

# National Distributed Energy Resources Grid Connection Guidelines

Technical Guidelines for Medium Voltage and High Voltage  
EG Connections

ENA DOC 041-2019

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## Key Information

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# Documents of Energy Networks Australia

## History of Energy Networks Australia

Energy Networks Australia is the peak national body representing gas distribution and electricity transmission and distribution businesses throughout Australia. It began trading under this name on 10 November 2016 but commenced operations as the Energy Networks Association in January 2004.

With more than 13 million customer connections across the National Electricity Market (NEM), Australia's energy networks provide the final step in the safe and reliable delivery of gas and electricity to households, businesses and industries. This document helps protect the delivery of these services.

## Documents

Part of the role of Energy Networks Australia is the development and management of support material such as codes, specifications, guidelines and handbooks to support the energy industry and members of the public in the interpretation and application of legislation and standards. All documents are written in collaboration with the industry through working groups and general consultation with the members of Energy Networks Australia.

It should be noted that legislation and standards may alter between editions of Energy Networks Australia documents, and they will always take precedence. As such, all document users must be aware of the current regulatory environment.



## Definitions<sup>1</sup>

<b><i>Basic micro embedded generation connection</i></b>	<i>A connection between a distribution network and a retail customer’s premises for a micro embedded generating unit, for which a model standing offer is in place or an equivalent model offer is in place in jurisdictions not subject to Chapter 5A of the National Electricity Rules</i>
<b>Central protection</b>	Central protection is the protection installed to perform the functions of; coordinating multiple EG unit installations at one site, providing protection for the entire EG system installation and islanding protection to the connected grid as well as preserving safety of grid personnel and the general public
<b>Connection point</b>	The agreed point of supply established between the distribution network service provider and generator, where the meter is installed as close as possible to this location
<b><i>Embedded generating unit</i></b>	<i>A generating unit connected within a distribution network and not having direct access to the transmission network</i>
<b>Embedded generating system</b>	A system comprising multiple <i>embedded generating units</i> , protection systems and control systems
<b>Distributed Energy Resources</b>	Power generation or energy storage units that are connected directly to the distribution network
<b>Energy storage unit</b>	Plant that is able to both, store electricity from, and discharge electricity to, units within the same generating system and/or distribution network (i.e. act as both a load and a generating unit)
<b>Energy storage system</b>	A system comprising one or more energy storage units
<b><i>Generating system</i></b>	<i>A system comprising one or more generating units</i>
<b><i>Generating unit</i></b>	<i>The plant used in the production of electricity and all related equipment essential to its functioning as a single entity.</i>
<b><i>Generation</i></b>	<i>The production of electrical power by converting another form of energy in a generating unit</i>
<b><i>Generator</i></b>	<i>A person who owns, operates or controls a generating unit</i>
<b>Grid isolation device</b>	A device designed to safely break voltage and current such as a circuit breaker or contactor on the customer side of the connection
<b>Inter-trip</b>	For the purpose of this guideline; an anti-islanding protection scheme via a Supervisory Control and Data Acquisition system that is operated by the distribution network service provider to disconnect the embedded generating system when a grid fault occurs

<sup>1</sup> Definitions in italics are consistent with the definitions under the National Electricity Rules

<b>Inverter energy system</b>	A system consisting of one or more inverters that connect to the grid and operate by converting direct current to alternating current. In the context of system capacity, this definition includes the capacity of AC coupled energy storage systems
<b>Low voltage</b>	Any voltage lower than 1 kV AC, that is, the mains voltage as most commonly used in any given network by domestic and light industrial and commercial consumers (typically 230V measured between phase and neutral, or 400V measured between phases for two or three phase supplies)
<b>Medium voltage/ High voltage</b>	Any voltage greater than 1 kV AC
<b>Medium voltage/ High voltage embedded generation connection</b>	Means a connection between an embedded generating unit and a medium voltage/ high voltage network for which the embedded generating system is not required to be, or is exempt from being, registered in the National Electricity Market or Wholesale Electricity Market, or is within other jurisdictions and is typically < 5 MVA
<b>Micro embedded generation connection</b>	<i>Means a connection between an embedded generating unit and a distribution network of the kind contemplated by Australian Standard AS 4777 (Grid connection of energy systems via inverters)</i>
<b>Market generating unit</b>	<i>A generating unit whose generation is not purchased in its entirety by a retailer or by a customer located at the same connection point (and for which the Generator receives payment for generation through the National Electricity Market or Wholesale Electricity Market)</i>
<b>Model standing offer</b>	<i>A document approved by the Australian Energy Regulator as a model standing offer to provide basic micro embedded generation connection services or standard connection services which contains (amongst other things) the safety and technical requirements to be complied with by the proponent. This definition also applies to an equivalent model offer for jurisdictions not subject to Chapter 5A of the National Electricity Rules</i>
<b>Model connection agreement</b>	A document that is a model standing offer, or an equivalent document that may or may not be approved by the Australian Energy Regulator, and that is used to provide a basis for low voltage or medium voltage and high voltage embedded generation connection services. The document contains (amongst other things) the safety and technical requirements to be complied with by the proponent
<b>Network isolation</b>	Means of isolation from the electricity network
<b>Non-inverter energy system</b>	A system consisting of one or more synchronous or asynchronous generating units that do not connect to the grid via inverters
<b>Proponent</b>	A person proposing to become a generator (the relevant owner, operator or controller of the generating unit (or their agent))
<b>Registered generator</b>	<i>A person who owns, operates or controls a generating unit that is connected to, or who otherwise supplies electricity to, a transmission or distribution system and who is registered by the Australian Energy Market Operator as a Generator under Chapter 2 of the National Electricity Rules</i>
<b>Simplified short circuit ratio</b>	Calculation of the simplified short circuit ratio $SCR = S_{CMVA} / P_{max}$ Where:

	<p><math>S_{CMVA}</math> is the minimum sub-transient fault contribution of the studied bus prior to the proposed connecting embedded generating system</p> <p><math>P_{max}</math> is the maximum inverter capacity of the proposed asynchronous (power electronic converter based) capacity</p>
<b>Site generation limit</b>	The generation threshold that the embedded generation system cannot exceed, measured downstream of the connection point
<b>Small generation aggregator</b>	<i>A person who has classified one or more small generating units as a market generating unit</i>
<b>Small registered generator</b>	<i>A generator who elects to register as a generator with the Australian Energy Market Operator as a market generating unit who would otherwise be entitled to an exemption to register based on size</i>
<b>Standard connection</b>	<i>A connection service (other than a basic micro embedded generation connection service) for a particular class (or sub-class) of connection applicant and for which an AER approved model standing offer is in place or for which an equivalent model offer is in place in jurisdictions not subject to Chapter 5A of the National Electricity Rules</i>
<b>System capacity</b>	Nameplate ratings of the inverter energy system or non-inverter energy system, measured in VA
<b>Total system capacity</b>	Sum of the nameplate ratings of inverter energy systems and non-inverter energy systems comprising the embedded generation connection, measured in VA
<b>Technical requirements document</b>	The document produced by each Distribution Network Service Provider setting out their requirements for proponents to enable a grid connection, to which these guidelines apply
<b>Type testing</b>	Factory acceptance testing of embedded generating system components prior to dispatch from the manufacturer with compliance outlined within a test report for the type test

