Part of Energy Queensland

STNW3511

Dynamic Standard for Low Voltage Embedded Generation Connections

Effective from 6 February 2023

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

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Abstract: This standard provides the requirements for connecting Dynamic Embedded Generating (EG) Systems in Parallel with a Distribution Network Service Provider's Low Voltage Distribution Network. This standard covers Inverter Energy System connections from 30 kVA to 1,500 kVA and Rotating Machine connections from 0 kVA to 1,500 kVA.

Keywords: embedded, dynamic, generating, low voltage, IES, solar, photovoltaic, wind, diesel, rotating, connection, rotating machine, 1,5000 kVA, 1500 kVA, 1.5 MVA.

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1 Introduction

1.1 Purpose

The purpose of this Standard is to provide Proponents of a Dynamic EG System with information about their obligations in respect of connecting to, and interfacing with the Energex or Ergon Energy Network's Distribution System. It has been developed to ensure safe and stable Parallel operation[1] of Dynamic EG Systems connected to the DNSP's Distribution Networks without causing a material degradation in the quality of supply to Distribution Network users.

1.2 Scope

This Standard applies to *new connections* and *connection alterations* that are Dynamic EG Connections, and:

- are intended to be connected to, and capable of operating in Parallel with the Distribution System; and
- meets all other technical requirements as set out in this Standard.

This Standard does not apply to:

- electric vehicles unless the Electric Vehicle Supply Equipment (EVSE) is capable of generating electricity to the Distribution System or electrical installation (in which case the requirements of this Standard shall apply).
- electrical equipment that does not generate electricity, unless they impact on the ability of the Dynamic EG System to meet the technical requirements of this Standard.
- off grid systems not connected in parallel with the Distribution System.
- stand-by generating systems with a Break-before-make changeover, configured to ensure the generating system cannot be connected in Parallel with the Distribution System.
- Dynamic 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
STNW3510	Dynamic Standard for Small IES 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 a Dynamic EG Connection as published by the Energy Networks Association (ENA).

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

1.3 Obligation of Proponents

Proponents shall:

a. obtain consent from the DNSP before interconnecting their Dynamic EG System with the Distribution System.
b. ensure that the design is certified by a Registered Professional Engineer of Queensland.
c. comply with this Standard and the terms and conditions of the relevant Connection Contract.
d. ensure construction, operation and maintenance of the proposed Dynamic EG System, and its connection to the Distribution System, complies with the relevant Energy Laws, including any applicable regulations, standards, manuals, guidelines and codes of practice as they apply in Queensland.
e. not connect additional inverters, make modifications, or install additional EG Units (including any Energy Storage Systems), without the prior written agreement of the DNSP.
f. meet the commissioning requirements applicable for connections to the LV Distribution System and complete commissioning under a commissioning plan certified by an RPEQ.

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) or rotating plant 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 system installed to perform the functions of: coordinating multiple EG Unit installations at one site, providing protection for the entire EG Energy System installation and islanding protection to the connected grid as well as preserving safety of grid personnel and the general public.
Connection Contract	A contract formed by the making and acceptance of a *connection offer* under Chapter 5A of the NER (or an offer to *connect* under Chapter 5, where the Proponent has made an election under rule 5A.A.2 of the NER
Connection Assets	Those components of a Distribution System which are used to provide *connection services*.

[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
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 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 Low Voltage section of the *distribution system* owned and operated by the DNSP to which the EG 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).
Dynamic Embedded Generating System(s) (or Dynamic EG System(s))	One or more Embedded Generating Units and auxiliary equipment that comprise either an Inverter Energy System or Rotating Machines and interconnect with the Distribution System at a Connection Point. Variation of some settings for the Dynamic EG System, such as Import and Export, are supported through publishing of Dynamic Operating Envelopes (DOEs) by the DNSP for the Proponent's Connection Point.
Dynamic EG Connection	A *connection* between an EG System and the Distribution System having variable limits for select settings for the Dynamic EG System that are frequently reviewed and applied.
Dynamic Operating Envelopes (or DOE(s))	Dynamic Operating Envelopes are where Dynamic EG System setting limits, such as Import and Export limits, can vary over time and location
Embedded Generating Unit (or EG Unit)	A Generating Unit connected to a Distribution Network 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 components (e.g. 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.

Term	Definition
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 batteries for energy storage) and controls, with an aggregate installed nameplate capacity of 30 kVA to 1,500 kVA.
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.
Network Coupling Point	The point at which Connection Assets join the shared Distribution Network, used to identify the distribution service price payable by the Proponent.
Non-export	An EG Unit that is capable of operating in Parallel with the Distribution System and which is designed and configured to prevent any Export of electricity to the Distribution System across the Connection Point.
Parallel (or Grid Connected)	This is where the EG Unit is configured such that the EG Unit and the Distribution System may operate in parallel from time to time (even if this is a very short period of time). This includes circumstances where an 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 EG Unit (including any Energy Storage System) Exports.
Partial-export	An EG Unit that is capable of operating in Parallel with the Distribution System and which is designed and configured to only Export as prescribed to operate in Section 4.3.1 of this Standard.
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.
Power Limiting	The ability to reduce or stop power output from a Dynamic EG System when Export exceeds a defined value.
Proponent	The relevant owner, operator, or controller of the Dynamic EG System (or their agent).

[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
PSCAD™/EMTDC™	Refers to a software package developed by the Manitoba-HVDC Research Centre that comprises a power systems computer-aided design package which includes an electromagnetic transients (including DC) simulation engine, and which is used to carry out electromagnetic transient type studies.
Rotating Machines	Electric rotating machinery with an aggregate installed nameplate capacity of 0 kVA to 1,500 kVA.
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 connected via this arrangement are supplied at LV either as single-phase or split-phase electric power.
Standard	This document that is entitled “Dynamic Standard for LV EG Connections”.
Technical Study	A study to evaluate the effects that the proposed connection of the Dynamic EG System will have on the Distribution System under different loading conditions or in the event of particular faults. A document will be produced for the Proponent that has requirements as part of the Connection Contract.

2.2 Abbreviations

Term, abbreviation or acronym	Definition
AC or a.c	Alternating current
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AFLC	Audio Frequency Load Control
AS/NZS	A jointly developed Australian and New Zealand Standard
AS	Australian Standard
ANSI	American National Standards Institute
CBD	Central Business District
CEC	Clean Energy Council
CSIP	Common Smart Inverter Protocol
DC or d.c.	Direct current
DER	Distributed Energy Resources
DRED	Demand Response Enabling Device
EG	Embedded Generating
EMC	Electromagnetic Compatibility
EMT	Electromagnetic Transients
EVSE	Electric Vehicle Supply Equipment
GPR	Grid Protection Relay
GSD	Generation Signalling Device

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IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
LV	Low Voltage
NEL	National Electricity Law
NER	National Electricity Rules
NVD	Neutral Voltage Displacement
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 Dynamic EG Systems described in Table 1:

Table 1 Subcategories

LV EG IES ≤ 200 kVA Dynamic EG Connection	LV EG IES > 200 kVA Dynamic EG Connection	LV EG Rotating Machines Dynamic EG Connection	LV EG non-standard Dynamic EG Connection
System capacity > 30 kVA and ≤ 200 kVA	System capacity > 200 kVA and ≤ 1,500 kVA[1]	System capacity > 0 kVA and ≤ 1,500 kVA[1]	Connecting to Brisbane CBD network, connections >1,500 kVA and <5 MVA or Premises with more than one LV Connection Point.

The following arrangements are considered to be non-standard Dynamic EG Connections and shall be assessed for technical limitations identified on a case-by-case basis:

- connecting Dynamic EG Connections within the Brisbane CBD Distribution System where that system is likely to contribute to an increase in the fault rating limitations of network infrastructure. The Dynamic EG Systems that intend to connect in the Brisbane CBD will be limited to systems that will not effectively contribute to a rise in fault level at the Connection Point e.g. bumpless transfer and IES).
- connections involving a Premises which has more than one LV Connection Point, or the Proponent’s network(s) is connected to more than one LV Connection Point. This type of connection will be considered in terms of their aggregated impact on the network for the Premises in their entirety.
- LV connections with an aggregated capacity > 1,500 kVA and <5 MVA.

