Northpower

Electricity Network Standard: 02.01.065
Date Approved:15/03/2019

Technical Requirements for Small Scale Distributed Generation

Document Type: Electricity Network Standard
Category: 02 - Technical Policies
Activity: 02.01 - Technical Policies

Authored By: David KEMSHALL
Document Owner: Roy HAMILTON

Table of Contents

1. Introduction & Scope

This standard details Northpower's technical requirements for the connection of small-scale (<10kW) distributed generation ("DG") systems using inverters to connect to Northpower's low voltage electricity distribution network.

The process of connecting distributed generation to Northpower's network is detailed in Northpower's standard *ENS 05.01.010 New LV Service Connections.* This include details of the customer application, network approval and connection process. This standard should be read in conjunction with these technical requirements.

1.1. Scope

This document applies to:

- generation systems that are <10kW in capacity, and
- are inverter connected to Northpower's low voltage network

This also applies to

- grid connected energy storage systems (batteries), including Electric Vehicle (EV) batteries with vehicle to grid export capability.

This document does not cover:

- generation systems greater than 10kW and up to 100kW, however this document can be used as a general background guide (only). You need to discuss your project with Northpower and determine what additional technical requirements may be involved.
- large scale systems greater than 100 kW or systems connected directly to the high voltage network (11 kV or 33 kV) – these will need connections to be specifically designed for each system.
- stand alone, standby or emergency generation systems that are not capable of feeding power into Northpower's network.
- the economics or the design of distributed generation systems.

2. References

Reference	Details
NORTHPOWER	
ENS 05.01.010	New LV Service Connections *(Note - Section 11 details Distributed Generation)*
Distributed Generation Livening Form	The Livening Form is required to be submitted to Northpower, certifying the details of the distributed generation installation. This form is *Appendix 3 - ENS 05.01.010 New LV Service Connections*
ENS 02.01.064	*Congestion Management Policy – Distributed Generation*
Northpower Website	Distributed Generation – Online Application Form
Customer Guide	Customer Guide - DG Connection (available on website)
EXTERNAL	
Accredited Inverter List	Australian Clean Energy Council Website "solar accreditation" http://www.solaraccreditation.com.au/products/inverters/approved-inverters.html
AS/NZS 3000	Electrical Installations (Wiring Rules)
AS/NZS 4777.1 (2016)	Grid Connection of Energy Systems via Inverters - Part 1: Installation requirements
AS/NZS 4777.2 (2015)	Grid Connection of Energy Systems via Inverters - Part 2: Inverter requirements. (*Note - the 2015 version supersedes the previous 2005 version.)*
AS/NZS 5033	Installation and Safety Requirements for Photovoltaic (PV) Arrays
AS/NZS 61000.3	Electromagnetic Compatibility (EMC)
BS EN 50160	Voltage characteristics of electricity supplied by public distribution system

Reference	Details
EEA Metering Safety Guide	EEA Metering Safety - Good Practice Guide, 2018
ECP 36	NZ Electrical Code of Practice for Harmonic Levels
EEA Guide	Electricity Engineers Association *"Guide for the Connection of Small Scale Inverter Based Distributed Generation" 2018, Interim Guide*
EIPC Code	Electricity Industry Participation Code 2010 - *Part 6, Connection of Distributed Generation* http://www.ea.govt.nz/code-and-compliance/the-code/part-6-connection-of-distributed-generation/
Electricity Authority	The Electricity Authority, website and reference material / guide documents
Electricity Safety Regulations	Electricity (Safety) Regulations 2010

3. Definitions

Reference	Details
Distributed Generation (DG)	means distributed generation being equipment used, or proposed to be used, for generating electricity that is: • connected, or proposed to be connected, to the Network or to a customer installation which is connected to the Network; and • is capable of injecting electricity into the Network. This includes Electric Vehicles (EV) or battery storage systems capable of exporting (injecting) electricity into the network.
Inverter	An electronic device intended to convert DC to AC.
Quality of Supply	The term "quality of supply" generally means: • the electrical voltage and frequency are maintained between limits defined in the Electricity (Safety) Regulations, and • the harmonic levels comply with: ECP 36 NZ Electrical Code of Practice for Harmonic Levels and AS/NZS 61000.3.6 Electromagnetic Compatibility, measured at the installation "point of supply" as applicable to the scenario.

5. Impact of DG Connections on safety & operations

5.1. Safety Risks

The potential for a distributed generation system (inverter connected) to export electricity onto the network either under normal operation or fault conditions, creates a potential risk to other connected customers and personnel working on the electricity distribution network.

