



Document Number	DG-001
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**DISTRIBUTED GENERATION CONNECTION POLICY AND
TECHNICAL STANDARDS: \geq 500KW**

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Revision Register		
Rev #	Date	Reason for Revision
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1	6/9/06	Final Issue

Table of Content

1	Introduction	1
2	Scope	1
3	Document Revisions	2
4	Definitions	2
5	Top Energy's Approach to Distributed Generation	3
6	Other Related Documents.....	3
7	General Procedure for Connection.....	4
7.1	Making a Connection Enquiry	5
7.2	Making a Formal Application	6
7.6	Retailers.....	7
8	Commercial Terms.....	7
9	Reactive Power.....	9
10	Technical Standards	9
11	Liabilities	9
12	Health and Safety	9
13	Change of Occupancy / Ownership.....	10
14	Contact Details.....	11
Appendix A	Technical Standards : $\geq 500\text{kW}$	12

1 Introduction

The term *Distributed Generation* (DG) (sometimes referred to as embedded generation) relates to any electricity generation facility that either produces electricity for use at the point of location or supplies electricity to other consumers through a local lines distribution network at distribution rather than transmission voltages.

The surplus energy not used by the consumer that operates a DG needs to be sold to an electricity *Retailer*. Top Energy is an Electricity Lines Business (as defined by the Electricity Act) and as such cannot purchase the surplus electricity.

2 Scope

This document does not apply to DG systems that are operating stand-alone and do not connect to the Top Energy network.

The information in this document applies to DG that is greater than or equal to 500 kW, which are likely to be installed in industrial/commercial premises or dedicated generation stations. The document is used by both Top Energy and the DG owner to enable efficient and safe connection of DG schemes to Top Energy's distribution network.

The exact technical standards and information requirements finally implemented may vary depending on the different impact that DG schemes have on the quality and supply provided to other connected consumers. Furthermore different conditions/requirements may apply depending on the location that the DG scheme is connected to Top Energy's network. In particular it should be noted that special contractual terms and technical requirements additional to those laid out in this policy may apply, and that the requirements outlined in this document constitute normal DG connection practice.

DG greater than 1,000 kW is also subject to the Electricity Governance Rules (EGR; Section 2.6, Part C Section III). The EGR rules are relatively comprehensive and depending on the size of the DG require the DG owner to (i) submit varying amounts of information to the System Operator (Transpower), (ii) install specific equipment, and (iii) adhere to specific rules. For more information in relation to the EGR rules either contact Top Energy or refer to the *Electricity Commission* web-site at:

<http://www.electricitycommission.govt.nz/rulesandregs/rules>.

Top Energy also recommends that large generation plant (ie. wind farms) owners should refer to Transpower's "Connection and Dispatch Guide"

<http://www.transpower.co.nz/notion/share/download.asp?cid=4578&csid=9331&mdid=&file=%2Fupload%2Fnotion%2Fsectionimages%2F9331%5Fgenerator%2Dguide%2Dversion%2D3%2Epdf>

and "Test Plan"

(<http://www.transpower.co.nz/notion/share/download.asp?cid=4472&csid=12371&mdid=&file=%2Fupload%2Fnotion%2Fsectionimages%2F12371%5Ftest%2Dplan%2Dfinal%2Ddraft%2D20041022%2Epdf>)

which Top Energy views as being a useful New Zealand guide for the connection and testing of large DG plant.

(Customers will need to register on the Transpower site to gain access to the Test Plan).

3 Document Revisions

Top Energy may amend and expand this document from time to time where it may be necessary to meet the requirements of the applicable regulations and to suit the needs of the distribution network.

4 Definitions

The following terms have been included in this document and are, for clarity, defined as outlined below.

Distributed Generation (DG)	Electrical equipment capable of producing electricity and which is distributed across Top Energy's electrical network.
Distributed Generator	The operator of a Distribution Generation facility.
Retailer	Electrical company that buys and sells electricity.
Electrical Lines Business (ELB)	Electrical network company that transports electricity from generators to consumers (on behalf of Retailers).
Certificate of Compliance (CoC)	Document signed by the installing electrical worker and a registered/licensed inspector that certifies that the Distributed Generation is electrically safe.
Electricity Governance Rules (EGRs)	Electricity rules and regulations as laid out by the Electricity Commission, New Zealand.
Transpower	Electricity transmission grid owner and operator.
Electricity Commission	The Electricity Commission is a Crown owned entity set up under the Electricity Act to oversee New Zealand's electricity industry and markets.
Connection Enquiry	Initial written approach to Top Energy containing proposed connection and DG information.
Formal Application	Completed application form submitted to Top Energy formally requesting permission to connect.
Interconnection Rate	Transpower charges for use of the transmission system that is allocated to distribution companies.

