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FOREWORD

Welcome to this Fifth (incorporating the 4th and 5th Addendum) edition of the WA Distribution Connections Manual. The intended purpose of this Manual is to provide a comprehensive single point of reference for industry and the community for an electrical connection of a customer's installation to the distribution network of:

- Horizon Power’s North West Interconnected System (NWIS);
- Western Power’s South West Interconnected System (SWIS):

Western Power and Horizon Power recognised that a consolidated Manual was needed to provide clear connection requirements in a format and language familiar to the electrical consulting and contracting industry, builders, architects and customers.

The Manual is intended to:

- Provide the necessary information to enable users to comply with statutory requirements and obligations;
- Incorporate commonly understood and universally accepted language;
- Consolidate all of the connection reference material into a single document;
- Provide a format that is easily accessible for all users;
- Involve and gain industry and community support.

The Manual has been constructed using both technical and non-technical Sections including diagrams and flow charts to aid the reader in achieving the required connection outcome. This edition supersedes all previous versions of the Manual, the Transitional Connections Manual and Horizon Power/Western Power material contained within the redundant Section 13 of WAER.

Horizon Power and Western Power would like to acknowledge the valuable support and contribution made during the development of this Manual by officers and personnel from industry Associations, Department of Mines, Industry Regulation and Safety (EnergySafety), Synergy and both Network Operators.

The authors hope you find this Manual informative and easy to read. Feedback on any aspect of the Manual is welcome and valued. We look forward to your support and involvement in the development of future editions of this document.

Engineer Services
Horizon Power

Grid Transformation
Western Power
Manual quick reference guide

The intent of this Manual is to provide relevant and related information associated with a customer’s residential or business electrical connection to a Network Operator’s distribution network.

It is understood that not all users of this document will have an electrical background therefore the Manual has been constructed in such a way so as assist and guide both technical and non-technical readers to those Sections of specific or relevant interest.

Although the below groupings have been provided to assist the reader, all Sections of this Manual need to addressed to obtain a network connection.

➢ For all manual users

Sections 1 to 3 contain definitions, document management processes and relevant legislation for the community and the industry.

➢ Architects, Builders, Customers and Designers.

Sections 4, 5, 6, 7, 9, and part of Section 11, provide specific and detailed information on electrical safety together with guidance for readers on how they will be charged, metering (location, tariffs etc.), what the connection will look like and what needs to be done by the various parties to achieve the connection.

➢ Electrical Consultants, Contractors, Designers and Workers

Sections 8, 10, 11, 12, 13, 14 and 15 contain specific technical content describing the technical requirements that must be satisfied before a Network Operator will allow the connection to their distribution network. Additional information is also provided on the ongoing customer obligations to keep and maintenance connection.

➢ Hyperlinks

Section 1 Definitions and abbreviations- contains an explanation of commonly used terms, phases and references contained throughout the Manual.

Section 2 Document management- provides details on the date of application for the Manual, together with instructions and to how to register as a user and subscriber or on how to provide feedback on the content.

Section 3 Scope and legislation- outlines how and where the Manual is to be used inclusive of an overview of the various pieces of State and Commonwealth Legislation that underpins both network and industry activity.

Section 4 Roles and responsibilities- describes the regulatory, contractual and practical roles that must exist and fulfilled by each party to ensure the effective connection, supply, distribution and consumption of electricity throughout the electricity supply chain.

Section 5 Contact details- is a useful summary and reference point within the Manual that provides regular contact details for both Horizon Power and Western Power.

Section 6 General requirements- contains information on general safety, clearances from overhead and underground electrical cables, site preparation, easements, network equipment and industry connections programs.

Section 7 Connection and disconnection applications- this part of the Manual is designed to provide guidance on the applicable processes when seeking either a new or upgraded connection or the removal of an existing connection to the network. The Section covers both low and high voltage connections as well as renewable energy connections including details and links to the various application forms.
Section 8 Notices and notifications explains the statutory obligations and notices used by the electrical industry prior to and on completion of electrical work. These notices form the basis of the regulatory system and the foundation of the industry safety and compliance structure.

Section 9 Charging policies includes guides to the applicable Network Operator policies on fees and charges. It is not a definitive source of information but does provide appropriate links to specific areas of their operations.

Section 10 Supply characteristics summarises the operation of both Horizon and Western Power's distribution networks including information on power quality, system voltages, fault levels, harmonics, flicker and customer related information such as sensitive supplies, disturbing loads or compensation payments.

Section 11 Metering is intended to provide both industry and the community with information on the various metering systems on offer to customers. This Section includes both informative and technical information on metering types, locations, connection methods for direct connected, current transformer, remote reading and renewable systems.

Section 12 Low voltage distribution supply specifies the requirements for the connection of a customer's low voltage electrical installation via either an overhead service cable or underground consumer's mains cable. Includes detail on connection policy; number, type and location of a connection equipment; poles; pillars; pits; temporary and builders supplies; and unmetered connections.

Section 13 High voltage distribution supply details the requirements for the connection of a customer's high voltage electrical installation including available voltages, submission processes, connection methods and arrangements, inspection, testing, switching, access and maintenance.

Section 14 Substations describes the requirements and customer responsibilities for installing new substations or for upgrading an existing substation installation. Included is information on substation types, locations and site preparation, enclosures, fire ratings and screens.

Section 15 Generation or more commonly known as standby, emergency or renewable generation systems, provides detailed technical information on the connection of engine driven generators, renewable energy systems, inverters, classifications, approvals, operational parameters, safety requirements, switching, labelling and customer responsibilities.

Note.
It is the hope of participating Network Operators that this Manual assists both Customers and Industry gain a better understanding of the roles, responsibilities, processes and minimum technical specifications required to facilitate and maintain a safe, reliable and affordable customer connection.
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Distribution
Connections Manual

Section one

Definitions and abbreviations
1 Definitions and abbreviations

1.1 Definition (origin) key
This Manual uses standard industry terminology wherever possible to match the document’s language with that used in Legislation, frequently referenced industry standards and Network Operator documents. Where a common definition or phrase is drawn from another document, the origin or source of that definition or phrase has been identified by the following key:

<table>
<thead>
<tr>
<th>Key</th>
<th>Origin or Source of the Definition (at the time of Manual development)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Access Code</td>
</tr>
<tr>
<td>(b)</td>
<td>AS/NZS 3000</td>
</tr>
<tr>
<td>(c)</td>
<td>Western Power’s Interim Connections Manual</td>
</tr>
<tr>
<td>(d)</td>
<td>Landgate</td>
</tr>
<tr>
<td>(e)</td>
<td>Western Power’s Substation Installation Requirements – DSB 95/5 and 95/6 (withdrawn)</td>
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<tr>
<td>(f)</td>
<td>Western Power’s Technical Rules</td>
</tr>
<tr>
<td>(g)</td>
<td>Western Power’s Underground Distribution Schemes Manual</td>
</tr>
<tr>
<td>(h)</td>
<td>WA Electrical Requirements (WAER)</td>
</tr>
<tr>
<td>(i)</td>
<td>Western Australian Planning Commission (WAPC)</td>
</tr>
<tr>
<td>(j)</td>
<td>Horizon Power</td>
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</tbody>
</table>

* Contains a variation to the original definition, represented by the underscoring.

1.2 Definitions
In this Manual the following words and expressions have the meaning as given by the following:

**The Act**
(h)* The Western Australian Electricity Act 1945 and all subsequent revisions.

**Access Contract**

**Applicant**
(e) The party that applies to the Network Operator for a new, relocated or upgraded electrical supply to an individual green title lot. The applicant may be the owner or, with prior written approval, an agent acting on behalf of the owner.

**Architect**
(e) A qualified person who is registered with the Architects Board of Western Australia and is entitled to be described as an architect who may be engaged by the customer to prepare drawings to comply with the Building Code of Australia and Local Government Authority requirements.

**Augmentation**
(a)* An increase in the capability of the network to provide services, including by the development, construction, acquisition or commissioning of new network assets.

**Carry over pole**
(c) A Network Operator supplied support pole installed in the road reserve to provide ground clearance for an overhead service cable.

**Cluster substation**
(e) A district or sole use substation where all equipment is “clustered” on a single site.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>Community</strong> (j)</td>
<td>A town site where the electrical supply network is the responsibility of Horizon Power.</td>
</tr>
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<td><strong>Connection agreement</strong> (f)</td>
<td>An agreement or other arrangement between the Network Service Provider and a User, which may form part of or include an access contract that specifies the technical requirements that apply in relation to the connection of a User’s equipment to the transmission or distribution system.</td>
</tr>
<tr>
<td><strong>Construction Project Manager</strong> (e)</td>
<td>The officer appointed by the Network Operator as its representative, to whom all site construction contractual and technical matters are referred.</td>
</tr>
<tr>
<td><strong>Consumer (customer’s) pole</strong> (c)</td>
<td>A support pole supplied and installed by the customer on the customer’s property, used to provide ground clearance for an overhead service cable, which may include the point of attachment/point of supply. (May also be known as an intermediate pole).</td>
</tr>
<tr>
<td><strong>Consumer mains</strong> (b)</td>
<td>Those conductors between the point of supply and the main switchboard. Refer to Clause 1.4.33 of AS/NZS 3000 (2007).</td>
</tr>
<tr>
<td><strong>Conduit:</strong> (c)</td>
<td>Electrical pipe used for electrical installations as defined in AS/NZS 2053.</td>
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<tr>
<td><strong>Contract</strong> (g)*</td>
<td>The formal agreement between the Network Operator and all or either the customer, owner, developer and the electrical contractor for the execution of the works.</td>
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<tr>
<td><strong>Connection point</strong></td>
<td>That point defined in an access contract or, where there is no specific access contract, the upstream terminals of the customer’s main switch or downstream of the meter.</td>
</tr>
<tr>
<td><strong>Customer(consumer)</strong> (h)*</td>
<td>Person and or entity to which electricity is sold for the purposes of consumption.</td>
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<td><strong>Customer owned substation</strong> (e)</td>
<td>A substation where the customer is on a high voltage tariff and owns and is responsible for all electrical equipment downstream of the Network Operator’s high voltage metering equipment.</td>
</tr>
<tr>
<td><strong>Customer’s installation</strong> (c)</td>
<td>That portion of an electrical installation as defined by Clause 1.4.47 AS/NZS 3000 (2007) excluding the Network Operator’s metering equipment.</td>
</tr>
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<td><strong>Developer</strong> (e)</td>
<td>A party that applies for an electrical supply for a development.</td>
</tr>
<tr>
<td><strong>Development</strong> (e)</td>
<td>A single green title lot with one or more customers, a single green title lot where provision has been made for a future customer(s) or a clearly identifiable group of one or more buildings making up a single development complex spread over a number of lots.</td>
</tr>
<tr>
<td><strong>Distribution system</strong> (f)</td>
<td>Any apparatus, equipment, plant or buildings used, or to be used for, or in connection with, the transportation of electricity at nominal voltages of less than 66 kV and which form part of the NWIS, NIS or SWIS.</td>
</tr>
<tr>
<td><strong>Distribution Design Catalogue (DDC)</strong> (g)*</td>
<td>Network Operator’s design catalogue of approved equipment and assemblies.</td>
</tr>
</tbody>
</table>
Distribution substation (Substation) (e) A collection of switchgear and/or a transformer/s on a single site (which may or may not be screened or enclosed). Also refer to Clause 1.4.90 of AS/NZS 3000 (2007).

