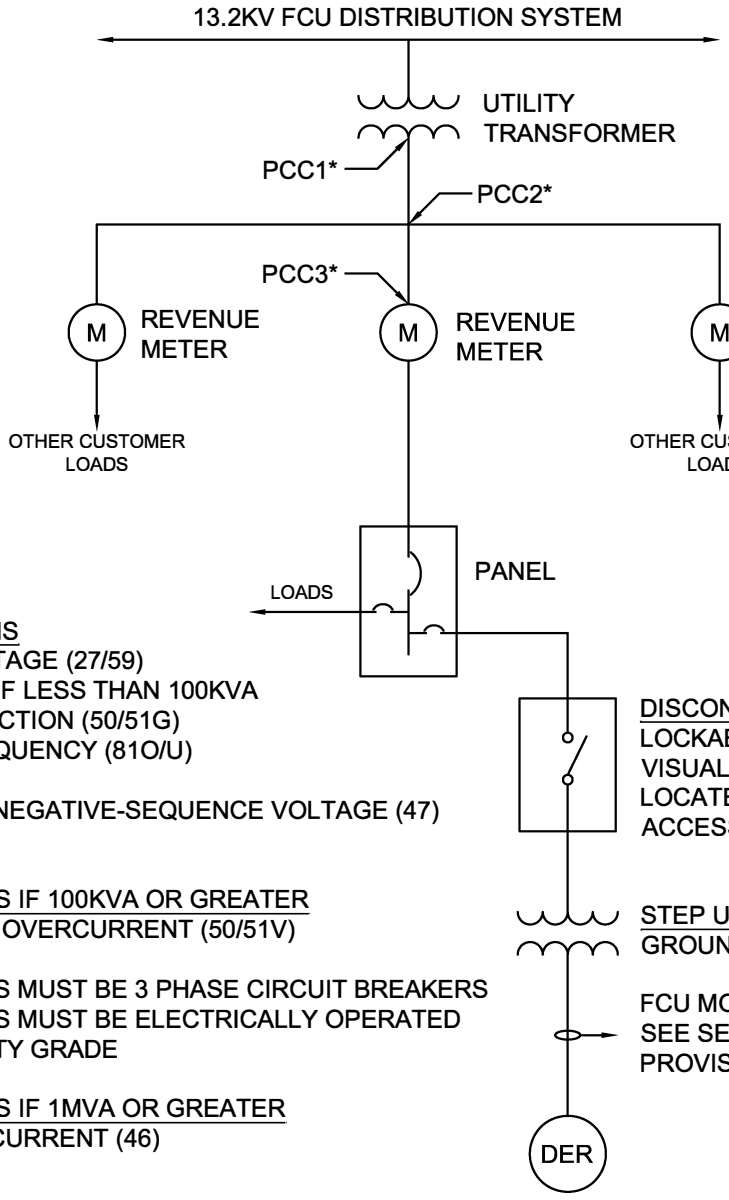
When a developer desires relief from a requirement within this document, such developer must first apply for a modification under Section 10.1 above and receive a notice of decision on that request from the Utilities official.

If after receiving a modification decision a developer desires to seek further relief, such developer may appeal the subject modification decision to the Light & Power Deputy Director stating that such decision was based on erroneous interpretation of the requirements contained in the FCU Interconnection Standards. Such appeal must be filed in writing with the Light & Power Deputy Director within ten days of the developer's receipt of notice that the Utilities official has denied the developer's modification request. The Light & Power Deputy Director is authorized to rule in favor of the developer when the Light & Power Deputy Director determines that the interpretation of the applicable requirements was erroneous or when the Light & Power Deputy Director determines an alternative design or plan is equivalent to the requirements prescribed considering effectiveness, fire resistance, durability, safety, health, and reliability.

FCU Interconnection Standards - Annex A

TYPICAL ONE-LINE CATEGORY A1 DER

CATEGORY A1 INCLUDES:
ALL SYNCHRONOUS GENERATORS EXCEPT WIND TURBINES



PROTECTIVE FUNCTIONS
OVER AND UNDER VOLTAGE (27/59)
OVERCURRENT (50/51) IF LESS THAN 100KVA
GROUND FAULT PROTECTION (50/51G)
OVER AND UNDER FREQUENCY (81O/U)
SYNC CHECK (25)
PHASE-SEQUENCE OR NEGATIVE-SEQUENCE VOLTAGE (47)
ANTI-ISLANDING

ADDITIONAL FUNCTIONS IF 100KVA OR GREATER
VOLTAGE RESTRAINED OVERCURRENT (50/51V)
REVERSE POWER (32)
INTERRUPTING DEVICES MUST BE 3 PHASE CIRCUIT BREAKERS
INTERRUPTING DEVICES MUST BE ELECTRICALLY OPERATED
RELAYS MUST BE UTILITY GRADE

ADDITIONAL FUNCTIONS IF 1MVA OR GREATER
NEGATIVE SEQUENCE CURRENT (46)
LOSS OF FIELD (40)

*POINT OF COMMON COUPLING (PCC):
PCC1 - PCC FOR COMMERCIAL CUSTOMERS SERVED BY DEDICATED TRANSFORMER
PCC2 - PCC FOR COMMERCIAL CUSTOMERS WITHOUT DEDICATED TRANSFORMER
PCC3 - PCC FOR RESIDENTIAL CUSTOMERS

