Part of Energy Queensland

STNW3510

Dynamic Standard for Small IES Connections

Effective from 6 February 2023

If this standard is a printed version, then the Energex or Ergon Energy Network internet site must be referenced to obtain the latest version to ensure compliance.

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Abstract: This Standard has been prepared by Energex and Ergon Energy Network to provide Proponents of Dynamic Small IES with information about their rights and obligations in respect of connecting to, and interfacing with, the Energex or Ergon Energy Network Distribution Network. Energex and Ergon Energy Network as Queensland DNSPs have an inherent obligation to ensure that Small IES do not cause a material degradation in the quality of supply to other network users and do not adversely affect the operation of the Distribution Network.

Keywords: inverter, solar, connection, photovoltaic, wind, energy storage system, export, low voltage, LV, PV, Micro EG, Small ESS, Small IES, IES

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1 Introduction

1.1 Purpose

The purpose of this Standard is to provide Proponents of Small IES Dynamic EG Connections under 30 kVA information about their obligations in respect of connecting to, and interfacing with Energex or Ergon Energy Network's Distribution Network. This Standard has been developed to ensure safe and stable Parallel operation[1] of Small IES Units connected to the DNSP's network at the Proponent's Premise.

1.2 Scope

This Standard applies to *new connections* and *connection alterations* of any Small IES with a total system capacity less than or equal to 30 kVA that is:

- intended to be connected to, and capable of operating in Parallel with, any part of the LV or HV Distribution Network; and
- capable of responding to dynamic operating envelopes set by the DNSP; and
- meeting all other technical requirements set out in this document.

This Standard does not apply to:

- electric vehicles, unless the Electric Vehicle Supply Equipment (EVSE) is capable of generating electricity to the LV or HV Distribution Network or electrical installation (in which case the requirements shall apply);
- DER systems that do not generate electricity, unless they impact on the ability of the Small IES to meet the technical requirements;
- back-up generation that does not operate in parallel with the Distribution Network; or
- EG Systems covered by the following Energex and Ergon Energy Network connection standards:

Standard Number	Title
STNW1170	Standard for Small IES Connections
STNW1174	Standard for LV EG Connections
STNW1175	Standard for HV EG Connections
STNW3511	Dynamic Standard for LV EG Connections
STNW3512	Standard for LV EG Connections to Isolated Networks

The technical requirements in this Standard comply with the framework of the National DER Connection Guidelines for Micro EG Connections as published by the Energy Networks Association (ENA).

1.3 Obligation of Proponents

Proponents shall:

a. obtain the consent from the DNSP before interconnecting their Small IES Unit with the Distribution Network.

[1] Section 225 of the *Electrical Safety Regulation 2013* requires that any person who has generating plant must comply with the entity's conditions for ensuring safe and stable parallel operation of the private generating plant with the works of the electricity entity.

b. ensure that the proposed Small IES Unit equipment and installation complies with the relevant Energy Laws, including any applicable standards, codes and guidelines.
c. comply with this Standard and the terms and conditions of the *negotiated connection contract*.

Proponents shall not connect additional inverters, make modifications, or install additional Small IES Units, including Energy Storage Systems, without the prior written agreement of the DNSP.

2 Definitions and abbreviations

2.1 Definitions[2]

Term	Definition
Accredited Person	A person accredited by a peak industry body as having demonstrated their competence to design and/or install renewable energy and/or ESS. This includes Accredited Installers, Designers and Supervisors operating within the classification of their accreditation. To be eligible to produce Renewable Energy Certificates a CEC accredited person must be engaged. In all instances though, a person authorised under the *Electrical Safety Act 2002* (Qld) is required to certify the installation.
Anti-islanding Protection	A protection system to detect islanded conditions and disconnect the inverter(s) from the Distribution System.
Break-before-make	Break-before-make operation is used in a switch that is configured to break (open) the first set of contacts before engaging (closing) the new contacts.
Central Protection	Central Protection is the protection contemplated by AS/NZS 4777 (grid connection of energy systems via inverters) installed to perform the functions of: coordinating multiple Inverter Energy System installations at one site, providing protection for the entire Inverter Energy System installation and islanding protection to the connected grid as well as preserving safety of grid personnel and the general public.
Connection Assets	Those components of a Distribution System which are used to provide *connection services*.
Connection Point	An agreed point of supply established between the DNSP's Distribution System and a Proponent's Premises.
Demand Response	The automated alteration of an inverter mode of operation in response to an initiating signal originating from or defined by the DNSP.
DER Technical Standards	Means the requirements for *embedded generating units* under Australian Standard AS4777.2:2020 as in force from time to time.
Distribution Network	A *network* which is not a *transmission network*. This Standard refers to the Low Voltage or High Voltage portion of the DNSP's Distribution Network.
Distribution System	A *distribution network*, together with the *connection assets* associated with the *distribution network,* which is connected to another *transmission system* or *distribution system*. The relevant *distribution system* owned and operated by the DNSP to which the Small IES Unit(s) is, or will be, *connected.*
Distribution Network Service Provider (or DNSP)	A person who engages in the activity of owning, controlling, or operating a *distribution system*. Depending on the context means either Energex (who owns and operates the Distribution System in South East Queensland) or Ergon Energy Network (who owns and operates the Distribution System in the remainder of Queensland).

[2] Terms in italics and not otherwise defined in this document, have the meaning given to that term in the NER or National Energy Retail Law.

Term	Definition
Dynamic Small IES	*Micro-embedded generators* of the kind contemplated by Australian Standard AS/NZS 4777 (Grid connection of energy systems via inverters) up to 30 kVA for which a Small IES Dynamic EG Connection is appropriate. Variation of some settings for the Dynamic Small IES, such as Import and Export, are supported through publishing of Dynamic Operating Envelopes (DOEs) by the DNSP for the Proponent's Connection Point.
Dynamic Operating Envelopes (or DOE(s))	Dynamic Operating Envelopes are where Dynamic Small IES setting limits, such as Import and Export limits, can vary over time and location
Embedded Generating System(s) (or EG System(s))	One or more *embedded generating units* and auxiliary equipment that are interconnected with the Distribution Network.
Embedded Generating Units(s) (or EG Units(s))	A generating unit connected within a Distribution System and not having direct access to the transmission network.
Emergency Backstop Mechanism	Involves the use of Generation Signalling Devices to provide a Demand Response that causes an IES to temporarily cease or reduce generation in emergency contingency events within the *power system*. The mechanism may be called upon to respond to a direction by AEMO issued in accordance with the NEL.
Energy Laws	Relevant laws relating to the subject matter of this Standard.
Energy Storage System (or ESS)	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.
Export	Net electricity that is fed into the Distribution System through the Connection Point.
Generating Unit	The plant used in the production of electricity and all related equipment essential to its functioning as a single entity.
Generation	The production of electrical power by converting another form of energy in a Generating Unit.
Generation Signalling Device (GSD)	A DRED providing functionalities and capabilities to achieve Demand Response, which satisfies the requirements of AS/NZS 4755.1[3].
High Voltage (or HV)	Any voltage greater than 1 kV a.c.
Import	Net electricity that is supplied via the Distribution System through the Connection Point.
Inverter Energy System (or IES)	A system comprising one or more inverters together with one or more energy sources (which may include an ESS) and controls, where the inverter(s) satisfies the requirements of AS/NZS 4777.2.
Isolated Network	Refers to the small remote electricity Distribution Systems operated by Ergon Energy Network that are not connected to the national electricity grid and are supplied via a dedicated power station.
Isolation Device	Device designed to safely prevent the flow of current such as circuit breaker or contactor.
Low Voltage (or LV)	A voltage of no more than 1,000 V a.c. or 1,500 V d.c.
Negotiated Small IES Dynamic EG Connection	A *connection* between a Distribution System and a *retail customer*'s Premises for a Small IES, for which a *negotiated connection contract* is in place.
Non-export	A Dynamic Small IES Unit that is capable of operating in Parallel with the Distribution Network and which is designed and configured to prevent any Export of electricity to the Distribution System across the Connection Point