District substation (e) A substation that has low voltage connections to the street mains. The Network Operator owns and is responsible for all electrical equipment within the substation.

Electrical consultant (h) A qualified person or organisation as defined by the WA Electrical Requirements Section 9, engaged by the customer to advise or design the customer’s electrical installation, project or works.

Electrical contractor (c) A qualified person or organisation as prescribed by the “Electricity (Licensing) Regulations 1991” Part 4, engaged by the customer to design and execute the requested electrical installation project or works.

Electrical engineer (h) See Professionally qualified electrical engineer

Electrical Licensing Area Boundary (j) The area defined around regional towns and communities where a Network Operator has a license to operate as an approved supplier of electricity.

Electricity infrastructure (g)* Means all existing Network Operator or customer network infrastructure, works and apparatus required for any extension and reinforcement of networks.

Flick (g)* Voltage fluctuations (‘flickering’) on the network, caused by large equipment or motor starts and other sudden impact disturbing loads.

Greenfields reinstatement (e) Re-instatement and compaction of excavated soil, excluding the replacement or installation of ground treatments such as grass, brickwork, concrete, paving or asphalt surfaces

Headwork (g)* Means new electricity infrastructure that needs to be installed from the existing network to the new installation to enable supply.

Intermediate pole (c) See consumer pole.

Islanding * Any situation where the electrical supply from an electricity distribution network is disrupted and one or more inverters maintains any form of electrical supply, be it stable or not, to any section of that electricity distribution network. (AS4777 part 3 Clause 3.6)

Lot (i) May also be known as freehold or green title. A defined portion of land depicted on a plan or diagram and for which a separate Crown Grant or Certificate of Title has been or can be issued or depicted on a diagram or plan of survey of a subdivision approved by the Commission but does not include a lot in relation to a strata scheme, a lot in relation to a survey strata scheme or a lot shown as common property on a survey strata plan as defined by the Strata Titles Act 1985.

Licensed person (c) As described and defined by the Electricity (Licensing) Regulations 1991.
Load (f)* Either
a) the electrical power at a point on either the customer’s installation or distribution network; or
b) the amount of electric power transferred at a defined instant at a specific point on the transmission or distribution system as the case requires.

Low Voltage (LV) design (g)* A software program to calculate voltage drops, line loads, kilowatt losses, transformer loads and fuse reach in underground and overhead low voltage networks.

Main switchboard (b) A switchboard from which the supply to the whole electrical installation can be controlled. Refer to Clause 1.4.92 of AS/NZS 3000. (2007).

Major regional centres (Horizon Power) * Broome, Carnarvon, Esperance, Karratha, Kununurra and Port Hedland.

Major regional centres (Western Power) * Albany, Bunbury, Geraldton, Kalgoorlie and Mandurah.

Metering installation (c) The devices and methods for the purpose of metrology as defined by the Metering Code.

Modular package substation (MPS) (e) A district substation where the transformer and/or high voltage switchgear and/or low voltage switchgear is housed in a self-contained metal enclosure/s, connected as a single package.

Must (g) A mandatory requirement.

Network (c) Means the transmission and distribution system within the NWIS, NIS or SWIS.

Network designer (e) The officer appointed by the Network Operator to negotiate with the applicant on all matters relating to design and quotation.

Network operator (b)* Means either Horizon Power or Western Power as the entity defined by Clause 1.4.50 of AS/NZS 3000 (2007) and which lawfully operates the transmission and distribution systems within the NWIS, NIS or SWIS.

Offer (quote) (g)* Means an offer by the Network Operator to the customer or customer’s representative setting out the costs, terms and conditions upon which the electricity infrastructure or connection of a customer’s installation will be provided, as described by the Network Operator’s design.

Overhead service cable (c) An overhead line operating at a voltage less than 1000 V generally located between the electricity utility’s overhead line and the point of connection to an electrical installation. Refer to Clause 1.4.52 AS 7000

Planning schemes (i) As referred to by the Western Australian Planning Commission (WAPC).
<table>
<thead>
<tr>
<th>Term (c)</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Pillar (pillar)</td>
<td>A distribution enclosure owned by the Network Operator, installed on the customer’s property, which provides the point of supply from the electricity network for the customer’s installation.</td>
</tr>
<tr>
<td>Point of attachment (POA)</td>
<td>The point at which aerial conductors of an overhead service cable or aerial consumers mains are terminated (secured) on the customer’s structure. There is no POA for underground connections. Refer to Clause 1.4.73 of AS/NZS 3000.</td>
</tr>
</tbody>
</table>
| Point of supply (POS) | The junction of the consumer mains with –
| | a) conductors of an electrical distribution system; or
| | b) output terminals of an electricity generating system within the premises |
| Refer to Clause 1.4.75 of AS/NZS 3000 (2007). |
| Practical completion | The completion of works such that they can be used for the purpose for which they were designed, without restriction. |
| Prefer | A choice to be adopted unless circumstances justify a variation. |
| Professionally qualified electrical engineer | Has the same meaning as professional qualified engineer given in Part 3 of the Electricity (Licensing) Regulations 1991, being a person who:
| | a) holds a power electrical engineering specialisation; and
| | b) is, or is eligible to be, a member of the body known as Engineers Australia otherwise than at the grade of student. |
| Property boundary | A surveyed line or boundary of a lot. |
| Retailer | A body holding a retail licence or integrated regional licence under the Electricity Industry Act 2004. |
| Requirement (require) | A mandatory obligation or action to confirm compliance or to facilitate an outcome. |
| Responsible person | The person responsible for the ongoing safety of people and property in relation to the management and conduct of undertakings at those premises. The Occupational Safety and Health Act 1984 and the Occupational Safety and Health Regulations 1996 establish duties upon a number of persons in respect to workplaces. |
| Service apparatus | Any works, apparatus or system capable of being or intended to be used for conveying, measuring or controlling electricity supplied from a Network Operator’s distribution system to the point of supply inclusive of Network Operator owned metering equipment. |
| Service protection device (SPD) | A fuse, circuit breaker or other device installed as required by the electricity distributor for interrupting the supply to an electrical installation on a customer’s premises from the supply main. Refer to Clause 1.4.84 of AS/NZS 3000 (2007). |
**Shall** (g) A mandatory requirement.

**Should** (g) A requirement to be adopted unless circumstances justify a variation.

**Site** (g)* The customer’s workplace, which includes all parts of the installation that are the subject of the offer and acceptance between the Network Operator and the customer for the provision of electricity infrastructure and or connection.

**Sole use substation** (e) A substation established for a single customer and which has no LV interconnection with the street mains. The Network Operator owns and is responsible for all electrical equipment within the substation.

**Standard supply** (c) Standard supply defined as 240 volt single phase (+/- 6%) or 415 volt three phase (+/- 6%) as:

- 63 amps single-phase (Perth metropolitan and SWIS major regional centres); or
- 32 amps single-phase (rural areas); or
- 32 amps per phase, three phase, for multi-phase (SWIS); and
- Maximum size of consumer mains cable shall not exceed 35 mm².

Note: For Horizon Power serviced areas please refer to Table 3 – Horizon Power Towns and Networks Maximum Allowable supply per installation.

**Strata plan** (d) Strata plans define the lots in a strata scheme (areas owned individually) and common property (areas owned jointly by all lot owners in the strata scheme). Strata lots are limited in height and depth (the stratum of the lot). Strata plans show a building on at least one lot of the strata plan and stratum of the lots is always linked to buildings shown on the plan.

**Strata title** (d) A certificate of title for a lot in a strata scheme created under, and subject to the provisions of the *Strata Titles Act 1985 as Amended*. Strata titles specify the ownership of the lot, and the lodged and registered interests and claims (encumbrances) against that ownership.

**Structural engineer** (e) A NPER qualified structural engineer who is engaged by the customer to design and prepare structural documentation for the substation enclosure to resist loads and forces as outlined in AS1170 where relevant.

**Survey - strata plan** (d) Survey-strata plans define the lots in a survey-strata scheme, which are the areas in the scheme owned individually. Common property areas owned jointly by all lot owners may, or may not exist in survey-strata schemes and are defined as "common property lots". Survey-strata lots may be limited in height and depth but generally are not. No buildings are shown on survey-strata plans.

**Survey - strata title** (d) A certificate of title for a lot in a survey-strata scheme created under, and subject to the provisions of the *Strata Titles Act 1985 as Amended*. Survey-strata titles specify the ownership of the lot, and the lodged and registered interests and claims (encumbrances) against that ownership.
Subdivision (g) The total area of land to be developed, including all stages. It includes the amalgamation of lots.

Substation (e) A collection of switchgear and / or transformer(s) on a single site (which may or may not be screened or enclosed).


The “Technical Rules for the South West Interconnected Network”, as published by Western Power and approved by the Economic Regulation Authority.

Terminal station * A bulk transmission point owned by the Network Operator used to step down and distribute power to transmission substations.

Transmission system (f) Any apparatus, equipment, plant or buildings used, or to be used for, or in connection with, the transportation of electricity at nominal voltages of 66 kV or higher that forms part of the NMIS, NIS or SWIS.

Voltage (f) The electronic force or electrical potential between two points that gives rise to the flow of electricity.

Voltage (general) (b) Refer to Clause 1.4.98 of AS/NZS 3000. (2007). Differences of potential normally existing between conductors and between conductors and earth as follows:

(a) Extra-low voltage: Not exceeding 50V ac or 120V ripple free dc.

(b) Low voltage: Exceeding extra-low voltage but not exceeding 1000V ac or 1500V dc

(c) High voltage: Exceeding low voltage.

Voltage (distribution) (c) Exceeding extra-low voltage but not exceeding or including 66kV.

Voltage (transmission) (c) Including 66kV and above.

Zone substation * A substation owned by the Network Operator used to transform transmission voltages to high voltage distribution voltages and provide point of control.

Wiring Rules (b) The edition of AS/NZS 3000 as published by Standards Australia.

Working day (g)* Any day from Monday to Friday excluding Public Holidays.

Works (e) The electricity works associated with the provision of electrical supplies to a development and that is the subject of a Network Operator’s offer.
1.3 Abbreviations

The following abbreviations are used in this Manual:

**AMR system**
- **(h)** Automated Meter Reading (AMR) system, also known as a remote reading system.

**DMIRS (EnergySafety & WorkSafe)**
- **(c)** Operational Sections within the Department of Mines, Industry Regulation and Safety established to monitor industry standards of safety and protection for industry and the community.

