



**INFORMATION TO ASSIST IN PLANNING CONNECTION OF
GENERATION PLANT TO THE POWERNET NETWORKS**

SEPTEMBER 2007

1. INTRODUCTION

This guide is provided to assist individuals with the task of connecting generation plant to one of the networks that PowerNet manages. This also documents the procedure PowerNet follows to meet the requirements of the “Electricity Governance (Connection of Distributed Generation) Regulations 2007”

Distributed Generation is defined in the regulations as “equipment used, or proposed to be used, for generating electricity that –

- (a) is connected, or proposed to be connected, to a distribution network, or to a consumer installation that is connected to a distribution network; and
- (b) is capable of injecting electricity into that distribution network.”

Other generation equipment is unlikely to interfere with the safe operation of the distribution network but PowerNet would still like to record the existence of such equipment.

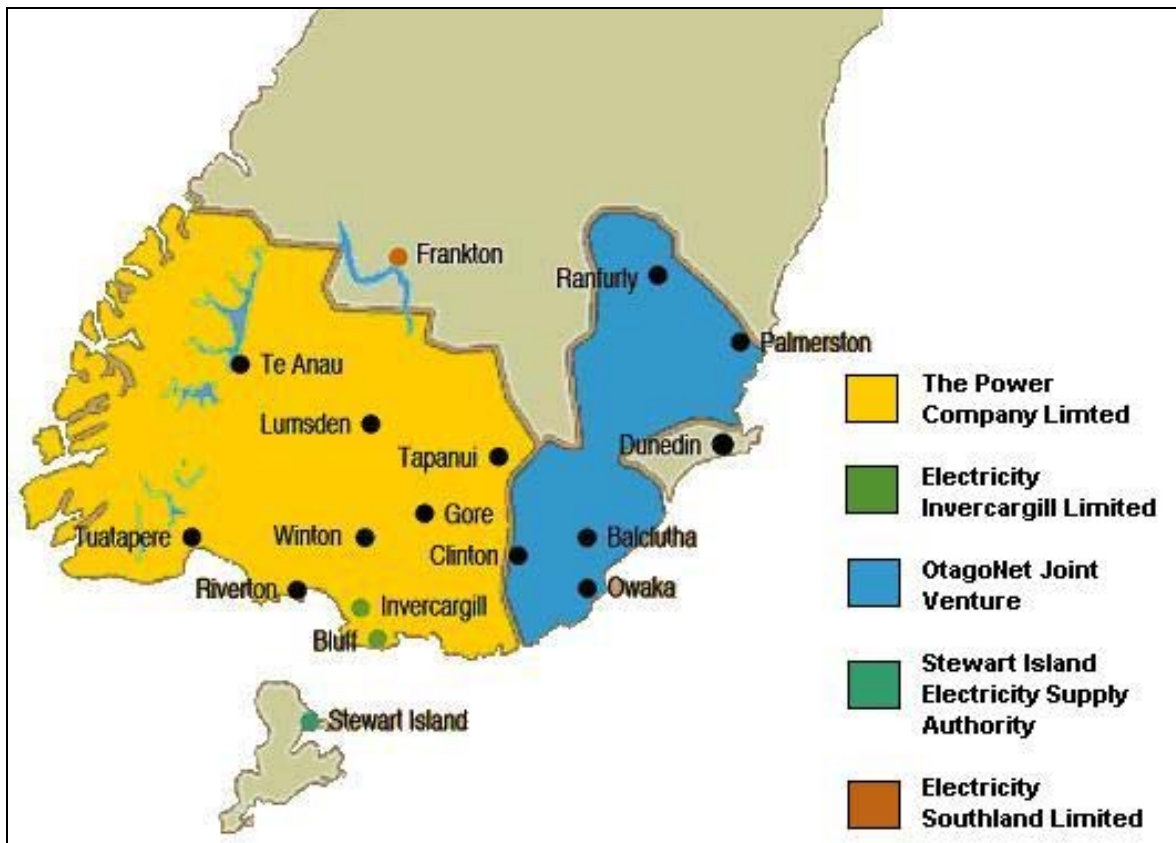


Figure 1 PowerNet Electricity Distribution Networks

2. GENERAL REQUIREMENTS

Before any electricity from a Distributed Generator may be exported into PowerNet's Distribution Network, the owner of the Distribution Generator must:

1. Obtain written permission to connect from PowerNet
2. Have a contract with an Electricity Retailer or
3. Show that the requirements of the EGR or any subsequent Industry agreement for trading electricity will be met.

