

ETSA Utilities

Delivering energy to South Australians

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**ETSA UTILITIES
CUSTOMER GUIDE
TO
EMBEDDED GENERATION
NETWORK CONNECTION**

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1. INTRODUCTION

1.1 Background

This Guideline has been prepared by ETSA Utilities to provide owners and proponents of embedded generation installations information about their rights and obligations for the connection to and interfacing with the ETSA Utilities Distribution Network. Embedded generators are defined in the National Electricity Code as generators connecting directly to the distribution network and not the transmission network.

The guidelines cover both large-embedded generation and small-embedded generation installations.

1.2 Definitions and Terms

Embedded Generator

A *Generator*, who owns, operates or controls an *embedded generating unit*.

Embedded generating unit

A *generating unit connected* within a *distribution network* and not having direct access to the *transmission network*.

Generating unit

The actual generator of electricity and all related equipment essential to its function as a single entity.

Generator

A person 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 system and who is registered with NEMMCO¹ in that capacity.

Small-Embedded Generator

A person who engages in the activity of owning, controlling, or operating a Small-Embedded Generation Installation.

Small-Embedded Generation Installation

For the purpose of this guideline a “small-embedded generation installation” is defined as: An embedded generation installation complying with the requirements of the Australian Standard AS 4777-2002, Grid connection of energy systems via inverters, Parts 1, 2 & 3:

- Part 1: Installation Requirements;
- Part 2: Inverter Requirements; and
- Part 3: Grid Protection Requirements.

This definition includes but not necessarily limited to such initiatives as:

- ◆ Photovoltaic (PV) installations;
- ◆ Fuel-cell installations;

which are connected to the customer's loads and to the network by an approved dc/ac sine wave inverters.

Large-Embedded Generation Installation

For the purpose of this guideline a “large-embedded generation installation” is defined as: All other embedded generation installation not covered by the requirements of the Australian Standard AS 4777-2002, Grid connection of energy systems via inverters.

This definition includes but not necessarily limited to such initiatives as:

- ◆ Photovoltaic (PV) installations greater than 10 kVA single phase or greater than 30 kVA three phase installations;
- ◆ Large fuel-cell installations;
- ◆ Wind turbine generators;
- ◆ Synchronous generators driven by hydro turbines;
- ◆ Synchronous generators driven by gas engines, gas turbines or diesel engines.

The final mentioned category includes commercial plant, which is operated and connected in parallel with the network by arrangement with ETSA Utilities for the purpose of demand management or for routine on-load testing.

1.3 Structure of this Guideline

This guideline provides guidance on the Technical and Commercial considerations and requirements for all embedded generation and defines the standard connection requirements for both small and large embedded generation installations.

1.4 Purpose and Principles

The purpose of this guideline is to ensure that due process is followed for the installation of embedded generators. The Guideline aims to:

- Outline the technical requirements for an embedded generator installation in accordance with the applicable Codes, Australian Standards, ETSA Utilities' Service and Installation Rules, and ETSA Utilities embedded generator connection requirements;
- Provide assistance to identify the generation proponent's responsibilities in regards to embedded generation connection and interface requirements to ETSA Utilities Network; and
- Provide assistance to the generation proponent to apply for embedded generation connection to the ETSA Utilities Network.

¹ NEMMCO means the National Electricity Market Management Company

1.5 Interpretation

In this Guideline the words “shall” and “must” indicate mandatory requirements.

This Guideline seeks to provide definitions consistent with those given in the Electricity Act, ESCOSA Electricity Distribution Code and the National Electricity Code.

1.6 Revisions

ETSA Utilities may amend and expand this guideline from time to time where it may be necessary to meet the requirements of the applicable regulations and to suit the needs of the Network.

A revision number and date will identify every version of ETSA Utilities Guideline “ETSA Utilities Customer Guide to Embedded Generation Network Connection”.

