



Orion New Zealand Limited

# Large Distributed Generation Systems

**Information Pack for Large System  
(above 10kW) Connections**

**Orion**  
your network

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## Introduction to large distributed generation systems (above 10 kilowatts)

Distributed generators, also known as 'embedded generators', are generators located at a home or business that are capable of generating electricity for that home or business's own use. They may also be capable of putting surplus energy back into Orion's distribution network. These generators can take several forms: solar panels, wind or micro-hydro turbines and diesel generators are the most common.

If you are interested in operating distributed generation and connecting it to our network, there are some things you need to know.

This guide contains information for organisations interested in connecting large distributed generation systems (above 10 kilowatts) to our network.

Systems of this size are typically installed in large businesses. Systems less than 10 kilowatts are typically installed in homes and small businesses.

For more information about distributed generation, please contact:

**Gavin Bonnett**

Operations Services Manager

DDI: 03 363 9731

Mobile: 027 474 7665

Email: [Generator.Application@oriongroup.co.nz](mailto:Generator.Application@oriongroup.co.nz)

Orion New Zealand Limited

PO Box 13896

565 Wairakei Road

Christchurch 8141

[oriongroup.co.nz](http://oriongroup.co.nz)

# Connecting distributed generation with capacity above 10 kilowatts

This information is for people who want to connect medium to large distributed generation systems (above 10kW) to Orion's electricity network to generate electricity and possibly export energy into our network. These systems are usually three-phase, and are typically installed at industrial, commercial or rural sites.

This information does not apply to generation systems which are not connected to our network.

For information about connecting smaller distributed generation, see our Information Pack for Small System Connections which is also available on our website.

## Talk to us about your proposed distributed generation

Installing distributed generation is complex. If you intend to install distributed generation that is capable of exporting any excess energy from the generator into our network (even if this seems unlikely), then you will need to involve us in the process as early as possible. Each distributed generation situation is different and needs to be discussed with us.

Any agreement to connect distributed generation to our network may include costs associated with design and reinforcement of the existing network. If network reinforcement is required, the design and schedule for this project work will need to be factored into your installation planning. Projects may be constrained by network resources and restrictions.

Once you have finalised your distributed generation design, we will need to review it before we will allow it to connect to our network. As with any new or altered electricity connections, we will need to see a certificate of compliance for the installation before it can be connected.

Larger generators (above 1000kW) may be subject to Transpower's terms and conditions. If this is the case, we will facilitate responses to Transpower's requests. The generation owner will be responsible for providing any requested information to us to assist in the process.

Distributed generation must meet all relevant statutory and regulatory requirements and comply with all applicable safety standards. If you connect distributed generation to our network, safety equipment and procedures must be in place to ensure safe interaction between your distributed generator and our network.

More information about distributed generation is available on the Electricity Authority Te Mana Hiko website: [ea.govt.nz](http://ea.govt.nz).

## **Process to connect distributed generation above 10kW to our network**

We outline below the steps that you will need to take to connect distributed generation above 10kW to our network. This information complies with the Electricity Authority, [Electricity Industry Participation Code 2010, Part 6 Connection of Distributed Generation](#) (“the Code”).

### **Select your system**

Usually distributed generation above 10kW will be diesel or wind generation. Occasionally it will be hydro, gas or co-generation. Your system must conform to AS/NZS 3000 – Electrical Installations (known as the Australian/New Zealand Wiring Rules) and associated standards, which you can purchase and download from [ess.govt.nz](http://ess.govt.nz) or view for free at your public library. Your system must also conform to Orion’s Network Code, which you can download from [oriongroup.co.nz](http://oriongroup.co.nz) or collect from our offices at 565 Wairakei Road, Christchurch 8053.

### **Contact your electricity retailer**

You must discuss your proposed distributed generation installation with your electricity retailer (or the Electricity Authority’s clearing manager, although this approach is less common), as any surplus energy you generate may be sold to them. Unless you have contractual arrangements for purchase of any surplus electricity generated, and an electricity retailer is responsible for the connection, you will not be able to connect to our network.

### **Notify us**

Generation systems above 10kW in capacity can have significant impacts on our network. We need to know where the distributed generation system will be connected and ensure the generation operates safely. Ideally, you should contact us as soon as you have decided which system you intend to install.

### **Your application**

You will need to complete an application form and return it to us, along with the detailed information requested in the form.

### **Application fees**

We may require an application fee to be paid, as prescribed in Schedule 5 of the Code.

### **Confirmation that your application is complete**

Within five business days of receiving your application we will advise you in writing whether or not your application is complete.