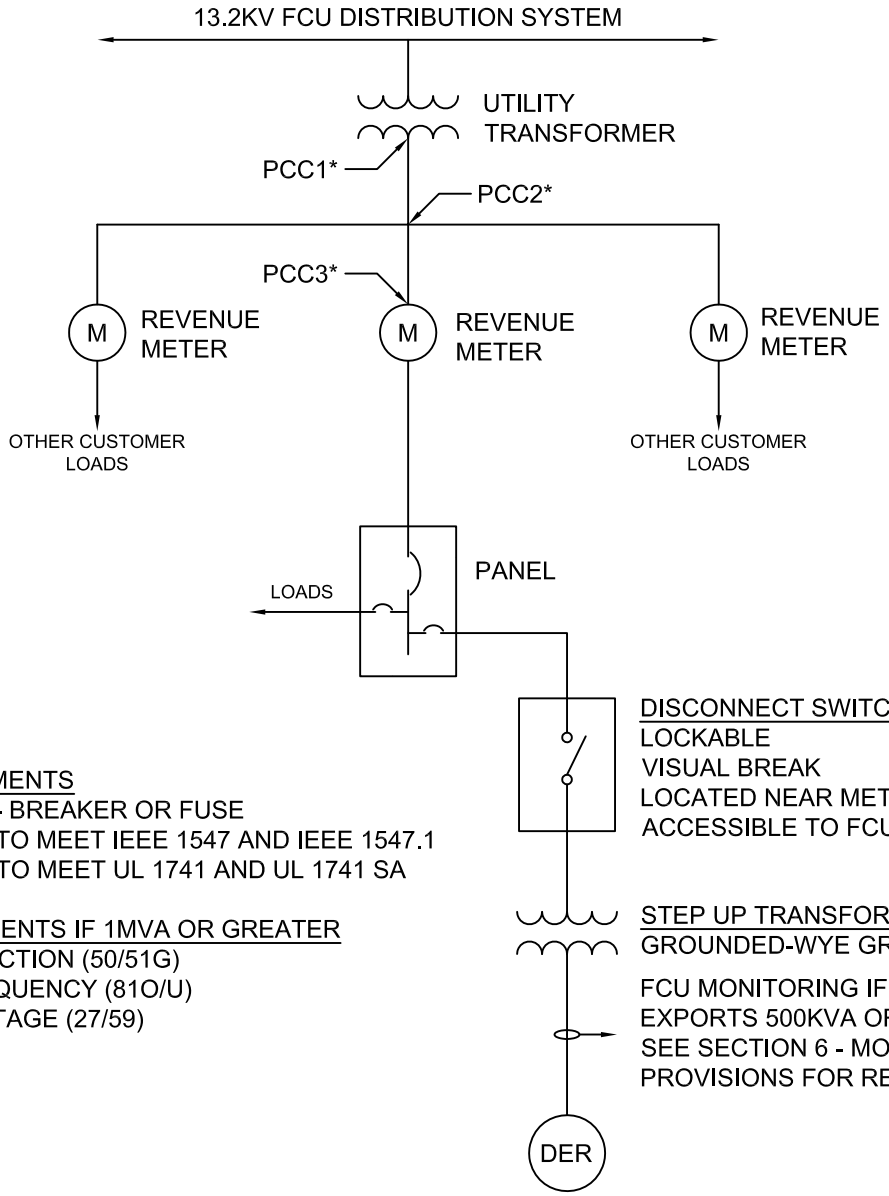
NOTES:
THIS DRAWING IS AN EXAMPLE AND MAY NOT BE REPRESENTATIVE OF ALL SYSTEMS.

SEE FCU INTERCONNECTION STANDARDS FOR COMPLETE REQUIREMENTS.

REV 10/2/2020

TYPICAL ONE-LINE CATEGORY B2 INVERTER CONNECTED DER

CATEGORY B2 (INVERTER) INCLUDES INVERTER CONNECTED DER SOURCED BY: SOLAR PV, ENERGY STORAGE, FUEL CELLS, OR ANY OTHER SOURCE



PROTECTIVE REQUIREMENTS
OVERCURRENT (50/51) - BREAKER OR FUSE
INVERTERS CERTIFIED TO MEET IEEE 1547 AND IEEE 1547.1
INVERTERS CERTIFIED TO MEET UL 1741 AND UL 1741 SA

ADDITIONAL REQUIREMENTS IF 1MVA OR GREATER
GROUND FAULT PROTECTION (50/51G)
OVER AND UNDER FREQUENCY (81O/U)
OVER AND UNDER VOLTAGE (27/59)

*POINT OF COMMON COUPLING (PCC):
PCC1 - PCC FOR COMMERCIAL CUSTOMERS SERVED BY DEDICATED TRANSFORMER
PCC2 - PCC FOR COMMERCIAL CUSTOMERS WITHOUT DEDICATED TRANSFORMER
PCC3 - PCC FOR RESIDENTIAL CUSTOMERS

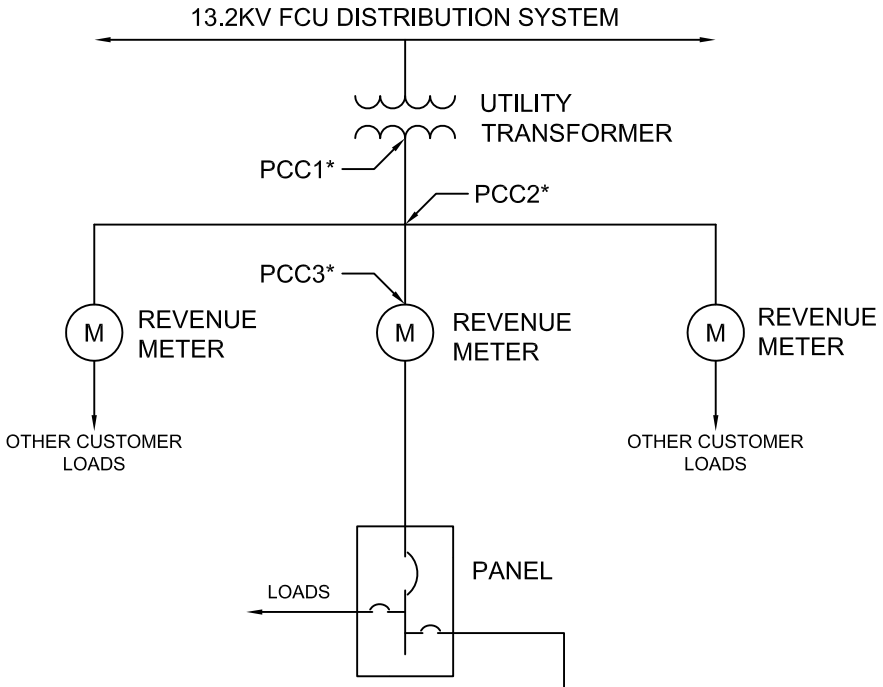
NOTES:
THIS DRAWING IS AN EXAMPLE AND MAY NOT BE REPRESENTATIVE OF ALL SYSTEMS.

SEE FCU INTERCONNECTION STANDARDS FOR COMPLETE REQUIREMENTS.