2. SMALL-EMBEDDED GENERATION INSTALLATION

2.1 Guidelines for Small-Embedded Generation Installations

Application of Guidelines

The ETSA Utilities Network Connection Guideline (“**Guideline**”) for small-embedded generator installations connected via Grid Connected Inverters apply to any inverter energy systems as described in **Energy Sources**, connected to the low voltage distribution network.

These Guidelines provide the framework for connection to the ETSA Utilities distribution network (“**Network**”) and have been developed to achieve the following aims:

- to detail the principles and guidelines governing connection and access to the Network for Small-Embedded Generators;
- to establish the process to be followed by a Small-Embedded Generator applicant, including PV Arrays, for connection to the Network;
- to establish processes to ensure ongoing compliance by Small-Embedded Generators with the technical requirements of these Guidelines.

Obligations of Small-Embedded Generators

A Small-Embedded Generator must maintain and operate all small-embedded generator plant and equipment in accordance with:

- Applicable Regulations and relevant laws;
- the Essential Services Commission of South Australia (ESCOSA) Codes (Electricity Distribution, Metering, Retail, etc);
- Electricity Act of SA and Technical Regulations;
- the requirements of these connection guidelines;
- Good electricity industry practice and applicable Australian Standards.

In particular each Small-Embedded Generator must:

1. submit an application to connect in respect of new or altered equipment owned, operated or controlled by it and enter into a Connection Agreement with ETSA Utilities in accordance with the requirements of Electricity Distribution Code and these guidelines prior to that equipment being connected to the network or altered (as the case may be);
2. comply with the reasonable requirements of ETSA Utilities in respect of design requirements of equipment proposed to be connected to the Network;
3. permit and participate in reasonable inspection and testing of facilities and equipment;
4. permit and participate in reasonable commissioning of facilities and equipment which is to be connected to the Network for the first time;
5. operate facilities and equipment in accordance with any reasonable direction given by ETSA Utilities;
6. give notice in writing of intended voluntary disconnection; and

7. arrange through their nominated Energy Retailer for the installation of import / export metering in compliance with the relevant Code.

Referenced Documents

The following Australian Standards are referred to in these guidelines:

AS 1319	“Safety signs for occupational environment”
AS 1931 Part 1	“High voltage - Test techniques - General definition and test requirements”
AS 2279	“Disturbances in mains supply networks”
AS/NZS 3000	“Electrical Installations (known as the Wiring rules)”
AS/ZNS 3017	“Electrical installations – Testing Guidelines”
AS/NZS 3100	“Approval and test specification - General requirements for electrical equipment”
AS 4777 (Parts 1, 2 & 3)	“Grid connection of energy systems via inverters”
AS/NZS 61000	“Electromagnetic compatibility (EMC)”

General

Energy Sources

Network connected inverter energy systems (excluding motor drive inverters). Single phase systems from 0 to 10 kVA, three phase systems from 0 to 30 kVA, connected at the nominal interconnection voltage and frequency. Herein referred to as inverter energy system(s).

Energy sources above 30 kVA will be subject to the requirements of the National Electricity Code, Chapter 2 ESCOSA Electricity Distribution Code and ETSA Utilities Guidelines for large-embedded generation installations.

Nominal Interconnection voltage

Voltages as defined in AS 60038 apply. The nominal supply voltage for the low voltage network is 230 Volts, phase to neutral, and 400 Volts phase to phase with a tolerance of +10% and –6%.

Grid connected inverters and grid protection devices shall be capable of operation within these parameters.

Nominal Interconnection frequency

50 Hz.

Network Characteristics

ETSA Utilities Network is operated as a solidly earthed system.

Accepted inverter

Only inverters that have been tested by an authorised testing laboratory and certified as being in compliance with AS 4777 and issued with an accreditation number will be regarded as an accepted inverter.

Lockable switch

Lockable switch means that the switch or circuit breaker must as a minimum have provision for insertion of a mechanical device or wire seal to prevent operation of the switch.

Electricity Distributor

ETSA Utilities is the owner, lessor and operator of the South Australian electricity distribution network.

