National DER Connection Guidelines – Basic and Low Voltage Connections (Final draft)

Webinar

6th December 2018

Energy Networks Australia

Agenda

1. Overview of intent and development process of the guidelines
2. Deep dive on technical settings for
   a) Basic Connections - technical settings
   b) LV Connections - technical settings
3. Next steps
4. Questions

Presenters

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Housekeeping

- Safety
  - Please ensure you are safe in your surrounding, feel free to leave at any time as needed.
- 'On hold'
  - DO NOT put us 'on hold', as this will prevent us from presenting the audio.
- Questions
  - please utilise the chat box function to record your question. We cannot hear you.
    - Please ensure enough detail in question to return to at end, if need be.
  - Questions may be answered as we go, otherwise will be covered at the end

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Overview

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What are the National DER Network Connection Guidelines?

- A series of guidelines which set out the structure, definitions and technical settings Australian DNSPs should adopt in the development and application of their technical requirements for grid connection of distributed energy resources (DER).
- The guidelines use instructional language directed towards network service providers (NSPs) in developing and applying their technical requirements

Note:

- The guidelines are intended to address current technical requirements, as “point in time” type documents.
- Future technical requirements are being identified and described through the Energy Networks Australia / Australian Energy Market Operator (AEMO) “Open Energy Networks” (OpEN) program of work.
- As requirements shift from “future” to “now”, revisions of the guidelines will capture these changes.

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What are the desired outcomes?

1. Increase **consistency** between NSPs in terms of technical requirements, documentation requirements and structure of technical requirements documentation
2. Improve **clarity** with respect to technical requirements
3. Strike the right **balance** between:
    a. Mitigation of network risks / network costs
    b. Efficiency in the connection process

    In terms of the level of **onerousness** of technical requirements
4. Establish a platform for NSPs to develop common standards and protocols for future management of active DER

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Do DNSPs need to comply with the guidelines?

- Compliance with the guidelines is ***voluntary,*** but…..
- Where the guidelines are not effective in driving desired outcomes, then regulators and policy makers are likely to consider mandatory (standards) based options

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How do DNSPs comply with the guidelines?

- Distribution network service providers (DNSPs) must produce their own technical requirements documents which adopt the structure, definitions and technical settings as set out by the guidelines
- Where DNSPs depart from the guidelines they may still be deemed to comply with the guidelines so long as:
  - The departure is documented
  - The reasons for the departure is documented in terms of the National Electricity Objective
- Customers/proponents are likely to expect DNSPs to comply and DNSPs will have a compelling reason if they need to deviate from the guidelines.

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How will Energy Networks Australia ensure the guidelines remain relevant given the rate of change regulatory and technical settings?

- The guidelines will be reviewed annually by Energy Networks Australia to identify whether there is a technology or regulatory trigger for update
- An independent evaluation will be conducted every two years to determine:
  - The level of compliance
  - Whether the desired outcomes have been achieved from both an NSP and proponent perspective
- The first review will occur six months after publication
- The first independent evaluation will occur one year after publication

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How did we develop the technical settings?

- Direct engagement with primary stakeholders through workshops and meetings
  - DNSPs
  - Clean Energy Council (CEC)
  - Australian Energy Market Operator (AEMO)
  - Australian Energy Market Commission (AEMC)

- Quarterly briefings to the Energy Networks Australia Asset Management Committee (representing all NSPs)
- Two public webinars
- Draft revision process via email submission from each DNSP

Principles in developing technical requirements

- Deliver consistency
- Improve clarity and transparency
- **Balancing network risk with connection efficiency** (reducing unnecessary onerousness)
- Promoting innovation

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Tim Edwards & Sanika Willard

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BASIC LV

Sub-categories Sub-categories

Generation Control Generation Control

Protection Protection

Earthing Earthing

Metering Metering

Power Quality Power Quality

Comms Systems Comms Systems

Cyber-security Cyber-security

Technical studies Technical studies

Testing & Comm. Testing & Comm.

O&M O&M

Webinar Objective

Present technical settings for basic and LV connections, as proposed within the final drafts

1. Sub-categories
2. Export limits
3. Protection
4. Earthing
5. Metering
6. Power Quality
7. Communications systems
8. Cybersecurity
9. Technical Studies
10. Testing and Commissioning
11. Operations and Maintenance

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Technical Settings – Basic Connections

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Basic Connections - Subcategories

Three subcategories for basic connections for which different technical settings may apply:

1. **Single phase basic micro-embedded generating unit (5kVA)** – Any micro-embedded generating IES unit, with system capacity equal to 5kVA and a single-phase network connection meeting requirements set out in the DNSP technical requirements document.

