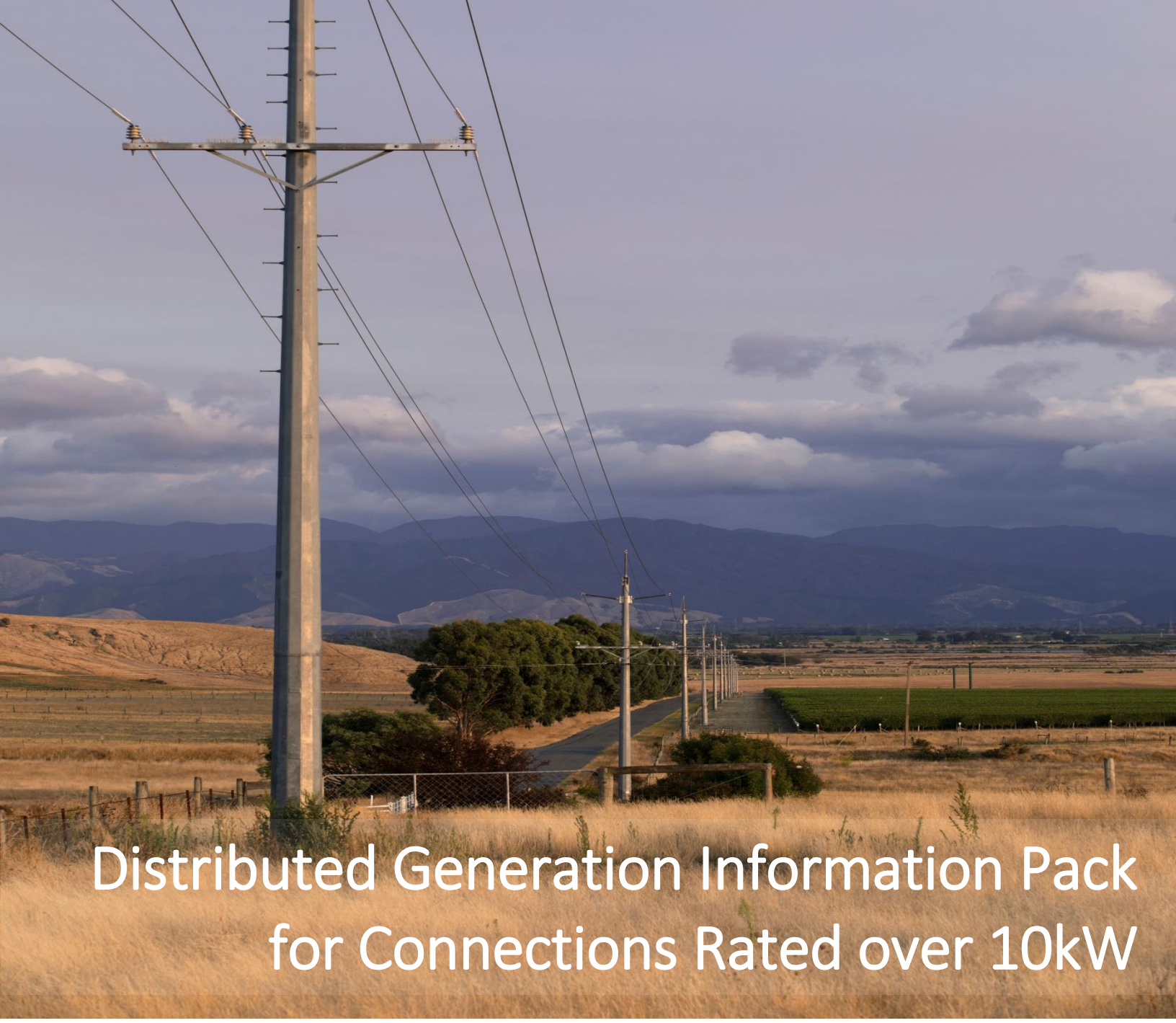

Distributed Generation Information Pack for Connections Rated over 10kW

June 2020

Marlborough Lines

Contents

Purpose of this document

This document provides information to anyone wanting to connect distributed generation of capacity over 10kW to Marlborough Lines Limited's (MLL's) electricity distribution network (distribution network).

The document introduces distributed generation, defines some terms used, provides general information for connecting distributed generation, and the formal process for connecting distributed generation.

It also discusses terms for connection of distributed generation, fees for assessing connection and observing commissioning tests by MLL, and, provides the forms necessary for an initial application and final application.

Finally, this document provides MLL's Connection and Operation Standards for distributed generation above 10kW.

Introduction to distributed generation

Distributed generation is generating plant that is connected to a distribution network, or to a consumer installation that is connected to a distribution network.