Connections to 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”.

Refer to Appendix F for further details on requirements that may be required for these non-standard Dynamic EG Systems.

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 Australian standard, international standard or industry code (except for a legislated industry code); 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 STNW1174 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
STNW1174	Standard for LV EG 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 STNW1174 from the following website: https://www.ergon.com.au/

Other controlled documents include:

Document number	Document name	Document type
NA000403R509	Queensland Electricity Connection Manual	Reference
STNW1174	Standard for LV EG Connections	Standard
STNW1175	Standard for HV EG Connections	Standard
STNW3512	Standard for LV EG Connections to Isolated Networks	Standard

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 4777.1	Grid connection of energy systems via inverters Part 1: Installation requirements	AU/NZ Joint Standard
AS/NZS 4777.2	Grid connection of energy systems via inverters Part 2: Inverter requirements	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 60034.1	Rotating electrical machines, Part 1: Rating and performance	Australian Standard
AS 60034.22	Rotating electrical machines, Part 22: AC generators for reciprocating internal combustion (RIC) engine driven generating sets	Australian Standard
AS 60038	Standard Voltages	Australian Standard
AS 61869	Instrument transformers (multiple parts)	Australian Standard
AS 61000.3.100	Electromagnetic compatibility (EMC) limits – Steady state voltage limits in public electricity systems	Australian Standard
AS/NZS IEC 60947.6.1	Low-voltage switchgear and controlgear	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
AS NZS IEC 62116	Utility-interconnected photovoltaic inverters – Test procedure of islanding prevention measures	AU/NZ Joint Standard

Document number	Document name	Document type
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
SA/SNZ TR IEC 61000.3.15	Electromagnetic compatibility (EMC), Part 3.15: Limits— Assessment of low frequency electromagnetic immunity and emission requirements for dispersed generation systems in LV network	AU/NZ Technical Report

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
IEC 60255-1	Measuring relays and protection equipment – Part 1: Common requirements	International Standard
IEC 60255-26	Electrical relays – Part 26: Electromagnetic compatibility requirements	International Standard
IEC 60255-27	Electrical relays – Part 27: Product safety requirements	International Standard
IEC 60255-127	Measuring relays and protection equipment – Part 127: Functional requirements for over/under voltage protection	International Standard
IEC 60255-181	Measuring relays and protection equipment – Part 181: Functional requirements for frequency protection	International Standard
IEC 60617	Graphical symbols for diagrams	International Standard
IEEE Std 519	IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems	IEEE Standard
IEEE Std C37.2	IEEE Standard Electrical Power System Device Function Numbers, Acronyms, and Contact Designations	IEEE 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 related 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:

- legislation and regulation; and
- this Standard,

the legislation and regulations will prevail.

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Document name	Document type
Construction and operation of solar farms – Code of Practice 2019	Code of Practice
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

All Dynamic EG Systems shall comply with AS/NZS 3000.

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

4.2 Maximum system capacity

Provided there is no constraint identified by the DNSP, the maximum aggregate system capacity for standard Dynamic EG Connections for each subcategory covered under this Standard shall be as per Table 2.

Under this Standard, the aggregate maximum system capacity of a Dynamic EG System at a Connection Point is 1,500 kVA.

Table 2 Maximum system capacity by subcategory

Dynamic LV EG IES ≤ 200 kVA Connection	Dynamic LV EG IES > 200 kVA Connection	Dynamic LV EG Rotating Machines Connection	Dynamic LV EG non-standard Connection
200 kVA	1,500 kVA	1,500 kVA	As per Technical Study

There is no limit for DC-coupled DER capacity. The limits for a Technical Study will be based on the aggregated AC capacity of the Dynamic EG Units at the Premises.

For Premises with multiple LV Connection Points, Premises with network(s) connected to multiple Connection Points, or Dynamic EG system(s) being connected to multiple Connection Points

a. The maximum capacity for a Connection Point in respect of a Premise is based on the aggregate of all EG Units connected or proposed to be connected within the Premise.

The requirements set out in this Standard and the Technical Study will be applied and determined based on the aggregate maximum capacity of all the EG Units connected, or proposed to be connected, within the Premise. The Dynamic EG System (comprising all EG Units capable of connecting to the Distribution System through a Connection Point) should be designed so that it does not exceed the ratings of equipment both within the Distribution System and the Proponent's side of the Connection Point when the Dynamic EG System operates in Parallel. A Dynamic EG System registered with the DNSP SEP2 Utility Server may be approved for an aggregate system capacity that exceeds ratings within the Distribution System at the Connection Point at the sole discretion of the DNSP.

The maximum capacity of the Dynamic EG System may exceed the rated capacity of the DNSP network assets while the Proponent's Dynamic EG System meets the dynamic operation requirements in Table 21.

If a Proponent is unable to meet the dynamic operation at any time, the maximum capacity of the Dynamic EG System shall be reduced to below the rated capacity of the DNSP network assets. The Proponent shall automatically disconnect EG Unit(s) from the Distribution Network to reduce the capacity the Dynamic EG System below the rated capacity of the Distribution Network.

Nameplate rating for any EG Unit shall be based on the maximum continuous rating of the EG Unit throughout this Standard.

4.3 Generation control

For all Dynamic EG Systems that may connect to the Distribution System, Table 3 defines the operation types, nature of Parallel operation and Export capability.

Table 3 Types of Dynamic EG Systems

Operation Type	Parallel Operation		Export Capability
	Duration	Frequency	
Bumpless transfer[1]	up to 2 seconds	N/A	Non-export only
Stand-by[2] (for testing only)	up to 6 hours	Every 3 months	Either Export or Non-export
Continuous Parallel	Greater than 24 hours	In a year	Either Export or Non-export

Note 1: Bumpless transfer shall be considered under this standard only where a Premises has at least one other EG Unit with Stand-by or Continuous Parallel operation.

Note 2: Stand-by operation is for operating Dynamic EG System for maintenance purposes. If the Dynamic EG System is part of a generation aggregation system, then it is automatically classified as continuous Parallel regardless of planned duration or frequency.

4.3.1 Export limits at Connection Point

4.3.1.1 Export limit study

The fixed Export limit shall be assessed and determined by the DNSP based on:

a. penetration of Dynamic EG Systems on the Distribution System;
b. asset capacity limits on the Distribution System;
c. power quality checks on the Distribution System;
d. voltage regulation impacts on the Distribution System; and
e. Distribution System protection impacts.

An indicative export limit may be provided by the DNSP at the enquiry stage.

4.3.1.2 Export limit types

A Proponent can elect to have Non-export, Partial-export or Full export Dynamic EG System.

Dynamic EG Systems shall be designed and operate within dynamic Export limits as seen in Table 4.

Non-export Dynamic EG Systems shall be designed to operate without Export into the Distribution System.

Partial-export Dynamic EG Systems shall be designed and operated to limit the amount of Export into the Distribution System to an agreed fixed Export limit as set out in the relevant Connection Contract.

Full Export Dynamic EG Systems can be designed with a fixed Export limit into the Distribution System to the full nameplate capacity (full AC rating) of that Dynamic EG System.

4.3.1.3 Export limits for a Dynamic EG System

The Export limits for a Dynamic EG System shall meet the following requirements:

a. Dynamic EG System have two Export limit types, a fixed Export limit and dynamic Export limits.

b. The fixed export limit, as set out in Table 4 must be met at all times when the Dynamic EG System is not receiving or able to respond to a dynamic Export limit.
c. The dynamic Export limits are supplied by the DNSP for the Dynamic EG System. The dynamic Export limit supplied will be no less than the minimum and no more than the maximum shown in Table 4.
d. For Premises with multiple Connection Points, the Export limits will apply to the Premises and each Connection Points (collectively) must come within the limits stated in Table 4 and 5.
e. The Import limits shall meet the measurement and control requirements set out in Section4.3.3.