## After your application

Within 30 business days of receiving your completed application we will provide you with the following information:

- (a) the capacity of our network, including both the design capacity (including fault levels) and actual operating levels;
- (b) the extent to which connection and operation of your distributed generation may result in a breach of the relevant standards for safety, voltage, power quality, and reliability of supply to other connected parties;
- (c) any measures or conditions (including modifications to the design and operation of our network or to the operation of your distributed generation) that may be necessary to address the matters referred to in paragraphs (a) and (b);
- (d) the approximate costs of any network-related measures or conditions identified under paragraph (c) and an estimate of time constraints or restrictions that may delay the connecting of your distributed generation;
- (e) any further detailed investigative studies that we reasonably consider are necessary to identify any potential adverse effects on the system resulting from the proposed connection, together with an indication of:
  - (i) whether we agree to you, or a suitably qualified agent for you, undertaking those studies; or
  - (ii) if not, whether we could undertake those studies and, if so, the estimated cost of the studies that you would be charged;
- (f) any obligations to other parties that may be imposed on us and that could affect your distributed generation (for example obligations to Transpower, in respect of other networks, or under the Electricity Industry Participation Code);
- (g) any additional information or documents that we consider would assist your application; and
- (h) information about the extent to which planned and unplanned outages may affect the operation of your distributed generation.

## Other information to assist with your decision making

You can request further information from us which is reasonably necessary to enable you to consider and act on the information which we provided in response to your application. We will provide this further information within 10 business days of receiving your request.

## **Our acceptance of your application for generation**

Within 45 business days of receiving your application we will give written notice of our decision to approve or decline your application for generation, and whether any conditions or other measures apply if we accept your application. Please note that notice can be extended under the provisions outlined in [Schedule 6.1 part 2 of the Code](#).

## **If we decline your application**

If we decline your application we will detail our reasons. If you disagree with our decision, a dispute resolution process is provided in [Schedule 6.3 of the Code](#).

## **Your intention to proceed**

After we approve your application you have 30 business days (or a mutually agreed longer period) to notify us in writing if you want to proceed with the distributed generation connection, and if so, confirming:

- (a) the details of the distributed generation to be connected; and
- (b) that you accept all of the conditions (or other measures) which we have specified as conditions of the connection.

Notice can be extended under the provisions outlined in [Schedule 6.1 part 2 of the Code](#). Please note that if you choose not to proceed, and then apply to connect the same generation at a later date, we may charge an application fee.

## **Connection of generation**

We have 30 business days to negotiate a connection contract with you after you notify us in writing of your intention to proceed. This contract will be based on the connection contract set out in [Schedule 6.2 of the Code](#). This schedule and terms are a default agreement if we are unable to negotiate a connection contract.

## **Testing and inspection before connection**

Please note that after your application has been approved and the steps outlined above are complete, as a minimum you must:

- (a) test and inspect your distributed generation before connection;
- (b) give us adequate notice of the tests and inspection – we may send qualified personnel to the site to observe the testing and inspection; and
- (c) provide us with a written test report after testing and inspection. This report must confirm that the metering installation has a certificate of compliance. The following tests should be carried out on both generation and associated control equipment:

- secondary injection testing of all protection
- proof of tripping circuits for protection operation
- automatic synchronising and interlocking
- load and VArS sharing stability
- loss of mains testing
- compliance of warning notices and labelling.

We may charge a fee for observing the testing and inspecting, as prescribed in [Schedule 6.5 of the Code](#).



## Application to connect and operate distributed generation with capacity above 10kW on Orion's network

### Details of your proposed distributed generation

You must provide Orion with enough information to enable your distributed generation to successfully connect to our network without affecting other connected customers. Please note that an application fee may be payable if we need to carry out significant research and analysis to assess the potential impact of your proposed distributed generation.

For all existing electricity connections, and when applying for a new electricity connection, we will evaluate the total export capacity of your proposed distributed generation (i.e. the maximum amount of electricity that your generation is able to inject into our network) to assess whether your proposed generation will exceed the capacity of your electricity connection. To complete this evaluation, we will need evidence of your generation capacity – normally a kilowatt rating. Please attach to your application a copy of the manufacturer's specifications and/or a photograph of the 'name plates' for your proposed generation, as evidence of its capacity. Additional information may be required if the manufacturer's specifications are not comprehensive.

The extent of the information required will depend on the size and type of generation. This information will remain confidential between us unless agreed otherwise, however we reserve the right to release information about the distributed generation to meet our obligations to Transpower, the operator of the national grid, or as required by the Electricity Industry Participation Code 2010.

We will use the information supplied in your application to evaluate and model our network to decide what method of connection would be needed and the voltage level at which the connection should be made.

