



INTERCONNECTION PROTECTION SETTINGS & COMMISSIONING

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 DER owner, employees or agents recognize that they are, at all times, solely responsible for the generator plant design, construction, operation and maintenance.

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SECTION 1: Protection Settings Validation

Interconnection Protective Equipment Nameplate Information

Use a separate form for each piece of equipment providing interconnection protective functions. For system protection requirements, review FortisAlberta’s *DER-02: Technical Interconnection Requirements Standard*

Note: Individual inverters only require certification

FortisAlberta Project #					Date		
Facility Status	New	<input type="checkbox"/>	Upgrade	<input type="checkbox"/>	Existing	<input type="checkbox"/>	
Aggregate Generation Capacity	Generation Type				Facility Nominal Voltage (VAC)		
Device Identifier (as per SLD)				Associated Relay Identifier (as per SLD)			
Relay Manufacturer				Relay Model			

Overcurrent Trip Settings

Provide below the protection settings that have been implemented or are intended to be utilized for the interconnection protection. *Note: Always verify upstream coordination with FortisAlberta.*

(50/51) Overcurrent Trip Settings: Use 25kV / 14.4kV as the base

Current Pickup (Amps)	Phase	CT Ratio		Ground	CT Ratio		
Curve Type							
Time Dial/Modifier							
Instantaneous Trip (Amps)							

(67/67N/32R) Directional Overcurrent / Reverse Power Trip Settings: Use 25kV / 14.4kV as the base

Element Pickup (Amps or Watts)	67P	67N	32R			
Curve Type						
Time Dial/Modifier						
Instantaneous Trip (Amps)						

Required Protection Settings

The following are the **required** protection settings for any interconnection to FortisAlberta's distribution system. Any variance to the below settings must be approved by FortisAlberta. If settings cannot be met please provide justification in the comments section.

Frequency Protection

(81U) Under-Frequency Trip		(81O) Over-Frequency Trip	
Required Setting	Required Trip	Required Setting	Required Trip
UF1 = 58.5 Hz	300sec	OF1 = 61.2 Hz	300sec
UF2 = 56.5 Hz	0.16sec	OF2 = 62.0 Hz	0.16sec

The frequency settings are as per Table 10 of FortisAlberta's *DER-02* standard.

Use the comment section for any variance to the tables.

Voltage Protection

(59) Over-Voltage Trip		(27) Under-Voltage Trip	
Required Setting	Required Trip (cycles)	Required Setting	Required Trip (cycles)
OV1 = 106%	2700 (45sec)	UV1 = 88%	120 (2sec)
OV2 = 110%	30 (0.5sec)	UV2 = 45%	10 (0.16sec)
OV3 = 120%	10 (0.16sec)		

The frequency settings are as per Table 9 of FortisAlberta's *DER-02* standard.

Use the comment section for any variance to the tables.

System Synchronizing

(25) Synchronizing			
Requirements	< 0.5 MVA	0.5 – 1.5 MVA	> 1.5 MVA
Frequency Difference	0.3 Hz	0.2 Hz	0.1 Hz
Voltage Difference	10 %	5 %	3 %
Phase Angle Difference	20 Degrees	15 Degrees	10 Degrees

The DER facility shall meet the synchronization requirements from CSA C22.3 No.9:20. Section 7.4.6.2

Use the comment section for any variance to the tables.

Anti-Islanding

Anti-Islanding	
Requirements	
Open Phase Detection	< 2 seconds
Loss of Utility Voltage	
Unit Restart Delay after Utility Voltage Returns	≥ 5 minutes
Dead Bus	No start
Communication Failure (upon detection of comm loss)	< 0.6 seconds
DER Facility Method of Detection	
Active	<input type="checkbox"/>
Passive	<input type="checkbox"/>
Scheme:	

The DER facility shall meet the **Anti-Islanding** requirements from FortisAlberta's *DER-02, Section 7.2*.