Table 4 Dynamic and fixed Export limits

Export Limit type	Fixed Export limit	Minimum dynamic Export limit	Maximum dynamic Export limit	Dynamic capability operational
Non-export	0 kW	0 kW	Rated nameplate capacity[1,2,3,4]	Yes
Partial-export	As per technical study[1,2,3,4]	1.5 kW	Rated nameplate capacity[1,2,3,4]	Yes
Full-export	Rated nameplate capacity[1,2,3,4]	1.5 kW	Rated nameplate capacity[1,2,3,4]	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 in Table 4 are subject to the availability of Distribution Network capacity.

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

Note 4: A Dynamic EG System shall be designed to prevent Export to the distribution that exceeds ratings of connection equipment on the Distribution Network.

The ability of the Proponent's Dynamic EG System to Export at the limits described above are not guaranteed and will depend on the characteristics of the Distribution Network, which may change over 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.

Additional constraints may apply to non-standard Dynamic EG Connections (including those referred to in Section 2.3.1).

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

a. The dynamic Import limits are supplied by the DNSP for the Dynamic EG System. The Dynamic Import Limit supplied will be no less than the minimum and no more than the maximum shown in Table 7.
b. For Premise with multiple Connection Points the Import limits will apply to the Premises and each Connection Point (collectively) must come within the limits in Table 5.
c. The Import limits shall meet the measurement and control requirements in Section 4.3.4.

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Table 5 Dynamic Import limits

Subcategory		Minimum Dynamic Import limit	Maxiumum Dynamic Import limit[1]	Techical study required
Three-phase		1.5 kW	As per Technical Study[2,3,]	Yes
SWER[4]	Single-phase	1.5 kW	10 kW[3,5]	Yes
	Split-phase	1.5 kW	10 kW per phase[1,2,3,]	Yes

Note 1: Availability of Import limits above the minimum dynamic Import limit in Table 5 are subject to availability of Distribution Network capacity.

Note 2: Multiphase EG Systems shall meet phase balance requirements from Section 4.3.5 of this Standard.

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

Note 4: This Standard applies to SWER with aggregate capacity > 30 kVA only.

The Proponent shall not exceed the maximum supply limits in the QECM or the limits within the Proponent's network connection agreement 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 to multiple Connection Points, the standard shall be applied to meet the following:

a. the minimum and maximum Export and Import limits is applied to the aggregate of all EG Units connected, or proposed for connection, at the LV Connection Points (collectively), within the Premise and for all connected network(s).
b. in addition to the maximum Export and Import limits, a Proponent may be required to design the EG system to meet the 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 a Premise.
c. all criteria in this Standard and the Technical Study will be applied for an aggregated Export limit.

4.3.4.2 Measurement of Export and Import limit

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.

The measurement equipment for the Grid Protection Relay (GRP) may be utilised for Export and Import limit control.

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4.3.4.4 Export limit settings

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: Where *k* is equal to the approved Partial-export power value as a per unit value of the EG Unit capacity.

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

a. Have a limit that will cause the Dynamic EG System 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 EG System meets the Export 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 control function, it shall reduce Export to the fixed Export limit.

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 Proponent’s *customer connection contract*.

The control of the Dynamic EG System for export or import limitation shall not interfere with Anti-islanding Protection of the inverter(s).

The Export and Import ability of the Proponent’s EG System to Export or Import at the limits described above are not guaranteed and will depend on the characteristics of the Distribution Network from time to time. Circumstances which may affect the Export or Import 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 EG Unit(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 exceed the current in any other phase by more than 20 A. Multiphase connections shall install phase balance protection where required under Section 4.7.2.2 of this Standard.

4.3.6 Emergency Backstop Mechanism

4.3.6.1 Application

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 Dynamic EG Connection is configured 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.

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

4.4 Inverter Energy Systems

The following requirements apply to an IES with LV EG 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 should 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 for IES less than or equal to 200 kVA.

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 4.10.2 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 protocol using CSIP directly or via a third party.

[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

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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 a Premises or the Distribution System is considered Grid Connected, unless the inverter is connected behind a Break-before-make switch in compliance with AS/NZS IEC 60947.6.1.

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. ESS are 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 the ESS will be included in the aggregated nameplate rating of inverters beyond the Connection Point within the customer's installation;
    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.

4.5 Network connection and isolation

Dynamic EG Systems can be connected to the Distribution System through a shared or dedicated transformer arrangement. Connection and Parallel operation with any part of the Distribution System is dependent upon compliance with the requirements outlined in this Standard at each Connection Point where the Dynamic EG System can Parallel.

Unless the DNSP otherwise agrees in writing, a Dynamic EG System shall only connect to the Distribution System via one Connection Point.

It is the Proponent's responsibility to provide an Isolation Device at the Connection Point, Dynamic EG System transformer(s) (if required) and all associated protection controls and ancillary equipment.

The Proponent shall provide a means of isolation that is capable of disconnecting the whole of the Dynamic EG System from the Distribution System. Where the Dynamic EG System is an aggregate of smaller distributed EG Units, multiple isolation points may be required.

Dynamic EG Systems that supply only part of the Proponent's installation shall have approved mechanisms in place to prevent the following:

a. Parallel connection of the DNSP's distribution transformers; and

b. connection of the Dynamic EG System to the Distribution System occurring without synchronisation and the operation of associated protection systems.

Network connection and isolation requirements shall be in accordance with AS/NZS 4777.1 and AS/NZS 3000 for all Dynamic EG Systems.

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In addition, the following requirements shall apply:

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

4.5.1 Changeover switches for bumpless transfer

Bumpless transfer shall be considered under this standard only where a Premises has at least one other EG Unit with Stand-by or Continuous Parallel operation. Bumpless transfer Dynamic EG Unit(s) shall incorporate a Make-before-break automatic transfer switch compliant with AS/NZS IEC 60947.6.1. Parallel operation with the Distribution System shall comply with the duration limits shown in Table 3.

4.6 Earthing

The earthing requirements shall include:

a. for all Dynamic EG Systems including IES, earthing requirements shall be as per AS/NZS 4777.1 and AS/NZS 3000.

b. for all Dynamic EG Systems including Rotating Machines shall have earthing requirements as per AS/NZS 3000 and AS/NZS 3010.

c. any ESS shall have earthing requirements as per AS/NZS 3000 and AS/NZS 5139.

4.6.1 Multiple Earth Neutral

Dynamic EG Systems that are connected to the Distribution System via a delta/star transformer (delta on the Distribution System side), may have the neutral directly connected to earth via a Multiple Earth Neutral link, in accordance with AS/NZS 3000.

4.6.2 Neutral harmonics

Effective isolation of the neutral may be required to inhibit the flow of harmonic currents through the neutral. The Proponent shall advise the DNSP of their proposed method to limit harmonic currents through the neutral.

4.7 Protection

Fault levels shall not exceed the equipment rating of the Dynamic EG System, Distribution Network equipment, associated switchgear and protection equipment. Where the Dynamic EG System is able to contribute to fault levels, the DNSP shall:

a. conduct fault studies which includes the fault contribution from the Proponent's Dynamic EG System; and
b. provide the Proponent with the existing fault levels and protection equipment ratings to assess whether the design of the Dynamic EG System exceeds relevant equipment ratings.

Where it is determined the design of the Dynamic EG System has the potential to raise the fault levels on the Distribution Network beyond the capacity of the DNSP's protection device(s) and/or equipment, the Proponent shall meet the cost to upgrade the protection device(s) and/or equipment, and ensure that their switchboard and equipment can withstand the total prospective fault currents.

Fault level considerations shall be made for the following configurations of Dynamic EG Systems with Rotating Machines:

1. bumpless transfer Dynamic EG Systems shall have fault levels considered only within the Proponent's installation;
2. Stand-by Dynamic EG Systems shall have a pro-rata factor applied to the prospective fault levels, which shall be dependent on the number of Dynamic EG System connected to the relevant part of the Distribution System at the same time; and
3. Continuous Parallel Dynamic EG Systems shall have fault levels considered for both HV and LV Distribution Systems.

