



NETWORK CONNECTION STANDARDS

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1. GENERAL

1.1 INTRODUCTION

MainPower New Zealand Limited (“MainPower”) owns and operates a Distribution Network (the “Network”).

MainPower will, subject to the necessary agreements being in place, make its Network available to Users.

Any such agreement will, in order for MainPower to be able to maintain the integrity of the Network, require all Users of the Network to comply with these Network Connection Standards.

MainPower and Users of the Network will also comply with the requirements of the Electricity Act 1992, Regulations made pursuant to this Act and other relevant Legislation.

The responsibility for costs associated with the use of, or connection to the Network is a matter to be agreed between the parties and therefore do not form part of the Standards.

Users will comply with MainPower’s standards of planning, operating, safety co-ordination, contingency planning, customer categories and metering. (the “Network Connection Standards”)

1.2 DEFINITIONS AND INTERPRETATIONS

In these Standards, unless the context otherwise requires:

Act	means Electricity Act 1992.
Active Power	means the product of voltage and current and the cosine of the phase angle between them (measured in kilowatts (kW) or mega-watts (MW)).
Apparatus	means all machines, fittings, and appliances in which conductors are used or supported, or of which they form a part.
Apparent Power	means the product of voltage and alternating current (measured in kilo-volt-amperes (kVA) or mega-volt-amperes (MVA)).
Authorisation	means the formal written sanction to undertake specified tasks that have a specific meaning in safety management systems.
Back-up Protection	means the Protection system designed to open a fault-current interrupting device in the absence of the correct operation of the primary Protection system.
Black Start	means the procedure necessary for a generator to recommence generating following a shutdown of the Total Network or all (or part) of the Network (or any User Network).
Black Start Capability	means the ability of a Power Station to commence generating without requiring a power supply external to that Power Station to do so.
Central Dispatch	means the dispatch of generating units by Transpower.
Civil Emergency	means a state of national, regional or local civil defence emergency as declared by the appropriate civil defence controller.
Connection Agreement	means any contractual agreement or arrangement between MainPower and a User which provides the User with the right to connect to and/or use the Network in accordance with the purpose and terms specified in the agreement.
Contingency Planning Standards	means those Standards forming part of the Network Connection

	Standards and detailed in Clause 5.
Control Centre	means a centre for the control and operation of all or part of the Network, the Transpower's Network, or the User Network.
Control Person	means a person who has been nominated by MainPower, Transpower or a User (as appropriate) to be responsible for controlling and co-ordinating Network operations, including all health and safety requirements in hazard identification and emergencies that will apply to people in the place of work and people in the vicinity of the place of work
Controlled	means the ability for MainPower to interrupt the supply of electricity for the purposes of Network load management in accordance with any load management agreement.
Customer	means any person who is party to a Connection Agreement with MainPower, the terms of which requires MainPower to provide Line Function Services.
Customer Category Standards	means those Standards forming part of the Network Connection Standards and detailed in Clause 6.
Customer's Installation	means any Fittings of a Customer used for the purpose of conveying electricity from the Network Connection Point to where the electricity may be consumed, including any Fittings owned or used by a Customer jointly with any other person, but does not include Fittings forming part of MainPower's Network.
Demand	means the electricity demand expressed in kVA/MVA, kW/MW or kVAr/MVAr of Apparent Power, Active Power and Reactive Power respectively.
Design Rating	means the maximum current or voltage, or combination of both, which an item of equipment is intended to have applied to it, taking into account cyclic variations of that voltage and current, together with other parameters as appropriate to specific items of equipment.
Design Standards	means those standards forming part of the Planning Standards and detailed in Clause 2.3.
Distribution Network (the "Network")	means MainPower's Distribution Network used for the conveyance of electricity terminating at the Network Connection Point and includes all Fittings comprising part of that Network.
Electricity Retailer	means any person who is party to a Conveyance Use of System Agreement with MainPower, for the purpose of using the Network to convey electricity to Customers.
Electrical Code of Practice	means an Electrical Code of Practice issued pursuant to the Act.
Embedded Generation Standards	means those standards forming part of Planning Standards and detailed in Clause 2.5.
Embedded Generator	means a Generator who injects electricity directly into the Network.
Event	means an unscheduled or unplanned (although it may be anticipated) occurrence on or relating to a Network, including, without limiting that

	general description, faults, outages, incidents and breakdowns.
Fittings	means equipment used or designed or intended for use, or in connection with the generation, conversion, transformation, conveyance or use of electricity.
Generator	means a person who generates electricity.
Good Industry Practice	means the exercise of that degree of skill, diligence, prudence and foresight which would reasonably and ordinarily be expected from a skilled and experienced operator engaged in the same type of undertaking under the same or similar circumstances.
Half Hour	means a period of 30 consecutive minutes commencing on the hour or at 30 minutes past the hour.
High Voltage	means 6600 volts ac between phases or greater.
Information Standards	means those standards forming part of the Planning Standards and detailed in Clause 2.4.
kVA	means kilo-Volt-Ampere (1000 Volt-Amperes).
kVAr	means kilo-Volt-Ampere reactive (1000 Volt-Amperes reactive).
kW	means kilo-Watt (1000 Watts).
Line Function Services	means the provision and maintenance of Fittings for the conveyance of electricity and the operation of such Fittings, including the control of voltage and load control.
Low Voltage	means 230 volts ac single phase or 400 volts ac, 3 phase.
MARIA Rules	means the rules of the Metering and Reconciliation Information Agreement established pursuant to a Deed of Establishment of Metering and Reconciliation Information Agreement between Electricity Market Company Limited and Transpower dated 21 March 1994, as amended from time to time or any other binding legal arrangement having a similar purpose to which MainPower is a party.
MainPower's Design and Construction Standards	means the design and construction standards published by MainPower from time to time, a current copy of which may be obtained from MainPower's head office during office hours.
Metering Equipment	means metering equipment and other Apparatus for the purpose of measuring and recording the quantity of the supply of electricity conveyed through the Network to a Customer's Network Connection Point, for consumption by the Customer including but not limited to: a) active and reactive energy meters with pulsing output; b) current transformers; c) voltage transformers; d) interval data recorders; e) relays; f) associated equipment (including wire and enclosure); g) modem
Metering Standards	means those Standards forming part of the Network Connection Standards and detailed in clause 7.

- Metering Transformers** means current and voltage transformers used as part of Metering Equipment.
- MVA** means Mega-Volt-Ampere (1,000,000 Volt-Ampere).
- MVA_r** means Mega-var (1,000,000 vars).
- MW** means Mega-Watt (1,000,000 Watts).
- Network** means MainPower’s Distribution Network.
- Network Connection Point** means the point between the Network and the Fittings owned or used by a User.

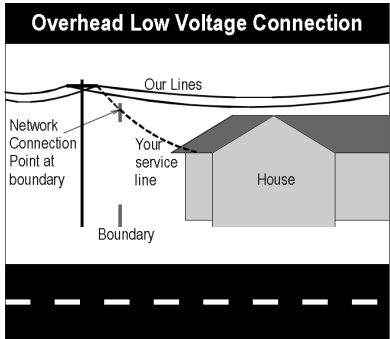


Figure 1
Overhead electricity supply. The Network Connection Point is at the premises boundary.

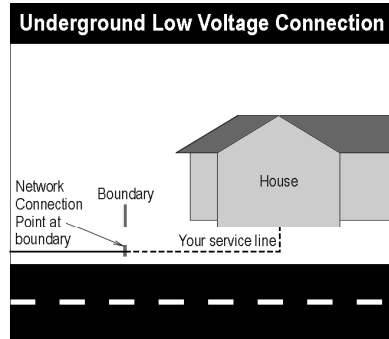


Figure 2
Underground electricity supply. The Network Connection Point is either at the fuse in the servicebox if the servicebox is on the boundary, or on the boundary if the servicebox or pole is not on the boundary.