Based on the criteria in DER-02, please indicate below the Anti-Islanding detection method and scheme

Breaker Failure Protection

Breaker Failure (BF)	
Requirements	
Fortis to Review BF Scheme	
Breaker Failure (upon detection of a BF condition)	≤ 0.3 second (pick-up)
	< 2 seconds (trip of secondary isolation point)

The DER facility shall meet the **Breaker Failure** requirements from FortisAlberta's *DER-02, Section 7.4*.

Breaker Failure protection shall be indicated on the *Electrical Single Line Diagram* with notes describing the protection philosophy.

Additional Comments / Protection Variances:

Electrical Single Line Diagram

Please provide the issue for construction (IFC) Electrical SLD of the facility, meeting *Section 5.1* of FortisAlberta's DER-02. The SLD shall indicate the required protection elements and clearly outline the breaker failure scheme as indicated in *Section 7.4* in Fortis Alberta's DER-02.

Provided by:

Reviewed by:

Power Producer (Name / Company)

FortisAlberta

Title (P.Eng Required)

Title

Signature

Signature

Date

Date

SECTION 2: Protection Performance and Equipment Commissioning

Protection Settings and Testing

Please provide in the table below the current settings of each of the system protection elements (section outlined in red). If an element differs from FortisAlberta’s requirement provide justification to the variance in the additional comments section. If the element is not applicable to the system indicate in the table as nonapplicable and provide a comment stating why it is not required.

Interconnection Protection Validation: Refers to the testing of the protection elements / schemes and system equipment during start-up commissioning or maintenance activities. Indicate in the table below the period at which the interconnection protection settings have been tested. **All validation testing reports must be made available upon request from FortisAlberta.**

Please refer to FortisAlberta’s *DER-02: Technical Interconnection Requirements Standard* for system requirements.

FortisAlberta Project #		Facility Name		Date		
Interconnection Protection Validation						
New Commissioning		<input type="checkbox"/>	Testing Completed ≤ 3 Years	<input type="checkbox"/>	Testing Completed > 3 Years	<input type="checkbox"/>
System Protection Elements and Validation						
Protection Elements		Settings		Reference		
		FortisAlberta Requirement	Facility Interconnection Settings			
Overcurrent (non-directional)						
51	Phase Time Overcurrent	Unique to System Configuration	Fill out Separate Overcurrent Trip Table	FortisAlberta DER-02, Section 7.5		
50	Phase Instantaneous					
Directional (non-export)						
67	Phase Directional Overcurrent	10% of Total Generation Capacity	Fill out Separate Table	FortisAlberta DER-02, Section 7.6		
67N	Ground / Neutral Directional Overcurrent	10% of Total Generation Capacity	Fill out Separate Table			
32R	Reverse Power	1% of Total Generation Capacity	Fill out Separate Table			

Voltage					
59	Over Voltage	OV1 = 106 %	OV1 =	FortisAlberta DER-02, Section 7.1	
		Trip = 45 sec	Trip =		
		OV2 = 110 %	OV2 =		
Trip = 0.5 sec	Trip =				
OV3 = 120 %	OV3 =				
Trip = 0.16 sec	Trip =				
27	Under Voltage	UV1 = 88%	UV1 =	FortisAlberta DER-02, Section 7.1	
		Trip = 2 sec	Trip =		
		UV2 = 45 %	UV2 =		
Trip = 0.16 sec	Trip =				
Frequency					
810	Over Frequency	OF1 = 61.2 Hz	OF1 =		FortisAlberta DER-02, Section 7.1
		Trip = 300 sec	Trip =		
		OF2 = 62.0 Hz	OF2 =		
Trip = 0.16 sec	Trip =				
81U	Under Frequency	UF1 = 58.5 Hz	UF1 =	FortisAlberta DER-02, Section 7.1	
		Trip = 300 sec	Trip =		
		UF2 = 56.5 Hz	UF2 =		
Trip = 0.16 sec	Trip =				
System Synchronizing					
25	Frequency Difference	0.1 - 0.3 Hz	FD =		FortisAlberta DER-02, Section 7.3
	Voltage Difference	3 - 10 %	VD =		
	Phase Angle Difference	10 - 20 Degrees	AD =		
Anti-Islanding					
Loss of Utility Voltage		Trip ≤ 2 sec	Trip =	FortisAlberta DER-02, Section 7.2	
Open Phase			Trip =		
Transfer-Trip			Trip =		

