# Technical Standard - TS129

## Small EG Connections Technical Requirements - Capacity not exceeding 30kVA

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SA Power Networks

Empowering South Australia

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# 1. Introduction

This technical standard provides designers, contractors, and consultants with an understanding of the technical connection requirements for small embedded generator (SEG) systems, with an inverter nameplate capacity not exceeding 30kVA, connected to and capable of operating in parallel with any part of the SA Power Networks LV distribution network.

New connections of SEG systems or modifications to existing SEG, where the SEG systems consist of IES, ESS or a combination of both is within the scope of this document.

The scope of this technical standard does NOT include:

- EG systems greater than 30kVA
- EV supply equipment without reverse power transfer capability.
- DER systems that do not generate electricity, including demand response/demand managements systems, unless they impact on the ability of the basic micro EG system to meet the technical requirements.

This standard complies with the National DER Connection Guidelines for Basic Micro EG Connections, with the exception of the deviations presented in Appendix A: Deviations from the National DER Connection Guidelines.

The effectivity date of this standard is 23 February 2025.

# 2. Definitions and Abbreviations

## 2.1 Definitions

| | |
|---|---|
| **Battery Inverter** | Converter DC power from batteries into useable AC power. |
| **Connection Point** | A connection point to a transmission or distribution network. For this document, the connection point also has the same meaning as Point of Supply as defined in AS/NZS 3000. |
| **Contractor** | A contractor and or their sub-contractor who is engaged by SA Power Networks to conduct works on or near SA Power Networks infrastructure. |
| **Customer** | A person who engages in the activity of purchasing electricity supplied through the distribution network to a connection point and is registered by AEMO as a customer under chapter 2 of the NER. |
| **Distributed Energy Resources** | Power generation, storage or demand response/management units that are connected directly to the distribution network. |
| **Distribution Network/Systems** | For the purposes of these rules references to Distribution Network means the network poles, wires, underground cables, transformers, substations etc, operated by SA Power Networks, which transports electricity from the transmission systems to a connection point. |
| **Electricity Distribution Code** | Electricity Distribution Code made by ESCOSA pursuant to Section 28 of the Essential Services Commission Act 2002. |
| **Embedded Generating Unit** | A generating unit connected within a distribution network and not having direct access to a transmission network. |
| **Embedded Generating System** | A system comprising of multiple embedded generating units. |

| | |
|---|---|
| **Energy Storage System** | A system comprising one or more batteries that store electricity generated by distributed energy resources or directly from the grid, and that can discharge the electricity to loads. |
| **Generating Systems** | All generating units, inverters and the associated control and protection equipment that is located on the generator's side of the connection point. |
| **Generating Unit** | The plant used in the production of electricity, including all related equipment essential to its function as a single entity. |
| **Generator** | A person/entity who engages in the activity of owning, controlling, or operating a generating system that supplies electricity to, or who otherwise supplies electricity to, a transmission or distribution network. |
| **Grid** | Refer Distribution Network |
| **Hard Limit** | A limit that will require the IES to disconnect |
| **High Voltage** | Voltage exceeding low voltage |
| **Hybrid Inverter** | A hybrid inverter is an inverter which can simultaneously manage inputs from PV panels and batteries and charge batteries using the DC from the PV panels. |
| **Interface Protection** | The protection relay functions that open the disconnection device of an inverter energy system, and prevent its closure, as appropriate in the case of:<br>• A fault on the grid;<br>• An unintentional islanding situation; or<br>• Voltage and frequency being outside the continuous operating range |
| **Inverter** | The device that forms part of the generating system which uses semi-conductor devices to transfer power between a DC source(s) or load and an AC source(s) or load. |
| **Inverter Energy Systems** | A system consisting of one or more inverters that connect to the grid and operate by converting direct current to alternating current. In the context of system capacity, this definition includes the capacity of AC coupled energy storage systems. |
| **Low Voltage** | Voltage not exceeding 1,000V ac, or 1,500V dc |
| **Model Standing Offer** | A document approved by the Australian Energy Regulator as a model standing offer to provide embedded generation connection services or standard connection services which contains (amongst other things) the safety and technical requirements to be complied with by the customer. |
| **Mode 3 EV Supply Equipment** | Method for the connection of an EV to an a.c. EV supply equipment permanently connected to an a.c. supply network, with a control pilot function that extends from the a.c. EV supply equipment to the EV. |