4.7.1 Inverter integrated protection

The inverter integrated protection requirements for inverters connected to the Distribution System shall comply with AS/NZS 4777.2 for active anti-islanding requirements. Other inverter settings including passive anti-islanding settings shall be set to the values given in Table 7 that is consistent with Table 13 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
Underfrequency (F<)	47 Hz	1 s	2 s
Overfrequency (F>)	52 Hz	—	0.2 s
Reconnect time	60 seconds	N/A	N/A

4.7.2 Central Protection

The functional requirements for Central Protection are outlined in Table 6.

Table 8 Central Protection requirements

Protection Requirements	LV EG IES				LV EG Rotating Machines	
	≤ 200 kVA		> 200 kVA			
	Export	Non-export	Export	Non-export	Export	Non-export
Grid reverse power (32R)	No	No	No	No	No	No
Power Limit protection (32)	No[1]	No[1]	No[1]	No[1]	No[1]	Yes
Generator circuit phase balance protection (46/47)	No	No	No	No	No	No
Grid overcurrent fault and earth fault protection (50/51)	No	No	No	No	Yes	Yes
Passive Anti-islanding Protection (27U/O, 59U/O, 81U/O, 81R)	Yes	Yes	Yes	Yes	Yes	Yes
Inter-tripping	No					

Note 1: Non-export or Partial-export systems shall meet the requirements of Section 4.7.2.6 Power Limiting Protection.

Where the Dynamic EG Systems comprises multiple inverters, all inverters on all three phases of the Dynamic EG System shall simultaneously disconnect from the Distribution System in response to the operation of protection or automatic controls.

The GPR shall be installed to provide back-up protection functions to ensure the Distribution System (at the Connection Point) and the installation is not exposed to a hazardous condition from the Dynamic EG System.

The GPR shall meet the following requirements:

a. coordinate multiple IES installations for one Connection Point[1];
b. provide protection functionality using one relay for all IES installations for the one Connection Point[1];
c. provide level 1 backup protection functions as prescribed in Table 7 for IES and Table 8 for Rotating Machines to meet the requirements of this Standard[2];
d. be integrated in such a way that it fails safe, and Dynamic EG System(s) do not generate whilst the GPR is out of service;
e. open the Isolation Device at either the Proponent's Connection Point or the Dynamic EG System(s); and
f. preserve safety of grid personnel and the general public.

The GPR shall be connected as close to the Connection Point as practicable, referencing a single point beyond the Connection Point within the Proponent's Premises.

The GPR reference point shall be connected at a location that has a lower impedance to the Connection Point than any EG Unit connected within the Proponent's Premises.

Note 1: Where there are both IES and Rotating Machine Dynamic EG Systems connected at a single Connection Point, two GPRs are allowed to be installed where one GPR shall coordinate all IES and one GPR shall coordinate all Rotating Machines.

Note 2: One GPR may be used for the entire Premises, to coordinate IES and Rotating Machine Dynamic EG Systems connected at a single Connection Point, where voltage and frequency setpoints align with Table 7. NVD and Power Limiting requirements shall continue to apply as per Rotating Machine requirements.

Further information on GPR arrangements can be found in Appendix B: Connection arrangement requirements.

Protection equipment shall operate the Isolation Device either directly or through interposing equipment. Such protection equipment and any interposing equipment shall have certified compliance with the following:

- IEC 60255-1 Common requirements;
- IEC 60255-26 EMC requirements;
- IEC 60255-27 Product safety requirements;
- IEC 60255-127 Functional requirements for over/under voltage protection; and
- IEC 60255-181 Functional requirements for frequency protection.

Marshalling of protection trips through control equipment shall be compliant with IEC 60255.

The instrument transformers used to interface the protection equipment with the Proponent's installation shall have certified compliance with:

- AS 61869.1 General requirements
- AS 61869.2 Additional requirements for current transformers;
- AS 61869.3 Additional requirements for inductive voltage transformers; and
- AS 61869.4 Additional requirements for combined transformers.

The GPR functionality in compliance with AS/NZS 4777.1 shall apply to all Dynamic EG Systems as per Table 9 and

Table **10**. Under and over voltage protection shall be installed to monitor all three phases. The Level 1 backup protection is for passive Anti-Islanding Protection.

Table 9 IES GPR Functions and settings

Protection functional description	ANSI/IEEE C37.2 Code	IEC 60617 Code	Default Setting	Time Delay
Level 1 backup protection				
Under voltage 2 (UV)	27P	U<	70 V_{l-n}	3.0 s
Under voltage 1 (UV)	27P	U<	180 V_{l-n}	12.0 s
Over voltage (OV)	59P	U>	275 V_{l-n}	0.2 s
Under frequency (UF)	81U	f<	47 Hz	3.0 s
Over frequency (OF)	81O	f>	52 Hz	2.0 s
Rate of change of frequency (ROCOF)	81R	df/dt	±4 Hz/s	0.5 s[1]

Note 1: Sampling period for calculation of ROCOF specific to the GPR can be additional to the time delay setting.

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Table 10 Rotating Machine GPR Functions and default settings

Protection functional description	ANSI/IEEE C37.2 Code	IEC 60617 Code	Default Setting	Time Delay
Level 1 backup protection				
Under voltage (UV)	27P	U<	180 V_{l-n}	11.0 s
Over voltage (OV)	59P	U>	265 V_{l-n}	1.0 s
Under frequency (UF)	81U	f<	47 Hz	2.0 s
Over frequency (OF)	81O	f>	52 Hz	2.0 s
Rate of change of frequency (ROCOF)	81R	df/dt	See Note 1	0.5 s[1]
Level 2 backup protection				
Neutral voltage displacement (NVD)[2]	59N	U0>	20%	3.0 s
Non-Export Dynamic EG Systems				
Power Limit protection	32	P→	From Technical Study[3]	From Technical Study[3]

Note 1: ROCOF calculated by the Proponent to ensure an island is not sustained when the Distribution System is de-energised. Where the calculated value is greater than 3 Hz/s, the DNSP shall be consulted. Sampling period for calculation of ROCOF specific to the GPR can be additional to the time delay setting.

Note 2: HV NVD as per Section 4.7.6.2 of this Standard.

Note 3: As per Section 4.7.2.6 of this Standard.

4.7.2.1 Grid reverse power protection

This section has been left intentionally blank.

4.7.2.2 Phase balance protection

Phase balance protection shall be required where:

a. inverters are connected across more than one phase at a Connection Point;
b. one or more inverters are single phase; and
c. one or more phase has greater than 5 kVA of aggregate inverter capacity.

Phase balance protection shall respond to current imbalance at the Connection Point caused by the aggregate IES EG Units on each phase, between phases greater than 20 A (5 kVA) by disconnecting all of the inverters from the Proponent's 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.

If required for Rotating Machines, specific settings for current unbalance protection shall be determined by a connection specific Technical Study.

Voltage unbalance protection may be required for Rotating Machine Dynamic EG Systems and shall be specified from a Technical Study at the time of the connection.

4.7.2.3 Overcurrent earth fault protection

Overcurrent and earth fault protection shall be provided at the Rotating Machines isolating switch in accordance with the equipment rating. The overcurrent and earth fault protection relays shall provide compensation for under voltage field weakening. Compensation for under voltage field weakening is not required where the Proponent can demonstrate that voltage depression at the

Dynamic EG System during fault events shall not adversely impact on the operation of the protection scheme.

Overcurrent and earth fault protection for the facility shall also be provided at the Dynamic EG System in accordance with AS/NZS 3000. This protection shall be set to detect faults within the Proponent's installation. Any additional requirements for overcurrent facility fault, overcurrent grid fault and earth fault protection may be advised by the DNSP in the Technical Study.

4.7.2.4 Passive Anti-islanding Protection

Passive anti-islanding settings shall be as per Table 7 for IES Dynamic EG Systems inverters.

Rotating Machine EG Unit(s) protection shall have the Level 1 backup protection functions from

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Table **10** that form the passive Anti-islanding Protection unless otherwise specified in the Technical Study. These functions shall have settings coordinating with the Rotating Machine GPR settings as outlined in

Table **10**.

An additional Anti-islanding Protection relay shall be installed if the Rotating Machine EG Unit(s) protection do not incorporate Level 1 back up protection as per

Table **10** This relay is to operate the Isolation Device at the Connection Point. This relay shall provide backup protection functions in Parallel with the GPR for loss of mains.