   OR

   Single phase basic micro-embedded generating unit (≤10kVA) – Any micro-embedded generating IES or IES with ESS unit, with a system capacity ≤10kVA and a single-phase network connection meeting requirements set out in the DNSP technical requirements document.

2. **Three phase basic micro-embedded generating unit (≤30kVA)** – Any micro-embedded generating IES or IES with ESS unit, with a system capacity ≤30kVA and a three-phase network connection meeting all technical requirements set out in the DNSP technical requirements document.

3. **Non-standard basic micro-embedded generating unit network connection** - Any micro-embedded generating unit connecting to a non-standard part of the network which may include SWER networks, isolated networks and/or CBD networks. NSPs are to identify which areas non-standard connections apply.

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Basic Connections - Generation Control

- Generation control apply in the form of:
  - Export limit at the metering point (**required**)
  - Site generation limit downstream of the metering point (**optional** unless DNSP requires it)

Basic Connections – Generation Control (Export Limits)

» Inclusion of Export limit at the metering point (required by DNSPs)

1. **Single phase basic micro-embedded generating unit (5kVA)** – System capacity equal to 5kVA and export limit (soft, defined as per AS4777) of 5kVA

   OR

   Single phase basic micro-embedded generating unit (≤10kVA) – Total combined system capacity ≤10kVA and export limit (soft, defined as per AS4777) of 5kVA

2. **Three phase basic micro-embedded generating unit (≤30kVA)** – Total combined system capacity ≤30kVA and export limit (soft, defined as per AS4777) of 15kVA

3. **Non-standard network basic micro-embedded generation connection** - System capacity and soft export limit (soft, defined as per AS4777) set out upfront in technical guidelines

Basic Connections – Generation Control (Site Generation Limits)

» Site generation limit downstream of the metering point (DNSPs may require this in addition to export limit)

1. **Single phase basic micro-embedded generating unit** – Site generation limit of 5kVA (such that load plus export does not exceed 5kVA)

2. **Three phase micro-embedded generating unit** – Site generation limit of 15kVA (such that load plus export does not exceed 15kVA)

3. **Non-standard network basic micro-embedded generation connection** – Site generation limit set out upfront in technical guidelines

Basic Connections - Protection

- As per AS/NZS 4777.1 and AS/NZS 4777.2
  - Inverter integrated protection requirements including anti-islanding
  - Central protection where required
  - Interlocking requirements

Basic Connections - Earthing

» As per the requirements of AS/NZS 3000 and AS/NZS 4777.1

Basic Connections - Metering

- For Jurisdictions subject to Chapter 7 of the NER: there are no requirements for metering
- For jurisdictions which are not subject to Chapter 7 of the NER: DNSPs may include metering requirements.

Basic Connections - Power Quality

- As per AS/NZS 4777.2 and AS/NZS 4777.1 for IES.
- PQ response modes
  - Volt-watt and/or volt-var response modes

  OR
  - Fixed power factor mode and/or volt-var response mode
- Inverters must have both Volt-Var and Volt-Watt settings available
- Response settings may then be set based on NSP own requirements

Basic Connections - Communication Systems

- No mandatory requirements at this stage (other than provision for DRED DRM 0 under AS/NZS 4777.2)
- Where there are communications requirements:
  - DNSPs may recommend requirements that proponents should adopt to enable participation in dynamic management by network (e.g. electronic registrations of API requirements via 4G)
  - DNSPs may recommend specific communications requirements for non-standard network Basic micro-embedded generation connections

Basic Connections - Data and Information

- Static data is required to be requested from proponents and provided to the DNSP to store
  - The static data will include shortlist of most likely datapoints, which AEMO will finalise by end of 2019.
  - The guidelines will then be updated to reflect AEMO datapoints and requirements for data storage and transfer
- Dynamic data requirements (for transfer of data to DNSP/other bodies) may be specified where communications systems are in place
- AEMO datapoints (draft)
  - DER Devices (i.e. Fuel source, Make/model/manufacturer, System Capacity, Installation details, remote control)
  - Inverter (Make/model/manufacturer, whether the installer changed default settings, capacity, installation details, DRM and enablement methods, PQ modes)
  - Trip settings (Frequency, Voltage)
  - Run back scheme applied (Name of scheme, Decommission date)

Basic Connections - Cybersecurity

» No requirements for basic connections unless communications systems are in place
  – Ensuring monitoring and communications devices are in lockable enclosures
  – Protection and control from the network systems
  – Privilege settings and password protection
  – Limiting access to only that which is required to monitor the generating unit.