| | |
|---|---|
| **Mode 4 EV Supply Equipment** | Method for the connection of an EV to an a.c. or d.c. supply network utilising a d.c. EV supply equipment, with a control pilot function that extends from the d.c. EV supply equipment to the EV. |
| **Multiple Mode Inverter** | Inverter that operates in more than one mode, for example having grid-interactive functionality when grid voltage is present and in stand-alone mode when the grid is de-energised or disconnected. |
| **Nameplate Capacity** | The maximum continuous output or consumption in kVA of an item of equipment as specified by the manufacturer, or as subsequently modified. |
| **Photo voltaic** | The generation of electrical power by converting solar radiation into direct current electricity |
| **PV Inverter** | Converts the DC output from the PV panel into AC that can be used for powering electrical appliances or fed back into the distribution grid |
| **Proponent** | A person proposing to become a generator (the relevant owner, operator, or controller of the generating unit (or their agent)). |
| **Single Wire Earth Return** | Parts of the electrical distribution network that use a single live conductor to supply single phase or split phase electric power with higher network impendences, and with distribution supplying low voltages to premises |
| **Small embedded generation system** | A single phase or three phase inverter connected embedded generation system up to 30kVA |
| **Soft Limit** | A limit that will cause the IES to reduce its output, preventing ongoing export greater than the limit. |
| **Supply** | The delivery of electricity |
| **Supply address** | The address at which the proponent customer is connected to SA Power Networks' distribution network |
| **Traditional area** | An area determined by SA Power Networks subject to a fixed export limit. SA Power Networks will define this area from time to time based on network factors. |
| **Two Phase System** | Two single phase inverters connected to different phases of a three-phase network |

## 2.2 Abbreviations

| | |
|---|---|
| **AEMO** | Australian Energy Market Operator |
| **AS/NZS** | A jointly developed Australian and New Zealand Standard |
| **CEC** | Clean Energy Council |
| **DNSP** | Distribution Network Service Provider. |
| **EDC** | Electricity Distribution Code made by ESCOSA pursuant to Section 28 of the Essential Services Commission Act 2002 |
| **EG** | Embedded Generation |
| **ESCOSA** | Essential Services Commission of South Australia |
| **ESS** | Energy Storage System |
| **EV** | Electric vehicle |
| **HV** | High voltage |
| **IES** | Inverter Energy System |
| **IPSD** | Inverter Power Sharing Device |
| **kVA** | kilovolt-amps |
| **kW** | Kilowatts |
| **LV** | Low voltage |
| **OTR** | Office of the Technical Regulator |
| **MSB** | Main Switchboard |
| **NER** | National Electricity Rules |
| **OTR** | Office of the Technical Regulator |
| **PV** | Photovoltaic |
| **SEG** | Small Embedded Generator |
| **SWER** | Single Wire Earth Return |

## 2.3 Terminology

| | |
|---|---|
| **may** | Indicates a requirement that may not be mandatorily imposed on the customer |
| **must** | Indicates a mandatory requirement |
| **shall** | Indicates a mandatory requirement |
| **should** | Indicates a recommendation that will not be mandatory imposed on the customer |

# 3. Relevant Rules, Regulations, Standards and Codes

## 3.1 Standards and Codes

This document shall be read in conjunction with SA Power Networks' Service and Installation Rules (S&IR), which is available at (www.sapowernetworks.com.au).

The following listed documents are for additional information and other documentation may be required on a project specific basis. Please Note: It is the responsibility of the installer to ensure you have complied with all applicable, SA Legislative Regulations (under Acts), ESCOSA/ENA/AEMC/IEC documentations, relevant AS/NZS standards, the SA Power Networks publications, and you have ensured their current publications, before implementing them.