REV 10/2/2020

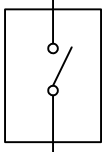
TYPICAL ONE-LINE CATEGORY B2 NON-INVERTER DER

CATEGORY B2 (NON-INVERTER) INCLUDES:
INDUCTION GENERATORS AND NON-INVERTER CONNECTED WIND TURBINES



PROTECTIVE FUNCTIONS
OVER AND UNDER VOLTAGE (27/59)
OVERCURRENT (50/51)
GROUND FAULT PROTECTION (50/51G)
AUTOMATIC SPEED MATCHING (15)
PHASE-SEQUENCE OR NEGATIVE-SEQUENCE VOLTAGE (47)

ADDITIONAL FUNCTIONS IF 100KVA OR GREATER
NEGATIVE SEQUENCE CURRENT (46)
OVER AND UNDER FREQUENCY (81O/U)
REVERSE POWER (32)
INTERRUPTING DEVICES MUST BE 3 PHASE CIRCUIT BREAKERS
INTERRUPTING DEVICES MUST BE ELECTRICALLY OPERATED
RELAYS MUST BE UTILITY GRADE



DISCONNECT SWITCH
LOCKABLE
VISUAL BREAK
LOCATED NEAR METER
ACCESSIBLE TO FCU PERSONNEL

STEP UP TRANSFORMER - IF NEEDED
GROUNDED-WYE GROUNDED-WYE

FCU MONITORING IF 100KVA OR LARGER
SEE SECTION 6 - MONITORING
PROVISIONS FOR REQUIREMENTS

DER

*POINT OF COMMON COUPLING (PCC):
PCC1 - PCC FOR COMMERCIAL CUSTOMERS SERVED BY DEDICATED TRANSFORMER
PCC2 - PCC FOR COMMERCIAL CUSTOMERS WITHOUT DEDICATED TRANSFORMER
PCC3 - PCC FOR RESIDENTIAL CUSTOMERS

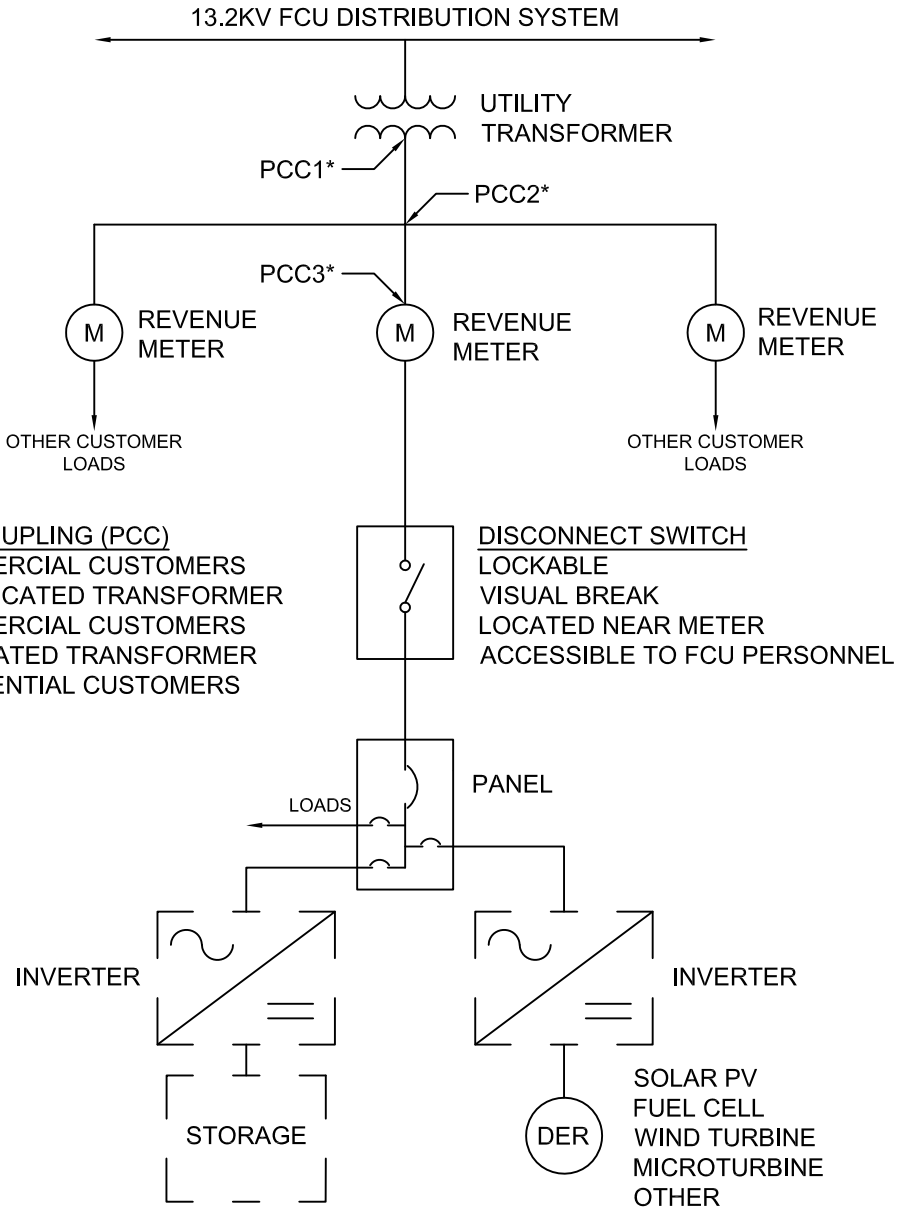
NOTES:
THIS DRAWING IS AN EXAMPLE AND MAY NOT BE REPRESENTATIVE OF ALL SYSTEMS.

SEE FCU INTERCONNECTION STANDARDS FOR COMPLETE REQUIREMENTS.

REV 10/2/2020

INVERTER CONNECTED DER INCLUDING STORAGE BELOW 1MVA

CONFIGURATION:
AC COUPLED WITH NO BACKED UP LOADS



*POINT OF COMMON COUPLING (PCC)
PCC1 - PCC FOR COMMERCIAL CUSTOMERS SERVED BY DEDICATED TRANSFORMER
PCC2 - PCC FOR COMMERCIAL CUSTOMERS WITHOUT DEDICATED TRANSFORMER
PCC3 - PCC FOR RESIDENTIAL CUSTOMERS

DISCONNECT SWITCH
LOCKABLE
VISUAL BREAK
LOCATED NEAR METER
ACCESSIBLE TO FCU PERSONNEL

NOTES:
THIS DRAWING IS AN EXAMPLE AND MAY NOT BE REPRESENTATIVE OF ALL SYSTEMS.