## Abbreviations

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<b>AC</b>	Alternating current
<b>AEMC</b>	Australian Energy Market Commission
<b>AEMO</b>	Australian Energy Market Operator
<b>AER</b>	Australian Energy Regulator
<b>AS/NZS</b>	A jointly developed Australian and New Zealand Standard
<b>AS</b>	Australian Standard
<b>CEC</b>	Clean Energy Council
<b>CPEng</b>	Chartered Professional Engineer of Engineers Australia
<b>DC</b>	Direct Current
<b>DER</b>	Distributed Energy Resources
<b>DNSP</b>	Distribution Network Service Provider
<b>EG</b>	Embedded Generation or Embedded Generating
<b>ESS</b>	Energy Storage System
<b>FAT</b>	Factory acceptance testing
<b>GDL</b>	Generation Dispatch Limiter
<b>HV</b>	High voltage
<b>IEC</b>	International Electrotechnical Commission
<b>IES</b>	Inverter Energy System
<b>LV</b>	Low voltage
<b>MV</b>	Medium voltage
<b>NBN</b>	National Broadband Network

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<b>NEM</b>	National Electricity Market
<b>NER</b>	National Electricity Rules
<b>NMI</b>	National Metering Identifier
<b>PV</b>	Photovoltaic
<b>ROCOF</b>	Rate of Change of Frequency
<b>RPEng</b>	Registered Professional Engineer of Professionals Australia
<b>RPEQ</b>	Registered Professional Engineer of Queensland
<b>SCADA</b>	Supervisory Control and Data Acquisition
<b>SCR</b>	Short Circuit Ratio
<b>SWIS</b>	South West Interconnected System
<b>WEM</b>	Wholesale Electricity Market servicing the SWIS
<b>xDSL</b>	X Digital Subscriber Line

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## Foreword

The electricity industry in Australia is undergoing a transformation from a centralised system of generation, transmission and distribution, dominated by relatively few participants, to a system of increasing decentralisation. The transformation is being largely driven by technological change in renewables and DER, enabling a broader range of stakeholders, including retail customers, to connect to and participate in existing and emerging energy markets.

As a result, network businesses are transforming from network service providers, facilitating one-way flow, to a customer connection provider, facilitating two-way flows between multiple distributed generating units and loads. The rate of transformation varies between networks due to the rate of uptake of DER and differing characteristics of network types.

Each network has responded to these challenges independently, resulting in a range of technical requirements and connection processes which, although consistent with regulatory requirements, result in some inconsistencies between networks and a lack of clarity for proponents. These issues have been identified as a major concern by stakeholders in numerous industry reports and reviews including the CSIRO/Energy Networks Australia's Energy Network Transformation Roadmap<sup>2</sup>, and the Clean Energy Council's Future Proofing Australia's Distribution Networks<sup>3</sup>.

These National DER Connection Guidelines have been developed in response to the needs identified in the abovementioned studies.

Energy Networks Australia, in partnership with the AEMO, is separately undertaking consultation on its '*Open Energy Networks*' project. Open Energy Networks proposes options for improving the electricity system to ensure household solar PV and ESS work in harmony and deliver the most value for all customers. The consultation has identified the need for common standards and protocols for active DER but is yet to develop specific technical requirements. It is envisaged that the outcomes of the Open Energy Networks consultation will be incorporated in future iterations of these National DER Connection Guidelines.

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<sup>2</sup> <http://www.energynetworks.com.au/electricity-network-transformation-roadmap>

<sup>3</sup> <http://fpdi.cleanenergycouncil.org.au/reports/grid-connection-standards-scoping-study.html>

## About the National DER Connection Guidelines

The National DER Connection Guidelines set out the framework, principles, approach and technical settings for Australian DNSPs to adopt in the development and application of their technical requirements for grid connection of DER. The ultimate aim of the guidelines is to facilitate the efficient integration of DER into the grid from the perspective of networks, renewable energy proponents and Australia's electricity system more generally.

In preparing these guidelines, Energy Networks Australia has consulted broadly with industry including: the AEMO, the AEMC, state and federal governments and the Clean Energy Council as well as each of the fourteen DNSPs across Australia, who are our member organisations.

### Objectives of the Guidelines

The objectives of the guidelines are to:

1. Give rise to clear, complete and accessible technical requirements for grid connection for each DNSP
2. Provide for a level of consistency between DNSPs' technical requirements for grid connection in terms of both structure of presentation and the requirements themselves
3. Ensure that DNSPs' technical requirements give regard to the long-term interest of consumers by appropriately balancing the economic benefits, costs and risks that the requirements impose upon their network, proponents and Australia's electricity system more generally; consistent with the National Electricity Objective to:

*"Promote efficient investment in, and efficient operation and use of, electricity services for the long-term interests of consumers of electricity with respect to: price, quality, safety and reliability and security of supply of electricity and; the reliability, safety and security of the national electricity system"*

4. Establish a platform for DNSPs to develop common standards and protocols for future management of active DER.

### Structure of the Guidelines

The guidelines are separated into four distinct documents:

1. **Framework and Principles guideline** – Specifies the number, scope and structure of the DNSP's technical requirements documents which all DNSPs shall develop as well as the principles DNSPs shall adopt in setting technical requirements
2. **Basic micro EG connection technical guidelines** – Specifies how DNSPs shall develop and apply technical requirements for the connection of a micro EG unit with a total system capacity set by DNSPs as: a value that is greater than or equal to 5 kVA for single-phase IES (excluding DC-coupled ESS), and a separate value that is less than or equal to a total system capacity of 30 kVA for three-phase IES (excluding DC-coupled ESS) to an LV distribution network
3. **LV EG connection technical guidelines** – Specifies how DNSPs shall develop and apply technical requirements for the connection of an EG unit or EG system (which is not a basic micro EG unit) to a LV distribution network
4. **MV/HV EG connection technical guidelines (this document)** – Specifies how DNSPs shall develop and apply technical requirements for the connection of an EG unit or EG system to a MV/HV distribution network, for which the EG unit or EG system is not required to be registered in the NEM or WEM, is within other jurisdictions and is < 5 MVA, or for which the EG unit or EG system

in the NEM or WEM has a specific exemption issued by the market operator in the relevant jurisdiction from being registered as a generator.

## How to Comply with the Guidelines

Compliance to the ENA DER Connection Guidelines is not legally required by DNSPs, however, all DNSPs have communicated an intention to adopt the requirements of the guidelines. To be deemed to comply with the guidelines, DNSPs shall:

- Structure their technical requirements documents consistent with the framework and principles set out in the Framework and Principles guideline
- Develop and apply technical requirements set out in the technical guidelines as relevant.

Where DNSPs choose to adopt an alternative setting, structure or approach, they shall still be deemed to comply so long as the deviation is set out and justified.

Justification shall include:

- That the alternative setting is required to respond to a jurisdictional legislative or regulatory requirement and/or
- That the alternative setting promotes improved benefits to Australia's electricity system (in terms of both network and proponent benefits, risks and costs).

Each deviation shall be listed in a table within the appendix of the DNSPs' technical requirements document, consistent with the format provided in Appendix A: Deviations from the National DER Connection Guidelines. The full justification shall be published separately on the DNSP's website and hyperlinked from the deviation table where appropriate.