Islanding

Islanding of inverter systems in the context of these guidelines means any situation where the Network fails or is tripped and one or more inverters maintains a supply of any description (be it stable or not) to any section of the distribution network outside the consumer's installation (ie on the distribution network side of the point of connection).

Power Flow Direction

Both directions of power flow allowed i.e. from inverter to Network and from Network to inverter.

Power Factor

Allowable range is from:

- 0.95 lagging to 0.8 leading for outputs from 20% to 100% of rated Volts-Amperes;

unless the device is approved by ETSA Utilities to control power factor beyond the above range for the purpose of providing voltage support at the point of connection. Alternatively under special circumstances ETSA Utilities may require the inverter to operate at a specific power factor.

Note: Lagging power factor is defined to be when reactive power flows from the grid to the inverter; that is, when the inverter acts as an inductive load from the grid perspective.

Connection & Installation Requirements**General**

Connection between the small-embedded generator (PV Array) and the network must be via an *accepted inverter* otherwise the connection must be undertaken in accordance with Chapter 2 of the ESCOSA Electricity Distribution Code and ETSA Utilities Guidelines for large-embedded generation.

ETSA Utilities will connect single phase systems with outputs less than 10 kVA. Installations above 10kVA must be three phase. Installation of three phase inverter energy system(s) above 30 kVA require analysis by ETSA Utilities to determine their impact on the distribution network.

Either current or voltage source inverters may be connected to the Network provided they comply with the requirements of these guidelines. Inverter energy systems must satisfy the requirements listed in the subsections below to satisfy these guidelines.

Electrical Safety

The inverter and grid protection device shall comply with appropriate electrical safety requirements of AS/NZS 3100

The installation shall comply with the appropriate requirements of AS/NZS 3000 (Wiring Rules) and AS 4777.1 (Grid connection of energy systems via inverters).

Inverters and Grid protection devices

The inverter shall comply with the requirements of AS 4777.2

The inverter energy system shall incorporate a grid protection device, which shall comply with the requirements of AS 4777.3. The grid protection device may be integral with the inverter. The protection settings of the grid protection device shall not exceed the capabilities of the inverter.

All inverters and grid protection devices must be tested by an authorised testing laboratory and certified as being in compliance with AS 4777 and issued with an accreditation number.

Connection Point

The **inverter energy system** shall be connected by fixed wiring to a dedicated circuit on a switchboard.

It is preferable that an **inverter energy system** be connected directly to the main switchboard. In installations where this is not possible or desirable the nearest distribution board shall be used and all distribution boards between the inverter energy system and the main switchboard including the main switchboard shall be labelled. See section on labelling/signage.

The rating of the inverter circuit cables and all the cables between any distribution boards and the main switchboard which carry inverter output must be rated for at least the full output of the **inverter energy system** in accordance with AS/NZS 3000.

Isolation Switches

There shall be a visible and accessible method of ensuring that the **inverter energy system** is disconnected from the Network and disconnected from the customer's installation.

The main switch for the switchboard, to which the **inverter energy system** is directly connected, shall be a lockable switch in the OFF position, which operates in all live conductors. The operation of this switch shall isolate the **inverter energy system** from that switchboard.

Note: This switch is to provide isolation of the **inverter energy system** for persons working on other parts of the electrical installation.

The switch located on the main switchboard which controls the sub-circuit of the distribution board to which the **inverter energy system** connects must be lockable.

Note: This switch is for the use of utility staff working on the Network as means of isolation for **inverter energy system**.

The isolation switches shall be installed to the requirements governing main switches in AS/NZS 3000, irrespective of where the **inverter energy system** circuit emanates from.

Residual current devices (RCDs)

The inverter energy system shall be connected to the electrical installation on the grid side of any residual current devices.

Isolation of inverter from energy source

A suitable isolation device shall be provided between the energy source and the inverter unless the inverter is physically integral with the energy source. This isolation device shall comply with the requirements of AS/NZS 3000 for isolation and switching devices.