4.7.2.5 Inter-tripping

The Proponent's design shall not require an inter-trip from the DNSP.

4.7.2.6 Power Limit protection

Where the Dynamic EG System has been approved by the DNSP as either a Non-export or Partial-export system and does not employ a "soft" controls as described in Section 4.3.1 of this Standard, Power Limit protection shall be installed at the Connection Point or upstream of all EG unit(s) within the Connection Point. Any Power Limiting protection settings shall meet the requirements of Table 4.

4.7.3 Interlocking

Fail-safe interlocking mechanisms shall be required as specified in

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Table **11** for installations with multiple transformers and/or Connection Points, bumpless transfer and off grid connections.

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Table 11 Interlocking requirements

Connection arrangement	Fail-safe interlocking[1] requirements
Multiple transformers and/or Connection Points	No distribution transformers are connected in Parallel
Bumpless transfer	During the transfer from one source to another, the interlock operation cannot enable the EG Unit and the Distribution System to both supply the load at the same time longer than the maximum allowable duration for bumpless transfer in Table **3** of Section 4.3 of this Standard. No distribution transformers will be connected in Parallel any point during the bumpless transfer.
Off grid	During the transfer from one source to another the interlock operation cannot allow the Generating Unit and the Distribution System to both supply the load at the same time.

Note 1: The interlocking mechanism should be a manual (key based) fail-safe system. Automated controlled fail-safe interlocking systems may be allowed upon approval of a functional design and operational specification certified by an RPEQ in the application stage.

4.7.4 Isolation Device fail protection

Loss of mains and Anti-islanding Protection scheme design shall make allowance for the failed operation of an Isolation Device.

The protection scheme shall not operate the same Isolation Device for both primary and backup protection. There may be multiple Isolation Devices for either primary or backup protection.

The Proponent may elect to use another form of Isolation Device fail protection, such as a circuit breaker fail scheme, subject to the DNSP's agreement.

4.7.4.1 Wireless Transfer

Where a Dynamic EG System's GPR and export monitoring device is remote from the Dynamic EG System's Isolation Device or inverters, a wireless communication system may be used. A GPR and export monitoring device utilising a wireless communication system shall meet the following requirements:

a. have a supervised wireless communications link;

b. have a communication delay that does not exceed 0.5 seconds; and

c. disconnect the Dynamic EG System from the Distribution System for any loss of communications longer than 5 seconds.

4.7.5 Synchronisation

The DNSPs apply an automatic feeder re-closing scheme on the majority of their Distribution Network. Automatic re-energisation of the feeder during this process opens the circuit breaker (with minimum delay) following a power system fault, and then attempts to automatically re-energise the feeder component after a predefined disconnected time (dead time). Automatic reclosing can happen multiple times depending on the Distribution Network location.

The Dynamic EG System shall disconnect within this dead time upon a loss of mains power to ensure safe restoration. Failure of the Dynamic EG System to disconnect when there is a loss of supply from the Distribution System may result in damage to the Dynamic EG System.

When the system voltage has been restored on the Distribution System side of the Connection Point, and the voltage and frequency have been maintained within protection limits for a period of no less than 60 seconds, the Dynamic EG System may reconnect with the Distribution System.

The Dynamic EG System shall incorporate either automatic or operator-controlled equipment that ensures the frequency, voltages, and phase sequence of the Dynamic EG System is identical with (synchronised to) those in the Distribution Network before it connects to the Distribution System. The Dynamic EG System shall not reconnect until it is synchronised with the Distribution Network.

4.7.6 Additional requirements for Rotating Machine Dynamic EG Systems

4.7.6.1 Standards compliance

All Dynamic EG Systems comprising a Rotating Machine EG Unit(s) that are installed under this Standard shall be compliant with:

a. AS 60034.1 Rotating electrical machines, Part 1: Rating and performance; and

b. AS 60034.22 Rotating electrical machines, Part 22: AC generators for reciprocating internal combustion (RIC) engine driven generating sets.

Dynamic EG Systems comprising Rotating Machine EG Unit(s) installed under this Standard, shall meet the protection requirements in Table 12 for NVD, loss of mains and Anti-islanding Protection based on operation type.

Table 12 Requirements for Rotating Machine Dynamic EG Systems

	Bumpless transfer[1]	Stand-by	Continuous Parallel
HV NVD	No	No	Yes
Loss of mains protection	No	Yes	Yes
Anti-islanding Protection	No	Yes	Yes

Note 1: Bumpless transfer EG Unit(s) shall be considered under this standard only where a Premises has at least one other EG Unit with Stand-by or Continuous Parallel operation

4.7.6.2 Neutral Voltage Displacement (NVD) protection

NVD protection shall be installed for Dynamic EG Systems comprising a Rotating Machine EG Unit(s) in accordance with Table 12. NVD protection is required to ensure that a Dynamic EG System disconnects if there is a high voltage network earth fault. NVD protection requires either phase-neutral or an open delta voltage measurement of the relevant part of the HV Distribution Network.

NVD protection requires equipment to be installed on the DNSP's assets.

4.8 Operating voltage and frequency

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

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

The maximum sustained voltage set point, $V_{nom\text{-}max}$ as per AS/NZS 4777.2 shall be set at 258 V.

The Dynamic EG System shall be designed and operated so that there is a maximum 2% voltage rise from the EG Unit terminals to the Connection Point.

4.9 Metering

4.9.1 Bulk metered connections

Where connections are bulk metered, like a strata titled development (such as townhouses or a retirement village), as illustrated in Figure 6 of Appendix B, there are three supply options available to the Proponent:

- Option 1 – aggregated Dynamic EG Systems off a separate circuit from the main switchboard that are not separately metered by the Proponent;
- Option 2 – separate reticulation circuit for Dynamic EG Systems and individual metering of each Dynamic EG System by the Proponent; or
- Option 3 – aggregated Dynamic EG Systems and Premises load off from mixed circuits.

Option 1 requires a GPR in accordance with Section 4.7.2 of this Standard. Options 2 and 3 may have the requirement for additional Anti-islanding Protection waived if the total installed capacity is less than 30% of the nameplate rating of the transformer supplying the bulk metered connection.

4.10 Power quality

4.10.1 General

All power quality measurements and limits are with reference to the Connection Point.

4.10.1.1 Voltage changes and flicker

The Proponent shall ensure that the Dynamic EG System is designed and commissioned to:

a. achieve the acceptable level and frequency of step voltage changes advised by the DNSP following the Technical Study.

b. the flicker contribution limits for Dynamic EG Systems is as per Table 13. The limits are considered as the direct contribution of the Dynamic EG System (i.e. the difference in flicker values between when the EG is operational and not operational).

Table 13 Flicker contributions limits

Connection type	P_{st}	P_{lt}
Dedicated distribution transformer	0.50	0.40
Shared distribution transformer	0.30	0.25

4.10.1.2 Short duration over voltages

The Proponent should comply with Section 7.6 of SA/SNZ TR IEC 61000.3.15 in order to minimise damage to the Proponent's equipment from short duration over voltages.

The transient voltage limits for Dynamic EG Systems comprising an IES EG unit(s) specified in clause 2.9 of AS/NZS 4777.2 shall be met by Proponents.

4.10.1.3 Harmonic Distortion

Harmonic voltage limits permitted to be injected into the Distribution System at the Network Coupling Point shall be as agreed with the DNSP and specified in the Connection Contract.

Harmonic current emission limits shall be allocated in accordance with IEEE 519. The harmonic current distortion level of the Dynamic EG System should be less than the emission limits specified by the DNSP when all the EG Units of the Dynamic EG System are in service.

4.10.1.4 Voltage Unbalance

The Proponent shall ensure that the current injected in each phase at each at the LV Connection Point is balanced so as to achieve average voltage unbalance less than or equal to the values set out in Table 14, where the average voltage unbalance is determined using the following formula:

$$\text{average voltage unbalance } (\%) = \text{average}_{\text{period}} \left(\frac{\text{negative sequence voltage}}{\text{positive sequence voltage}} \right) \times 100$$

Table 14 Voltage Unbalance levels

Condition	Averaging period	Voltage Unbalance
No contingency	30 minutes	2.0%
Credible contingency event	30 minutes	2.0%
General	10 minutes	2.5%
Once per hour	1 minute	3.0%

4.10.1.5 Disturbance Issues

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

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

4.10.2 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 15, Table 16 and

Table **17** for IES.