### You must obtain our written agreement before you can connect distributed generation to our network

Details of person/organisation applying to connect distributed generation	Details of customer at premises where distributed generation is to be connected
Name: _____	Name: _____
Company: _____	Company: _____
Address: _____ _____	Address: _____ _____
Phone: _____	Phone: _____
Facsimile: _____	Facsimile: _____
Email: _____	Email: _____



Connection:      Existing ☐      Upgrade ☐      New ☐

ICP number from your power account (if new or upgraded connection): \_\_\_\_\_

Proposed date to connect your distributed generation: \_\_\_\_\_

## Technical information for distributed generation

The following information must be supplied to us:

### Data required for each distributed generation system

Data required for range of power output	10-100 kVA	100-750 kVA	>750 kVA
Type of generation unit – synchronous, asynchronous, etc			
Type of prime mover			
Rated terminal voltage (kV)			
Rated generation capacity (kVA)			
Rated minimum power factors (both over and under excited) at rated kVA	X		
Maximum continuous active power generated (kW)			
Maximum short term active power generated (kW)	X		
For asynchronous generations, reactive power requirements (kVAr)			
Anticipated operating regime e.g. continuous, intermittent, peak lopping			
Method of voltage control			
Generation transformer details, if applicable	X	X	

### Interface arrangements

Data required for range of power output	10-100 kVA	100-750 kVA	>750 kVA
The means of connection and disconnection			
The means of synchronisation between the distribution network and the distributed generation			
Generation neutral earthing arrangements	X	X	
Single line diagram for installation detailing circuit breakers, base loads and generation capabilities			

## Technical data

Data required for range of power output	10-100 kVA	100-750 kVA	>750 kVA
Lowest frequency at which the distributed generation can run	X	X	
Actual low frequency trip setting and time delay			
Actual over frequency trip setting and time delay			
Minimum operating power	X	X	
<i>Generation kW/kVAr capability charts (at lower voltage terminals at nominal and <math>\pm 10\%</math> of nominal voltage) at:</i>			
(a) maximum short term power	X	X	
(b) maximum continuous power	X		
(c) 75% output	X	X	
(d) 50% output	X	X	
(e) minimum power	X	X	
<i>Auxiliary power requirements at:</i>			
(a) rated power output	X	X	
(b) minimum power output	X	X	
(c) start up	X	X	
<i>Start up times to minimum operating power:</i>			
(a) from cold	X	X	
(b) from warm	X	X	
(c) from hot	X	X	
Normal ramp rate	X	X	
Time for cold start to full rated output	X		
Inertia constant (seconds) (whole machine)	X	X	
Stator resistance	X	X	
Direct axis synchronous reactance	X	X	
Quadrature axis synchronous reactance	X	X	



Direct axis transient reactance	X	X	
Quadrature axis transient reactance	X	X	
Direct axis sub transient reactance	X	X	
Quadrature axis sub transient reactance	X	X	
Leakage (positive sequence) reactance	X	X	
Negative sequence reactance	X	X	
Zero sequence reactance	X	X	
Earthing resistance/reactance	X	X	
Time constants:			
(a) direct axis transient open circuit	X	X	
(b) quadrature axis transient open circuit	X	X	
(c) direct axis sub transient open circuit	X	X	
(d) quadrature axis sub transient open circuit	X	X	
Generation transformer details (impedance, tap changer, vector group, earthing, maximum overvoltage capability at rated frequency etc.)	X	X	
Type of excitation system (block diagram/specifications, forward/feedback gains/time constants and limits)	X		
Speed governor and prime mover data (detailed functional description of governing system with all subsystems including system control and turbine time)	X		

## Control arrangements

It is preferable for distributed generators not subject to despatch to export reactive energy (kVArh) whenever real energy (kWh) is exported onto our network. Subject to network voltage remaining within agreed limits, the desired power factor should be between 0.85 and 0.9. See protection and generator network islanding below for islanding detection requirements.

We will advise if continuously acting fast response automatic excitation and/or governor control systems are required to control the distributed generator voltage and frequency without instability over the entire operating range of the distributed generator. This will depend on the size and type of distributed generator and the characteristics of the part of our network to which it is connected.

## Protection

The distributed generator must be equipped with the appropriate protection elements as required by the "EEA Guide for the Connection of Generating Plant". Distributed generator owners must consult us with regard to any special arrangements or protection that may be

necessary due to the characteristics of our network. The general protection requirements are outlined below.