## Terminology

In these guidelines the following terminology is used:

- The word *shall* indicates that adopting the setting or approach is mandatory in order for DNSPs to be deemed to comply with these guidelines
- The word *may* indicates an optional setting or approach that DNSPs shall consider. DNSPs will still be deemed to comply with the guidelines if they do not adopt that setting.

## Relationship to Other Documents

The guidelines are intended to be consistent with and to complement existing legislation and regulations.

To the extent that the application of these guidelines results in any inconsistency between existing legislation and regulations, and DNSPs' technical requirements, existing legislation and regulations shall prevail. The implications of any inconsistency on DNSP's ability to comply with these guidelines shall be set out within a table of deviations as per Appendix A: Deviations from the National DER Connection Guidelines.

These guidelines are also intended to be consistent with relevant Australian/International Standards and Industry Codes. In some cases, these guidelines require DNSPs to apply additional requirements or additional specificity beyond Australian/International Standards and Industry Codes. Any inconsistency shall be interpreted as deliberate and shall not be used as justification for a deviation.



# Preparing MV/HV EG Connection Technical Requirements

DNSPs shall produce a technical requirements document for MV/HV EG connections that:

1. Follows the structure and content as detailed in these guidelines
2. Includes the terms “Medium Voltage/ High Voltage or MV/HV EG Connection Technical Requirements” in their key search terminology for their technical requirements document
3. Includes the terms “*Medium Voltage/ High Voltage EG Connection Technical Requirements*” in the title of the technical requirements document. The document title may include other terms where required for consistency with the DNSP’s document classification system.

## 1 Introduction

This section shall include an introduction to the DNSP’s technical requirements document that provides proponents with an overview of the technical requirements for the equipment and installation of MV/HV EG connections to the DNSP’s MV/HV network, including:

1. The definition of an MV/HV EG connection, consistent with the definition provided within the Framework and Principles guideline being:  
*“An MV/HV EG connection that is an IES or non-IES network connection for which the EG system is:*
  - a. *not required to be or is exempt from being registered in the {insert the electricity market within which the DNSP operates which is either the NEM, WEM or another jurisdiction}*
  - b. *an IES or non-IES network connection that typically has a system capacity of less than {insert the maximum total system capacity of the market generating unit defined by the market operator<sup>4 5</sup> in the relevant jurisdiction, and 5 kVA for all other jurisdictions}*
  - c. *connected to, and capable of operating in parallel with, any part of the MV/HV distribution network*
  - d. *meeting all other technical requirements set out in this document”*
2. The purpose of the DNSP’s technical requirements document, being:  
*“to provide proponents of MV/HV EG connections, information about their obligations for connection to and interfacing with the MV/HV distribution network”*
3. An outline of the scope of connections to which the DNSP’s technical requirements document applies, being:
  - a. New connections of MV/HV EG systems or modifications to existing MV/HV EG systems, where the MV/HV EG system consists of IES, non-IES, ESS or a combination of these

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<sup>4</sup> <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Participant-information/New-participants/Exemption-and-classification-guides>

<sup>5</sup> <https://www.erawa.com.au/electricity/electricity-access/western-power-network/technical-rules/approved-technical-rules>

- b. Temporarily connected EG systems
4. An outline of the scope of EG units to which the DNSP's technical requirements document does NOT apply, being:
  - a. EG units covered by the DNSP's Basic Micro EG Connection Technical Requirements
  - b. EG units covered by the DNSP's LV EG Connection Technical Requirements
  - c. Electric vehicles, unless the on-board battery storage system is capable of exporting to the MV/HV network (in which case the requirements shall apply)
  - d. DER units that are not capable of generating electricity including demand response/demand management systems, unless they impact on the ability of the MV/HV EG system to meet the technical requirements
  - e. EG units that are registered within the NEM, WEM, or other jurisdictions
  - f. EG units directly connected to the transmission network
5. The general obligations of proponents, including:
  - a. The obligation to comply with the technical requirements as well as relevant national standards, industry codes, legislation and regulations. The instrument that shall prevail in the event of any inconsistency shall be the legislation and regulations, followed by the DNSP's technical requirements document, followed by national standards and industry codes
  - b. The obligation to not add additional inverters, make modifications or install additional MV/HV EG units, including ESS, without prior written agreement from the DNSP
  - c. The obligation to comply with the DNSP's connection agreement
  - d. The obligation to meet the requirements in the design, installation, operation and maintenance of the MV/HV EG system
  - e. The obligation to meet the connection, commissioning, operations and maintenance requirements to the MV/HV distribution network
6. A statement of acknowledgement from the DNSP of their obligations to ensure the safe and reliable operation of the distribution system for operating personnel, customers and the general public
7. A statement that the technical requirements comply with the National DER Connection Guidelines for MV/HV EG Connections, with the exception of the deviations presented in Appendix A: Deviations from the National DER Connection Guidelines
8. A reference to the connection process in a separate schedule or reference document that is to be appropriately linked in this section.

## 2 Definitions and Abbreviations

### 2.1 Definitions

This section shall provide a tabulated list of definitions for any technical or industry terms used throughout the DNSP's technical requirements document. The definitions shall be consistent with the definitions provided within the National DER Connections Guidelines (including these technical guidelines and the Framework and Principles Guideline) as relevant.

## 2.2 Abbreviations

This section shall provide a tabulated list of all abbreviations used throughout the DNSP's technical requirements document.

## 2.3 Terminology

This section shall outline how instructional terms are to be interpreted, being:

1. The word 'shall' indicates a mandatory requirement
2. The word 'may' indicates a requirement that may be mandatorily imposed on the proponent
3. The word 'should' indicates a recommendation that will not be mandatorily imposed on the proponent.

### 2.3.1 Subcategories

This section shall state the subcategories for which different technical settings may apply, being:

1. MV/HV EG IES connection – Any EG system with a total system capacity less than *{insert the maximum total system capacity of the market generating unit defined by the market operator<sup>6 7</sup> in the relevant jurisdiction, and 5 kVA for all other jurisdictions}* or with a total system capacity greater than or equal to *{insert the maximum total system capacity of the market generating unit defined by the market operator<sup>8 9</sup> in the relevant jurisdiction, and 5 kVA for all other jurisdictions}* but that has a specific exemption issued by *{insert market operator in the relevant jurisdiction}* for a three-phase IES MV/HV distribution network connection, meeting all relevant technical requirements set out in the DNSP's technical requirements document.
2. MV/HV EG non-IES connection – Any EG system that is synchronous or asynchronous with a total system capacity less than *{insert the maximum total system capacity of the market generating unit defined by the market operator<sup>10 11</sup> in the relevant jurisdiction, and 5 kVA for all other jurisdictions}* or with a total system capacity greater than or equal to *{insert the maximum total system capacity of the market generating unit defined by the market operator<sup>12 13</sup> in the relevant jurisdiction, and 5 kVA for all other jurisdictions}* but that has a specific exemption issued by *{insert market operator in the relevant jurisdiction}* for a three-phase non-IES MV/HV distribution network connection, meeting all relevant technical requirements set out in the DNSP's technical requirements document.

