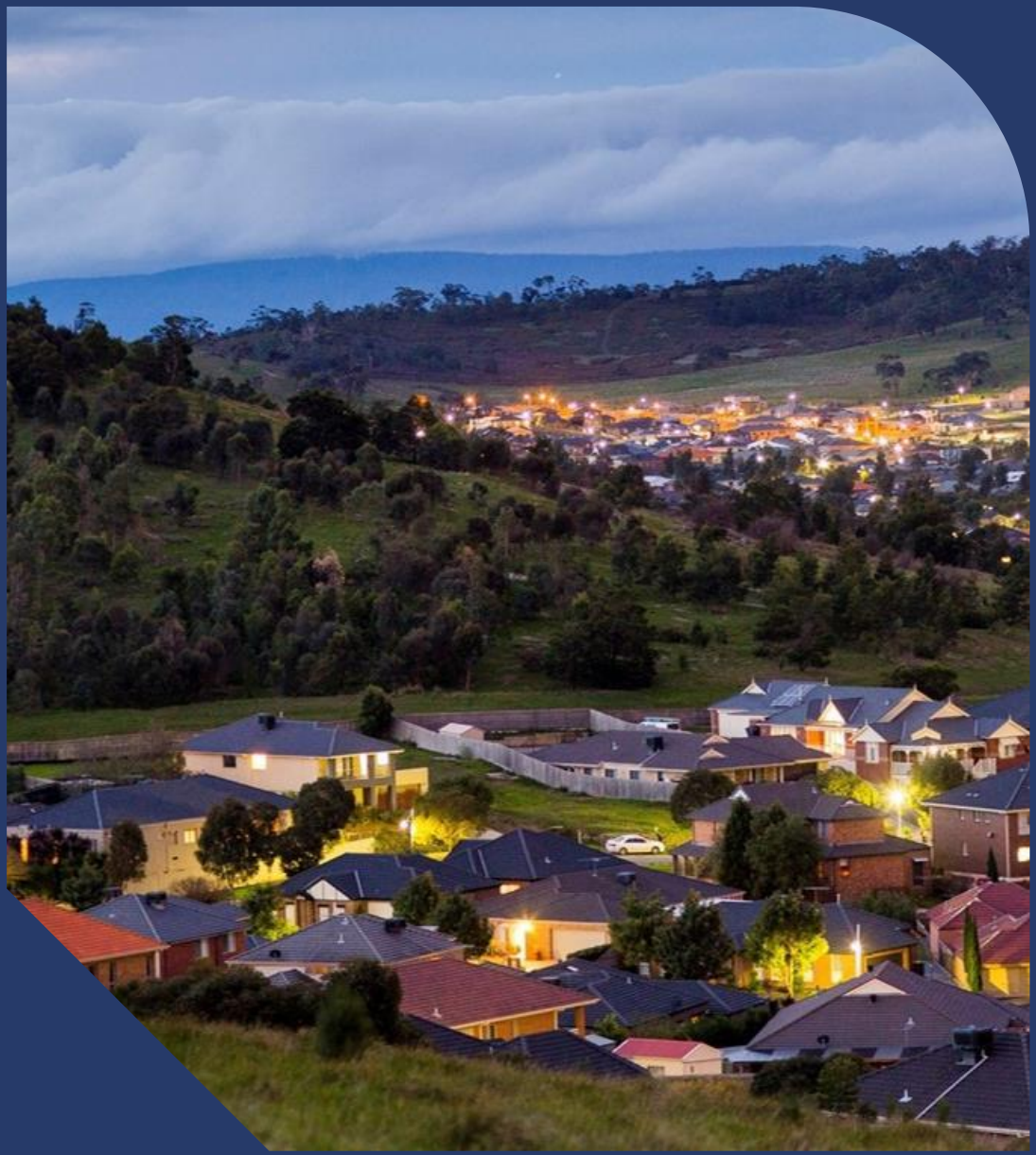
AusNet

Embedded Generator 30 kW up to 1.5 MW: Central Protection Commissioning Test Report

Standard operating procedure



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Embedded Generator 30 kW up to 1.5 MW: Central Protection Commissioning Test Report

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1. Purpose

The procedure outlined in this report, describes the on-site Commissioning tests reports required to be provided by the Installer of Embedded Generator systems 30 kW up to 1.5 MW which require Central Protection. The tests and certification are the minimum requirement. Additional tests to confirm the initial performance of an Embedded Generator may be required by the installer or by AusNet Services.