Technical requirements and standards have been established that address these risks, with specific grid protection settings to manage:

- Faults within the generation system or installation
- Faults occurring within the electricity distribution network
- Preventing the generation system from feeding power into the electricity distribution network during an unplanned network outage (i.e. faults) or planned shutdown (i.e. maintenance works).

In addition, all electrical assets and wiring that are part of the customer's installation (including the service main, meter station, switchboard and internal wiring) must comply with *AS/NZS 3000 Electrical Installations* and the *EEA Metering Safety Guide.*

Where possible, Northpower has adopted the use of New Zealand standards and regulations to ensure consistency of equipment and application.

5.2. Quality of supply

Where generation can export electricity to the network, this can impact on the quality of the electricity supply on that section of network (for example voltage fluctuations). This can impact on the electricity supply to nearby customers and neighbours.

There are regulatory requirements and industry standards that Northpower must meet, which are the basis of Northpower's technical requirements for the connection of the generation system. This includes maintaining the quality of electricity supplied (as measured at the customer installations "points of supply) in compliance with:

- electrical voltage and frequency levels, as detailed in the *Electricity (Safety) Regulations*
- harmonic levels, as detailed in *ECP 36 NZ Electrical Code of Practice for Harmonic Levels* and *AS/NZS 61000.3.6 Electromagnetic Compatibility* as applicable to the scenario.

6. Network Requirements for Distributed Generation

The following sections detail the technical requirements for connecting distributed generation to Northpower's electricity distribution network.

6.1. Inverters & protection settings

Inverters that are allowed to be used to connect generation systems to Northpower's network must:

- comply with *AS/NZS 4777.2 (2015) Grid Connection of Energy Systems via Inverters: Part 1 - Inverter requirements*
- include a grid protection or anti islanding device which must prevent power being fed into the network during a power outage or shutdown. *Note that the generation system may run, if capable, the associated installation while islanded or disconnected from the network.*
- be set to the specific New Zealand voltage settings detailed in *AS/NZS 4777.2* and detailed below in Table 1.

Table 1 – AS/NZS4777 NZ Settings for Inverter Settings

Inverter Voltage and Frequency Limits (Passive Anti-Islanding Set-Point Values)			
Parameter	**Limit**	**Minimum Trip Delay Time**	**Maximum Disconnection (trip) Time**
Vnom-max (10 minute average)	248 V		
Overvoltage 1	260 V	1 second	2 seconds
Overvoltage 2	265 V	-	0.2 seconds
Undervoltage	180 V	1 second	2 seconds
Under-frequency	45 Hz	1 second	2 seconds
Over-frequency	52 Hz	-	0.2 seconds
Minimum reconnection time	60 Seconds		

6.1.1. Voltage Response Capability

Northpower requires that, if available, the Inverters voltage response is enabled to avoid any adverse effect on voltage at the point of supply. Our preference in enabling this feature is as follows:

- If both Volt-VAr and Volt-Watt responses are available, then both should be enabled (if possible)
- If both modes cannot be enabled simultaneously then just the Volt-VAr response should be enabled
- If only the Volt-Watt response is available, then that should be enabled

If Northpower does not require the voltage response to be enabled, this will be advised by Northpower as part of the generation connection approval process.

The required volt responses are specified in Table 2 below – these are the recommended preferences of the *Green Grid Network Analysis Group (NAG)* and the *EEA Guide for the connection of small scale inverter based distributed generation.*

Table 2 – Volt Response requirements

Volt Response Reference Values		
Reference	**Volt-VAr Response**	**Volt-Watt Response**
V1	207	207
V2	220	220
V3	235	244
V4	244	246

6.1.2. Acceptable Inverters

Northpower will accept Inverters that are compliant with the current *AS/NZS4777 standard*. A list of inverters accredited as compliant with AS4777 can be found on the Australian Clean Energy Council website: http://www.solaraccreditation.com.au/products/inverters/approved-inverters.html.

6.2. Photovoltaic Arrays

Photovoltaic (PV) arrays which form part of the generation system are to comply with *AS/NZS 5033 Installation and Safety Requirements for Photovoltaic (PV) Arrays.*

6.3. Connection Requirements

6.3.1. Point of Isolation

In most cases, Northpower considers a readily accessible service main fuse as the point of Isolation from the network. If this is not readily accessible, an additional point of isolation may be required.