Where:

1. Proponents wishing to connect a system at or near the maximum MV/HV EG total system capacity shall contact the DNSP to determine any additional requirements as a non-registered generator or a generator exempt from being registered

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<sup>6</sup> Ibid footnote 4

<sup>7</sup> Ibid footnote 5

<sup>8</sup> Ibid footnote 4

<sup>9</sup> Ibid footnote 5

<sup>10</sup> Ibid footnote 4

<sup>11</sup> Ibid footnote 5

<sup>12</sup> Ibid footnote 4

<sup>13</sup> Ibid footnote 5

2. Exporting systems shall be considered to be MV/HV EG systems operating in parallel with the MV/HV distribution network and exporting electricity either via partial-export or full-export into the MV/HV distribution network, where:
  - a. Partial-export MV/HV EG systems limit the amount of export into the MV/HV distribution network to an agreed export threshold defined in the connection agreement
  - b. Full-export MV/HV EG systems can export into the MV/HV distribution network to the full MV/HV EG total system capacity (maximum continuous AC rating).
3. Non-exporting systems shall be considered to be MV/HV EG systems operating in parallel with the MV/HV distribution network that are not approved to, and are limited to ensure they cannot, export electricity into the MV/HV distribution network.

This section shall also provide contact details in case there is any doubt as to which subcategory applies.

The technical requirements set out in these guidelines should be interpreted as applying to all subcategories of MV/HV EG connections unless otherwise specified.

## 3 Relevant Rules, Regulations, Standards and Codes

### 3.1 Standards and Codes

This section shall provide a list of all the Australian and international standards and industry codes which shall apply to the design, manufacture, installation, testing and commissioning, and operation and maintenance of all plant and equipment for MV/HV EG connections to the distribution network.

This section shall be consistent with the standards provided within the Framework and Principles guideline and shall only include those relevant to the DNSP's jurisdiction.

This section shall also state that in the event of any inconsistency between Australian and international standards and industry codes, and the DNSP technical requirements, the DNSP technical requirements shall prevail.

### 3.2 Legislation and Regulation

This section shall provide a list of all the relevant legislation and regulations which shall apply to the design, manufacture, installation, testing and commissioning, and operation and maintenance of all plant and equipment for MV/HV EG connections to the distribution network.

This section shall be consistent with the legislation and regulation provided within the Framework and Principles guideline and shall only include those relevant to the DNSP's jurisdiction.

This section shall also state that in the event of any inconsistency between legislation and regulations, and the DNSP technical requirements, the legislation and regulations shall prevail.

## 4 Technical Requirements

### 4.1 Labelling and Signage

This section shall specify that the labels and signs on the installation, including cables, shall be as per AS/NZS 2067, AS/NZS 5033, jurisdictional requirements, and preferably as per AS/NZS 4777.1 (where applicable).

In addition, this section may provide further specificity, including but not limited to:

1. Additional descriptors of the EG unit or EG system
2. Details as to where within the installation and/or the DNSP's equipment the labelling and signage should be placed.

Any requirements which are additional to AS/NZS 2067, AS/NZS 5033 and AS/NZS 4777.1 shall be clearly stated as such.

### 4.2 Maximum System Capacity

This section shall specify that for IES and/or non-IES, the maximum system capacity at the same connection point shall be determined at the time of application but shall be typically less than *{insert maximum MV/HV total system capacity of market generating unit, as is set out within the NEM or WEM registration guides}*.

This section shall specify that for DC-coupled ESS, there is no limit placed on the maximum system capacity installed.

### 4.3 Generation Control

This section shall specify that generation control requirements may apply depending on the outcome of steady-state studies as outlined within section 4.14 Technical Studies of this document.

#### 4.3.1 Export Limits at Connection Point

This section shall specify that where an export limit is assessed by the DNSP to be required or is requested by the proponent, it shall be determined at the time of application considering the following factors, including:

1. Steady-state study Existing asset ratings
2. Existing power quality at the relevant network location
3. Existing and forecast DER penetration at the relevant network location.
4. Existing demand at peak generation
5. Existing protection system capability and performance.

This section shall further specify the following:

1. Whether an indicative export limit will be provided at the enquiry stage
2. That export limits, where applied, shall be specified as "soft", a limit that will cause the IES or non-IES to reduce its output and prevent ongoing export greater than the limit, and/or "hard", a limit that will cause the connection to disconnect from the network
3. That the export limit is to be interpreted by the proponent as a maximum. The ability of the proponent's MV/HV EG system to export at the export limit is not guaranteed, but rather, it will

depend upon scenarios where output may need to be constrained and network characteristics which change over time

4. Descriptions of those scenarios where output may need to be constrained, including, but not limited to, power output where power quality response modes are in operation or where local runback schemes are in operation
5. Whether generation control requirements will be specified in this section and where these are required, descriptions of the generation control requirements
6. An estimate of the likelihood of constraints occurring and the impact on the proponent's overall export volumes may be provided at the time of connection application.

#### 4.3.2 Site Generation Limit Downstream of Connection Point

This section shall specify that where a site generation limit in addition to an export limit is assessed by the DNSP to be required or is requested by the proponent, it shall be determined at the time of application considering the following factors, including:

1. Retail and market operations
2. Existing asset ratings
3. Existing power quality at the relevant network location
4. Existing demand at peak generation
5. Existing and forecast DER penetration at the relevant network location.

This section may recommend generation control requirements.

Where the DNSP does not have site generation limit requirements, this section shall be retained, but noted as intentionally blank.

#### 4.4 Inverter Energy Systems

This section shall state the requirements that apply to IES, including:

1. IES EG units connected to MV/HV networks shall comprise of inverters that are:
  - a. If used in solar PV systems: type tested and certified as being compliant with an accreditation number or certificate of suitability as evidence of compliance to IEC 62116 for anti-islanding protection
2. IES EG units shall comprise of inverters that have the following inverter power quality response modes available:
  - a. Reactive power control mode
  - b. Central control mode via a master/slave system
  - c. Volt response modes (i.e. volt-var and volt-watt)
  - d. Fixed power factor or reactive power mode
  - e. Power rate limit (i.e. ramp rate control)
3. IES EG units generating at LV shall comprise of inverters that are:
  - a. If used in solar PV systems: type tested and certified as being compliant with an accreditation number or certificate of suitability as evidence of compliance to IEC 62116 for anti-islanding protection

- b. Preferably tested by an authorised testing laboratory and certified as being compliant, with an accreditation number or certificate of suitability as evidence of compliance, to AS/NZS 4777.2
- c. Preferably registered with CEC as approved grid connect inverters
- d. Preferably installed in compliance to AS/NZS 4777.1 (where applicable).

## 4.5 Network Isolation

This section shall specify the network isolation requirements, including:

1. Operation and ownership of the network isolation device (i.e. the connection point recloser) shall lie with the DNSP. Where the proponent has ownership of the device, visibility and control over communications and SCADA shall be provided to the DNSP.

## 4.6 Earthing

This section shall specify the earthing requirements, including:

1. IES EG systems have earthing requirements as per AS/NZS 2067, AS/NZS 3010 and applicable jurisdictional requirements
2. Non-IES have earthing requirements as per AS/NZS 2067, AS/NZS 3010 and applicable jurisdictional requirements. Any additional requirements shall be clearly stated as such
3. ESS have earthing requirements as per AS/NZS 2067, AS/NZS 3010, AS 3011, AS 5139 and applicable jurisdictional requirements. Any additional requirements shall be clearly stated as such.