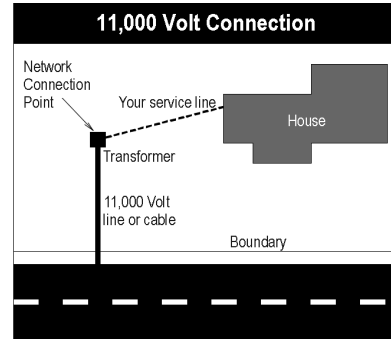


Figure 3
11,000 volt connection. The Network Connection Point is typically at the low voltage terminals of the transformer unless otherwise agreed to between us.

- Normal Operating Frequency** means the number of alternating current cycles per second, expressed in hertz, at which the Network normally operates, ie 50 Hertz
- Operational Boundary** means the boundary between the Fittings operated by MainPower and any User.
- Operating Standards** means those standards forming part of the Network Connection Standards and detailed in clause 3.
- Outage** means removal of equipment from service, generally to permit maintenance or other work to be undertaken or resulting from a fault
- Planned Outage** means a pre-planned outage of generating plant, or of part of the Transpower’s Network, or of part of the Network
- Planning Standards** means those standards forming part of the Network Connection Standards and detailed in clause 2.
- Power Factor** means the ratio of Active Power to Apparent Power calculated in accordance with the following formula

$$\text{Power Factor} = \frac{A}{\sqrt{(A^2 + R^2)}}$$

where: A = Active Power
 R = Reactive Power

both A and R being the instantaneous values integrated over one and the same minimum time period used for billing purposes

- Power Station** means an installation comprising one or more generating units, even where sited separately, which are owned and/or Controlled by the same

	Generator and may reasonably be considered as being managed as one Power Station.
Protection	means the arrangements designed to detect abnormal conditions in the Network and initiating fault clearance, or actuating signals or indications.
Reactive Power	means the product of voltage and current and the sine of the phase angle between them, which is normally measured in kilo-vars (kVAr) or Mega-vars (MVar).
Regulations	means Regulations made pursuant to the Act and any other relevant Regulations in force from time to time.
Safety Co-ordination Standards	means those standards forming part of the Network Connection Standards and detailed in clause 4.
Scheduling	means the procedure for determining intended usage of generating plant
Superimposed Signals	means those electrical signals conveyed on a Network for the purpose of information transfer or load management.
Supply Standards	means those standards forming part of the Planning Standards and detailed in clause 2.2.
Top-Up	means the supply of electricity to a User on a continuing or regular basis to make good any shortfall between the User's total supply requirements and that met from other sources.
Total Network	means Transpower's Network, the Network and any other User Network for the time being connected to either Transpower's Network or the Network [in either of the South Island or the North Island of New Zealand respectively].
Transpower	means Transpower New Zealand Limited, its successors and assigns.
Transpower's Network	means the electricity transmission system owned and operated by Transpower.
Uncontrolled	means that the supply of electricity is not interrupted for the purposes of Network load management in accordance with any load management agreement.
User	means any person who owns or has the use of Fittings connected to the Network or, where the context of this Agreement otherwise requires, proposes to own or is to have the use of Fittings connected to the Network, and any person who is party to an agreement to use the Network for an approved purpose even though the use of the Network for this purpose does not require the need for Fittings to be connected to the Network and includes, but is not limited to, a Customer, Electricity Retailer or Generator but does not include Transpower.
User Network	means any Fittings owned by a User including a generating unit and/or distribution networks and/or equipment connecting generating units and distribution networks
User With Own Generation	means a User with one or more generating units being part of a User Network providing all or part of the Customer's electricity requirements, and which may use the Network for the export of any surplus of electricity.

- 1.3 Clause and other headings are for ease of reference only.
- 1.4 Any reference in this Agreement to any gender includes all genders and a reference to the singular includes the plural and vice versa.
- 1.5 A reference to a “person” includes a reference to a natural person, corporation sole, company or other body corporate, an unincorporated body of persons, a statutory body, and an instrument of the Crown.
- 1.6 References to Clauses and Appendices are references to clauses of appendices to these Standards.
- 1.7 Any reference in these Standards to a statute, statutory instrument, regulation or order will be construed as a reference to such statute, statutory instrument, regulation or order as amended or re-enacted from time to time.
- 1.8 Any reference in these Standards to a published standard or Electrical Code of Practice shall be construed as a reference to such standard or Electrical Code of Practice as amended or substituted from time to time.
- 1.9 Any reference in these Standards to the User includes, where the context permits, the agents or employees of the same and their permitted successors and assigns.

2. PLANNING STANDARDS

2.1 INTRODUCTION

The Planning Standards apply to supply, design, information and embedded generation associated with the connection or intended connection to the Network or change to an existing connection to the Network

The Planning Standards will:

- a) enable the Network to be planned, designed and constructed to operate efficiently, reliably, securely and safely;
- b) facilitate the use of the Network by Users;
- c) establish technical conditions which facilitate the interfacing of Networks and User Networks at points of entry to and exit from the Network;
- d) formalise the exchange of planning data;
- e) provide sufficient information to Users in order that Users may assess opportunities for connection to the Network and, where applicable, to provide sufficient information for Users to plan and develop User Networks to achieve compatibility with the Network.

The Planning Standards are intended to encourage innovation and the introduction of new technology where this is consistent with the overall requirement of the Standards.

2.2 SUPPLY STANDARDS

2.2.1 Security

The Network and any User Network connected to or to be connected to the Network shall be designed in accordance with the security requirements and practices of MainPower, any relevant Statutes and Regulations and the applicable Electrical Code of Practice.

MainPower’s detailed security requirements and practices, the relevant Statutes, Regulations and the Electrical Code of Practice will be made available on request.

2.2.2 Frequency and Voltage

The Network and any User Network connected to or to be connected to the Network shall be designed to enable the Normal Operating Frequency and voltages to be supplied to Users, and to comply with Statutes, Regulations and the applicable Electrical Code of Practice.

Further information on Normal Operating Frequency and voltages and the relevant Statutes, Regulations and the Electrical Code of Practice will be made available on request.

2.2.3 Network Disturbances and Waveform Distortion

MainPower endeavours to ensure that the quality of the voltage waveform delivered to customers is maintained at acceptable levels at all times.

Disturbances in the network are often caused by customer equipment connected to the network. Customers must not take any action or use any equipment that adversely affects the supply of electricity to another customer. Any changes required to the network to mitigate disturbances caused by a customer will be at their cost.

Customer equipment which can cause disturbances include, but is not limited to, any of the following: electric motors, welders and power electronics e.g. motor starters, variable speed drives and inverters.

Some common sources of power quality issues arising from customer operations include:

a) Voltage Fluctuations due to motor starting

Direct on line (DOL) motor starting causes many supply quality issues. Traditionally this has been an issue with industrial customers, but is becoming more prevalent in residential areas with the installation of spa pools and air conditioning/heat pumps.

The following should be used as a guide:

For three phase installations, any motor greater than 4kW must not have DOL starting unless approved by MainPower.

For single phase installations, any motor greater than 1.5kW must not have DOL starting unless approved by MainPower.

b) Unbalanced Loads

Customers with two or three phase supplies are required to take all reasonable efforts to design and maintain their installations to balance loads over the phases.

c) Waveform distortion due to non-linear loads (>20kW)

To minimise the effects of harmonic currents on our network and interference to customer's installations, MainPower requires that customers notify us of the connection of all individual non-linear loads larger than 20kW or where the total non-linear load at an installation exceeds 20kW.

Examples of large distorting non-linear loads are variable speed drives used to control irrigation pumps or industrial plant and rectified loads.

Connection of these types of devices may contribute to increased network voltage distortion causing damage to electrical equipment and other adverse effects for other customers. The affected areas are generally within MainPower's rural network; however some areas within the urban network may also be affected.

For the purposes of this clause, non-linear loads are defined as individual loads within an installation with a Current Total Harmonic Distortion (ITHD) greater than 10%. ITHD is calculated as the percentage ratio of rms harmonic current to fundamental rms current at the equipment's full load, when supplied from a 50Hz power supply with 2% Voltage Total Harmonic Distortion (VTHD) and 1.5% voltage out of balance (i.e. the ratio of negative to positive phase sequence voltage).