Method of Detection	Review Reference Material		FortisAlberta DER-02, Section 7.2
Generator Start after Voltage Restoration	Block Start ≥ 300 sec	Start =	
Dead Bus	No Start		
Loss of Communication (upon detection of comm. loss)	Trip ≤ 0.6 sec	Trip =	
Breaker Failure			
BF Detection	Pickup ≤ 0.3 sec	Pickup =	FortisAlberta DER-02, Section 7.4
Secondary Isolation	Trip ≤ 2 sec	Trip =	

(50/51) Overcurrent Trip: Use 25kV / 14.4kV as the base

Current Pickup (Amps)	Phase		Ground	
Curve Type				
Time Dial/Modifier				
Instantaneous Trip (Amps)				
CT Ratio				

(67/67N/32R) Directional Overcurrent / Reverse Power Trip: Use 25kV / 14.4kV as the base

Element Pickup (Amps)	67P		67N	
Curve Type				
Time Dial/Modifier				
Instantaneous Trip (Amps)				
Element Pickup (Watts)	32R			
Time Delay				

Interconnection Equipment Testing

The DER Owner is responsible for the inspection, testing, and calibration of its equipment, at the PCC / PoC. Testing shall be conducted prior to the initial energization of the facility and on a periodic basis for maintenance purposes. Review DER-02, *Section 9.0* and CSA C22.3 No. 9: 20, *Section 8.5.2.1* for inspection and testing requirements.

The following interconnection equipment at the PCC / PoC shall be included in all testing, but not limited to:

- Interrupting / Isolation devices (i.e. Breaker, Recloser, Disconnect Switch)
- Instrumentation (i.e. Current / Voltage Transformers, Sensing Devices)
- Control Wiring
- Underground Cabling
- Main Power Transformers
- Protection Function Testing
- Interconnection SCADA DNP3 Mapping: Refer to DER-02, *Annex 'A'* for requirements and mapping

Test results shall be documented and made available upon the request of FortisAlberta.

Refer to manufacturer guidelines for equipment testing and expected values. In the absence of the manufacturer's information, use the latest industry standards for testing equipment. **Indicate below the testing period and the standard(s) used for testing**

Interconnection Equipment Testing					
New Commissioning	<input type="checkbox"/>	Testing Completed ≤ 3 Years	<input type="checkbox"/>	Testing Completed > 3 Years	<input type="checkbox"/>
Testing Standard(s) Applied (i.e. NETA ATS 2017, CSA C22.3 No 9, IEEE 1547.1)					

FortisAlberta SCADA Verification					
RTU – Bench Test Device to RTU Point Test Validation.	<input type="checkbox"/>	Facility SCADA Map Available and Reviewed	<input type="checkbox"/>	Not Applicable	<input type="checkbox"/>

SCADA Verification:

Applies to new constructed facilities requiring FortisAlberta monitoring and control. Review DER-02, Annex A for SCADA requirements and DNP3 mapping. An RTU bench test shall be required and submitted before FortisAlberta arriving at site for SCADA commissioning, this includes real point to point test verification of the protective relay functions back to the RTU.

All mapping shall align with the map in Annex 'A'. Any variances must be accepted by FortisAlberta prior to commissioning. If agreed upon, the variance shall be added to

Additional Comments / Variances:

Testing Certification

Your signature below indicates that the information that has been provided is accurate and the testing of the protection and facility equipment aligns with the requirements in FortisAlberta's DER-02 standard. It also indicates that all testing results have been documented and are available upon request by FortisAlberta.

Certified by:

Witnessed / Reviewed by:

Power Producer (name / company)

FortisAlberta

Title

Title

Signature

Signature

Date

Date

REFERENCE MATERIAL

Inspections and Tests

The following are the minimum expectations for each type of inspection and test. Refer to the equipment manufacturer for recommended routine maintenance tests, if not available use the latest NETA Acceptance Testing Standard (ATS) as a reference for applicable inspections, test procedures and expected results.