Large scale distributed generation (over 10kW) is usually site specific and can vary significantly between installations depending on location, energy source, and type of generator equipment utilised. Large scale distributed generation is invariably capable of exporting electrical energy into MLL's distribution network.

The connection of distributed generation, and application process for it, is outlined in Part 6 of the Electricity Industry Participation Code 2010 (Code). The reader is referred to the Part 6 of the Code, and to the Electricity Authority's Guideline for Connection of Distributed Generation and Information Sheet Embedded generation for further information and distributed generator responsibilities.

The Guideline and Information Sheet are found at the following link:

https://www.ea.govt.nz/operations/distribution/distributed-generation/

For information about connecting smaller distributed generation, 10kW or below, see MLL's 'Distributed Generation Information Pack for generators rated under 10kW'.

If you are interested in operating distributed generation and connecting it to MLL's distribution network, this guide contains information designed to help you understand distributed generation and how to apply to connect it to MLL's distribution network. The following two sections give definitions of terms used throughout, and, outlines general information for connection of distributed generation to our distribution network.

Contact information

For more information about distributed generation, and enquiries relating to the connection of distributed generation to MLL's distribution network, please contact:

Warner Nichol
Operations Manager
Marlborough Lines Ltd
1 Alfred Street, Blenheim

Phone: 03 579 3812
Email: warner.nichol@mll.co.nz

Definitions

Where definitions are repeated from those defined in Part 1 of the Code they are marked as such. At all times, the Code's definitions provide the most up-to-date definition.

Code: The Electricity Industry Participation Code 2010.

Congestion: where power flow or current flow exceeds the rating of particular distribution network equipment, or power quality levels exceed those required by MLL's Connection and Operation Standards, or required of MLL by regulation or standards. Power quality levels may for example be voltage level, flicker, harmonics, or any other power quality measure.

Distributor: the owner and operator of the distribution network.

Distribution network (defined in the Code)**:** the electricity lines, and associated equipment, owned or operated by a distributor.

Distributed generation (defined in the Code): a generating plant that is connected, or that a distributed generator proposes to connect, to a distribution network or to a consumer installation that is connected to a distribution network. While not defined, where either generator or generation are used on their own, they refer to distributed generation.

Distributed generator (defined in the Code): a person who owns or operates, or intends to own or operate, distributed generation.

Embedded generation: a generating station within an embedded network, a network behind an ICP identifier (see Code for strict definition).

Export: transfer of active and/or reactive energy from distributed generation to MLL's distribution network.

ICP: Installation Control Point, a point of connection of a customer installation to the distribution network.

Import: transfer of active and/or reactive energy to distributed generation from MLL's distribution network.

kVA: kilovolt-amp, the product of the rated voltage and current of an electrical device, divided by 1,000.

kW: kilowatt of electrical power.

kWh: kilowatt hour of electrical energy.

Low voltage: the low voltage (LV) at which electrical energy is distributed on the low voltage distribution network, which in New Zealand is 400 Volts phase-to-phase and 230 Volts phase-to-neutral.

Medium voltage: the medium voltage (MV) distribution network, which in MLL's distribution network is typically 11kV or 33kV.

MVA: megavolt-amp, the product of the rated voltage and current of an electrical device, divided by 1,000,000.

MW: megawatt of electrical power (See Code for strict definition).

MWh: megawatt hour of electrical energy.

Point of connection: a point at which electricity may flow into or out of a distribution network (see Code for strict definition).

General information for connecting distributed generation with capacity above 10kW

The following sets out general information for connection of distributed generation to MLL's distribution network. Fees are payable with certain applications. Fees are given here.

APPROACH MLL AS EARLY AS POSSIBLE, EVEN BEFORE AN INITIAL APPLICATION

Talk with MLL as early as possible, even when you are in the early stages of considering new distributed generation, or making changes to existing distributed generation; large scale distributed generation (over 10kW) is usually site specific and can vary significantly between installations depending on location, energy source (solar, wind, hydro, diesel, or other), and type of generator equipment utilised (such as inverter connected, synchronous rotating machine, or induction machine).

Location has a bearing on the point of connection to MLL's distribution network, based on the MLL distribution network assets closest to the proposed distributed generation site, and may require construction of new lines to connect the distributed generation to MLL's distribution network.

Further, the voltage level of the MLL distribution network being connected to, and distance from the MLL substation will also have a bearing on the size of distributed generation that can be connected to maintain power quality within MLL's standards and in turn to other consumers.

Energy source determines when the distributed generation is likely to be generating (throughout a day and seasonally) which combined with typical load on MLL's distribution network, and at the location of connection, will help MLL assess loading on the distribution network, which may in turn impact on equipment ratings and/or power quality, such as voltage level.