Basic Connections - Technical Studies

- No technical studies required by proponents to connect to the distribution network
- DNSP may carry out technical studies at their own cost, but outcomes shall not affect technical requirements for basic connections

Basic Connections - Testing and Commissioning

- For basic connections, testing and commissioning requirements are as per
  - AS/NZS 4777.1 and
  - AS/NZS 5033 and
  - the equipment manufacturer's specifications

Basic Connections - Operation and Maintenance

- IES and ESS are required to be operated and maintained to ensure compliance with connection agreement and legislation, codes, and other regulatory instruments
- DNSP may inspect the IES/ESS at any time at DNSP's cost
- General expectations
  - Maintain electrical installation in safe condition
  - Qualified electrician carries out all electrical work and customer is provided CoC for install/change
  - Seek DNSP approval prior to altering system capacity or IES settings

Technical Settings – LV Connections

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LV Connections - Sub Categories

We propose three sub-categories for LV Connections - for which different technical settings may apply:

1. **Non-basic micro-embedded generating unit (IES or IES with ESS ≤200kVA)** – Any non-basic embedded generating IES (or IES with ESS) unit less than or equal to 200kVA connecting in parallel to LV network. Further subcategorised by:
   - » Exporting
   - » Non-exporting

2. **Embedded generating unit (IES or IES with ESS >200kVA)** – Any non-basic embedded generating IES (or IES with ESS) greater than 200kVA and less than the network prescribed LV max system capacity connecting in parallel to the LV network. Further subcategorised by:
   - » Exporting
   - » Non-exporting

3. **Embedded generating unit (Non-IES)** - Any synchronous or asynchronous embedded generating Non-IES greater than 0kVA and less than the network prescribed LV max system capacity connecting in parallel to the LV network. Further subcategorised by:
   - » Exporting
   - » Non-exporting

Proponents wishing to connect a system at or near the network prescribed max system capacity should contact the NSP to determine whether an LV Connection is appropriate.

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LV Connections – Generation Control

- Generation control shall apply in the form of:
  - Export limit at the metering point (**required**)
  - Site generation limit downstream of the metering point (**optional** unless DNSP requires it)

LV Connections – Generation Control (Export Limits)

- Inclusion of Export limit at the metering point (required)
- Export limits are to be determined at time of application on a **case by case** basis for all LV systems and expressed in terms of kVA and applied as a “soft” limit as per AS/NZS 4777.1
- The export limit is defined as the maximum level at which the proponent is able to export at any given time.
  - Ability of proponent to export at the limit is not guaranteed
  - Will depend on network characteristics which change over time
  - Scenarios where output may be constrained will be described
- The export limit shall be calculated with consideration to
  - power quality,
  - asset ratings,
  - existing and future penetration of DER
- An indicative estimate may be provided at the enquiry stage
- The proponent may request a higher export limit, and in these circumstances, the NSP must provide the augmentation cost of this alternative export limit.

LV Connections – Generation Control (Site Generation Limits)

- Site generation limit downstream of the metering point (DNSPs may require this in addition to export limit)
- Site generation limit determined at time of application
- Factors considered in determining site generation limit
  - Retail and market operations
  - Existing asset ratings
  - Existing PQ at the relevant network location
  - Existing and forecast DER penetration at the relevant network location.

LV Connections - Protection

- As per AS/NZS 4777.1 and AS/NZS 4777.2
- Inverter integrated protection requirements including anti-islanding
- Central protection where required
  - Grid reverse power determined via connection specific technical assessment
  - Generator circuit phase balance protection where not inverter integrated,
    - DNSP can specify either current unbalance or voltage unbalance requirements
    - All non-IES shall have current unbalance and voltage unbalance requirements
  - Overcurrent facility fault, grid fault and earth fault protection
  - Passive anti-islanding
  - Active anti-islanding
  - Inter-tripping protection function(s) and requirements
- Interlocking requirements for balanced output between phases
- Requirements for LV embedded generation Non-IES (allow for differences between synchronous and asynchronous)