MainPower may require that all such connected loads or the sum of these individual loads (excluding any other linear loads within the installation) are fitted with suitable equipment, for example passive or active filters, which reduces the ITHD to less than 10% when supplied from a 50Hz power supply with 2% Voltage Total Harmonic Distortion (VTHD) and 1.5% voltage out of balance. The injected rms harmonic current must also not exceed 10% of the full load fundamental rms current over the equipment full operating load range.

Equipment suppliers and customers should be aware that typical network operating conditions will include some existing voltage distortion and voltage imbalance between phases, and these will modify the effectiveness of harmonic filtering. Manufacturers generally specify harmonic performance under ideal network supply conditions, so in most cases a filter specified for an ITHD of less than 10% is required to be installed to obtain 10% ITHD at the VTHD and voltage out of balance values specified above. It is strongly recommended that the installation be modelled using software provided by the drive and/or filter supplier, to confirm it will comply with these requirements.

Where non-linear loads totaling more than 20kW are connected at an installation, whether new or due to a capacity upgrade, the installation owner shall provide written evidence compliance with this requirement.

Customers must also comply with the following standards, where applicable:

AS/NZS61000.3.2 - Limits for Harmonic Current Emissions (Equipment Input \leq 16A per Phase)

AS/NZS61000.3.3 - Limitation of Voltage Changes, Voltage Fluctuations and Flicker in Public Low Voltage Supply Systems (Equipment Input \leq 16A phase and not Subject to Conditional Connection)

The preceding two standards generally specify the required performance of standard consumer electrical devices in terms of the potential for the equipment to produce disturbances on the electrical network, which could affect other consumers. Both standards assume a standard short circuit ratio at the point of common coupling.

AS/NZS61000.3.4 - Limitation of Emission of Harmonic Currents in Low Voltage Power Supply Systems for Re-equipment with Rated Current Greater than 16A.

AS/NZS61000.3.5 - Limitation of Voltage Changes and Flicker in Low Voltage Supply Systems (Equipment Input $>$ 16A per phase).

The preceding two standards specify the required performance of larger electrical devices, which because of their size have a very much increased probability of causing significant disturbances on the electrical network. Both standards specify allowable emission values dependent on the actual short circuit ratio at the point of common coupling.

AS/NZS61000.3.6 - Assessment of Emission Limits for Distorting Loads in MV and HV Power Systems - Basic EMC Publications.

AS/NZS61000.3.7 - Assessment of Emission Limits for Fluctuating Loads in MV and HV Power Systems - Basic EMC Publications.

The preceding two standards specify the required performance of much larger loads connected to the high voltage network.

AS/NZS61000.3.11 - Limitation of Voltage Changes, Voltage Fluctuations and Flicker in Public Low Voltage Supply Systems (Equipment Input \leq 75A per phase and Subject to Conditional Connection).

This standard is applicable to equipment which does not comply with the requirements of AS/NZS61000.3.3 because it would require a source impedance lower than the standard reference impedance and thus is subject to conditional connection.

2.2.4 Network Signalling

MainPower operates ripple injection plants for load control, tariff control and other purposes. The signals operate at 283Hz. In order to ensure the correct operation of the Network signalling equipment, Users shall design and operate equipment connected to their User Network such that it does not interfere with the operation of the Network signalling system. Appliances, Apparatus and systems that interfere with the operation of MainPower's signalling systems shall not be used.

2.2.5 Power Factor

The average power factor of a connected consumer's load, measured at the network connection point as the ratio of kWh to kVAh consumed during any 30 minute period, shall not be less than 0.95 lagging at any time.

In the case of irrigation pump motors, power factor correction is only required where the nameplate rating of the pump motor exceeds 20kW. Power factor correction shall be installed to achieve power factors of at least 0.96. This requirement is to ensure additional loading on our network resulting from reactive energy load flows during times of peak loading is minimal.

Power factor correction capacitors may interfere with ripple control signals and/or cause harmonic resonance problems. Consumers must operate such equipment connected to their installations so that it does not interfere with the electricity network or the operation of our ripple control system.

2.3 DESIGN STANDARDS

MainPower reserves the right to refuse to connect or take ownership of any Fittings that do not comply with MainPower's Design and Construction Standards or any other technical standards which MainPower may reasonably set. Clause 2.3.1 to 2.3.10 provide a summary of a number of the more important Design and Construction Standards.

A copy of MainPower's Design and Construction Standards will be made available to Users or intended Users on request.

2.3.1 Earthing

The arrangements for connecting the Network or User Network with earth shall be designed to comply with the requirements of the Regulations and such Electrical Code of Practice as may be applicable.

The method of earthing of the Network shall be advised by MainPower to the User. The specification of associated equipment shall meet the voltages and fault levels which will be imposed on the equipment as a result of the method of earthing.

Design practices for multiple earth neutral networks shall comply with Good Industry Practice.

Users shall take precautions to limit the occurrence and effects of circulating currents in respect of the neutral points connected with earth where there is more than one source of energy.

2.3.2 Protection

The User's arrangements for Protection, including types of equipment and Protection settings, must be compatible with standard practices on the Network, as specified by MainPower. In particular:

- a) maximum clearance times must be within the limits established by MainPower in accordance with Protection rating and equipment short circuit rating;
- b) in connecting to the Network, the User should be aware that auto-reclosing or sequential switching features may be in use on the Network. MainPower will, on request, provide details of auto-reclosing or sequential switching features in order that the User may take this into account in the design of the User Network, including Protection arrangements;

- c) the User should be aware that the Protection arrangements on the Network may cause disconnection of one phase only of a three phase supply for certain types of fault.

The Network and each User Network shall incorporate protective devices in accordance with the relevant Regulations and Electrical Code of Practice.

In order to ensure satisfactory operation of the Network, Protection systems, operating times, discrimination and sensitivity at the Network Connection Point shall, before connection, be subject to approval by MainPower.

MainPower will not accept Users limiting the fault current infeed to the Network by use of Protection and associated equipment, in circumstances where the failure of that Protection and associated equipment in fault conditions, could result in the fault rating of equipment owned by MainPower being exceeded.

Discrimination between any User's equipment and MainPower's equipment shall be maintained at all times and evidence of satisfactory discrimination may be requested by MainPower.

Users should refer to MainPower's Design and Construction Standards for further information on Protection requirements.

2.3.3 Superimposed Signals

Where a User installs mains borne signalling equipment, it shall comply with the appropriate industry standards. No User shall use such equipment to superimpose signals on the Network without MainPower's prior written agreement, which may be withheld by MainPower at its absolute discretion.

If any User's signals leak into the Network, the User shall indemnify MainPower from any loss or damage whatsoever caused by the User using the Network for such conveyance.

2.3.4 Capacitors

Where a User installs capacitors as part of its Fittings, these capacitors must be designed so that they do not affect the Network and any signals which MainPower conveys via the Network. MainPower reserves the right to require the User to provide any necessary corrective measures if the User's capacitors interfere with MainPower's signals.

2.3.5 Interconnection

Where a User has more than one Network Connection Point no interconnection between these Points of Connection will be made (or be allowed to be made) without MainPower's prior written agreement, which may be withheld by MainPower at its absolute discretion.

2.3.6 Fittings At Network Connection Point

All Fittings at the Network Connection Point shall meet the design principles contained in the Design Standards and MainPower's Design and Construction Standards. Connection for entry to and exit from the Network shall incorporate a means of disconnection of the User Network by MainPower.

2.3.7 Fault Level Consideration

The short circuit rating of User's Fittings at the connection point should not be less than the design fault level of the Network. Design fault levels are given in MainPower's Design and Construction Standards.

2.3.8 Motor Starting

Except where alternative arrangements are agreed in writing between MainPower and the User, all motor starting is to comply with ESEANZ Committee Report on Motor Starting Currents for AC Motors dated February 1982, or as subsequently amended or replaced.

2.3.9 Capacitive and Inductive Effects

Details will be required of capacitor banks and reactors connected at high voltage which could affect the Network. Sufficient detail is required for the following:

- a) to verify that controlling equipment of the Network is suitably rated;
- b) to show that the performance of the Network will not be impaired.

