AE-CC01-S Network Connection Standard

Standard

Contents

Tables

Figures

I Document Control

Responsibility	Name	Position
Document Approver:		GM Regulatory & Commercial
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II Approval & Revision History

Version	Date	Revision Notes
1.0	25/09/2020	• Replaces legacy policy AE-S014
1.1	11/06/2021	• Sections 6.2 and 11.2 amended

For submitting feedback or a change request refer to the Aurora Energy Controlled Document System homepage.

III Document Contributors

Name	Position	Content Provided	Page #
Alec Findlater	GM Regulatory & Commercial	Text	Ibid.

IV Normative References

Reference Code	Title
	Electricity Act 1992 Electricity (Safety) Regulations 2010 Electricity Industry Participation Code 2010

V External References

Reference Code	Title
AS/NZS3000:2018	Australian/New Zealand Wiring Rules
AS/NZS 61000.3.11: 2002	Electromagnetic compatibility (EMC) Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply

	systems - Equipment with rated current less than or equal to 75 A and subject to conditional connection
Electricity Authority	Guidelines for Metering, Reconciliation and Registry Arrangements for Secondary Networks
IEC 60354	Loading Guide for Oil-Immersed Transformers
NZECP34:2001	New Zealand Electrical Code of Practice for Electrical Safe Distances
NZECP36:1993	New Zealand Electrical Code of Practice for Harmonic Levels

VI Internal References

Reference Code	**Title**
AE-CB01-S	Capital Contributions
AE-CA05-S	Easements
AE-CC03-S	Network Connections for Controlled Lighting
AE-CC01-G01	Guide to Small Scale Distributed Generation
AE-CC01-G02	Guide to Large Scale Distributed Generation
AE-NF04-S	Distribution and Consumer Substations – Design and Construction
AE-NR03-T02	Substations in Customer Buildings Requirements
AE-NR01-T01	Construction of Pole Substations
NS5.3 (legacy policy)	Distributed Generation Technical Standard

1 Introduction

1.1 Purpose

This standard defines the technical and commercial requirements for Connections to the Network.

1.2 Scope

This standard applies to all connections to the Network.

This standard is not applied retrospectively. Connections that complied with our connection requirements when first connected are considered compliant; however, any alterations to the Connection must comply with this standard.

1.3 Definitions

Aspect	Definition
Approved Contractor	means a contractor that is a party to an Approved Contractor Agreement with Aurora Energy, and which is approved to design and construct additions to the network.
Central Area	means that part of the Aurora Energy Network connected to Transpower via the Clyde, Cromwell and Frankton grid exit points.
Certificate of Compliance	has the meaning given in regulation 4 of the Electricity (Safety) Regulations 2010.
Certified Design	means a design certified in accordance with regulation 58 of the Electricity (Safety) Regulations 2010.
Code	means the Electricity Industry Participation Code.
Connection Capacity	means the maximum load, in kVA, that a connection is designed to serve. The Connection Capacity is synonymous with the Assessed Capacity, as defined in Aurora Energy's published Pricing Methodology.
Customer	means the person, or organisation, for whom Aurora Energy will provide the new or upgraded connection. The term Customer is to be read synonymously with the terms "consumer", "developer" or "subdivider" that may be in use in other controlled documents.
Customer Network	means an electricity distribution network that is owned by someone other than Aurora Energy, where consumers connected to it are not switchable and therefore have no choice of retailer.
Dunedin Area	means that part of the Aurora Energy Network connected to Transpower via the Halfway Bush and South Dunedin grid exit points.
Electrical Safety Certificate	has the meaning given in regulation 4 of the Electricity (Safety) Regulations 2010.
Embedded Network	means an electricity distribution network that is owned by someone other than Aurora Energy, where consumers have ICPs allocated and managed by the embedded network owner acting as the distributor for that network (or another distributor appointed for that purpose), and the electricity traded is reconciled at the point of connection between the embedded network and the Aurora Energy Network, by the embedded network owner who must be certified as a reconciliation participant in accordance with the Code.
Installation	has the meaning given in section 2(1) of the Electricity Act 1992.

Livening Agent	means a registered electrical inspector who has been authorised by Aurora Energy to conduct the final connection of installations to the network.
Mains	has the meaning given in regulation 4 of the Electricity (Safety) Regulations 2010.
Metering Point	means the location within a Customer's Installation where the MEP's equipment is installed.
Network Extension	means an electricity distribution network that is owned by someone other than Aurora Energy, where consumers have ICPs allocated and managed by Aurora Energy, and the electricity traded is reconciled at the NSP for Aurora Energy at the grid exit point (GXP)
Network Supply Point	means the point at which a Secondary Network connects to the Aurora Energy network.
NZECP	means a New Zealand Electrical Code of Practice.
Point of Common Coupling	means the point in the Network, electrically nearest to the Customer, at which other Customers are or may be connected.
Point of Supply	has the meaning given in section 2(3) of the Electricity Act 1992, as modified in section 7.2.
Residential	means areas that are zoned residential in the relevant Local Authority District Plan, including rural residential.
Retailer	means an electricity retailer that has a valid Use-of-System contract with Aurora Energy.
Rural	means areas zoned rural in the relevant Local Authority District Plan.
Secondary Network	means either a Customer Network, an Embedded Network, or a Network Extension.
Te Anau Area	means that part of the Network connected to The Power Company network via the Heritage Estate network supply point.
Temporary Supply	means a temporary connection given to builders and other tradespeople for the purposes of providing electricity supply at a worksite where there are no existing electricity network supplies available.
Urban	means developed areas that are not zoned rural in the relevant Local Authority District Plan.

1.4 Acronyms

Short Form	**Long Form**
CIW	Customer Initiated Works
MCCB	means moulded case circuit breaker.
MEP	means Metering Equipment Provider.
PoS	Point(s) of Supply
VSD	Variable speed drive

1.5 Accountabilities

1.5.1 GM Regulatory & Commercial

Accountable for ensuring that this standard is maintained, and available on Aurora Energy's website.

1.5.2 Engineering Manager

Accountable for ensuring that the technical aspects of this standard are regularly reviewed and updated as needed.

1.5.3 Commercial Manager

Accountable for ensuring that the commercial aspects of this standard are regularly reviewed and updated as needed.

1.5.4 CIW Manager

Accountable for ensuring that CIW and connection processes comply with this standard.

PART A - GENERAL REQUIREMENTS

2 Connection Applications

Connection Applications and Connection Capacity Change Applications are submitted to Aurora by an Aurora-approved contractor. The Aurora-approved contractor will determine the extent of the work required to connect the customer, liaise with Aurora on technical and funding matters, and then provide a quotation to the Customer.

2.1 Connection Application

A Connection Application is required for:

- new permanent connections to the Network;
- temporary connections to the Network;
- installation of any notifiable loads as defined in Section 10.1; and
- replacement of all or part of the mains.

The purpose of the Connection Application is to collect information required by the Code, and for network billing and management purposes.

2.2 Connection Capacity Change Application

A Connection Capacity Change Application is required when:

- increasing the installation load beyond the existing assessed capacity of the connection; or
- installing a load limiting circuit breaker to obtain a low capacity connection, as detailed in Section 9.1.

The purpose of the Connection Capacity Change Application is to collect information required by the Code, and for network billing purposes.

3 Supply Availability and Supply Confirmation Letters

3.1 Supply Availability Letters

Some territorial authorities require developers, as part of their resource consent application process, to provide confirmation from Aurora Energy that a Point of Supply (PoS) can be made available to their development, to enable an electricity connection.

Generally, a PoS can be made available for any development within our supply area, provided that it is legally and technically feasible; however, there may be costs associated with establishing the PoS, and the developer may be required to make a capital contribution in accordance with our published Capital Contributions (AE-CB01-S) standard.

Supply availability letters are provided on this basis only. They do not imply that a PoS is available now, or that we will make a PoS available entirely at our cost.

Requests for supply availability letters can be made to getconnected@auroraenergy.nz

3.2 Supply Confirmation Letters

Some territorial authorities require developers to provide evidence, from Aurora Energy, that a PoS has been constructed to serve their development. This evidence is required before the territorial authority will issue a certificate of approval that complies with section 224(c) of the Resource Management Act 1991.

Supply confirmation letters will only be issued once all matters relating to the construction of the PoS have been completed. These matters include; provision of completion documentation and as-built records by the developer's chosen contractor, completion of draft land transfer (LT) plans by the developer's surveyor and checking of draft LT plans and associated easements by Aurora's solicitor. This process can take several weeks to conclude following completed installation of the electricity distribution infrastructure.

Requests for supply confirmation letters can be made to getconnected@auroraenergy.nz

4 Connection Process

Generally, new connections fall into two categories:

1. A PoS is available, and a connection may be made without requiring an easement; or
2. A PoS is not available and network additions / modifications will need to be constructed before the connection can be made, or a PoS is available, but an easement is required.

4.1 PoS Available

Where a PoS is available, the following steps apply:

1. The Customer (or Customer's electrician) initiates CIW project with an Approved Contractor;
2. The Approved Contractor will submit a connection application.
3. Aurora Energy will issue connection approval within 10 working days of acceptance of the completed connection application.
4. The Approved Contractor will liaise with the Customer (or Customer's electrician) to make the connection in accordance with this standard and engage a Livening Agent, who will inspect and test the connection, supply and install Network fuses to liven the connection, and provide us with livening information.

4.2 PoS not Available

Where a PoS is not available, the following steps apply:

1. Customer (or Customer's electrician/consultant) initiates CIW project with Approved Contractor;
2. Approved Contractor prepares design, connection application and applies for capital funding;
3. Aurora Energy approves design, connection application, and funding, and advises any conditions;
4. Approved Contractor prepares quotation, connection contract and easement agreements (as necessary) and sends to Customer.
5. Customer accepts quotation, signs connection contract and easement agreement and returns Approved Contractor.
6. Approved Contractor forwards connection contract and easement agreement to Aurora Energy.
7. Aurora Energy issues purchase order to Approved Contractor;

8. Approved Contractor builds connection;
9. Approved Contractor submits as-build documentation and advises ready for livening.
10. Aurora Energy may undertake quality assurance inspection and advises Livening Agent that the connection is ready to liven.
11. Livening Agent performs final safety checks and livens connection;

5 Capital Contributions and Easements

Customers may be required to make a capital contribution toward the cost of establishing a new PoS and will be required to grant or arrange easements in gross, in favour of Aurora Energy, over private land on which Aurora Energy assets will be placed in order to establish the PoS.

Further details are available in Aurora Energy's published Capital Contributions (AE-CB01-S) and Easements (AE-CA05-S) standards, available from www.auroraenergy.co.nz.