All Distributed Generators connected directly to PowerNet's Networks shall, as a minimum requirement, comply with the requirements of the "EEA Guide for the Connection of Generating Plant" (This may be purchased from <http://www.eea.co.nz>) and shall be installed in accordance with NZECP4:1993 and/or NZS/AS 3000:2000 or any subsequent revision.

The general requirements outlined in AS 4777 for Distributed Generation up to 30 kW shall also be followed, where the Generation plant uses inverters. (This may be purchased from <http://www.saiglobal.com/>)

The installation must also comply with PowerNet's Installation Connection Standard. This is available on PowerNet's Website <http://www.powernet.co.nz/documents/standards.html>.

2.1 OPERATION

The presence of Distributed Generation shall not restrict PowerNet's requirements for switching on the Distribution Network. This is to allow isolation of fault equipment and allow maintenance to be carried out.

2.2 CONTACT POWERNET

It is important that you contact PowerNet early in your project development stage to enable PowerNet to coordinate with your requirements. In many cases it will be possible to connect Distributed Generation at the lower end of the 10kW to 1MW rated capacity range, to the existing Distribution Network without major modifications to the Network. However, for other cases there may be significant investigation and network modification required. Should alterations to the Network and/or the connection to the Network be required, there may be charges for this work. Therefore early discussions with PowerNet are essential.

3. INFORMATION

3.1 BASIC DETAILS

The owner of the Distributed Generator must provide sufficient information to PowerNet to enable successful connection to the Distribution Network without affecting other connected Customers. Where the determination of this requires significant research and analysis, this may require a contribution from the prospective Generator owner.

The amount of information required will depend on the size and type of generation, and will remain confidential between the parties unless agreed otherwise. PowerNet reserves the right to release sufficient information relating to Distributed Generators for the purpose of meeting its obligations to Transpower, if Transpower requires such information under the Common Quality Requirements.

Subject to the Distributed Generator owner agreeing to meet its reasonable costs in doing so, PowerNet will, use the information provided to model the Distribution Network and to decide what method of connection will need to be employed and the Voltage level at which the connection should be made.

3.2 TECHNICAL INFORMATION FOR DISTRIBUTED GENERATORS

3.2.1 The information required to be supplied to PowerNet for all Distributed Generation is as follows:

	< 10 kVA	10 to 100 kVA	100 to 750 kVA	> 750 kVA
Type of generator unit - synchronous, asynchronous, etc	✓	✓	✓	✓
Type of prime mover	✓	✓	✓	✓
Rated terminal Voltage (kV)	✓	✓	✓	✓
Rated generator capacity (kVA)	✓	✓	✓	✓
Rated minimum power factors (both over and under excited) at rated kVA			✓	✓
Maximum continuous active power generated (kW)	✓	✓	✓	✓
Maximum short term active power generated (kW)			✓	✓
For asynchronous generators, reactive power requirements (kVAr)		✓	✓	✓
Anticipated operating regime e.g. continuous, intermittent, peak lopping		✓	✓	✓
Method of Voltage control		✓	✓	✓

3.2.2 Interface Arrangements

	< 10 kVA	10 to 100 kVA	100 to 750 kVA	> 750 kVA
The means of connection and disconnection	✓	✓	✓	✓
The means of synchronisation between the Distribution Network and the Distributed Generator		✓	✓	✓
Generator neutral earthing arrangements				✓