2.3.10 Telemetry

Any telemetry equipment required for monitoring a User Network shall be specified by MainPower. Generating units and Power Stations subject to Central Dispatch will need to provide signals to Transpower's Control Centre for the efficient management of the Total Network.

2.4 PLANNING INFORMATION

This standard details the planning information which will, at MainPower's request, be exchanged between MainPower and the User. The standard also details the information MainPower will require to be available by the User to provide MainPower with the ability to quantify the impact on the Network of any increase or decrease in load and also gives Users notice of MainPower's requirement for information in support of the administration associated with communication, charging, reporting and statistical purposes.

MainPower reserves the right to refuse to connect, or to disconnect any User who does not comply with the requirements of this Standard.

2.4.1 MainPower's Responsibility

MainPower will provide all Network parameters reasonably required for planning by the User.

2.4.2 User's Responsibility

Users must ensure that MainPower is provided with sufficient planning data/information and safety management information as directed by MainPower from time to time, to enable MainPower to comply with and to confirm that Users have complied with the legislative, technical and administrative requirements deemed necessary by MainPower.

Users must give MainPower reasonable notice of any addition or deletion to its Fittings, User Network or the associated operating regime to enable MainPower sufficient lead time to accommodate these changes in its Asset Management Plan and to implement any modifications to the Network.

Users will be required prior to connection to the Network, or prior to using the Network, to provide MainPower with all information considered necessary by MainPower, to satisfy its administrative requirement. Failure to comply with this Standard may result in the connection to the Network being disconnected or use of the Network being suspended.

2.4.3 Reactive Compensation Plant

Users shall provide MainPower with information on any reactive compensation plant connected to the Network including:

- a) The MVA_r capacitive or inductive rating of the equipment and operating range if variable;

- b) details of any automatic control logic; and
- c) the Network Connection Point to the Network.

2.4.4 Lumped Network Susceptance

The User shall provide MainPower with details of the equivalent lumped User Network susceptance of the User Network referred back to the connection with the Network when reasonably requested by MainPower in writing.

2.4.5 Fault Infeeds

Provided it is reasonably available or accessible, information shall be exchanged between MainPower and the User on fault infeed levels at the Network Connection Point in the form of:

- a) the maximum and minimum 3 phase symmetrical and phase-earth short circuit infeed;
- b) in the case of interconnected Network and User Networks, adequate equivalent information.

2.4.6 Demand Transfer Capability

Information shall be exchanged on demand transfer capability where the same Demand may be supplied from alternative User points of supply. This shall include the proportion of Demand normally fed from each point of supply and the arrangements for transfer under outage conditions.

2.4.7 Transient Overvoltage Effects

For a User's busbars connected to the Network, sufficient details may need to be exchanged with respect to the User/MainPower Network Connection Point to enable an assessment, where necessary, to be made of transient overvoltage effects.

2.4.8 Load Characteristics

For supplies at low voltage it is usually possible to assess whether a proposed connection to the Network is acceptable, and to determine the necessary supply arrangements, from analysis of the following limited data:

- a) maximum power requirements (kVA);
- b) type and electrical loading of equipment to be connected, eg. number and size of motors, including maximum starting currents, frequency of starts and electrical heating arrangements;
- c) the date when the connection is required.

This information should be provided to MainPower when a connection is requested. Should a preliminary examination of this data indicate that more detailed information is required, this shall be provided to MainPower upon request.

MainPower's standard connection provides for 63 Amps single phase and 40 Amps three phase. Where a connection is required that is greater than the standard connection the Customer is required to apply to MainPower in writing for increased capacity.

For supplies at high voltage, it is necessary for the following additional information to be provided.

- a) All types of Demand;
 - i) maximum Active Power requirement;
 - ii) maximum and minimum Reactive Power requirements;
 - iii) type of load and control arrangements, eg Controlled rectifier or larger motor drives with maximum starting currents;

- iv) maximum load on each phase at the time of maximum Demand; and
- v) the maximum levels of harmonic voltage and current to be imposed on the Network.

b) Fluctuating Loads:

Details of the cyclic variation, and where applicable the duty cycle, of Active Power (and Reactive Power, if appropriate), in particular:

- i) the rates of change of Active Power and Reactive Power, both increasing and decreasing;
- ii) the shortest repetitive time interval between fluctuations in Active Power and Reactive Power; and
- iii) the magnitude of the largest step changes in Active Power and Reactive Power, both increasing and decreasing.

In some cases, more detailed information such as an indication of the pattern of build up of load and a proposed commissioning programme may be required.

2.4.9 Connection Arrangements

The design of connections between the Network and a User Network shall be in accordance with the principles set out in clause 2.2, subject to any modification to which MainPower may, at their discretion, approve.

When an application for connection is made, MainPower will agree with the User the voltage to which the User will be connected in accordance with MainPower's normal practice for the type of load to be supplied. MainPower may on occasion specify a different connection voltage in order to avoid potential disturbance caused by the User's Apparatus to other Users, or for other technical reasons, or may agree alternative methods for minimising the effects of disturbing loads.

a) Subdivisions

Special provisions apply to subdivisions to ensure provision is made for future development in accordance with the Constituent Council's District Plans. These provisions will ensure cabling is of an adequate rating to supply on-going development without the need to upgrade initial cabling or excavate established subdivision. Full details are included in Appendix 1.

b) Supply At High Voltage

In certain circumstances supply will be provided at high voltage. In such cases MainPower will supply high voltage cables, switchgear and Metering Equipment up to the Customer Network Connection Point. The User will be responsible, unless MainPower agrees otherwise, for all Fittings beyond the Customer Network Connection Point.

Customers proposing a connection at high voltage are strongly recommended to contact MainPower at an early stage (NZS6108.1984 applies to such connections). Additional requirements for such connections can be found in Appendix 2.

MainPower's general requirements in relation to substations are as specified in NZS 6108.1984, Specification for Accommodation for Electricity Supply Substations in Consumers Buildings.

2.4.10 Communications

Routine and emergency communication between MainPower and the User shall be provided and maintained as agreed in writing between MainPower and the User in each particular case.

2.4.11 Demand Management

Where MainPower or the User has a need for a co-ordinated means of Demand management, the means of implementing this shall be agreed between the two parties.

Arrangements for emergency Demand management may also form part of the overall Demand management agreement. Information on the available emergency load shedding on the User Network shall be made available to MainPower on request.

2.5 EMBEDDED GENERATION STANDARDS

This section is applicable to all existing or prospective Generators, including Users With Own Generation having plant operating in parallel with the Network.

2.5.1 General Requirements

Embedded Generators connected at or below 11kV and with a station output not in excess of 300 kW shall, as a minimum requirement, comply with the requirements of such Regulations and Electrical Code of Practice as may be applicable and any additional requirements advised by MainPower. Their presence shall not restrict switching on the Network.

Embedded Generators connected at a higher voltage or of a larger capacity shall, in addition to the minimum requirements, comply with the general principles of the Transpower Connection Standards and any additional requirements advised by MainPower.

2.5.2 Planning Information

Embedded Generators will fall within three basic classes for which minimum information as outlined below shall be provided to MainPower by the Generator. The classes are:

- Generator with embedded generating plant connected at a voltage level of 11kV or below with a Power Station capacity less than 300 kW;
- Generator with embedded generating plant connected at a voltage level greater than 11kV or with a Power Station capacity of between 300 kW and 25 MW. Such plant may be subject to routine dispatch control by MainPower or Transpower;
- Generator with embedded generating plant with a Power Station capacity in excess of 25 MW. Such plant will be subject to dispatch control by MainPower or Transpower.

The following information will be required by MainPower before entering into an agreement to connect generating plant to the Network.

a) General

The information detailed in Appendix 3, shall be provided by the Generator to enable successful interfacing with the Network without affecting other Users.

