

Protection, Network Congestion & Approved Inverters for DG

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1. NETWORK PROTECTION

Scanpower's HV Network has a coordinated system of protection devices as follows:

The Transpower 11kV feeders supplying the network are fitted with an Inverse Definite Minimum Time Overcurrent and Definite Time Earth Fault protection scheme at the Dannevirke and Woodville grid exit points. These circuit breakers are equipped with an auto-reclosing function providing 3 recloses on a 10-second delay.

Scanpower's network is fitted with auto-reclosing 11kV circuit breakers that coordinate both in terms of fault magnitude and time with Transpower's protection devices. This automation includes sectionalising equipment which automatically undertakes fault isolation in conjunction with our reclosers.

The majority of our 11kV protection is provided by K-Type expulsion fusing which has extremely inverse time curves. These devices are finely set to provide both overcurrent and earth fault protection.

The expulsion fusing is configured in a traditional transformer, group and branch scheme with the branch fuses backed up using fuse-saving devices (one-shot sectionalisers).

1.1 DG INTEGRATION

All elements of the protection scheme are coordinated for both overcurrent and earth fault for both fault level and time discrimination.

Parties wishing to connect generation intended to supply Scanpower's network will need to provide protection coordination details. These will be highly dependent on where in the network the generation is connected and how its presence alters fault levels.

1.2 SAFETY DISCONNECTION DEVICES

If you intend to connect to our network, your DG must include the following safety features:

- It must not attempt to re-connect during our re-closing sequence.
- It must delay any attempt to re-connect until at least 1 minute after mains voltage has been re-established.

Any provision for over-speed control of rotating plant, or dumping of primary energy during a generation trip is your responsibility.

2. NETWORK CONGESTION

Our network takes supply directly from Transpower at 11kV, so its overall construction is very light in almost all areas. This means that our network is increasingly voltage constrained in many areas with very little ability to accept injected DG.

2.1 CONDUCTOR SIZES AND NETWORK CONFIGURATION

We have standardised the following conductor sizes for our lines, so our network is broadly constrained in the following conductor capacities:

Location	Conductor type	Distance to 5% volt drop limit	Capacity at 5% volt drop distance	Line capacity at 0.95 power factor
Main lines	Dog	5.9km	2MW	325A
Secondary lines	Ferret	7.4km	1MW	170A
Spurs or ends of secondary lines	Gopher	8.3km	500kW	135A

Our 11kV lines run radially from the Transpower grid exit points (GXP) at Rua Roa (8 lines) and Woodlands Rd near Woodville (3 lines). Dog conductor runs to the approximate load centre of each line which is typically 10km to 30km from the GXP.

If the total electricity generation injected into our network exceeds the total load, the electricity may flow in directions that it was never intended to. Our protection relays may see that as a fault or abnormal operating condition and trip the circuit breakers, interrupting the electricity supply. In addition, connection of single-phase loads or generation as low as 20A may trip our protection on lightly loaded lines.

2.2 GRID LIMITS

Reverse flows of electricity may also affect Transpower's grid if the DG on a line exceeds the load at that time. To avoid this occurring, total injection (that is all DG, not just yours) into our network is limited as follows:

GXP	Line	Max. Amps	Max. kW
Dannevirke	Weber	20A	400kW
	Mangatera	20A	400kW
	Central	30A	600kW
	Pacific	35A	700kW
	East	30A	600kW
	North	25A	500kW
	Adelaide	25A	500kW
	Te Rehunga	10A	200kW
Woodville	All 3 lines	10A	200kW

Accordingly, Transpower may require you to constrain your generation, or they may make changes to their projection settings (which will be at your cost).

2.3 AFFECTING OR DISTURBING OUR OTHER CUSTOMERS

The size and nature of injected DG can also affect the quality of electricity supply received by our other customers, such as voltage stability, flicker or harmonics. If your DG is likely to cause supply quality issues, we may require you to connect to a stronger point in our network which will principally require you to build a longer line to connect.

Our Network Connection Standard provides for the following capacity options on our 400V network:

- 1-phase 60A
- 3-phase 40A
- 3-phase 100A if connected to the distribution transformer.

In rural areas you should assume that there is little if any capacity for new connections (either load or DG) as the network tends to be designed for known loads only.

2.4 ISSUES WITH NETWORK AUTOMATION

We have voltage regulators at Matamau, Motea and Oringi which may lead to voltage differences between the points at which we can interconnect lines downstream of those regulators. Connection of DG may interfere with the way those voltage regulators operate and require additional automation which may have to be at your expense.

2.5 POWER FLOW

Our automation is not capable of operating a reverse power flow scenarios (it is not fitted with CTs on both incoming and outgoing bushings). Aggregated generation causes reverse power flows at automation points which may require equipment upgrades. This will be dependent on the diversity between the system load profiles i.e. at times there may be generation operating constraints which could be conducive to a network automation upgrade.

2.6 DISTRIBUTION TRANSFORMER SIZING

We install distribution transformers based on the after diversity maximum demand (ADMD) which is based on the number of connected customers and certain assumptions about their load patterns. DG that is greater than 3kW in urban areas or 5kW in rural areas may not match those assumptions. This may require us to install either a larger transformer or a transformer dedicated for your connection. In both cases you should expect to contribute to that cost.

3. APPROVED INVERTERS

Applications to connect DG to Scanpower's network are required to be supported with manufacturer's technical data demonstrating compliance with AS4777.2 for all inverters that have not been through the approval process and listed on the approved inverter table below.

Make	Model	Date approved bus	Edition of AS 4777 used for testing
Enphase	M215 Micro	09/04/15	2013
Shenzhen	Suntwin 5000TL	10/07/14	2013
SMA	5TP 12000TL	03/08/2012	2005