Protection requirements	10kW > 100kW	100kW > 750kW	> 750 kW
Generation circuit breaker			
Dedicated transformer	X	X	
Disconnect/isolate switch			
Over-voltage protection			
Under-voltage protection			
Over-frequency protection			
Under-frequency protection			
Earth-fault protection	X		
Over-current voltage restraint protection	X	X	
Neutral voltage displacement protection			
Synchronisation			
Loss of network supply (see Islanding notes)			
Power factor or voltage regulation equipment	X		

The protection associated with the distributed generator must co-ordinate with the protection associated with our network as follows:

- In order to keep the impact of faults on our network to a minimum, the distributed generation must meet target clearance times agreed between us and the generation owner, for fault power flowing from our network. We will ensure that the relevant protection settings are compatible with the target clearance times that we specify;
- The settings of any protection which controls a circuit breaker, or the operating parameters of any automatic switching device at any network connection point, must be approved by us;
- The distributed generation protection must co-ordinate with any auto re-close settings specified by us; and
- Any distributed generator connected to our network may be required to withstand, without tripping, the negative phase sequence loading incurred during the clearance of a close-up phase-to-phase fault by our network back-up protection and which is within the plant short-time rating.

### Generator network islanding

All distributed generation must disconnect from our network when a network outage is detected.



Generator network islanding occurs when a fault on our network is isolated by network switches and the generator continues to supply power to the isolated network. Many generators will disconnect and supply a load within their installation during a network outage (creating their own island).

Managing safety for operations and people becomes an issue with network islanding. If an attempt is made to re-liven the local network without synchronising to the distributed generation then substantial damage can occur to the network and to the customer's installation equipment.

It is therefore critical that all generator operating intentions and protection systems are detailed to us. We will decide, based on local network conditions and information given by you, whether network islanding is a credible possibility.

For more information about distributed generation, please email us:

[Generator.Application@oriongroup.co.nz](mailto:Generator.Application@oriongroup.co.nz)

# Congestion Management & Safety

## Congestion management policy

Distributed generation on our network has traditionally been installed by individual customers who wish to enhance the security of their electricity supply and reduce their costs associated with peak demand on our network.

The electricity generated has generally been used at the premises where it was generated and at a time coinciding with high network demand.

New forms of distributed generation, such as solar power (photovoltaic panels) are predominantly being installed to reduce the quantity of electrical energy required from the network on a continuous basis. This change in approach can lead to significant amounts of electricity being exported on to our local area network. This is particularly true in the height of summer when photovoltaic output is at a maximum and homeowners may be at work or away on vacation with very little electricity being used in the home.

Our network is mainly engineered so that electricity flows in one direction. Continued growth of distributed generation is likely to create reverse energy flows and congestion on some parts of our network. Typically this will create excessively high voltage, which can damage customers' electrical appliances as well as our network equipment.

At the moment small distributed generators are not causing any congestion on our network although we will continue to monitor this. We will undertake regular assessments (using our database of distributed generation installations and network capacity models) to determine what areas on our network will be congested with the addition of future distributed generation. We will report areas of distributed generation congestion on our network.

Distributed generation can be provided in many different forms, with wide variations in the business model and operational requirements. Congestion management is best determined on a case-by-case basis during the network application process. There are two main ways to manage network congestion:

- by ensuring that distributed generation connection only occurs in uncongested areas or is always accompanied by an appropriate network upgrade
- by agreeing on a case-by-case basis the real-time operational rules that will apply.

The outcome will depend on the nature of the network congestion, the distributed generation operational characteristics and the business model of the proposal.

In line with the pricing principles in the [Electricity Industry Participation Code 2010 Part 6 Connection of Distributed Generation](#), in situations where a proposed generator will add to

(rather than relieve) network congestion, and where this congestion requires reinforcement of the network, we will charge this to the connecting distributed generator.

Future updates to this Congestion Management Policy will detail our approach to managing distributed generation congestion, including operational rules.

In some instances, events on Transpower's national transmission grid may restrict distributed generation.

## **Emergency response policies**

Our emergency response policies are detailed in our Asset Management Plan (Section 6.9.1: List of Contingency Plans). Printed copies are available from our offices at 565 Wairakei Road, Christchurch 8053.

## **Safety standards**

Our safety standards are detailed in our Asset Management Plan (Section 6.3: Safety, and Section 3.3.5: Service Level Measures - Safety). Printed copies are available from our offices at 565 Wairakei Road, Christchurch 8053.



# Credits and charges

## Delivery credits

Generators can often reduce our delivery costs by lowering the peak loading levels on our network, which reduces our need to upgrade and reinforce our network. We reflect these savings through our export and generation credits arrangements - providing high credit rates for generation that occurs during our relatively short peak loading periods.