The type of generator equipment utilised affects how the generator will interact with MLL's distribution network, and, may require additional equipment to manage these interactions.

REQUIREMENTS FOR SALE OF ENERGY

After deciding on your distributed generation system, you will need to discuss the sale of your excess energy with your energy retailer, or with the Electricity Authority's Clearing Manager if you intend to participate directly in the New Zealand Electricity Market (NZEM). Contractual arrangements for sale of your excess generation, a retailer responsible for your connection, and metering are necessary for you to be able to connect to MLL's distribution network.

Other requirements are given in MLL's Connection and Operation Standards for Distributed Generation. Metering requirements are also set out in MLL's Connection and Operation Standards for Distributed Generation and the Code.

ASSOCIATED COSTS AND DESIGN APPROVAL

Any connection of distributed generation to MLL's distribution network may require reinforcement of the existing distribution network, and therefore include costs associated with design and reinforcement of the existing distribution network, and any additional operation and maintenance costs. If distribution network reinforcement is required, the design, schedule, and cost for this project work will need to be factored into your installation planning.

Once you have finalised your distributed generation design, we will need to review it before we will allow it to connect to our distribution 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.

If extensions, such as purpose-built electricity distribution lines, are required to connect the distributed generation to MLL's distribution network, the distributed generator will be responsible for the costs associated with this. MLL encourages the distributed generator to contract directly for the construction of extensions to take advantage of the competitive electrical contracting alternatives that are available.

DISTRIBUTED GENERATION MUST MEET STATUTORY, REGULATORY, SAFETY AND PROTECTION REQUIREMENTS

Distributed generation must meet relevant statutory and regulatory requirements and comply with all applicable safety standards. Safety is of the utmost importance to MLL, and in connecting distributed generation to the MLL distribution network, safety equipment and procedures must be in place to ensure safety of personnel and the public. Distributed generation may involve the export of large amounts of electrical energy to MLL's distribution network, which is itself is capable of supplying large amounts of energy. Unless connected correctly, either the distributed generation or MLL's distribution network may be damaged in the event of a fault. Hence protection must also be in place to ensure MLL's distribution network and the distributed generation is protected in the event of a fault.

The earlier you engage with MLL to discuss your proposed scheme, the greater understanding both parties will have of the distributed generation scheme, likely connection options to MLL's distribution network, and any potential constraints. This will assist in the formal application process, set out in the next section.

Formal process for connecting distributed generation above 10kW

The process for connection distributed generation, including timing and obligations for timing, is set out in the Code, Part 6, Schedule 6.1, Part 2. It is a two-part application process, involving an initial application, followed by a final application. Testing and inspection follow this.

INITIAL APPLICATION

Once you have selected your distributed generation system, you submit an initial application to MLL. The application form for this, including the information required by MLL in an initial application, is given in Appendix One.

Following an initial application, MLL will provide you with information about connecting to its distribution network, in the location specified in your initial application, such as the capacity of the distribution network, possible standards that may be breached by the distributed generation operation such as voltage, safety, power quality and reliability, and measures or conditions that may be necessary to enable the distributed generation connection and/or avoid any possible breaches. MLL will also provide the approximate cost of allowing the connection and estimated timeframe to facilitate safe and reliable connection. MLL will also advise whether further detailed studies are required to assess the connection, MLL's obligations to other parties (such as Transpower or other distributed generators) that may be affected by the new distributed generation connection, and how planned and unplanned outages may affect the operation of the distributed generation.

After the initial application, and the provision of the above information, further information may be required by the distributed generator or MLL. The fee to consider the initial application is set out here, noting that this is based on the Code and in situations where the Code is updated and there is a difference in the values applying, the values of the Code will apply.

FINAL APPLICATION

A distributed generator must make a final application within 12 months of the information provided by MLL as part of the initial application. Alternatively, MLL and the distributed generator may agree that a final application is not required. The final application form, including information required by MLL in the final application, is given in Appendix Two.

After receipt of the final application, MLL must consider other already connected distributed generation that would be affected by the connection of the new distributed generation in the final application. MLL must also consider initial applications and final applications outstanding by other distributed generators. This is dealt with in Part 6, Schedule 6.1, Part 2 of the Code.

If MLL approves the distributed generator's final application, the distributed generator must inform MLL whether it intends to proceed with the distributed generation. Part 2 of Schedule 6.1 of the Code also deals with dispute resolution between parties, and the negotiation of the connection contract for distributed generation to MLL distribution network.

TESTING AND INSPECTION

The distributed generator must test and inspect the distributed generation after the final application with an agreed timeframe, unless the requirement for this is waived by MLL. MLL may require to observe the test and inspection, for which it will charge the fee set out in Section 0, noting that this is based on the Code and in situations where the Code is updated and there is a difference in the values applying, the values of the Code will apply.