**Standards Australia Publications:**

| | | |
|---|---|---|
| AS 1359.0 | 1998 | Rotating Electrical Machines - General Requirements<br>Part 0: Introduction and list of parts |
| AS 60038 | 2022 | Standard voltages |
| AS/NZS 3000 | 2018 | Electrical Installations (known as the wiring rules) |
| AS/NZS 3008.1.1 | 2017 | Electrical Installations - Selection of cables<br>Part 1.1: Cables for altering voltages up to and including 0.6/1 kV - Typical Australian installation conditions |
| AS/NZS 3010 | 2017 | Electrical Installations - Generating sets |
| AS 3011.1 | 2019 | Electrical Installations – Secondary batteries installed in buildings<br>Vented cells |
| AS 3011.2 | 2019 | Electrical Installations – Secondary batteries installed in buildings<br>Sealed cells |
| AS/NZS 3017 | 2022 | Electrical installations - Testing User Guides |
| AS/NZS 3100 | 2022 | Approval and test specification - General requirements for electrical |
| AS/NZS 3835.1 | 2006 | Earth potential rise<br>Part 1: Protection of telecommunications network users, Equipment personnel and plant |
| AS/NZS 4777.1 | 2024 | Grid connection of energy systems via inverters<br>Part 1: Installation requirements |
| AS/NZS 4777.2 | 2020 | Grid connection of energy systems via inverters<br>Part 2: Inverter requirements |
| AS/NZS 5033 | 2021 | Installation and safety requirements for photovoltaic (PV) arrays |
| AS/NZS 5139 | 2019 | Electrical Installations – Safety of battery systems for use with power conversion equipment |
| AS 62040.1 | 2019 | Uninterruptible power systems (UPS)<br>Part 1: Safety requirements |
| AS/NZS IEC 62116 | 2020 | Utility-interconnected photovoltaic inverters- Test procedure of islanding prevention measures |
| IEC 61851-1 | 2017 | Electric vehicle conductive charging system – Part 1: General requirements |
| IEC TS 62786-1 | 2023 | Distributed energy resources connection with the grid – Part1: General requirements |

**SA Power Networks Documents:**

- Manual 14: Safety, Reliability, Maintenance & Technical Management Plan
- Manual 18: Network Tariff & Negotiated Services

Manual 32: Service and Installation Rules

**Energy Networks Australia:**

| | | |
|---|---|---|
| ENA DOC 039 | 2019 | National Distributed Energy Resources Connection Guidelines: Technical Guidelines for Basic Micro EG Connections |

## 3.1 Legislation and Regulations

This section provides a list of all the relevant legislation and regulations which shall apply to the design, manufacture, installation, testing and commissioning, and operations and maintenance of all plant and equipment for SEG connections to the distribution network.

In an event where there is any inconsistency between legislation and regulations and these technical requirements, the legislation and regulations shall prevail.

- Electricity Act 1996
- Electricity (General) Regulations 2012
- National Electricity Rules
- Electricity Distribution Code
- Work Health and Safety Act 2012
- Work Health and Safety Regulations 2012

# 4. Technical Requirements

## 4.1 Maximum System Capacity and Export Limits

The South Australian Electricity Act 1996, Clause 36AC, defines small photovoltaic generator as a photovoltaic system with capacity up to 10kVA for a single-phase connection and up to 30kVA for a three-phase connection. This being the current legislation, the maximum PV inverter size for a single-phase connection is 10kVA. Below are the allowable inverter energy system configurations able to be connected to the grid.

### 4.1.1 Single, Two and Three Phase Systems

SA Power Networks enables a maximum PV inverter size of 10kVA per phase and a maximum battery inverter capacity of 10kVA per phase, provided the entire site is export limited to the values shown in Table 1.

In some circumstances the connection consists of a single-phase transformer that is split into two or a SWER transformer. These cases are to be considered as a single-phase connection and are to be limited to the values shown in Table 1.

For systems with a total inverter capacity greater than 30kVA please refer to TS132.

### 4.1.2 Phase Imbalance

The IES must have a balanced output. For multiple-phase connection sites, the unbalance between phases (with respect to its rating and tolerance) must be no more than 5kVA between any two phases in normal operation as per Clause C.3.2 and Table C.1 of AS/NZS 4777.1. This imbalance is judged on nameplate capacity.

In the case where a multiple-phase IES comprises multiple mode inverters which are capable of charging energy storage via the grid-interactive port, the a.c. rated power input phase imbalance of all IES shall not exceed 5kVA between any phases. If the voltage balance mode is available, it shall be disabled by default.

The addition of a battery inverter to one phase will not be considered in the calculation of output phase imbalance.

### 4.1.3 Hybrid Inverters

Hybrid inverters are considered as both a PV and battery inverter combined. Where a hybrid inverter is being used as a battery inverter only, the capacity of the hybrid inverter will only be included in the calculation of the battery capacity of the system only.

Where a hybrid inverter(s) is used as a battery inverter only for the purpose of Table 1 battery capacity limits, PV must not be connected to the hybrid inverter(s) at a later date unless approved by SA Power Networks.

### 4.1.4 SWER Systems

For addresses supplied by SA Power Networks' 19kV Single Wire Earth Return (SWER) system, the maximum PV inverter capacity is 10kVA and a maximum battery inverter capacity of 10kVA. These values are dependent on an evaluation and approval from SA Power Networks which considers factors such as the SWER transformer size and network constraints. The entire site is to be export limited to the values shown in Table 1 and a meter isolator is to be installed in accordance with the SA Power Networks Service & Installation Rules.