As the Installation of an Embedded Generator is prescribed in accordance with the *Electrical Safety (Installations) Regulations 2009* Clause 238 (1) (f), a Certificate of Electrical Service will always need to be provided.

The approved installer is required to submit the proposed Commissioning test plan. Relevant test results are to be provided in the following format.

If the Commissioning tests require that the system is energised, AusNet Services provides consent for the installer to undertake Commissioning tests subject to compliance with Clause 6.9.5 of the *Victorian Service & Installation Rules* and when appropriate as advised by AusNet Services with the AusNet Services Operations Control Room.

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2. Scope

This document outlines the on-site commissioning tests and certification requirements for installers of Embedded Generator systems with Central Protection Relay.

This document is not intended to provide guidance on the design, protection or operation of embedded generators, but rather the documentation process for submitting a proposed commissioning test plan.

3. Abbreviations and definitions

Specific terms and abbreviations used in this document are defined in Table 1.

Table 1 Abbreviations and definitions

TERM	DEFINITION
CSIP-Aus	Common Smart Inverter Profile Australia
Inverter Energy Systems (IES)	An EG system comprising one or more inverters together with one or more energy sources (which may include energy storage) and controls.
LFDI	Long Form Device Identifier
MSL	Minimum System Load: Minimum load needed to preserve system stability and security across the grid. This is monitored and managed by AEMO.
NMI	National Metering Identifier
PV	Photovoltaic

4. Relay test report

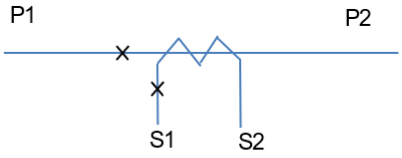
The following information is required for each Relay followed by the appropriate test report for each element required; a single line diagram with ANSI elements labelled is required in the Test Report.

INFORMATION	DETAILS
Project no.	
Customer	
Location	
Relay make	
Model (if applicable)	
Serial number	
Date	

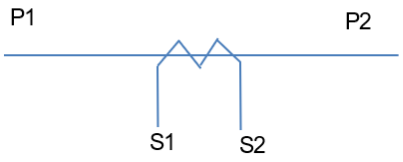
4.1. Generic test results

4.1.1. CT polarity test

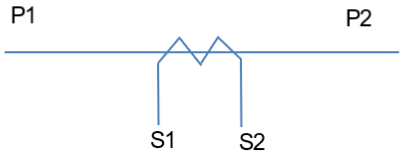
The following indication of correct polarity shall be provided for each phase.



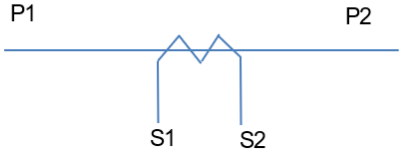
Red Phase



White Phase



Blue Phase



4.1.2. Central protection anti-islanding functionality test record

The test should be undertaken by opening the site main switch so that generation and the site load is interrupted.

INVERTER NO. 1 ANTI-ISLANDING OPERATION	MEASUREMENT	RESULT
Test 1: Disconnection time must be < 2 seconds to pass	.....**Sec**	Pass / Fail **(circle one)**
Test 2: Reconnection time must be >60 seconds to pass	.....**Sec**	Pass / Fail **(circle one)**

4.2. Relay elements test report

4.2.1. Test plan: Limited export central protection

Refer to SOP 33-06 for Commissioning requirements.