Avoided Transmission Benefits	Potential benefit resulting from reduced transmission charges.
Islanded Network	Network condition whereby a DG operates and supplies a local load whilst not connected to the national grid.
Interconnection Adjustment Factor	Ratio applied to the Interconnection Rate to take account of subsequent year adjustments
Grid Exit Point (GXP)	Transpower substation from which Top Energy takes electrical supply.

5 Top Energy's Approach to Distributed Generation

Top Energy's approach to DG is based on the following key principles:

- a) DG are able to connect to Top Energy's electricity distribution network on fair and equitable terms that do not discriminate between different DG schemes,
- b) The terms under which DG can connect and operate are as clear and straightforward as possible (within the limitations of maintaining a secure and safe electrical distribution network),
- c) All DG applications will be processed as fast as possible,
- d) All technical and safety standards relating to DG are based on industry practice, and
- e) All relevant legislation and regulatory requirements are adhered to.
- f) The company's right to limit the total capacity of DG connected to its network (in particular to each 11kV/22kV feeder).
- g) That large DG installations would be subject to normal industry connection requirements, in particular those outlined by in the EGR.

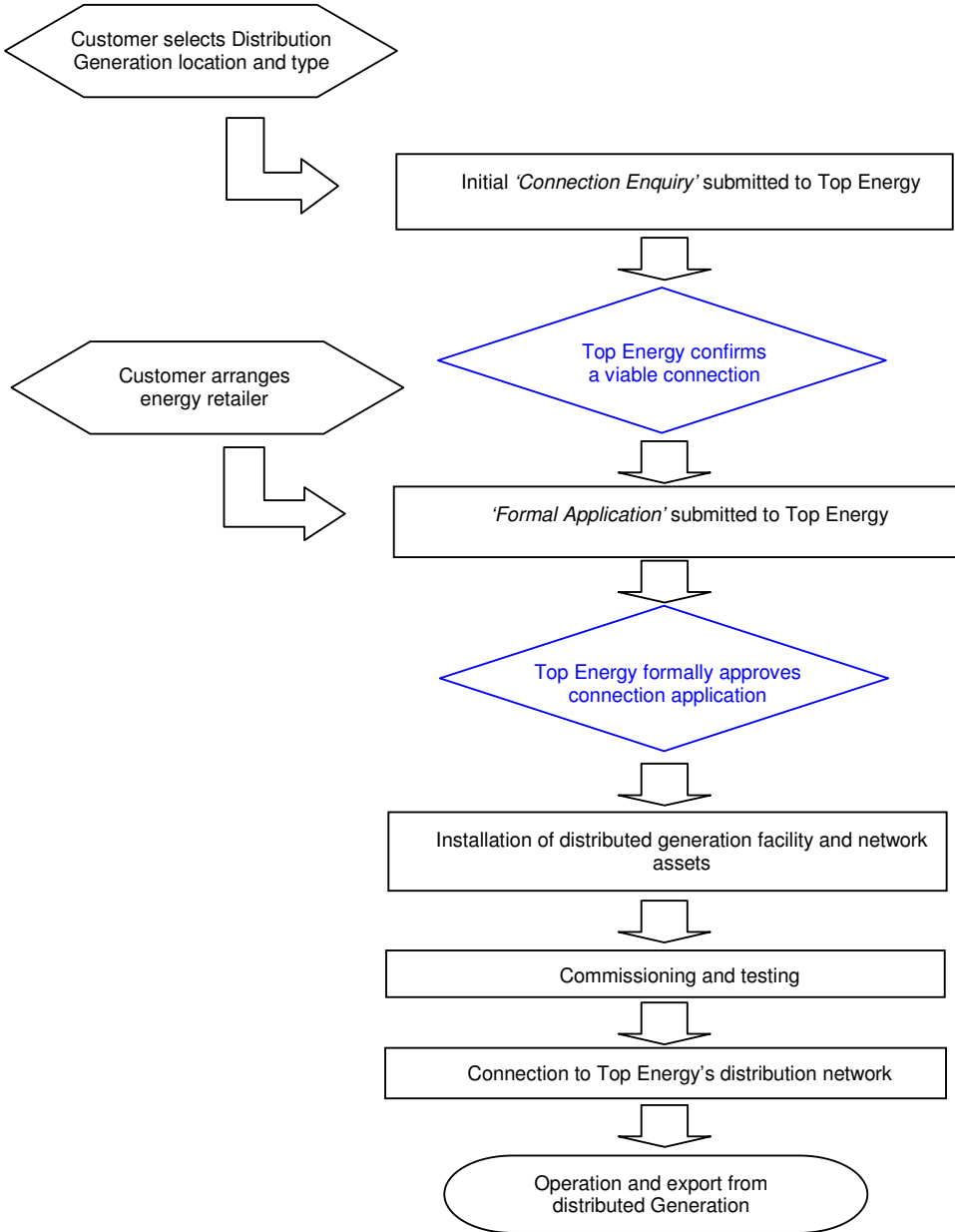
6 Other Related Documents

DG-002 DG Connection Policy and Technical Standards: $\geq 10\text{kW}$ & $< 500\text{kW}$

DG-003 DG Connection Policy and Technical Standards: $< 10\text{kW}$

7 General Procedure for Connection

The following flow chart outlines a simplistic approach to the connection process required to connect a DG to Top Energy’s network (from initial enquiry to final connection).



7.1 Making a Connection Enquiry

Prior to making a formal application to connect a DG, a *'Connection Enquiry'* should be made to Top Energy indicating an interest to connect. This enquiry should include sufficient information to enable Top Energy to assess the viability of the proposed connection location and the ability to inject electricity into the distribution network.

This enquiry should contain background and technical information on the proposed facility and connection including:

- h) Type and technical specification of the DG equipment,
- i) Manufacturer rating of equipment,
- j) Number of phases,
- k) Proposed point of connection to the Top Energy network,
- l) The proposed schedule time-line for installation,
- m) Contact details, and
- n) Any other features of the DG or connection the enquirer feels may be relevant or useful.

Top Energy will process an initial DG *'Connection Enquiry'* within 20 working days, and will provide an initial response outlining:

- o) Whether connection to the existing infrastructure is possible without augmentation and a cost estimate to connect if appropriate.