The type of information will depend on the category of generation, and will remain confidential between the parties until agreed otherwise. MainPower reserves the right to release sufficient information relating to existing generators and those for which a Connection Agreement has been approved for the purpose of meeting its obligations to Transpower, if requested by Transpower.

b) Generators Connected At Low Voltage, With Capacity Less Than 300 kW

Such Generators cover most of those in category 2.5.2(a) above. They shall be installed in accordance with NZECP 4: 1993 or any subsequent revision.

c) Generators Connected At High Voltage Or With Capacity Greater Than 300 kW

MainPower will use the information provided to model the Network and determine what method of connection will need to be employed and the voltage level at which the connection should be made.

2.5.3 Technical And Performance Requirements

For embedded generating plant in excess of 50 MW and those subject to Central Dispatch, the electrical requirements will be those detailed in the Transpower Connection Standards. For generation not subject to Central Dispatch, the electrical parameters required to be achieved at the generating unit terminals are defined according to the connection method and will be specified by MainPower. The output power should not be affected by voltage or frequency changes in the permitted operating range.

a) Frequency Variations

Normally specifications for generating plant in New Zealand call for the following frequency excursions:

- i) Normal frequency variation + 0.25Hz around a normal frequency of 50Hz with a period of not less than 1 minute;
- ii) Following a significant Event the ac system frequency may go to either 45Hz for a duration of 1 minute or 55Hz for a duration of 10 seconds. After 1 minute, the frequency deviation would be reduced in a step to 47.5Hz or 52.5Hz. Following this, the ac system frequency would be gradually restored over a period of 35 minutes to 49.25Hz or 50.75Hz. A frequency deviation of 0.75Hz above and 0.75Hz below 50Hz can persist for an indefinite period; and
- iii) The maximum frequency excursions occur simultaneously with system highest voltage.

b) Control Arrangements

MainPower will advise if a continuously acting fast response automatic excitation control system is required to control the generating unit voltage without instability over the entire operating range of the generating unit or Power Station. This will be dependent on the size and type of generating plant or Power Station and the Network to which it is connected.

c) Protection

The Protection associated with embedded generating plant shall co-ordinate with the Protection associated with the Network as follows:

- i) for generating plant directly connected to the Network, the Generator must meet the target clearance times for fault current flowing from the Network, in order to reduce to a minimum the impact on the Network of faults on circuits owned by the Generator. MainPower will ensure that the Protection settings meet its own target clearance times. The target clearance times are specified by MainPower;
- ii) the settings of any Protection controlling a circuit breaker, or operating values of any automatic switching device at any Network Connection Point, shall be approved by MainPower;
- iii) it will be necessary for the generating plant Protection to co-ordinate with any auto-reclose settings specified by MainPower; and
- iv) any generating unit or Power Station connected to the Network will be required to withstand, without tripping, the negative phase sequence loading incurred during the clearance of a close-up phase-to-phase fault by Network Back-up Protection which will be within the plant short time rating on the Network.

d) Islanding

It is conceivable that a part of the Network to which embedded Generators are connected can, during emergency conditions, become detached from the rest of the Network. It will be necessary for MainPower to decide, dependent on local network conditions, if it is desirable for the embedded Generators to continue to generate onto the islanded section of the Network. If no facilities exist for the subsequent resynchronisation with the rest of the Network the embedded Generator will, under MainPower's instruction, ensure that the generating plant is disconnected for resynchronisation.

Under emergency conditions, there is an expectation that some generation will continue to operate outside the statutory frequency limits. However, for embedded Generators connected to the Network at a voltage level less than 22kV, it is likely that this could mean connection within an automatic low frequency

load disconnection zone. Consequently, embedded Generators should ensure that all Protection on generating plant should have settings to co-ordinate with those on the automatic low frequency load shedding equipment. Information on this equipment will be provided by MainPower on request.

e) Black Start Capability

Embedded Generators shall notify MainPower if their generating plant has a Black Start Capability.

2.5.4 Commissioning Tests

Where generating plant requires connection to the Network in advance of the commissioning date for the purposes of testing, the Generator must comply with the requirements of the Connection Agreement. The Generator shall provide MainPower with a commissioning programme for prior approval.

3. OPERATING STANDARDS

This part of the Standards specifies criteria and procedures used by MainPower in the operating of the Network. The Operating Standards also applies to Users of the Network in terms of the operating of their User Network and installations insofar as they affect the operation of the Network.

The Operating Standards deals with various operational matters affecting Users, including the provision of forecasts of likely Demand, the planning of outages, the reporting of operational changes and events, safety matters, and procedures for dealing with contingencies.

3.1 DEMAND FORECASTS

3.1.1 Introduction

In order for MainPower to operate the Network efficiently, and to ensure maximum security and Network stability, MainPower needs to forecast loadings on the Network with sufficient accuracy and for a sufficiently long forward period to enable it to plan the development of the Network. MainPower also needs to forecast Demand for each busbar to which it is connected, or proposes to be connected, from Transpower.

3.1.2 Scope of Forecasts

This section applies to the following Users:

- a) Embedded Generators which are not subject to Central Dispatch and with generating plant over 300 kW;
- b) Electricity Retailers; and
- c) Users with Demands over 300 kVA.

3.1.3 Information Required

All or some (as specified by MainPower) of the following information shall be required:

- Winter maximum Demand
- Summer maximum Demand
- Power Factor at maximum Demand
- Total annual energy
- Projected energy usage over any period specified by MainPower New Zealand Limited

Users With Own Generation will be required to furnish such information as MainPower may reasonably consider would affect its Demand forecasts.

All information required by MainPower from Users shall be in writing in a format agreed by MainPower and shall be supplied at such times of the year as may be required by MainPower.

In addition to the information described above, Users will provide MainPower with their forecasts of additional load that will require additional transformer or cable capacity.

3.2 OUTAGE PLANNING

3.2.1 Introduction

In order to plan and co-ordinate its construction, maintenance and operational activities, MainPower requires information on Planned Outages of Users' major plant and Apparatus which may affect the operation of the Network, or require the commitment of resources. This section of the Connection standards establishes procedures to enable the collection of such data from the following Users:

- a) embedded generating plant in the Network whose maximum generating capacity is greater than 300 kW, and which is not subject to Central Dispatch;
- b) Electricity Retailers;
- c) Users With Own Generation; and
- d) Users connected to the high voltage Network.

3.2.2 Outage Planning Procedures

a) Embedded Generating Plant

Information relating to embedded generating plant not subject to Central Dispatch, and whose maximum generation capacity is greater than 300 kW, shall be provided directly to MainPower. This may include Users With Own Generation where MainPower considers this to be appropriate.

MainPower will seek Scheduling information from Generators for all embedded generating plant not subject to Central Dispatch, where it considers this to be appropriate.

b) Other Fittings

Information relating to all Fittings connected to the Network, or that which may affect its operation, shall be co-ordinated with MainPower.

c) Time Scale

Users shall provide MainPower, details and schedules of their Fittings Planned Outages which may affect the operation of the Network.

3.3 TESTING AND MONITORING

MainPower reserves the right to test and/or monitor the Network to ensure that Users are not operating outside the technical parameters required by any part of this Connection Standard.

3.3.1 Testing and Monitoring Procedures

The testing and monitoring relates to two aspects of the Network, namely quality of supply and connection point parameters.

a) Quality of Supply

MainPower will from time-to-time determine the need to test and/or monitor the quality of supply at various points on the Network. The requirement for specific testing and/or monitoring may be initiated by the receipt of complaints.

Where the results of such tests show that the User is operating outside the technical parameters specified in any part of the Connection standards, or of any other statutory regulation or Electrical Code of Practice, the User will be informed accordingly.

Where the User requests, a re-test can be carried out and witnessed by a User representative.

Any User shown to be operating outside the limits specified above will immediately, or within such time as may be agreed with MainPower, remedy the situation or disconnect from the Network the Fittings causing the problem. Continued failure to remedy the situation will result in the User being disconnected from the Network.

b) Connection Point Parameters

MainPower may from time-to-time monitor the effect of the User on the Network. The monitoring will normally be related to voltage fluctuations and/or harmonic content transferred across the Network Connection Point. Where the User is exporting to or importing from the Network Active Power and Reactive Power in excess of the parameters in the Connection Agreement, MainPower will inform the User of, and where appropriate demonstrate, the results of such monitoring.