## 4.7 Protection

### 4.7.1 Inverter Integrated Protection

This section shall specify the inverter integrated protection requirements, including:

1. Under and over voltage limits
2. Under and over frequency limits
3. Active anti-islanding protection requirements
4. Phase balance protection (where applicable)
5. Synchronisation facilities (where ESS are in use).

Where applicable, inverter integrated protection requirements should preferably be as per AS/NZS 4777.2.

This section shall specify that the settings will be specified via the connection-specific technical assessment.

### 4.7.2 Central Protection

This section shall specify the protection requirements that apply, including:

1. Central protection for IES EG units that apply in addition to the inverter integrated protection requirements
2. Central protection for non-IES EG units.

This section shall reproduce Table 1 below, with further details as per sections 4.7.2.1 to 4.7.2.12 of this guideline.

Table 1 – Protection requirements

Protection Requirements	MV/HV EG IES	MV/HV EG non-IES
Passive anti-islanding:		
Under-voltage (27) and over-voltage (59)	✓	✓
Under-frequency (81U) and over-frequency (81O)	✓	✓
ROCOF (81R)	✓	✓
Vector shift (78)	–	–
Overcurrent facility fault, grid fault and earth fault (50/51)	✓	✓
Grid reverse power (32R) or grid low forward power (32F)	–	–
Synchronisation facilities (25)	–	✓
Generator phase balance protection (47)	–	✓
Generator pole slip	✗	–
Neutral voltage displacement (59N)	–	–
Inter-trip	–	–
DC system or UPS integration protection	✓	–
Failsafe tripping	–	–
Interlocking	–	–
Grid isolation device	✓	✓

Symbols are used to denote protection requirements, where:

- ✓ Represents that the protection shall be adopted by DNSPs and will be set by the DNSP as being ‘required’ for proponents to adopt
- Represents that the protection may be adopted by DNSPs and will be set by the DNSP as being either ‘required’, ‘not required’ or ‘may be required’ for proponents to adopt
- ✗ Represents that the protection shall not be adopted by DNSPs and will be set by the DNSP as being ‘not required’ for proponents to adopt.

#### 4.7.2.1 Passive Anti-islanding Protection

This section shall specify the passive anti-islanding protection requirements where applicable as per Table 1, including:

1. Under and over voltage limits
2. Under and over frequency limits
3. Rate of change of frequency



4. Vector shift.

This section shall further specify:

1. Whether ROCOF is required to be interlocked with vector shift protection
2. Ride-through considerations in the settings for passive anti-islanding protection
3. Protection settings will be determined via the connection-specific technical assessment.

#### 4.7.2.2 Overcurrent Facility Fault, Overcurrent Grid Fault and Earth Fault Protection

This section shall specify the overcurrent facility fault, overcurrent grid fault and earth fault protection requirements where applicable as per Table 1, including:

1. MV/HV EG IES connections shall include overcurrent facility fault or overcurrent grid fault, and earth fault protection
2. MV/HV EG non-IES connections shall include overcurrent facility fault, overcurrent grid fault and earth fault protection.

This section shall further specify:

1. Protection settings may be determined via the connection-specific technical assessment where deemed necessary to provide for network performance.

#### 4.7.2.3 Grid Reverse Power or Grid Low Forward Power Protection

This section shall specify the grid reverse power protection requirements or grid low forward power protection requirements where applicable as per Table 1, including:

1. Grid reverse power protection requirements:
  - a. Reverse power protection should be set as low as practicable with consideration of protection relay, CT accuracy and EG system synchronisation characteristics
  - b. Design of control systems should minimise reverse power flow immediately following synchronisation
  - c. Maximum disconnection time and trip delay time
  - d. Specific settings for grid reverse power protection shall be determined via a connection-specific technical assessment.
2. Grid low forward power protection requirements:
  - a. Unless an inter-trip is installed, non-exporting EG systems may include grid low forward power protection
  - b. Maximum disconnection time and trip delay time
  - c. Specific settings for grid low forward power protection shall be determined via a connection-specific technical assessment.

#### 4.7.2.4 Synchronisation facilities

This section shall specify the automatic synchronising and synchronisation check requirements where it is intended that parallel operation of a EG unit will occur, including:

1. MV/HV EG IES connections shall comprise of inverters with internal synchronisation facilities where ESS are in use
2. MV/HV EG non-IES connections shall have synchronisation facilities.

#### 4.7.2.5 Generator phase balance protection

This section shall specify the generator phase balance protection requirements where applicable as per Table 1, and set out as per sections 4.7.2.5.1 and 4.7.2.5.2.

##### 4.7.2.5.1 Current unbalance protection

This section may specify the current unbalance requirements set at the generator, including:

1. Threshold of current unbalance: maximum difference between any of the phase currents and the average value of phase currents (%)
2. Minimum limit of measured current as a percentage of nominal current, from which the current unbalance protection is enabled (%)
3. Delay of current unbalance protection (sec)
4. Specific settings for current unbalance protection shall be determined via a connection-specific technical assessment.

Where DNSPs do not adopt this requirement and do adopt voltage unbalance protection instead, this section shall state that there are no current unbalance protection requirements.

##### 4.7.2.5.2 Voltage unbalance protection

This section may specify the voltage unbalance requirements set at the connection point, including:

1. Threshold of voltage unbalance, i.e. amplitude asymmetry (%)
2. Undervoltage limit of the positive sequence (%)
3. Overvoltage limit of the negative sequence (%)
4. Delay of the voltage unbalance (amplitude asymmetry) protection (sec)
5. Direction of correct phase rotation (clockwise, counter-clockwise, any).

This section shall specify that the specific settings for voltage unbalance protection may be determined via a connection-specific technical assessment.

Where DNSPs do not adopt this requirement and do adopt current unbalance protection instead, this section shall state that there are no voltage unbalance protection requirements.

#### 4.7.2.6 Generator pole slip

This section shall specify generator pole slip requirements where applicable as per Table 1, including:

1. That a pole slip protection scheme should disconnect synchronous EG units following a loss of synchronism.

#### 4.7.2.7 Neutral Voltage Displacement

This section shall specify the neutral voltage displacement requirements where applicable as per Table 1, including:

1. That neutral voltage displacement protection may be determined to be required depending on the outcomes of a site-specific assessment by the DNSP
2. Scenarios under which neutral voltage displacement will always apply
3. Voltage transformer(s) requirements
  - a. The specifications for voltage transformer(s) components

- b. Installation requirements of the voltage transformer(s)
- c. Associated costs should be borne by the proponent
- d. Ownership and maintenance of the component should be held by the proponent.

#### 4.7.2.8 Inter-trip

This section shall specify the inter-trip protection function(s) and requirements where applicable as per Table 1, including:

1. That inter-trip protection may be required depending on the outcomes of a site-specific assessment by the DNSP
2. Responsibilities for the set-up and monitoring of the communication link between an EG system (specifically connecting to an interface panel on the customer's site) and the DNSP's data collection system
3. Interface requirements
4. Responsibilities for tripping the circuit breaker upon receiving the inter-trip signal
5. Actions that shall be undertaken by the DNSP should the communication link fail until such time when the link is restored
6. Actions that should be undertaken by the proponent should the communication link fail until such time when the link is restored
7. Responsibilities for including a tripping function of the EG system in the case where the DC supply to the protection scheme is lost.