- p) If augmentation is required, the extent involved and whether Top Energy will provide this, or whether it would be at the applicants cost. If the later, then an estimate will be provided. If substantial further engineering investigations are required that the customer would be expected to meet, then an estimate for these will be provided before proceeding.

Top Energy may also wish to discuss the initial concept design and connection to ensure that the installation is acceptable to both parties.

7.2 Making a Formal Application

A 'Formal Application' to connect DG should be made by completing a 'Distributed Generator Installation Application Form'. Applications forms are provided at the back of Appendix A of this policy document and are also available from Top Energy offices, via written request or can be down loaded from the web-site (<http://www.topenergy.co.nz/>).

Connection to Top Energy's distribution network should only be made after written approval for the connection has been obtained from Top Energy via a Formal Application.

Top Energy reserves the right to refuse the connection of a DG plant.

In the event that an application to connect DG is declined, Top Energy will provide the enquirer with an explanation of the decision. Any steps or measures which could be taken to enable a connection will be provided with the explanation, if appropriate. For larger DG an agreement to reinforce the distribution may be required.

Note that Top Energy may need to carry out significant detailed power system analysis to determine the impact of parallel operation of the DG on the Top Energy network, the costs associated with this activity may be passed onto the applicant. Top Energy will inform the applicant prior to undertaking any analytical work that will be on-charged.

7.3 Progress after Application

All 'Formal Applications' received by Top Energy will be recorded and the approval process advanced as quickly as possible.

The completed application forms must contain all necessary information in order to assess the connection and agreement to connect will only be granted if:

- a) The distribution network is able to support the proposed DG and absorb the electricity generated,
- b) The DG scheme proposed meets Top Energy's network connection and safety requirements,
- c) The injected electricity does not exceed the distribution network capacity at the point of connection, and
- d) The DG will not have a negative impact on the quality of supply to other network users supplied from the distribution lines network.

7.4 Prior to Final Connection

After approval of the *Formal Application* the following issues must be provided to Top Energy prior to final physical connection:

- An outline of the final installation design,
A copy of the Certificate of Compliance (CoC), and
A copy of the energy sale/purchase agreement with an electricity *Retailer*.
- a) In addition, prior to final connection, Top Energy may also require the DG owner to:
- Complete and sign a Distributed Generation Connection Agreement,
 - Complete and sign a Distributed and/or Transmission Benefits Agreement,
 - Submit a set of commissioning procedures, and
 - Submit a set of operational procedures.
 - Submit a the results of commissioning tests (i.e. protection & earthing tests).

