SCHEDULE "J"

Town of Cardston

Technical Interconnection Requirements (up to 150kW)

Electrical Distribution System Operational Documents

Version 1.023

LIMITATION OF LIABILITY AND DISCLAIMER

This document is not a replacement for electrical codes or other applicable standards.
This document is not intended or provided as a design specification or as an instruction manual.
The distributed energy resources (DER) owner, employees or agents recognize that they are, at all times, solely responsible for the generator plant design, construction and operation. Town of Cardston and any person employed on its behalf, makes no warranties or representations of any kind with respect to the DER requirements contained in this document, including, without limitation, its quality, accuracy, completeness or fitness for any particular purpose, and Town of Cardston will not be liable for any loss or damage arising from the use of this document, any conclusions a user derives from the information in this document or any reliance by the user on the information it contains. Town of Cardston reserves the right to amend any of the requirements at any time. Any person wishing to make a decision based on the content of this document should consult with Town of Cardston prior to making any such decision.

Contents

1. Scope

This document is prepared to assist distributed energy resources (DER) owners understand their roles and responsibilities when connecting to the Cardston Electric Utility electrical distribution system as a generator.

The requirements listed in this document apply to the following:

- DER System less than or equal to 150kW
  - Inverter based
  - A certified unit or a certified system of units
- Examples of such DER systems may include
  - Residential solar
  - Commercial solar

This document does NOT apply to the following:

- DER systems greater than 150kW
- Inverter based systems that are not certified either as a unit or a system of units
- Generators (Momentary Closed Transition) connecting momentarily (Parallel the distribution for 100 ms or less) through automatic transfer switches (such as back-up / standby generators).

Note: For "Momentary Closed Transition" applications please refer to the document "Interconnection Requirement Checklist - Standby or Backup Generator" on the Town of Cardston's Website.

2. Normative References

Knowledge of the following documents are prerequisites for these interconnection requirements. The documents shall be understood and followed, especially when cited in this document.

Interconnection Standards

- CSA C22.3 No. 9-08 (R2015) – Interconnection of distributed resources and electricity supply system
- IEEE P1547-2018 – Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces
- C22.1 No. 1-2018 - Canadian Electrical Code (CEC), Part 1

Equipment Standards

- CSA C22.2 No. 107.1-16 – Power Conversion Equipment
- UL 1741 (2018) – Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources
- UL 1741 Supplement A – Test methods for advanced inverter functions

Other Technical Standards

- IEEE 519-2014 – Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
- IEEE 2030-2011 – Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), and End-Use Applications and Loads
- NISTIR 7628 (2010) – Guidelines for Smart Grid Cyber Security

3. Glossary

- **anti-islanding:** a protective functionality aimed at preventing the continued existence of an unintentional electrical island (see "Islanding" below) to avoid safety concerns and potential damage to customer equipment.
- **backup or emergency generator:** an independent reserve source of electric energy that, upon failure or outage of the normal source, automatically provides reliable electric power within a specified time to critical devices and equipment whose failure to operate satisfactorily would jeopardize the health and safety of personnel or result in damage to property.
- **certified:** tested and approved and by an accredited certification organization such as CSA, UL, IEEE
- **cease to energize**: cessation of active power delivery under steady-state and transient conditions and limitation of reactive power exchange.
- **distributed energy resource (DER):** a source of electric power that is not directly connected to a bulk power system. DER includes both generators and energy storage technologies capable of exporting active power to an EPS. DER includes DG and MG.
- **distributed energy resource (DER) system:** the DER Unit's, interconnection systems, control systems, sensing devices or functions, and protection devices or functions up to the point of the DER connection.