#### 4.7.2.9 DC System or UPS Integration Protection

This section shall specify the DC system or UPS integration protection requirements where applicable as per Table 1, including:

1. The EG system shall be automatically disconnected where a failure in the DC system supply or UPS supply to the central protection and control systems is detected. Where there is a failure in the DC system supply or UPS supply to the HV incomer relay protection, an alarm shall automatically be issued and the EG system should not be disconnected
2. Scenarios in which protection schemes for MV/HV EG will require duplicate DC supplies (e.g. inter-tripping).

#### 4.7.2.10 Failsafe Tripping

This section shall specify the failsafe tripping requirements where applicable as per Table 1, including:

1. Failsafe tripping may be determined to be required depending on the outcomes of a site-specific assessment by the DNSP
2. Scenarios in which failsafe tripping may not be required.

#### 4.7.2.11 Interlocking

This section shall specify the interlocking requirements for sites with multiple sources of generation.

#### 4.7.2.12 Grid Isolation Device

This section shall specify the main switch grid isolation device requirements, including:

1. Ownership of the device should lie with the proponent
2. Jurisdictional requirements shall be clearly stated as such.

### 4.7.3 Protection Relay

This section shall specify the requirements of the protection relay for central protection, including:

1. Function of the protection relay
2. Specifications of the protection relay (i.e. utility grade, EG unit class and being subject to appropriate FAT testing of performance and accuracy)
3. Compliance of the protection relay to IEC 60255.

### 4.7.4 Additional Requirements for non-IES

This section shall specify additional protection functions that may be required for EG Non-IES beyond those specified within Table 1 to allow for the differences between synchronous and asynchronous generator technology and applications on the MV/HV network.

Where DNSPs do not adopt any additional non-IES requirement(s), this section shall state that there are no additional protection requirements.

### 4.7.5 Runback Schemes

This section may specify the requirements for runback schemes.

## 4.8 Operating Voltage and Frequency

This section shall specify the operating voltage and frequency requirements, including:

1. Operating voltage and frequency requirements of the connection point specifically for:
  - a. IES EG units, preferably as per AS/NZS 4777.2 (where applicable)
  - b. Non-IES EG units, as per AS/NZS 61000.3.7:2001, and/or AS/NZS 61000.3.100:2011, and/or jurisdictional requirements that shall be clearly stated as such
2. Under and over voltage limits as per section 4.7.2.1
3. Under and over frequency limits as per section 4.7.2.1
4. Nominated maximum voltage set point.

## 4.9 Metering

This section shall specify metering requirements for DNSPs in jurisdictions subject to Chapter 7 of the NER are as per Chapter 7 of the NER.

This section may specify jurisdictional metering requirements for DNSPs in jurisdictions which are not subject to Chapter 7 of the NER.

## 4.10 Power Quality

### 4.10.1 Quality of Supply

This section shall specify that the connection shall comply with the applicable power quality requirements of the AS/NZS 61000 series as well as relevant state-based regulations and licence conditions, including:

1. Network voltage control
2. Voltage fluctuations/step voltage
3. Harmonics
4. Voltage unbalance
5. Ramp rates preferably as per AS/NZS 4777 (where applicable) and in accordance to specific DNSP settings.

This section shall further specify the references to relevant standards, state-based regulations and license conditions for each requirement listed above.

### 4.10.2 Power Quality Response

This section shall specify that EG systems comprising IES EG units or synchronous non-IES EG units should manage power quality response through either:

1. Activating in-built power quality responses where the capabilities exist, with requirements as per sections 4.10.2.1 and 4.10.2.2
2. A central control mode via a master/slave system, with requirements as per sections 4.10.2.1 and 4.10.2.2.

This section shall further specify the considerations in the assessment of whether additional devices (e.g. STATCOM) may be required, including:

1. Whether there are in-built capabilities for power quality responses available
2. Load at the site
3. Generation capacity
4. If ramp rate control or flicker management is required for ESS.

#### 4.10.2.1 IES Power Quality Response Modes

This section shall specify either of the following IES power quality response modes as being required:

1. Voltage control modes enablement, including:
  - a. Response mode settings will be site-specific and determined depending on the outcomes of technical studies
  - b. Default settings, as an indication only, for the voltage control mode set-point values
  - c. Jurisdictional requirements that shall be stated as such.

OR

2. Fixed power factor mode enablement, including:
  - a. Response mode settings will be site-specific and determined depending on the outcomes of technical studies

- b. Default settings, as an indication only, for: achieving a power factor operating window at the connection point of *{insert default power factor setting}* lagging (i.e. absorbing) and not leading (i.e. not producing) unless otherwise agreed to by the DNSP
- c. Jurisdictional requirements that shall be stated as such.

#### 4.10.2.2 Non-IES Synchronous Power Quality Response

This section shall specify either of the following non-IES power quality response modes as being required:

1. Voltage control modes enablement, including:
  - a. That response mode settings will be site-specific and determined depending on the outcomes of technical studies
  - b. Default settings, as an indication only, for the voltage control mode set-point values
  - c. Jurisdictional requirements that shall be stated as such.

OR

2. Fixed power factor mode enablement, including:
  - a. That response mode settings will be site-specific and determined depending on the outcomes of technical studies
  - b. Default settings, as an indication only, for: achieving a power factor operating window at the connection point of *{insert default power factor setting}* lagging (i.e. absorbing) and not leading (i.e. not producing) unless otherwise agreed to by the DNSP
  - c. Jurisdictional requirements that shall be stated as such.

### 4.11 Communications Systems

This section shall set out the communications systems requirements, including:

1. EG systems with a net export less than or equal to 200 kVA may be set by the DNSP to have no communications systems requirements to adopt
2. EG systems with a net export greater than 200 kVA have the following communications systems requirements:
  - a. Continuous monitoring of current per phase, voltage per phase, active power flow and reactive power flow
  - b. The options for communication technology that may be adopted include the DNSP's private communications network (e.g. radio optical fibre) or third-party networks (e.g. 3G, 4G, xDSL, broadband, NBN, etc.) with appropriate cybersecurity measures as per section 4.13
  - c. The responsibilities for the set-up and monitoring of the communication link between the EG system and the DNSP's data collection system
  - d. The interface signal requirements for digital outputs and analogue outputs from the DNSP to the EG system and digital inputs and analogue inputs required from the EG system to the DNSP
  - e. The communication signal fail-safe scheme requirements for remote monitoring (telemetry) and control functionality at the master controller level or at the inverter level. Details of the requirements shall include timing and expected outcome (e.g. reduce GDL or cease exporting via permissive signalling)

- f. The communications equipment DC supply requirements and associated fail-safe schemes
- g. Any inter-trip communications requirements (if applicable) and the associated signal fail-safe scheme requirements. These requirements may include details such as availability, integrity monitoring and maximum latency
- h. The preferred data format/protocol for transmitting data to the DNSP (e.g. DNP3).

## 4.12 Data and Information

### 4.12.1 Static Data and Information

This section shall specify the static data and information that is required to be provided by the proponent to the DNSP as per Appendix D: Static Data and Information.

This section may specify the format and method for submitting the static data and information to the DNSP but shall not impose any additional communications systems requirements.

### 4.12.2 Dynamic Data and Information

This section shall specify the data format and protocol requirements for transmitting dynamic data and information to the DNSP and any other bodies, which proponents shall adopt where communications systems are in place.