TERMS OF CONNECTION

Unless otherwise agreed, where MLL approves the application for distributed generation by the distributed generator, connection of distributed generation is made under the Regulated Terms given in Schedule 6.2 of Part 6 of the Code, available from our offices at 1 Alfred Street, Blenheim and at the following link:

https://www.ea.govt.nz/code-and-compliance/the-code/

FEES FOR APPLICATION AND OBSERVATION OF TESTING AND INSPECTION

MLL may require application fees prescribed in Schedule 6.5 of the Code. The maximum fees that may be required are set out below:

Fee for application for distributed generation above 10kW

Description of Fee	Fee, $ (exclusive of GST)
Application fee for distributed generation with nameplate capacity of more than 10kW but less than 100kW	500
Application fee for distributed generation with nameplate capacity of 100kW or more in total but less than 1MW	1,000
Application fee for distributed generation with nameplate capacity of 1MW or more	5,000

Fee for observation of testing and inspection distributed generation above 10kW

Description of Fee	Fee, $ (exclusive of GST)
Fee for observation of testing and inspection of distributed generation with nameplate capacity of more than 10kW but less than 100kW	120
Fee for observation of testing and inspection of distributed generation with nameplate capacity of 100kW or more	1,200

Approved inverters

If the distributed generator is connecting distributed generation via an inverter at 400 Volts, MLL requires that the inverter comply with the AS/NZS 4777.2:2015 standard and be capable of voltage regulation and protection referred to in the EEA Guide for Connection of Small-Scale Inverter-Based Distributed Generation. Parameters for voltage regulation and protection are those given in the EEA Guide for Connection of Small-Scale Inverter-Based Distributed Generation. For connections to MLL's medium voltage distribution network the inverter requirements will be determined on a case-by-case basis.

Appendix One – Form for initial application

Name and address of distributed generator and contact person, and new or incremental distributed generation.

Details of person/organisation to contact regarding the distributed generation		Details of distributed generation and location where distributed generation is to be connected	
Name:		Name:	
Company:		Company:	
Address:		Location and Address:	
Phone:		Phone:	
Email:		Email:	
Connection:	Existing ☐	Upgrade ☐	New ☐
ICP number from your power account (if existing or upgraded connection):			
Energy retailer who has agreed to purchase your electricity:			

Data required of the distributed generator	Information or reference to attached documents & location of information within documents
Nameplate capacity – evidence to be supplied (kW and kVA): If the application is to change the nameplate capacity and/or the fuel type, supply: (1) the nameplate capacity after the change; and (2) the aggregate nameplate capacity that all distributed generation connected to the point of connection will have after the change; and (3) the fuel type after the change.	
Fuel type (e.g. solar, wind, hydro, diesel, petrol, CNG, LPG, or hydrogen):	
Date when the distributed generation is expected to be connected:	
Technical specifications: (1) Technical specifications of equipment that allows the distributed generation to be electrically disconnected from the distribution network on loss of mains voltage (2) Manufacturer's rating of generation equipment or energy source and inverter if inverter connected (kW and kVA) (3) Number of phases (4) Proposed/current point of connection to the distribution network (ICP identifier and street address) (5) Details of inverter if connected via inverter and battery if a battery is involved. (6) Details of any load at the point of connection (7) Details of the voltage when electrically connected (8) Generator rated terminal voltage (V or kV) (9) Generator rated generation capacity (kVA)	
Information showing how the distributed generation complies with MLL's Connection and Operation Standards – refer to MLL's Connection and Operation Standards for Distributed Generation:	
Maximum active power injection to MLL's distribution network and any consumption from MLL's distribution network (kW):	
Reactive power requirements (kVAr) including direction of reactive power flow:	
Resistance and reactance details of the distributed generation:	
Fault level contribution (kA) at the point of connection to MLL:	
Method of voltage control:	
Single line diagram of proposed connection:	
Means of synchronizing with, electrically connecting to, and electrically disconnecting from the distribution network, including the type and ratings of the proposed circuit breaker:	
Details of compliance with frequency and voltage support requirements specified in the Code:	
Proposed periods and amounts of electricity injections into, and offtakes from, MLL's distribution network:	
Any information that is required by the System Operator.[1]	
Any additional information or documents that are reasonably required by the distributor (see below):	
Information on the type of generator (e.g. synchronous, rotating asynchronous a.c., or inverter connected):	
If an asynchronous induction generator, information on the type (such as squirrel cage, wound rotor, or doubly fed):.	
Anticipated operating regime e.g. continuous, intermittent, peak lopping:	
Generation transformer details, if applicable:	

[1] The System Operator must be notified of any distributed generation above 1MW, and distributed generation above 10MW may be subject to requirements regarding dispatch by the System Operator. For further information see the Electricity Authority's Information Sheet referred to earlier.