6 Connection and Livening

6.1 New Installations

The following conditions must be fulfilled before a connection will be livened:

- the Customer has entered into an agreement with a Retailer to purchase electricity;
- the installation complies with the Electricity (Safety) Regulations 2010; including, but not limited to:
    - the installation has been constructed in a manner that observes electrical safe distances, in accordance with regulation 17;
    - the installation has been tested in accordance with regulations 63 or 64;
    - a Certificate of Compliance has been issued in accordance with regulation 65;
    - the installation has been inspected in accordance with regulation 70;
    - an Electrical Safety Certificate has been issued in accordance with regulation 74A; and
    - documentation and records are available, in accordance with Part 5 of the regulations;
- the mains and metering have been inspected by an Aurora Energy Livening Agent, and verified as complying with the Electricity (Safety) Regulations 2010 and Aurora Energy requirements; and
- the customer has paid any capital contribution required for the establishment or upgrade of the connection.

6.2 Upgrading/Downgrading Mains

Where mains are being replaced with a high or lower capacity conductor (i.e., not a like-for-like replacement), then the requirements of section 6.1, above, apply where relevant. An Aurora Energy Livening Agent is required to verify that the mains are safe, in fulfilment of Aurora Energy's obligations under regulation 73A of the Electricity (Safety) Regulations 2010.

6.3 Replacement Mains and Associated Equipment

Maintenance and like-for-like renewal of mains and fittings associated with mains is classified as low risk prescribed electrical work and therefore not subject to inspection.

Because of its low risk designation, Aurora does not require the like-for-like renewal of mains and fittings associated with mains to be tested and inspected by a Livening Agent, prior to reconnection.

The Approved Contractor performing the replacement work must perform all necessary testing, including as prescribed in regulation 73A of the Electricity (Safety) Regulations 2010 and issue an Electrical Safety Certificate in accordance with regulation 74A.

7 Network / Installation Boundary

7.1 General

To define maintenance responsibilities and allocate capital costs, it is necessary to define the boundaries between fittings that are part of the Network, and fittings that are part of a Customer's installation. We have applied the provisions of the Electricity Act 1992 in establishing the following rules for determining the ownership boundaries of new assets.

7.2 Point(s) of Supply (PoS)

We own, and are responsible for the maintenance of, all assets between the transmission Grid Exit Point and the PoS, unless specifically agreed otherwise in writing. Figure 3 to Figure 9 shows the PoS for a range of supply configurations.

Unless specifically agreed otherwise in writing, we own, and are responsible for the maintenance of, the following fittings irrespective of who owns the property they are located on:

- incoming high voltage switchgear, where the Customer elects to take supply at high voltage;
- high voltage substation equipment and high voltage lines and cables, unless this equipment is owned by a Customer that takes supply at high voltage; and
- the low voltage mains protection device; i.e., service fuse-holder and fuse link, or moulded case circuit breaker.

All low voltage distribution on private property that is for the exclusive use of the owner or occupier of that property shall be owned and maintained by the property owner.

Low voltage distribution equipment on a private property that supplies multiple properties will be owned by Aurora Energy and easements in favour of Aurora Energy will be required over this equipment.

When supply to a Customer's property crosses a neighbour's property, the Customer is required to arrange an easement in favour of Aurora Energy, over the neighbour's property.

Low voltage distribution on a private property that supplies multiple Customers on the property (e.g., a unit title development) will generally not be owned by Aurora Energy, but Aurora Energy may take ownership if the low voltage distribution is installed in a right of way and easements in favour of Aurora Energy are created.

7.2.1 Unit Title to Freehold Subdivisions

Where a unit titled development with existing electricity supplies is further subdivided, the PoS to individual dwellings generally changes, and assets that were previously the Customer's maintenance responsibility become Aurora Energy's responsibility. This has the potential to shift the Customer's maintenance costs to the general consumer base that funds Aurora Energy's activities.

Under these circumstances, Aurora Energy offers the subdivider two options:

1. reconfigure the supply to individual dwellings affected by the subdivision so that the mains supplying each property are completely contained within that property; or
2. grant Aurora Energy an easement in gross over that portion of the mains from the existing connection point (old PoS) to the new PoS. This will require the Customer to:

- provide a Certificate of Compliance that confirms the lawfulness and safety of the cable, or if a Certificate of Compliance is not available, an assessment from an approved Aurora Energy contractor that the cable can be accepted without causing any issues for the network;
- provide calculations, for verification by Aurora Energy, confirming that accepting the cable will not result in voltage drop issues;
- undertake a cable location to confirm the position of the cable and to inform the required easement area;

The terms of the easement will require, if underground mains require replacement, the costs of trenching and reinstatement will be borne by the Customer.

All costs associated with the above including Aurora Energy's reasonable legal fees will be met by the customer.

Unless either of the above options is selected, Aurora Energy will be unable to provide the subdivider/developer with a supply confirmation letter (refer s3.2).

7.2.2 Street Lighting Connections – Underground Supply Areas

The point of supply is the supply side of the LV fuse installed in the base of each column. All equipment downstream of the point of supply, including the LV fuses, associated luminaires and columns is generally owned by the local / roading authority, but may be owned by another party. Refer to the Network Connections for Controlled Lighting (AE-CC03-S) standard.

7.2.3 Street Lighting Connections – Overhead Supply Areas

The point of supply is the connection of the lead from the luminaire to the controlled lighting circuit and neutral conductor. The luminaires and associated fittings are generally owned by the local / roading authority but may be owned by another party. The pole is often owned by Aurora but may be owned by another party.

7.3 Ownership of Customer Substation Civil Works

For substations on a Customer's property, the transformers, standard concrete pads, associated switchgear and earthing facilities are part of the Network. Specialist foundations, buildings or other weather and physical protective facilities are owned by the Customer.

Specific details of the requirements relating to substations on Customer property are contained in Substations in Customer Buildings Requirements (AE-NR03-T02) technical specification.

7.4 Easements

Aurora Energy requires a registered easement over private property that is occupied by fittings that form part of the Network. Easements provide Aurora Energy with access rights for maintenance or replacement of the fittings, and place certain restrictions on the property owner to safeguard the fittings; e.g., limiting erection of buildings or planting of trees close to the fittings. Easements also afford the landowner legal protection with respect to property damage caused by Aurora or its contractors. Further information is available in the Easements (AE-CA05-S) standard.

7.5 Electrical Safe Distances

Customers are responsible for ensuring that their structures (houses, sheds, building extensions, decks, etc.) maintain a safe distance for electricity network infrastructure. Safe distances are specific in the New Zealand Electrical Code of Practice 34 (NZECP34): Electrical Safety Distances, available for download free of charge from WorkSafe's website (www.worksafe.govt.nz).

Experience has shown that there is a common misconception among Customers that, having obtained a resource consent or a building consent, they consider their obligations regarding the electrical safe distances specified in NZECP34 have been externally verified and met. This is incorrect, since neither the Resource Management Act 1991 nor the Building Act 2004 consider electrical safe distances.

Aurora Energy will not liven the connection to any new installation that does not comply with NZECP34. Aurora Energy will also not fund any modifications to its infrastructure that may be required as a result of a Customer having breached the requirements of NZECP34.

Customers that are intending to build near network assets, should seek advice from Aurora Energy prior to obtaining resource consent, to ensure that their proposed development will not conflict with NZECP34 requirements. Such requests should be sent to getconnected@auroraenergy.nz.

PART B – TECHNICAL REQUIREMENTS

8 Network Connections

The type of Network connection provided for a Customer will be dependent upon the connection capacity required, the position of the Customer's main switchboard, and the location and nature of the Customer's property.

All connections, and network extensions required to provide connections, shall be designed to minimise the extent to which Aurora Energy assets will be placed on private property.

8.1 Low Voltage Connections

Low voltage connections are generally made by connecting Customers mains to the low voltage distribution system, or by connection to the low voltage side of a transformer.

The requirement for a transformer depends upon the connection capacity required, the available capacity of existing low voltage distribution circuits near the installation, and the distance from the Customer's property boundary to the Customer's main switchboard. Each connection application will be considered individually, and the most appropriate connection method chosen. Guidance on the connection capacities usually available is given below.

8.1.1 Urban Areas

The maximum capacity for an installation will often depend upon the capacity of the low voltage Network in the vicinity; however, connection capacities of up to 3 phase 100 amps will generally be available from the low voltage distribution system. Connection capacities of between 100 and 400 amps may require the installation of a transformer; however, some locations may support connections of up to 400 amps directly onto the low voltage distribution system. Connection capacities greater than 400 amps (>276kVA) will require the installation of a transformer.

8.1.2 Rural Areas

In many rural areas, the high voltage distribution is 2-wire, and only single-phase supply is available. In those areas, the largest connection capacity available, without upgrading the high voltage distribution to 3-phase, is 50kVA single phase.

Where a Customer requires a new supply located further than 150 metres from an existing transformer, a new, closer, transformer may be required. Preferably this transformer would be located within the legal road, with the Customer taking supply via low voltage Mains. In situations where the Customer's main switchboard is further than 150 metres from a high voltage line in the road reserve, the most economical solution is usually the installation of a high voltage line across the Customer's property to a transformer close to the main switchboard.

8.1.3 Temporary Supplies

A Temporary Supply shall be treated as being a Customer installation and must be located on property owned by the Customer.

Temporary supplies shall be allocated an ICP and may be metered or unmetered according to the requirements of the responsible retailer.

The connection between the temporary supply switchboard / meter box and the distribution system shall be by means of Customer/contractor owned mains in order to provide a clear demarcation between Aurora Energy's networks and the Customer's installation.

Temporary supply switchboards / meter boxes shall be completely self-supported and shall not, under any circumstances, be fixed to Aurora Energy's assets. This includes, but is not limited to, Aurora Energy's distribution service pillars, cabinets, transformers and poles.

Sites where multiple temporary low voltage supplies are needed require separate ICP's to be established.

8.2 Secondary Network Connections & High Voltage Customers

Customers may elect to establish a high voltage Secondary Network, where the Customer owns all assets downstream of the Network Supply Point. This is generally only economic for capacities greater than 1,000 kVA, or when the Customer has a special need for high voltage.

Aurora Energy distributes high voltage electricity at 11,000 and 6,600 volts - the voltage used will be the voltage available in the area. It should be noted that Aurora Energy has long-term plans to migrate its distribution from 6,600 volts to 11,000 volts and recommends that high voltage customers install dual ratio transformers in areas with 6,600 volt supply.

High voltage Secondary Networks have specific requirements, which are detailed in Section 15.

9 Standard Connection Capacities

Aurora Energy's line charges are based on the assessed capacity of the connection. The standard connection capacities for connections up to 276kVA are generally determined by the size of service fuse used to protect the Customer's Mains. The installed standard distribution transformer size will generally be used to determine the assessed capacity for connections greater than, or equal to, 300kVA. The maximum transformer size installed on the network is limited to 1,000kVA. Where capacity greater than 1,000kVA is required, multiple transformers will be required.