**DAO (Previously DQA)**
- **Design and Access Offer application. Used to apply for supplies greater than standard.**
- **Distribution Construction Standard (Horizon Power)**

**DCS**
- **Distribution Construction Standards Handbook (Western Power)**

**DCSH**
- **Distribution Customer Connection Requirements (Western Power)**

**DCCR**
- **Distribution Design Catalogue**

**DDR**
- **Distribution Design Rules (Horizon Power)**

**DSM**
- **Distribution Substation Manual**

**DSPM**
- **Distribution Substation Plant Manual (Western Power)**

**ERA**
- **(c)** Economic Regulation Authority - The Authority regulates monopoly aspects of the gas, electricity and rail industries including licensing providers of gas, electricity and water services.

**MEN**
- **(e)** Multiple Earthed Neutral network installation. That is, the neutral may be earthed at numerous points in the network and at each customer’s main switchboard.

**NMI**
- **National Meter Identifier.**

**NWIS**
- **(j)** North West Interconnected System - The transmission and distribution electricity network owned and operated by Horizon Power in the Pilbara Region extending from Karratha to Port Hedland in the North West of Western Australia.

**HV**
- **High Voltage (See definition for voltage)**

**kA**
- **Kilo Amps**

**kVA**
- **Kilo Volt Amps**

**LV**
- **Low Voltage (See definition for voltage)**

**MPS**
- **(e)** Modular package substation.

**NIS**
- **(j)** Non-Interconnected System - The transmission and distribution electricity network owned and operated by Horizon Power in towns and communities outside those areas covered by the NWIS and the SWIS.
PoA (c) Point of attachment.
PoS (c) Point of supply
RESP (j) The Regional Electricity Supply Policy developed by Horizon Power for customers requesting supplies that are located outside the Electrical Licensing Area Boundary.
SRG (c) Stakeholder Reference Group. A committee representing both internal and external stakeholders from industry and the community.
SWIS (e) South West Interconnected System – The transmission and distribution electricity network owned and operated by Western Power in the South West corner of Western Australia.
SPD (c) Service protection device
SPUD (e)* Single Phase Underground Distribution. Network reticulation system for a subdivision.
SPURS (e)* Single Phase Underground Rural Supply for an individual customer.
UCIM Underground Cable Installation Manual
UDS Underground Distribution Schemes Manual
UMS Un-metered Supply Standard
WADCM Western Australian Distribution Connections Manual
WAPC (i) Western Australian Planning Commission. The WAPC is the statutory authority with state-wide responsibilities for urban, rural and regional land use, planning and land development matters.
Landgate (d) Landgate is the Statutory Authority responsible for Western Australia’s land and property information.
1.4 References
This policy should be read in conjunction with but not limited to the following:

1.4.1 Acts and Regulations
The WA State Government publishes the following Acts and Regulations via its website State Law Publisher:

- Electricity Act 1945
- Electricity Regulations 1947
- Electricity Corporations Act 2005
- Electricity Distribution Regulations 1997.
- Electricity (Licensing) Regulations 1991
- Electricity Industry Act 2004
- Electricity Industry (Metering) Code 2012
- The Energy Coordination Act 1994
- Energy Operators (Power’s) Act 1979
- Occupational Safety and Health Act 1984
- Occupational Safety and Health Regulations 1996
- Mines Safety and Inspection Act 1994
- Mines Safety and Inspection Regulations 1995
- Planning and Development Act 2005
- Transfer of Land Act 1893
- Land Administration Act 1997

1.4.2 General codes and publications

- Code of Practice “Safe Low Voltage Work Practice by Electricians” published by DMIRS (EnergySafety)
- Code of Practice for Persons working on or near energised electrical installations, published by DMIRS (EnergySafety)
- Electricity Networks Access Code 2004, published by the WA State Government
- Guidelines for the management of vegetation near powerlines, published by DMIRS (EnergySafety)
- Guidelines for the Safe management of high voltage electrical installations, published by DMIRS (EnergySafety)
- Guidelines for work in the vicinity of Overhead power lines published by DMIRS (WorkSafe)
- Private power poles and lines published by DMIRS (EnergySafety)
- Utility Providers Code of Practice published by Dial Before You Dig
- WA Electrical Requirements, published by DMIRS (EnergySafety)
1.4.3 **Documents published by Horizon Power**
The following documents may be accessed through the Manual and standards section of the public website:

- Decorative Fixtures, Signs, Banners and Artwork of Horizon Power Assets
- Distribution Equipment Labelling Standard
- Distribution Construction Standard
- Distribution Design Catalogue
- Distribution Design Rules
- Distribution Pole to Pillar Guidelines
- Electrical Safety Standards
- Guideline for Excavation work Near Horizon Power Networks
- Maximum Transformer Sizes for Non-Interconnected Systems
- Network Testing and Commission Standards
- Underground Cable Installation Manual
- Underground Distribution Schemes Manual
- Un-metered Supply Policy
- Western Australian Distribution Connection Manual

The following document may be accessed by activating the relevant hyper link:
- [Technical Rules](#)

1.4.4 **Documents published by Western Power**
The following documents may be accessed through the Technical guidelines and manuals section of the public website:

- Artwork on Western Power Assets
- Deciding Between Overhead and Underground Construction in Road Reserves
- Decorative Fixtures, Signs, Banners and Artwork of Our Power Assets
- Distribution Customer Connection Requirements
- Distribution Construction Standards Handbook
- Distribution Design Catalogue
- Distribution Pole To Pillar Policy
- Distribution Substation Plant Manual
- Placement of Poles in Road Reserves
- Network Testing and Commissioning Standard
- Underground Cable Installation Manual
- Underground Distribution Schemes Manual
- Un-metered Supply Policy
- Western Australian Distribution Connection Manual

The following documents may be accessed by activating the relevant hyper link:
- [Technical Rules](#)
1.4.5 Documents published by Standards Australia

- AS/NZS 1026: Electric Cables
- AS 1033: High Voltage Fuses
- AS 1243: Voltage Transformers
- AS 1319: “Safety signs for occupational environment”
- AS 1359: Motors and Generators
- AS/NZS 1429: Electric Cables
- AS 1767: ‘Insulating oil for transformers and switchgear’.
- AS 1883: ‘Guide to maintenance and supervision of insulating oils in service’
- AS 1940: ‘The storage and handling of flammable and combustible liquids’.
- AS/NZS 2053: Parts 1–8 Conduits and fitting for electrical installations.
- AS 2067: Substations and high voltage installations exceeding 1 kV a.c.
- AS 2467: ‘Maintenance of electrical switchgear’
- AS 2790: Electricity generating sets—Transportable (Up to 25 kW)
- AS 3010: Electrical installations—Generating sets
- AS/NZS 3013: “Electrical installations – Classification of the fire and mechanical performance wiring system elements.”
- AS/NZS 3100: “Approval and test specification - General requirements for electrical equipment”
- AS 4086: Secondary batteries for use with stand-alone power systems
- AS/NZS 4509: Stand-alone power systems
- AS/NZS 4741: Testing of connections to low voltage electricity networks
- AS 4777: (Parts 1, 2 and 3) “Grid connection of energy systems via inverters”
- AS/NZS 5033: Installation of photovoltaic (PV) arrays
- AS/NZS 7000: Overhead line design - Detailed procedures
- AS/NZS 61000: “Electromagnetic compatibility (EMC)”
- AS/NZS 61000.3.6: Assessment of emission limits for distorting loads in MV and HV power systems.
- AS/NZS 61000.3.7: Assessment of emission limits for fluctuating loads in MV and HV power systems.
- AS 62271: Switchgear and Control gear.
- IEC 60255: Relays and Protection Equipment
- IEC 61230: Ed 1.0 (Bilingual 1993) Live Working – Portable equipment for earthing or earthing and short-circuiting
- HB 187: Guide to selecting a safe multimeter
- HB 264: Power quality: Recommendations for the application of AS/NZS
- HB 331: Overhead Line Design
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Section two

Document management
2 Document management

2.1 Disclaimer
This Manual has been compiled and published by Horizon Power and Western Power using definitions, drawings, guidelines, standards, electricity supply publications and information consistent with the relevant Acts and Regulations of the state of Western Australia at the date of publication. Users are responsible for determining the relevance and applicability of that material, to their circumstances.

Standards and electricity supply publications are revised periodically. This Manual may not be up to date and users should make their own inquiries.

2.2 Manual ownership and administration
This Manual is the property of the copyright owners, Electricity Networks Corporation and Regional Power Corporation, who reserve the right to develop, administer, publish and revise the Manual, as they see fit.

2.3 Copyright
Copyright Electricity Networks Corporation trading as Western Power and Regional Power trading as Horizon Power. Any use of this material except for the educational purposes by Western Australian based Registered Training Organisations or as permitted by written agreement from the copyright owners is prohibited.

This Manual includes material reprinted with the permission of Victorian SIR Management Committee. Western Australian participating Network Operators wish to acknowledge and thank Victorian SIR Management Committee for its support and assistance during the preparation of this document.

2.4 Application
This edition supersedes all previous versions of the Manual, the Transitional Connections Manual and Horizon Power/Western Power material contained within the redundant Section 13 of the WAER (2008). The application of the information within this Manual and subsequent amendments is not retrospective unless an existing electrical installation or part thereof is altered, modified, upgraded or constitutes a safety issue as determined by an authorised inspector under the Energy Coordination Act 1994.

These requirements are to be applied to all new electrical installations as soon as practical during the period up to but not exceeding six months from the date of publication, after which time it will become compulsory.

Where work on an electrical installation has commenced or formal contracts to undertake electrical work were signed prior to the publication of these requirements, the Network Operator may grant permission, on receipt of an application, for exemption from these requirements. This will allow for the electrical installation to be completed in accordance the previously published Network Operator requirements. Exemption will not be granted where there is a safety concern.

Additionally, there may be connection requirements, configurations or unusual situations that cannot be covered by this Manual. In such circumstances the Network Operator must be advised and consulted before any design or installation work commences. Refer to Clause 3.5
2.5 Publication

2.5.1 Application date
These requirements shall apply from the date shown in the “Record of revisions” located at the rear of this document.

2.5.2 Printing and updates
This is an electronic media based document and is therefore uncontrolled when printed or copied. To ensure you are using the most current version, please refer to the web based document which can be found at:

- Horizon Power - Western Australian Distribution Connections Manual
- Western Power - Western Australian Distribution Connections Manual

2.5.3 On-line subscription
Parties wishing to receive updates and information via e-mail in the event that this on-line Manual is revised or updated can register on-line with the Documentation Subscription Service at:

- Horizon Power - Horizon Power Feedback
- Western Power - Documentation Subscription.