[3] A list of Approved GSD can be found at Energex at: https://www.energex.com.au/home/our-services/connections/low-voltage-generation/emergency-backstop-mechanism and Ergon Energy Network at: https://www.ergon.com.au/network/connections/low-voltage-generation/emergency-backstop-mechanism

Term	Definition
Off-grid	A Small IES Unit which can supply a customer load as back-up, also known as “non-parallel”. In this circumstance, the Small IES Unit(s) is not connected in Parallel and does not synchronise with the Distribution System. Loads shall be isolated from the Distribution Network when being supplied from the non-parallel Small IES Unit.
Parallel (or Grid Connected)	This is where the Small IES Unit is configured such that the Small IES Unit and the Distribution Network may operate in parallel from time to time (even if this is a very short period of time). This includes circumstances where energy storage systems can be tied directly or indirectly back to the Distribution System through an AS/NZS 4777.2 grid connect inverter. It is irrelevant whether the Small IES Unit (including any ESS) Exports.
Partial-export	A Small IES that is capable of operating in Parallel with the Distribution Network and which is designed and configured to only Export as prescribed to operate in Section 4.3.1 of this Standard.
Power Limiting	The ability to reduce or stop power output from inverters when Export exceeds a defined value.
Premises	Means any land (whether a single block or multiple contiguous blocks), building(s) (whether whole or part), and structure(s) (or adjuncts thereto) that are owned, occupied or controlled by the *Proponent* in the vicinity of the proposed connection and which can reasonably be considered to be part of a single overarching operation.
Proponent	The *retail customer* that is the relevant owner, operator, or controller of the Small IES (or their agent).
Reactive Power	The rate at which reactive energy is transferred, which is a necessary part of an alternating current system containing inductive and capacitive components, as it regulates the voltage within the system. Reactive Power is measured in vars within the scope of this Standard.
Single Wire Earth Return (or SWER)	Parts of the electrical high voltage Distribution Network that use a single live conductor with the earth as the return current path. All Premises are supplied at LV either as single-phase or split-phase electric power.
Small IES Dynamic Embedded Generation Connection (or Small IES Dynamic EG Connection)	*A connection* between Dynamic Small IES and a *distribution network.*
Small IES Unit	A Generating Unit forming part of a Dynamic Small IES.
Split-phase SWER	A split-phase connection is a two-phase supply provided off a single SWER transformer.
Standard	This document that is entitled “Dynamic Standard for Small IES Connections”.

2.2 Abbreviations

Term, abbreviation or acronym	Definition
AC or a.c.	Alternating current
AEMO	Australian Energy Market Operator
AFLC	Audio Frequency Load Control
AS/NZS	A jointly developed Australian and New Zealand Standard
AS	Australian Standard
CEC	Clean Energy Council
CSIP	Common Smart Inverter Profile

Term, abbreviation or acronym	Definition
DC or d.c.	Direct current
DER	Distributed Energy Resources
DOE	Dynamic Operating Envelope
DRED	Demand Response Enabling Device
EMC	Electromagnetic Compatibility
EVSE	Electric Vehicle Supply Equipment
GSD	Generation Signalling Device
IEC	International Electrotechnical Commission
NEL	National Electricity Law
NER	National Electricity Rules
PV	Photovoltaic
QECM	Queensland Electricity Connection Manual
RPEQ	Registered Professional Engineer of Queensland
SEP2	IEEE 2030.5 *Standard for Smart Energy Profile Application Protocol*

2.3 Terminology

In this Standard:

- the word “shall” indicates a mandatory requirement that the Proponent must comply with;
- the word “should” indicates a recommended requirement that will not be mandatorily imposed on the Proponent; and
- the word “may” indicates a requirement that the DNSP may determine the Proponent must comply with.

2.3.1 Subcategories

The technical requirements set out in this Standard shall apply to the following subcategories of Small IES Dynamic EG Connections described in Table 1:

Table 1 Subcategories

Single-phase Small IES Dynamic EG Connection	Two-phase Small IES Dynamic EG Connection	Three-phase Small IES Dynamic EG Connection	Non-standard Small IES Dynamic EG Connection
System capacity ≤ 20 kVA[1]	System capacity ≤ 10 kVA per phase, up to 20 kVA[1]	System capacity ≤ 10 kVA per phase, up to 30 kVA[1]	Aggregate system capacity ≤ 30 kVA[1]: • SWER network; or • Premises with more than one LV Connection Point

Note 1: Export limits apply for each subcategory and are as set out in Table 3 of this Standard.

The following connections are considered to be non-standard for this Standard:

- Premises connected (or connecting) to a SWER networks, located within the Ergon Energy Network Distribution Network that have technical constraints which limits the capacity of Small IES Units to be connected to LV networks with upstream SWER networks in comparison to the standard urban and rural networks.
- Premises connected (or connecting) to the Distribution System at more than one LV Connection Point.

Isolated Networks and HV Distribution Networks are outside the scope of this Standard and are covered by other connection standards as follows:

- Premises connected (or connecting to) an Isolated Network are covered under STNW3512 “Standard for LV EG Connections to Isolated Networks”.
- Premises connected (or connecting to) a HV networks are covered under STNW1175 “Standard for Connection of EG to a Distributor’s HV Network”.

Further details regarding the categories of Small IES that are capable of being connected under the DNSP Standards are set out in Appendix G: Small IES Dynamic EG Connection Types.

If further clarification is required to determine which subcategory applies to a Proponent, please contact

For Ergon Energy Network – ergongeneration@energyq.com.au

For Energex – energexgeneration@energyq.com.au

3 Relevant rules, regulations, standards and codes

3.1 Standards and codes

There are a range of applicable standards and industry codes which define connection types and applicable requirements, as set out below.

In the event of any inconsistency between:

- an applicable Australian and international standards and industry codes (except for legislated industry codes); and
- this Standard,

this Standard will prevail.