Labelling/Signage

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

Signage shall as a minimum be placed:

- On the switchboard that has the **inverter energy system** directly connected to it.
- On all switchboards including main switchboard and distribution board(s) between the main switchboard and the board that has the **inverter energy system** directly connected to it.
- In all meter boxes containing the distributor's metering equipment.

Signage should describe the actual **type** of generation source installed.

The installer of the **inverter energy system** shall supply and install appropriate signage on the installation in accordance with requirements as required by AS 4777.2, and as outlined in Item 2.9 Signage.

The materials for the labelling/signage shall comply with AS/NZS 3100.

Reconnection Procedure

If voltage and / or frequency fall below set limits as defined in AS4777, the inverter energy system must be automatically disconnected from the Network. Tests shall be carried out to confirm that there is a minimum 1 minute time delay before the inverter energy system is automatically reconnected onto the Network after the Network has returned to nominal voltage and frequency.

Short Circuit Capacity

The plant must comply with AS/NZS 3000.

Cables and Wires

The installation must comply with all appropriate Australian Standards including but not limited to:

- AS/NZS 3000 for all wiring
- AS/NZS 3100 for equipment requirements.

Contribution to Fault Levels

It is expected that systems with inverters will not contribute significantly to network fault levels.

Metering

Metering that measures both import and export energy is a requirement for all grid connected inverter installations (small-embedded generation) under the electricity regulations.

The Small-Embedded Generator must pay the costs of the supply and installation of import / export metering and arrange the metering via their Energy Retailer, refer section 2.6.

Off-peak (hot water) metering is not affected by these connections.

2.2 Procedures for Small-Embedded Generation Installations

ETSA Utilities has procedures in place to handle all requests for connection of small embedded generator installations to the distribution network.

The proponent wishing to install a small-embedded generator must submit a request to ETSA Utilities Network for permission to connect to the Network. The small-embedded application request for network connection must be addressed to:

Networks Minor Works Manager (1 Anzac Highway, Keswick SA 5035)

E-mail: SmallEmbeddedGenerators@etsautilities.com.au

Facsimile: (08) 8404 5692

and include:

- Customer name;
- Customer address of installation;
- AS 4777 compliant Inverter details, including make, model and accreditation number;
- Capacity of photovoltaic array or other energy source;
- Contractors / installers name;
- Contractors / installers Electrical License number;
- Contractors / installers BCSE accreditation number; and
- Customer acceptance of the terms and conditions of the Small Embedded Generator Connection Agreement.

On receipt of a proponent's connection application and acceptance of terms and conditions of the Small Embedded Generator Connection Agreement for small-embedded generator the proponent's proposed inverter details are checked against the list of type tested and approved inverters.

Provided the proposed inverter is certified as complying with AS 4777, the customer's data is registered in the Small-embedded Generation Installation Register. New connection applications with an approved grid connected inverter proposed are advised in writing of ETSA Utilities' permission to connect.

2.3 Small Embedded Generator Connection Agreement

It is a requirement of the Electricity Distribution Code that a proponent (***Small Embedded Generator***) wishing to install and connect a small embedded generating unit to the distribution network must enter into an ESCOSA approved connection agreement with ETSA Utilities. The Small-Embedded Generator Connection Agreement covers each party's roles and responsibilities particularly as the network connection of small-embedded generation has potential safety issues

for both the customer and the network. A copy of the approved “Small Embedded Generator Connection Agreement” is available on our website.

2.4 Compliance and Monitoring

The Small-Embedded Generator is responsible for and must:

- maintain the electrical installation at the supply address in a safe condition;
- 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 keeps a Certificate of Compliance issued in respect of any of the changes;
- ensure that the electrical installation at the supply address, including the Small-Embedded Generation Installation, complies at all times with the requirements in the Connection Agreement;
- ensure the protection of ETSA Utilities equipment located at the supply address;
- ensure that any structures and vehicles are kept clear of ETSA Utilities equipment;
- seek approval prior to altering the small-embedded generation capacity or inverter. ETSA Utilities will advise if additional work is required and the associated cost (if any);
- provide sufficient information to ETSA Utilities, on request, so that the electricity used by any un-metered loads that the customer has installed can be calculated;
- ensure that the customer’s employees, servants or agents who carry out any electrical maintenance function on the Small-Embedded Generation Installation 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);
- ensure that a Notice of Alteration form is forwarded to ETSA Utilities or from the customer’s electrician when the customer changes the electricity supply requirements by installing additional electrical appliances or equipment of capacity 2.5 kW or greater;
- seek approval prior to installing any additional appliances or equipment of capacity 5kW or greater, so that ETSA Utilities can assess the ability of the network and the customer connection to the network to meet the additional requirements and advise the customer if additional work is required and the associated cost (if any);