### 4.1.5 Flexible Exports

To enhance the ability of our network to host solar , SA Power Networks has developed systems to produce flexible export limits.

For all of our customers, any export limits are maximum limits and the actual amount of electricity which may be exported into the distribution network may be less than these limits. This is because the amount of electricity which may be exported from a premises will depend upon various factors including the location of the premises, the number of generators already connected within the area in which the premises is located, the capacity of the distribution network and safety and technical factors impacting the distribution network.

EG Systems must be configured with an appropriate limiting mechanism to ensure that in aggregate not more than the agreed amount of electricity is exported into the distribution network.

Customers may elect for a fixed export or flexible export limit. The export limits for both these options are as follows:

1. fixed export limit – 0kW or 1.5kW per phase, as determined by SA Power Networks; or
2. flexible export limit - up to 10kW per phase.

These limits are maximum limits. Customers who are classified as fixed export limit will still be subject to interruptions and curtailments from time to time to preserve the stability of the distribution network and for various other reasons. The EG Systems of those customers must be configured with an appropriate limiting mechanism to ensure that in aggregate not more than the fixed export limit is exported into the distribution network.

The actual export capacity available to flexible export limit customers at any given time will be determined in accordance with the processes below.

Where a premises is classified as flexible export limit, the amount of electricity which may be exported into the distribution network from that premises' system at any given time will be determined by SA Power Networks having regard to those matters impacting the distribution system. At any given time the permitted export from a premises classified as flexible export may be more or less than the fixed export limit.

The maximum amount that may be exported at any time from a flexible export premises is 10 kW per phase.

To gain access to a flexible export limit, the EG system shall have compliant equipment installed, commissioned, and actively communicating with SA Power Networks. The compliant equipment is listed in the SEG application. The customer must ensure this equipment is properly operated and maintained so it operates at all times in good working order and in accordance with its intended purpose. The customer must take the steps SA Power Networks requires to enable SA Power Networks' systems (or its contractor's systems) to interface with that equipment. The interface will require internet connectivity to be provided by the customer. SA Power Networks may use that interface (including through its contractors) to limit the amount of electricity the premises exports into the distribution network.

Through the interface SA Power Networks may receive data about the EG System and its operation and use such data to exercise its rights and discharge its obligations under its contract relating to electricity supply to the premises and for operation of the distribution network.

For any period in which the interface is unavailable, the premises will be classified a fixed export and output must be limited to the fixed export limit.

A customer may at any time request SA Power Networks to change the classification of their premises. A request to change from flexible to fixed will take effect up to 30 days after SA Power Networks receives the request. A request to change from fixed to flexible will take effect up to 7 days after SA Power Networks receives the request, provided the EG Systems at the premises satisfy the requirements for flexible export. Any change in classification requires SA Power Networks' consent (which consent SA Power Networks will not unreasonably withhold having regard to the requirement to preserve the safety, stability and integrity of the distribution network).

SA Power Networks may change the classification of a premises by notice to the customer if SA Power Networks considers this is required to preserve the safety, stability and integrity of the distribution network, if required by law or direction of a regulator or government authority (including without limitation the Australian Energy Market Operator or a Minister) or if the application of the flexible export program is discontinued.

Also if, to SA Power Networks' knowledge, ownership of the premises is transferred the premises will be reclassified as fixed export (if currently classified as flexible export) until such time as a request for flexible export is received and approved.

### 4.1.6 Inverter Energy System Configurations

Table 1 specifies the inverter capacity and export limits based on the designated generation area and the transformer type.

The total inverter capacity limits apply to any single, multiple, hybrid or any combination of these inverters.

The total system capacity allowable is 30kVA.

| Configuration | Limits (total) Per phase | | SWER, single-phase transformer that is split into two or in highly constrained network areas |
|---|---|---|---|
| PV only; OR<br><br>New PV + new battery[2]; OR<br><br>Existing PV + new additional PV; OR<br><br>Existing PV + new additional PV + new battery[2] | Inverter capacity | ≤10kVA PV + ≤10kVA battery up to a total of 30kVA for 3 phase connections | ≤10kVA PV + ≤10kVA battery |
| | Site export | 1.5-10kW | 0-10kW[1] |
| Existing PV[1] + new battery only | Inverter capacity | ≤10kVA PV + ≤10kVA battery up to a total of 30kVA for 3 phase connections | ≤5kVA PV + ≤10kVA battery |
| | Site export | 1.5-10kW | 0-10kW |

**Table 1: IES Configurations Inverter Capacity & Export Limits**

Notes:

1. 5kW or the existing limit if the existing solar is unchanged. For example, if the existing agreement is for 6kW export from the existing solar 6kVA solar system, the 6kW export limit may remain if only a battery is being added.