3.2.3 Technical Data

	< 10 kVA	10 to 100 kVA	100 to 750 kVA	>750 kVA
Lowest frequency at which the Distributed Generator can run				✓
Actual low frequency trip setting and time delay		✓	✓	✓
Actual over frequency trip setting and time delay		✓	✓	✓
Minimum operating power				✓
<i>Generator kW/kVAr capability charts (at lower Voltage terminals at nominal and ±10% of nominal voltage) at:</i>				
(a) maximum short term power				✓
(b) maximum continuous power			✓	✓
(c) 75% output				✓
(d) 50% output				✓
(e) minimum power				✓
<i>Auxiliary power requirements at:</i>				
(a) Rated power output				✓
(b) Minimum power output				✓
(c) Start up				✓
<i>Start up times to minimum operating power:</i>				
(a) From Cold				✓
(b) From Warm				✓
(c) From Hot				✓
Normal ramp rate				✓
Time for cold start to full rated output			✓	✓
Inertia constant (secs) (whole machine)				✓
Stator resistance				✓
Direct axis synchronous reactance				✓
Quadrature axis synchronous reactance				✓
Direct axis transient reactance				✓
Quadrature axis transient reactance				✓
Direct axis sub transient reactance				✓
Quadrature axis sub transient reactance				✓
Leakage (positive sequence) reactance				✓
Negative sequence reactance				✓
Zero sequence reactance				✓

	< 10 kVA	10 to 100 kVA	100 to 750 kVA	>750 kVA
Earthing resistance/reactance				✓
<i>Time constants:</i>				✓
(a) Direct axis transient open circuit				✓
(b) Quadrature axis transient open circuit				✓
(c) Direct axis sub transient open circuit				✓
(d) Quadrature axis sub transient open circuit				✓
Generator transformer details (impedance, tap changer, vector group, earthing, maximum overvoltage capability at rated frequency etc.)				✓
Type of excitation system: (block diagram/specifications, forward/feedback, gains/time constants and limits)			✓	✓
Speed governor and prime mover data: (detailed functional description of governing system with all subsystems including system control and turbine time)			✓	✓

3.2.4 Further information required

There may also be other information required under terms of contracts between PowerNet and other governance parties¹ in respect of Distributed Generation.

4. DISTRIBUTED GENERATION OPERATION

Normal operation of Distributed Generation is to export reactive energy (kVArh) whenever real energy (kWh) is exported into the Distribution Network. As long as the voltage is within agreed limits the power factor should be between 0.85 and 0.9.

Special control requirements may be required if the Distributed Generator is connected to a point where the Distribution Network fault level is not greater than ten times the Distributed Generator rating. {This is to limit voltage flicker to under irritation levels.}

'Notice of outages' will require all Distributed Generation to be isolated from the Distribution Network for the duration of the 'notice', with all distribution lines to be treated as live unless specific authority is obtained from the PowerNet System Control.

Emergency isolation of Distributed Generation greater than 10kW may require an external switch with a PowerNet lock to allow field staff to 'tag' generation as isolated.

¹ Transpower, Electricity Commission, Ministry of Economic Development, Commerce Commission

5. PROTECTION

The Distributed Generator shall be equipped with the appropriate protection elements as required by the “EEA Guide for the Connection of Generating Plant”. Distributed Generator owners are to consult PowerNet with regard to any special arrangements or protection that may be necessary due to the characteristics of the Distribution Network.

Protection Requirements	< 10 kVA	10 to 100 kVA	100 to 750 kVA	>750 kVA
Generator Circuit Breaker	✓	✓	✓	✓
Disconnect/Isolate Switch	✓	✓	✓	✓
Over-voltage protection	✓	✓	✓	✓
Under-voltage protection	✓	✓	✓	✓
Over-frequency protection	✓	✓	✓	✓
Under-frequency protection	✓	✓	✓	✓
Earth-fault protection			✓	✓
Over-current Voltage Restraint Protection				✓
Neutral Voltage Displacement Protection		✓	✓	✓
Synchronisation	✓	✓	✓	✓
Loss of Network supply (Islanding)	✓	✓	✓	✓
Power factor or Voltage Regulation Equipment			✓	✓