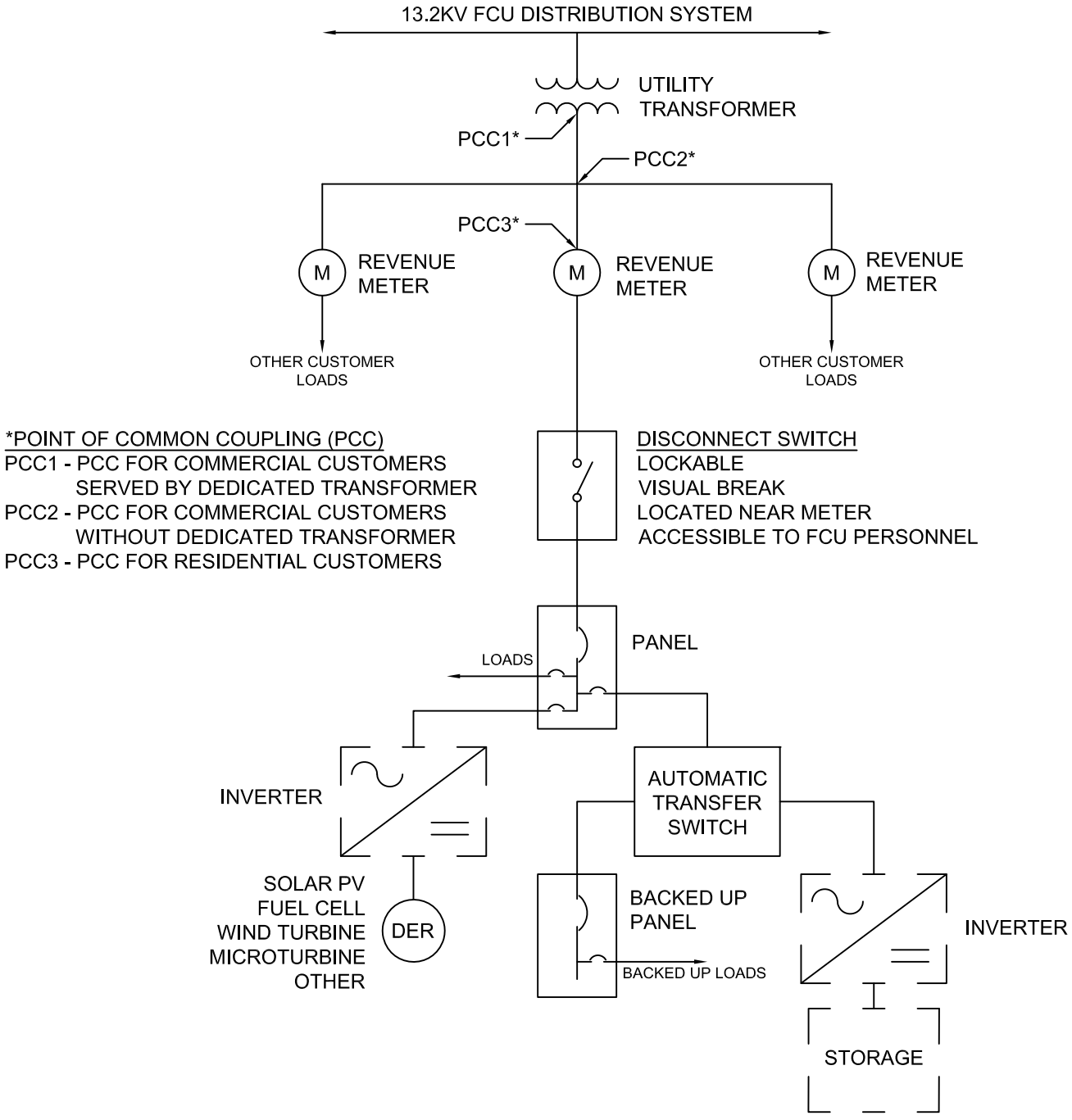
ALL ENERGY SOURCES ELECTRICALLY CONNECTED TO THE FCU DISTRIBUTION SYSTEM MUST BE ABLE TO BE ISOLATED BY A DISCONNECT SWITCH. MORE THAN ONE DISCONNECT SWITCH MAY BE USED TO SATISFY THIS REQUIREMENT.

SEE FCU INTERCONNECTION STANDARDS FOR COMPLETE REQUIREMENTS.

REV 10/2/2020

INVERTER CONNECTED DER INCLUDING STORAGE BELOW 1MVA

CONFIGURATION:
AC COUPLED WITH BACKED UP LOADS
NON-STORAGE DER NOT OPERATIONAL DURING BACKUP



NOTES:
THIS DRAWING IS AN EXAMPLE AND MAY NOT BE REPRESENTATIVE OF ALL SYSTEMS.

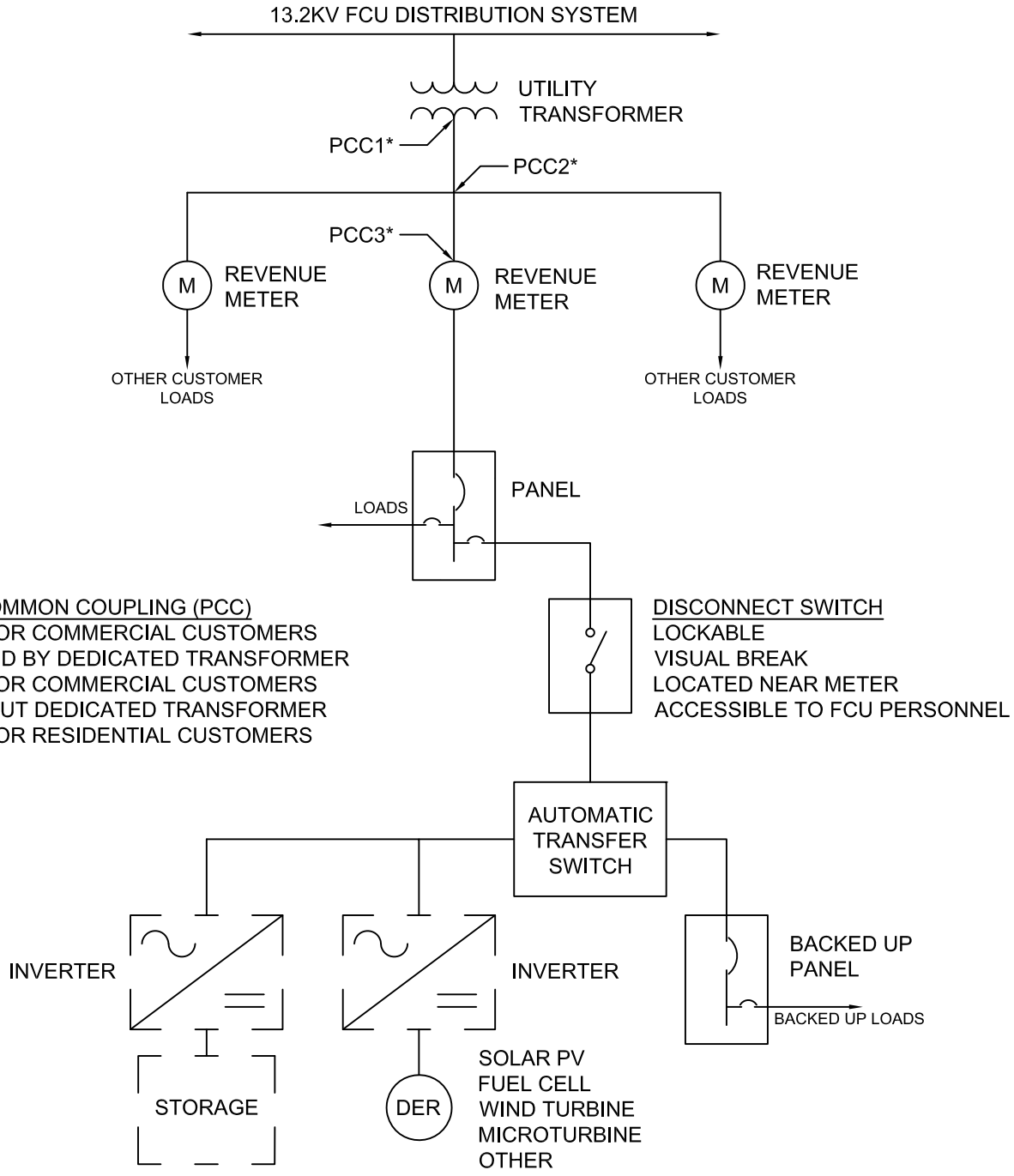
ALL ENERGY SOURCES ELECTRICALLY CONNECTED TO THE FCU DISTRIBUTION SYSTEM MUST BE ABLE TO BE ISOLATED BY A DISCONNECT SWITCH. MORE THAN ONE DISCONNECT SWITCH MAY BE USED TO SATISFY THIS REQUIREMENT.