7.5 Connection to Top Energy's network

Once Top Energy is satisfied that the DG owner has provided all relevant information and is compliant with the required Top Energy and industry standards (including building and electrical codes) final connection to the network may be made.

It is the responsibility of the DG to contact the local council and satisfy any building or other consents which may be required.

7.6 Retailers

A DG owner will need to engage an electricity *Retailer* who will provide a mechanism to trade any surplus/exported DG electricity within the New Zealand Electricity Market (NZEM); i.e. the *Retailer* will purchase any surplus electricity. The requirements for *Retailers* in relation to trading electricity on the electricity market are covered in the EGRs.

The electricity *Retailers* currently operating on Top Energy's network are:

- e) Contact Energy (<http://www.contact-energy.co.nz/>)
- f) Genesis (<http://www.genesisenergy.co.nz/>)
- g) Mercury Energy (<http://www.mercury.co.nz/Home/Default.aspx>)
- h) Trustpower (<http://www.trustpower.co.nz/>)

The *Retailer* will arrange the metering arrangements required for the DG scheme and may install a new meter or second meter to record the amount of electricity generated and exported into the network. They will also outline the tariff and/or meter charge depending on the DG connection location and the type of metering installed.

8 Commercial Terms

Top Energy will offer and enter into a commercial agreement upon acceptance with each DG, such agreements will include, but are not limited to the following key principles:

- i) any payments, terms and conditions will be subject to an agreement between Top Energy and the DG;
- j) all costs incurred by Top Energy pertaining to the investigation, design and planning of any connection proposal may be charged to the DG owner;
- k) all capital expenditure, operational and maintenance costs associated with the cost of connecting the DG to the Top Energy network will be met by and/or completely recovered from the DG owner;
- l) all capital expenditure, operational and maintenance costs associated with the cost of a DG scheme that injects into the national grid (“the Grid”) will be met by and/or completely recovered from the DG owner;
- m) measurable reductions in Top Energy’s transmission costs as a direct result of the DG may be shared with the DG owner; these costs are known as ‘*Avoided Transmission Benefits*’ and are explained in Section 8.1.

8.1 Avoided Transmission Benefits

The current charging mechanism for the use of the Transpower transmission system is by the allocation of: asset, operational, maintenance and inter connection charges to each distribution company. Before the beginning of new pricing period Transpower calculates its allowable revenue with respect to the ‘*Price Path Threshold*’, from this allowable revenue the cost of: supplying, operating and maintaining connection assets that are directly attributable to each distribution company is subtracted; the remainder is the allowable revenue for: supplying, operating and maintaining the inter connection assets. The allocation of these charges to each distribution company is based on: the average of the twelve highest peak demands (kW), ‘*Anytime Maximum Demand*’ (AMD), measured at each ‘Grid Exit Point’ (GXP) any time during the Transpower measurement period.

A potential benefit exists for DG to reduce the transmission charges attributable to Top Energy by decreasing the amount of energy taken from the transmission network at peak demand times, therefore reducing Top Energy’s AMD measured at each of Top Energy’s GXPs, of which Top Energy are accountable for one at Kaikohe and one Kaitaia.

The magnitude of the effect that a DG has is dependent upon: the size of the DG, its operational profile and whether this profile coincides with the peak demand of the corresponding GXP. The difficulty with assessing the value of DG when issuing *Avoided Transmission benefits* is that the value depends on the demand realisations at each GXP during the Transpower measurement period and the DG’s coincident energy export at the same time and date as each of the twelve highest demands recorded during this period. Therefore any *Avoided Transmission benefits* that Top Energy may share with the DG would be issued based on retrospective generation. However once a DG has developed a generation profile, Top Energy may enter into more sophisticated *Avoided Transmission Benefit* contracts such as derivative contracts.

9 Reactive Power

At some locations in Top Energy's network (and the Transpower grid) there is a need for additional reactive power sources. Depending on the DG connection location there may be some commercial benefit associated with installing DG plant with high reactive power output capabilities. Top Energy will consider this issue on a case by case basis.

10 Technical Standards

In order to connect to Top Energy's network a DG must meet with Top Energy's Technical Standards. These standards are outlined in Appendix A.