3.1.1 Energex controlled documents

A copy of the latest version of this Standard may be obtained by searching for STNW3510 from the following website: https://www.energex.com.au/

Other controlled documents include:

Document number	Document name	Document type
Manual 01811	Queensland Electricity Connection Manual	Reference
STNW1170	Standard for Small IES Connections	Standard
STNW1175	Standard for HV EG Connections	Standard

3.1.2 Ergon Energy Network controlled documents

A copy of the latest version of this Standard may be obtained by searching for STNW3510 from the following website: https://www.ergon.com.au/

Other controlled documents include:

Document number	Document name	Document type
STNW1170	Standard for Small IES Connections	Standard
STNW1175	Standard for HV EG Connections	Standard
STNW3512	Standard for EG Connections on Isolated Networks	Standard
NA000403R509	Queensland Electricity Connection Manual	Reference

3.1.3 Australian and New Zealand Standards

Document number	Document name	Document type
AS/NZS 3000	Electrical Installations – Wiring Rules	AU/NZ Joint Standard
AS/NZS 4755.1	Demand response capabilities and supporting technologies for electrical products – Part 1: Demand response framework and requirements for demand response enabling devices (DREDs)	AU/NZ Joint Standard
AS/NZS 4777	Grid connection of energy systems via inverters, (multiple parts)	AU/NZ Joint Standard
AS/NZS 5033	Installation and Safety Requirements for Photovoltaic (PV) Arrays	AU/NZ Joint Standard
AS/NZS 5139	Electrical Installations - Safety of battery systems for use with power conversion equipment	AU/NZ Joint Standard
AS/NZS 61000.4.30	Electromagnetic compatibility (EMC) – Part 4.30: Testing and measurement techniques - Power quality measurement methods	AU/NZ Joint Standard
SA/SNZ TR IEC 61000.3.14	Electromagnetic compatibility (EMC) – Part 3.14: Limits - Assessment of emission limits for harmonics, interharmonics, voltage fluctuations and unbalance for the connection of disturbing installations to LV power systems	AU/NZ Joint Standard
AS/NZS IEC 62116	Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures	Australian Standard

3.1.4 International Standards

Document number	Document name	Document type
CSIP	IEEE 2030.5 Common California IOU Rule 21 Implementation Guide for Smart Inverters	International Standard
IEEE 2030.5 (or SEP2)	2030.5-2018 - IEEE Standard for Smart Energy Profile Application Protocol	International Standard

3.2 Legislation and regulation

Set out below is a list of the applicable legislation and regulations (which may be amended, replaced, repealed or have further instruments enacted from time to time).

In the event of any inconsistency between:

- any applicable legislation and regulation; and
- this Standard,

the legislation and regulations will prevail.

Document name	Document type
DER Technical Standard	Regulation
Electricity Act 1994 (Qld)	Legislation
Electricity Regulation 2006 (Qld)	Regulation
Electrical Safety Act 2002 (Qld)	Legislation
Electrical Safety Regulation 2013 (Qld)	Regulation
Electricity - National Scheme (Queensland) Act 1997 (Qld)	Legislation
National Electricity (Queensland) Law, as defined in the *Electricity - National Scheme (Queensland) Act 1997* (Qld)	Regulation
National Energy Retail Law (Queensland) Act 2014 (Qld)	Legislation
National Energy Retail Law (Queensland), as defined in the *National Energy Retail Law (Queensland) Act 2014* (Qld)	Regulation
National Electricity Rules	Regulation
Professional Engineers Act 2002 (Qld)	Legislation

4 Technical requirements

4.1 Labelling and signage

Labels and signs on the Dynamic Small IES, including cables, shall meet the requirements of AS/NZS 4777.1, AS/NZS 3000, AS/NZS 5033 and AS/NZS 5139.

4.2 Maximum system capacity

The maximum aggregate system capacity for Small IES Dynamic EG Connections covered under this Standard shall meet the requirements in Table 2. For single-phase connections with an aggregate capacity > 10 kVA, the maximum capacity allocation is split into allocations for solar PV and ESS.

Table 2 Small IES Dynamic EG Connection maximum system capacity

		Not enabled for dynamic operation[1]	Enabled for dynamic operation[1]
Single-phase		≤ 10 kVA per phase	≤ 10 kVA PV & ≤ 10 kVA ESS[2]
Two-phase		≤ 10 kVA per phase[3]	≤ 10 kVA per phase[3]
Three-phase		≤ 10 kVA per phase[3]	≤ 10 kVA per phase[3]
SWER	Single-phase	≤ 10 kVA	≤ 15 kVA PV & ≤ 15 kVA ESS[3]
	Split-phase	≤ 10 kVA per phase	≤ 15 kVA per phase[2, 3, 4]

Note 1: A Dynamic Small IES is enabled for dynamic operation where it meets the requirements of Table 13 in Section 7.2.

Note 2: For maximum capacity with separate allocation limits for PV and ESS:

- the maximum capacity for PV is calculated based on the total IES with connected solar PV; and
- the maximum capacity for Energy Storage Systems (ESS) includes the total IES with connected ESS, including batteries and electric vehicles as per Sections 4.4.1 and 4.4.2.

Note 3: Multiphase EG Systems shall meet phase balance requirements from Section 4.3.5 of this Standard.

Note 4: A Proponent supplied by only a single phase from a SWER transformer with split-phase supply shall have a maximum capacity of ≤ 10 kVA .

Where there are multiple EG Systems at a Premises connected via a single Connection Point, the system capacity will consider the aggregate of the existing and proposed EG System.

For Premises with multiple LV Connection Points, Premises with network(s) connected to multiple Connection Points, or EG system(s) being connected to multiple Connection Points, the standard shall be applied to meet the following:

a. The maximum capacity is the aggregate of all EG units connected or proposed for connection to all LV Connection Points, on the Premise and for all connected network(s).
b. All criteria in this Standard and the Technical Study will be applied for the aggregate maximum capacity.

This section shall be applied with consideration to the entire Standard. Proponents with a multi-phase connection shall meet the phase balance requirements of Section 4.3.1 of this Standard.

This Standard can only be applied up to a total aggregate capacity of 30 kVA. System capacity for a bulk metered Premises, such as strata title (e.g. retirement villages) are aggregated at the Connection Point. The Proponent is responsible for compliance with the requirements set out in this Standard, including, but not limited to, phase balancing.

4.3 Generation control

4.3.1 Export limits at Connection Point

The Export limits for a Dynamic Small IES shall meet the following requirements:

a. Dynamic Small IES have two Export limit types, a fixed Export limit and dynamic Export limits.
b. The fixed Export limit, as per Table 3, will be met at all times when the Dynamic Small IES is not receiving or able to respond to a dynamic Export limit.
c. The dynamic Export limits are supplied by the DNSP to the Dynamic Small IES. The dynamic Export limit supplied will be no less than the minimum and no more than the maximum shown in Table 3.
d. For Premises with multiple Connection Points the aggregate of the Export limits across the multiple Connection Points will not exceed the limits in Table 3 and 4.
e. The Import limits shall meet the measurement and control requirements in Section 4.3.4.