The protection associated with a Distributed Generator shall co-ordinate with the protection associated with the Distribution Network as follows:

- (a) In order to reduce to a minimum the impact of faults on the Distribution Network, the generator must meet target clearance times, that are agreed between PowerNet and the generator owner, for fault power flowing from the Distribution Network, PowerNet will ensure that the relevant protection settings are compatible with the target clearance times that are specified by PowerNet;
- (b) The settings of any protection which controls a circuit breaker, or the operating parameters of any automatic switching device at any Network Connection Point, shall be approved by PowerNet;
- (c) It will be necessary for the Distributed Generator protection to co-ordinate with any network auto re-close settings specified by PowerNet, and;
- (d) Any Distributed Generator connected to the Distribution Network may be required to withstand, without tripping, the negative phase sequence loading incurred during the clearance of a phase-to-phase fault by Distribution Network back-up protection, which is within the Distributed Generator’s short time rating.

6. ISLANDING

The part of the Distribution Network to which a Distributed Generator is connected, may inadvertently, or during emergency conditions, become detached from the rest of the Distribution Network, creating an "island". PowerNet will decide based on the local Distribution Network conditions, whether islanding is a credible possibility, and whether it is desirable for the Distributed Generator to continue to generate while connected to the islanded section of the Distribution Network. PowerNet would generally require that the Distributed Generator disconnect from the Distribution Network upon the detection of islanding.

If no facilities exist for the subsequent re-synchronisation with the rest of the Distribution Network, the Distributed Generator owner will, under PowerNet's control, disconnect the Distributed Generator prior to reconnection of the island to the rest of the Distribution Network and the subsequent re-synchronisation of the Distributed Generator.

Where PowerNet determines that undesirable islanding is a credible possibility and that the Distributed Generator is to disconnect upon detection, PowerNet will require that the Distributed Generator always export more reactive power than any credible islanded load can absorb. The Distributed Generator owner is to install equipment that is capable of detecting the resulting reduction in reactive power export/increase in voltage which would be caused by islanding and disconnect the Generator from the Distribution Network.

Under emergency conditions, some Distributed Generators may continue to operate outside the statutory frequency limits. Where Distributed Generators are connected to the Distribution Network at a Voltage level of 11kV or less, it is possible that there could be automatic low frequency load disconnection equipment within the load. Consequently, Distributed Generator owners should ensure that all protection on their Distributed Generator's has settings to coordinate with those on the automatic low frequency load shedding equipment. PowerNet will provide information on this equipment on request.

7. COMMISSIONING

Where Distributed Generators require connection to the Distribution Network in advance of the commissioning date for the purposes of testing, the Distributed Generator owner must comply with the requirements of the negotiated agreement. The Distributed Generator owner shall provide PowerNet with a commissioning programme for prior approval by PowerNet.

PowerNet may desire to observe the commissioning tests to ensure safe and reliable operation of the Distribution Network, to this ends at least five working days notice of the commissioning testing shall be given.

8. METERING

Metering is the responsibility of the generator owner (if an Electricity Market Participant) or the Electricity Market Participant that purchases any exported electricity. However, provided the metering is installed to the requirements of the Electricity Governance Rules, the metering can be arranged and owned by any party.

PowerNet requires metering that will measure both import and export volumes. For generators above 10kW that are connected to PowerNet's low voltage network the minimum metering requirement will be to measure active energy, in half-hour intervals. For generators above 10 kW that are connected to PowerNet's HV network, the minimum metering requirement will be to measure active and reactive energy, in half-hour intervals. This will require 4-quadrant "Time Of Use" (TOU) metering to be installed. This metering will require either a telephone connection or a cellular connection for remote interrogation.

You should discuss the metering with your electricity retailer first, as they may install the required metering or choose to modify your existing metering.