4.2.2. Test plan: Overvoltage central protection

TEST	EXPECTED	ACTUAL	COMMENTS	RESULT PASS / FAIL
R.Ph.Overvoltage Time Stage 1	2 Sec			
R.Ph.Overvoltage Pickup Stage 1	260 V			
W.Ph.Overvoltage Time Stage 1	2 Sec			
W.Ph.Overvoltage Pickup Stage 1	260 V			
B.Ph.Overvoltage Time Stage 1	2 Sec			
B.Ph.Overvoltage Pickup Stage 1	260 V			

4.2.3. Test plan: Undervoltage Central Protection

TEST	EXPECTED	ACTUAL	COMMENTS	RESULT PASS / FAIL
R.Ph. Undervoltage Time Stage 1	2 Sec			
R.Ph. Undervoltage Pickup Stage 1	180 V			
W.Ph. Undervoltage Time Stage 1	2 Sec			
W.Ph. Undervoltage Pickup Stage 1	180 V			
B.Ph. Undervoltage Time Stage 1	2 Sec			
B.Ph. Undervoltage Pickup Stage 1	180 V			

4.2.4. Test plan: Overfrequency central protection

TEST	EXPECTED	ACTUAL	COMMENTS	RESULT PASS / FAIL
3.Ph. Overfrequency Pickup	52 Hz			
3.Ph. Overfrequency	2 Sec			

4.2.5. Test plan: Underfrequency central protection

TEST	EXPECTED	ACTUAL	COMMENTS	RESULT PASS / FAIL
3.Ph. Underfrequency Pickup	47 Hz			
3.Ph. Underfrequency Time	2 Sec			

4.2.6. Test plan: Phase balance central protection

If required, unbalance between any two phases eg. required for micro inverter systems and single phase inverter systems.

TEST	EXPECTED	ACTUAL	COMMENTS	RESULT PASS / FAIL
R phase Pick up	20 Amps			
R Phase Time	2 Sec			
W phase Pick up	20 Amps			
W Phase Time	2 Sec			
B phase Pick up	20 Amps			
B Phase Time	2 Sec			

If no volts are present, disconnect all phases

TEST	EXPECTED	ACTUAL	COMMENTS	RESULT PASS / FAIL
R Phase Time	2 Sec			
W Phase Time	2 Sec			
B Phase Time	2 Sec			

4.2.7. Test plan: Vector shift central protection

TEST	EXPECTED	ACTUAL	COMMENTS	RESULT PASS / FAIL
Leading Angle Vector Shift time	1 Sec			
Leading Angle Vector Shift setting	8 Deg			
Lagging Angle Vector Shift time	1 Sec			
Lagging Angle Vector Shift setting	8 Deg			
60 Sec Reconnection delay once nominal source voltage established				

4.2.8. Test plan: ROCOF central protection

Ramp in range 49.5-50.5 Hz

TEST	EXPECTED	ACTUAL	COMMENTS	RESULT PASS / FAIL
Increasing Frequency RoCoF Time	1 Sec			
Increasing Frequency RoCoF Setting	2 Hz/sec			
Decreasing Frequency RoCoF Time	1 Sec			
Decreasing Frequency RoCoF Setting	2 Hz/sec			
Reconnection delay once nominal; source voltage established	60 Sec			
Increasing Frequency inside normal band	No Trip			
Decreasing Frequency inside normal band	No Trip			

4.2.9. Test plan: Declaration

TESTED BY	
Name	
Signature	
Date	

WITNESSED BY	
Name	
Signature	

4.2.10. Referenced standard

INFORMATION	DETAILS
Test instrument manufacturer	
Test instrument model	
Serial number	
Last calibration date	
Next calibration date	

4.2.10.1. Comments

5. Anti–island inverter functionality test report

5.1. Anti-islanding functionality test records

Each test should be undertaken by opening the site main switch on each occasion in accordance with this form. To be undertaken for each inverter and also for the total installation.