11 Liabilities

In the absence of a specific contract between Top Energy and a Distributed Generation scheme the following general liabilities apply:

- n) Top Energy has no liability for damage to the DG equipment or persons that results from the operation of the DG installation,
- o) Top Energy has no liability for damage to the DG equipment (or consequential losses) resulting from the operation of Top Energy's distribution equipment except where Top Energy has been negligent, and then Top Energy's liability is limited to the direct losses of the DG,
- p) The DG will be fully liable for all damages to Top Energy if it does not comply with Top Energy's DG Technical Standards, and
- q) Top Energy reserves the right to disconnect the DG for failure to comply with Top Energy's DG Technical Standards. Where practical Top Energy will give reasonable notice before disconnection. In emergency situations, for safety and security of supply reasons, Top Energy reserves the right to disconnect DG equipment without prior warning.

12 Health and Safety

Top Energy places significant emphasis on health & safety. That is the health & safety of DG owners, the public, other connected consumers and those working on the Top Energy network. Historically distribution networks were designed to facilitate the distribution of electricity from point to point and no consideration was included to allow for injection of electricity mid-network. Subsequently a number of health and safety, technical, and commercial implications arise.

12.1 Health and safety implications

If there is a power cut (loss of supply from Top Energy's network) and the DG plant continues to operate some electricity wires could still be *live* (even in Top Energy's network) at a time when they are assumed to be *dead*. This situation could pose the risk of serious injury to anyone working on the network or damage to connected equipment. Hence the need to ensure that DG equipment disconnects and provides isolation during a power-cut.

Therefore, in addition to technical standards, DG must meet and comply with safety and manufacturing standards specified by Top Energy.

Top Energy reserves the right to disconnect any DG scheme found to be unsafe, and shall not reconnect the DG until Top Energy approved it as safe.

For health & safety reasons, always check with Top Energy before installing or connecting DG plant.

13 Change of Occupancy / Ownership

Should a consumer sell their property or company (including the DG) it is important that the new owner/operator of the DG equipment understands the requirements for ensuring a safe and well maintained electrical connection. The new owner/operator is required to complete and resubmit to Top Energy an updated '*DG Installation Application Form*' (including the updated contact details).

14 Contact Details

More information in relation to connecting DG to Top Energy's network can be obtained by contacting:

Top Energy Limited	
Station Road PO Box 243 Kaikohe 0400 New Zealand	
General Enquiries	
	Phone : +64-9-401 5440
	Fax : +64-9-401 5611
Email	: info@topenergy.co.nz
Web	: http://www.topenergy.co.nz/

Appendix A Technical Standards : $\geq 500\text{kW}$

A.1 Introduction

This appendix details the requirements for the connection and operation of Distributed Generation (DG) rated **above 500 kW**.

These requirements apply to all existing or prospective DG that may operate in parallel with Top Energy's distribution network regardless of whether energy is exported or not.

A.2 Regulations and Standards

All electrical apparatus, materials and wiring supplied shall comply with the latest editions of the relevant New Zealand standards, and the relevant IEC/IEEE standards. In particular this would include the following:

Standard Number (if applicable)	Title/Organisation/Documentation
-	The New Zealand Electricity Act
-	The Electricity Regulations
-	New Zealand Electricity Codes of Practice (NZECP)
-	EEA Guide for the Connection of Generating Plant
-	Electricity Governance Rules (EGR)
AS/NZS 3000:2000	Australia/New Zealand Standard - Wiring Rules
AS/NZS 61000.3.7	Electromagnetic compatibility (EMC) Limits – Assessment of emission limits for fluctuating loads in MV and HV power systems
IEEE Standard 519-1992	Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
IEC 60255	Electrical relays (all relevant standards)
IEC 60068-2	Environmental testing
IEC 61000-4	Electromagnetic compatibility
IEEE 929-2000	IEEE Recommended Practices for Utility

	Interface of Photovoltaic (PV) systems
AS 4777	Australian Standard for Grid Connection of Energy Systems via Inverters

A.3 Definitions

The following have been included in this document and are defined as outlined below

Fault	A physical condition that causes a device, a component, or an element to fail to perform in required manner.
Point of Common Coupling (PCC)	The point at which a consumer connects to the Top Energy network (ownership boundary).
Islanded	Network condition whereby a DG operates supplies a local load whilst not connected to the national grid.