2.6 Enquires and contacts
Participating Network Operators welcome comment regarding the Manual and its application. When specific trends in the questions received justify, a Frequently Asked Question (FAQ) and response may be issued and an amendment considered at the next review of the Manual. If you have any comments or queries please contact the relevant Network Operator on:

2.6.1 Horizon Power
- Residential account and general enquiries - 1800 267 926
- Business account and general enquiries - 1800 737 036
- On-line:
- Horizon Power: Feedback
- In writing to:
  Horizon Power Standards and Performance Manager
  Asset Strategy and Capability Division, PO Box 1066, Bentley DC, WA 6983

2.6.2 Western Power
- Customer Service Centre on 13 10 87:
- In writing to:
  The Network Standards and Policy Manager,
  Customer Services Division,
  Locked Bag 2511 Perth WA 6001.
2.7 **Review and updates**

The Manual is intended to translate and interpret changes in legislation; regulations; technology and work practices into readily understandable requirements and instructions resulting in an affordable and reliable connection to the Network Operator’s distribution system.

These requirements will be reviewed regularly by the WADCM Management Committee in conjunction with relevant industry groups as part of the ongoing development of the Manual. Comments and suggestions on the content of the Manual should be forwarded via the mechanism described at Clause 2.6.

The flow chart (Figure 1) depicts the process to be adopted in the management of reviews, enquiries and potential amendments:

*Figure 1: WADCM management flow chart*
2.7.1 Seeking assistance with these requirements
To ensure that all questions, comments and suggested changes to the requirements are appropriately addressed, written feedback should be directed to the WADCM Management Committee. Feedback can then be logged and outcomes recorded for the benefit of all users. Any one of the following methods may be utilised:

- Via a participating Network Operator Clause 2.6.
- Through an industry association (refer to Clause 2.9 for contact details of participating Stakeholder Reference Groups);
- Direct contact for members of the public and non-association industry operatives;
- For Network Operator staff, via an Area Manager/Team leader.

2.7.2 Consideration and assessment
On receipt of a formal enquiry, the WADCM Management Committee will assess the feedback. Where the meaning of the requirement is clear, an immediate explanation may be provided. Where there may be broader industry/community interest in the enquiry, an FAQ may be posted on the Network Operator’s website. Should the requirement require modification, the WADCM Management Committee may wish to consult with another affected party/ies. In all cases a response will be provided through the relevant Network Operator to the author of the enquiry, on any relevant outcome(s)/action(s).

2.7.3 Website for (FAQ's)
FAQs may be viewed on the Network Operators’ websites. Where a clarification of the requirements is given in the form of FAQ the response will be included in the regular review process to determine if a permanent amendment to the requirements is required. If a change results, the specific FAQ will be deleted from the website and all registered users advised of the amendment.

2.7.4 Amendments and consultation
Where an enquiry results in a clarification, is intricate or may have the potential to trigger an amendment to the requirements, the issue will be categorised as either simple or complex:

Simple enquiry - an enquiry that impacts on only one sector of the industry and does not have cost implications.

Complex enquiry - an enquiry that may impact multiple sectors of the industry and/or may have cost implications.

Where the WADCM Management Committee considers an amendment is necessary, draft wording will be prepared. In the case of a simple enquiry only the affected party/ies will be consulted and the outcome forwarded for approval.

If the issue be considered complex, or as having major consequences for the industry and the community, more extensive consultation with all stakeholders may occur followed by a submission to senior management within each Network Operator for final consideration and determination.

2.7.5 Approval and consolidation
Based on review recommendations, Network Operator senior management will make a determination on an appropriate course of action(s) pertaining to any amendment or modification of the requirements. The WADCM Management Committee will then be informed in order to implement any changes, which will be regarded as final and accepted by all affected parties.
2.7.6 **Publication and notification of changes**
The WADCM Management Committee will post any revision(s) on the Network Operators’ websites and notify all registered users of the changes or amendments. See Clause 2.5

2.8 **Amendment information**
A list of amendments and changes made to this Manual will be maintained in the Appendices and supporting documentation to assist industry comply with the Network Operator’s requirements.

2.9 **Stakeholder Reference Group (SRG)**
The Stakeholder Reference Group (SRG) is made up of invited representatives from the following organisations:

- Australian Institute of Architects - [AIA](https://www.aia.com.au)
- [Consult Australia](https://www.consultaustralia.com) (formerly Association of Consulting Engineers Australia)
- Department of Mines, Industry Regulation and Safety ([EnergySafety](https://www.dmiwa.wa.gov.au/))
- Housing Industry Association - [HIA](https://www.hia.com.au)
- Horizon Power - [Horizon Power](https://www.horizonpower.wa.gov.au)
- Master Builders Association - [MBA](https://www.mba.com.au)
- Master Electricians Australia - [MEA](https://www.mea.com.au)
- National Electrical Communications Association (WA Chapter) - [NECA](https://www.neca.com.au)
- National Electrical Switchboard Manufacturers Association – [NESMA](https://www.nesma.org.au)
- Synergy - [Synergy](https://www.synergy.com.au)
- Western Power - [Western Power](https://www.westernpower.wa.gov.au)
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Section three

Scope and legislation
3 Introduction

3.1 Purpose

The purpose of the Western Australian Distribution Connections Manual (the requirements) is to provide industry and the community with information on Network Operator connection conditions to assist them in applying for and establishing a connection to a distribution or stand-alone network.

The requirements contained within this Manual are particular to the specific Network Operator’s electricity network. Maps depicting Network Operator coverage are in the Appendices. For information about connection requirements in other locations please refer to the relevant Network Operator in that area. If unknown, please refer to the WA Electrical Requirements WAER or go to the Economic Regulation Authority’s website for Network Operator licensing details, operational maps and reports. ERA Economic Regulation Authority of Western Australia - Electricity Licensing - Licence Holders

3.2 Scope of these requirements

These requirements are in addition to the requirements prescribed within the WAER and applicable Australian Standards including but not limited to AS/NZS 3000. These requirements apply to all new installations, alterations or additions to existing installations that require a connection or upgraded connection, to the Network Operator’s distribution networks within the NWIS, NIS and the SWIS. In summary, the contents of this Manual cover:

- Single customer supply arrangements
- Connection requirements in addition to those prescribed in WA Legislation
- Types of available supply and connections
- Application processes
- Service (overhead and underground) arrangements
- Metering requirements (including multiple master metering)
- Reference material and contact details

This Manual does not cover the Network Operator’s requirements for:

- Subdivisions
- The customer’s installation downstream of the point of connection
- Or issues relating to electrical licensing

These requirements do not apply to existing connections made to the network prior to publication of the WADCM as long as the connection was compliant with the relevant requirements at the time of energisation.

3.3 Users

Unlicensed individuals may use this document for information purposes only. It should be noted that it is unlawful and dangerous for unlicensed individuals to perform electrical work, as this may place themselves or others at risk of harm or prosecution, or both. Refer to Clause 3.7
3.4 Compliance with these requirements

A Network Operator will not connect a non-compliant customer's electrical installation, until it is made compliant by the applicant.

A Network Operator may disconnect a non-compliant customer's electrical installation until the non-compliant element of the installation complies with the requirements of this Manual.

Re-inspection of the customer's electrical installation may be required for reasons of non-compliance. In such cases the Network Operator may apply a reinspection fee.

3.5 Innovation and variations

These requirements do not preclude the use of other methods, innovation, or technologies that achieve the same outcome(s) as detailed in this Manual. Should a customer or their agent have an alternative arrangement or proposal it must be forwarded to the applicable Network Operator for formal evaluation and acceptance.

Where alternative methods to those prescribed in this Manual are proposed a formal application shall be submitted to the Network Operator accompanied by:

a) A detailed statement of the reasons why non-compliance with these requirements is sought or cannot be achieved; and

b) The owner or controlling body of the installation shall provide a Statement of Consent in the form of a signed affidavit acknowledging and approving the application for exception.

Until such time as a formal response, either accepting or rejecting the application, is received from the Network Operator, the applicant or their agent shall not commence any work or take any action on the project/installation that is the subject of the application. Applications pertaining to exceptional circumstances shall be addressed to.

3.5.1 Horizon Power

For further information and guidance on Horizon Power’s requirements for a connection within the NWIS or NIS phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

3.5.2 Western Power

Area Manager Customer Connections Design
Western Power, Locked bag 2511 Perth 6001

3.6 Compliance with acts and regulations

Applicants and industry participants seeking a connection must ensure that the customer's electrical installation is electrically safe and compliant with applicable legislation.

This requirement also applies where an existing electrical installation is altered, in that the applicant and their agent must ensure that the altered portion of the installation is electrically safe and compliant when the installation is connected.

Non-compliance may result in action being taken against the offending party(s) by the responsible governing agency or the installation not being connected, disconnected or the electricity connection delayed.

The following limited legislative overview has been provided as a guide to assist readers gain an awareness of the regulatory framework within the building and construction environment. The following references should not be construed as a full or complete list of all statutory requirements:
3.6.1 **Electricity Corporations Act 2005**
This is a governing Act, which establishes and sets out the functions and powers of each of the following organisations:

- Horizon Power
- Synergy (Merged Electricity Generation and Retail Corporation)
- Western Power.

3.6.2 **Electricity Act 1945**
This Act:

- Provides for the examination and licensing of persons who carry out work related to electricity
- Specifies supply authorities and Network Operator’s duties and Power’s; and
- Regulates the approval and prohibition of electrical appliances.

Under this Act Network Operators must:

- Maintain their equipment installed on the customer’s property in a safe and fit condition
- From the time when the Network Operator begins to supply electricity through the distributing main, maintain a continuous and steady supply of electricity
- Take all reasonable steps to avoid the risk of fire or damage to customer’s property from Network Operators equipment; and
- Maintain the system pressure and frequency of electricity supply to the customer within a prescribed limit.

The Act also provides for the following Regulations:

3.6.2.1 **Electricity (Licensing) Regulations 1991**
These Regulations make provision for the:

- Scope of work required to be performed by licensed persons
- Licensing of electrical workers and contractors
- Duties and responsibilities of licensed persons
- Regulation of electrical work and the application of standards to that
- Notification of the commencement and completion of electrical work
- Reporting of defective installations or work
- Reporting of electrical accidents and incidents.

As a part of the provisions of these Regulations electrical work is to be carried out in accordance with certain requirements including but not limited to:

- The Wiring Rules (AS/NZS 3000)
- The WA Electrical Requirements *(WAER).*

Where any code or standard that is identified within the Regulations is inconsistent with the WAER, the WAER shall prevail to the extent of that inconsistency.

3.6.2.2 **Electricity (Network Safety) Regulations 2015**
These Regulations provide for the safety of operations on the electricity network.
3.6.2.3 **Electricity Regulations 1947**

The 1947 Regulations regulate the actions of Network Operators in relation to the supply of electricity to customers. They also stipulate the:

- General safety requirements for electrical work including notification and inspection systems
- Contractors’ responsibilities for the submission of notices and the certification of the standard of work
- Energy efficient labelling requirements
- Provision for the approval of electrical appliances
- Employer responsibilities to supply electrical safety equipment and implement safety procedures.