SEE FCU INTERCONNECTION STANDARDS FOR COMPLETE REQUIREMENTS.

REV 10/2/2020

INVERTER CONNECTED DER INCLUDING STORAGE BELOW 1MVA

CONFIGURATION:
AC COUPLED WITH BACKED UP LOADS
NON-STORAGE DER OPERATIONAL DURING BACKUP



*POINT OF COMMON COUPLING (PCC)
PCC1 - PCC FOR COMMERCIAL CUSTOMERS SERVED BY DEDICATED TRANSFORMER
PCC2 - PCC FOR COMMERCIAL CUSTOMERS WITHOUT DEDICATED TRANSFORMER
PCC3 - PCC FOR RESIDENTIAL CUSTOMERS

DISCONNECT SWITCH
LOCKABLE
VISUAL BREAK
LOCATED NEAR METER
ACCESSIBLE TO FCU PERSONNEL

NOTES:
THIS DRAWING IS AN EXAMPLE AND MAY NOT BE REPRESENTATIVE OF ALL SYSTEMS.

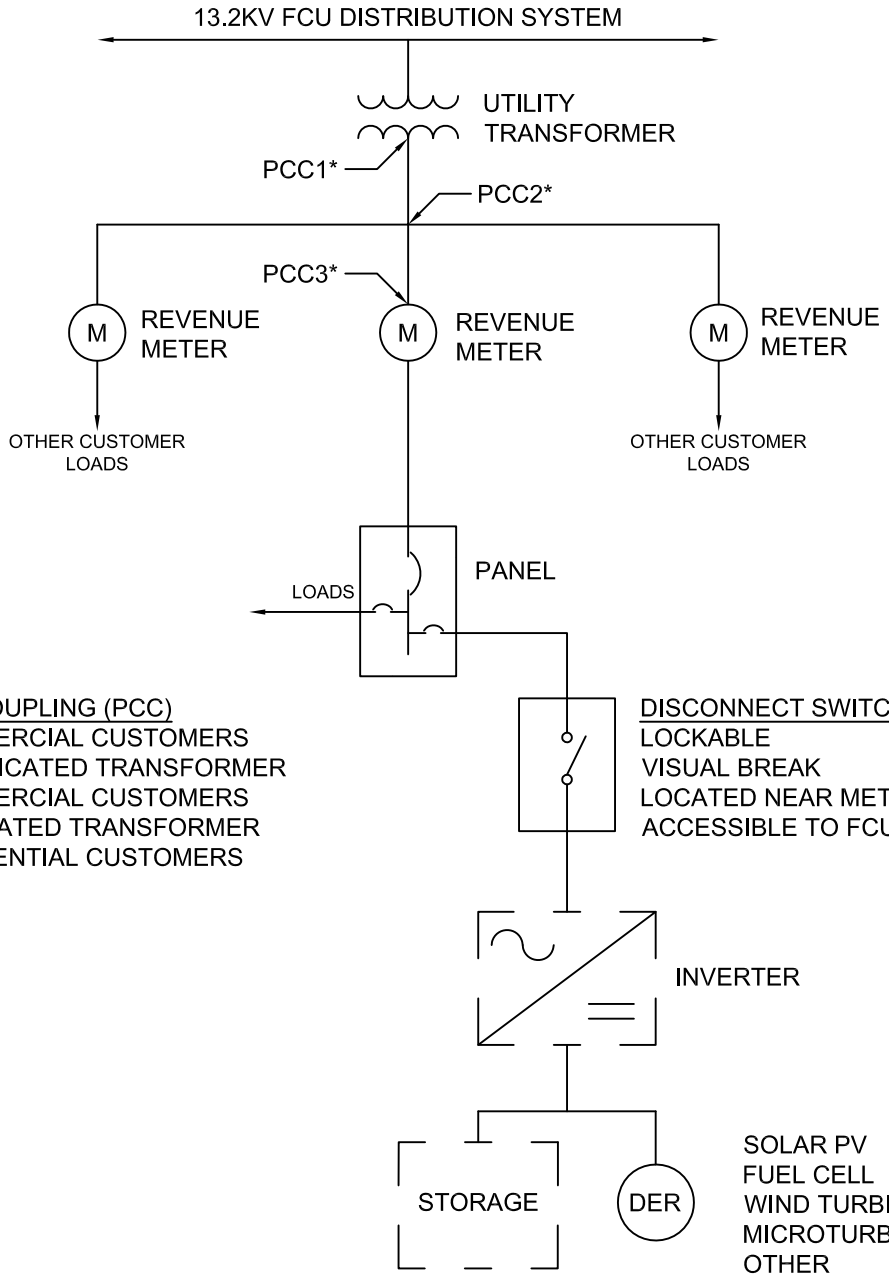
ALL ENERGY SOURCES ELECTRICALLY CONNECTED TO THE FCU DISTRIBUTION SYSTEM MUST BE ABLE TO BE ISOLATED BY A DISCONNECT SWITCH. MORE THAN ONE DISCONNECT SWITCH MAY BE USED TO SATISFY THIS REQUIREMENT.

SEE FCU INTERCONNECTION STANDARDS FOR COMPLETE REQUIREMENTS.