Standard connection capacities are shown in Table 1 below:

Fuse Size	Notes	1 Phase	2 Phase	3 Phase
63A	5A MCCB	1kVA**		
63A	20A MCCB			≤ 15kVA*
63A	35A MCCB	≤ 8kVA*		≤ 24kVA*
63A		≤ 15kVA	≤ 28kVA	≤ 41kVA
100A		≤ 23kVA		≤ 69kVA
150A				≤ 103kVA
200A				≤ 138kVA
250A				≤ 173kVA
300A				≤ 207kVA
400A				≤ 276kVA

* Reduced capacity connection with load limiting circuit breaker – refer section 9.1

** Unmetered connection – refer section 9.2.

Table 1 - Standard Connection Capacities

It should be noted that the assessed capacities of connections do not represent a guaranteed service level. There may be instances, especially during periods of high network loading, where the full assessed capacity is not available. This is particularly true for residential connections, where the distribution network is generally designed using an after diversity maximum demand that is much lower than the assessed capacity[1].

9.1 Low Capacity Connections

The lowest available connection capacity is usually 15kVA single phase (determined by a 63-amp service fuse). Special low capacity connections of 8kVA (32A) single phase, 15kVA (20A) three phase, or 24kVA (32A) three phase can be made if the Customer installs, at their cost, a load-limiting circuit breaker upstream of the Installation metering. The circuit breaker shall automatically disconnect the supply of electricity should the rated connection current be exceeded. The load-limiting circuit breaker shall have provision to be sealed and be of the 6kA 'C' curve type with tripping 5-10 times the rated current.

9.2 Unmetered Connections

Small capacity fixed loads such as telephone box supplies may be, but do not require to be, metered. To qualify as an unmetered supply, the following conditions must be observed:

- In any rolling 12-month period the load may no be greater than 3,000kWh (or 6,000kWh if the load is predictable load of a type approved and published by the Electricity Authority); and
- The Customer's electricity retailer offers and unmetered product.

For the avoidance of doubt, electricity retailers are responsible for metering, and will make the final decision whether an installation is to be metered or not. Customers seeking an unmetered supply need to have confirmed acceptance with their electricity retailer before submitting a connection application.

A low-voltage, single-phase, 15kVA builders temporary supply connection may be unmetered, subject to the following additional conditions:

- the purpose of the temporary supply must be for a builder's temporary supply only;
- all power outlets are to be supplied from RCD devices (residual current protection); and
- if the connection is still required after 6 months, a re-inspection fee will apply, and for every subsequent 6 months.

9.3 Connection Overloads

For Customers supplied via low voltage fuse or MCCB protection, the connection capacity is determined by the protection rating. If the Customer's load exceeds the protection rating, protection operation can result.

For Customers supplied at low voltage, via direct connection to the low voltage terminals of a transformer (refer Section 15.2), the connection capacity of the connection is the transformer rating. Transformers have some overload capacity, and Customers are permitted to utilise this, subject to the transformer loading not exceeding 120% of its rating and the overload being of a temporary nature unlikely to shorten the useful life of the transformer. The Customer's incoming circuit breaker overcurrent protection shall be set to operate at, or less than, this value. The Customer's mains and main switch must be rated to carry the overload. The loading on the transformer shall not exceed the appropriate values for normal cyclic loading defined in IEC 60354 Loading Guide for Oil-Immersed Transformers.

[1] After diversity maximum demand (ADMD) is the simultaneous maximum electrical demand (kVA) of a group of Customers, divided by the number of Customers. ADMD allows the electrical network to be planned and constructed to service existing connections, as well as making reasonable provision for future connections and load growth. Use of ADMD allows network to be built economically, and at much lower costs than if the maximum demand of each individual connection was considered. Accordingly, use of ADMD in the design process limits the network costs that must be recovered from Customers in the form of line charges.

9.4 Multiple Connections

If the Customer has more than one ICP associated with the same property, the Customer shall not parallel those connections, or provide any facilities to parallel the connections. This is to avoid the possibility of back feeds creating hazards on the Network.

In all cases, each ICP must be able to be separately de-energised from the Network without affecting the electricity supply to any other ICP's present upon the same property.

10 Customer Loads

10.1 Notifiable Loads

The following work has special requirements and must be specifically notified:

- Installing appliances subject to load control;
- Installing charging facilities for plugin electric vehicles;
- Installing electric motors with capacities greater than the exempt ratings specified in Section 12.2, below. This includes appliances with motors, such as heat pumps and refrigeration units;
- Installing an appliance that may affect the quality of supply to other Customers by the introduction of harmonics, or by causing voltage fluctuations;
- Installation of an individual load that exceeds 40% of the installation's connection capacity (6kW for a 15kVA connection);
- Installation of capacitors that result in the total capacitive load of an installation exceeding 100 kVAr;
- Installation of generators, including photo-voltaic panels and/or batteries – refer to Section 16.

10.2 Motor Starting

The starting of electric motors can cause severe voltage dips on the Network, resulting in irritation to other Customers. In addition to complying with starting requirements, running motors with fluctuating loads shall not cause excessive voltage fluctuation – refer to section 10.5.

10.2.1 Exempt Motor Sizes

AC motors, up to and including the ratings shown in Table 2 below, are not subject to starting current limits and may be installed with direct-on-line starting without specific permission to connect.

	Rural	Urban	
		Residential	Non-Residential
Single Phase (Not Exceeding)	0.75 kW	1.5 kW	2.2 kW
Three Phase (Not Exceeding)	4.0 kW	4.0 kW	7.5 kW

Table 2 - Schedule of Exempt Motor Sizes

10.2.2 Non-exempt Motor Sizes

All a.c. motors above the ratings specified in Table 2 shall be approved by Aurora Energy prior to connection. The criteria used for approval is that the relative voltage changes on motor start-up shall not exceed the values in Table 3, below:

Frequency of Starting	At Point of Common Coupling	At Zone Substation HV Bus
More than 10 starts per hour.	1%	0.5%
More than 3 starts per day, but not more than 10 starts per hour.	3%	1.0%
Not more than 3 starts per day, including not more than 1 start between the hours of 5 pm and 11 pm on any day.	6%	1.5%
Emergency equipment started infrequently (e.g., fire pumps).	12%	2.0%

Table 3 - Schedule of maximum allowable voltage change during motor starting

In Installations where several large motors start automatically, the effect of these motors starting simultaneously when supply is restored after a service interruption needs to be considered. Unless delayed starting is installed to Aurora Energy's satisfaction, the relative voltage change will be assessed based on all motors on automatic control starting simultaneously.

10.3 Load Power Factor

The true power factor of a Customer's Installation, measured at the metering point, shall not be less than 0.95 lagging. For the purposes of this standard, power factor is defined as true power factor (kW/kVA), not displacement power factor (cosθ). Installations shall not operate with unreasonably low leading Power Factor when operating at reduced load. At reduced load, high levels of leading VAr can result in supply resonances amplifying harmonic currents and voltages.

10.4 Voltage

The Network will be designed and operated to maintain the Customer's voltage within the limits prescribed by Regulation 28 of the Electricity (Safety) Regulations 2010. The limit for standard low voltage is 230 volts ± 6% when measured at the Point of Supply.

10.5 Voltage Fluctuations

Some electric appliances, such as motors with fluctuating loads and welders, can cause voltage fluctuations in the Network, resulting in annoyance to other Customers. Customer's fittings and appliances shall comply with Regulation 31 of the Electricity (Safety) Regulations 2010, and specifically, shall not cause voltage fluctuations, at the Point of Supply, in excess of the compatibility limits specified in AS/NZS 61000.3.11: 2002.

10.6 Harmonic Disturbances

Customers' fittings and appliances shall comply with Regulation 31 of the Electricity (Safety) Regulations 2010 and, specifically, shall not inject into the Network any harmonic distortions that exceed the levels specified in NZECP36:1993 - New Zealand Electrical Code of Practice for Harmonic Levels. Harmonics are particularly prevalent in variable speed motor drives.

Installation of harmonic mitigating devices in conjunction with VSDs must be planned so that Aurora can properly evaluate harmonic compliance. On request from Aurora, harmonic performance of the equipment rated at 20kW or greater shall be demonstrated to show that it meets the appropriate compliance limit. Aurora will fund re-tests in instances where abnormal Network conditions have interfered with the original test.

The maximum allowable Total Voltage Distortion due to harmonics is 5.0% when measured at the Point of Common Connection with no individual harmonic to exceed 3.0%.

The maximum allowable current distortion limits from harmonics are defined in the table below. By limiting the harmonic injection from individual harmonic loads, unacceptable voltage distortions at the PCC can be controlled effectively for normal system characteristics. This also means that other sensitive equipment connected in the vicinity will operate free from the effects of harmonic distortion.

Current distortions that result in a dc offset, e.g. half-wave converters, are not allowed.

Individual limits are assessed based on the ratio of full load current to distribution transformer capacity (L/Tx).

L/Tx	h<11	11≤h<17	17≤h<23	23≤h<35	35≤h	Total
>0.8*	4.0%	2.0%	1.5%	0.6%	0.3%	**5.0%**
0.5-0.8	7.0%	3.5%	2.5%	1.0%	0.5%	**8.0%**
0.2-0.5	10.0%	4.5%	4.0%	1.5%	0.7%	**12.0%**
0.1-0.2	12.0%	5.5%	5.0%	2.0%	1.0%	**15.0%**
<0.1	15.0%	7.0%	6.0%	2.5%	1.4%	**20.0%**

Table 3 – Maximum Current Harmonic Levels

Notes:

*All power generation equipment is limited to these values of current distortion, regardless of the actual ratio.

In the Dunedin area, the 1050Hz ripple[2] frequency corresponds to the 21st harmonic. In addition to the requirements of NZECP36, Customers' appliances shall not cause 1050Hz voltages in excess of 0.7% at the Point of Supply. Care needs to be taken with regard to appliances utilising solid state inverters.

10.7 Capacitors

Capacitors are generally installed in Customers' installations to provide power factor correction, either as part of a power factor correction unit or associated with individual appliances such as motors or fluorescent light fittings. They can absorb ripple control signals, resulting in insufficient signal strength to operate the Customer's and adjacent Customers' ripple control relays.

The excessive absorption of ripple control signals by capacitors shall be prevented by the installation of suitably rated blocking chokes on the network side of individual capacitors or groups of appliances containing capacitors.

Aurora Energy operates a 317Hz ripple injection system in the Central Otago area. Generally, the installation of small power factor correction capacitors has little effect at this frequency, and capacitor banks of up to 100kVAr may be installed without specific permission. For the installation of capacitor banks above 100kVAr in the Central Otago area, specific permission shall be obtained. Aurora Energy's Asset Management and Planning group will determine, in each case, if measures to prevent any problems are required. The design, installation and operation of these measures shall be the responsibility of the Customer.

In the Dunedin area, Aurora Energy operates a 1050Hz ripple injection system, and absorption of the ripple signal can be reduced by the installation of 1050Hz blocking chokes on the Network side of individual capacitors, or groups of appliances containing capacitors. Customers are permitted to install unblocked capacitor capacity (kVAr) up to 2% of connection kVA capacity. For 3 phase connections, the maximum kVAr, per phase is 1/3 the total kVAr allowed. For capacitive loads exceeding this in the Dunedin area, specific permission to connect shall be obtained. Aurora Energy's Asset Management and Planning group will determine if 1050Hz blocking is required in each case. The Customer is responsible for the provision and correct operation of the blocking chokes.