3.6.3 **Electricity Industry Act 2004**

This Act:

- Creates the wholesale electricity market
- Implements a licensing regime for electricity by the ERA
- Provides for a network infrastructure access code
- Creates a tariff equalisation fund
- Provides for a Code of Conduct and an Ombudsman to protect small use customers (up to 160 MWh per year)
- Allows for the preparation and submission of policies to the Coordinator of Energy governing extension, expansion and customer connection to the transmission and distribution system.

The Act also provides a framework for the ERA to govern matters such as:

- The administration of electricity licensing (not Worker licensing)
- Electricity metering
- Transfer of customers between Retailers
- Electricity quality and reliability standards
- Compensation payable if licensees fail to meet electricity quality and reliability standards
- Access to certain public and private electricity networks for parties who are not owners or operators of a network.

3.6.3.1 **Electricity Networks Access Code 2004**

The Code

- Establishes the framework for third party access to electricity transmission and distribution networks with the objective of promoting economical efficient investment in, operation and use of, networks and services of networks in Western Australia.

3.6.3.2 **Small User Customer Code**

The Small User Customer Code gains its authority from the Electricity Industry Act and is administered by the Economic Regulation Authority. Its purpose/objectives are to regulate and control the conduct of electricity marketing agents, Retailers and distributors by:

- Defining standards of conduct in the supply and marketing of electricity to customers; and
- Protecting customers from undesirable marketing conduct.
3.6.3.3 **Electricity Industry (Obligation to Connect) Regulations 2005**

These regulations make provision for the placement of an additional condition on Network Operators in relation to an obligation to connect where the premises is:

- Not already attached to a distribution system
- Is attached to a distribution system but is not energised.

3.6.3.4 **Electricity Industry Metering Code 2012**

In summary the provisions of this Code relate to:

- Supply, ownership, installation and maintenance of meters and metering installations
- Accuracy and specification of metering installations
- Revenue metering installations and check metering installations used for the measurement of active energy and where appropriate, reactive energy
- The metering database, including registry requirements
- Provision of and charges for metering services provided by a Network Operator
- Collection, processing and provision of energy data and standing data
- Security of, ownership and rights of access to energy data and standing data
- Documents under this Code including model service level agreements and communication rules for the transfer of energy data and standing data to the relevant parties.

3.6.4 **Occupational Safety and Health Act 1984**

The objectives of this Act are to:

- Promote and secure the safety and health of persons at work
- Protect persons at work from hazards
- Assist in securing safe and hygienic work environments
- To reduce, eliminate and control hazards to which persons are exposed at work
- To foster co-operation and consultation
- To promote education and community awareness on matters relating to OS&H.

3.6.4.1 **Occupational Safety and Health Regulations 1996**

These Regulations make provision for the:

- General and administrative provisions of the act
- Workplace safety including general duties, environmental, workplace activities, electricity, earthworks, and demolition as they apply to the workplace
- Plant and equipment
- Hazardous substances
- Certificates of competency.

3.6.4.2 **National Standard for Construction Work**

Developed by the National Occupational Health and Safety Commission (now the Australian Safety and Compensation Council) to provide a nationally consistent approach to managing OSH in the construction industry.
This national standard has been adopted throughout Australia and in Western Australia via Part 3 Division 12 of the OSH Regulations 1996. The new standard covers high-risk activities including but not limited to work:

- Where there is a risk of falling more than 2 metres
- Excavations to a depth of more than 1.5 metres
- On or near energised electrical installations and lines (whether overhead or underground).

### 3.6.5 Mines Safety and Inspection Act 1994

The objectives of this Act are to:

- Promote, and secure the safety and health of persons engaged in mining operations
- Assist in identifying and reduce hazards relating to mines, mining operations, work systems and plant at mines
- Protect against and eliminate risks associated with mines, mining operations, mining systems, and plant and hazardous substances
- Foster and facilitate cooperation and consultation
- Provide for procedures to contribute to the development and formulation of safety legislation.

#### 3.6.5.1 Mines Safety and Inspection Regulations 1995

These Regulations make provision for the:

- General and administrative provisions of the Act
- Management of mines
- General safety requirements
- Electricity in mines
- General mining types and specific methods of operations.

### 3.6.6 Energy Operators (Power's) Act 1979

This Act provides Energy Utility Companies with the legal authority required to ensure an energy supply can be maintained throughout the network. Sections 46, 48 and 49 of the Act provides Network Operator staff with powers of access and entry for construction/maintenance purposes, though only when prior notification has been given. Where the situation is considered an emergency notification is not required prior to entry.

### 3.6.7 The Energy Coordination Act 1994

This Act provides for inspectors to be appointed and for the establishment of their Power's for the purposes of this Act including but not limited to:

- Entering upon land where electricity is generated, transmitted, distributed, is supplied or used
- Inspect plant, works, apparatus and installations
- Determine whether the Act or any other conditions are being complied with
- Investigate and report on the cause of any electricity related failure or damage
- Investigate and report on the cause of any death, injury, or property damage
- Serve written orders on a person(s) who controls or is responsible for an electrical related danger to be mitigated or remove that danger; and
- Inspect electricity related work practices and serve written orders on the person who is in responsible prohibiting that work practice or ordering that work practice to be modified

Any person who fails to comply with an inspector’s order commits an offence.
3.7 **Necessity for employing a licensed person**

In Western Australia, regulations do not permit unlicensed persons to work on electrical installations. Additional conditions apply to the licensing of electrical contractors including advertising as, or contracting to perform such work.

For enquiries regarding licensing, the qualifications to work, to undertake work, and/or to contract to perform electrical work on electrical installations should be referred to:

The Manager Electrical Licensing Board  
Department of Mines, Industry Regulation and Safety (EnergySafety)  
303 Sevenoaks Street, Cannington WA 6107  
P O Box 135 Cannington WA 6987  
**Phone** 08 6251 2000. **Fax** 08 6251 1902.  
**Web**: [energylicensing@dmirs.wa.gov.au](mailto:energylicensing@dmirs.wa.gov.au)

3.8 **Offences**

A person other than those legally entitled and endorsed to carry out electrical work shall not insert or remove or operate a Network Operator's fuse/link/circuit breaker or operate a customer's service protection device, tamper with or alter any meter measuring equipment, make or break any electrical connection (including seals and locks), dismantle any component part of a Network Operator's equipment or detach such equipment from its fixings. Additionally, obtaining electricity by any means other than by an approved method is classified as theft.

If a person is found guilty of such an offence, it may result in the imposition of substantial penalties together with an order for damages to compensate the Network Operator for any loss or rectification inclusive of court costs.

3.9 **Testing**

All electrical installation work including minor and maintenance work must be checked and tested by the installing electrical contractor prior to it being connected to the network or where permitted energised. In addition to these requirements the Network Operator may require testing and reporting as part of its installation and commission processes. The nature and type of testing required will depend on the both the type of installation and the voltage configuration. Further information on the Network Operator’s requirements is contained within the relevant technical Sections of this Manual.

3.10 **Access**

Network Operator personnel, including but not limited to emergency service crew, maintenance and construction staff, meter readers and inspectors, require 24 hour / 7 day access to network infrastructure and elements of the customer’s electrical installation including switchboard and metering equipment to perform their duties and to comply with their responsibilities. Network Operators generally do not require access to the customer’s installation downstream of the installations main switch(s).

Wherever possible Network Operator staff will seek to arrange a convenient time or schedule an appointment to meet on site if access to private property is required, however there are circumstances and times when this may not be possible. Customers need to be aware that Network Operators have the legal right to entry or gain access to private property.

For more information on energy utility company’s access rights refer to [Clause 3.6.6](#)
3.11 Inspection of customer’s premises

Network Operators must ensure that before electricity is supplied to the customer's premises, the installation has been checked, tested, is safe and ready to connect to their network.

A Network Operator’s inspection plan provides for a sample audit of all notifiable electrical work. As such not all electrical installations or electrical work is required to be inspected. The need to inspect is determined by but not limited to the:

- Nature and complexity of electrical installation
- Skills and experience of the electrical contractor and their employees
- Type of Licence held by the electrical contractor
- Type of Network Operator connection authorisation held by the electrical contractor.

For more information on the roles of Inspectors refer to Clause 3.6.7.
Distribution Connections Manual

Section four

Roles and responsibilities
4 Roles and responsibilities

4.1 Energy reform (disaggregation)

In April of 2006 Western Power Corporation as it was then known was split into four operational entities, each with new and specific responsibilities. In 2014 the retailer (Synergy) and generator (Verve) were merged, continuing to operate under the Synergy name.

- **Horizon Power** - Generator, Retailer and Network Operator (North West and Regional WA)
- **Synergy** - Generator and Retailer (Merged Electricity Generation and Retail Corporation)
- **Western Power** - Network Operator (South West Interconnected System).

The changes were part of the State Government’s reform of Western Power and the way in which electricity is generated, distributed and retailed in Western Australia. This Section provides a brief overview and summary of the roles and responsibilities of these four new entities as well as the other key stakeholders in the electricity supply chain.

Further information for all WA Network Operators, Retailers, and Generators can be found at either the Public Utilities Office’s website [Electricity Retailers](#) or by reference to the [ERA](#).

4.2 Regulatory, contractual and practical relationships

![Diagram of customer, industry, and regulatory relationships](#)

**Figure 2:** Customer, industry and regulatory relationships

**Note:** Number references relate to the following Clauses

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*PUO 4.3.10, DMIRS 4.3.7 & 4.8, ERA 4.3.9, Acts, Regulations, Standards, Codes and Guidelines 3.6, Generator 4.3.1, Network Operator 4.3.2, Electricity Retailer 4.3.3, Consumer 4.3.4, Consumer’s Agent 4.3.5 & 4.6, Connections Manual, Consumer’s Installation, Contract Agreements*
4.3  Electricity supply chain

In Figure 2 and the following descriptions, depict the regulatory and contractual relationships in conjunction with the practical roles required to be fulfilled by each party to ensure the effective supply, distribution and consumption of electricity throughout the electricity supply chain.

4.3.1  Generators

A Generator is any person or entity that owns, controls, or operates a generation system that supplies electricity to a distribution or transmission system. Owners of such systems can be either public or private and may also include alternative generation such as photovoltaic, wind or micro hydro systems.

4.3.2  Network Operators

Network Operators have a number of responsibilities associated with the transportation and delivery of electricity generated by others and purchased by Retailers for sale to customers. These include:

- Providing and maintaining, up to the point of supply, a distribution and transmission network for the conveyance of electricity
- Providing a point on the network (point of supply) to facilitate the customer's connection
- Negotiating the provision of and type of supply required by the customer
- Depending on the nature of the required supply, connecting of the customer's electrical installation to the distribution or transmission network
- Providing an administration structure for the connection process
- Administering National Metering Identifier (NMI’s) systems and procedures
- Providing meters for the Retailer’s use to measure electricity consumption
- Liaising with and confirmation of the connection details with the Retailer
- Providing an inspection regime to validate the customer’s installation
- Assuming responsibility for the reliability and quality of the supply.

Note: A customer is required to establish an account with a Retailer before a Network Operator can energise an installation.