Table 3 Fixed Export limits

Subcategory		Fixed Export limit	Techical study required
Single-phase		≤ 1.5 kW	No
Two-phase		≤ 5 kW per phase[1]	No
Three-phase		≤ 5 kW per phase[1]	No
SWER	Single-phase	≤ 1.5 kW	No
	Split-phase	≤ 2 kW	No

Note 1: Multiphase EG Systems shall meet phase balance requirements from Section 4.3.5 of this Standard.

Table 4 Dynamic Export limits

Subcategory	Minimum dynamic Export limit	Maxiumum dynamic Export limit	Enabled for dynamic operation
All	1.5 kW	10 kW per phase[1,2,3]	Yes

Note 1: Multiphase EG Systems shall meet phase balance requirements from Section 4.3.5 of this Standard.

Note 2: Availability of Export limits above the minimum dynamic Export limit inTable 4, are subject to availability of Distribution Network capacity.

Note 3: Aggregate Export limits will not be permitted to exceed Distribution Network capacity limits.

The ability of the Proponent's Dynamic Small IES to Export at the limits described above are not guaranteed and will depend on the characteristics of the Distribution Network at any point in time. Circumstances which may affect the Export to be constrained include, but are not limited to, inverter power output where power quality response modes are in operation.

4.3.2 Site generation limit downstream of Connection Point

This section has been left intentionally blank.

4.3.3 Import limits at Connection Point

Dynamic Small IES capable of importing electricity from the Distribution Network, such as an ESS, shall be subject to Import limits. The Import limits for a Dynamic Small IES shall meet the following requirements:

a. The dynamic Import limits are supplied by the DNSP to the Dynamic Small IES. The dynamic Import limit supplied will be no less than the minimum and no more than the maximum shown in Table 5 **Table 7**.
b. For Premises with multiple Connection Points the aggregate of the Import limits are applied to the Premises, and all across the multiple Connection Points must collectively will not exceed the limits in Table 5.
c. The Import limits shall meet the measurement and control requirements in Section 4.3.4.

Table 5 Dynamic Import limits

Subcategory		Minimum dynamic Import limit	Maxiumum dynamic Import limit	Techical study required
Single-phase		1.5 kW	18 kW	No
Two-phase		1.5 kW	10 kW per phase[1,2,3]	No
Three-phase		1.5 kW	10 kW per phase[1,2,3]	No
SWER	Single-phase	1.5 kW	10 kW	Yes
	Split-phase	1.5 kW	10 kW per phase[1,2,3]	Yes

Note 1: Multiphase EG Systems shall meet phase balance requirements from Section 4.3.5 of this Standard.

Note 2: Availability of Import limits above the minimum dynamic Import limit in Table 5 are subject to availability of Distribution Network capacity.

Note 3: Aggregate Import limits will not be permitted to exceed Distribution Network capacity limits.

The Proponent shall not exceed the maximum supply limits in the Queensland Electricity Connection Manual (QECM) or the limits within the *customer connection contract* for supply.

4.3.4 Export and Import limit measurement and control

4.3.4.1 General

The total aggregate Export or Import of all the inverters at the Connection Point shall not exceed the approved limits.

For Premises with multiple LV Connection Points, Premises with network(s) connected to multiple Connection Points, or EG system(s) being connected (directly or indirectly) to multiple Connection Points, the standard shall be applied to meet the following:

a. the minimum and maximum Export and Import limits are applied to the Premises and the Connection Points must collectively achieve these limits;
b. in addition to the maximum Export and Import limits, a Proponent may be required to design the EG system to meet Export or Import limits applied to an individual Connection Point. No Export or Import limit for an individual Connection Point shall exceed the maximum Export and Import limit for the Premise;
c. all criteria in this Standard and the Technical Study will be applied for the Premises and the Connection Points collectively.

4.3.4.2 Measurement of Export and Import limits

The reference point for the measurement of Export and Import limits shall be:

a. Measured at a point as close to the Connection Point as practicable, referencing a single point beyond the Connection Point within the Proponent's Premises.
b. Connected at a location that has a lower impedance to the Connection Point than any EG Unit connected within the Proponent's Premises.

4.3.4.3 Measurement device compliance

The instrument transformers used to interface the equipment used to manage Export and Import limits for the Proponent's Premises shall have certified compliance with:

a. AS 61869.1 General requirements
b. AS 61869.2 Additional requirements for current transformers;
c. AS 61869.3 Additional requirements for inductive voltage transformers; and
d. AS 61869.4 Additional requirements for combined transformers

4.3.4.4 Control of Export and Import limit

Export limits shall be interpreted as "soft" and meet the definition of soft Export limits in clause 3.4.8 of AS/NZS 4777.1. Export limits shall be set to meet Table 6.

Table 6 Export limit settings

	Non-export	Partial-export
Export limit setting (kW)	0	*k* of total inverter rating

Note 1: Where *k* is equal to the approved Partial-export power value as a per unit value of the inverter capacity. For example, where the approved Partial-export value is 2.5 kW of a 5 kVA inverter, k = 0.5 (or 50%).

The control function for Import limitation shall meet the following requirements:

a. have a limit that will cause the Dynamic Small IES to reduce its consumption, preventing Import at the Connection Point greater than the Import limit;.
b. where the Import limit is exceeded, the Import control function shall operate to ensure the Dynamic Small IES meets the import conditions within 15 seconds;

c. the Import control device settings shall be secured against inadvertent or unauthorized tampering. Changes to settings shall require the use of a tool and special instructions not provided to unauthorized personnel.

Where the Export (or Import) control function loses connection with an external device, or detects any fault or loss of operation of the Export (or Import) control function, it shall reduce Export (or Import) to the fixed Export limit (or fixed Import limit respectively).

The Import limit shall apply to all of the EG Units connected within the Premises. Total Import at the Connection Point to the electrical installation will remain within the limits described in the *customer connection contract*.

The control of the Small IES for Export or Import limitation shall not interfere with Anti-islanding Protection of the inverter(s).

The ability of the Proponent's EG System to Export and Import at the limits described in Table 4 and Table 5are not guaranteed and will depend on the characteristics of the Distribution Network from time to time. Circumstances which may affect the Export to be constrained include but are not limited to when power quality response modes are in operation.

4.3.5 Phase Balance

For Premises with a multiphase connection to the Distribution System, the inverter(s) shall be configured to ensure the difference in power generated into any two-phases does not exceed 5 kVA per phase in normal operation. In accordance with clause 4.1 of the QECM, Proponents shall also ensure that the current in any phase does not differ from the current in any other phase by more than 20 A. Multiphase connections shall install phase balance protection where required under Section 4.7.3 of this Standard.