A.4 Technical Requirements

A.4.1 General

Point of Isolation

A means of isolation shall be provided between the DG and the Top Energy distribution network. This shall be lockable in the open position.

Short-circuit Level

If the DG fault contribution causes the short-circuit level in the distribution network to exceed equipment ratings or to reduce fault level headroom below a value acceptable to Top Energy, the DG owner will have to pay to upgrade the relevant equipment in order to facilitate DG connection.

Network Reinforcement

If a power system study indicates that network reinforcement is required due to the capacity and location of a DG, a capital contribution from the DG may be required for the reinforcement work.

Earthing Arrangement

The method for earthing the generator and any associated generator transformers shall be agreed with Top Energy. In the case of 400V generator equipment Top Energy recommends the use of:

- r) A generator with the star/neutral terminal earthed
- s) A dYn generator transformer (star connected HV side with star/neutral point earthed) that is fitted with appropriate protection equipment (as outlined in Section A.4.8).

Synchronisation

An automatic synchronising facility shall be provided for synchronous generators. Where this is shared between multiple generators, a synchronising check relay shall be installed on each generator. The voltage fluctuation at the connection point during synchronising shall not exceed 3%.

The voltage fluctuation at the connection point during connection of asynchronous generators shall not exceed 3%, unless a different value has been agreed with Top Energy.

Backlivening/Backfeeding of Network

In the event of loss of mains supply the DG shall not back liven the Top Energy network as outlined in Section A.4.4 - Islanding.

A.4.2 Power Quality**General**

The DG owner must not connect and operate equipment in a manner which adversely affects the quality of supply received by other network users.

If there is an adverse affect on the power quality to other network users, Top Energy may disconnect the equipment from the network. Where practical Top Energy will provide the DG owner with five days notice of Top Energy's intent to disconnect the connection.

DC Injection

The DG owner must ensure that their equipment will not inject direct current (DC) into the distribution network.

Limitation of Voltage Flicker

Operation of the DG shall not cause voltage flicker level to exceed planning levels indicated in AS/NZS 61000.3.7

Harmonics

Injection of harmonic currents by the DG into the distribution network at the PCC shall not exceed the limits specified in Table 10.3 of '*IEEE Standard 519-1992*'.

A.4.3 Power Factor

Correction is required if the power factor, as measured at the point of common coupling, is less than 0.95 (leading or lagging).

A.4.4 Islanding

Islanded operation of the DG occurs when a part of the distribution network continues to be supplied by the DG after it has been disconnected from the normal supply.

The DG owner shall provide a means to detect islanding and to disconnect the DG from the distribution network within two seconds.

Where the probability of islanding is significant, the method of detection shall be reliable in every situation including those in which the active energy flow at the PCC is very small or zero prior to, and after, islanding. The method of detection shall be approved by Top Energy.

Operation of the DG as an alternative/emergency supply when disconnected from the distribution network does not concern Top Energy (provided there is no chance of backfeed into the Top Energy network) and is the responsibility of the DG owner.

A.4.5 Generator Control Equipment Requirements

Control equipment shall be provided to enable the DG to operate in a stable manner over its output range when connected to the distribution network.

Top Energy will advise any special governor and AVR requirements, which will depend on size of the DG and its location in the distribution network.

Frequency droop mode and voltage droop mode are the preferred methods of control for active and reactive power output respectively for DG plant operating in parallel with the distribution network.

A.4.6 SCADA/Control/Dispatch

If the DG plant exports into the distribution network then Top Energy reserves the right to control its dispatch. The method of control of dispatch will be via Top Energy's mains borne ripple control system or via a Top Energy approved Remote Terminal Unit (RTU).

All DG equipment greater than or equal to 500 kW must be equipped with a Top Energy approved RTU. This device will be used to deliver real-time data and status indication of the DG plant to the Top Energy control room. If a repeater site is specifically required to facilitate the remote RTU communication then the DG owner may be asked to contribute to the cost of the repeater.

A.4.7 Disconnection/Reconnection

If there is a loss of grid event (Top Energy network outage) the DG system must be automatically disconnected from the network. Depending on the size of the DG system Top Energy may require the DG owner to contact Top Energy's control room prior to reconnecting to Top Energy's network. Automated reconnection systems should be approved by Top Energy and tests shall be carried out to confirm that there is an appropriate time delay before the DG plant is automatically reconnected onto the network after the network has returned to nominal voltage and frequency.