ADDITIONAL TECHNICAL DATA FOR GENERATORS OVER 100KW

This schedule must be completed if the total distributed generation on your site will exceed 100kW.

Data required	Information or reference to attached documents and location of information within documents
Generation kW/kVAr capability charts at maximum continuous power	
Startup times to full rated output from cold	
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)	

ADDITIONAL TECHNICAL DATA FOR GENERATORS OVER 750KW

This schedule must be completed if the total distributed generation on your site will exceed 750kW.

Data required	Information or reference to attached documents and location of information within documents
Minimum operating power (kW)	
Lowest frequency at which generation can operate (Hz)	
Generation kW/kVAr capability charts at 50% output	
Inertia constant (seconds) (whole machine)	
Auxiliary power requirements	
Startup time to minimum operating power from cold	
Startup time to minimum operating power from hot	
Normal ramp rate	
Maximum ramp rate	
Inertia constant whole machine (seconds)	
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	
Earthing resistance/reactance	
Time constant- direct axis transient open circuit	
Time constant- quadrature axis transient open circuit	
Time constant- direct axis sub transient open circuit	
Time constant- quadrature axis sub transient open circuit	
Generation transformer details (impedance, tap changer, vector group, earthing, maximum overvoltage capability at rated frequency	

Appendix Two – Form for final application

If the design of the distributed generator has changed between the initial application and the final application, the final application is to be accompanied by a newly completed initial application, with differences between initial and final application clearly noted. The reason for this is to capture information in the final application that is covered by the initial application form. Such changes may include but are not limited to, for example, a different inverter model and performance parameters, different distributed generator single-line-diagram including different transformer details of proposed connection to Marlborough Lines point of supply, and/or different inverter rating and/or fault level contribution.

Applicant Details	
Name:	
Company:	
Address:	
City:	
Postcode:	
Phone:	
Email:	

Electrician Details	
Name:	
Company:	
Address:	
City:	
Postcode:	
Phone:	
Email:	

Installation Details	
Installation time frame:	
ICP Number:	
Energy Retailer:	
Installation: (new or existing):	
Installation (residential or commercial):	
Address:	
Phone: Email:	

Technical Details **For generators 1MW or larger, or connected at 11kV or higher, MLL may request further information**	
Generator manufacturer: *	
Generator model: *	
Year generator manufactured:	
Type of generator (DC inverter, AC synchronous, or AC asynchronous):	
Energy source (solar, wind, hydro, gas turbine, steam turbine, diesel, battery storage, or other (specify)):	
Proposed operation (intermittent, peak, or continuous)	
Output voltage:	
Output current:	
Output kW:	
Output kVA:	
Number of phases (single or three):	
Power factor:	
Reactive power requirements:	
Method of voltage control:	
Fault level contribution (kA) at the point of connection to MLL:	
Means of synchronization:	
Means of connection and disconnection (provide circuit breaker details):	
Means of isolation (provide details):	
Protection scheme (provide details):	
Single line diagram attached (provide details):	
Means of compliance with voltage standards and requirements:	
Means of compliance with frequency standards and requirements:	
Compliance with MLL's Connection and Operation Standards, including standards listed – provide details:	
Proposed date of connection to the MLL distribution network:	

*Include both photovoltaic panels and inverters for photovoltaic solar power installations.

Confirmation I hereby apply to connect distributed generation to the Marlborough Lines Ltd distribution network and confirm that the above information is correct and that the distributed generation shall at all times be operated in accordance with the Marlborough Lines Ltd Connection and Operation Standards. I confirm that I will not connect any generation until I have received written approval from Marlborough Lines Ltd.	
Name:	
Date:	
Signature:	

Appendix Three – MLL's connection & operation standard for distributed generation above 10kW

INTRODUCTION

This Connection and Operation Standard for distributed generation above 10kW contains requirements relating to the planning, design, construction, testing, inspecting, and operation of distributed generation that is, or is proposed to be, connected. In addition to this it includes MLL's Congestion Management Policy, Emergency Response Policy, Safety Standards, and protection requirements. Finally, the standards include warning labels for distributed generation.

RELEVANT STANDARDS AND REGULATIONS

MLL requires compliance with all relevant industry regulations, codes of practice and standards for any person or company involved constructing, operating, and maintaining distributed generation. Some standards and codes of practice required are listed below. A person or company includes, but is not limited to, the distributed generator and distributed generator personnel, customer, and contractor. Furthermore, any equipment connected to MLL's distribution network must also comply with at least the following industry regulations, codes, and standards.

