



## SA Power Networks Commissioning Witnessing Checklist (AS4777.2:2020)

LOGGER NUMBER:

LOGGER IP ADDRESS: 10.225.126.

ORDER NUMBER: 90001

CUSTOMER NAME:

ADDRESS:

SITE NUMBER:

NMI:

TRANSFORMER NUMBER:

SOLAR PV APPROVED CAPACITY: kVA (AC) kVA (DC)

BATTERY APPROVED CAPACITY: kVA (AC)

OPERATING PHILOSOPHY: IMPORT CONTROL / EXPORT CONTROL

MAXIMUM EXPORT kW (AC): MAXIMUM IMPORT kW (AC):

ON SITE TECHNICIAN:

INSTALLER ACCREDITATION NUMBER: ELECTRICAL (PGE) SOLAR (CEC):

INSTALLED DATE:

WITNESSING DATE: \_\_\_ / \_\_\_ / \_\_\_\_\_ (dd/mm/yyyy)

SITE CONTACT NAME:

SITE CONTACT MOBILE PHONE NUMBER:

COMMISSIONING OFFICER:

ENGINEERING REPORT NUMBER: CN5000

Checklist Release Date: 31/03/2021

**PART A: Pre-Connection Off-Line Testing**

Table 1 details all required documentation that must be provided prior to SA Power Networks commissioning officer attending site for commissioning witnessing. All documentation is to be sent to the Project Manager before any commissioning witnessing booked for appointment.

Documentation Provided Prior to Witness Booking Date
Protection test results for the protection relay(s)
Written statement from protection technician
Protection Settings Report
Commissioning Plan
Compliance Monitoring Plan
Single Line Diagrams (as built)
Incomer CB injection testing, earth grid testing results (for new sites connected at HV)
All new inverters with nominal voltages <1kV are compliant with the Smarter Homes Regulation requirements for voltage ride through and are included in the Technical Regulator’s <a href="#">list of approved Inverters</a>
A copy of the instructions to be followed by the installer to commission the Remote disconnection / reconnection technical solution per the provider’s specifications.

**Table 1:** Documentation Checklist

Pre-Commissioning Smarter Homes Compliance Checks	Response		Prop	SAPN
Relevant Agent appointed for the generating system				
Technical solution used for Remote disconnection and reconnection				
New plant installed is as per the original approved application. The proponent accepts responsibility to rectify this if found to be incorrect.	Yes	No (do not proceed)		

**Table 2:** Pre-Commissioning Smarter Homes Regulations Checks

Table 3 details the required pre-connection checks carried out by the SA Power Networks commissioning officer prior to proceeding to compliance testing in Part B.

Pre-Connection Checks	Proponent	SAPN
Electrical Certificate of Compliance for the Generating System(s)		
Installers Electrical Certification Viewed		
Inverters will disconnect when rotary generator operates		
Bi-directional/import/export meter installed		
Protection relay installed and ready for testing		
Site National Meter Identifier (NMI) Correct as per Engineering Report		
Site additional NMI (parent/meshed)		
Power quality logger installed for 7-day measure (2 days prior to gen online)		

**Table 3:** Pre-Connection Checklist

Outstanding Issues
Any observed defects affecting safety (ie AS/NZS3000/S&IR non-compliance) communicated to owner/installer (D)Note: also apply DEI process if required

For new or altered installations, the installation is subject to electrical checks as per table 4 below. The connection of generation (without altering the supply) is to be regarded as an alteration to the installation (but not the connection) and must not compromise any existing functionality or compliance. The **marker (M)** denotes **mandatory** compliance for witness procedure, while **(D)** denotes **defect or concern to be noted** with record of communication to REC to be kept (this paperwork). Note that these checks do not constitute approval of compliance to the Service & Installation Rules by the SA Power Networks commissioning officer and the onus remains on the Customer/Proponent to ensure the installation complies with the relevant rules.