2.5 Registration

Small-Embedded Generators do not require a generation licence however these installations must be registered with ETSA Utilities. This is both a safety issue and a network security issue; registration is not intended to restrict connection, but rather provide for safety and information for future planning requirements.

2.6 Metering Installations

The ESCOSA Metering Code requires the installation of meters that measure both import / export electricity for embedded generation installations connected to the distribution network.

The Small-Embedded Generator or the installer must submit an “Application for Connection / Alteration / Removal of Supply” form to their chosen Energy Retailer so that the installation of the appropriate meter can be arranged. The application form is available from the Energy Retailers and / or ETSA Utilities web site - (<http://www.etsautilities.com.au>) look under Services / Residential or Business / You & Your Connection and you will find ETSA Utilities Application for Connection / Alteration / Removal of Supply form.

2.7 Import Export Metering Charges

Costs associated with the supply and installation of an import / export meter, in compliance with the Code, are applicable to all Small-Embedded Generation Installations.

2.8 Issues that may require further investigation by ETSA Utilities

The following items are seen as potential issues for the connection of small-embedded generation in the distribution network and may require further investigation.

- Network Load Balance for local distribution feeders:
- Network Thermal Overload conditions:
- Harmonic Saturation:

ETSA Utilities sees that the control and recording of small-embedded generation installations as imperative in managing quality of supply. It is envisaged that limits will need to be enforced on the total kVA of small-embedded generation installations connected per transformer, with lower limits applying on LV networks to minimise the impact of harmonic saturation.

2.9 Sample Signage

This is only a sample of appropriate signage. It is indicative of the type of appropriate signage required at the various locations specified.

Note: Words in italic can change to describe the type of generation (eg. photovoltaic, wind turbine generator, other renewable energy sources connected via grid connected inverter system.)

Size specifications are a minimum size.

Main switchboard and distribution board(s) upstream of distribution board where the inverter energy system is connected.

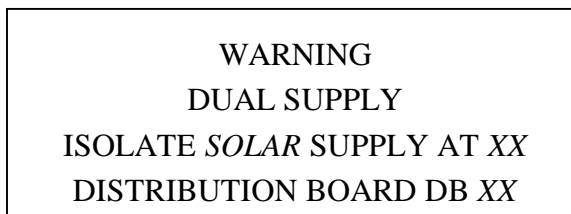
Qty: 1

Lettering: 4mm,

(8mm “WARNING”)

Colour: Red, white letters

Size: 120 x 60mm



Where *XX* is the switchboard identification where the **inverter energy system** is directly connected

Main switchboard and/or distribution board where the inverter energy system is directly connected.

Qty: 1

Lettering: 4mm

(8mm "WARNING")

Colour: Red, white letters

Size: 120 x 60mm

WARNING
DUAL SUPPLY
ISOLATE BOTH NORMAL AND *SOLAR*
SUPPLIES BEFORE WORKING ON THIS
SWITCHBOARD

Main switchboard and/or distribution board where inverter energy system is connected.

NORMAL SUPPLY MAIN SWITCH

Qty: 1

Lettering: 5mm

Colour: White, black letters

Size: 75 x 30mm

NORMAL SUPPLY MAIN SWITCH

SOLAR GENERATOR MAIN SWITCH

Qty: 1

Lettering: Title 5mm, words 4mm

Colour: White, black letters

Size: 75 x 30mm

SOLAR SUPPLY MAIN SWITCH