[1] Where a SWER transformer is rated below 10kVA, the upper limit of the flexible exports connection will be set according to the transformer rating.

## 4.2 Generation Control

### 4.2.1 Export Limits at Connection Points

Export limits for the different applications are shown in section 4.1.

IES shall have soft limit export control function which shall be enabled, when export limiting is required. Where the net export limit is exceeded, the export control function shall operate to ensure the IES meets the export conditions within 15 seconds.

If the IES and/or export control function loses its connection with the external device, the IES shall reduce IES output to the limit setting as a maximum. The connection shall be re-established and stable for a minimum of 60 seconds before the export control function is restored. Soft limit shall detect any fault loss of operability of the export control function and reduce IES power output to zero. The export control function settings shall be secured against inadvertent or unauthorised tampering (eg. special interface devices and/or passwords).

### 4.2.2 Site Generation limit Downstream of Connection Point

SA Power Networks may aggregate clusters of generating units on the same title or adjacent titles of land when they are owned or operated by customers that share an interest in the other generator or the land.

The site generation limits for small EG connections is as follows:

1. Single phase SEG connections of IES (excluding ESS), the site generation limit shall be no more than 10kVA downstream of the connection point.
3. For three phase SEG connection of IES (excluding ESS), the site generation limit shall be no more than 10kVA per phase with a balanced output of no more than 5kVA unbalance between any phases downstream of the connection point.
4. For SWER SEG connections of IES (excluding ESS), the site generation limit shall be no more than 10kVA downstream of the connection point.[1]
5. For two phase SEG connections of IES (excluding ESS), the site generation limit shall be no more than 10kVA per phase with a balanced output of no more than 5kVA unbalance between any phases downstream of the connection point.

## 4.3 Inverter Energy System

The inverter shall comply with the requirements of AS/NZS 4777.1, AS/NZS 4777.2 and those set out in the Electricity (General) Regulations 2012.

The IES shall incorporate a grid protection device, which shall comply with the requirements of AS/NZS 4777.2. The grid protection device may be integral with the inverter. The protection settings of the grid protection device shall not exceed the capability of the inverter.

All inverters and grid protection devices must be tested by an authorised testing laboratory and certified as being compliant with AS/NZS 4777.2 and issued with an accreditation number.

The IES shall comprise of inverters that had been installed in compliance with AS/NZS 4777.1.

The IES shall comprise of inverters that have both volt-var and volt-watt response modes available and both these parameters are required to be set as active. Please see section 4.9 for the mandatory response modes.

The ‘Clean Energy Council’ (CEC) maintains a list of approved solar modules and inverters that meet Australian Standards for use in the design and installation of solar PV systems

As required by the Smarter Homes regulatory changes which are incorporated in the Electricity (General) Regulations, inverter systems installed from 28 September 2020 are required, with some minor exemptions, to be capable of being remotely disconnected and reconnected.

### 4.3.1 Electric Vehicle Supply Equipment capable of reverse power transfer

When electric vehicles which are connected via EV supply equipment capable of reverse power transfer with a flexible lead and plug to be used as an inverter system, the power connection shall conform with AS/NZS 4777.1 and AS/NZS 4777.2.

Reverse power transmission shall not be delivered by Mode 1 and Mode 2 EV supply equipment, it may be delivered by either Mode 3 or Mode 4 EV supply equipment as described in AS/NZS 3000, AS/NZS 4777.2 and IEC 61851-1.

It will be included in the calculation of the battery capacity of the system.

### 4.3.2 Inverter Power Sharing Device (IPSD)

The IPSD shall not interfere with the safety, functional and performance of requirements for an IES conforming with AS/NZS 4777.1. It shall be installed in accordance with Clause 3.6 AS/NZS 4777.1.

Where loss or isolation of a supply occurs for any electrical installation as part of multiple electrical installation that has supplementary supply from an IPSD, the supplementary supply to that electrical installation shall disconnect and isolate within 2s from that electrical installation.

### 4.3.3 Independent Supply IES

Independent supply inverter with an ac input port that can be connected to the grid shall comply with AS/NZS 4777.2 Appendix M.