4.3.6 Emergency Backstop Mechanism

4.3.6.1 Application

Negotiated Small IES Dynamic EG Connections that satisfy the following conditions shall comply with Section 4.3.6.2 of this Standard to enable the Emergency Backstop Mechanism:

a. the aggregated system capacity of all inverters[4] at the Premises is equal to or above 10 kVA; and
b. the Distribution System has AFLC service available at the Connection Point[5].

4.3.6.2 Configuration for an Emergency Backstop Mechanism

Subject to Section 4.3.6.1 of this Standard, a Proponent shall ensure that any Negotiated Small IES Dynamic EG Connection is configured to comply with the following requirements:

a. installation of a GSD in accordance with the QECM Supplement No.2 for all inverters that:
    1. are, or were, installed or altered pursuant to a Connection Contract dated on or from 6 February 2023; and
    2. are not connected exclusively with an ESS DC source;
b. the inverter is configured to enable functionality of the demand response mode DRM 0 in compliance with AS/NZS 4777.2.

[4] Including inverters with ESS DC sources.

[5] AFLC service availability can be checked for Energex at: https://www.energex.com.au/home/our-services/connections/low-voltage-generation/emergency-backstop-mechanism and Ergon Energy Network at: https://www.ergon.com.au/network/connections/low-voltage-generation/emergency-backstop-mechanism

c. where the inverter does not have an integrated device for the demand response mode, an external device is installed in accordance with clause 3.2.1 of AS/NZS 4777.2.

4.4 Inverter Energy Systems

The following requirements apply to IES that are comprised of Dynamic Small IES inverters:

a. inverters shall be tested and certified by an authorised testing laboratory as being compliant with AS/NZS 4777.2 (with an accreditation number issued).
b. the inverters shall be registered with CEC as approved grid connect inverters.
c. the inverters shall be tested and certified by an authorised testing laboratory as being compliant with AS/NZS IEC 62116 for active Anti-islanding Protection.
d. the inverters shall be installed in compliance with AS/NZS 4777.1.
e. the inverters shall have both volt-var and volt-watt response modes available and be capable of operating the modes concurrently, as per Section 4.10.1 of this Standard.
f. the inverters shall be set to the regional setting “Australia A”.
g. inverters shall be capable of sending and receiving information via SEP2 using CSIP directly or via a third party.

4.4.1 Energy Storage System (ESS)

The connection of an ESS (such as batteries) capable of supplying electricity to an electrical installation such as the Premises or the Distribution System is considered Grid Connected, unless the inverter is connected behind a Break-before-make switch in accordance with Section 4.5.1 of this Standard.

Where the ESS is considered to be Grid Connected:

a. the ESS shall be subject to the requirements of this Standard.
b. the inverters for the ESS shall be installed in accordance with Section 4.4 of this Standard;
c. the installation of the ESS shall comply with AS/NZS 5139.
d. the ESS is either externally DC coupled to an AC inverter or packaged as a product into an integrated system with an AC inverter. The following requirements shall apply to ESS inverters:
    1. the inverter capacity for any ESS inverter will be included in the aggregated nameplate rating[6] of inverters at the Connection Point.
    2. the Export limit for the ESS inverter will be considered as part of the aggregated Export limit at the Connection Point.

The installation and commissioning of an ESS shall be certified as compliant by an Accredited Person.

4.4.2 Electric vehicles

Electric Vehicle Supply Equipment (EVSE) that is only capable of charging from the grid are not considered a Small IES Unit but rather a load and are subject to the requirements outlined in Section 4.2 of the QECM.

[6] Nameplate rating for any inverter shall be based on the maximum continuous rating of the inverter throughout this Standard

EVSE shall be considered a Small IES Unit with an ESS and is subject to the requirements set out in Section 4.2 of the QECM and this Standard, where:

a. the EVSE is capable of Export into the Proponent's Premises but not the Distribution System, resulting in a Non-export configuration (also referred to as Vehicle-to-Building or V2B);
b. the EVSE is capable of Export into the Distribution System, resulting in either a full- or Partial-export configuration (also referred to as Vehicle-to-Grid or V2G); or
c. the EVSE being installed has the capability to Export into either the Proponent's Premises or the Distribution System.

A EVSE which is a Small IES Unit shall be installed in accordance with Section 4.4 of this Standard.

4.5 Network connection and isolation

Requirements for connecting to the Distribution System, including any isolation requirements, shall be in accordance with AS/NZS 4777.1.

In addition, the following conditions shall apply:

a. mechanical isolation shall be in accordance with AS/NZS 3000 including that the isolator must always be readily accessible;
b. any means of isolation (where lockable) shall be able to be locked in the open position only.

4.5.1 Changeover switches

Any Small IES Unit connected behind a Break-before-make switch, that is, it isolates the changeover circuit when transferring between a Grid Connected supply to Generation supply, will be considered as an Off-grid inverter.

The following shall be considered as Grid Connected Small IES Units and will be required to comply with the requirements of this Standard:

a. a Small IES Unit connected behind a Make-before-break switch that results in a momentary, or longer, connection between grid supply and Generation supply circuits when performing a changeover.
b. a multiple mode inverter with uninterruptible power supply (UPS) mode functionality that is Grid Connected but also supplies an Off-grid circuit.

4.6 Earthing

The earthing requirements shall include:

a. for IES, earthing requirements shall be as per AS/NZS 4777.1 and AS/NZS 3000;
b. for ESS, earthing requirements shall be as per AS/NZS 5139.

4.7 Protection

4.7.1 Inverter integrated protection

The inverter integrated protection requirements for inverters connected to the Distribution System shall comply with AS/NZS 4777.1 and AS/NZS 4777.2.

Active Anti-islanding Protection requirements shall apply as per AS/NZS 4777.2.

Inverters shall be set to the values given in Table 7 of this Standard, which is consistent with the passive Anti-islanding Protection requirements in Table 4.1 and Table 4.2 from AS/NZS 4777.2.

Table 7 Prescribed Inverter Settings

Parameter	Settings	Trip delay time	Maximum disconnection time
Undervoltage 2 (V<<)	70 V	1 s	2 s
Undervoltage 1 (V<)	180 V	10 s	11 s
Overvoltage 1 (V>)	265 V	1 s	2 s
Overvoltage 2 (V>>)	275 V	—	0.2 s
Under-frequency (F<)	47 Hz	1 s	2 s
Over-frequency (F>)	52 Hz	—	0.2 s
Reconnect time	60 seconds	N/A	N/A

4.7.2 Central Protection

Central Protection is not required for Small IES Dynamic EG Connections that comply with AS/NZS 4777.1, unless phase balance protection is required by Section 4.7.3 of this Standard.

4.7.3 Phase balance protection

Phase balance protection shall respond to current imbalance at the Connection Point caused by the aggregate of the Small IES Units on each phase, between phases greater than 20 A (5 kVA) by disconnecting all of the Small IES Units from the installation automatically within 30 seconds. Disconnection for phase balance shall be by a method compliant with clause 3.4.4.2 of AS/NZS 4777.1. Phase balance protection shall meet the central protection requirements of Clause 3.4.4.1 of AS/NZS 4777.1. Phase balance protection is required for Small IES Units as specified in

Table **8**.