- **distributed energy resource (DER) unit**: an individual DER device inside a group of DER that collectively form a system.
- **distributed generation (DG):** power generators that are connected to a distribution system through a Point of Common Coupling (PCC).
- **distribution system:** a system for distributing electricity, including any structures, equipment or other things used for that purpose. A distribution system is comprised of the main system capable of distributing electricity to many customers and the connection assets used to connect a customer to the main distribution system.
- **electric power system (EPS):** facilities that deliver electric power to a load.
- **energize:** active power outflow of the DER to an EPS under any conditions (e.g. steady state and transient)
- **flicker:** a perceptible change in electric light source intensity due to a fluctuation of input voltage. (In the context of power supply disturbances, the term applies to perceptible, subjective, objectionable and random or periodic variations of the light output).
- **harmonics:** sinusoidal voltages and currents at frequencies that are integral multiples of the fundamental power frequency which is 60 Hz in Alberta.
- **inverter:** a machine, device, or system that changes direct-current power to alternating-current power
- **islanding:** a condition in which a portion of a transmission and/or distribution system is energized solely by one or more DERs, while that portion is electrically separated from the rest of the transmission or distribution system.
- **micro generation (MG):** a DER system which meets the requirements of the Alberta Energy Micro-Generation Regulation, Section 1(1)(h).
- **measurement point:** the location where the interconnection performance requirements specified in this standard apply.
- **momentary closed transition:** a DER which parallels to the distribution system for less than 100ms. See CSA C22.3 No 9-08 (7.4.13)
- **point of common coupling (PCC):** the point of connection between the wires owner and the a DER facility.

- **point of connection (PoC):** the point of connection to where a DER unit is connected to a DER system.
- **ride-through:** ability to withstand voltage or frequency disturbances inside defined limits and to continue operating as specified
- **synchronization:** the state and operation where the DG facility is connected to the distribution system and supplies loads along with the electric grid.
- **total harmonic distortion (THD):** the ratio of the rms value of the sum of the squared individual harmonic amplitudes to the rms value of the fundamental frequency of a complex waveform**.**
- **wires owner:** the entity who owns and/or operates a distribution system

4. Interconnection Requirements

Measurement Point

- The measurement location is the location where the DER system measures power system quantities for the purpose of implementing the protection and control functions required by this Standard.
  - **Under 150kW—**Measurement point may be between the point of common coupling (PCC) and the point of connection (PoC).

Note: conductor type, distance to service entrance, DER type and size are all required as a part of the SLD submitted with the application. This information will help to model and calculate issues concerning voltage rise which may need to be mitigated.

Isolating Device

- All DER systems must follow the Canadian Electrical Code Part I and be capable of isolating from the distribution during maintenance and emergency conditions (See Section 84 of CEC, Part I).

Interconnection Grounding

- In accordance with CSA C22.3 No. 9-08, DG Systems must be grounded as per manufacturer's recommendations and CEC Part I. Transformer grounding systems shall be coordinated with FortisAlberta and shall not cause voltage disturbances or disrupt coordination of distribution system ground fault protection.

- DER Unit Certification For all individual inverter systems and multiple inverter systems:
  - CSA C22.2 107.1 and UL 1741/SA/SB certifications are required prior to energization.
  - Starting on January 1, 2023, UL 1741 SB certification will be required for all inverter-based generation.
  - Only inverters which are certified may be connected to the distribution system.

5. Power Quality (Technical specifications and performance requirements)

Voltage

- DER owner is responsible to manage the voltage/power control modes of the DER system to ensure compliance of Town of Cardston's system with the range specified in CSA C235. This applies to both primary voltage and secondary voltage where the concern is multiple customers off the same service transformer.

Note – DER systems which are under 10kW may operate in any voltage control mode.

Harmonic Distortion

- Harmonic current distortion must comply with the limits from CSA C22.3 No. 9. Current total harmonic distortion (THD) shall not exceed 5% of rated current.

DC Current Injection

- The DC current injection must not exceed 0.5% of the full rated output current at the measurement point.

Reactive Power and Voltage/Power Control Requirements

- DER systems shall be capable of sourcing (injecting, over-excited, capacitive) and consuming (absorbing, under-excited, inductive) reactive power, Q up to levels within the range of values as indicated below at all PCC feed-in active power, P levels from 20% of corresponding DER nameplate kVA rating and onward.