In some cases the User may want increased Active Power and Reactive Power.

3.4 DEMAND CONTROL

This section is concerned with the provisions for Demand control under emergency conditions to be made by MainPower or by the User in relation to its User Network. Procedures must be established to enable MainPower, following a request from Transpower or otherwise, to achieve a reduction in Demand in order to avoid a breakdown or overload of any part of the Total Network or the Network. The following methods of reducing Demand are dealt with:

- a) voltage reduction;
- b) User Demand management;
- c) User disconnection;
- d) automatic low frequency disconnection; and
- e) emergency manual User disconnection.

3.4.1 Demand Control Procedures

This section of the Connection standards applies to MainPower and Users, including embedded Generators. Implementation of Demand control by MainPower may affect Customers of Electricity Retailers, and where applicable, contractual arrangements between Electricity Retailers and their Customers should reflect this.

Demand control may take the following forms:

a) Operational Network Load Reduction

MainPower has developed procedures to reduce load within the Network in a Controlled manner by reducing voltage and/or disconnecting Customers or portions of Customer loads which may be amended or replaced from time to time.

A system of warnings may be contained within the load reduction procedures to give notice, wherever practicable, of implementation of load reduction measures beyond normal operational or economically-based Demand control measures which may be detailed in a Connection Agreement.

b) Automatic Disconnection of Demand Through Low-Frequency Detectors

MainPower shall not be responsible for any low frequency disconnection operations initiated by Transpower, even if such arrangements were made in consultation with MainPower.

(c) Emergency Manual Disconnection of Demand

If requested by Transpower, or for its own purposes, MainPower may arrange to have available an emergency manual disconnection procedure based on Transpower points of supply. The procedure will be designed to be called upon to operate irrespective of Network frequency.

3.5 OPERATIONAL LIAISON

This section sets out the requirements for the exchange of information in relation to operating or other events on the Network, or the User Network connected to the Network. It does not seek to deal with any actions arising from the exchange of information, but merely with that exchange.

3.5.1 Nomination of Officers

MainPower and each User to whom this section of the Connection standards applies will nominate personnel having the knowledge and experience required to operate the Network and the User Network connected to the Network respectively and will agree communication channels to ensure the effectiveness of the exchange of information specified herein.

3.5.2 Notification of Operations and Events

a) Requirement to Notify

In the case of an operation or Event on the User Network which has an operational effect on the Network, the User will notify MainPower in writing in accordance with these Connection standards.

b) Form of Notification

A notification under this section of the Connection standards shall be of sufficient detail to describe the operation or Event and shall include the name of the individual reporting the operation or Event.

c) Timing of Notification

Notification of a planned or anticipated operation will be given as far in advance as possible, and in any case shall be given in sufficient time to reasonably allow the recipient to consider and assess the implications and risks arising. In all other cases, notification shall be given as soon as possible following the operation or Event occurring.

3.6 EQUIPMENT NUMBERING AND NOMENCLATURE

3.6.1 New Apparatus

When MainPower or a User intends installing Apparatus, the proposed numbering and/or nomenclature to be adopted for the Apparatus must be notified to the other party. The notification will be made in writing to the relevant party and will consist of an operation diagram incorporating the proposed new Apparatus to be installed, and its proposed numbering and/or nomenclature.

The notification will be made to the relevant party prior to the proposed installation of the Apparatus with a view to obtaining such parties agreement to the proposed numbering and nomenclature. In the event that agreement cannot be reached between MainPower and such parties, MainPower, acting reasonably, shall have the right to determine the numbering and nomenclature to be applied at that site.

3.6.2 Existing Apparatus

MainPower and/or every User shall supply MainPower and/or every other User, on request, with details of the numbering and nomenclature of Apparatus on sites having a Network Connection Point. MainPower and every User shall be responsible for the provision and erection of clear unambiguous labelling showing the numbering and nomenclature of its Apparatus on sites having a Network Connection Point.

3.6.3 Changes to Existing Apparatus

Where MainPower or a User needs or wishes to change the existing numbering or nomenclature of any of its Apparatus on any site having a Network Connection Point, the provisions of 3.6.1 – New Apparatus – shall apply, with any amendments necessary to reflect that only a change is being made.

Where a User changes the numbering and/or nomenclature of its Apparatus, the User will be responsible for provision and erection of clear and unambiguous labelling after agreement with MainPower.

Where MainPower changes the numbering and/or nomenclature of its Apparatus, MainPower will be responsible for the provision and erection of clear and unambiguous labelling.

3.6.4 Access to Equipment

Where MainPower requires to inspect, repair, install, replace or test MainPower Apparatus or Fittings that are on a User site or sites, the User shall not unreasonably withhold access.

4. SAFETY CO-ORDINATION STANDARDS

The Safety Co-ordination Standards specify the safety management to be applied by MainPower to meet the requirements of the Safety Rules and General Safety Handbooks for the Electricity Industry, and other legislative requirements and relevant Standards imposed on owners and operators of the Network.

Similar criteria and standards of safety management are required to be applied by Users when carrying out work or tests at the operational interface with the Network.

4.1 OBJECTIVE

The objective is to specify the requirements with a view to ensuring safety of persons working on the Network and at or across operational and Ownership Boundaries.

4.2 PROCEDURE

This section of the Connection standards is to be complied with by MainPower and all Users.

4.2.1 Safety Management Systems

MainPower will establish an approved health and safety management system in accordance with the requirements of the Health and Safety in Employment Act. This system will specify the principles and procedures, and where appropriate, the documentation to be applied, so as to ensure the health and safety of all who are liable to be working or testing on the Network, or on plant and Apparatus connected to the Network.

4.2.2 Operational Boundaries and Principles

At sites or locations where an Operational Boundary exists, the health and safety management system to be adopted and the time for a Customer category, shall be jointly agreed to in writing. This will include provision for control persons who have the knowledge and experience to operate to the health and safety management systems in use by field personnel where appropriate.

A system of documentation shall be maintained by MainPower and the User which records the agreed inter-system safety precautions taken when:

- a) work or testing is to be carried out on high voltage plant and/or Apparatus across the Operational Boundary;
- b) isolation and/or earthing of User Networks is needed.

Where relevant, copies of the health and safety management systems and related documentation shall be exchanged between MainPower and Users for each Operational Boundary, and also if appropriate for each working occasion.

4.2.3 Authorised Personnel

The health and safety management system shall include the provision for written Authorisation to agreed levels confirming the training, knowledge and experience of personnel concerned with the control, operation, work, or testing of plant and Apparatus forming part of, or connected to, the Network.

Each individual Authorisation shall indicate the class of operation and/or work permitted, and the section of the Network to which the Authorisation applies.

4.2.4 Environmental Safety

Arrangements shall be made to ensure site environmental safety and security, as required by statute. Where risks include contamination or similar, suitable decontamination facilities and procedures shall be provided and used.

4.2.5 Operations Control

- a) Control Responsibilities

MainPower and Users shall jointly agree and set down in writing schedules specifying the responsibilities for operations control of equipment at the Network Connection Point. These shall ensure that only one party is responsible for any item of plant or Apparatus at any one time.

MainPower and each User shall at all times have nominated a person or persons responsible for the control and co-ordination of safety from the Network pursuant to this section of the Connection standards.

- b) Control Documentation

MainPower and Users shall maintain a suitable set of documentation which records all relevant operational Events that have taken place on the Network or any User Network connected to it, and the co-ordination of relevant safety precautions for work.

- c) Network Diagrams

Diagrams illustrating sufficient and up to date information for control personnel to carry out their duties shall be exchanged by MainPower and the User and supported by written documentation. Updated versions will be supplied on request.

- d) Communications

Suitable communication networks shall be established between MainPower and Users to ensure the control function is carried out in a safe and secure manner.

MainPower and Users will establish 24 hour availability of personnel with suitable Authorisation where the joint operation requirements demand it.