The Proponent shall ensure the design and the commissioning plan and report for the phase balance protection is carried out under engineering supervision by a Registered Professional Engineering of Queensland. A copy of these records shall be made available to the DNSP on request.

Table 8 Requirements for phase balance protection functions

Aggregate inverter capacity at Connection Point	**Inverter capacity ≤ 30 kVA**		**Inverter capacity ≤ 20 kVA**		**Inverter capacity ≤ 30 kVA**		**Inverter capacity ≤ 30 kVA**	
Distribution Network connection type	Single-phase		Two-phase		Three-phase		Three-phase	
Inverter type	Single-phase inverter/s		Multiple single-phase inverters		Multiple inverters with at least one single-phase		Three-phase inverter/s	
One or more phase has greater than 5 kVA of aggregate inverter capacity	No	Yes	No	Yes	No	Yes	No	Yes
Phase balance protection required	No	No	No	Yes	No	Yes	No	No

4.8 Operating voltage and frequency

The proposed installation shall be able to operate within the limits of supply voltage:

$V_{phase\text{-}to\text{-}neutral}$ = 230V +10% / -6%.

The maximum sustained voltage set point, V_{nom_max} as per AS/NZS 4777.2, shall be set at 258V.

The proposed Small IES Unit installation shall not cause more than 2% voltage rise at the Connection Point as per clause 3.3.3 of AS/NZS 4777.1. Voltage rise is calculated from the a.c. terminals of the inverter or inverters to the Connection Point.

4.9 Metering

This section has been left intentionally blank.

4.10 Power quality

4.10.1 IES power quality response modes

The volt–var and volt–watt response modes specified in clause 3.3.2.2, clause 3.3.2.3 and clause 3.4.3 of AS/NZS 4777.2 shall both be enabled as per below Table 9,Table 10 and

Table **11** for an IES.

Table 9 Volt–var response mode settings

Reference	Voltage	Inverter reactive power level (Q) % of S_{rated}
V_{V1}	207 V	44% supplying
V_{V2}	220 V	0%
V_{V3}	240 V	0%
V_{V4}	258 V	60% absorbing

Note 1: Within this Standard, absorbing is when the Small IES Unit absorbs reactive power from the Distribution System and supplying is when the Small IES Unit acts as a source of reactive power into the Distribution System**.**

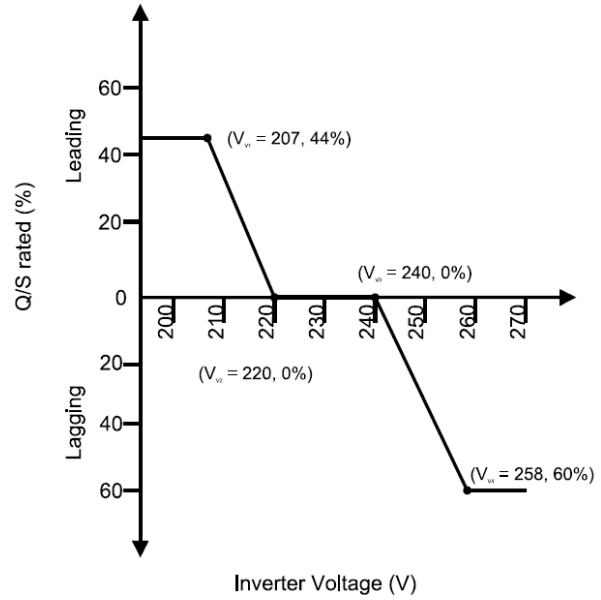


Figure 1 Volt-var response mode

Table 10 Volt-watt response mode settings

Reference	Voltage	Inverter maximum active power output level (P) % of S_{rated}
V_{W1}	253 V	100%
V_{W2}	260 V	20%

Note 1: Where P is the output power of the inverter and P_{rated} is the rated output power of the inverter.

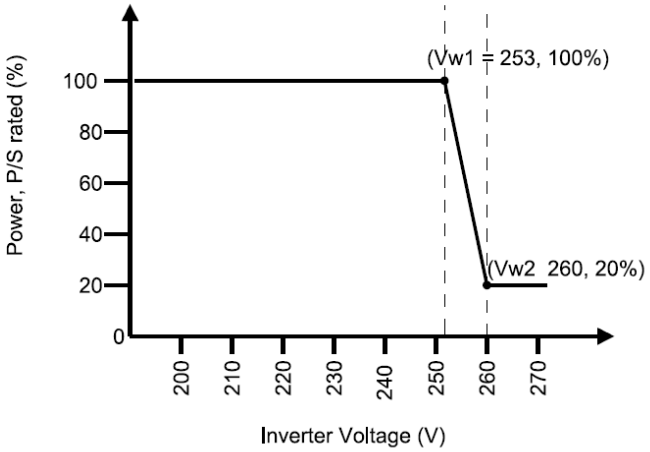


Figure 2: Volt-watt response mode

Table 11 Volt-watt response mode settings for inverters with energy storage when charging

Reference	Voltage	Power Input, $P_{charge}/P_{rated-ch}$ (%)
V_{W1-ch}	207 V	20%
V_{W2-ch}	215 V	100%

Power quality response modes shall commence and complete in accordance with their defined characteristics in clause 3.3.2 and 3.4.3 in AS/NZS 4777.2 within the relevant times specified in Table 12 below:

Table 12 Maximum response time for power quality response modes

Response commencement time	Response completion time
1 s	10 s

4.10.2 Disturbance issues

Disturbance to the LV network shall be assessed against SA/SNZ TR IEC 61000.3.14.

Measurement of voltage disturbances shall be as described in AS/NZS 61000.4.30 using Class A instruments.

4.11 Communications systems

4.11.1 General

A Dynamic Small IES shall support the sending and receiving of information to the DNSP with communication systems that meets the following requirements:

a. connection of the Dynamic Small IES to the public internet; and
b. compliance with SEP2 using CSIP.

4.11.2 Connection of communication system

The communication systems for a Dynamic Small IES shall be met by one of the following methods of connection for information exchange via SEP2 using CSIP:

a. direct connection of an EG Unit; or
b. third-party device which communicates with the EG Unit(s); or
c. cloud based vendor which communicates with the EG Unit(s).

4.11.3 Information exchange

The communications system shall be able to support sending and receiving information with the following frequency and capacity:

a. frequency of no less than 5 minutes; or
b. forecast information shall be provided for up to 24 hours, with the supply of 5-minute forecasts for the next immediate hour and 1 hourly forecasts for the next 23 hours.

4.12 Data and information

4.12.1 Static data and information

Static data and information that is required to be provided by the Proponent to the DNSP as per Appendix D: Static Data and Information.

4.12.2 Dynamic data and information

Dynamic data and information that is required to be provided by the Proponent to the DNSP as per Appendix E: Dynamic data and information.