Table 15 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

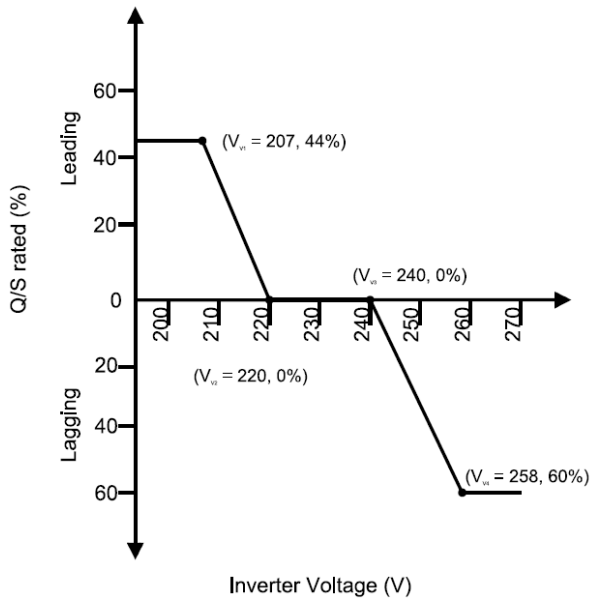

Figure 1: Volt-var response mode

Table 16 Volt-watt response mode settings

Reference	Voltage	Inverter maximum active power output level (P) % of S_{rated}
V_{W1}	253 V	100%
V_{W4}	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

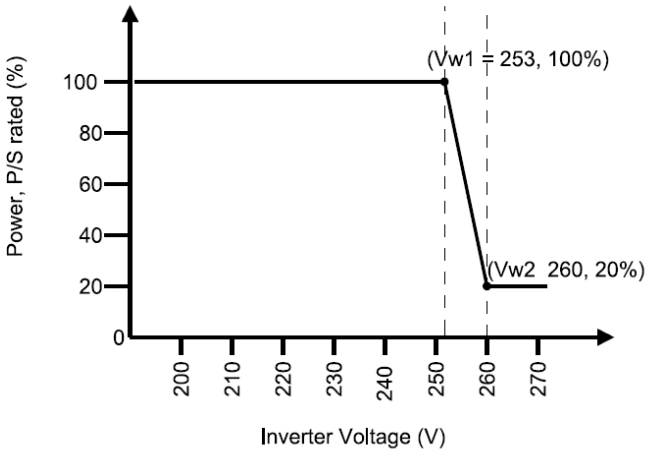

Figure 2: Volt-watt response mode

Table 17 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 18 below:

Table 18 Maximum response time for power quality response modes

Response commencement time	Response completion time
1 s	10 s

4.10.3 LV EG Rotating Machines power quality response

A Dynamic EG System comprising a Rotating Machine EG Unit(s) shall be designed and operated to adequately control real and reactive power output to achieve a power factor at the Connection Point of greater than 0.8 lagging and not leading unless otherwise agreed to in writing by the DNSP.

4.11 Communications systems

4.11.1 General

A Dynamic EG System shall support the sending and receiving of information to the DNSP with communication systems that meet the following requirements:

a. Connection of the Dynamic EG System to the public internet; and
b. Compliance with SEP2 using CSIP.

4.11.2 Connection of communication system

The communication systems for a Dynamic EG System 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 shall be provided by the Proponent to the DNSP in accordance with 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

Technical Studies shall be undertaken by the DNSP as part of the connection application and in accordance with jurisdictional requirements. Technical Study requirements are shown in Table 19. Unless otherwise specified in the notes for Table 19, the DNSP shall be performing the Technical Study.

Table 19 Technical Study requirements

Technical study	LV EG IES				LV EG Rotating Machines	
	≤ 200 kVA		> 200 kVA			
	Export	Non-export	Export	Non-export	Export	Non-export
Voltage regulation	Yes	No	Yes	No	Yes	No
Power flow	Yes	No	Yes	No	Yes	No
Fault level	Yes	Yes	Yes	Yes	Yes	Yes
Protection grading	No	No	No	No	Yes[1]	Yes[1]

Note 1: The Proponent shall do the study based on DNSP's upstream protection settings.

Where the Dynamic EG System is greater than 200 kVA and is identified to be connecting to a Distribution System with constraints, the DNSP may require the Proponent to provide a manufacturer-developed EMT model of the EG unit(s) with relevant site-specific settings. The EMT model shall be developed using PSCAD™/EMTDC™.

5 Connection application process, fees and charges

The connection application process for the connection referred to in this Standard are outlined in Chapter 5A of the NER (or where the Proponent has made an election under rule 5A.A.2 of the NER,) and can be found on both DNSP's websites:

Energex: https://www.energex.com.au/home/our-services/connections/major-business/large-generation-and-batteries

Ergon Energy Network: https://www.ergon.com.au/network/connections/major-business-connections/large-scale-solar

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

Testing and commissioning requirements for Dynamic EG Connections include:

a. testing and commissioning plans shall be prepared by the Proponent and may be required to be approved by the DNSP under the Connection Contract.

b. the commissioning plan, certification and acceptance shall be provided by an RPEQ[6];

c. testing and commissioning acceptance may require the DNSP to carry out witnessing at the DNSP's expense.

d. for IES, testing and commissioning requirements shall be in accordance with AS/NZS 4777.1, AS/NZS 3000, AS/NZS 3017 and AS/NZS 5033 (where applicable), the equipment manufacturer's specifications and the DNSP technical requirements and shall demonstrate that the Dynamic EG Systems including IES complies with the requirements set out in the Connection Contract.

e. for Rotating Machines, testing and commissioning requirements shall be in accordance with the equipment manufacturer's specifications and the DNSP's technical requirements and shall demonstrate that the LV EG Rotating Machines system meets the requirements of the Connection Contract.

f. the Proponent shall submit a compliance report as outlined in the Connection Contract that comprises (but is not limited to) the final approved drawings, test results and specifications.

The application of testing and commissioning requirements shall be applied to specific subcategories as shown in

[6] Engineering supervision by an RPEQ need not be required for the commissioning of an EG System with bumpless transfer connection to the Distribution System if compliant with Section 4.5.1 and Section 4.7.3.

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Table **20**.

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Table 20 Testing and commissioning requirements

Testing and commissioning requirements	LV EG IES				LV EG Rotating Machines	
	≤ 200 kVA		> 200 kVA			
	Export	Non-export	Export	Non-export	Export	Non-export
Protection settings and performance	Yes	Yes	Yes	Yes	Yes	Yes
Power quality settings and performance	Yes	Yes	Yes	Yes	Yes	Yes
Export limits settings and performance	Yes	Yes	Yes	Yes	Yes	Yes
Communications settings and performance	No	No	No	No	No	No
Shutdown Procedures	No	No	No	No	Yes	Yes
Confirm system is as per specifications	Yes	Yes	Yes	Yes	Yes	Yes
Confirm SLD is located on site	Yes	Yes	Yes	Yes	Yes	Yes

7 Operations and maintenance

7.1 General

Operations and maintenance requirements for Dynamic EG Connection shall include, but are not be limited to:

a. an operation and maintenance plan shall be produced, with a copy to remain on site.

b. the Dynamic EG System shall be operated and maintained to ensure compliance at all times with the Connection Contract and all applicable legislation (including the Energy Laws), codes, and/or other regulatory instruments.

c. operation and maintenance reports may be required by the DNSP at a specified interval no more frequently than annually.

d. the electrical installation at the supply address shall be maintained in a safe condition.

e. subject to item f below, the Proponent shall 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 Proponent holds a Certificate of Compliance issued in respect of any of the changes.

f. the Proponent shall seek DNSP approval prior to altering the connection in terms of an addition, upgrade, extension, expansion, replacement, augmentation or any other kind of alteration, including changing inverter/GPR settings;

g. the Proponent shall notify the DNSP of any scheduled and unscheduled protection or communications outages or failures.