As with our delivery charges, credits are usually paid to electricity retailers who pass them on to generators.

The credits are optional and generators must apply for them and agree to the associated conditions. In most situations, additional metering is required in order to apply the credits (see metering below).

In our experience, distributed wind generation provides a highly correlated contribution which does not effectively reduce our peak loadings, and photovoltaic generation does not reduce our significant winter evening peaks. On this basis, we do not generally provide credits for these forms of generation.

For further details, refer to our 'export and generation credits schedule' available from our website.

## Energy credits

Separately, and in addition to our delivery credits, generators are able to contract with electricity retailers (or the Electricity Authority's clearing manager) to sell any generation that is injected back into our network.

## Charges

We do not currently apply a fee for assessing generation applications.

For the initial connection to our network, we consider the costs of any extension or modifications that are required (including any ongoing operational and maintenance costs) and generally require the generator to cover all of these costs via a one-off capital contribution. Wherever possible, we encourage generators to contract directly for the construction of extensions to take advantage of the competitive electrical contracting alternatives that are available.

We do not currently impose any ongoing charges in relation to distributed generation, and normal delivery charges can often be reduced significantly by generating to supply some or all of the load at the connection.

For further details, refer to our 'connections and extensions policy', available on our website.

# Metering

The generator is responsible for ensuring that suitable metering is installed which meets the minimum requirements for the size of the generator, and is also suitable for the pricing options applicable for the generator. This metering must be certified and compliant with the metering standards set out in the Electricity Industry Participation Code (the EIPC).

The generator must ensure that arrangements are in place to read meters and provide this metering information to Orion in a suitable format.

## Minimum metering requirements

Total generation capacity installed	Metering category of the connection (under the EIPC)	Orion's minimum metering requirement
10kW or less - or - 30kW or less (with no export, or minimal export)	1 or 2	Separate import/export metering of accumulated kWh flows at the network connection point.
Above 10kW and up to 350kW	1 or 2	Half-hour interval metering to separately measure kWh import and export volumes at the network connection point.
350kW or less	3 and above (with low voltage 230/400V network connection)	
350kW or less	3 and above (with high voltage 11kV network connection)	Half-hour interval metering to separately measure kWh and kVarh import and export volumes each half hour at the network connection point (ie four-quadrant interval metering).
Above 350kW	any category	

## Metering requirements for export and generation credits

In order to take advantage of the applicable export and generation credits that we offer (see above) the generator will need to ensure that the following additional metering is in place:

Credit and total generation capacity installed	Metering
Export credits	
Small (0 to 5kVA)	No additional metering requirements.
Medium (5 to 30kVA)	Switched kWh metering measuring accumulated export at the network connection point during Orion's ripple signalled <i>peak period</i> .
Large (above 30kVA) - real component	Switched half-hour interval metering to separately measure kWh export volumes at the network connection point each half hour during Orion's ripple signalled <i>control period</i> .
Large (above 30kVA) - reactive component (required only for optional reactive power credit)	Switched half-hour interval metering to separately measure kVARh export volumes at the network connection point each half hour during Orion's ripple signalled <i>control period</i> .
Generation credits (above 30kVA)	Switched metering of accumulated kWh generation volumes at the connection point of the generator during Orion's ripple signalled <i>generation period</i> . We do not require this metering to be certified, but it must be installed to a standard which is consistent with the standards set out in the Electricity Industry Participation Code.

On application, we will consider the suitability of alternative metering arrangements.

Please note that these metering requirements are additional to our general metering requirements for delivery, and electricity retailers will also specify their own requirements. We recommend that generators discuss their metering with their electricity retailer who can provide metering options that meet all requirements.

# Maximum fees for connection of distributed generation

## Schedule 6.5 of the Electricity Industry Participation Code 2010 (Connection of Distributed Generation)

In this schedule, reference to a kW or MW rate, in relation to distributed generation, is a reference to the kW or MW rate at which distributed generation is capable of generating electricity.

A distributor may require the payment of fees for any of the following activities prescribed under the regulations up to the maximum fee specified in the column opposite the activity:

<b>Fee for application for distributed generation 10 kW or less in total</b>	\$
Distributed generation of 10 kW or less in total	200
<b>Fee for application for distributed generation above 10 kW</b>	
Distributed generation of above 10 kW in total but less than 100 kW in total	500
Distributed generation of 100 kW or above in total but less than 1 MW	1,000
Distributed generation of 1 MW and above	5,000
<b>Fee for observation of testing and inspection</b>	
Distributed generation of 10 kW or less in total	60
Distributed generation of above 10 kW in total but less than 100 kW in total	120
Distributed generation of 100 kW and above	1,200