- Electricity (Safety) Regulations 2010 and subsequent amendments (including the electrical codes of practice referred to).
- The Electricity Industry Participation Code, all parts, in particular Part 6 (https://www.ea.govt.nz/code-and-compliance/the-code/).
- AS/NZS 4777.2:2015 (Grid connection of energy systems via inverters, Part 2: inverter requirements). This is relevant for inverter connection to low voltage (400V) electricity distribution networks up to 34.5 kW three-phase or 18.4 kW single-phase. (Until this standard is cited by the Electricity (Safety) Regulations 2010 it should be used as design guide, with a certified designer, and its parameters should be used.)
- AS/NZS 4777.1:2016 (Grid connection of energy systems via inverters, Part 1: installation requirements). This is relevant for inverter connection to low voltage (400V) electricity distribution networks up to 200kVA. (Until this standard is referenced in the Electricity (Safety) Regulations 2010, it should be used as a design guide, with a certified designer, and its parameters should be used.)
- AS 4777.3:2005 (Grid connection of energy systems via inverters Grid protection requirements). Relevant for three phase systems up to 30kVA, although similar principles can be used for the grid protection of larger systems. The parameters given in AS/NZS 4777.2:2015, which supersedes this standard, are to be used.
- AS/NZS 3000:2007 Australian/New Zealand Wiring Rules and any subsequent revision.
- ENA, Pricing guidelines for electricity distributors, A handbook for pricing practitioners, November 2016.
- Relevant harmonic standards.
- EEA draft Guide for the Connection of Small-Scale Inverter-Based Distributed Generation.
- All other standards relevant to electrical power quality, safety and protection in New Zealand.

CURTAILMENT OF DISTRIBUTED GENERATION (MLL'S CONGESTION MANAGEMENT POLICY)

This section describes circumstances in which distributed generation may be disconnected or curtailed from time-to-time.

MLL may, from time to time, isolate any distributed generation for any of the following reasons:

- To manage distribution network congestion, such as excessive voltage levels on MLL's distribution network or overloading of certain equipment on MLL's distribution network.
- To perform necessary planned maintenance tasks, construction, or repairs on the distribution network.
- To protect, or prevent danger or damage to, persons or property.
- To manage the distribution network capacity.
- Any other technical reason that may arise and which in the opinion of MLL's Operations Manager could pose a threat to the stability of MLL's own distribution network.
- An event on Transpower's transmission network.
- Any other reason referred to in the Terms of Connection.

MLL may also reduce the distributed generation output to manage distribution network congestion, such as excessive voltage levels on MLL's distribution network, overloading of certain equipment on MLL's distribution network, or due to an event on Transpower's transmission network.

EXPORT CONGESTION

There are no known locations in MLL's distribution network currently subject to export congestion, nor expected to be subject to export congestion in the next 12 months. However, locations in MLL's distribution network that may become congested in the near future are:

- The 11kV Sounds feeder beginning at Linkwater, supplying Mahau Sound, the area between Queen Charlotte Sound and Perlorus Sound to Endeavour Inlet, and Opani-Aputa Point, Forsyth Island, Cape Jackson and Alligator Head, and all connected 400V distribution networks.
- The Wairau Valley beyond Wairau Valley Township.

Given the potential size of distributed generation over 10kW, it is possible that its connection may lead to congestion. Congestion is usually due to reversal of power flow, resulting in voltage levels outside the limits (which may damage consumer or MLL's equipment), and/or overloading of equipment. This may occur in either or both the low voltage and medium voltage distribution networks.

Because congestion depends on the size of the distributed generation, times of generation compared to load, and the part of the distribution network it is connecting to, congestion of large-scale distributed generation can generally only be assessed on a case-by case basis. Congestion will be assessed by MLL during the application process, using the information provided about the distributed generation in the application, and MLL's information about its distribution network.

If MLL's assessment shows that congestion is likely to occur, it may be necessary to reinforce or support the distribution network. This, and its cost, will be discussed with the distributed generator at the time, and in line with the Code, the incremental cost will be recovered from the distributed generator. Alternatively, or in addition, it may be necessary to place operation restrictions on the distributed generation that cover when it can operate.

MLL'S EMERGENCY RESPONSE POLICIES

MLL provides a 24hr 365 days a year fault service. Faults are dealt with as soon as practical. In the event of multiple faults, safety is our first consideration, followed by restoration of supply to critical customers (e.g. hospitals), then followed by prioritising work by the number of affected customers.

More information on our emergency response policies and network management are detailed in our Asset Management Plan, available on our website: www.marlboroughlines.co.nz.

MLL'S SAFETY STANDARDS

MLL's safety standards are available at MLL's website at: https://www.marlboroughlines.co.nz/Safety.aspx.