The DNSP may at its own cost inspect the Proponent's Dynamic EG System at any time. The DNSP may require access to the site of the Dynamic EG System and isolation points for Distribution System maintenance and testing purposes.

Distribution System maintenance may cause interruptions to the operation of the Dynamic EG System. Co-operative scheduling of these activities should be undertaken to reduce the outage period and minimise the associated impacts.

If the DNSP through an audit or an investigation determines that the Dynamic EG System is non-compliant with the Connection Contract, the Proponent shall be advised of this in writing. If the concern has a material impact, the DNSP shall disconnect the Dynamic EG System until the non-compliance has been remediated by the Proponent to the DNSP's satisfaction.

The DNSP does not guarantee the operation of any customer appliances, including EG Units and their associated components. The Proponent shall take necessary steps to ensure their Dynamic EG System operates as anticipated and also adhere to their applicable Connection Contract.

7.2 Dynamic operation

A Dynamic EG System shall be operate fixed or dynamic limits as per Table 21.

Table 21 Dynamic operation criteria

Operational function	Requirements
Fixed limits	• Connection Contract for a Dynamic EG System. • Installed in accordance with this Standard.
Dynamic limits	• Connection Contract for a Dynamic EG System. • Installed in compliance with this Standard. • Registered to the DNSP IEEE SEP2 Utility Server. • Receive dynamic Export and Import limits. • Operate Dynamic EG System 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.

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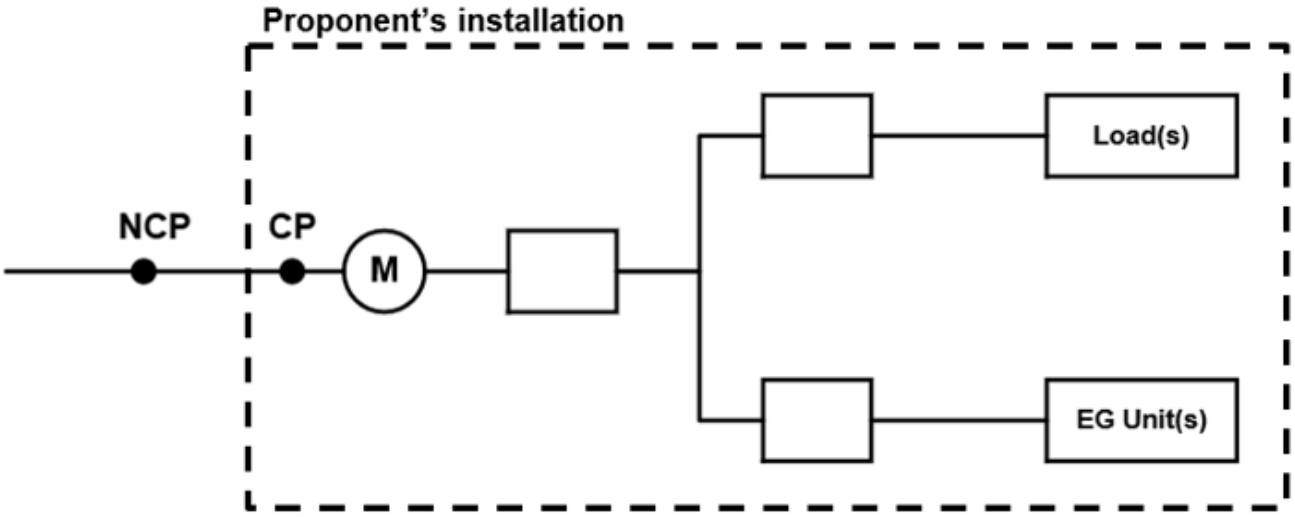
Appendix B: Connection arrangement requirements (normative)

Following figure is a representation for a LV Dynamic EG Connection as considered in this Standard.



NCP	Network Coupling Point
CP	Connection Point
M	Metering
▭	Isolation Device with protection functions

Figure 3: LV EG Installation representation

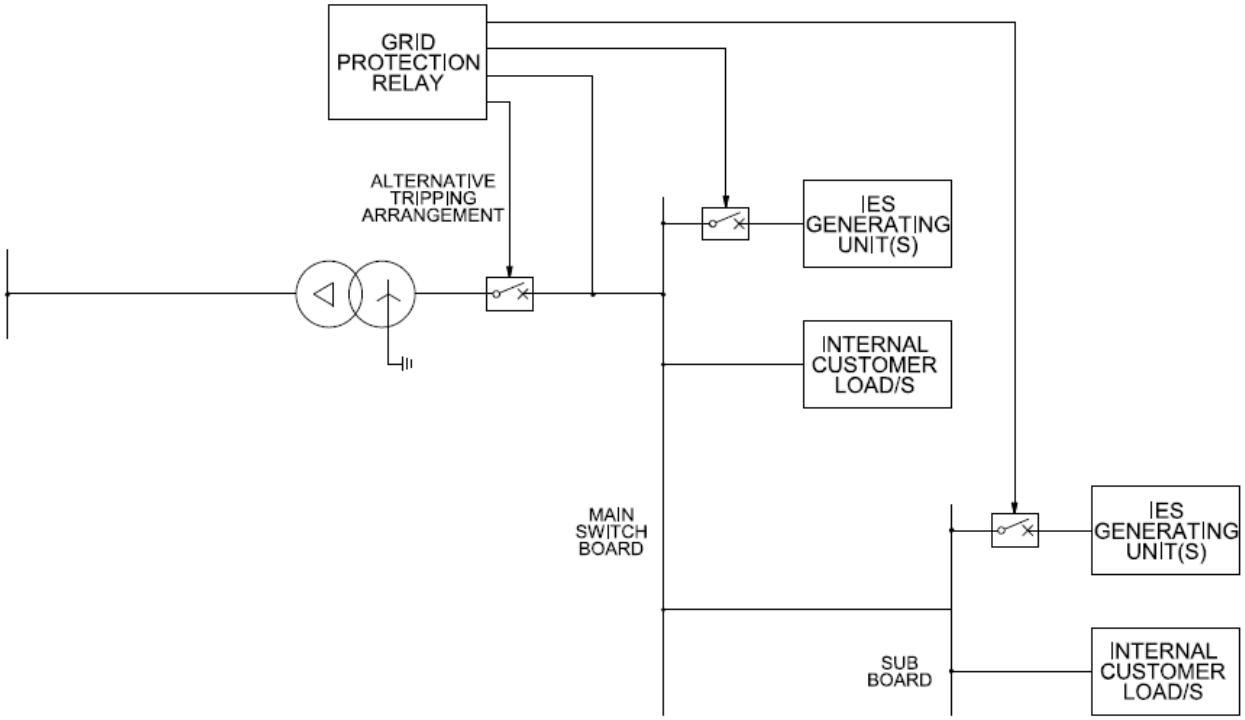


Figure 4: Protection arrangement for Dynamic EG Systems comprising IES EG unit(s)