[2] Note that Aurora Energy is progressively decommissioning its 1050Hz ripple injection system.

Although a 317Hz ripple injection system is being introduced in Dunedin, the prevalence of installations with 1050Hz signalling equipment means that the Dunedin requirements, stated above, will be maintained for some time.

Customers installing fluorescent lighting loads are advised to use fittings with lead-lag ballasts, which will provide power factor correction without the risk of ripple signal absorption. Electronic fluorescent lighting ballasts do not require capacitors for power factor correction, and do not absorb ripple control signals.

10.8 Load Control

The facility to switch off certain loads at peak times allows Aurora to reduce costs associated with peak loads, including Transpower charges. Customers with controlled loads pay lower annual line charges, via retailer tariffs, in consideration of the controlled load being switched off during peak times.

It is recommended that the following appliances be controlled:

- Residential charging facilities for plug-in electric vehicles. These could be supplied from an 8-hour controlled circuit (service hours between 10pm and 7am).
- Residential storage water heaters above 135 litres.
- Storage space heaters and underfloor heating.
- Electric kilns.
- Spa and swimming pools.
- Irrigation pumps.

Modern load control relays can directly switch resistive loads up to 9kW. Older relays are limited to 6kW, and in some cases 4.7kW. Loads in excess of these values will require a contactor which shall be supplied and installed at the Customer's cost.

Customers must not employ devices that defeat the load control system by switching the controlled load to uncontrolled circuits when, by contractual terms agreed with their electricity retailer, those loads should be off.

Customers may install water heaters that contain a quick recovery system (a separate top element). The quick recovery element must be connected to an uncontrolled circuit and configured so that it provides a maximum "one-shot" boost duration of one hour, initiated via a manual switch / push-button.

Note: Subject to changes in Aurora Energy's Pricing Methodology, if a Customer requires a 2 phase 63 amp (28kVA), or 3 phase 35 amp (24kVA), or one phase 100 amp (23kVA) supply to service off peak controllable load, and the capacity above 15kVA is solely required to service off-peak load, then for the purposes of line charges, the connection will be assessed at 15 kVA.

11 Low Voltage Mains

11.1 Mains and Circuit Sizing

The correct sizing of mains and sub-circuits is the Customer's responsibility and shall be in accordance with AS/NZS3000:2018.

It is recommended that all mains neutral conductors be the same size as the phase conductors. This will reduce the chance of neutral conductor overloads due to imbalanced loads and harmonics.

11.2 Cost Responsibility

The cost responsibility for installing and connecting low voltage mains to the Aurora Energy Network is defined in the Capital Contributions standard (AE-CB01-S).

11.3 Low Voltage Mains in Underground Areas

Low voltage mains in areas with underground low voltage distribution will be connected via a low voltage service pillar. Service pillars are available in 100, 200 and 400-amp capacities, and are normally located on the street side of the Customer's property boundary. In residential areas, service pillars are generally placed on the street frontage at the junction of two property boundaries, allowing the pillar to serve two Customers.

Due to physical limitations, service pillars are generally not suitable for the termination of steel wire armoured or paper insulated lead sheathed mains cable.

11.3.1 Service Pillar Terminations

The termination of low voltage mains into service pillars must be undertaken by an Approved Contractor. Customers shall ensure that their mains cable is installed to the service pillar position with enough length to facilitate termination. Copper and aluminium cables can be used for underground mains, but for 63-amp and 100-amp connections, aluminium cable cores will need to be terminated with copper tails via Al/Cu transition joints. The maximum cable sizes for 63-amp and 100-amp connections are 35mm^2 and 50mm^2 respectively. If the mains exceed these sizes, then reduced size tails are required.

11.4 Low Voltage Underground Mains in an Overhead Area

In areas where the low voltage distribution is overhead, Customer mains can be connected directly to pole-top fuses provided that the connection capacity is less than 150-amps, and the conditions in Section 11.4.2 are complied with. In all other cases a boundary service pillar is required for the termination of the Customer's mains. This service pillar is then connected to the overhead network. See Figure 2 for a diagram of the two connection options.

11.4.1 Aerial Low Voltage Mains

For new connections, Aurora Energy no longer offers connection by aerial mains.

Alteration of existing low voltage aerial service mains may be controlled or prohibited by the relevant Local Authority's By-Laws and/or District Plan.

Where permitted, renewed aerial mains shall be copper neutral-screened cable with a minimum cross-sectional area of 16 mm^2. The Customer is responsible for providing supports for conductor insulators and terminations on the property. The mains shall be installed in accordance with AS/NZS3000:2007, Regulation 17 of the Electricity (Safety) Regulations 2010, and NZECP34 (Electrical Safety Distances.

The current carrying capacity of low voltage aerial mains shall be limited to 160A, being the maximum standard fuse link size carried in approved pole top fuse-holders.

11.4.2 Pole-top Supply

This involves connection of the Customer's underground mains directly to pole-top fuses, subject to the following conditions:

- A suitable pole must be available on the same side of the street as the Customer, located within two metres of the Customer's lateral boundary, and within 5 metres of the general property frontage (Figure 2).
- The physical circumstances, such as ground levels and footpath conditions, must be suitable for the installation of an underground cable.

- All mains cables shall be copper neutral screened. Steel wire armoured cable is not acceptable. The maximum conductor size is 95mm^2.
- The cable in the road reserve shall be laid parallel, or at right angles, to the street and the cable shall cross the Customer's property boundary at a location that results in the minimum trenching in the road reserve. The Customer shall provide the cable from the property boundary to the pole top connection. The total cable length shall allow for the cabling in the road reserve, and for 9m of cable up the pole, and shall be left coiled at the boundary for installation by the Approved Contractor.
- The cable shall be mechanically protected to 2.5m above ground level, and the protection shall continue 200mm below ground level. Where electrical conduit is used as mechanical protection, grey or black high impact conduit shall be used with galvanised steel saddles and stainless-steel screws. The conduit and fixings shall be supplied by the Customer.

11.5 Supply via Unmetered Sub-circuit

When electricity is distributed through a building complex, such as a shopping mall, high-rise apartments, or an office block, different occupiers of the building often require a separately metered supply of electricity. This is achieved using unmetered circuits such as rising mains, ring mains, and sub-mains supplied from the installation main switchboard.

In order to limit kWh losses, the maximum voltage drop in unmetered circuits between the point of supply and the metering point shall not exceed 2.5%.

Each occupier has a separately metered "network connection" onto an unmetered sub-circuit. These unmetered sub-circuits are not part of Aurora Energy's Network, but Aurora Energy will supply the fuses for the connection of individual Customers to an unmetered sub-circuit. The installation of these fuses is the responsibility of the complex owner. The fuses will remain part of the Network and will be sealed by Aurora Energy's Livening Agent. The fuses shall always be accessible for Aurora Energy and the Customer's Retailer. Figure 15, on page 36, shows a typical unmetered sub-circuit configuration.

12 Fault Level Considerations

The short circuit rating of Customers' equipment should be not less than the design fault level of the Network to which it is connected. The choice of equipment for connection at low voltage may consider attenuation in the mains.

Aurora Energy's 11kV and 6.6kV Networks are designed for a maximum short circuit level of 250MVA - 13kA at 11kV and 22kA at 6.6kV. Customers taking supply at 11kV or 6.6kV shall design their installations for a 250MVA prospective short circuit level for a duration of 1 second.

For Customers supplied from the low voltage Network in residential areas, the prospective short circuit levels at the Customer's main switchboard will typically be less than 6kA. For Customers supplied from a dedicated transformer, the maximum prospective short circuit levels at the low voltage terminals of the transformer will be in accordance with Table 4, below.

For the purposes of designing installations, Customers should use the figures provided in Table 4 or, on request, a maximum prospective short circuit current can be provided for their point of supply.

Transformer Size (kVA 3-Phase)	*Maximum Prospective Short Circuit Current (kA)*
15	*1*
30	*1.5*
50	*2*
100	*4*
200	*6.5*
300	*9.5*
400	*11*
500	*15*
750	*22*
1,000	*28*

NB: For sizes not included, use the short circuit current of the next largest transformer shown.

Table 4 - Maximum Short Circuit Currents at Distribution Transformer LV Terminals (6.6kV & 11kV)

12.1 Customer Contribution to Fault Levels

Design of the Network will consider the contribution to fault level by Customers' apparatus, such as large motor loads.

13 Electrical Protection

Regulation 32(1) of the Electricity (Safety) Regulations 2010 requires that every person supplying a line function service to any Customer shall provide to that Customer a service protective device of appropriate rating to provide protection against short circuits or earth faults on mains, while AS/NZS3000:2007 requires that the maximum current in a cable must not exceed the current rating of the conductor.

13.1 Protection of Low Voltage Mains Connected to Low Voltage Distribution

Mains will be protected by HRC fuses housed in service pillars or mounted at pole-top. The minimum capacity fuse available is 63-amps, and the maximum 400-amps. Customers shall ensure that the rating of their mains and main switchboard is greater than, or equal to, the service fuse rating. At existing installations that have mains rated less than 63-amps, the Customer shall either provide appropriate protection or upgrade the mains before any additional load is connected.

Connections to installations requiring a capacity less than 63-amps will be protected by 63-amp HRC fuses and should be sized accordingly.

The protection of unmetered sub-circuits is the responsibility of the sub-circuit owner.

13.2 Protection of LV Mains from a Transformer

For connection capacities up to 276kVA (400A), mains protection will be provided by low voltage HRC fuses or a MCCB mounted adjacent to the transformer.

Customers are required to provide low voltage mains overload protection. To ensure the transformer high voltage fuses can detect phase-to-earth faults at the Customer's main switchboard, the mains shall be sized to carry the rated current of the transformer and be no longer than 20 metres. Distances longer than 20 metres will be subject to approval by Aurora Energy's Asset Management and Planning group.

When a Customer is supplied from a transformer that is primarily for that Customer's use, but also has an interconnection with the low voltage Network, the Customer's mains will be protected by HRC fuses for connection capacities up to 400-amps, and by a MCCB for connection capacities between 400 and 800-amps.

Where supply is via paralleled transformers, inter-tripping from the high voltage fuse switch to the low voltage incoming circuit breakers is required, to ensure faults on the transformer high voltage windings are not back-fed via the low voltage bus.

13.3 Protection of High Voltage Mains

The Customer's protection must be designed to discriminate with the Network protection, such that faults within the Customer's installation beyond the Customer's incoming circuit breaker or fuse switch will not normally result in tripping of a zone substation feeder circuit breaker.

13.4 Protection against Unbalanced Voltage

It is possible for one or two fuses of a 3-phase set protecting mains or a transformer to operate, resulting in Customers receiving an unbalanced or reduced voltage supply. If a Customer has equipment that is vulnerable to damage by unbalanced or reduced voltage, they are advised to install their own protection that will automatically disconnect the appropriate equipment. Aurora Energy will not accept responsibility for any damage to a Customer’s equipment caused by unbalanced voltage resulting from the operation of a protection device.