(Minimum DER System Reactive Power Capabilities)

- Sourcing (capacitive) and Consumption (inductive) Capability as % of as Nameplate Apparent Power, S (kVA) Rating
- 44% over +/- 5% of PCC nominal voltage range Note: 44% is equivalent to a power factor range of ± 0.9 (i.e., 0.9 lagging and leading)

6. Technical Protection Requirements

Trip Requirements

- All DER Units shall comply with the voltage and frequency ride-through requirements for Supplemental Grade for inverter interfaced generation or doubly fed induction generation and Baseline Grade for synchronous and induction generation as per section 7.4.6.5 of CSA C22.3 No. 9:20.

Table 1 – Voltage Trip Requirements

Inverter-Based Generation			Machine Based Generation		
Trip Function	Voltage (% of nominal voltage)	Clearing time(s)	Trip Function	Voltage (% of nominal voltage)	Clearing time(s)
OV3	120	0.16	OV3	120	0.16
OV2	110	2	OV2	110	2
OV1	106	45	OV1	106	45
UV1	88	10	UV1	88	10
UV2	45	0.16	UV2	45	0.16

Table 2 – Frequency Trip Requirements

Trip Function	Frequency (Hz)	Clearing time (s)
OF2	62.0	0.16
OF1	61.2	300.0
UF1	58.5	300.0
UF2	58.5	0.16

All DER systems shall cease to energize and trip when a fault is detected on the distribution system.

Ride Through Requirements

- All DER Units shall comply with the voltage and frequency ride-through requirements for Supplemental Grade for inverter interfaced generation or doubly fed induction generation and Baseline Grade for synchronous and induction generation as per section 7.4.6.5 of CSA C22.3 No. 9:20.

Note – The design criteria shall match the default minimum ride-through time (s) and maximum response time (s) identified in CSA C22.3 No 9:20 in Table, 12 / 13.

Anti-Islanding

- Inverter based generation shall meet the anti-islanding requirements of CSA C22.2 No. 107.1 and UL 1741 SA
- All other forms of generation must cease to energize and trip within 2 seconds of the formation of an island.

Return to Service after Trip

- After ceasing to energize the distribution system due to any abnormal condition, the DER system must wait 300 seconds before attempting to reconnect.

Synchronization

- The synchronization or interconnection process for any DER system shall not create a voltage drop greater than 5% and shall, at the measurement point, meet the flicker requirements of CAN/CSA 61000-3-5 (Low Voltage) and CAN/CSA 61000-3-7 (Medium Voltage).

7. Control and Monitoring Requirements

- DER Facility shall have the provision for monitoring the isolation device at the PoC.
- A SCADA link and modem to Town of Cardston's network is not required but may be requested at a later date.
- Monitoring data requirements shall comply with IEEE 1547-2018 (Section 10) for all available data points. Minimum required data points which Town of Cardston may request are currently the following:

Minimum Required Data Points	
Active Power (W)	Reactive Power (Var)
Voltage (V)	Frequency (Hz)
Operational State (Generation On or Off, Operational Mode)	Connection Status
Alarm Status	Operational State of Charge (if applicable)

Note 1 – All DER monitoring requirements of IEEE 1547 must be available through a DER unit to make available for future monitoring and control.

8. Communication Requirements

- The DER system shall be capable of providing real-time operating information to Town of Cardston from an intelligent electronic device (micro-processor relay, inverter, etc.). When deemed applicable by Town of Cardston, a communication interface module may be supplied by Town of Cardston for real-time control and/or monitoring. Eligible Protocols (IEEE 1547-2018)

Eligible Protocols (IEEE 1547-2018)

Protocol	Transport	Physical layer
IEEE Std 2030.5 (SEP2)	TCP/IP	Ethernet
IEEE Std 1815	TCP/IP	Ethernet
SunSpec Modbus	TCP/IP	Ethernet
	N\A	RS-485