LV Connections – Network Connection and Isolation

- As per AS/NZS 4777.1 and AS/NZS 3000 as a minimum
- Mechanical isolation shall be specified as per AS/NZS 3000
- Any means of isolation (where lockable) shall be able to be locked in the open position only
- Grid protection devices shall have certified compliance with AS/NZS 4777.2 and issued with accreditation number
- IES (or IES with ESS) shall be connected to electrical installation on grid side of any RCD
- Requirements for multiple mode IES

LV Connections - Earthing Requirements

- For IES: as per the requirements of AS/NZS 3000 and AS/NZS 4777.1 or with references to the premises thereof
- For Non-IES: as per the requirements of AS/NZS 3000 and AS/NZS 3010 as a minimum
- For ESS: as per AS 3011

LV Connections - Metering

- For Jurisdictions subject to Chapter 7 of the NER: there are no requirements for metering
- For jurisdictions which are not subject to Chapter 7 of the NER: DNSPs may include metering requirements.

LV Connections - Power Quality Requirements

- Quality of supply requirements as per AS/NZS 61000 series as well as state-based regulations and license conditions
  - Network voltage control
  - Voltage fluctuations
  - Harmonics
  - Voltage balance.
- For IES requirements for PQ modes are as per AS/NZS 4777.2
  - Volt-watt and/or volt-var response modes OR
  - Fixed power factor mode and/or volt-var response mode
- For Synchronous Non-IES requirements for PQ response modes
  - Fixed power factor mode OR
  - Voltage control mode
- Inverters must have both Volt-Var and Volt-Watt settings available
- Response settings may then be set based on NSP own requirements

LV Connections - Communication Systems

Communications requirements may be specified by DNSPs.

1. **Non-basic micro-embedded generating unit (IES or IES with ESS ≤200kVA)**
   - » For exporting and non-exporting systems there are no mandatory requirements at this stage (other than provision for DRED DRM 0 under AS/NZS 4777.2)
   - » Where DNSPs have communications requirements: DNSPs may recommend requirements that proponents should adopt enable participation in dynamic management by network (e.g. electronic registrations of API requirements via 4G)
2. **Embedded generating unit (IES or IES with ESS >200kVA)**
   - » Non-exporting – No requirements
   - » Exporting – Continuous monitoring (current per phase, active power flow, reactive power flow) via communication technology options, responsibilities for set up and monitoring of communication link, and interface signal requirements
3. **Embedded generating unit (Non-IES)**
   - » Non-exporting – No requirements
   - » Exporting – Continuous monitoring (current per phase, active power flow, reactive power flow) via communication technology options, responsibilities for set up and monitoring of communication link, and interface signal requirements

LV Connections – Data and Information

- Static data is required to be requested from proponents and provided to the DNSP to store
  - The static data will include shortlist of most likely datapoints, which AEMO will finalise by end of 2019.
  - The guidelines will then be updated to reflect AEMO datapoints and requirements for data storage and transfer
- Dynamic data requirements (for transfer of data to DNSP/other bodies) may be specified where communications systems are in place
- AEMO datapoints (draft)
  - DER Devices (i.e. Fuel source, Make/model/manufacturer, System Capacity, Installation details, remote control)
  - Inverter (Make/model/manufacturer, whether the installer changed default settings, capacity, installation details, DRM and enablement methods, PQ modes)
  - Trip settings (Frequency, Voltage)
  - Run back scheme applied (Name of scheme, Decommission date)

LV Connections - Cybersecurity

1. **Non-basic micro-embedded generating unit (IES or IES with ESS ≤200kVA)**
   - » No requirements for basic connections unless communications systems are in place
   - » Where communications are in place – monitoring and communications devices are in lockable enclosures, Protection and control from the network systems (firewalls), Privilege settings and password protection, Limiting access to only that which is required to monitor the generating unit.

2. **Embedded generating unit (IES or IES with ESS >200kVA)**
   - » Non-exporting – No requirements
   - » Exporting – monitoring and communications devices are in lockable enclosures, Protection and control from the network systems (firewalls), Privilege settings and password protection, Limiting access to only that which is required to monitor the generating unit.

3. **Embedded generating unit (Non-IES)**
   - » Non-exporting – No requirements
   - » Exporting – monitoring and communications devices are in lockable enclosures, Protection and control from the network systems (firewalls), Privilege settings and password protection, Limiting access to only that which is required to monitor the generating unit.