13.5 Protection of Sensitive Equipment

Circumstances or events beyond Aurora Energy’s control may cause unplanned service interruptions or transient voltages (these are momentary fluctuation in voltage and sometimes referred to as ‘surges’ or ‘spikes’), potentially damaging equipment or appliances. These events include motor vehicle incidents damaging network equipment, lightning strikes and storm damage.

Customers with sensitive equipment or appliances that may be affected by an unplanned service interruption or transient voltage, which may include computers, televisions, phones, computerised appliances and whiteware, should consider appropriate protection. Normally, this is achieved by installing back-up devices or surge protectors, which can be plugged into appliances or wired into the installation mains. Customers are also advised to arrange insurance that covers damage from transient voltages.

Aurora Energy will not accept liability for any damage or loss suffered by a Customer as a result of momentary fluctuations in voltage or frequency of the electricity supply.

14 Metering

Customers shall provide appropriate space within their premises to accommodate metering equipment. Metering equipment requirements will be defined by the Customer’s electricity retailer (or the electricity retailer’s metering equipment provider).

Where the Customer’s connection capacity is greater than 149kVA but not half-hourly metered, the Customer shall ensure that enough room is available in the meter enclosure for an additional meter to measure control period demand.

15 Secondary Networks and High Voltage Customers

The owner of a Secondary Network is responsible for the maintenance and safe operation of the Secondary Network, along with compliance with the Electricity Act 1992, Electricity (Safety)

Regulations 2010, and where applicable, the Code. For a new Secondary Network connection, the owner will be required, as a condition of connection, to provide details of how they intend to manage their compliance obligations.

Electricity Authority publication "Guidelines for Metering, Reconciliation and Registry Arrangements for Secondary Networks", available from the Authority's website (www.ea.govt.nz), explains the various characteristics of Secondary Networks, along with the obligations imposed on Secondary Network owners.

Aurora Energy will not assume responsibility for the registry management of ICPs connected to a Secondary Network and will therefore not connect any Secondary Network that is intended to be a Network Extension.

Typical configurations for high voltage Secondary Network connections are indicated in Figure 15 to Figure 19. Supply will be via an incoming isolation device such as a circuit breaker, isolator, or fuse-switch supplied and maintained by Aurora Energy, but the Customer shall provide suitable accommodation for this equipment.

High voltage metering units incorporating current transformers and voltage transformers will generally be required for all high voltage Secondary Network connections. The metering unit shall be installed no further than 5m from the network supply point (the demarcation between the local and secondary networks). All costs associated with metering the connection will be the responsibility of the high voltage Secondary Network owner.

When supply is required from paralleled high voltage feeders to meet loading or security requirements, special protection facilities will be required.

Owners of works (who may be high voltage Customers) with a distribution capacity of 10MVA or greater must implement a safety management system, in compliance with Regulations 47 to 56 of the Electricity (Safety) Regulations 2010, and have the safety management system audited. Owners of works (who may be HV Customers) with an installed distribution capacity of less than 10MVA must ensure they have inspection, maintenance and record-keeping practices in place that comply with Regulations 40 to 46 of the Electricity Safety Regulations 2010; however, they may voluntarily implement an audited safety management system as an alternative.

Customers wishing to connect to the Aurora Energy network and take supply at high voltage will be required to:

- furnish a copy of the Certified Design for the high voltage installation;
- furnish a copy of a properly completed Certificate of Compliance covering the high voltage installation;
- furnish a copy of the record of testing in accordance with regulations 38 and 64 of the Electricity (Safety) Regulations 2010;
- furnish a copy of the record of inspection in accordance with regulation 72 of the Electricity (Safety) Regulations 2010; and
- furnish evidence that the owner of the high voltage installation has either an audited safety management system in accordance with regulations 47 to 56 of the Electricity (Safety) Regulations 2010, or has a management system in place that satisfies the requirements of regulations 40 to 46 of the Electricity (Safety) Regulations 2010

High voltage Secondary Network connections may be metered at low voltage where the following conditions are met:

- The high voltage Secondary Network is a Customer Network as defined by the Electricity Authority's "Guidelines for Metering, Reconciliation and Registry Arrangements for Secondary Networks";
- No more than one transformer is connected to the Customer Network; and
- The low voltage metering point is immediately adjacent to the transformer and has a meter which measures in half-hourly intervals.

The low voltage fuses will be owned by Aurora Energy and the connection capacity will be based on the low voltage fuse size or transformer capacity, as outlined in section 9.

Where any of the above conditions change for an LV metered HV Secondary Network connection, the Secondary Network owner will be required, at their cost, to establish HV metering as close as practicable to the Network Supply Point.

16 Distributed Generation

Distributed generation requirements are defined in Aurora Energy's:

- Guide to Small Scale Distributed Generation (AE-CC01-G01)
- Guide to Large Scale Distributed Generation (AE-CC01-G02)
- Distributed Generation Technical Standard (NS5.3 legacy policy)

These documents are available on the 'Generating Your Own Electricity" page of the Aurora Energy website (www.auroraenergy.co.nz), along with the associated application forms.

17 Costs for Establishing Network Connections

17.1 Cost Responsibilities

All costs associated with the Customer's installation are the responsibility of the Customer. In order to establish a Network connection, Aurora Energy may need to carry out additions or alterations to its Network, and Customers may be required to contribute towards the cost of this work, in accordance with Aurora Energy's Capital Contributions (AE-CB01-S) standard (available from www.auroraenergy.co.nz).

When there is a choice of connection method, the method resulting in the lowest cost to Aurora Energy shall be used; however, if a Customer requires a connection method other than the method resulting in the lowest cost to Aurora Energy, the Customer shall make an additional contribution equal to the difference in cost between the selected method and the lowest cost method.

17.2 Enhanced Supply

When a Customer requires a supply with enhanced electrical characteristics or enhanced reliability beyond that which would normally be provided, then the Customer shall meet the additional costs incurred by Aurora Energy in providing facilities to satisfy those requirements.

17.3 Cost-sharing on Joint-use Customer Substations

Any Customer requesting new or increased supply has the choice of paying for supply based on a distribution substation located on their property, or elsewhere. Subject to the availability of practical alternatives, it is not compulsory that Customers provide space on their property – the alternative may simply be more expensive for them.

- Where Aurora Energy prefers (for reason of lower cost) a substation located on the Customer's property, and the Customer prefers to pay the higher cost of one located elsewhere, then Aurora Energy will charge the Customer based on the minimum configuration necessary to supply the Customer's load from the remote site, being a single feed regardless of load. The Customer may choose to pay for a more reliable configuration, but the additional cost will be fully charged.
- Where Aurora Energy prefers a substation located on the Customer's property and the Customer agrees but rejects a low voltage intertie, then Aurora Energy will charge the Customer based on the minimum configuration necessary to supply their load, being a fused-tee high

voltage supply. The Customer may choose to pay for a more reliable configuration, but the additional cost will be fully charged.

- Where Aurora Energy prefers a substation located on the Customer's property and the Customer agrees to this and to a low voltage intertie, then Aurora Energy will charge the Customer pro-rata, based on kVA, for a ring-main unit high voltage supply. The Customer will then get the benefit of more reliable supply at both high and low voltage and pay a lower cost for providing a useful site to Aurora Energy.

17.4 Temporary Supply

All costs associated with the provision and removal of a temporary connection shall be met by the Customer.

18 Substations on Customer's Property

The standard transformer capacities available are single-phase 15, 30 and 50kVA, and three-phase 30, 50, 75, 100, 150, 200, 300, 500, 750, and 1,000kVA. Customers requiring capacities in excess of 1,000kVA will require more than one transformer. When a Customer is supplied by more than one transformer, the low voltage connections from the transformers shall not be paralleled unless the inter-tripping facilities detailed in section 13.2 are installed.

When it is necessary to install a substation on a Customer's property, the Customer shall make available suitable space to accommodate the transformer, high voltage cable or lines and associated switchgear, and provide easements as required.

The common connection configurations for substations on a Customer's property are depicted in Figure 10 to Figure 15. High voltage circuits across the Customer's property can be either underground cable or overhead line.

All substations and high voltage circuits on the Customer's property shall be constructed in accordance with the requirements of the Distribution and Consumer Substations – Design and Construction (AE-NF04-S) standard.

Installation of new high voltage overhead circuits may be controlled or forbidden by the relevant Local Authority's By-Laws and/or District Plan. The connection configuration appropriate for each Customer will be decided by Aurora Energy in consultation with the Customer.

The following non-exhaustive factors are considered when choosing the most appropriate connection method:

- Location of high voltage distribution lines and cables;
- Location of the Customer's main switchboard;
- Access to the substation (immediate 24-hour access required);
- Supply security requirements;
- Connection capacity;
- Requirement for low voltage interconnection; and
- Cost.

All connections shall be designed to minimise the extent to which Aurora Energy assets will be placed on private property.

The fused tee connection depicted in Figure 10 is generally used for supply from the high voltage overhead Network, and for transformer capacities up to 500kVA. Where it is not possible to fit fuses to the tee-off pole, high voltage fuses will be installed on the first available pole.

The tee connection in Figure 11 is used for supply from the high voltage overhead Network when the transformer capacity is greater than 500 kVA, and a ground-mounted fuse-switch is required to isolate the transformer.

The feed-through connection in Figure 12 is used for connections to the underground high voltage Network. The Figure 12solution, with the switchgear and transformer sharing the same enclosure, is generally the most economic when the transformer location is close to the property boundary. If the transformer location is a significant distance from the property boundary, Figure 13 will be more economical due to a smaller cable being required from the fuse switch to the transformer. The options shown in Figure 12, Figure 13, and Figure 14 usually provide a more secure connection as, after a fault on one of the two cables supplying the substation, supply can normally be restored by switching.

The provision of a low voltage interconnection from the transformer to the low voltage Network, as depicted in Figure 14, requires the transformer to be close to the property boundary. The advantage of this arrangement to the Customer is that an emergency low voltage supply can be provided should the transformer fail.

18.1 Space Requirements

The space requirements for a substation on a Customer's property will depend upon the substation type and will be individually advised. The following types of substation are used:

18.1.1 Pole Substations

Pole substations on a Customer's property are generally only used in rural locations when the high voltage supply to the substation is via overhead line. Transformer capacities of 15 to 75kVA are standard. The siting of the substation will depend on the location of buildings and the routing of high voltage lines. Electrical clearances defined in NZECP 34 shall be maintained.

Aurora Energy's specific requirements for pole substations are defined in the Construction of Pole Substations (AE-NR01-T01) technical specification.

18.1.2 Indoor Substations

Indoor substations are used when the Customer is unable to provide a suitable outdoor site, or for technical or economic reasons. The entire substation can be indoors or just the high voltage switchgear, or just the transformer.

Aurora Energy's specific requirements for indoor substations are defined in the Substations in Customer Buildings Requirements (AE-NR03-T02) technical specification.