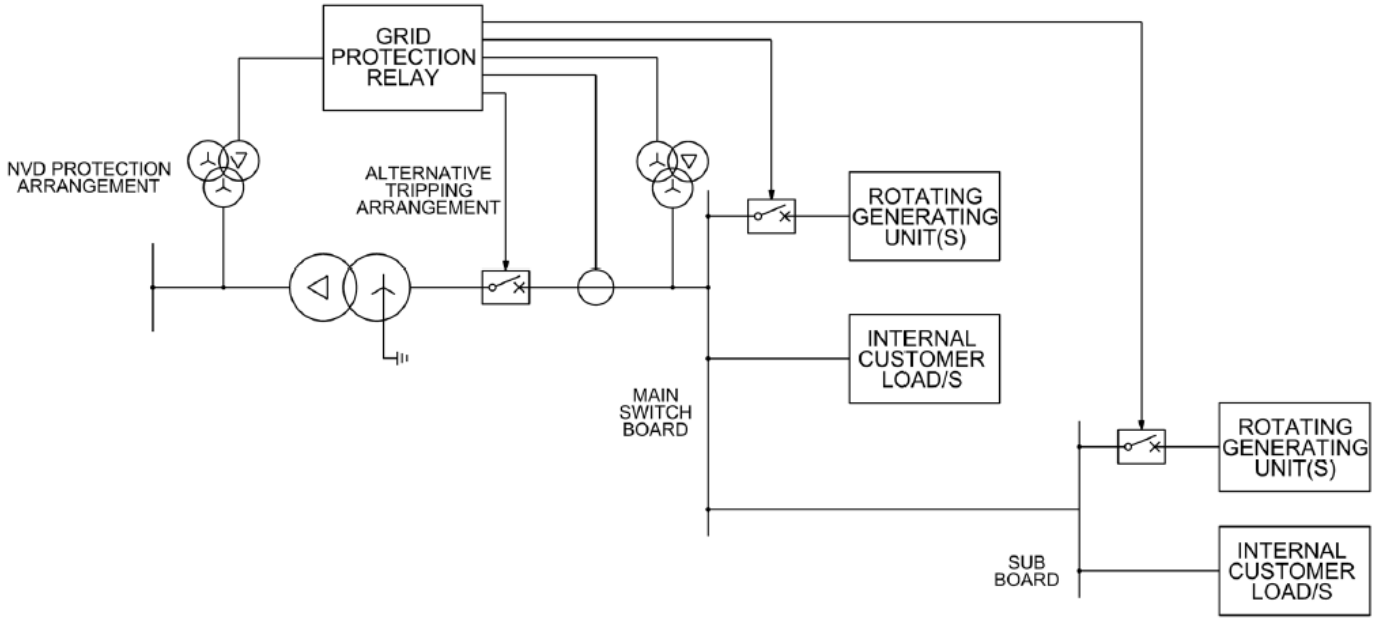


Figure 5: Protection arrangement for Dynamic EG Systems comprising rotating EG unit(s)

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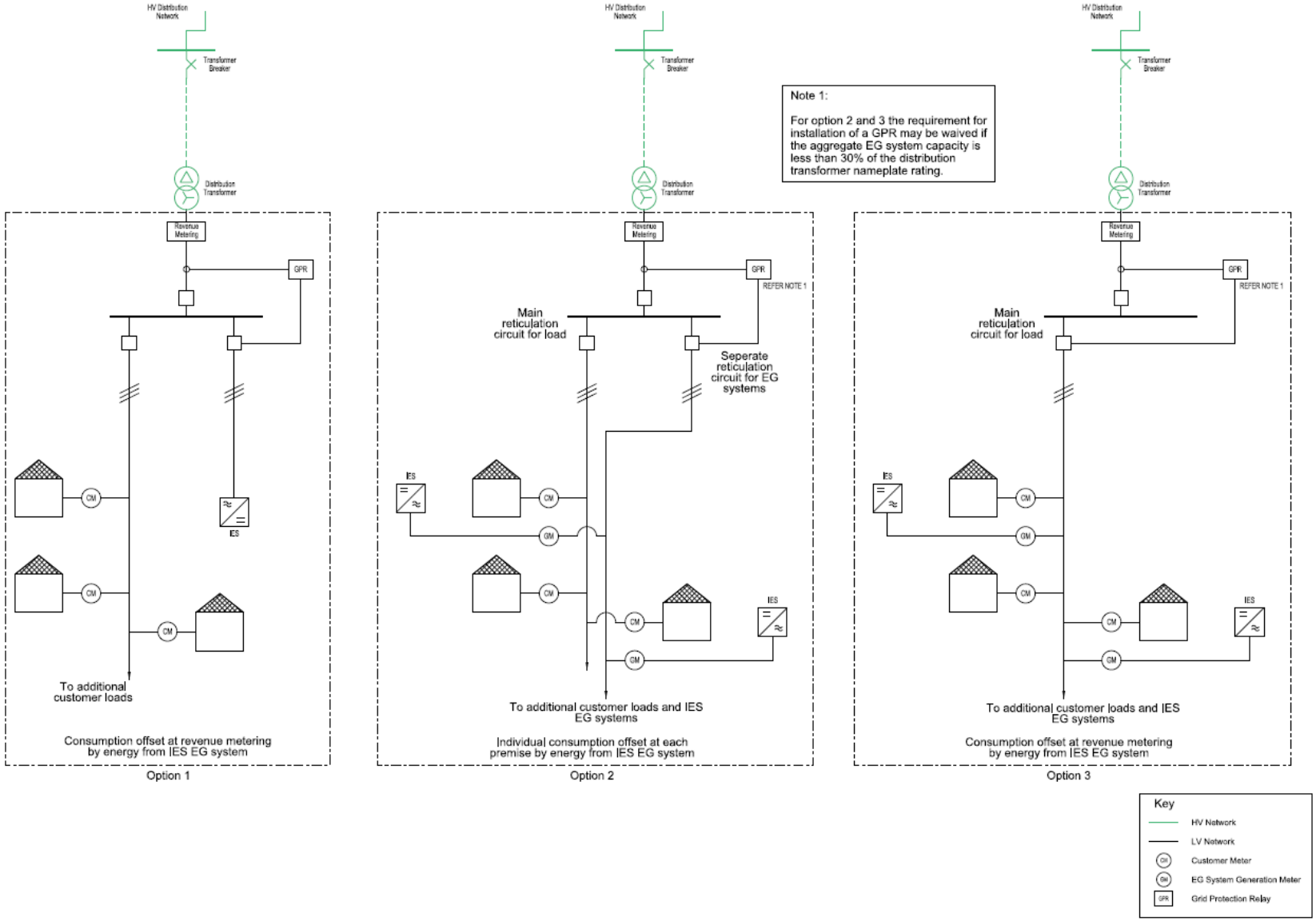

Figure 6: Protection arrangement for Dynamic EG Systems comprising IES EG unit(s)

Appendix C: Model Standing Offer (informative)

This section has been left intentionally blank.

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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. Detailed single line diagram demonstrating EG Units connected, and proposed for connection, at the Premise (including detail of any interlocking).
    b. Number of phases available and number of phases DER installed
    c. Energy source
    d. Maximum output rating
    e. Any proposed Export limit (full / partial / minimal) and method of Export control
    f. 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

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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 your application type and may include some of the following below (but not limited to):

Table 22 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 23 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).

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Appendix F: LV Dynamic EG Connection arrangement requirements summary (informative)

	> 30 kVA ≤ 1,500 kVA IES (3 Phase)				> 30 kVA ≤ 1,500 kVA Rotating Machines (3 Phase)			
	Shared transformer		Dedicated transformer		Shared or dedicated transformer			
					Limited Parallel operation		Continuous Parallel operation	
	Non-export	Export	Non-export	Export	Bumpless transfer	Stand-by (6 hr per 3 months)	Non-export	Export
Level 1 Backup protection[1]	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Level 2 Backup protection[2]	No	No	No	No	No	No	Yes[2]	Yes[2]
Grid reverse power protection	No	No	No	No	No	No	Yes	Yes
AS/NZS 4777.2 inverters required with active anti-islanding to AS/NZS IEC 62116 requirements	Yes	Yes	Yes	Yes	Not Applicable			
Distribution System capacity review required	No	Yes	No	Yes	No	No	No	Yes
Power quality to AS/NZS 61000 series requirements	Yes	Yes	Yes	Yes	No	Yes	No	Yes
Fault level contribution to the Distribution System included in the DNSP's Technical Study[3]	No	No	No	No	No	Yes	Yes	Yes
Compliant with SEP2 CSIP. Register EG System with SEP2 utility server	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
RPEQ design and commissioning plan	Yes	Yes	Yes	Yes	Yes[4]	Yes	Yes	Yes

1. Level 1 backup protection – Over and under voltage, over and under frequency and rate of change of frequency.
2. Level 2 backup protection – Neutral voltage detection/unbalance.
3. Fault current contribution is dependent on size, number and hours of operation
4. RPEQ commissioning is not required if there is no electronically controlled interlocking arrangement as per S 4.7.3 and transfer switch's standards compliance in S 4.5.1.

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