MLL'S PROTECTION REQUIREMENTS

The distributed generation must be equipped with the appropriate protection systems set out in Table 1. The distributed generator must consult MLL with regard to any special arrangements or protection that may be necessary due to the characteristics of MLL's distribution network or the distributed generation. The general protection requirements are outlined below.

The distributed generator's protection systems must be co-ordinated with the other protection systems associated with the distribution network. The settings or operating limits of any protection controlling a circuit breaker, or operating values of any automatic switching device at any point of connection between the distributed generation and the distribution network, shall be agreed in writing, between MLL and the distributed generator, during the process for approval and connection of the distributed generation. These protection settings or operating values must not be changed without the express written agreement of MLL. Operators of distributed generation must ensure that voltage and frequency levels of injected energy to the grid remain within the requirements of the Electricity (Safety) Regulations, Code and MLL's requirements.

In order to keep the impact of faults on MLL's distribution network to a minimum, the distributed generation must meet target clearance times agreed between MLL and the distributed generator, for fault power flowing from our distribution network. MLL will ensure that the relevant protection settings are compatible with the target clearance times that we specify.

Any distributed generation connected to MLL's distribution 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 distribution network back-up protection and which is within the plant short-time rating.

Table 1: MLL's protection and power quality requirements

Distributed Generator Technical Requirement. Requirement is necessary for the distributed generation of size given in the columns if the cell is marked with a ✓	Distributed generation total capacity is above 10kW but lower than or equal to 100kW	Distributed generation total capacity is above 100kW but lower than or equal to 750kW	Distributed generation total capacity is above 750kW
Information on the proposed protection arrangements and settings for the generator installation for approval. Site specific limits and gradings will be provided by MLL.	✓	✓	✓
Protection against islanding	✓	✓ If becomes islanded, MLL reserves the right to disconnect the plant at point of connection	✓ If becomes islanded, MLL reserves the right to disconnect the plant at point of connection
Circuit breaker or other automated switch at the point of connection enabling connection and disconnection	✓	✓	✓
Circuit breaker controlled by distributed generator's own protection schemes and by an agreed signal from MLL's control room.			✓
Synchronization relay at the circuit breaker at the point of connection for rotating machine connections.	✓	✓	✓
Dedicated transformer required for connection	At MLL's discretion	At MLL's discretion	✓
Over-voltage protection (refer to Table 2)	✓	✓	✓
Under-voltage protection (refer to Table 2)	✓	✓	✓
Loss of mains protection	✓	✓	✓
Normal frequency operating range of 50Hz ± 0.75Hz	✓	✓	✓
Under frequency performance: as set out in Part 8, 8.19 of the Electricity Industry Participation Code for rotating generators and as set out in the EEA Guide for Connection of Small-Scale Inverter-Based Distributed Generation for inverter-based generators.	✓	✓	✓
Over frequency performance - 52.5Hz for a period of 30 seconds for any generator over 1MVA. As set out in the EEA Guide for Connection of Small-Scale Inverter-Based Distributed Generation for inverter-based generators.	✓	✓	✓
Earth fault protection (time-current characteristic to be agreed)		✓	✓
Neutral voltage displacement: Solidly earthed neutral required for the transformer or the generator (if directly connected). Other earth schemes may be permissible on discussion with MLL	✓	✓	✓
Neutral voltage displacement protection			✓
Over-current voltage restraint protection			✓
Directional over-current alarm (export) (at point of connection)	✓	✓	✓
Directional over-current trip (export) (at point of connection)	✓	✓	✓
Diagram and details of the protection systems, including relay settings.	✓	✓	✓

Distributed Generator Technical Requirement. Requirement is necessary for the distributed generation of size given in the columns if the cell is marked with a ✓	Distributed generation total capacity is above 10kW but lower than or equal to 100kW	Distributed generation total capacity is above 100kW but lower than or equal to 750kW	Distributed generation total capacity is above 750kW
Any operation that disconnects the generator from MLL's distribution network: the generator must remain locked out until permission is given from MLL's control room to permit reconnection. For the purpose of clarification, this means no automatic reclosing.	✓	✓	✓
Reconnection made following MLL's operating procedures	✓	✓	✓
The means of generator disconnection provides a visible indication of isolation.	✓	✓	✓
MLL SCADA visibility of status and metering			✓
Power factor or voltage regulation equipment required	✓	✓	✓
Voltage level at the point of supply on the 400 V distribution network is maintained in accordance with the Electricity (Safety) Regulations 2010.	✓	✓	✓
Voltage operating range at voltages above 400 V (11kV and 33kV for example) is maintained in accordance with the Electricity (Safety) regulations 2010 unless otherwise agreed.	✓	✓	✓
Single line diagram for installation detailing circuit breakers, base loads and generation capabilities	✓	✓	✓

Table 2: MLL's voltage/current protection parameters for distributed generation at the point of connection

Refer to Table 2 of the EEA Guide for Connection of Small-Scale Inverter-Based Distributed Generation for 400V inverter connected distributed generation voltage and frequency parameters.