INVERTER NO. 1 **ANTI-ISLANDING OPERATION**	**INVERTER MAKE** ……	**INVERTER MODEL** ……
Test 1: Time for inverter to disconnect Must be < 2 seconds to pass	**Measurement** ……**Sec**	**Result** Pass / Fail **(circle one)**
Test 2: Reconnection time for inverter to reconnect Must be > 60 seconds to pass	**Measurement** ……**Sec**	**Result** Pass / Fail **(circle one)**

INVERTER NO. 2 **ANTI-ISLANDING OPERATION**	**INVERTER MAKE** ……	**INVERTER MODEL** ……
Test 1: Time for inverter to disconnect Must be < 2 seconds to pass	**Measurement** ……**Sec**	**Result** Pass / Fail **(circle one)**
Test 2: Reconnection time for inverter to reconnect Must be > 60 seconds to pass	**Measurement** ……**Sec**	**Result** Pass / Fail **(circle one)**

INVERTER NO. 3 **ANTI-ISLANDING OPERATION**	**INVERTER MAKE** ……	**INVERTER MODEL** ……
Test 1: Time for inverter to disconnect Must be < 2 seconds to pass	**Measurement** ……**Sec**	**Result** Pass / Fail **(circle one)**
Test 2: Reconnection time for inverter to reconnect Must be > 60 seconds to pass	**Measurement** ……**Sec**	**Result** Pass / Fail **(circle one)**

INVERTER NO. 4 ANTI-ISLANDING OPERATION	INVERTER MAKE ……	INVERTER MODEL ……
Test 1: Time for inverter to disconnect Must be < 2 seconds to pass	**Measurement** ……**Sec**	**Result** Pass / Fail **(circle one)**
Test 2: Reconnection time for inverter to reconnect Must be > 60 seconds to pass	**Measurement** ……**Sec**	**Result** Pass / Fail **(circle one)**

INVERTER NO. 5 ANTI-ISLANDING OPERATION	INVERTER MAKE ……	INVERTER MODEL ……
Test 1: Time for inverter to disconnect Must be < 2 seconds to pass	**Measurement** ……**Sec**	**Result** Pass / Fail **(circle one)**
Test 2: Reconnection time for inverter to reconnect Must be > 60 seconds to pass	**Measurement** ……**Sec**	**Result** Pass / Fail **(circle one)**

TOTAL INSTALLATION ANTI-ISLANDING OPERATION	MEASUREMENT	RESULT
Test 1: Time for inverter/s to disconnect Must be < 2 seconds to pass	……**Sec**	Pass / Fail **(circle one)**
Test 2: Reconnection time for inverter/s to reconnect Must be > 60 seconds to pass	……**Sec**	Pass / Fail **(circle one)**

By signing this form, you acknowledge and represent that:

- the Inverter Energy System complies with the *Electricity Safety Act 1998 (Vic)* and associated Safety Regulations, the Electricity Distribution Code, the Victorian Service & Installation Rules, AS/NZS3000 (Wiring Rules) and AS4777 (Grid Connection of Energy Systems via Inverters), and any other relevant Acts, regulations, standards or guidelines
- the Inverter Energy System is connected to a dedicated circuit complete with lockable isolating switch at the switchboard
- the main switchboard, isolating fuse/switch/circuit breaker are labelled correctly
- commissioning tests as specified in the Service and Installation Rules have been completed and passed
- alternative supply signage has been installed

- a Prescribed Certificate of Electrical Safety (CES) has been obtained; with copies of the Electrical Works Request and CES to be sent to the Inverter Energy System Owner's Retailer and a copy of this form is to be sent directly to AusNet Services; and
- the Inverter Energy System owner has been advised that the Inverter Energy System should remain switched off until any metering upgrades are complete to avoid potential metering and billing issues. Once the metering upgrades have been completed, it is the IES owner's responsibility to turn their Inverter energy system on.

TEST UNDERTAKEN BY

Licenced Electrical Installation Worker Name: _____

Licence No*.:_____ **Date**: _____

Signature: _____

5.2. Inverter test procedure

5.2.1. Process for functionality testing of Inverter Energy Systems

This document outlines a simple testing process to confirm the operation of the AC solar main switch and testing of the Anti-Islanding protection of the installation as per AS/NZS 4777.

5.2.2. Test methodology

Carrying out this test involves dealing with live 230 volt terminals and must only be carried out by a licensed electrician.