### 4.3.4 Like for Like Warranty Replacements

Like-for-like warranty replacement of an inverter will not be required to be compliant with SA Power Network's current Technical Standards unless the capability exists within the replacement inverter. In this case the settings must be updated to the current standard, in particular the power quality response mode settings (refer Section 4.9). Like-for-like warranty replacement will be defined as equipment with the same manufacturer and model.

Replacement inverters must still comply with all necessary safety standards and requirements.

Any changes made to an installation must be advised to us via the SEG application, including any inverter replacements under warranty or increases in panel capacity.

## 4.4 Network Connection and Isolation

### 4.4.1 Labelling and Signage

The IES must include warning signage to clearly indicate that the electrical installation has multiple supplies and identify which circuits are affected by these supplies.

The installer of the inverter energy system shall supply and install appropriate signage on the installation in accordance with AS/NZS 4777.1.

### 4.4.2 Isolation switches

The network connection and isolation requirements shall be as per AS/NZS 4777.1. As a minimum, mechanical isolation shall be as per AS/NZS 3000. Any means of isolation shall be able to be secured in the open position only.

## 4.5 Earthing

For IES, the earthing requirements shall be as per AS/NZS 4777.1, AS/NZS 4777.2 and AS/NZS 3000.

For ESS, the earthing requirements shall be as per AS/NZS 5139 and AS/NZS 3000.

## 4.6 Protection

The protection systems shall be designed in accordance with Acts, Regulations and SA Power Networks' standards. The inverter grid protection shall comply with the requirements of AS/NZS 4777.2.

### 4.6.1 Inverter Integrated Protection

In accordance with the grid protection requirements of AS/NZS 4777.2, the inverter must incorporate under- and over-voltage and under- and over-frequency protection.

In addition, the inverter must include at least one method of active anti-islanding protection, which will operate to disconnect the device within 2 seconds.

Any additional anti-islanding protection installed by the customer must be capable of automatically reconnecting to the Network once the network voltage and frequency have been maintained with their tolerable range for a minimum of 60 seconds.

No voltage stabilization devices are to be added in series with the IES circuit(s), see clause 3.2.2.1 in AS/NZS 4777.1.

#### *4.6.1.1 Under/Over Frequency*

Under and over frequency protection must be installed. The inverter must be disconnected from the Network for the following settings:

| Protective Function | Protective Function Set Point | Trip Delay Time | Maximum Disconnection Time |
|---|---|---|---|
| Under frequency 1 (f < ) | 47 Hz | 1 s | 2 s |
| Over frequency 1 (f > ) | 52 Hz | - | 0.2 s |

**Table** 2**: Passive anti-islanding frequency limit values**

#### *4.6.1.2 Under/Over Voltage*

Under and over voltage protection must be installed to monitor all three phases at the connection point. The inverter must be disconnected from the Network for the following settings:

| Protective Function | Protective Function Limit | Trip Delay Time | Maximum Disconnection Time |
|---|---|---|---|
| Under voltage 2 (V < < ) | 70 V | 1 s | 2 s |
| Under voltage 1 (V < ) | 180 V | 10 s | 11 s |
| Over voltage 1 (V > ) | 265 V | 1 s | 2 s |
| Over voltage 2 (V > > ) | 275 V | - | 0.2 s |

**Table 3: Passive anti-islanding voltage limit values**

The inverter shall remain in continuous operation and operate, as required by Clauses 4.5.4, 4.5.5 and 4.5.6 AS/NZS 4777.2, for voltage and frequency variations with a duration shorter than the trip delay time specified in Table **2** and Table 3.

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

#### *4.6.1.3 Interface Protection*

Interface protection shall apply to IES or aggregated IES on electrical installation greater than 200kVA at a connection point.

However, some variations may apply for interface protection limits for:

- Inverter Power Sharing Devices (IPSD) as per AS4777.1: 2024 Clause 3.6.5.4;
- Electrical installations that are part of multiple electrical installations with a single grid supply (e.g. embedded networks);
- Alterations or additions to legacy systems; and
- Risk of overloading network assets.

#### *4.6.1.4 Interlocking*

The inverters must be physically prevented from operating independently and all installed inverters must simultaneously disconnect from, or connect to, our distribution systems in response to protection or automatic controls (e.g. anti-islanding trip and subsequent reconnection).

## 4.7 Operating Voltage and Frequency

The inverter and customer installation must be designed, installed, and maintained in a manner that ensures that the maximum steady state voltage at any socket outlet or fixed equipment (other than the inverter) within the installation complies at all times with the requirements of AS/NZS 4777.1 and AS/NZS 4777.2.