A.4.8 Protective Equipment

General

Protection shall meet the requirements of the draft '*EEA Guide for the Connection of Generating Plant*'. Wherever special arrangements are required due to the nature of the generating plant or distribution network, Top Energy shall be consulted.

In addition:

- t) Protection settings shall be agreed with Top Energy, and
- u) Protection relays shall be of SEL manufacture, comply with IEC 60255 and be agreed with Top Energy. Relatively low cost multifunction relays are available, for example "SEL-547 - Distributed Generator Interconnection Relay" <http://www.selinc.com/sel-547.htm>.

Minimum Protection Equipment

The protection equipment (in addition to the protection relays) which should be fitted as a minimum includes:

- v) Generator Circuit Breaker, and
- w) Disconnect/Isolate Switch (lockable).

Minimum Protection Relays

The minimum protection relay equipment which should be fitted includes:

- x) Overvoltage,
- y) Undervoltage,
- z) Overfrequency,
- aa) Underfrequency,
- bb) Earthfault,
- cc) Overcurrent, and
- dd) Loss of mains detection (i.e. Rate of Change of Frequency (ROCOF) and/or vector shift relays).

In addition to the minimum protection relay requirements:

- ee) *Overcurrent Voltage Restraint Protection* shall be provided if conventional overcurrent relays are not able to operate for phase faults in the distribution network, due to generator fault current decrement, and

-
- ff) *Neutral Voltage Displacement Protection* shall be provided if earth faults in the distribution network may not be cleared by current-based earth fault protection.

The DG owner shall be responsible for providing appropriate generator and prime mover protection.

A.4.9 Metering

The connection of DG requires the installation of suitable energy metering to measure and record both import and export of active and reactive energy at the connection point. The meter shall be provided by the *Retailer*, or the DG owner, according to '*Electricity Governance Rules – Part D*'.

A meter capable of measuring every half hour the electricity used (imported) or injected back into the distribution system (export) is required. The complexity of the metering will depend upon the contract and commercial arrangement between the DG and the *Retailer*.

The metering may require a communication facility, either through a phone line or cellular modem, to allow for remote interrogation. The *Retailer* may charge a rental tariff or meter charge fee depending upon the DG location and metering system, a data handling fees associated with the metering may also be required.

The metering installation would need to comply with the requirements outlined within the EGR rules (*Part D-Metering Arrangements*) (<http://www.electricitycommission.govt.nz/rulesandregs/rules>).

A.5 Information

A.5.1 DG Information

DG information required to perform the study is as outlined in Top Energy's '*Distributed Generation Installation Application Form*'.

A.5.2 Generator Transformer (if applicable)

If fitted, the generator transformer information required to perform power system studies is as outlined in Top Energy's '*Distributed Generation Installation Application Form*'.

A.5.3 Single Line Diagram

The following electrical single line diagrams should be provided to Top Energy which clearly illustrate:

- gg) external supply connection point,
- hh) generator (and transformer if applicable) neutral earthing arrangement,
- ii) main switchgear details,
- jj) protection and control details, and
- kk) synchronising points.

A.5.4 Excitation/Governor System and Prime-Mover

In the case of large installations (>5MW) Top Energy may require the DG owner to provide details of the mathematic models associated with the excitation/governor systems and associated prime-mover (for power system modelling).

A.6 Testing and Commissioning**A.6.1 General**

The DG owner shall be responsible for testing and commissioning of the control and protection equipment required for parallel operation. Tests shall be witnessed by a representative of Top Energy.

The DG owner shall provide Top Energy with a commissioning programme for approval.

Written commissioning and maintenance records shall be kept by the DG owner, and shall be made available for inspection by Top Energy.

A.6.2 Interconnection Test**Synchronisation**

The automatic synchronising circuit, and sync check circuit if applicable, shall be tested to demonstrate that frequency, voltage, and phase angle differences at the time of circuit breaker closing are within the permissible limits.

Abnormal Frequency and Voltage Response

Pickup and time delay settings of protection relays and trip circuits shall be confirmed by secondary injection.

Harmonics

Triplen harmonic current flow in the generator neutral circuit shall be measured and remedial action taken if required.

Harmonic voltage distortion shall be measured if this is an issue.

Islanding

A realistic test shall be carried out to verify compliance with the requirements of Section A.4.4. Arrangements shall be made with Top Energy for any HV switching required.

Witness

Top Energy reserves the right to have a Top Energy representative present during DG commissioning and network interconnection.