Item	Rule	Comment	Checked
<b>Connection Point – Common Point of Coupling – Main Switch Board</b>			
Confirm revenue meter aligns with NMI. (Available from PM) <sub>(M)</sub>	Aligns with SEG/LEG approval		
Meter, CTs, voltage taps etc. physically and electrically located correctly. <sub>(M)</sub>	S&IR 7.5.1, 8.5, 8.14		
No unmetered equipment or connections. <sub>(M)</sub>	S&IR - 7.8.2.3		
PV labels at MSB. <sub>(M)</sub>	AS/NZS 4777.1 6.5		
‘Main Switch’ label(s) correct size / colour. <sub>(M)</sub>	AS/NZS 4777.1 - 6 AS/NZS3000 - 2.3.3.5		
Drawing showing generating units’ location(s) <sub>(D)</sub>	AS/NZS 4777.1 6.4		
<b>Switchboard – Main or Sub-boards</b>			
Fire panel labels and drawings in place <sub>(D)</sub>	AS/NZS 4777.1 – 6.1		
Main Switch for inverter able to be secured in the open position. <sub>(M)</sub>	AS/NZS 4777.1 – 3.4.3(b) AS/NZS3000 - 2.3.3.6		
Isolation switches are readily available	AS/NZS 4777.1 – 5.3.1		
Maximum of two solar main switches	AS/NZS 4777.1 – 5.5.3.2		
Drawing showing generating units’ location(s) <sub>(D)</sub>	AS/NZS 4777.1 6.4		
<b>Solar Distribution Board</b>			
Solar Meets Restricted Access Requirements. <sub>(D)</sub>	AS/NZS 4777.1 - 1.3.27		
Main Isolator Label. <sub>(M)</sub>	AS/NZS 4777.1 - 6		
Shut Down Procedure Label. <sub>(M)</sub>	AS/NZS 4777.1 - 6.7		
<b>Network Protection Unit</b>			
Main Isolator Isolates Entire Board. <sub>(D)</sub>	AS/NZS 4777.1 - 3.4.3		
Motorised CB or isolator used as isolator must be able to be secured in the open position and not able to be overridden. <sub>(M)</sub>	AS/NZS3000 - 2.3.3.6		
Number of Main Isolators. <sub>(D)</sub>	AS/NZS 4777.1 - 5.5.1 AS/NZS 3000 - 2.3.3.3		
Protection Relay Label. <sub>(M)</sub>	SAPN Requirement		

**Table 4:** Electrical Checklist



Table 9 details the required protection setting check<sup>1</sup> on the installed protection relay to ensure compliance to AS4777.1 and the requirements in the Engineering Report.

Protection Relay Make/Model: \_\_\_\_\_ Relay Serial Number: \_\_\_\_\_  
 Voltage, (Ø-N): (R) \_\_\_\_\_ V, (W) \_\_\_\_\_ V, (B) \_\_\_\_\_ V Grid frequency: \_\_\_\_\_ Hz

Relay Protection	Setting <sup>2</sup>		Trip Time		Proponent	SAPN
Reference Voltage	230		400			
Control Device	Contactor		Circuit Breaker			
Change - Auto Fault Reset Delay Time	5sec					
Over Voltage	260V	113%	2sec	100cyc		
Over Voltage Function Test Value						
Under Voltage	180V	78%	2sec	100cyc		
Under Voltage Function Test Value						
Sustained Overvoltage (average 10 mins)	258V	112%	Instantaneous			
Over Frequency	52Hz	104%	2sec	100cyc		
Over Frequency Function Test Value						
Under Frequency	47Hz	94%	2sec	100cyc		
Under Frequency Function Test Value						
Select one: ROCOF Stage 1 (preferred) or ROCOF Stage 2	±4 Hz/Sec		0.25sec	12.5cyc		
	±3 Hz/Sec		1sec	50cyc		
Vector Shift	Disabled <sup>3</sup>					
Current Unbalance <sup>4</sup>	21.7 A		30sec	1,500cyc		
Voltage Imbalance	3 %		0.4 sec			
Auto Fault Reset	Enabled		60sec	3,000cyc		
Minimum Import / Zero Export (if applicable)	(limit)		(delay)			
Tamper seal serial number						
Protection Relay Password						

**Table 9:** Protection Relay Settings Checklist

Injection Testing  (Applicable only to installations above 200kVA and/or if controlled testing could not be performed)

If the protection elements in the relay are to be demonstrated via an injection test kit, SA Power Networks commissioning officer to witness the correct settings being applied and the appropriate breaker being operated. A copy of the log of events are to be provided to SA Power Networks at the end of the testing.