4.2.6 Responsibility

a) Ownership, Operation and Maintenance Schedules

Schedules specifying the responsibilities for ownership, operation and maintenance shall be jointly agreed to in writing by MainPower and Users for each location where an operational interface or joint responsibilities exist.

b) Maintenance of Schedules and Diagrams

All schedules and diagrams shall be maintained by MainPower and Users and exchanged as necessary to ensure they reflect the current agreements and Network configuration.

5. CONTINGENCY PLANNING STANDARDS

Contingency Planning Standards relate to the need to restart and operate the Total Network in abnormal situations which require co-ordination between Transpower, MainPower and Users, with a common approach to give uniformity of priorities. It also specifies requirements to be met during periods of declared civil emergencies.

5.1 EMERGENCY LOAD SHEDDING

As part of MainPower's agreement to connect to the Transpower transmission system, MainPower is required to make provision for automated emergency load shedding on under frequency. This is undertaken from major substations and it is not possible to isolate individual Users from an automatic load shedding block. In circumstances where Users have critical loads they should make provision for their own standby generation.

5.2 NETWORK RECOVERY PROCEDURES

The Total Network may experience complete or partial shutdown in situations where a major fault has a cascading effect through the Network, or where there has been a significant loss of generation. In such situations, Network recovery must be co-ordinated in such a way that ensures it is carried out in a minimum of time. To this end, MainPower is required to follow the procedures which it has agreed with Transpower it will follow and to liaise with Transpower when taking any action which may have an impact on Transpower's Network.

Where generation has been lost completely, start-up of those embedded Generators subject to Central Dispatch and which have been identified as having Black Start Capability shall be the responsibility of Transpower.

The start-up of embedded Generators not subject to Central Dispatch and which have Black Start Capability shall be co-ordinated by MainPower, with due notification being given to Transpower. Where there is sufficient generating capacity available by configuring the Network appropriately, MainPower shall establish stable "islands of supply" around particular Generators.

The strategy to be applied in the above circumstances shall be documented by MainPower.

5.3 CIVIL EMERGENCIES

MainPower has an obligation to carry out certain Civil Emergency duties in relation to the Network. Under such emergency situations the actions of MainPower and all parties connected either directly or indirectly to the Network will be governed by the procedures laid down in the relevant portions of the Civil Defence Act.

6. CUSTOMER CATEGORY STANDARDS

6.1 INTRODUCTION

Customer Category Standards detail the availability and the criteria, including the customer category in respect of the provision of Line Function Services, to be adopted by MainPower when approving a Customer category relating to a new connection to the Network or where the Customer has requested that MainPower give consideration to approving a change in category.

The Retailer, as Agent for the Customer must provide any information requested by MainPower to assist in the determination of the appropriate Customer category and to allow MainPower to maintain an adequate Customer database for communication, charging, reporting and statistical purposes. Failure to supply this information on request may result in MainPower refusing to connect the Customer to the Network or the disconnection of the Customer from the Network. Where a Customer has any installation supplied by more than one Retailer, then the Customer must provide separate disconnection points for each Retailer.

If MainPower becomes aware that the customer has not met their obligations under MainPower's Network Connection Agreement or the agreement that the customer has entered into with the Network User for the supply of electricity to that customer, then MainPower may at its absolute discretion disconnect the customer from MainPower's network, and advise the Network User, being the customer's agent accordingly, where such advice has not already been received by MainPower from the Network User.

6.2 FIXED CHARGES

The Fixed Charge component of a contract for the supply of Line Function Services is for a minimum 12 month period in all cases.

Fixed Charges apply to all customer categories excluding streetlighting.

Inclusion of multiple installations under one metering point will not preclude MainPower from applying fixed charges based on the Customer Category of each individual installation connected to that metering point.

Water pumps up to 3.5 kW motor rating can be connected to any Customer Category. Water pumps sized greater than 3.5 kW motor rating will be classified as either Irrigation or Commercial depending on the predominant use.

MainPower reserves the right to decide the customer category for every installation and to reassess any concessions made on these properties.

6.3 RESIDENTIAL

Installations are considered to be categorised as Residential where they are lived in and take supply at up to 63 Amps on single phase or 30 Amps on two or three phases. All installations that require greater supply ratings and that are requested to be Residential in nature will be assessed by MainPower on a case by case basis. The following options are available under the Residential Customer Category.

6.3.1 Controlled

- a) Installation must have an electric Controlled storage type hot water system of minimum capacity of 180 litres (40 gallon) or a gas operated, non-electric hot water system.
- b) Under-sink type cylinders of 40 litres or less are approved for connection to the Uncontrolled supply subject to the requirements of (a) above being met.
- c) Quick recovery electric systems utilising a separate top element may have that element connected to the Uncontrolled supply subject to the conditions in clause (a) being met, and that the size of the top element is 2 kW or less and that the top element is Controlled by the Customer in such a manner as to prevent

continuous operation (fitting of a time limit switch with 1 hour maximum on time, or a single shot recharge switch is required).

- d) Spa Pools may be connected to the Uncontrolled customer category provided that the conditions of clause (a) are met.
- e) For Controlled loads with a demand greater than 30 amps the Customer shall supply a suitable contactor device for switching the load.
- f) Existing installations charged in accordance with previous controlled customer categories, where the requirements of cylinder capacity are not met, may continue to qualify for this Customer category.

6.3.2 Night Special

Only approved fixed wired storage waterheating or storage space heating load can be connected to this customer category. Elements or appliances

- a) connected to this customer category will not be made switchable to any other customer category.
- b) Supply of Night Special is limited to a maximum of 8 hours availability between the hours of 9:30 pm and 7:30 am.
- c) For Controlled loads with a demand greater than 30 amps the Customer shall supply a suitable contactor device for switching the load.
- d) Other storage systems will be subject to approval.
- e) Quick recovery systems utilising a separate top element may have that element connected to the Uncontrolled supply.
- f) This Customer category is not a stand-alone customer category. It is available in conjunction with Residential Controlled or Uncontrolled.

6.3.3 Uncontrolled

- a) All installations that do not have electric storage waterheating under MainPower's direct control will qualify for this Customer category.
- b) This customer category has no controlled load..
- c) For the avoidance of doubt, this Customer category will apply to those installations with 'instant', i.e. on demand hot water systems.

6.4 OTHER SUPPLY

This Customer Category applies to all installations other than Residential.

6.4.1 Industrial, commercial, Farming, Community

Applicable to installations where the predominant use is Industrial /Commercial/Farming/Community. All storage water heating shall be controlled. MainPower New Zealand Limited reserves the right to charge a higher fixed charge where the customer requests an uncontrolled supply in this instance.

6.4.2 Night Special

Availability of Night Special to installations where the predominant use is Industrial/Commercial/Farming/Community is limited to special circumstances and is subject to negotiation between MainPower New Zealand Limited and the customer.

6.4.3 Irrigation

Applicable to installations where the predominant use is Irrigation. All Irrigation installations will attract a Motor Capacity charge, based on the installed capacity of any motor(s) in that installation that may run at the same time. No other fixed charges apply.

- a) Where a Domestic water pump is installed in the same installation, it will qualify for inclusion in the irrigation customer category provided that the motor capacity is 3.5 kW or less, and the motor capacity is included in the irrigation motor capacity charge.
- b) Motor capacity charges are based on annual charges, and cannot be avoided by disconnection and reconnection within any 12 month period, except where disconnection of the supply and removal of the service line and or transformer occurs.
- c) A standard 3 pin outlet and lighting circuit are permissible within the installation on this customer category.

6.4.4 Council Pumping

Council water pumping schemes with reservoir systems will be controlled. MainPower New Zealand Limited reserves the right to charge a higher fixed charge where the customer requests an uncontrolled supply in this instance.

6.4.5 Large User

Customers consuming over 500,000 units of energy per annum may qualify for a volume discount. The level of discount is subject to negotiation between MainPower New Zealand Limited and the customer and will take into account the customers load characteristics and other relevant information.

MainPower New Zealand Limited reserves the right at any time to review volume discounts where large movements occur in the customers energy consumption.

6.4.6 Street Lighting

Applicable to installations , either Customer owned or local authority owned, where use is for lighting.