The test must be conducted at a time of day when the prevailing weather conditions allow the PV system to be producing at least a minimum power output. This output from the inverter must be greater than 20% of the rated output of the PV array or the inverter (whichever is less).

Note: The site connected load should be selected to match as close as practicable the power output of the inverter being tested.

5.2.3. Test 1: inverter must cease supplying power within two seconds of a loss of mains

The time taken for the inverter to cease supplying power is to be measured with a timing device and recorded. A voltage probe placed on the installation side of the main solar switch is to be used to determine when the inverter has ceased attempting to export power.

The DC supply from the solar array is to remain connected to the inverter for the duration of the test the inverter must cease supplying power within two seconds of loss of mains.

5.2.4. Test 2: Inverter must not resume supplying power until mains has been present for more than sixty seconds

The time taken for the inverter to resume power supply after installation has been re-energized is to be measured and recorded. A Voltage Amp Meter is to be placed on the installation side of the main solar switch to determine when the inverter recommences exporting power.

The DC supply from the solar array is to remain connected to the inverter for the duration of the test, the inverter must not resume supplying power until mains has been present for more than 60 seconds.

5.3. Solar Emergency Backstop Testing

5.3.1. Process for CSIP-Aus functionality testing of Inverter Energy Systems

This document outlines a simple testing process to confirm the operation of the Solar Emergency Backstop compliance testing using CSIP-Aus.

5.3.2. Test methodology

The test must be conducted at a time of day when the prevailing weather conditions allow the PV system to be producing at least 1 kW of output and minimum load is present, ie. ≥ 0.5 kW. Check the inverter settings and make sure the fallback settings are set to 1 kW maximum output for the entire system, or as specified in the connection agreement.

For in-band registration use the manufacturer's platform or app and enter the NMI or other details as directed to start the testing.

For out-of-band registration, use the manufacturer's platform or app to find or generate a long form device identifier (LFDI) and enter the LFDI on the post-installation form on the portal to commence the testing.

5.3.3. Test 1: Connectivity test

Use the 'check connection' feature in the portal to confirm if connectivity is successful. A connectivity test ensures that the solar inverter or emergency backstop system is successfully communicating with the utility server. If any errors occur, review the error messages and address them accordingly. Upon successful checks, the system status will update and continue to the capability test.

5.3.4. Test 2: Capability test

Use the 'check capability' feature in the portal to confirm if capability testing is successful. A compatibility test is a process to verify that the device can perform specific functions as required by AusNet Services. It ensures that the system can respond correctly to MSL grid events, manage power flow, and maintain compliance with set technical parameters. If any errors occur, review the error messages and address them accordingly. Upon successful checks, the system status will update the status to Solar Emergency Backstop compliant. Proceed with the following sections of the post-installation form on the portal and submit the application.

6. Legislative references

STATE	REGULATOR	REFERENCE
ALL	Clean Energy Regulator (CER)	AS/NZS 4777 Grid connection of energy systems via inverters Parts 1 and 2
ALL	Standards Australia	AS/NZS3000 Wiring Rules
VIC	Energy Safe Victoria	Electrical Safety (Installations) Regulations 2009
VIC	Energy Safe Victoria	Electricity Safety Act 1998 (Vic)
VIC	Essential Services Commission	Electricity Distribution Code of Practice
VIC	Victorian Service Installation Rules Management Committee	Victorian Service & Installation Rules 2014 (SIRs)

7. Resource references

DOCUMENT ID	DOCUMENT TITLE
SOP 11-16	Standard Operating Procedure 11-16: Protection Requirements of Embedded Generators less than 5 MVA (LV + HV up to 22 kV)
SOP 33-06	Standard Operating Procedure 33-06: Export limits for Embedded Generators up to 200kVA connected at Low Voltage

8. Appendices

None.

9. Schedule of revisions

ISSUE	DATE	AUTHOR	DETAILS OF CHANGE
1	12/6/2015	H Al-Khalidi	Embedded Generator 30kW to 200 kW: Central Protection Commissioning Test Report
2	17/9/2024	R Muneer	Updated SEB requirements for all systems size

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