Parameter	11 kV and above	400 V Values
Over-voltage Alarm	1.05 p.u.	*
Over-voltage Trip	1.10 p.u. instantaneous 1.06 p.u. for greater than 10 seconds	*
Under-voltage Trip	0.9 p.u. for greater than 30 seconds	*
Directional Overcurrent Alarm (export)	To be negotiated	To be negotiated
Directional Overcurrent Alarm (export)	To be negotiated	To be negotiated

* As set out in the EEA Guide for Connection of Small-Scale Inverter-Based Distributed Generation.

MLL'S METERING REQUIREMENTS

MLL's metering requirements are set out in Table 3.

Table 3: MLL's metering requirements

Distributed Generator Technical Requirement. Requirement is necessary for the distributed generation of size given in the columns if the cell is marked with a ✓	Distributed generation capacity is above 10kW but lower than or equal to 100kW	Distributed generation capacity is above 100kW but lower than or equal to 750kW	Distributed generation capacity is above 750kW
Metering installed and interval data made available consistent with the Terms of Connection and Code, Part 10.	✓	✓	✓
Both active (kWh) and reactive (kVAr) power metered half-hourly. Separate import (from MLL's distribution network) and export (to MLL's distribution network) metered half-hourly and accumulated kWh and kVAr flows at the point of connection. I.e. four-quadrant interval metering.	To be discussed depending on the installation	✓	✓

MLL'S GENERAL REQUIREMENTS

General requirements are set out in Table 4.

Table 4: MLL's general requirements

Distributed Generator Technical Requirement. Requirement is necessary for the distributed generation of size given in the columns if the cell is marked with a ✓	Distributed generation is above 10kW but lower than or equal to 100kW	Distributed generation is above 100kW but lower than or equal to 750kW	Distributed generation is above 750kW
Ability to enter the distributed generator's premises according to the Terms of Connection	✓	✓	✓
Interruptions and disconnections of the distributed generation according to the Terms of Connection	✓	✓	✓
Single line diagram for installation detailing circuit breakers, base loads and generation capabilities	✓	✓	✓

CONTROL ARRANGEMENTS AND REACTIVE POWER

MLL requires that distributed generation controls reactive power consumption or production to manage voltage within MLL's limits when the distributed generation is exporting power into the MLL distribution network. Such an arrangement shall be agreed with the distributed generator during the application process and is subject to change based on possible charges for power factor/reactive power applied by Transpower.

For inverter-based distributed generation connecting at 400 V, the Volt-VAr and Volt-Watt characteristics set out in the EEA Guide for the Connection of Small-Scale Inverter-Based Distributed Generation shall be required.

If the distributed generation is unable to control reactive power to manage voltage, MLL requires that the distributed generation maintain a power factor above 0.95, based on aggregate generation at the point of connection. If the power factor is outside of this bound MLL will:

> *On the first occasion this clause applies, allow the distributed generator three months to correct the power factor at the distributed generator's point of connection;*
>
> *On the second and subsequent occasions this clause applies, charge the power factor charge using the kVAr rate set out in MLL's price schedule, available from MLL's website at:*
>
> *https://www.marlboroughlines.co.nz/About-us/Disclosures/Pricing.aspx.*
>
> *The charging methodology applied shall be that set out in the ENA Pricing Guidelines, November 2016, using the 'First Approach', or 'Method 1', where reactive energy outside the 0.95 power factor limit is charged for based on the single maximum half-hour reactive load, to or from the distribution network. Reactive energy shall be based on aggregate generation.*
>
> *If the distributed generation continues to generate outside the 0.95 power factor limit, MLL shall base its charges on the 'Alternative Approach', where all reactive energy outside the 0.95 power factor limit is charged for.*

SIGNAGE

Suitable signage shall be attached to all switchboards that can be supplied from any generation in accordance with AS/NZS3000 and AS/NZS 4777 standards where relevant. Typical signage is shown in the Appendix.

Appendix Four – Warning signs/labels

WARNING

-DUAL SUPPLY-

ISOLATE BOTH NORMAL AND GENERATOR SUPPLIES BEFORE WORKING ON THIS SWITCHBOARD

Sign on switchboard to which generator is connected (above)

WARNING

-DUAL SUPPLY-

ISOLATE GENERATOR SUPPLY AT GENERATOR DISTRIBUTION BOARD BEFORE WORKING ON THIS SWITCHBOARD

Sign on intermediate distribution switchboard (above)