## 4.13 Cybersecurity

This section shall set out the cybersecurity requirements for which a communication link between the DNSP's data collection system and the EG system is required.

Cybersecurity requirements shall include but not be limited to:

1. Ensuring EG monitoring and communications devices are in lockable enclosures
2. Controlled access to protection and control from the network systems (e.g. firewalls)
3. Privilege settings, firmware and password protection
4. Limiting access to only that which is required to monitor the EG unit
5. Implementing measures to ensure the integrity of communications channels and trust (i.e. use of encrypted tunnels and certificate-based authentication).

This section may specify the relevant standards and documents relating to cybersecurity (e.g. compliance to Australian Signals Directorate Essential Eight and Federal Government's Critical Infrastructure Centre for Operational Cyber Security).

## 4.14 Technical Studies

This section shall specify the technical studies requirements, including:

1. Steady state studies that may be undertaken and completed as part of the connection application process and as per jurisdictional requirements include:
  - a. Protection study
  - b. Harmonics, flicker and unbalance
  - c. Fault level

- d. Active and reactive power flow
- e. Voltage level (including additional voltage step change studies)
- f. Earthing study

This section shall also specify that an assessment of system strength through the steady state studies and a simplified SCR calculation (that considers nearby asynchronous EG connections) will be undertaken by DNSPs to determine whether additional studies will be required, including:

- a. The method of SCR calculation used by the DNSP to account for nearby asynchronous EG connections
  - b. Criteria for assessment of system strength:
    - i. If simplified  $SCR \leq 5$ , then dynamic studies may be required
    - ii. If simplified  $SCR > 5$ , then no further studies may be required unless outcomes of steady state studies reflect the need
2. Dynamic studies may be required depending on; the outcome of steady-state studies, whether there are non-standard design features of the proposed EG connection (e.g. STATCOM) and whether the connection is to a shared feeder. The dynamic studies may include:
- a. Transient/step frequency disturbance
  - b. Transient/step voltage fluctuation
  - c. Generator stability
  - d. Generator governor control/excitation control
  - e. Frequency response
  - f. Fault ride through

Where dynamic studies are undertaken by the proponent or their consultant, this section shall further specify:

- a. Modelling guidance (e.g. format)
  - b. That due diligence should be undertaken by the DNSP or DNSP-assigned consultant
  - c. That the site-specific dynamic model shall be provided by the proponent to the DNSP
  - d. That the site-specific dynamic model shall comply with jurisdictional requirements that shall be clearly stated as such
3. The DNSP shall nominate which technical studies may be completed by:
- a. The DNSP
  - b. The proponent
  - c. Either the DNSP or proponent
4. For each technical study that shall or may be undertaken by the proponent, this section shall state the following and may be presented in a separate schedule or reference document that is to be appropriately linked in this section:
- a. The relevant inputs to be provided by the DNSP
  - b. The outputs required from the proponent
  - c. The criteria against which the study shall be assessed by the DNSP



5. For each technical study that is undertaken by the DNSP, the DNSP shall outline the following and may present this in a separate schedule or reference document that is to be appropriately linked in this section:
  - a. The relevant inputs to be provided by the proponent
  - b. The estimated time and cost to complete the study
  - c. The outputs provided
  - d. The criteria against which the study shall be assessed by the DNSP
6. Where one or more of the technical studies do not meet the assessment criteria, the DNSP shall provide the proponent with an alternative option which may include:
  - a. Alternative configurations of the EG systems (e.g. lower generation control limits)
  - b. Network augmentation (and associated cost of network augmentation).

## 5 Fees and Charges

This section shall specify fees and charges applicable to proponents and any jurisdictional requirements including:

1. The types of connection fees that shall be applied
2. Any ongoing charges applicable regarding the installation and operation of the EG system while maintaining the connection to the distribution network and how these are determined
3. The fee payable and/or how the fees are determined
4. How the fees are to be paid by the proponent.

This section may provide hyperlinked website addresses with short descriptions where information is published separately on the DNSP's website.

## 6 Testing and Commissioning

This section shall specify testing and commissioning requirements, including:

1. Testing and commissioning plans will require the following:
  - a. Commissioning to occur only after installation of metering and communications systems (e.g. SCADA) equipment
  - b. Tests and checks to:
    - i. Confirm that the single line diagram accurately reflects the installed system and is located on site
    - ii. Confirm that the system and components are as per specifications (i.e. switchgear, transformers, IES, non-IES)
    - iii. Describe the shutdown procedures
    - iv. Outline the communications settings and performance
    - v. Confirm the export limits settings and performance (only for exporting or partially exporting)

- vi. Confirm the power quality settings, performance and observations (as per DNSP's requirements)
  - vii. Test the protection settings, performance and compliance to relevant standards (e.g. anti-islanding, synchronising, tamper-proofing, control system settings, control system firmware versions and failsafe protection)
  - viii. Test the earthing connections settings and compliance to AS 2067 and relevant jurisdictional requirements
  - ix. Test voltage fluctuations
  - c. Documented operating procedures including requirements for preserving the integrity of protection settings and interlocks and procedures for subsequent changes to settings
  - d. Signs/labels/safety warnings
  - e. Operating personnel to be appropriately trained such that they are familiar with operating procedures
  - f. Additional installation-specific tests and installations relevant for parallel operation of the EG and coordination with the distribution network (e.g. runback schemes; rerating; additional performance testing such as ride-through/network disturbance)
2. Testing and commissioning plans are required to be produced and are specified by the DNSP to be produced by either:
    - a. The proponent (a suitably degree-qualified engineer), or
    - b. The DNSP approved suitably qualified person, or
    - c. The CPEng, RPEng or equivalent RPEQ (only in Queensland) engaged by the proponent
  3. Testing and commissioning plans may be required by the DNSP to be signed off prior to forming a connection agreement and specified by the DNSP to be signed off by either:
    - a. The DNSP approved suitably qualified person, or
    - b. The CPEng, RPEng or equivalent RPEQ (only in Queensland) engaged by the proponent
  4. Testing and commissioning acceptance is required and specified by the DNSP to be signed off by either:
    - a. The CPEng, RPEng or equivalent RPEQ (only in Queensland) engaged by the proponent, or
    - b. The DNSP approved suitably qualified person

Where there are jurisdictional requirements, they shall be clearly stated as such
  5. Testing and commissioning acceptance witnessing may be required, in these instances, the DNSP may attend at the proponent's expense. Where there are jurisdictional requirements, they shall be clearly stated as such
  6. Testing and commissioning requirements of IES EG systems, including:
    - a. Preferably meeting requirements as per AS/NZS 4777.1 section 7 (where applicable), AS/NZS 3000 (where applicable) and AS/NZS 5033 (where applicable)
    - b. Compliance with the equipment manufacturer's specifications and the DNSP's technical requirements to demonstrate that the IES EG system meets the requirements of the connection agreement
    - c. Requirement for a corresponding electrical certificate of compliance issued prior to network connection

- d. The name of the relevant accreditation authority for electrical certificates of compliance
7. Testing and commissioning requirements of non-IES EG systems shall be in accordance with the equipment manufacturer's specifications and the DNSP's technical requirements to demonstrate that the non-IES EG system meets the requirements of the connection agreement
8. Testing shall involve installation tests, not type tests, with the exception of IEC 62116
9. How the DNSP proposes to respond to non-complying MV/HV EG systems prior to energisation or final commissioning, and may specify that:
  - a. The EG system should not be permitted to reconnect until the proponent prepares a rectification plan and provides evidence of corrective actions and/or demonstrates compliance
  - b. Depending on the severity of non-compliance, the DNSP may be required to witness the testing at the proponent's expense prior to allowing connection
10. Completed copies of the tests, final testing and commissioning report, and post-commissioning test reports may be requested by the DNSP as evidence detailing the requirements being tested, test equipment used, specification of the pass or fail criteria, test methods used and data/time/duration of testing.