End-to-End Wire Checks:

- Verify tightness of accessible bolted connections by use of a calibrated torque wrench. Use manufacturer specifications for required torque levels.
- Inspect, tug test and tighten all loose circuit wiring connections.
- Confirm each wire is terminated as indicated in vendor / engineered drawings.
- Verify end-to-end continuity.
- Verify single point grounding.
- Ensure proper phasing.

Insulation-Resistance & Dielectric Withstand Testing:

- One-minute insulation resistance on each phase. Shall include both phase-to-phase and phase-to-ground tests.
- Insulation-resistance tests shall be conducted when the breaker or isolation switch is in the closed position.
- For required test voltages and expected values refer to manufacturer data, Table 100.1 or Table 100.5 (Transformers) in NETA ATS.
- Isolation switches requiring dielectric withstand tests shall be conducted with the switch in the closed position, testing each phase, phase-to-phase and phase-to-ground. Refer to manufacturer recommendations.
- Breakers requiring dielectric withstand testing (for vacuum bottle integrity) shall be conducted across the vacuum bottle when the breaker is in the open position.

Contact Resistance Tests:

- Tests to be conducted across switchblades, fuse holders and breaker contacts in the closed position. Each phase shall be tested and compared. A low-ohm meter shall be used for each test.
- Comparing each phase, at a maximum, test values shall not differ by more than 50 percent of the lowest phase.

Breaker Timing Tests:

- Verification of when the breaker receives an open / close signal to the actual mechanical open / close of the breaker contacts.
- Test values shall reflect manufacturers specification. In the absence of manufacturer data values times shall be recorded for maintenance purposes.

Breaker / Isolation Switch Function Tests:

- Verify that breaker functions electrically via protection controller (inter-tie relay).
- Breaker open and close functions shall be verified manually by push button and/or mechanical lever.
- When applicable both the undervoltage and anti-pump functions of the breaker shall be tested.
- Manually operate switches to verify proper engagement of switchblades.

Inspections and Tests Cont'd

Analog Inputs / Configuration:

- Inject voltage and current into meter inputs to ensure accuracy.
- Confirm voltage and current ratios configured directly reflect instrument ratios and system parameters.
- Verify / configure meter for event capturing that complies to 'Annex B' of FortisAlberta's *Technical Interconnection Requirements Standard* (DER-02).

Transformers

Ratio / Polarity:

- (Power) Perform turns ratio test on the nominal operating tap and for each winding.
(Instrument) Perform turns ratio test on each PT and CT at the PCC.
- (Power) Ratios shall not differ by more than 0.5% on each winding pair.
- (Instrument) Ratio errors shall conform to ANSI/IEEE C57.13

Winding Resistance:

- (Power) Resistance shall be measured on both the high and low voltage windings at the operating tap.
- (Power) Temperature corrected winding resistance shall be compared within one percent of factory or previously obtained results.

Excitation Current:

- (Power) Excitation current shall be measured on both the high and low voltage windings at the nominal operating tap.
- (Power) Excitation current pattern for a 2-winding transformer shall have two similar readings and one lower current reading.
- (Instrumentation - CT) Testing shall be in accordance to ANSI/IEEE C57.13.1.
- (Instrumentation - CT) Excitation results shall match the curve supplied by the manufacturer or be in accordance with ANSI/IEEE C57.13.1.

Power Factor:

- (Power) Insulation Power Factor tests shall be performed on all windings of the transformer as per testing equipment manufacturers recommendation.
- (Power) Expected CHL values shall be less than:
Oil (Power) = 0.5%
Dry (Power) = 2.0%
Dry (Distribution) = 5.0%
- (Power) Insulation Power Factor tests shall be performed on all windings of the transformer as per testing equipment manufacturers recommendation.

Burden:

- (Instrumentation) Measured transformer burdens shall not exceed instrument transformer name-plate rating.