LV Connections - Technical Studies

» The following studies shall be either completed by the NSP and paid for by proponent or arranged to be completed by the proponent:

Technical Studies	IES				Non-IES	
	Non-basic micro EG (≤200kVA)		EG (>200kVA)			
	Exporting	Non-Exporting	Exporting	Non-Exporting	Exporting	Non-Exporting
Voltage level (incl. power factor)	✓	–	✓	–	✓	✓
Power flow	✓	–	✓	–	✓	✓
Fault Level	–	–	✓	–	✓	✓
Protection grading	–	–	✓	–	✓	✓

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LV Connections - Technical Studies

- For each technical study that is undertaken by proponent, the DNSP will provide
  - Relevant inputs to be provided by DNSP
  - Outputs required from proponent
  - Criteria against which the study shall be assessed by DNSP
- For each technical study that is undertaken by DNSP, the DNSP will provide
  - estimated time and cost to complete
  - Outputs provided
  - Criteria against which the study shall be assessed by the DNSP
- Where a connection application fails a technical assessment, the NSP must provide the proponent with alternative options which may include:
  - Alternative configurations of the generating systems (e.g. lower export limits)
  - Network augmentation (and associated cost of network augmentation)

LV Connections - Testing and Commissioning

» The following testing and commissioning must be undertaken:

Testing and commissioning requirements	IES				Non-IES	
	Non-basic micro EG (≤200kVA)		EG (>200kVA)			
	Exporting	Non-Exporting	Exporting	Non-Exporting	Exporting	Non-Exporting
Protection Settings	✓	✓	✓	✓	✓	✓
Power Quality Settings	✓	✓	✓	✓	✓	✓
Export Limits	✓	✓	✓	✓	✓	✓
Comms Settings	✘	✘	✓	–	✓	✓
Shutdown Procedures	✘	✘	✓	–	✓	✓

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LV Connections - Testing and Commissioning Acceptance

- Testing and commissioning plans shall be produced by the proponent and may be required to be signed off by the NSP prior to finalising the connection agreement
- Testing and commissioning acceptance shall be signed off by a CPEng (or RPEQ), or DNSP's suitably qualified person
- Testing and commissioning acceptance may require the DNSP to carry out witnessing at the DNSP's expense
- For IES, testing and commissioning requirements shall be in accordance with
  - AS/NZS 4777.1 and AS/NZS 4777.2,
  - AS/NZS 3000 and
  - AS/NZS 5033 (where applicable) and
  - equipment manufacturer's specifications
- For Non-IES technical settings that will be required and tested will include:
  - protection settings,
  - power quality settings,
  - export limits,
  - communications settings and
  - shutdown procedures.

LV Connections - Operation and Maintenance

- O&M requirements
  - An O&M plan shall be produced and the DNSP may require for it to be signed off prior to forming a connection agreement
  - The 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
  - O&M reports may be submitted to the DNSP at a specified interval no more frequently than annually
  - The DNSP may inspect the EG unit at any time at the DNSP's expense.
- General expectations for operating and maintaining the EG system
  - Maintain the electrical installation at the supply address in a safe condition
  - Ensure that any changes to the electrical installation at the supply address are performed by an electrician lawfully permitted to do the work and that the customer holds a Certificate of Compliance issued in respect of any of the changes
  - Seek DNSP approval prior to altering the IES capacity or inverter.

Basic & LV Connection Guidelines Appendices

- Deviations
- Connection arrangement requirements (SLDs, schematic diagrams)
- Model offers attached

Next Steps

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Next steps

- Basic and LV guidelines – Finalise by end of December 2018
  - Meet with CEC on 12 December
  - Receive final input
  - Final version by 21 December
  - Seek approval from Energy Networks Australia Asset Management Committee

- MV & HV DER Technical Network Connection Guidelines (Jan to June 2019)
  - Kickoff in mid January 2019

- Guideline review and implementation evaluations (July 2019 & Feb 2020)
  - The first review will occur six months after publication
  - The first independent evaluation will occur one year after publication

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Questions?

Final opportunity to provide input

Noting that these guidelines are aimed at clarifying, harmonising and balancing DNSP connection requirements, we have clearly targeted DNSPs and proponents (via the CEC) in our consultation process.

» However, if other stakeholders would like to provide detailed input into the Final Draft revision process, please email Heath Frewin at hfrewin@energynetworks.com.au prior to COB 10th December 2018

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