4.3.3  Retailers

Retailers, have a range of responsibilities associated with the sale of electricity to customers including:

- Purchasing electricity from generators;
- Selling (retail) electricity at nominated tariffs (usage charges) to customers
- Establishing and administering customer electricity usage contracts and accounts
- Creating Customer Reference Numbers (CRN) for the administration of the customer’s account
- Confirming with the Network Operator, the customer’s electrical connection parameters in accordance with the customer’s contract including:
  - Metering arrangements
  - Type of connection
  - Date of connection or disconnection.

It should be noted that electricity accounts are categorized as contestable and non-contestable. For more information please refer to Clause 4.4 in this Section.
4.3.4 **Customers**

Being the recipient of electricity, the customer's key obligations are to:

- Make an application for a connection to a Network Operator's distribution or transmission network
- Choose and establish an electricity account with a Retailer
- Ensure their electrical installation is used in the manner for which it was intended and is regularly maintained and remains hazard free
- Engage the services of an electrical contractor, either directly or via an agent, to undertake any required electrical work.

4.3.5 **Customer’s agent / representative**

A customer's agent represents the customer in the processes of design, manufacture, construction, connection and delivery of the customer's installation in accordance with the customer's instructions or direction. Such parties may include:

- Architects
- Electrical consulting engineers
- Builders
- Developers
- Registered electrical contractors and their electrical workers
- Equipment manufacturers

Where the customer chooses to place the responsibility of their project under the control of an agent that entity is responsible to ensure the customer's obligations, to those parties identified within this Section of the requirements, are fulfilled in a timely manner.

4.3.6 **Electrical Contractors**

The electrical contractor's role is to complete the electrical installation and where approved complete the connection to the network. The electrical contractor may be contracted either directly by the customer or via an agent. Regardless of the contractual arrangement the electrical contractor must:

- Consider, in consultation with the customer or their agent, the type of connection required (i.e. single or three phase)
- Determine the amount of electricity required for current and future use
- Before commencing the work, advise the Network Operator or Regulator of the intention to commence electrical installation work as required by a “Preliminary Notice”
- Complete the installation to the required standard(s) together with the installation of the consumer mains cable
- Where approved, install and connect the meter and connect the mains cable
- Test and commission the installation
- Where approved, energise the installation
- Provide the customer account details (CRN number) to and advise the Network Operator as required by a “Completion Notice” that the electrical work is complete and is ready for connection or is complete and has been connected/energised
- Provide the customer with an “Electrical Safety Certificate”.
4.3.7 Department of Mines. Industry Regulation & Safety (EnergySafety)

EnergySafety is a division of the Western Australian Department of Mines, Industry Regulation and Safety responsible for the technical and safety regulation of the electrical industry and most of the gas industry in the State. EnergySafety’s responsibilities include:

- Safety standards and standards of workmanship
- Safety and energy efficiency of appliances and certain types of equipment
- Ensuring Network Operators, Generators, industry and community compliance with legislation
- Administration of occupational licensing of contractors and workers.

EnergySafety also promotes electrical and gas safety to customers in the home and at work, and in various ways encourages electrical and gas workers in industry to use safe work practices. For more information about EnergySafety please refer to their website.

4.3.8 Department Mines. Industry Regulation & Safety (WorkSafe)

WorkSafe is also a Division of the Department of Mines, Industry Regulation and Safety, responsible for the administration of the occupational safety and health legislation throughout the state. The principal objective of the Occupational Safety and Health Act 1984 is to promote and secure the safety and health of persons in the workplace. For more information about WorkSafe please refer to their website.

4.3.9 Economic Regulation Authority (ERA)

The ERA is an independent economic Regulator for Western Australia that regulates monopoly aspects of the gas, electricity and rail industries, which includes the licensing of gas, electricity and water services.

It has a range of responsibilities in the retailing of gas and surveillance of the wholesale electricity market in Western Australia and has functions that are designed to benefit the Western Australian community by maintaining a competitive, efficient and fair commercial environment, particularly where businesses operate as natural monopolies. For more information about the ERA please refer to their website.

4.3.10 Public Utilities Office (PUO)

The Public Utilities Office provides a range of services on energy matters to the Minister for Energy, Government, the energy sector and the West Australian community. It:

- Plans, develops and implements energy policies and strategies for Western Australia
- Develops and administers subsidies, rebates and grants for the Western Australian community and energy industry
- Researches, analyses and advises on energy sector developments, trends and issues
- Provides information and education materials for industry and customers
- Consults and communicates with industry, customers and other stakeholders
- Monitors the performance of Government-owned, network owners and private generators.

For more information about the Public Utilities Office please refer to their website.
4.3.11 The Independent Market Operator (IMO)

The Independent Market Operator’s aim is to provide and maintain effective infrastructure for the efficient operation of the Wholesale Electricity Market in Western Australia. The IMO’s responsibilities can be summarised as:

- Administering the market rules
- Operating the wholesale electricity market
- Facilitating the provision of sufficient generation capacity and demand side management to meet expected demand.

4.4 Contestable accounts

Generally Network Operators are no longer able to sell electricity or establish and administer customer’s electricity accounts unless they are the holder of a retail Licence issued by the ERA. This is now a primary function of electricity Retailers. To establish an electricity account a separate application must be made to either a designated Retailer for non-contestable accounts or to a Retailer of the customers’ choosing where the account is deemed to be contestable. The boundaries for account contestability are set and monitored by the Public Utilities Office.

A non-contestable account is determined by the amount of electricity consumed being less than 50 MWh a year or approximately 137 units a day.

Contestable accounts are also determined by the amount of electricity used. Where consumption exceeds 50 MWh a year the account holder may choose an electricity Retailer and negotiate the tariff/price for electricity purchased.

4.4.1 NWIS or NIS distribution areas customers (Horizon Power)

Contestable customers should contact Horizon Power for additional information on electricity account in their designated distribution area. All Horizon Power customers are contestable.

Website www.horizonpower.com.au or call 1800 267 926 (Residential) or 1800 737 036 (Business).

4.4.2 SWIS distribution areas customers (Western Power)

Customers connected to Western Power’s SWIS network may elect to choose a Retailer where the contestability criterion has been satisfied.

4.4.2.1 Non-contestable accounts

For non-contestable accounts, Synergy is the only designated electricity Retailer within the SWIS designated distribution area.

Website www.synergy.net.au

or call 13 13 53 (Residential) 13 13 54 (Business).

4.4.2.2 Contestable accounts

For details of available electricity Retailers for contestable accounts refer to the Public Utilities Office website.

4.5 Dispute resolution

In addition to and in collaboration with the Network Operator’s individual Customer Charter, (Clause 3.6.3.2), a formal disputes resolution mechanism has been established, designed to resolve issues relating to the distribution connection process.
Where contact has been established at the operation level, ongoing communication is encouraged with that Network Operator representative to address unresolved issues. Should the customer or their agent not have an initial point of contact then the matter should be referred to the applicable Network Operator’s Customer Contact Centre.

4.5.1 Horizon Power
Residential enquiries call 1800 267 926 and Business enquiries call 1800 737 036.

4.5.2 Western Power
All enquiries contact Western Power on 13 10 87.

4.5.3 Unresolved issues
If it is perceived by one or more of the affected parties that the issue has not been addressed satisfactorily then the party(s) may choose to escalate the issue (via the Network Operators customer contact centre) to the next level by seeking an appeal of any outcomes /decisions made by operational staff. Network Operator senior management will conduct a review of the issue/complaint.

Where the customer remains dissatisfied with the review and response from the Network Operator regarding their complaint or should the customer disagree with the action taken or decision made then the matter may be referred to the Energy Ombudsman. Refer to Clause 5.3.4 for contact details.

4.5.4 Distribution connection resolution pathway
The following flow chart (Figure 3) depicts the process for resolution of customer concerns or disputes:

![Flow chart for resolution of distribution disputes](image)

**Figure 3:** Flow chart for resolution of distribution disputes
Distribution
Connections Manual

Section five

Contact details
5 Contact details
5.1 Horizon Power contacts

<table>
<thead>
<tr>
<th>Contact reason</th>
<th>Contact number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential account enquiries</td>
<td>1800 267 926</td>
</tr>
<tr>
<td>Business account enquiries</td>
<td>1800 737 036</td>
</tr>
<tr>
<td>Emergency or supply interruptions and restoration times.</td>
<td>13 23 51</td>
</tr>
<tr>
<td>Faulty streetlights and poles</td>
<td>1800 264 914</td>
</tr>
<tr>
<td>Media Enquiries</td>
<td>1800 799 745 (all hours)</td>
</tr>
<tr>
<td>TTY (Speech or Hearing Difficulties)</td>
<td>1800 461 499</td>
</tr>
<tr>
<td>Interpreter Service</td>
<td>13 14 50</td>
</tr>
</tbody>
</table>

Table 1: Horizon Power contact details

5.1.1 Head office
PO Box 817 Karratha WA 6714 Australia
Phone: (618) 9159 7250  Fax: (618) 9159 7288
Online: Contact Us

5.1.2 Bentley administration centre
PO Box 1066 Bentley DC WA 6983 Australia
Phone: (618) 6310 1000  Fax: (618) 6310 1010
Online: Contact Us

5.1.3 Regional offices
Please note: Regional Offices should not be contacted regarding faults or customer account enquiries.

Broome
Lot 1050 McDaniel Rd Broome
WA 6725
Ph: (08) 9192 9900  Fax: (08) 9192 9901

Esperance
143 Sims Street, Esperance, WA 6450
PO Box 148 Esperance WA 6450
Ph: (08) 9072 3400  Fax: (08) 9072 3401

Kununurra
Lot 228 Messmate Way Kununurra
WA 6743
Ph: (08) 9166 4700  Fax: (08) 9166 4720

Carnarvon and Mid West
Corner Iles Rd and Robinson St Carnarvon
WA 6701
Ph: (08) 9941 6299  Fax: (08) 9941 2595

Karratha
Shop 24, Karratha Village Stovehill Road,
Karratha, WA 6714
PO Box 817 Karratha WA 6714
Phone (08) 9159 7250  Fax (08) 9159 7288

Port Hedland
18 Anderson St Port Hedland
WA 6721
Ph: (08) 9173 8281  Fax: (08) 9173 8222

5.1.4 Complaints
Horizon Power Customer Service Representatives are available to assist customers with any matters relating to their power supply (Complaints).