The following specific voltage and frequency settings must be programmed into the inverter:

### 4.7.1 Voltage

Where the Inverter has a maximum voltage limit for sustained operation (based on averaged measurements over periods 10 minutes or less), this parameter must be set to 258V (phase to neutral).

If the Inverter does not have a maximum voltage limit for sustained operation setting, the anti-islanding maximum voltage trip point (based on a short-term measurement) must be set to a low enough voltage (depending on the installation characteristics), to ensure compliance.

Failure to design for this requirement may expose appliances and fixed equipment to potentially damaging voltages.

### 4.7.2 Frequency

1. Minimum frequency trip point (Fmin) is 47Hz.
6. Maximum frequency trip point (Fmax) is 52Hz.

If voltage and/or frequency fall outside the set limits, the generating systems must be automatically disconnected from our network. The reconnection procedure for the inverter must comply with AS/NZS 4777.2.

## 4.8 Metering

An import/export meter is a requirement for all grid connected inverter installations under the Electricity (General) Regulations 2012.

In accordance with the Electricity (General) Regulations 2012, from 28 September 2020, a meter installed at a connection point must be capable of separately measuring and controlling an electricity generating plant and controllable load from the essential load.

The metering installation requirements are outlined in the 'Smart Meter Requirements', which is available on the Energy & Mining website.

## 4.9 Power Quality

### 4.9.1 IES Power Quality Response Modes (Mandatory)

The customer/electrical contractor/installer must ensure the 'Australia A' power quality mode settings, as shown in AS/NZS 4777.2 have been set in the inverter(s) and must not be changed without written approval from SA Power Networks. These settings must be validated and tested by the electrical contractor/SEG installer.

The power quality response modes are:

- Volt-VAr response mode
- Volt-Watt response mode

Settings for the power quality response modes are shown below.

| Reference | Voltage in Volts | VAr % Rated VA |
|---|---|---|
| $Vv_1$ | 207 (default) | 44% leading (Supplying) |
| $Vv_2$ | 220 (default) | 0 |
| $Vv_3$ | 240 | 0 |
| $Vv_4$ | 258 | 60% lagging (Absorbing) |

**Table 4: Mandatory Volt-VAr response mode**

| Reference | Voltage in Volts | Power % rated Power |
|---|---|---|
| $Vw_1$ | 207 (default) | 100% (default) |
| $Vw_2$ | 220 (default) | 100% (default) |
| $Vw_3$ | 253 (default) | 100% (default) |
| $Vw_4$ | 260 (default) | 20% (default) |

**Table 5: Mandatory Volt-Watt response mode**

| Reference | Voltage |
|---|---|
| $V_{nom\text{-}max}$ | 258 volts |

**Table 6: Sustained Operation for Voltage Variations**

Power quality response mode settings shall be the same for all inverters at site where such capabilities exist. While all new inverters shall operate with the required 'Australia A' Australian power quality response modes, multiple power quality response mode settings are allowed where the following is satisfied:

- All inverters installed on or after 1 December 2017 operate with the required South Australian power quality response modes.
- Inverters installed prior to 1 December 2017, which are capable of operating with an approved power quality response mode, shall have it activated if requested by SA Power Networks.
- Inverters installed prior to 1 December 2017 which are not capable of operating with an approved power quality response mode are operating at unity power factor.
- Replacement inverters, including warranty replacements, shall be configured to operate with the required South Australian power quality response modes, if the capability exists within the replacement inverter.

Any capacitive power factor correction units are to be isolated when the Generating System is net exporting unless specifically advised by the customer to be utilised as reactive power support.

### 4.9.2 Volt-watt response for inverters with energy storage when charging (Mandatory)

The volt-watt response mode for charging of energy storage varies the maximum active power input of the inverter from the grid in response to the voltage at its grid-interactive port.

When energy storage charges from an inverter through the grid-interactive port, the maximum active power input of the inverter from the grid is varied in response to voltage at the grid-interactive port. This volt-watt response mode shall be enabled by default.

The response values are shown in Table 7 below where $P_{\text{charge}}$ refers to the power input level through the grid interactive port, and $P_{\text{rated-ch}}$ refers to the rated active power input through the grid-interactive port used for charging the energy storage.

| | Region 'Australia A' Value | $V_{W1-ch}$ | $V_{W2-ch}$ |
|---|---|---|---|
| Set Point Nominal | Voltage | 207 V | 215 V |
| | $P_{\text{charge}}/P_{\text{rated-ch}}$ | 20% | 100% |

**Table 7 . Volt-watt response set-point values for multiple mode inverters with energy storage when charging**

### 4.9.3 Power Rate Limit

The power rate limit is the ramp rate of active power output in response to changes in power and is defined as a percentage of rated power per minute. The default setting for the power rate limit for increase and decrease shall be 16.67% of rated power per minute which is a nominal ramp time of 6 minutes.