Controlled Testing

If the protection elements are to be demonstrated via set-point manipulation on the relay, the set-points will be adjusted to cause a trip under normal operational conditions. ie Under Voltage will be tested by setting the trip point to 245V. Table 9 details the manipulated settings and whether the breaker has operated and all IES isolated from the Network.

Ensure that all set points are returned to correct settings as listed in Table 9.

Check fail-safe operation of relay(s): Inverters isolated on loss of supply to the relay.

Check Circuit Breaker Fail operation (if applicable).



<sup>1</sup> The settings must be verifiable via visual inspection either on the protection relay panel or software on device connected to the relay.

<sup>2</sup> Settings are for LV connected systems only and the V% is based on 230V nominal.

<sup>3</sup> Vector Shift must remain disabled unless special SA Power Networks approval is given.

<sup>4</sup> Only applicable for installations of single-phase inverter capacity above 5kVA.

**PART C: On-Line Commissioning**

Table 10 details tests (if applicable) that are to be demonstrated to SA Power Networks that the generating system meets the requirements of the Engineering Report after connection to the network.

Pre-Commission Control Checks	Settings			Proponent	SAPN
Loss of supply all inverters isolate from network	No	Yes			
Rotary generator interlock	Tested	Viewed	None		
Radio frequency remote interlock	Tested	Viewed	None		
Control Method	PLC	Manager	Inverter		
Export / Import controller	PLC	Manager	Inverter		

Export / Import - Protection Relay Control Test			Setting		Proponent	SAPN
Control method of disconnection			Hard	Soft		
Connection point control trip value	Export	Import				
Connection point fixed power factor value						
Export / Import - Control Manager / Inverter / PLC Tests			Load	Inverter	Proponent	SAPN
Control device - serial number			Contactora	Breaker		
Remove all control – record total generation & load						
Apply 50% control of recorded generation						
Apply 20% control of recorded generation						
Apply 0% control of recorded generation						
Disconnect communication cable to reference meter						
Protection relay status for above condition			Stays On	Trips		
Control manager /PLC/ Inverter status for above condition			Ramp to 0	Trips		
Reconnect communication cable – system ramp or instant			0 – 100%	100%		
Apply all control –record total generation & load						
Battery Control Test		Battery Value	Load Value	Inverter Value	Proponent	SAPN
Remove all controls values	Export		Import			
Record total generation, battery, load - values		%				
Isolate meter isolator – record revenue meter display			On	Off		
Battery inverter status for above condition		Discharge	Backup	On	Off	
Solar inverter status for above condition			On	Off		
Record total generation, battery, load - values		%				
Switch on meter isolator – record revenue meter display			On	Off		
Change over times		sec	sec	sec		
Charge battery from grid charge - rate		%	Kw	Kw		
Discharge battery to grid - rate		%	Kw	Kw		
Reinstate all controls	Export		Import			