5.1.5 Feedback
Your satisfaction is important, which is why we would like to hear from you. This will help us to further improve our services. (Horizon Power Feedback)
5.2  **Western Power country and metropolitan contacts**

<table>
<thead>
<tr>
<th>Contact reason</th>
<th>Contact number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faults and emergencies, power interruptions, estimated restoration times (24 hours)</td>
<td>13 13 51</td>
</tr>
<tr>
<td><em>Power Quality</em> (lights flickering, appliances fail or television and radio interference)</td>
<td>Online form or 13 13 51</td>
</tr>
<tr>
<td>Street light faults (off during the night or on all day)</td>
<td>Online form or 1800 622 008</td>
</tr>
<tr>
<td>Graffiti (24 hours a day, 7 days a week)</td>
<td>Online form or 1800 442 255</td>
</tr>
<tr>
<td>General and technical enquiries (No fault information)</td>
<td>13 10 87 <a href="mailto:enquiry@westernpower.com.au">enquiry@westernpower.com.au</a></td>
</tr>
<tr>
<td>Pillar and Pit energisation enquiries</td>
<td>13 10 87</td>
</tr>
<tr>
<td>Trees that are close to powerlines (No fault information)</td>
<td>1300 368 733</td>
</tr>
<tr>
<td>Media enquiries (No fault information)</td>
<td><a href="mailto:media@westernpower.com.au">media@westernpower.com.au</a></td>
</tr>
<tr>
<td><em>Complaints and feedback</em></td>
<td>Online form or 13 10 87</td>
</tr>
<tr>
<td>Western Power administration - head office (No fault information)</td>
<td>08 9326 4911</td>
</tr>
<tr>
<td>Website feedback - missing pages, positive or negative feedback</td>
<td>Email us</td>
</tr>
</tbody>
</table>

**Table 2:** Western Power contact details

5.2.1  **Accessibility**

Customers with hearing or speech difficulties please phone **TTY 08 9326 6175**.

5.2.2  **Postal address**

Main Western Power Mailing Address
GPO Box L921, Perth, WA 6842

Customer Service and Complaints
Locked Bag 2504, Perth, WA, 6001

Meter Reading Services (Self-Read Meter Cards)
Reply Paid 8285, Perth BC, 6849

5.2.3  **Email address**

Western Power has an Online form for providing feedback about the organisation.

5.2.4  **Head office location**

Head Office
363 Wellington Street, Perth, WA, 6000

5.2.5  **How to report a problem**

All cases of emergencies, faults, power interruptions, and estimated restoration times (24 hours) should be referred to the Western Power Call Centre on 13 13 51. More information regarding what to do can be found at [how to report it](#).
5.2.6 Calls from mobile phones
Calls from mobile phones will attract higher call rates. If the call is about a power interruption, it is recommended to use a landline phone. Western Power’s system can identify the area the call is from and therefore give the caller the relevant information more quickly. It is suggested that customers keep a standard (non-cordless) telephone at their premises, as these devices generally work even when the power has been disrupted.

5.2.7 Network connections
Electrical contractors may obtain specific supply or regulatory rulings by submitting a Preliminary Notice to Western Power’s Connections Office.

South West Interconnected System – Telephone 13 10 87 for the latest details of Connections Office locations and mail, phone and fax details.

5.3 General contacts

5.3.1 Dial Before You Dig
For information on existing gas, water, communications and electricity underground networks. Call 1100 or Dial Before You Dig

5.3.2 Electricity retailers
Electricity can be purchased from an electricity Retailer who also manages and administers electricity accounts. Unlike Horizon Power, Western Power does not sell electricity; as their role is restricted to distributing (transport) electricity through the network. For full details and a list of all Electricity Retailers refer to the Public Utilities Office website.

5.3.3 Electrical industry licensing
Enquiries regarding licensing, qualifications to work, to undertake work, and/or to contract to perform electrical work on electrical installations contact:

The Manager,
Electrical Licensing Board,
303 Sevenoaks Street, Cannington WA 6107
Phone 08 6251 2000. Fax 08 6251 1902.
Web: energylicensing@dmirs.wa.gov.au

5.3.4 Energy ombudsman
Enquiries regarding the resolution of complaints from residential and small business customers about their electricity/gas company can be addressed to:

Energy Ombudsman
12th Floor, St Martins Tower
44 St Georges Terrace Perth WA 6000
Phone: 08 9220 7588 Free call: 1800 754 004 Free fax: 1800 611 279
Email: energy@ombudsman.wa.gov.au
Distribution Connections Manual

Section six

General requirements
6 General requirements

6.1 Introduction
Every person regardless of whether they are a Network Operator employee, customer, agent, electrical contractor/worker, or a member of the public has both a direct and indirect responsibility for their own safety and the safety of others. Each person must take all reasonable steps to ensure their own health and safety while at the same time actively seeking to ensure that they avoid adversely affecting the health and safety of any others due to any act or omission on their part.

Every task or action described within this Manual must be performed in accordance with the relevant Acts, Regulations, Codes of Practice, Standards, and Network Operator requirements.

6.2 Safety policy statement
Safety and health is central to everything Horizon Power and Western Power do. No activity or task is considered to be that important that it will be permitted to compromise safety. Work must cease if safety cannot be assured.

The potential hazards of electricity require the highest standards of safety and health. Horizon Power and Western Power are committed to the prevention of injury and harm and will strive to continuously improve safety and health performance.

6.2.1 Safety and operational procedures
Any person, contractor, authorised operative or supplier working on or near a distribution network, must manage their safety and health obligations in accordance with sound industry practice, applicable legislation, codes and the Network Operator’s requirements.

All electrical installations, apparatus and equipment shall be regarded as live until isolated, proven to be de-energised and where required earthed or short circuited. No work shall commence until the required work permits have been issued or obtained and the appropriate safety, danger, out of service or operational tags have been fitted in accordance with the Network Operator procedures.

The Network Operator shall be contacted at the earliest opportunity where isolation of a supply is required to enable work to be performed safely. Refer to the relevant Network Operator for details of their Network Access Procedures.

In addition to the Network Operator's requirements persons working on a customer's installation must, also apply and observe the requirements of EnergySafety's Code of Practice “Safe Low Voltage Work Practice by Electricians”

6.2.2 Operational clearances
These requirements specify the clearances to be maintained at all times when working either on or near a Network Operator’s distribution network. Where the required clearances cannot be maintained, the Network Operator must be contacted to arrange the appropriate isolation of or alteration to the distribution network to achieve the required level of operational safety and clearances.

6.2.2.1 Horizon Power safety guidelines
For further information and guidance refer to Horizon Power’s Contractor Occupational Safety and Health guidelines.
6.2.2.2 Western Power safety guidelines

Western Power published policies and guidelines including Electrical System Safety Rules and Works Practices Manual must be adhered to when on or near the SWIS network.

The Electrical System Safety Rules provide a standard set of requirements and procedures to govern access to Western Power’s network. The requirements are intended for all persons who work on or near the Western Power electrical system.

The Works Practices Manual contains specific directions and instructions relating to particular tasks and activities undertaken to provide a connection to the network. These requirements apply to all Western Power personnel and contractors when undertaking work for or on behalf of Western Power.

6.3 Working near network infrastructure

It is the responsibility of the site owner, company or contractor to ensure that work near overhead or underground services can be carried out safely. Clearance requirements must be maintained at all times.

If work is planned near Network Operator underground or overhead powerlines, permission must be obtained from the Network Operator before commencing the work. Additionally adequate clearances must be maintained for privately owned lines.

6.3.1 Horizon Power requirements

For further information and guidance on Horizon Power’s requirements for working near overhead powerlines within the NWIS or NIS phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

6.3.2 Western Power requirements


6.4 Underground (excavation)

Regardless of whether the area to be excavated is in an undeveloped location, built up area, road reserve or public open space there may be services buried in the ground but not physically identified. There may also be registered services such as high-pressure gas mains, underground distribution cabling, water, and telecommunications services located within easements on private property.

All utility services located within road reserves and public open spaces are registered with the Dial Before You Dig (DBYD) system. The customer or their agent must contact DBYD to confirm the existence of any services within the proposed trench vicinity before any work is commenced. This simple action can prevent damage or disruption to essential services.

DBYD is a free national referral service, supported by Horizon Power and Western Power, which in most cases can provide plans showing the location of any underground services and cabling within two working days of an enquiry.

Irrespective of the location of the excavation, be it on public or private land, use of the DBYD service is strongly recommended prior to any work commencing. Responsible persons should also be aware that in the event of a service being damaged, some insurance claims may not be accepted. Heavy financial penalties may be applied for negligent behaviour if the DBYD system was not utilised. For more information refer to Dial Before You Dig
6.4.1 **Horizon Power guidelines**
For further information and guidance on Horizon Power’s requirements for excavation works within the NWIS or NIS phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

6.4.2 **Western Power guidelines**
Additional information is available from Western Power where excavation work is required near or around Western Power’s underground, overhead distribution or transmission infrastructure to protect both the installed infrastructure and the people involved in the process. The Electrical System Safety Rules and the Works Practices Manual provides guidance on:

- Minimum requirements
- Work permits
- Approach distances for underground cables
- Danger zones for overhead powerlines
- Emergency procedures

6.5 **Overhead powerlines**
Working near or in close proximity to overhead powerlines is hazardous if appropriate precautions are not implemented. It is not necessary to come into physical contact with a powerline to endanger life or cause damage to property. Regardless of the voltage, electricity can arc across an air gap if the clearance is not sufficient.

Consequently it is important to maintain appropriate distances to ensure safety when work is carried out near powerlines such as new building construction, restoration/renovation work, installation of advertising equipment or the erection of scaffolding.

To ensure the safety of both industry operatives and the public, WorkSafe WA has enacted legislation that sets clearance boundaries, known as danger zones, around overhead powerlines which must be maintained at all times. These zones range from six (6) metres down to 500 mm from overhead lines, dependent on the voltage and type of conductor used.

For more information on WorkSafe’s danger zones (Regulation 3.64) and related work requirements refer to their brochure on Overhead Powerlines.

6.5.1 **Horizon Power guidelines**
For further information and guidance on Horizon Power’s requirements for excavation works to be undertaken near overhead infrastructure within the NWIS or NIS phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

6.5.2 **Western Power guidelines**
6.5.3 Building and structural clearances near powerlines
As is the case for safe working distances, there are also minimum clearances from overhead powerlines that must be maintained for completed structures, buildings, roads, paths and access ways.

It is the customer’s responsibility to determine whether their structure is at a safe distance from overhead lines. If there is any doubt as to the requirements, the customer or their agent should seek the advice of a professionally qualified electrical engineer, electrical contractor, Regulator or Network Operator.

Clearances from transmission/distribution lines and overhead service cables must be in accordance with AS/NZS 7000 “Overhead line design - Detailed procedures”. For more information on structural clearances refer to Standards Australia or refer to the Network Operator’s policy documentation on conductor clearances from structures.

Australian standard AS/NZS 3000 Table 3.8 also contains conditions for Minimum Aerial Conductor Clearances for a range of situations over or near which customer aerials may pass including structures such as buildings, roofs, antennas, swimming pools etc.

Should there be an inconsistency in the minimum clearance requirements between AS/NZS 7000 and AS/NZS 3000, the more stringent requirement shall be applied.

6.5.4 Vegetation
There are two aspects to be considered when determining vegetation clearances from powerlines. The first relates to persons working in close proximity to powerlines, and the second deals with the maintenance and control of vegetation near overhead lines.