6.3.2. Connection Phasing Requirements

The connection of distributed generation must meet Northpower's phasing requirements, which are detailed in Table 3 below, and depend on:

- the generation capacity of the generation system
- the supply capacity of the network and associated distribution transformer that it will be connected to
- any constraints on generation output (as identified in the Connection Approval)
- any network congestion management requirements for that location (refer *ENS 02.01.064 Congestion Management Policy - Distributed Generation*)

TABLE 3 – Generation Connection Phasing requirements

DG Capacity (kW)	Generation Connection Phasing Requirements
0-5kW (up to 21.7A)	1, 2 or 3 phase as requested and as available
>5-10kW with battery storage	1, 2 or 3 phase as requested and as available
>5-10kW without battery storage	1 phase only if ICP connected 1 phase otherwise 2 or 3 phase as connected

6.4. Signs or Labelling

For the purposes of safety, it is the Customer's responsibility to ensure that the generating circuit is clearly labelled on the main switchboard and any sub-main switchboards it passes through. A label should also be placed on the Customer's service fuse as a reminder to test and prove that the circuit is de-energised before carrying out any work on the Customer's service main.

Northpower will identify the DG Connection in our Geographical Information System (GIS) system, to alert our personnel to its location.

6.5. UPS Installations

Generation may be used in conjunction with batteries to provide an uninterruptible power supply (UPS) for certain circuits within the premises.

In this instance, no protection device shall interrupt the neutral or earth conductors between the network and the inverter.

This prevents the use of residual current devices (RCD's) between the inverter and the network

7. Metering & sale of exported electricity

Electricity metering that allows measurement of electricity import (consumption) and export, is required to be installed on site. Metering installation is to be arranged by the Customer with their Electricity Retailer, along with an agreement for the sale/purchase of the exported electricity.

Further details should be obtained from the customers Electricity Retailer.

8. Installation, Inspection and Commissioning Information

8.1. Installation

The installation must meet *AS/NZS 4777.1 (2016) Grid Connection of Energy Systems via Inverters - Part 1: Installation requirements.* All internal wiring must meet *AS/NZS 3000* (Wiring Rules).

8.2. Testing and Electrical Inspection

The generation system requires an electrical inspection by a registered Electrical Inspector as it is defined as high risk prescribed electrical work in the Electricity (Safety) Regulations.

The generation system is required to meet Northpowers requirements as specified in this Standard, including the following standards:

- AS/NZS 4777.1 Grid connection of energy systems via inverters: Part 1 - Installation requirements
- AS/NZS 4777.2 Grid connection of energy systems via inverters: Part 2 - Inverter requirements
- AS/NZS 5033 Installation and safety requirements for photovoltaic (PV) arrays *(where applicable)*

8.3. Northpower Verification

Northpower may require to visit the generation system to verify compliance with Northpowers requirements, generally held in conjunction with the Electrical Inspection. This is to verify the following is satisfactory:

- Certificate of compliance
- Inspection and record of inspection
- Generation System meets Northpowers requirements including:
    - Northpowers Network Approval
    - Network Standards, including these technical requirements
    - Generation capacity and phasing
    - Operation of the grid protection device (typically anti-islanding)
    - Volt-VAr and Volt-Watt response enabled and set correctly when available

8.4. Comissioning Information to be provided to Northpower

Key details from the commissioning of the generation system are required to be provided to Northpower. Northpower's information requirements are detailed in Northpower's standard *ENS 05.01.010 New LV Service Connections (Appendix 4 - DG Livening Form).*

Information required includes details such as:

- Customer, ICP and physical location (site address)
- Generation system details – type, make, model, capacity, approved net export
- Inverter make, model and AS/NZS 4777 compliance
- Test results for operations and protection mechanisms
- Electrical Inspector details

9. Responsibility of Owner/Operator of the Generation System

The owner or operator or the distributed generation system is responsible for the following:

- Maintenance and safe operation of the generation system (including inverters, protection devices, cabling and solar panels).
- Ensure the generation system complies with all relevant acts, regulations, standards rules and codes of practice.
- Operating the system within the generation capacity approved by Northpower.

10. Access by Northpower

The Customer shall provide Northpower with safe and unobstructed access to the generation site and all upstream equipment at all reasonable times, providing:

- Access is required for matters concerning the generation circuit and its connection to the Northpower network.
- Northpower shall make a written request to the Customer to access the site for scheduled works.
- Northpower may not interfere with the Customer's equipment without their express permission. This does not include methods of isolation.
- Northpower may require immediate access to the Customer's equipment in the event of an emergency (i.e., to prevent a breach of safety or damage to property). Northpower shall inform the Customer of the circumstances and events as soon as practicable.

11. Interruptions / Temporary Disconnection from the Network

Northpower may, from time to time, isolate any Distributed Generation in order to perform certain maintenance tasks or manage the network capacity in accordance with the requirements of Northpower's operational requirements and *ENS 02.01.064 Congestion Management Policy - Distributed Generation.*

12. Application for Connection of DG

The process of connecting distributed generation to Northpower's network is detailed in Northpower's standard *ENS 05.01.010 New LV Service Connections.* This include details of the customer application, network approval and connection process. For further details, please refer to this document.