The inverter power rate limit is applicable to operate in the following modes:

- Soft ramp up after connect, reconnect or soft ramp up/down following a response to frequency disturbance
- Changes in a.c. operation and control
- Changes in energy source operation

## 4.10 Communications Systems

To receive a flexible export limit, internet connectivity is required and to be provided by the customer. In the event this communication is not available or interrupted, the export limit must default to the fixed export limit.

Communications systems may be required for some non-standard SEG connections. In these situations, SA Power Networks will specify the communication system requirements that the customer shall adopt.

## 4.11 Data and Information

### 4.11.1 Static Data and Information

The static data and information required to be provided by the customer to SA Power Networks is as per Appendix D: Static Data and Information.

### 4.11.2 Dynamic Data and Information

If communications systems are stipulated by SA Power Networks, the requirements for transmitting dynamic data and information will be provided by SA Power Networks.

## 4.12 Technical Studies

No technical studies are required to be carried out by the customer or at the customer's expense to enable connection to the distribution network.

# 5. Fees and Charges

Fees and charges are as per those stipulated in SA Power Networks' Manual 18.

# 6. Testing and Commissioning

Upon, or at any time after, completion of the installation of the small inverter energy system, SA Power Networks may request access to the premises at a reasonable time to conduct a test of the system for the purpose of establishing compliance.

The test will consist of:

1. disconnection of the premises from our distribution system;
2. reconnection of the premises to our distribution system; and
3. inspection and such testing of the small generator as we consider necessary for compliance.

# 7. Operations and Maintenance

The customer/owner of the IES is responsible for, and must:

- maintain the electrical installation at the supply address in a safe condition
- ensure South Australian power quality response modes are enabled and correctly configured
- ensure that any changes to the electrical installation at the supply address are performed by an electrician lawfully permitted to do the work and that the customer holds a Certificate of Compliance issued in respect of any of the changes
- ensure that the electrical installation at the supply address, including the IES installation, complies at all times with the requirements in the Network Connection Agreement
- ensure the protection of any SA Power Networks equipment located at the supply address
- seek approval prior to altering the IES capacity or inverter. SA Power Networks will advise if additional work is required and the associated cost (if any)
- ensure that any electrical maintenance function on the IES or any other part of the customer's electrical equipment are appropriately qualified and licensed to perform such work
- comply with all legislation, codes, Rules, or other regulatory instruments (as amended)

# Appendices

## A. Deviations from the National DER Connection Guidelines

| Section | Description of deviation | Type of deviation | Justification |
|---|---|---|---|
| Title | Called small embedded generation in lieu of basic micro embedded generation | Jurisdictional | Electricity Act 1996 states small embedded generation |
| 4.1 | Export stated in kW | Improvement | Exports are in kW not kVA |
| 4.1.5 | Flexible export option added | Improvement | Customer satisfaction |
| 4.1.6 | Export limit change. If existing agreement allows for a larger export than 5kW, if a customer adds a battery their export limit will not be reduced to 5kW. | Improvement | Customer satisfaction |
| 4.2.2 | Statement on cluster of generating units | Improvement | Network Stability |
| 4.3 | Requirement for inverters to be remote communications capable | Jurisdictional | Electricity (General) Regulations 2012 |
| 4.8 | Added metering requirements as per 'Smarter Homes' regulatory requirements | Jurisdictional | Electricity (General) Regulations 2012 |

# B. Connection Arrangement Requirements

Refer to AS/NZS 4777.1 for typical installation of inverter energy systems

# C. Model Standing Offer

SA Power Networks' Model Standing Offer document, 3602, is available on our Website.

# D. Static Data and Information

For your on-line application you will be required to provide us the following information.

1. Your customer's name, address, contact details and ABN (if you're acting on someone's behalf)
2. Your own contact and business details including ABN
3. NMI and meter number
4. A valid installer CEC accreditation or REC license number
5. DER devices
   (a) Fuel source – primary (ie solar)
   (b) Make, model and manufacture
   (c) Maximum capacity (kVA)
   (d) Storage capacity (kWh)
   (e) Installer
6. Inverter
   (a) Make, model and manufacturer
   (b) Whether the installer has changed the inverter default manufacture settings (Y/N)
   (c) Maximum capacity (kVA)
   (d) Date of installation