## 7 Operations and Maintenance

This section shall specify the operations and maintenance requirements, including:

1. Operations and maintenance plans are required to include:
  - a. A maintenance schedule for relevant equipment
  - b. Frequency of checks and type of checks
  - c. Maintenance of relevant equipment
  - d. How evidence of operations and maintenance is to be recorded and stored
  - e. A template of the operations and maintenance report
  - f. Documented operating procedures including requirements for preserving the integrity of protection settings and interlocks and procedures for subsequent changes to settings
  - g. Signs/labels/safety warnings
2. Operations and maintenance plans shall be required to be produced and are specified by the DNSP to be produced by either:
  - a. The proponent (a suitably degree-qualified engineer), or
  - b. The CPEng, RPEng or equivalent RPEQ (only in Queensland) engaged by the proponent
3. Operations and maintenance plans may be required by the DNSP to be signed off prior to energisation as a part of the connection agreement, and specified to be signed off by:
  - a. The DNSP approved suitably qualified person
4. Operations and maintenance reports are required to include:
  - a. Maintenance items as per a maintenance schedule including dates of checks, details of conformances/non-conformances and rectification works

- b. Other operations and maintenance works relating to the equipment (e.g. warranty replacements or changes to the system) including dates and details of any works
    - c. Other operations and maintenance works relating to the installation (e.g. signs/labels/safety warnings) including dates and details of any works
5. Operations and maintenance reports are required to be produced and may be specified as being required to be submitted to the DNSP at a specified interval no more frequently than annually
6. The MV/HV EG system shall be operated and maintained to ensure compliance with the connection agreement and all legislation, codes, and/or other regulatory instruments at all times, including:
  - a. AS 2067
7. The DNSP may inspect the MV/HV EG system at any time at the proponent's expense, and shall provide a minimum period within which notice will be given to the proponent
8. The general expectations for operating and maintaining the MV/HV EG system, including:
  - a. Maintaining the electrical installation at the supply address in a safe condition
  - b. Ensuring that any changes to the electrical installation at the supply address are performed by an electrician lawfully permitted to do the work and that the customer holds a Certificate of Compliance issued in respect of any of the changes
  - c. Seeking DNSP approval prior to altering the connection in terms of an addition, upgrade, extension, expansion, augmentation or any other kind of alteration, including changing operational or protection settings for both IES and non-IES EG systems
  - d. How the DNSP proposes to respond to non-complying MV/HV EG systems and may specify that:
    - i. Non-complying EG systems should be dealt with through DNSP-specific policies and in accordance with the connection agreement
    - ii. Non-complying EG systems should be curtailed or disconnected, and not be permitted to reconnect until the proponent prepares a rectification plan and provides evidence of corrective actions and/or demonstrates compliance
    - iii. Depending on the severity of non-compliance, the DNSP may be required to witness the testing at the proponent's expense prior to allowing reconnection at the proponent's expense
    - iv. The DNSP is not liable for any losses incurred by the proponent for actions taken in response to non-compliance
  - e. Costs associated with the operations and maintenance of the EG system are to be borne by the proponent.

## Appendix A: Deviations from the National DER Connection Guidelines

This appendix shall include a register of all deviations from these technical guidelines in the format provided in Table 2.

Table 2 - Table of Deviations from National DER Connection Guidelines

Section	Description of deviation	Type of deviation	Justification
<i>{Section of this technical guideline document to which the deviation applies}</i>	<i>{High level description of the deviation}</i>	<i>{Nominates whether the deviation is to meet a jurisdictional requirement or is to promote improved benefits to Australia's electricity system}</i>	<i>Justification {either N/A where the deviation is to meet a jurisdictional requirement or provides a link to the justification documentation}</i>

## Appendix B: Connection Arrangement Requirements

This appendix shall include:

1. Single line diagrams of the DNSP's preferred connection arrangements, and a range of other possible connection arrangements, showing:
  - a) The connection point
  - b) The point of common coupling
  - c) The EG unit(s)
  - d) Load(s)
  - e) Meter(s)
  - f) Circuit breaker(s)
  - g) Isolator(s)
2. A sample schematic diagram of the protection system and control system relevant to the connection of an EG unit to the distribution network, showing the protection system and control system, and including:
  - a) All relevant current circuits
  - b) Relay potential circuits
  - c) Alarm and monitoring circuits
  - d) Back-up systems
  - e) Parameters of protection and control system elements and settings (that shall be verified via injection tests in the as-built schematic).

## Appendix C: Model Connection Agreement

This section may include a connection agreement document used as the basis to form a connection agreement. The model connection agreement shall be entirely consistent with the DNSP's technical requirements document.

This section may provide hyperlinked website addresses with short descriptions where information is published separately on the DNSP's website.

## Appendix D: Static Data and Information

This appendix shall include the static data and information that is required to be provided by the proponent to the DNSP as per the AEMO DER Register Information Guidelines, and as a minimum this includes the following categories of data:

1. DER Installation at an NMI in aggregate:
  - a) NMI
  - b) Approved capacity
  - c) Installer identification
  - d) Connection agreement 'Job number' (provided by DNSP)
  - e) Number of phases available
  - f) Number of phases with DER installed
  - g) Central protection and control
  - h) Islandable installation
  - i) Protection and control modes
2. AC grid connection of a DER installation:
  - a) Number of AC connections
  - b) AC equipment type
  - c) Inverter/small generating unit manufacturer
  - d) Inverter series
  - e) Inverter model number
  - f) Inverter serial number
  - g) Commissioning date
  - h) Status of inverter (active, inactive or decommissioned)
  - i) Inverter device capacity (kVA)
  - j) What standards apply to the inverter
  - k) Sustained overvoltage (V)
  - l) Over-frequency (Hz)
  - m) Under-frequency (Hz)
  - n) Inverter – demand response enabled device interaction
  - o) Inverter power quality response mode – volt-watt (where enabled)
  - p) Inverter power quality response mode – volt-var (where enabled)
  - q) Inverter power quality response mode – reactive power mode (where enabled)
  - r) Inverter power quality response mode – fixed power factor mode (where enabled)
  - s) Inverter power quality response mode – power factor curve/power response mode (where enabled)
  - t) Inverter power quality response mode – power rate limit mode (where enabled)



- u) Non-inverter generator – voltage/reactive power regulation
  - v) Non-inverter generator ramp rate (where enabled)
  - w) Non-inverter generator frequency response mode (where enabled)
  - x) Protection and control modes (i.e. ROCOF, vector shift, inter-trip, neutral voltage displacement)
3. DER energy sources:
- a) Number of devices
  - b) Manufacturer
  - c) Model number
  - d) Status
  - e) Device type
  - f) Nominal rated capacity (kVA)
  - g) Nominal storage capacity (kVAh).

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