REV 10/2/2020

INVERTER CONNECTED DER INCLUDING STORAGE BELOW 1MVA

CONFIGURATION:
DC COUPLED WITH NO BACKED UP LOADS



*POINT OF COMMON COUPLING (PCC)
PCC1 - PCC FOR COMMERCIAL CUSTOMERS SERVED BY DEDICATED TRANSFORMER
PCC2 - PCC FOR COMMERCIAL CUSTOMERS WITHOUT DEDICATED TRANSFORMER
PCC3 - PCC FOR RESIDENTIAL CUSTOMERS

DISCONNECT SWITCH
LOCKABLE
VISUAL BREAK
LOCATED NEAR METER
ACCESSIBLE TO FCU PERSONNEL

NOTES:
THIS DRAWING IS AN EXAMPLE AND MAY NOT BE REPRESENTATIVE OF ALL SYSTEMS.

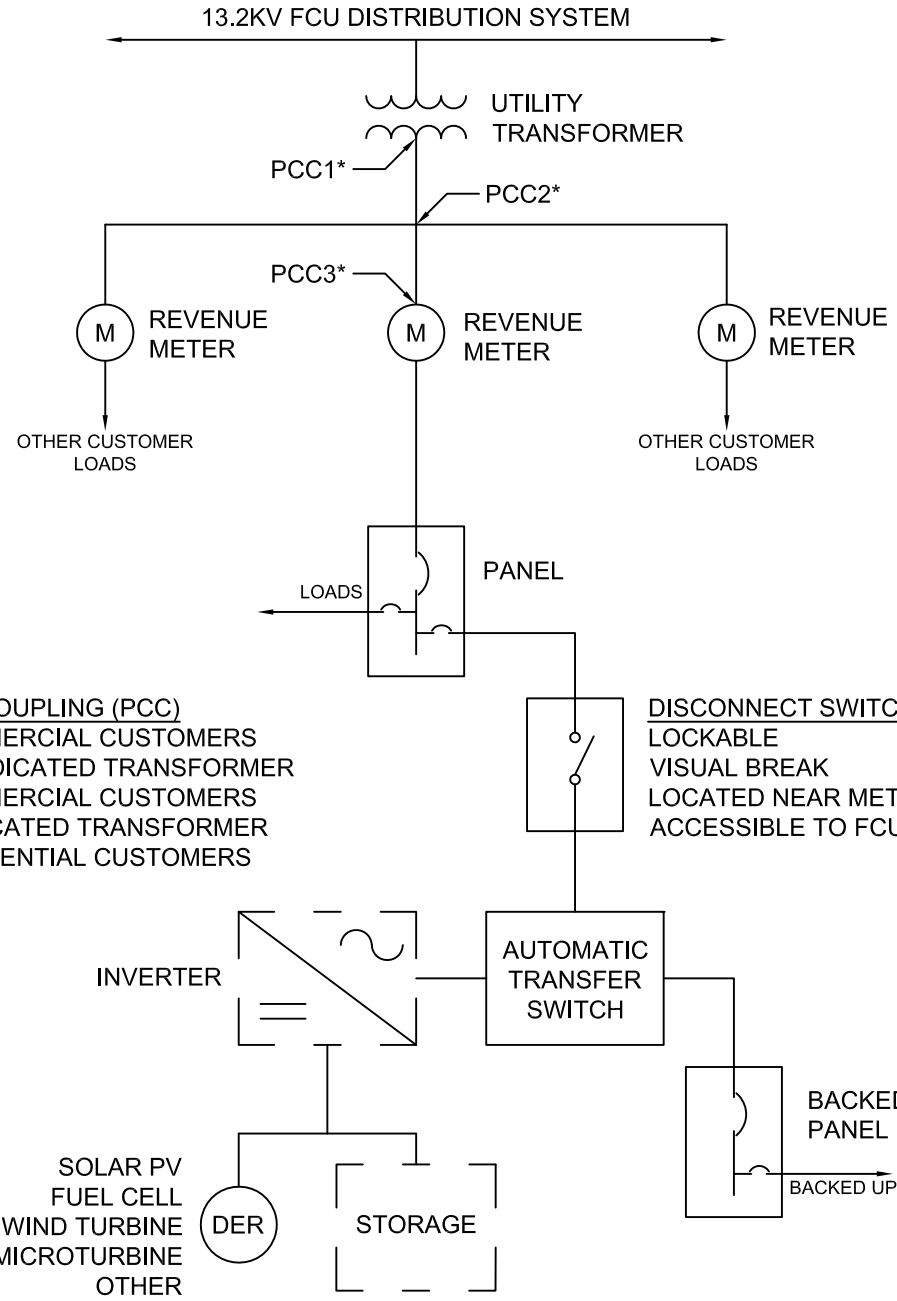
ALL ENERGY SOURCES ELECTRICALLY CONNECTED TO THE FCU DISTRIBUTION SYSTEM MUST BE ABLE TO BE ISOLATED BY A DISCONNECT SWITCH. MORE THAN ONE DISCONNECT SWITCH MAY BE USED TO SATISFY THIS REQUIREMENT.

SEE FCU INTERCONNECTION STANDARDS FOR COMPLETE REQUIREMENTS.

REV 10/2/2020

INVERTER CONNECTED DER INCLUDING STORAGE BELOW 1MVA

CONFIGURATION:
DC COUPLED WITH BACKED UP LOADS



*POINT OF COMMON COUPLING (PCC)
PCC1 - PCC FOR COMMERCIAL CUSTOMERS SERVED BY DEDICATED TRANSFORMER
PCC2 - PCC FOR COMMERCIAL CUSTOMERS WITHOUT DEDICATED TRANSFORMER
PCC3 - PCC FOR RESIDENTIAL CUSTOMERS

DISCONNECT SWITCH
LOCKABLE
VISUAL BREAK
LOCATED NEAR METER
ACCESSIBLE TO FCU PERSONNEL

NOTES:
THIS DRAWING IS AN EXAMPLE AND MAY NOT BE REPRESENTATIVE OF ALL SYSTEMS.

ALL ENERGY SOURCES ELECTRICALLY CONNECTED TO THE FCU DISTRIBUTION SYSTEM MUST BE ABLE TO BE ISOLATED BY A DISCONNECT SWITCH. MORE THAN ONE DISCONNECT SWITCH MAY BE USED TO SATISFY THIS REQUIREMENT.

SEE FCU INTERCONNECTION STANDARDS FOR COMPLETE REQUIREMENTS.

REV 10/2/2020

Fort Collins Utilities
222 Laporte Ave
Fort Collins, CO 80521
fcgov.com/utilities

FCU Interconnection Standards – Annex B:
Single-Phase DER Commissioning Test

Customer		**Test Info**	
Name:		Date & Time:	
Phone:		FCU Technician:	
Address:		Weather:	
		Notes:	
Account #:			
Meter #			

DER Info	
Contractor:	
DER Type:	
Manufacturer:	
Model:	
Max AC Output:	
DC Capacity:	
Power Factor:	

DER Storage Info (if present)	
Manufacturer:	
Model:	
Serial #:	
Capacity (kWh):	
Max Export (kW):	
Power Factor:	

The following is a test to ensure the DER is compliant with the Fort Collins Utilities Interconnection Standards for Distributed Energy Resources.