18.1.3 Ground Mounted Substations

Aurora Energy's specific requirements for ground mounted substations are defined in the Distribution and Consumer Substations – Design and Construction (AE-NF04-S) technical specification.

Unenclosed

Unenclosed ground mounted substations consist of a pad-mounted unenclosed transformer. They can be supplied via drop-out fuses for capacities up to 500kVA. For transformer capacities greater than 500kVA, ground mounted switchgear is required to switch inrush current. This switchgear may be remote from the transformer. It can be accommodated in a switch-room or, if suitable, installed outdoors.

Mini

Mini ground mounted substations are factory-made ground mounted substations that commonly have a cubicle for low voltage switchgear at one end. A cubicle at the opposite end of the transformer is generally used for high voltage cable terminations but may on occasion house high voltage switchgear and/or instrumentation transformers. These substations have capacities from 100 to 1000 kVA. The space occupied by a mini substation can be up to 2.8L x 1.5W x 1.6H metres, with additional working space required for the operation and maintenance of the substation.

Micro

Micro ground mounted substations are small factory-made ground mounted substations with available capacities 15kVA to 100kVA. They do not accommodate high voltage switchgear and are generally used when an underground connection to the high voltage overhead Network is required.

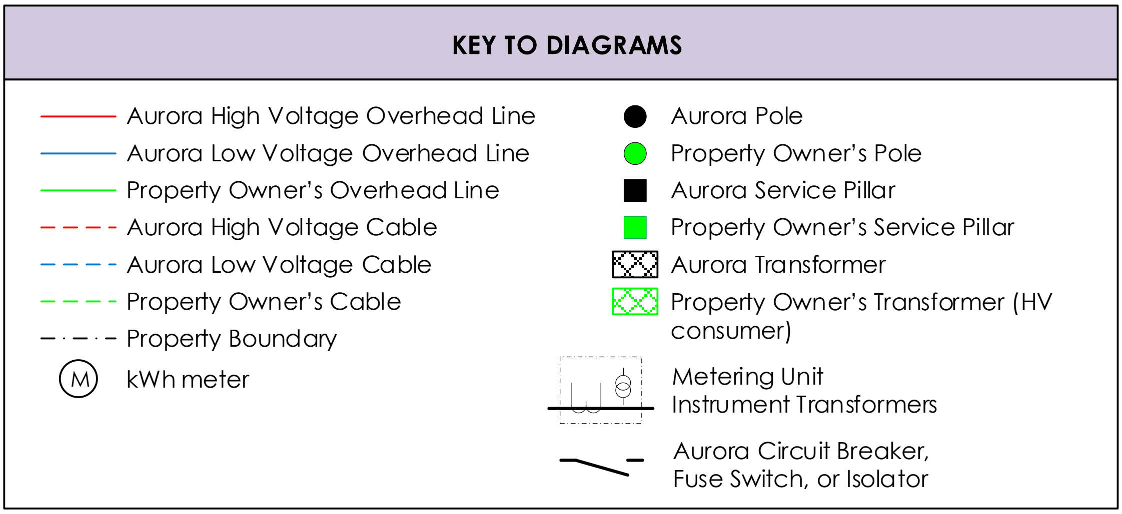

Figure 1 - Key to diagrams

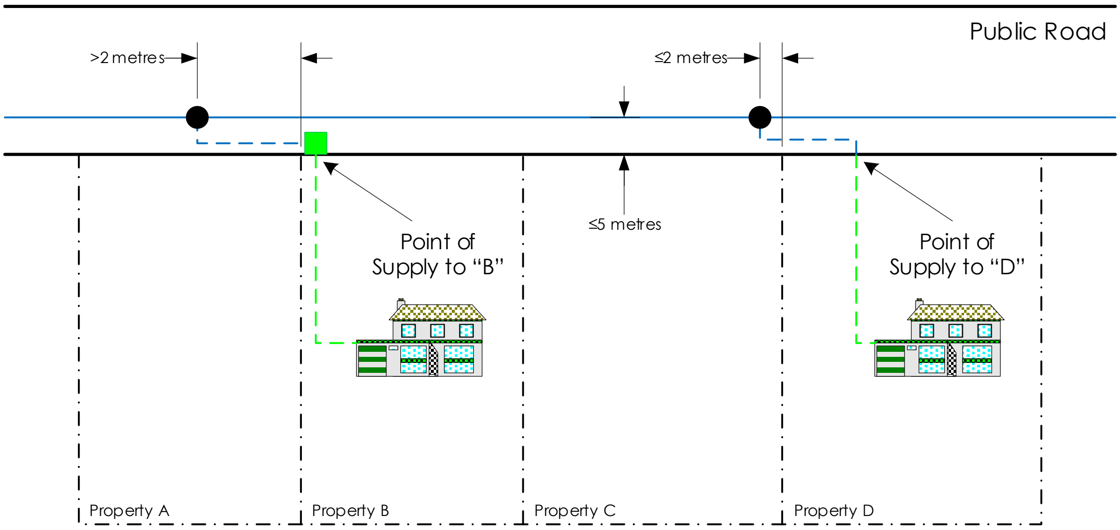

Figure 2 - Underground connections from overhead supply

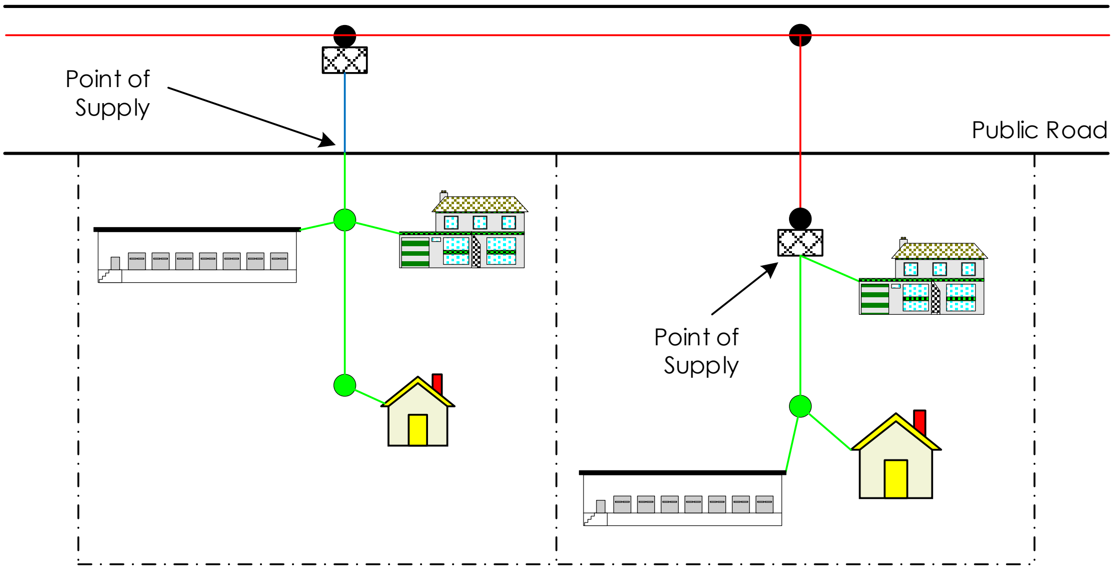

Figure 3 - Point of supply explanatory diagram 1

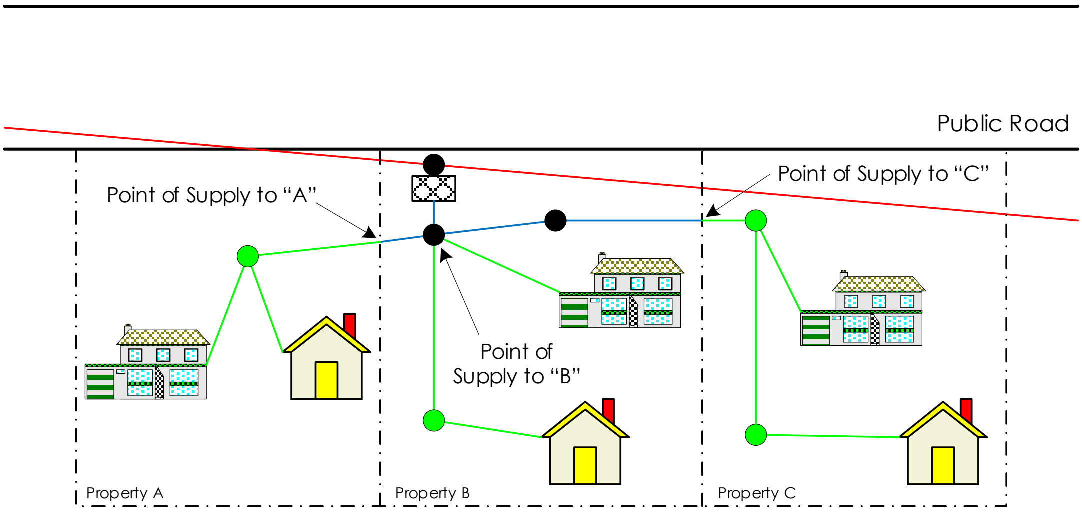

Figure 4 - Point of supply explanatory diagram 2

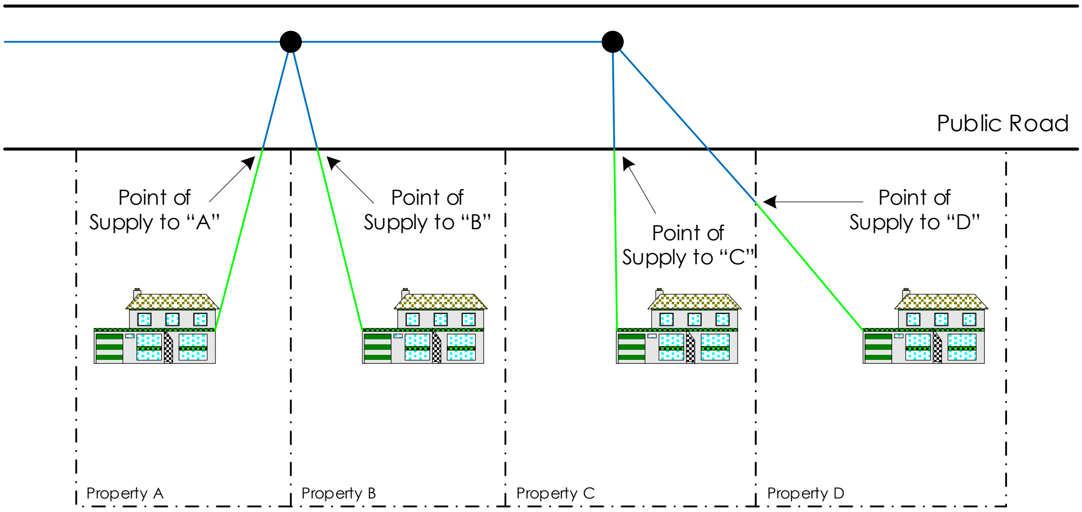

Figure 5 - Point of supply explanatory diagram 3

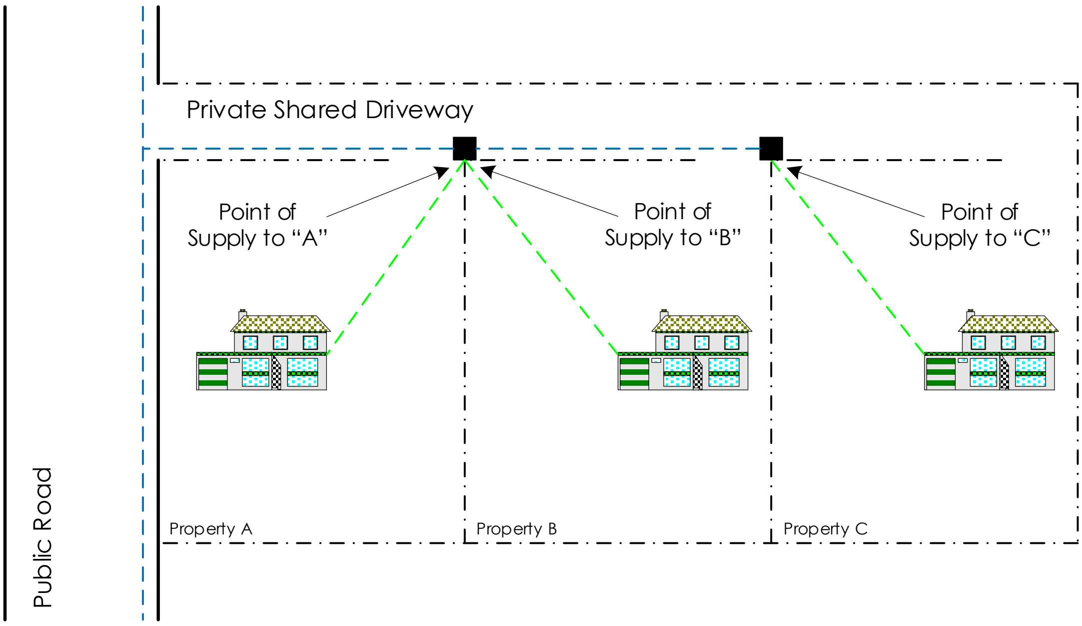

Figure 6 - Point of supply explanatory diagram 4

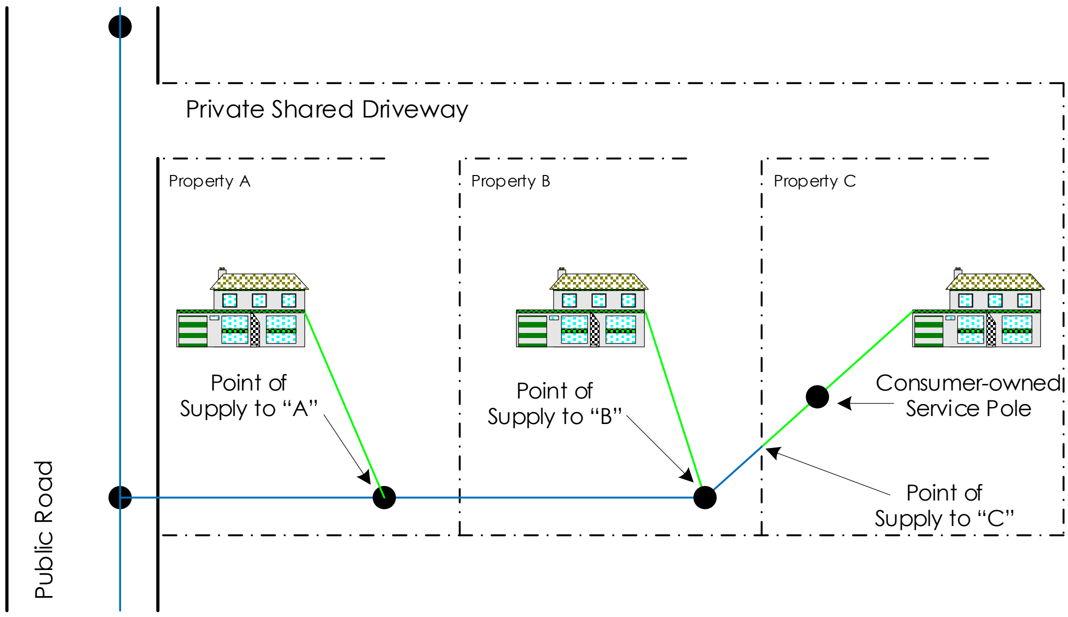

Figure 7 - Point of supply explanatory diagram 5

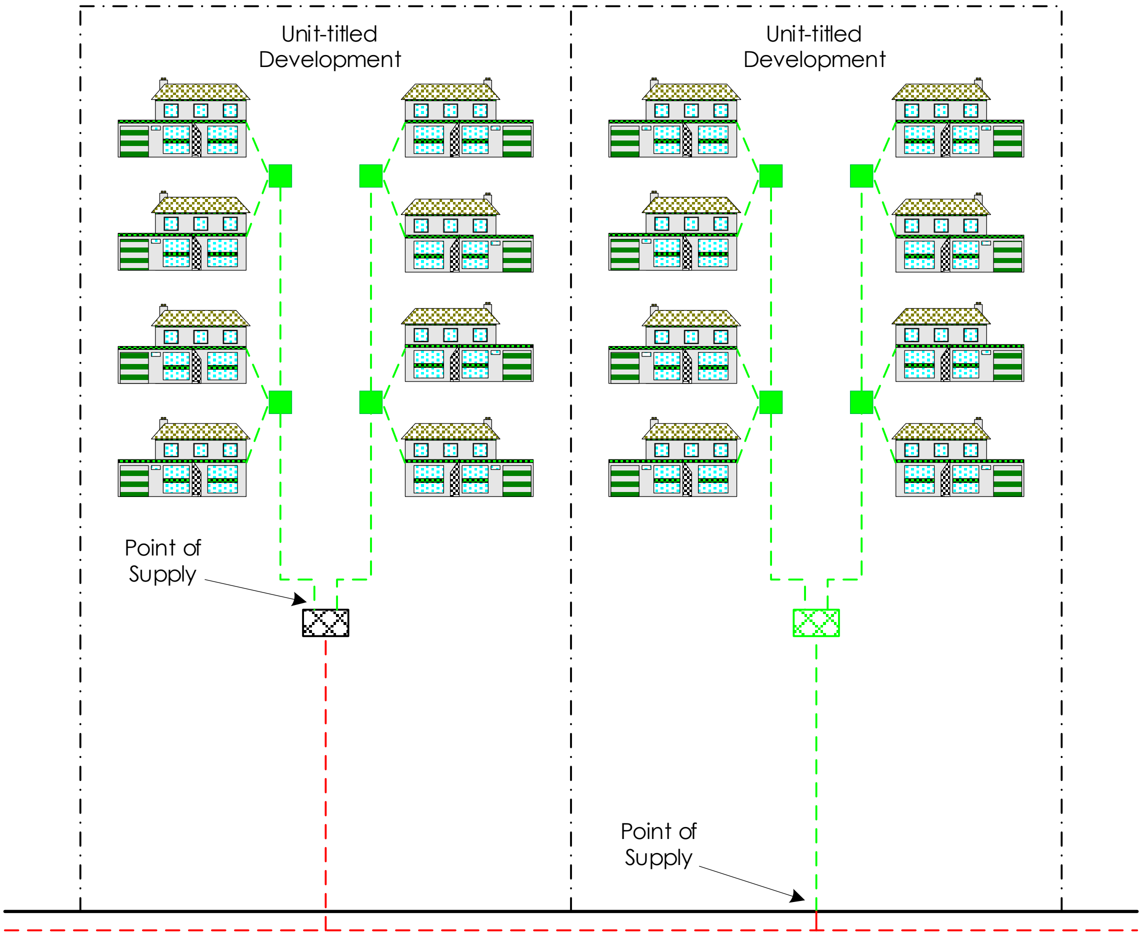

Figure 8 - Point of supply explanatory diagram 6

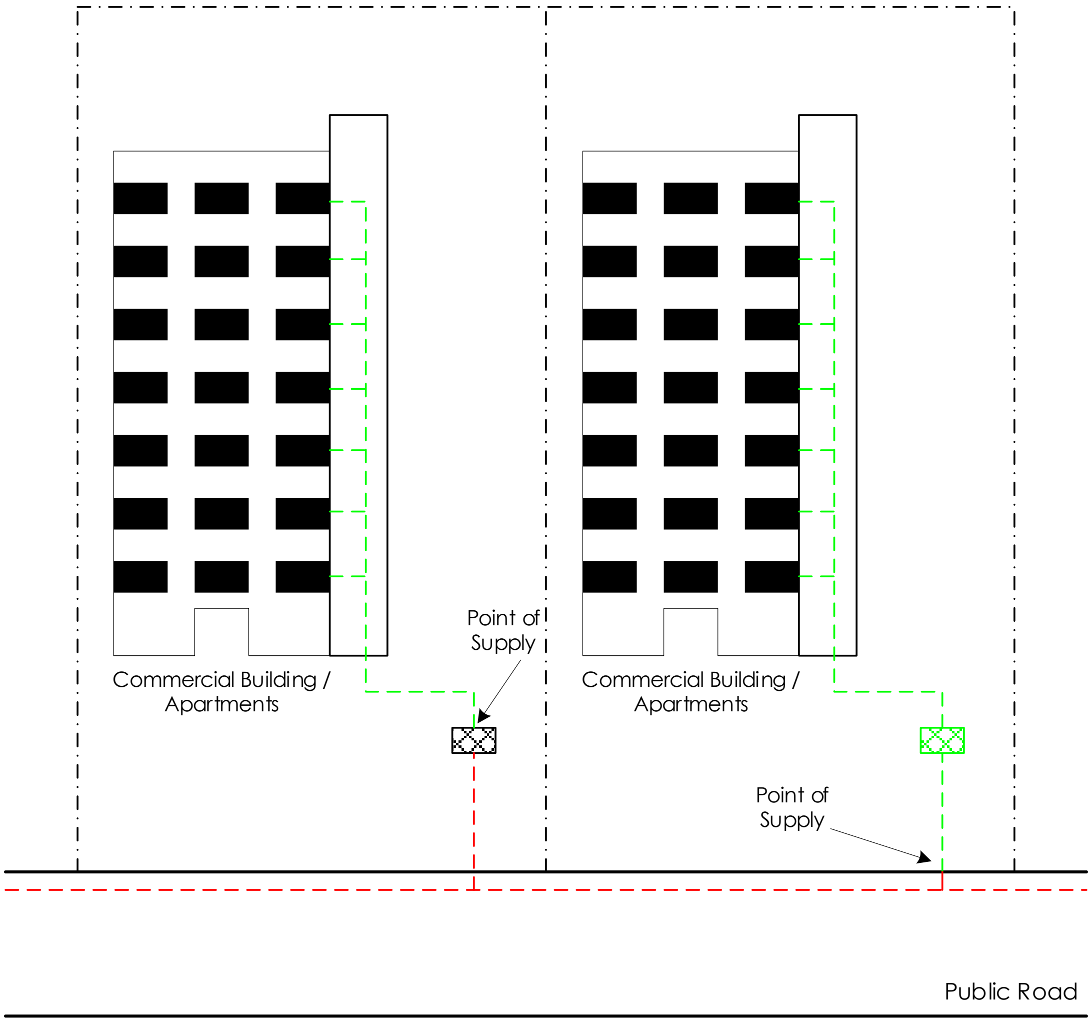