SCADA <sup>5</sup> Control Test						
<b>Contact NOC and sign on to the feeder</b>		NOC operator Name				
Instruction	Exp-Limit	GDL	Pf	Kva	VArS	
SCADA Voltage 0% Generation	Red		White		Blue	
Instruction			Pf	Kva	VArS	
Remove all controls – record system maximum values						
GDL Limit Control Test	Exp - Limit	GDL	Pf	Kva	VArS	
Alter GDL - Export Limit Max			0.95			
Ramp up 10% of Max Value						
Ramp 50% of Max Value						
Ramp 100% of Max Value						
SCADA Voltage 100% Generation	Red		White		Blue	
Export Limit Control Test	Exp-Limit	GDL	Pf	Kva	VArS	
Alter Export limit – Keep GDL Max			0.95			
Ramp down to 50% Max Value						
Ramp down to 10% Max						
Ramp system to 100 % Max						
Permission denied – record time taken to 0%		min				
Power Factor Limit Control	Exp - Limit	GDL	Pf	Kva	VArS	
Set GDL Max						
Set Exp – Limit to Max						
Permission granted – record time taken to 100%		min				
Alter power factor			1.00			
SCADA Voltage	Red		White		Blue	
Alter power factor			0.95			
SCADA Voltage	Red		White		Blue	
Alter power factor			0.90			
SCADA Voltage	Red		White		Blue	
Alter power factor			0.85			
SCADA Voltage	Red		White		Blue	
Alter Power Factor			0.95			
SCADA Voltage	Red		White		Blue	
Alter Power Factor			0.85			
SCADA Voltage	Red		White		Blue	
Set required power factor						
Set required GDL						
Set Required Export Limit						
<b>System should now be in what will be normal / Auto operation mode</b>						

<sup>5</sup> These tests should be undertaken with SA Power Network's NOC or ADMS resources available to issue the applicable set points.

Communication Controls Test									
Disconnect RTU communication - inverters need to ramp to 0 %				Yes	No				
System Soft Ramps down	Time		Inverter State	On	Off	Control Device	Trip	Idle	
System Hard Ramps down				On	Off		Trip	Idle	
Reconnect RTU communication	Confirm heartbeat starts					Yes	No		
System Soft ramps up	Time								
Disconnect communication between inverter and reference meter									
System Soft Ramps down	Time		Inverter State	On	Off	Control Device	Trip	Idle	
System Hard Ramps down				On	Off		Trip	Idle	
Re-instate communication between inverter and reference meter									
System Soft ramps up	Time								
System should now be in what will be normal / Auto operation mode									
<b>Contact NOC and sign off the feeder</b>			NOC Operator Name						

**Table 10:** Online Tests

**Comments:**

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Final Agreement	Proponent	SAPN
Go ahead has been received from all parties		
Site Witness sticker placed on NPU panel		

Smarter Homes Regulations Check		
Parameter	Prop. (Signature)	Date
The Proponent of the designated electricity generating plant confirms that they have commissioned the Remote disconnection / Reconnection technical solution as per the provider's instructions and is capable of performing the function at the time of installation.		

**Table 11: Remote disconnection and reconnection confirmation**

Customer/Proponent Representative	
Name:	
Signed:	
Date:	

SA Power Networks Representative	
Name:	
Signed:	
Date:	

**DISCLAIMER:**

SA Power Networks takes no responsibility for any damage to any of the customer/proponent's infrastructure during periods when the inverter(s) may be operating at voltages outside of the current Australian Voltage Standard.

## Appendix A – Alternate Tables for HV Inverters (Where Applicable Only)

### PART B: Compliance Testing

The following table is for use in place of Table 5 when inverters are connected at HV:

Inverter Anti-Islanding Protection	Setting	Trip Time		Customer/Proponent	SAPN
Over Voltage Level 1 (V)	110%	1.0sec	50cyc		
Over Voltage Level 2 (V)	115%	0.2sec	10cyc		
Under Voltage (V)	80%	1.0sec	50cyc		
Over Frequency (f)	52Hz	0.2sec	10cyc		
Under Frequency (f)	47Hz	1.0sec	50cyc		
Active anti-islanding	Enabled				
Soft Ramp Up after Reconnect	Enabled 16.67%				
Reconnect Time	60sec				

**Table 5A:** HV Inverter Settings Checklist

The following table is for use in place of Table 9 when the NPU relay's VT is are connected at HV:

Relay Protection	Setting	Trip Time		Customer/Proponent	SAPN
Over Voltage Level 1	110%	2sec	100cyc		
Over Voltage Level 2	115%	1sec	50cyc		
Under Voltage	80%	2sec	100cyc		
Over Frequency	104%	2sec	100cyc		
Under Frequency	94%	2sec	100cyc		
Select one: ROCOF Stage 1 (preferred)	±4 Hz/Sec	0.25sec	12.5cyc		
or ROCOF Stage 2	±3 Hz/Sec	1sec	50cyc		
Vector Shift	Disabled				
Minimum Import / Zero Export (if applicable)					
Auto Fault Reset	Enabled	60sec	3,000 cyc		
Relay Delay Time Change					

**Table 9A:** HV Protection Relay Settings Checklist

## Appendix B– Alternate Tables for Rotating Generating Units (Where Applicable Only)

### PART B: Compliance Testing

Commissioning of rotating generating units does not require witness commissioning of Table 5, Table 7, and Table 8 (p4).

The following table is for use in place of Table 6 for rotating generating units:

Power Quality Response		Setting	Customer/Proponent	SAPN
Fixed Power Factor mode (as per Engineering Report if stated)		pf		
Ramp Rate	Enabled	%		

The following table is for use in place of Table 9 when the NPU relay's VT is are connected at LV:

Relay Protection	Setting	Trip Time		Customer/Proponent	SAPN
Over Voltage	110%	0.4sec	20cyc		
Under Voltage	94% (LV) or 90% (HV)	0.4sec	20cyc		
Over Frequency	104%	0.4sec	20cyc		
Under Frequency	94%	0.4sec	20cyc		
Select one: ROCOF Stage 1 (preferred) or ROCOF Stage 2	±4 Hz/Sec	0.25sec	12.5cyc		
	±3 Hz/Sec	1sec	50cyc		
Vector Shift	Disabled				
Minimum Import / Zero Export (if applicable)					
Auto Fault Reset	Disabled				
Relay Delay Time Change					

**Table 9B.1:** Rotating Protection Relay Settings Checklist

The following table is for use in place of Table 9 when the NPU relay's VT is are connected at HV:

**Table 9B.2:** HV Rotating Protection Relay Settings Checklist

## Appendix C– Witness Commissioning Inter-trip Protection Schemes (Where Applicable Only)

### PART B: Compliance Testing (cont.)

The requirements for an inter-trip will be captured within the Engineering Report for rotating generating system not using *Minimum Import*, or inverter generating systems that are *not AS 4777* compliant. Prior to commencing ‘PART C: On-line Commissioning’, proceed with the following **inter-trip** process.

If the protection does not respond as intended, **do not proceed with witness commissioning**. The rotating generating units may not connect to the network until the defect is rectified.

#### At the time of confirming the appointment:

Confirm with the Project Manager who will be the responsible site contact   
 (Contact Substation Operations – David Skein).

*Included in the appointment will be a check sheet that needs to be completed at the time of a testing.*

#### At the time of confirming the appointment:

- Record the name of the substation(s) the trip signal will be sent from

	Substation
1	
2	

- Confirm with the Substation Operate the inter-trip labelling at the substation is correct

- Record the nominated circuit breaker(s) that will be operating, and the breaker labelling is correct.

Circuit Breaker No	Label	Trip from Sub 1	Trip from Sub 2

Circuit Breaker No	Label	Trip from Sub 1	Trip from Sub 2

- Confirm with the Substation Operator what the expectations will be when the signal is sent; explain this process to the customer.
- Operate the generator (which must be running) at level acceptable to the customer. Expect this to be low in order to avoid damage to generating unit equipment.
- Request the Substation Operator to simulate the trip signal.
- The trip signal needs to be received and the nominated breaker(s) should trip instantaneously. Confirm the nominated breaker(s) tripped.
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- Check the generating units cannot start (try force start the generation, force close of contact or PLC)
- Allow 30sec to check if there is any auto reclose function. This may not occur.
- Request the Substation Operator release the latch signal (ie. restore to system normal).
- Allow customer to start generator and ramp to an acceptable level.
- Repeat for substation 2 (if applicable).

- Proceed with ‘PART C: On-line Commissioning’.

**Note:** Permission denied on rotating systems must result in the generator circuit breaker(s) opening (not immediately but upon a ramp down to a low enough level without causing potential damage to gen).