Visual Inspection of the DER

- ☐ Number of generators/inverters: _____
- ☐ Verify inverter nameplate data and UL listing if applicable
- ☐ Serial Number(s): _____

Visual Inspection of the Disconnect Switch(es)

- ☐ Manually operable
- ☐ Has visible break when open
- ☐ Accessible to FCU personnel
- ☐ Lock-out/tag-out capable

Anti-Islanding Test

Note: If the system has more than one disconnect switch isolating separate inverters, perform this test individually for each disconnect.

- ☐ Energize the DER (active power flowing from the DER) to the maximum available capacity at the time of the test
- ☐ Open the DER disconnect switch

  Confirm the system demonstrates at least one of the responses below:
  - ☐ The DER ceases to energize and trips within 2 seconds of the time the disconnect switch was opened
  - ☐ The automatic transfer switch operates, isolating the storage DER within 2 seconds of the time the disconnect switch was opened
- ☐ Close the disconnect switch
- ☐ Confirm the system delays returning to/entering service for a minimum of 5 minutes (300 seconds) from the time the disconnect switch was closed

Results:

- ☐ All required tests have been performed with satisfactory results
- ☐ Issues with testing or system response

Comments:

FCU Tech Signature: _____ Date: _____

Complete only if DER interconnects using a meter collar with internal transfer switch

Meter Functionality Test

- ☐ Energize the DER (active power flowing from the DER) to the maximum available capacity at the time of the test
- ☐ Open the FCU revenue meter's internal disconnect switch using the hand-held device or remotely via AMI
- ☐ Confirm the automatic transfer switch isolates the DER from the meter within 2 seconds of the FCU revenue meter's disconnect switch opening
- ☐ Close the FCU revenue meter's internal disconnect switch using the hand-held device or remotely via AMI
- ☐ Confirm the FCU revenue meter's disconnect switch successfully closes
- ☐ Confirm the system delays returning to service for a minimum of 5 minutes (300 seconds) from the time the disconnect switch was closed

Comments:

FCU Tech Signature: _____ Date: _____

Fort Collins Utilities
222 Laporte Ave
Fort Collins, CO 80521
fcgov.com/utilities

FCU Interconnection Standards – Annex C:
Three-Phase DER Commissioning Test

Project Name: _____ DER Address: _____

Operator Phone: _____ _____

DER Contractors: _____ FCU Reps: _____

Minimum one LP Engr rep and one Energy Services rep required

_____ _____

Test Date: _____

Weather Conditions: _____

Meter: _____

Notes:

DER Type: _____

Manufacturer: _____

Model: _____

Max AC Output: _____

Frequency: _____

Power Factor: _____

Max DC Input: _____

MPPT Voltage: _____

The following is a test to ensure the DER is compliant with the Fort Collins Utilities Interconnection Standards for Distributed Energy Resources.

In order to consider this test complete, all required sections must be completed and signed off by a Fort Collins representative.

Initial Energization

Prior to energizing the DER, notify Supervisory Control Operations (SCO) so they may alert line crews working on or near the circuit serving the DER.

Visual Inspection of the Distribution Transformer

- ☐ Record transformer switchpoint(s) for SCO maps: _____
- ☐ Record transformer identification number: _____

Comments:

FCU Rep Signature: _____ Date: _____

Visual Inspection of the DER

- ☐ Number of generators/inverters: _____
- ☐ Verify inverter UL listing if applicable
- ☐ Verify inverter nameplate data
- ☐ Serial Number(s): _____

Comments:

FCU Rep Signature: _____ Date: _____

Visual Inspection of the Disconnect Switch(es)

- ☐ Manually operable
- ☐ Has visible break when open
- ☐ Accessible to FCU personnel
- ☐ FCU lock and tag are installed (if needed) and DER owner is notified of lock

Comments:

FCU Rep Signature: _____ Date: _____

Complete only if a breaker or fuse is used as the disconnect

Visual Inspection of the Breaker

- ☐ Is drawout type
- ☐ Capable of being locked out in disconnect position
- ☐ Operator or Operator's agents available at all times to disconnect and remove breaker at FCU's request

Comments:

FCU Rep Signature: _____ Date: _____

Visual Inspection of the Fuses

- ☐ Capable of being removed from the bus to provide visual open point
- ☐ Operator or Operator's agents available at all times to remove fuse at FCU's request

Comments:

FCU Rep Signature: _____ Date: _____

Operation Test of the Disconnect Switch

- ☐ Lock-out/tag-out capable
- ☐ Open/close function test

Comments:

FCU Rep Signature: _____ Date: _____

Complete only if DER is a synchronous generator

Phasing Test

- ☐ In the case of synchronous generator, the Operator must prove that the generator is connected to the system with the proper phase rotation and that all three phases of generator voltage match those of the system at the same instant in time. This test is commonly known as “phasing out” the generator.

Comments:

FCU Rep Signature: _____ Date: _____

Sync Test

- ☐ In the case of a synchronous generator, the Operator must prove that the generator synchronizer and sync check relay is capable of connecting the generator to the system properly and in synchronism. This test must be done before the generator is allowed to actually connect to the system.

Comments:

FCU Rep Signature: _____ Date: _____

Commissioning Test

Phase Loss Test

- ☐ Energize the DER (active power flowing from the DER) to the maximum available capacity at the time of the test
- ☐ Open one phase (typically phase C) of the circuit by disconnecting a primary source of power by means of loadbreak elbow, fuse, etc. It is preferred that the circuit is opened on the utility of the distribution transformer for safety and to establish an open phase condition at the point of common coupling (PCC).
- ☐ Confirm the DER ceases to energize and trips within 2 seconds of phase loss
- ☐ Confirm the DER remains offline for a minimum of 5 minutes (300 seconds). The DER shall not attempt to return to service with an open phase.