4.13 Cybersecurity

This section has been left intentionally blank.

4.14 Technical studies

Negotiated Small IES Dynamic EG Connections covered by this Standard that do not meet the criteria for a DNSP's Model Standing Offer may be required to undertake technical studies.

5 Fees and charges

Information regarding fees and charges applicable to Proponents is available at the following links:

Energex: https://www.energex.com.au/home/our-services/connections/residential/connection-charges

Ergon Energy Network: https://www.ergon.com.au/network/connections/residential-connections/connection-services-charges

6 Testing and commissioning

6.1 General

On-site testing and commissioning shall be undertaken in accordance with AS/NZS 4777.1, AS/NZS 3000 and AS/NZS 5033 (where applicable), the equipment manufacturer's specifications, and the DNSP's technical requirements to demonstrate that the Dynamic Small IES meets the requirements of the applicable *connection contract*. The tests shall be installation tests not type tests.

Commissioning tests for the inverter shall be in accordance with AS/NZS 4777, including:

a. operate the main switch (Inverter Supply) and verify the connection time is greater than 60 seconds;
b. isolate the main switch (Mains Supply) and verify the disconnect time is less than 2 seconds;
c. where Power Limiting Operation is required, disconnect Proponent's load and confirm Export to the grid does not exceed the approved limits.

6.2 Commissioning of limits

A Dynamic Small IES shall be commissioned with fixed Export limits only. Export limits shall not be set above the fixed Export limits by an installer or the Proponent.

To support Dynamic Limits being issued to the Dynamic Small IES by the DNSP:

a. the Dynamic Small IES shall be connected to the internet; and
b. Registration[7] for the Premises with the DNSP, via the Registration System shall be completed by the Proponent.

[7] Registration will not be available until after June 2022. The DNSP will provide notification of the availability of the Registration System through an Industry Alert.

6.3 Electromechanical meters

If the meter at the Proponent's Premises is an electromechanical meter, the Proponent shall ensure that the Small IES Unit shall be left with DC isolators on and AC isolators off until the Proponent's electricity retailer has confirmed that the metering equipment at the Premises has been modified or reconfigured to comply with the Energy Laws. For all *new connections* and *connection alterations*, the Accredited Person shall ensure compliance of the IES and complete the compliance checklist in Appendix F, and a copy of this checklist shall be left on site for the DNSP's connection officers.

7 Operations and maintenance

7.1 General

Dynamic Small IESs shall be operated and maintained by the Proponent, to ensure compliance with their *customer connection contract* and all legislation, codes, and/or other regulatory requirements at all times.

The Proponent shall ensure that the Dynamic Small IES and other systems and facilities at the Premises operate satisfactorily:

a. for the full range of variation of system parameters and characteristics; and
b. within the distortions and disturbances specified in these technical requirements.

The DNSP does not guarantee the operation of any customer appliances, including Small IES Units and their associated components. The Proponent shall take necessary steps to ensure their Small IES Unit operates as anticipated and also adhere to their applicable *customer connection contract*.

The DNSP may inspect Dynamic Small IES at any time at the DNSP's expense.

7.2 Dynamic operation

A Dynamic Small IES shall be operated in fixed or dynamic limits as per Table 13**Table 12**.

Table 13 Dynamic operation criteria

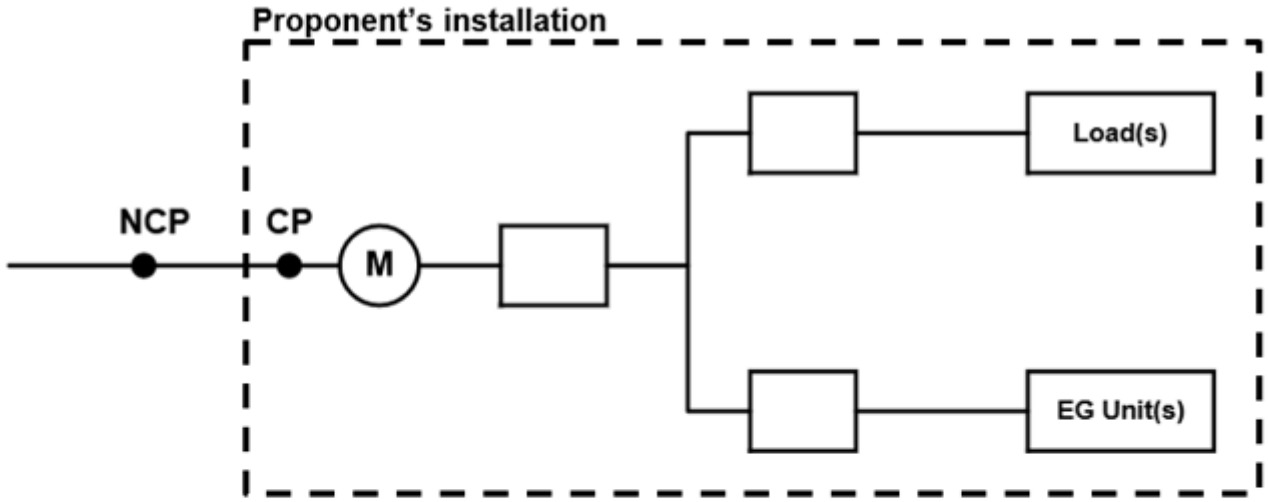
Operational function	Requirements
Fixed limits	• C*onnection contract* for a Dynamic Small IES. • Installed in compliance with this Standard.
Dynamic limits	• *Connection contract* for a Dynamic Small IES. • Installed in compliance with this Standard. • Registered to the DNSP IEEE SEP2 Utility Server. • Receive dynamic Export and Import limits. • Operate Dynamic Small IES to meet Export and Import limits.

Appendix A: Deviations from the National DER Connection Guidelines (informative)

There are no current National DER Connection Guidelines for dynamic connections. This Standard has been developed in alignment with the framework of the National DER Connection Guidelines.

Appendix B: Connection arrangement requirements (normative)

Following is a representation for a Small IES Unit installation as considered in this Standard.



NCP	Network Coupling Point
CP	Connection Point
M	Metering
▭	Isolation Device

Figure 3: Small IES Dynamic EG Connection installation representation

Appendix C: Model Standing Offer (informative)

This section has been left intentionally blank.