A.7 Installation

The installation of all DG plant must be undertaken by a qualified person to ensure compliance with all the required building and electrical codes and standards. All wiring associated with the system must comply with AS/NZS 3000 or any successive standard or legislation. The DG owner must also ensure that all building and other consents are obtained.

A.8 Inspection of Installation

The following items shall be inspected:

- ll) Earthing,
- mm) Synchronising/interlocking arrangements,
- nn) Isolation device, and
- oo) Warning labels.

Copies of inspection certificates should be forwarded to Top Energy

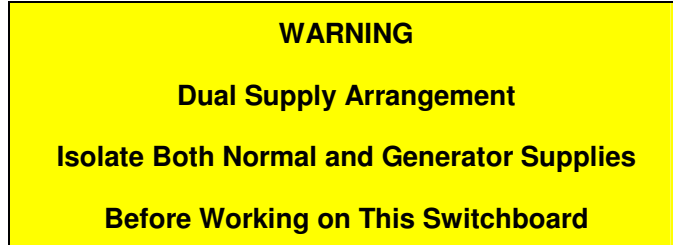
A.9 Commissioning Tests

The following commissioning tests must be performed as a minimum and results approved by Top Energy:

- pp) Protection trip tests on load, and
- qq) Verification of governor and AVR performance for parallel operation.

A.10 Signage

Appropriate signage shall be attached to all switchboards that can be supplied from any generation in accordance with AS/NZS 3000. Typical switchboard signage for consumers who connect generators to their internal networks is shown below:



A.11 Monitoring

The voltage and frequency on Top Energy's network side of the point of common coupling should be monitored.

A.12 Operating Requirements

The DG owner shall provide a 24-hour telephone contact(s).



TOP ENERGY

DISTRIBUTED GENERATION INSTALLATION APPLICATION FORM RATED GENERATION OUTPUT ABOVE 500 KW

(Please print this form, complete it and return to Top Energy)

A. Consumer Facility Information – Where will the generating facility be	
Name shown on Retailer Account	
ICP Number (from power bill)	
Electricity Retailer	
Electricity Retailer Account No.	
Meter Number	
Street Address	
Suburb	
City	
Phone No.	

Note: If available please also submit a copy of electricity retailer bill

B. Contact Information – Who should be contacted for additional information?	
Contact Person	
Company Name	
Phone	
Fax	
E-mail	
Mailing Address	
City/Town	

C. Technical Information	
Generation Plant Manufacturer	
Generation Plant Model	
Generator Supplier	
Primary Energy Source	
Rating and type of prime mover	
Type of alternator	
Rating Details:	

Apparent Power	KVA
Power Factor	
Current	Amps
Voltage	Volts
Phases	<input type="checkbox"/> 1 - phase <input type="checkbox"/> 3-
Rated Maximum Output (kW)	
Inertia constant (prime mover and	
Impedances	(state if the data is not provided as unsaturated values in p.u. on the generator MVA base)
Armature/stator resistance (R_a)	
Direct Axis	
Synchronous reactance (X_d)	
Transient reactance (X'_d)	
Subtransient reactance (X''_d)	
Quadrature Axis	
Synchronous reactance (X_q)	
Transient reactance (if applicable) (X'_q)	
Subtransient reactance (X''_q)	
Time Constants	(state if time constants provided are not open - circuit time constants)
Direct Axis	
Transient time constant (T'_{do}) (s)	
Subtransient time constant (T''_{do}) (s)	
Quadrature Axis	
Transient time constant (T'_{qo}) (s)	
Subtransient time constant (T''_{qo}) (s)	
Leakage (positive sequence) reactance (X_1)	
Negative sequence reactance (X_2)	
Zero sequence reactance (X_0)	

Armature time constant	
Estimated daily peak, minimum, and average power output	

Note: A copy of the generator technical specification should be submitted.

D. Generator Transformer Data (if applicable)	
Rated output (kVA)	
Rated impedance	
Vector group	

D. Single/One-line diagram attached – as per Section A.5.3 Yes
 No

E. Operating Date – From what date is the generator expected to operate

I acknowledge that I am responsible for the connection of the generating facility and that it will be installed to the appropriate standards as required and outlined by Top Energy.

I acknowledge that I am also responsible for the maintenance and operation of the facility and recognise the responsibilities and obligations associated with connecting distributed generation to the Top Energy distribution network.

Signed

Print Name: _____

Position: _____

On Behalf of: _____

Date: _____

END OF DOCUMENT