Comments:

FCU Rep Signature: _____ Date: _____

Phase Absent Test

- ☐ Confirm the DER is experiencing an open-phase condition from the utility source and the DER is in a cease-to-energize operational mode
- ☐ Open all three phases simultaneously at the DER three-phase disconnect switch. Keep the switch open for ~5 seconds.
- ☐ Close the three-phase disconnect switch
- ☐ Confirm system remains offline for a minimum of 5 minutes from the time the disconnect was closed. The DER shall not attempt to return to service with an open phase.
- ☐ Close the open phase at the location where it was opened during the Phase Loss Test
- ☐ Confirm the system delays entering service for a minimum of 5 minutes (300 seconds) from the time the open phase was closed
- ☐ Observe the system enters service after a period of more than 5 minutes (300 seconds) from the time the open phase was closed

Comments:

FCU Rep Signature: _____ Date: _____

Anti-Islanding Test

- ☐ Energize the DER (active power flowing from the DER) to the maximum available capacity at the time of the test
- ☐ Open all three phases simultaneously at the DER three-phase disconnect switch
- ☐ Confirm the DER ceases to energize and trips within 2 seconds of the time the disconnect switch was opened
- ☐ Close the three-phase disconnect switch
- ☐ Confirm the system delays entering service for a minimum of 5 minutes (300 seconds) from the time the disconnect switch was closed
- ☐ Observe the system enters service after a period of more than 5 minutes (300 seconds) from the time the open phase was closed

Comments:

FCU Rep Signature: _____ Date: _____

Complete only if DER is not inverter-based

Protective Function Test Reports

- ☐ Relays or protective functions provided by the DER manufacturer shall be tested and relay test reports shall be made available to FCU. All of the functions required in Section 3.5 of FCU Interconnection Standards shall be tested.
  DER systems with inverters tested by an independent laboratory are not required to perform this testing.

Comments:

FCU Rep Signature: _____ Date: _____

Complete only if DER nameplate rating is 1,000kVA or larger OR if FCU Light & Power Engineering has requested the test

Power Quality Test

Testing equipment will be installed and removed by FCU meter shop personnel. The equipment is typically left in place for several days to record data. Analysis and approval will be conducted by FCU engineering staff.

Refer to Section 5 of FCU Interconnection Standards for complete requirements.

Voltage Regulation (Section 5.1)

☐ The DER does not actively regulate voltage at the PCC unless given prior approval

Comments:

FCU Rep Signature: _____ Date: _____

System Voltage (Section 5.2)

☐ If the voltage at the PCC varies from nominal, the DER ceases to energize and trips according to the table below

Voltage at PCC p.u. of nominal	Maximum Clearing Time	
	Category A1	Category B2
V ≤ 0.45	0.16s / 10 cycles	0.16s / 10 cycles
0.45 < V ≤ 0.70	2.0s / 120 cycles	10s / 600 cycles
0.70 < V < 1.10	Continuous Operation	Continuous Operation
1.10 ≤ V < 1.20	2.0s / 120 cycles	2.0s / 120 cycles
1.20 ≤ V	0.16s / 10 cycles	0.16s / 10 cycles

☐ If the voltage at the PCC varies from nominal and the conditions in Section 5.2.4 are satisfied, the DER rides through abnormal voltage conditions as outlined in Table 5-3 or Table 5-4, depending on DER's category

Comments:

FCU Rep Signature: _____ Date: _____

System Frequency (Section 5.3)

☐ DER operates in synchronism with FCU
☐ If the frequency at the PCC varies from nominal, the DER ceases to energize and trips according to the table below

Frequency at PCC (Hz)	Maximum Clearing Time Categories A & B
Hz ≤ 56.5	0.16s / 10 cycles
56.5 < Hz ≤ 58.5	300s / 18,000 cycles
58.5 < Hz < 61.2	Continuous Operation
61.2 ≤ Hz < 62.0	300s / 18,000 cycles
62.0 ≤ Hz	0.16s / 10 cycles

☐ If the frequency at the PCC varies from nominal and the conditions in Section 5.3.3 are satisfied, the DER rides through abnormal frequency conditions as outlined in Table 5-6

Comments:

FCU Rep Signature: _____ Date: _____

Synchronization (Section 5.4)

☐ If the DER is a synchronous machine, the synchronizer and sync-check relays shall be set as shown in the table below

Rating of DER (kVA)	Max Slip Rate (Hz)	Max Voltage Difference (%V)	Max Phase Angle Difference (deg.)
DER ≤ 500	0.3	10	20
500 < DER ≤ 1,500	0.2	5	15
1,500 < DER	0.1	3	10

Comments:

FCU Rep Signature: _____ Date: _____

Flicker (Section 5.5)

- ☐ Flicker limits caused by the DER do not exceed limits defined by the "Maximum Borderline of Irritation Curve" in IEEE 519, IEEE 141, and IEEE 1453

Comments:

FCU Rep Signature: _____ Date: _____

Harmonics (Section 5.6)

- ☐ Harmonic current distortion remains within the limits shown in Table 5-8 and Table 5-9
- ☐ DER does not inject direct current greater than 0.5% of the rated output into the FCU distribution system
- ☐ Harmonic distortion measured at the PCC is compliant with IEEE 519 and IEEE 1547

Comments:

FCU Rep Signature: _____ Date: _____

Power Factor (Section 5.7)

- ☐ The power factor at the PCC remains within 0.95 lagging to 0.95 leading unless an exception has been previously requested and approved

Comments:

FCU Rep Signature: _____ Date: _____

Fort Collins Utilities
222 Laporte Ave
Fort Collins, CO 80521
fcgov.com/utilities

FCU Interconnection Standards – Annex D: Approved Meter Collar Adapters for DER Interconnection

Only meter collar adapter models that have been approved and appear on the list below will be accepted as a method of interconnection. Refer to Section 3.8 of the FCU Interconnection Standards for meter collar adapter installation requirements.

To have a model considered for the approval list, the manufacturer shall contact L&P Standards Engineering at standardsengineering@fcgov.com to initiate the review process. The review requires a non-returnable sample of the meter collar adapter be provided.

Approved Meter Collar Models

Manufacturer	Model	Approval Date	Notes
ConnectDER	Simple ConnectDER	4/12/2022	The Simple ConnectDER does not provide a visible open disconnect, so a separate disconnect switch will still be required. Only solar PV may be interconnected through using the Simple ConnectDER.
Tesla	Backup Switch	9/10/2021	The Backup Switch does not provide a visible open disconnect, so a separate disconnect switch will still be required. Utility operational procedures require line crews to open and lockout all DER system disconnect switches in the vicinity during both planned outage work and unplanned outage restoration. Based on information provided by Tesla, opening a disconnect that's located between the Backup Switch and inverter will cause a rapid shutdown to occur. This will disable the backup power capability of the battery while the disconnect is open, even if the disconnect does not

			electrically isolate the battery from the backed-up loads. A customer's Tesla battery backup system using the Backup Switch may reduce the frequency and duration of power interruptions but will not eliminate them when line crews are working in the area. As this device, used in conjunction with a disconnect switch, reduces the functionality a customer is likely expecting from the battery backup system, it is required that the customer is made aware of the limitation by the developer prior to installation.