- a) Meters will not normally be required for this customer category.
- b) Charges will be determined by type of lamp and billed monthly.
- c) Maintenance agreements are not part of this standard.

6.4.7 Temporary Supply

This customer category is only available with installations, where power is required for a temporary nature for construction or other short term purpose.

Applicable to installations where the predominant use is Builders' Temporary Supply and Temporary Lighting.

- a) The charges for a Temporary Supply are based on the activity being a Commercial undertaking.
- b) Temporary Supply Customers are not deemed to be Qualifying Customers in the matter of issue of rebate shares.
- c) Electricity must not be used for any purpose other than that directly related to the building and lighting activity.

7. METERING STANDARDS

7.1 INTRODUCTION

The Metering Standards detail the requirements for all Metering Equipment installed for the purpose of

measuring and recording of Line Function Services and recording the consumption of electricity conveyed to Customers connected to MainPower's Network. All Metering Equipment will comply with the Metering and Reconciliation Information Agreement (MARIA) Codes of Practice which apply at 1 April or at any the date of installation, whichever is the later. Metering Equipment and its installation shall also comply with the requirements of the Electricity Regulations and any of MainPower's Network Connection Standards.

7.2 INVESTIGATIONS

If any party to the electricity supply arrangements relating to a metering installation suggests that the metering installation might be reading incorrectly, the meter owner shall make available the most recent calibration results for the Metering Equipment, and shall discuss the situation with them.

If, after such discussion and consideration of the costs involved, any party may request that further testing be carried out. The meter owner may carry out such on-site tests as may be appropriate to determine whether or not the meter would be likely to be found defective in a formal laboratory test.

Conclusions reached, as a result of these tests shall be discussed with the complainant.

Where as a result of the above tests, or for any other sound engineering reason, there is reason to believe that a meter is within the required accuracy limits, but any party believes that the meter readings do not accurately reflect the actual consumption, the meter owner shall carry out such tests as are appropriate, using their professional judgement, to attempt to ascertain the cause of any problem.

At any stage during the above process, any party may request that the meter is removed and subjected to formal laboratory tests.

7.3 SECURITY

Current transformer chambers and potential fuses shall be completely and securely sealed by the meter owner to prevent unauthorised alterations which may affect the Metering Equipment integrity or performance.

7.4 RESPONSIBILITY FOR METERING EQUIPMENT AND ENCLOSURE

The Customer's Electricity Retailer will be responsible for all meters and low voltage current transformers. The Customer must provide a suitable weatherproof enclosure capable of housing all Metering Equipment required for any installation connected to the Network.

7.5 RIPPLE RELAY

MainPower owns all ripple relays. Where it is desirable to install a second ripple relay, for the purposes of economies of cabling in cases of central metering or remote metering situations, the Customer may be charged for the additional relay(s) at a rate determined from time to time by MainPower. Maintenance costs of such relays will be the responsibility of the Customer.

The potential supply for all ripple relays irrespective of location shall be from a permanently live supply which is suitably fused.

APPENDIX 1 - TECHNICAL REQUIREMENTS FOR RETICULATION OF NEW SUBDIVISIONS

1. GENERAL

MainPower requires that subdivision electrical reticulation which will become part of the Network be constructed in accordance with the Network Connection Standards and MainPower's Design and Construction Standards.

2. PLANNING PERIOD

Reticulation for subdivisions shall be designed to supply all Customers likely to be connected to the Network within a ten year period of the commencement of the development.

2.1 Further Development

Where it is likely further developments, whether by the current developer or by other developers, will occur within the planning period, that may be supplied using reticulation assets for the original development, then the original development assets shall be designed to allow for those further developments.

2.2 Territorial Authority Endorsement

Design assumptions relating to further developments shall be discussed with the appropriate Territorial Authority and shall be endorsed by an officer of that Territorial Authority before being submitted to MainPower for approval.

3. PREFERRED DESIGN

All work involving extensions to the Network must comply with MainPower's Design and Construction Standards.

3.1 Design Approval

Designs for extensions that will form part of the Network must be approved by MainPower prior to construction.

APPENDIX 2 - REQUIREMENTS FOR CUSTOMERS SUPPLIED AT HIGH VOLTAGE

1. GENERAL

All those requirements listed in NZS6108.1984 shall apply, and in addition to the requirements detailed in this appendix.

2. METERING

In all cases, MainPower shall approve current transformer and voltage transformer units required for metering of Customer's high voltage supplies.

3. CIRCUIT BREAKER

Where required by MainPower, provisions shall be allowed for control of Customer's circuit breakers from MainPower's equipment. This may be from Protection and/or remote control signals as determined by MainPower to maintain Network integrity.

APPENDIX 3 - INFORMATION REQUIREMENTS FOR EMBEDDED GENERATION

1. REQUIRED FOR ALL GENERATORS CONNECTED TO THE NETWORK

1.1 Generating Plant Data

- a) terminal volts (kV)
- b) rated kVA;
- c) rated kW;
- d) maximum Active Power sent out (kW max) Reactive Power requirements (kVAr), if any;
- e) type of generating plant – synchronous, asynchronous, etc.;
- f) type of prime mover;
- g) anticipated operating regime of generation, e.g. continuous, intermittent, peak lopping;
- h) fault level contribution (for large machines, this may be covered by the details listed in part B);
- i) method of voltage control;
- j) generator transformer details, as applicable;
- k) requirements for Top-Up supplies and/or standby supplies.

1.2 Interface Arrangements

- a) the means of synchronisation between the Network and the Generator.
- b) details of arrangements for connecting with earth that part of the Generator's system directly connected to the Network;
- c) the means of connection and disconnection which are to be employed;
- d) precautions to be taken to ensure the continuance of safe conditions should any earthed neutral point of the Generator's system operated at HV become disconnected from earth.

2. INFORMATION REQUIRED FOR LARGE GENERATORS

This section applies to embedded Generators connected at voltages greater than 11kV or of capacity greater than 300 kW and details the technical and design information requirements not specifically covered above. The following information will be requested by MainPower to enable the effect of the proposed Generation on the Network.

2.1 Technical Data

- a) generating plant information (impedances p.u. on rating);
 - Type of prime mover
 - Rated MVA
 - Rated MW
 - Generator MW/MVAr capability chart (at lower voltage terminals)
 - Type of excitation system
 - Inertia constant MW secs/MVA (whole machine)
 - Stator resistance

Direct axis reactances	Sub-Transient Transient Synchronous
Quadrature axis reactances	Sub-Transient Synchronous
Time constants	Direct axis Sub-Transient & Transient Quadrature Axis Sub-Transient (stating either open or short circuit time Constant)
Zero sequence	Resistance Reactance
Negative sequence	Resistance Reactance
Generator transformer	Resistance Reactance MVA Rating Tap arrangement Vector group Earthing

b) automatic voltage regulator;

A block diagram for the model of the AVR system including the data on the forward and feedback gains, time constants and voltage control limits.

c) speed governor and prime mover data;

A block diagram for the model of the generating plant governor detailing the governor flyball, if applicable, and system control and turbine time constants, together with the turbine rating and maximum power.

2.2 Capacity And Standby Requirements

- registered capacity and minimum generation of each generating unit and Power Station in MW;
- generating unit and Power Station auxiliary Demand (Active Power and Reactive Power) in MW and MVA_r, at registered capacity conditions. For Users With Own Generation, this should include Top-Up requirements;
- generating unit and Power Station auxiliary Demand (Active Power and Reactive Power) in MW and MVA_r, under minimum generation conditions. For Users With Own Generation, this should include Top-Up and standby requirements.

3. FURTHER INFORMATION REQUIRED BY TRANSPOWER

Generators with large machines may be subject to the Transpower Connection Standards and Central Dispatch. Where this applies any information supplied to MainPower, and also any further information requested by Transpower will be forwarded to Transpower. It will be the responsibility of the Generator to provide the information required to MainPower. MainPower will pass on the information to Transpower.

There may also be information required under the terms of any Transpower contract in respect of the transfer of energy from the Generator to the Generator's Customer.