9. SIGNAGE

Suitable signage shall be attached to all switchboards that can be supplied from any generation in accordance with AS/NZS 3000. Typical signage is shown below:

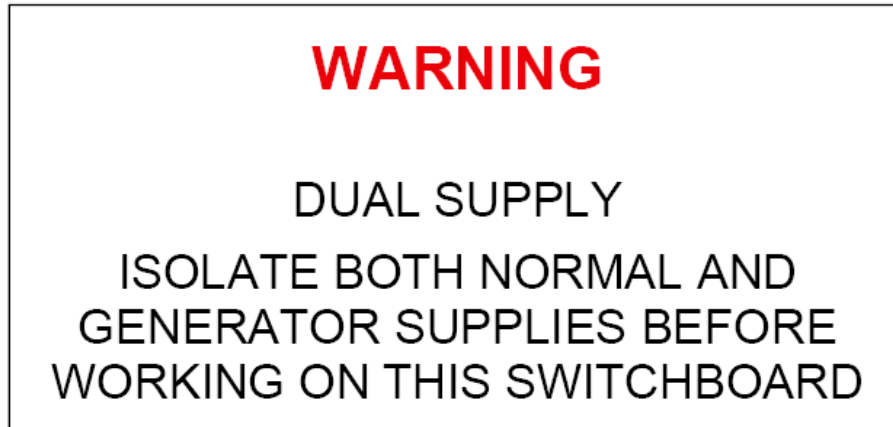


Figure 2 Sign on Switchboard to which Generator is connected

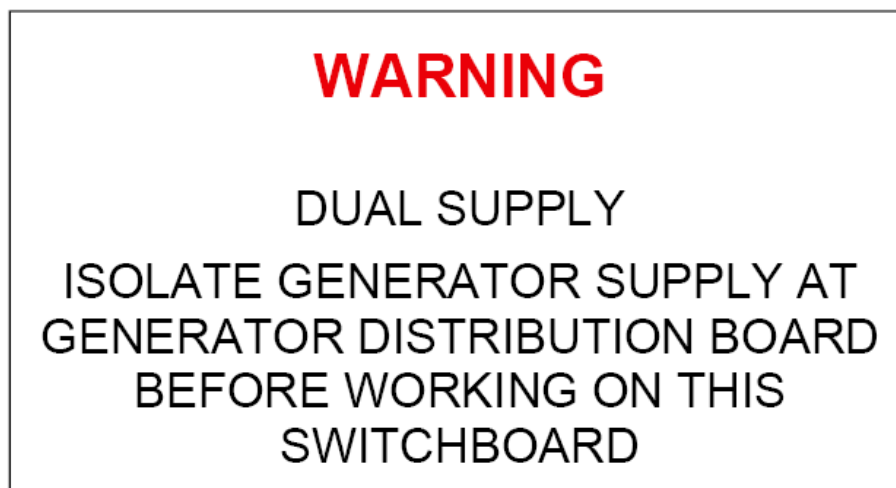


Figure 3 Sign on Intermediate Distribution Switchboard

10. PAYMENTS AND CHARGES

As owner of the Distributed Generation installation you will need to negotiate a contract for the amount of electricity that is sold to an electricity retailer, or to another party via an electricity retailer.

There are specialist companies that provide analysis and price prediction, should you wish to compare any offers from Retailers, or discuss other options to sell the electricity generated.

Your Time of Use meter will enable you to be paid by your retailer and/or the purchaser of your exported electricity for the correct amount that you have exported during the peak periods.

Note that in some areas, due to the amount of Distributed Generation, injection occurs into the Transpower Network. If this occurs parties that connected after this time will need to pay HVDC charges to Transpower based on their portion of injection.

There will often be initial one-off Network charges for the connection of your Distributed Generation system, and there may also be other Network modifications required which could require funding arrangements to be agreed between the owner and PowerNet, therefore early discussions with PowerNet are essential.

11. REGULATED TERMS

Parties with new Distributed Generation may operate under the regulated terms specified in schedule 2 of the Electricity Governance (Connection of Distributed Generation) Regulations 2007, or negotiate a specific Connection Agreement, which will replace the regulated terms.