Figure 9 - Point of supply explanatory diagram 7

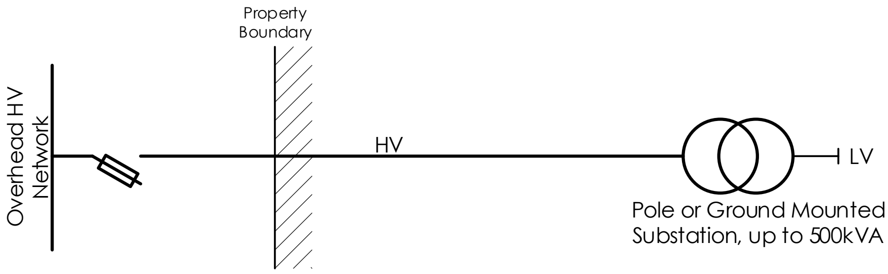

Figure 10 - Typical fused tee connection – LV supply

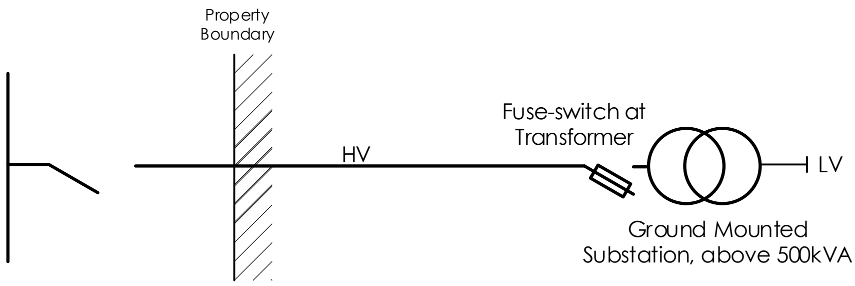

Figure 11 - Typical tee connection – LV supply

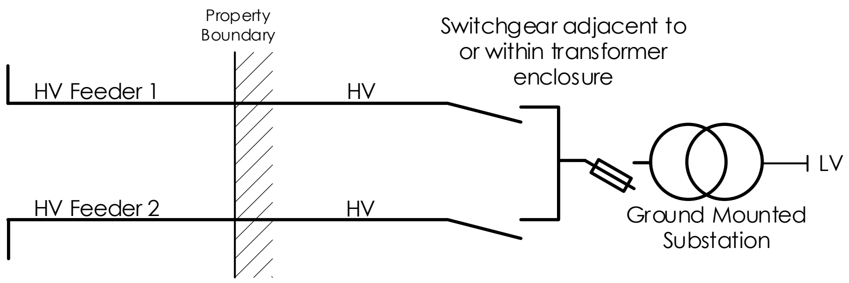

Figure 12 - Typical LV connection with HV feed-through (type 1)

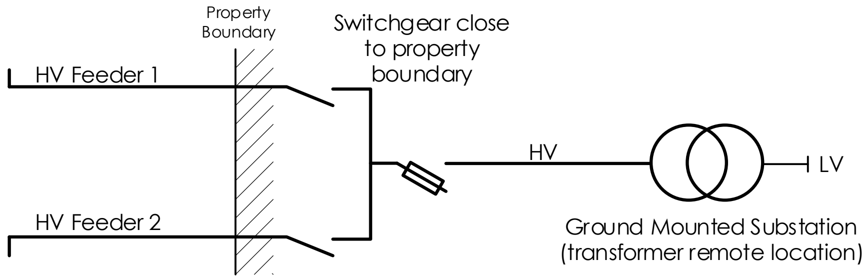

Figure 13 - Typical LV connection with HV feed-through (type 2)

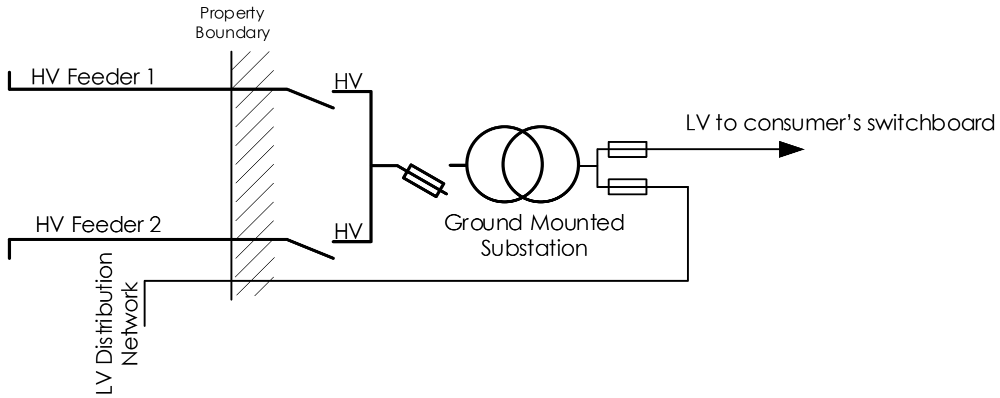

Figure 14 - Typical LV connection with HV feed-through and LV inter-connection

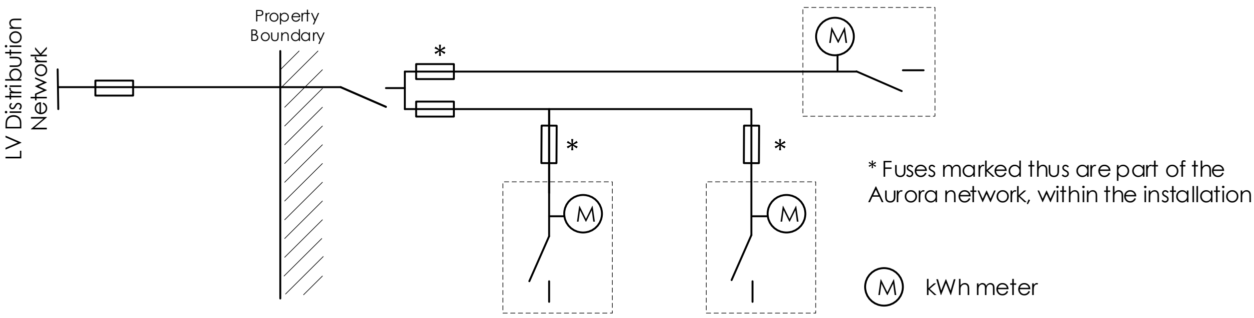

Figure 15 - Typical LV installation with un-metered sub-circuits

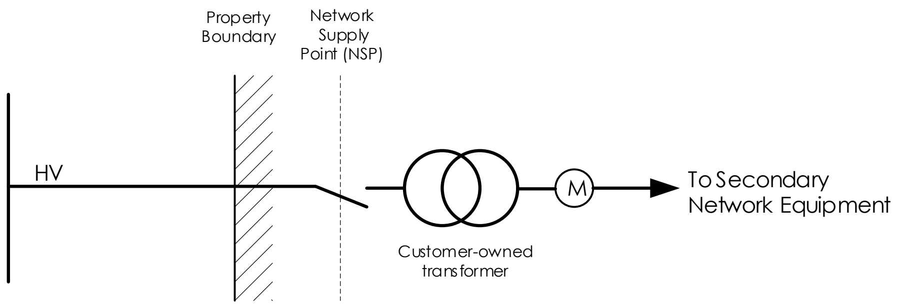

Figure 16 - HV secondary network tee connection – LV metering

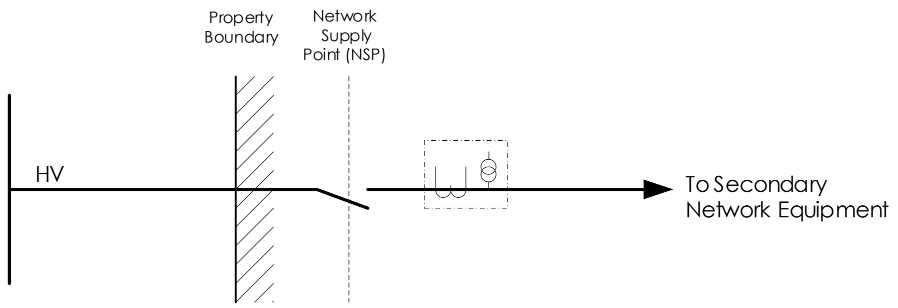

Figure 17 - HV secondary network tee connection – HV metering

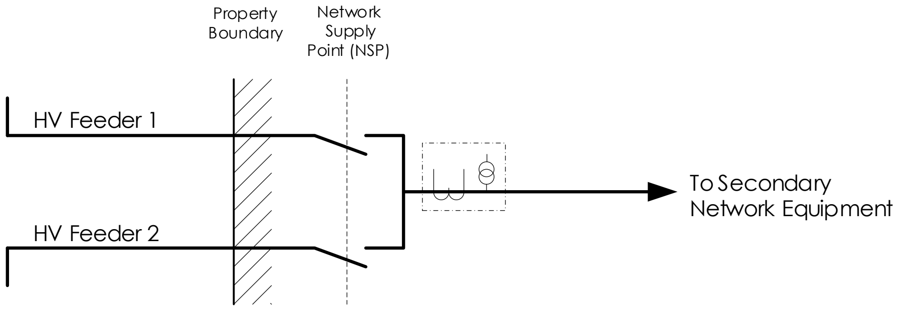

Figure 18 - HV secondary network feed-through connection – HV metering

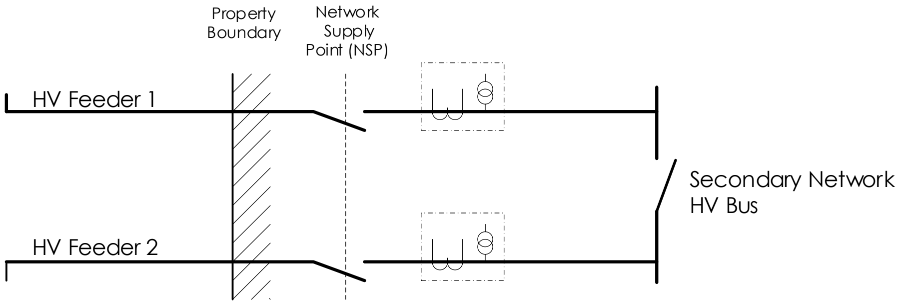

Figure 19 - HV secondary network dual-feed connection – HV metering