Appendix D: Static data and information (informative)

Static data and information shall be provided by the Proponent to the DNSP based on your application type and may include some of the following below (but not limited to):

1. NMI meter numbers
2. System information
    a. Number of phases available and number of phases DER installed
    b. Energy source
    c. Maximum output rating
    d. Any proposed Export limit (Full / Partial- / Non-) and method of Export control
    e. Metering scheme information (gross or net)
3. Inverter
    a. Make, model and manufacturer
    b. Number installed
    c. Power quality modes
4. Device information
    a. Type (e.g. panel, battery)
    b. Make, model and manufacturer
    c. Number installed
5. Applicant and Customer information
    a. Type
    b. Business and / or Personal Names
    c. Address and contact information
6. Installer information
7. Dynamic DER Registration information

Appendix E: Dynamic data and information (informative)

Dynamic data and information shall be provided by the Proponent to the DNSP or by the DNSP to the Proponent based on the application type and may include (but is not limited to) the following:

Table 14 Dynamic monitoring information via CSIP

Category	Dynamic information	Function set
Monitoring of real power, reactive power at the connection point and voltage	Average Real (Active) Power (W)	Metering Mirror function set
	Average Reactive Power (VA)	
	Average Voltage (V)	

Table 15 Dynamic control functions via CSIP

Category	Support function	DER control requirements
Export limit	Real Power Output Limit Control	DERControl:opModMaxLimW
Import limit	Set Active Power Mode	DERControl:opModFixedW; or DERControl:opModTargetW
Forecasting[1]	Forecasting using DERControl	Using DERControl function

Note 1 – Capable of supporting a minimum of five-minute interval envelope events for the next hour and thirty-minute interval events for the following 23 hours, updated every five minutes under normal circumstances. (58 events per Connection Point per DER Control).

Appendix F: Compliance checklist (informative)

The purpose of this compliance checklist is to aid the Proponent with the design and commissioning of the Small IES Unit to ensure it meets the relevant requirements, as set out in this Standard.

Registration to the SEP2 utility server is required to support dynamic operation within dynamic Export and Import limits.

Table 16 General Inverter Settings

Parameter	Settings	Australia A Region
V_{nom_max}	258 V	Default 'Australia A' region settings
Volt-var settings (refer to Table 7)	V_{V1} = 207 V; 44% supplying V_{V2} = 220 V; 0% V_{V3} = 240 V; 0% V_{V4} = 258 V; 60% absorbing	
Volt-watt settings (refer to Table 8)	V_{W1} = 253 V; 100% V_{W2} = 260 V; 20%	
Volt-watt settings for energy storage when charging (refer to Table 9)	$V_{W1\text{-}ch}$ = 207 V; 20% $V_{W2\text{-}ch}$ = 215 V; 100%	
Reconnect time	60 seconds	

Table 17 Disconnection Times

Parameter	Settings	Trip Time Delay	Maximum Disconnection Time	Australia A Region
Overvoltage 1 (V>)	265 V	1 s	2 s	Default 'Australia A' region settings
Overvoltage 2 (V>>)	275 V	-	0.2 s	
Undervoltage 1 (V<)	180 V	10 s	11 s	
Undervoltage 2 (V<<)	70 V	1 s	2 s	
Overfrequency (F>)	52 Hz	-	0.2 s	
Underfrequency (F<)	47 Hz	1 s	2 s	

Table 18 Power Limiting Settings

Parameter	Settings
Export Power Limit	As approved
Time delay	15 s

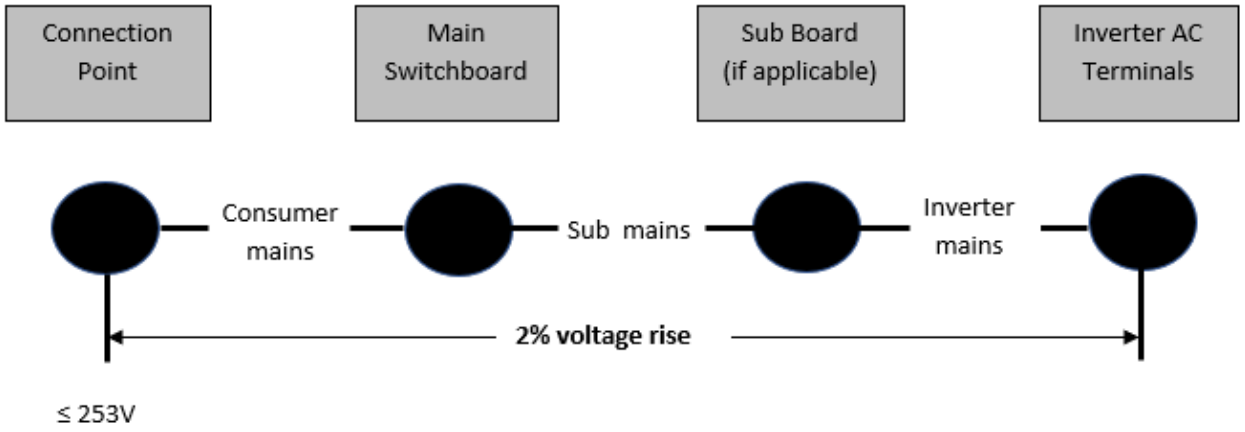


Figure 4 Voltage Rise Calculation Diagram

Table 19 Calculated voltage rise

Voltage rise	Consumer mains	Submains	Inverter mains	Total voltage rise
Calculated (V)				
Percentage (%)				

Appendix G: Small IES Dynamic EG Connection types (informative)

Table 20 Connection types - Small IES Dynamic EG Connections to Energex and Ergon Energy Network LV Distribution System

Connection types[1]		Capacity		Export		Import[3]		Contract type
		Maximum capacity limit where dynamic operation is not enabled	Maximum capacity limit where dynamic operation is enabled	Minimum dynamic Export limit	Maximum dynamic Export limit	Minimum dynamic Import limit	Maximum dynamic Import limit	
Single-phase		≤ 10 kVA	≤ 10 kVA PV & ≤ 10 kVA ESS	1.5 kW	10 kW	1.5 kW	18 kW	Negotiated
Two-phase		≤ 10 kVA per phase[2]	≤ 10 kVA per phase[2]	1.5 kW	10 kW per phase[2]	1.5 kW	10 kW per phase[2]	Negotiated
Three-phase		≤ 10 kVA per phase[2]	≤ 10 kVA per phase[2]	1.5 kW	10 kW per phase[2]	1.5 kW	10 kW per phase[2]	Negotiated
SWER	Single-phase	≤ 10 kVA	≤ 15 kVA PV & ≤ 15 kVA ESS	1.5 kW	≤ 10 kW	1.5 kW	10 kW	Negotiated
	Split-phase	≤ 10 kVA per phase[2]	≤ 15 kVA per phase[2,4]	1.5 kW	≤ 5 kW per phase[2]	1.5 kW	10 kW per phase[2]	Negotiated

Note 1:These limits shall be considered applicable to the aggregate of all Small IES Dynamic Connections at a Premises, including Premises with more than one LV Connection Point and where a Proponent is seeking connection to the Distribution System at more than one LV Connection Point.

Note 2: Multiphase EG Systems have phase balance requirements.

Note 3: Total Import limit by a Proponent at the Connection Point shall meet the requirements of a Proponent's network *customer connection contract* for supply. The operation of Import limits shall not enable a Proponent to exceed the maximum supply limits for the Premises under the applicable *customer connection contract*.

Note 4: A Proponent supplied by only a single phase from a SWER transformer with split-phase supply shall have a maximum capacity of ≤ 10 kVA

Note 5: Fixed Export limits are as per Section 4.3.1.

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