WorkSafe Regulations, specifically regulation 3.64, describes the requirements and sets the boundaries pertaining to danger zones around and within overhead powerlines. These zones restrict the entry of persons, plant or material used by or controlled by those persons and place additional operational obligations if work is required within the zone. For further information on WorkSafe’s requirements refer to their brochure on Overhead Powerlines.

It is important that vegetation is controlled and powerline clearances maintained to ensure community and property safety and to avoid damage to the electricity network. EnergySafety’s Guidelines for the management of vegetation near powerlines provides vegetation clearances details and information on the requirements for certification as a vegetation control person.

Note: The diagram to the left illustrates responsibilities for trimming trees: The orange trees inside the boundaries of ‘Property A’ are the responsibility of the occupier of Property A; while the green trees inside the boundaries of ‘Property B’ are the responsibility of the occupier of Property B. Trees planted on verges are the responsibility of the local council.

Figure 4: Responsibilities for vegetation control.
Network Operators strongly recommend the use of professional certified tree pruning companies to trim trees. Contact details for approved companies are listed with the Network Operators strongly recommend the use of professional certified tree pruning companies to trim trees. Contact details for approved companies are listed with the Tree Guild or in the Yellow Pages.

### 6.6 Road reserve allocation

To ensure the maintenance of required clearances and the efficient use of limited space in road reserves and public open spaces, the Utility Providers Services Committee (UPSC) has been given a range of responsibilities including the coordination and allocation of alignments and space for services within road reserves.

To assist contractors and Utilities including Network Operators, the UPSC has developed and published a Utility Providers Code of Practice. The code refers to road reserves in urban and town site areas. Application of this code applies to standard service alignments and common trenching. In rural reserves outside urban and town site areas, reference should be made to either Main Roads WA or local government for advice, as urban type allocations may not apply.

**Figure 5** provides a typical but not definitive layout of services in road reserves. For detailed information including drawings of road reserves and emergency procedures refer to **Utilities Providers Code of Practice**.

![Figure 5: Cable alignment and depth for greenfield sites](image)

**Note:**
1. Minimum depth of cover over cables should be a minimum 750 mm. However, the depth of cover over cables in nominal alignments may be increased as required so that cables joints have the necessary depth of cover.
2. The width of the power allotment shown above as 500 mm may vary up to 600 mm

The Code of Practice also provides details for lot entry arrangement drawings indicating location of utility service provisions from road reserves to lots without retaining walls or with retaining walls less than 1.1 m high at the services location.

### 6.7 Private property

There is no single set of rules governing the installation of essential services including electrical, water, gas, communications, and sewage within a private property. **WAER** and AS/NZS 3000 determine the installation methods to be observed by electrical contractors when installing electrical services including those to be enclosed within a common services trench. The location of underground services may vary dependent on the customer’s requirements or the builder’s works program. Although it is common to locate essential services within the same building alignment, extreme care should always be exercised prior to and during excavation works.
6.7.1 **Surveying, levels and pegs**

The customer or their agent is responsible for surveying, pegging and accurately defining the project’s property boundaries/levels, inclusive of cable routes and the position of any network equipment, substations or pillars to be located within the customer’s property.

The customer is responsible for replacing any missing pegs and shall ensure that before any distribution network work begins, the project’s finished ground levels have been established and all pegs are in place. The customer will be charged for any additional costs incurred by the Network Operator where cable routes or boundaries have been incorrectly pegged.

6.8 **Easements**

Easements provide an individual, company or entity with "rights of use or engagement" over land owned by another. Where an easement is required on or above a third party’s property, the applicant (customer) must negotiate with all affected parties to arrange for an easement to be created in accordance with the relevant State/Federal Acts and the Network Operator.

The customer is responsible for lodging the easement application and for all costs associated with the creation of the easement. Additionally the customer is responsible for advising all potential land users or purchasers of the existence of an easement, its location and any usage or restriction issues.

The creation of common property or an easement on private property, public open space (POS), public access way (PAW) or on public road reserves may be required to ensure:

- Access to a service pillar, LV frame or substation for the purposes of installing and connecting consumer mains or sub-mains to a site main switchboard where there or more than two installations on a lot; or
- For the erection and installation of overhead or underground power systems including supplementary equipment as a part of the network or a supply an individual customer.

Easement details shall be recorded on the Diagram of Survey and on the Certificate of Title. Easement restrictions should generally include:

- No building is allowed over the easement
- Network Operator requires unimpeded access to the easement at all times.
- No cultivated vegetation is allowed over the easement.

The minimum width of an easement for the installation of underground cables shall be 1 metre. Easements can be created in a number of different ways with the following examples being the most common.

6.8.1 **Easement types**

6.8.1.1 **Section 167 easement (previously section 27A easement)**

This is an easement created automatically for new lots and subdivisions under Section 167 of the Planning and Development Act 2005 (previously known as Section 27A of the Town Planning and Development Act, 1928) to facilitate the installation of and ongoing access for roads and utility services including Network Operator transmission and distribution systems.
6.8.1.2 **Section 136C easement**

An easement may be created on existing Crown and freehold titles including survey strata lots and plans under Section 136C of the *Transfer of Land Act 1893* to provide for customer owned services such as electrical and plumbing connections to the requisite utility network.

6.8.1.3 **Section 144 crown easement**

Under Part 8 of the *Land Administration Act 1997* the Minister may grant an easement over Crown land to permit works on the land to allow for the passage of persons or provision of services such as electricity.

6.8.2 **Assistance with easements**

The application for and the granting of an easement can be a complex matter therefore Network Operators strongly recommend that before any action is taken in regards to such matters advice is sought from Landgate (previously known as the Department of Land Information) or the Western Australian Planning Commission.

6.8.3 **Strata schemes**

There are two types of schemes permitted under the *Strata Titles Act 1985*, being:

- **Strata Schemes** are the original form of "strata scheme", or "strata plan", commonly known as "building or built strata". At least one building must be shown on the strata plan with the boundaries of the strata lots, including the height of the lots (stratum) defined by reference to the building. Prior to June 1985, lots could only be within a building. After that date, part of the lot can also include land outside the building and parts of the building structure.

- **Survey-Strata Schemes** were introduced in 1995 and commonly known as a "survey-strata scheme". The boundaries of survey-strata lots must be surveyed by a licensed surveyor and may include common property but not shown buildings. The lots on a survey-strata plan can have a similar appearance and look to lots shown on surveys (deposited plans, plans and diagrams) for non-strata freehold titles.

In January of 2006 the WAPC’s model conditions and associated advisory notes were amended to include model condition E2, relating to “service access rights” for strata schemes. This condition is designed to ensure that each lot has access to essential service connection points via an implied or Section 136C easement or through the use of common property.

However, there may still be undeveloped subdivided strata and survey strata lots that predate this process or falls outside the jurisdiction of the WAPC and therefore may have unidentified access/rights issues.

In such cases it is responsibility of the affected land owner(s) to negotiate and secure appropriate access for the installation and connection of their essential services, including consumer mains cable to the designated service pillar by their electrical contractor.

6.8.4 **Dispute negotiation and mediation**

The resolution of disputes relating to strata title issues, easements and access rights can cause unwanted additional legal/construction costs, protracted delays in building timeframes with possible long term discontent remaining between future neighbours.

Where an access dispute arises, the affected land owner(s) need to resolve their differences by implementing appropriate and affirmative course(s) of action.
This may take the form of or incorporate one or more of the following steps:

- Initiate dialogue between the parties concerned aimed at seeking resolution of the dispute
- Apply to the strata company (where applicable) for a determination in accordance with the strata company by-laws
- Refer the dispute to an independent mediation service
- Seek guidance from Landgate through the strata advice line 9273 7044
- Refer the matter to the Strata Titles Referee and the State Administrative Tribunal (SAT) to assist in the resolution of the dispute
- Seek individual legal advice for resolution of the dispute in the District Court.

**Note:** Access disputes are outside of the scope of Network Operators and customer agents.

It should be noted that one on one dialogue or private mediation between the affected parties can produce a better outcome for all concerned as opposed to the other suggested options. This methodology allows for all to gain an appreciation of the disputed issues, with the potential to decrease the likelihood of any ongoing conflict between neighbours.

It must be noted that before an application can be made to SAT, the applicant must have complied with any procedure for the resolution of disputes contained in by-laws of the strata company. SAT may only make an order if satisfied that certain specified circumstances exist. Reference to the *State Administrative Tribunal Act 2004* by the applicant is essential; to understand the circumstances which must exist before an “order” may be made by the Tribunal.

Before choosing to pursue a legal action or approach to the District or higher Court the affected parties should carefully consider the possible outcomes and financial implications for all concerned.

### 6.9 Cable ducts

The customer is responsible for supplying and installing all underground power cable ducts on the customer’s property, at the applicant’s own cost. The size and number of ducts will be detailed on Network Operator’s design drawing(s). Ducts are always required where Network Operator cable is installed on the customer’s property, regardless of whether they are shown on the drawing(s) or not.

Additional information can be obtained from the relevant Network Operators Underground Cable Installation manual (UCIM).

#### 6.9.1 Materials

Ducts shall be heavy duty, rigid, orange UPVC conduit complying with *AS/NZS 2053: Parts 1 – 8 Conduits and fitting for electrical installations*. Size of ducts shall be either 40 mm, 50 mm, 80 mm, 100 mm, 150 mm or 160 mm as specified by the Network Operator.

#### 6.9.2 Installation of ducts

All ducts shall have a minimum cover of 750 mm to the top of the duct and be bedded in sand for a minimum distance of 150 mm below the lowest duct, and 150 mm above the highest duct. No ducts shall be installed with more than 1100 mm cover unless required to have sufficient clearance from other services. The Network Operator shall be consulted prior to ducts being installed below the maximum requirement.
In general ducts are to be laid in horizontal formation up to four in number, and thereafter in tier formation. For road-crossing ducts, the length of the ducts should be the road width plus 1000 mm minimum projection either side of the kerb.

For specific detailed information on network installation requirements refer to the relevant Network Operator’s technical requirements:

- **Horizon Power:**
  - Distribution Design Rules DDR
  - Distribution Construction Standard DCS
  - Underground Cable Installation Manual; UCIM
  - Underground Distribution Scheme Manual UDS

- **Western Power:**
  - Distribution Construction Standard Handbook DCSH
  - Distribution Substation Plant Manual - DSPM
  - Underground Cable Installation Manual; UCIM
  - Underground Distribution Scheme Manual UDS

All ducts shall be plugged with suitable end caps. Marker tape shall be attached to each end and brought out to ground level with a marker peg at one end. Non-metallic draw wires shall be provided in all ducts. Marker tape (danger tape) shall be installed above the duct as prescribed by AS/NZS 3000 or as directed by the Network Operator.

### 6.9.3 Supervision of installation

The applicant must contact the Network Operator’s local or regional office or where nominated the Construction Project Manager before any back filling of the duct installation occurs to allow the Network Operator time to inspect the installation if required.

The applicant accepts full responsibility for the supervision of the duct installation. Any remedial works requested by the Construction Project Manager must be carried out promptly. Any extra costs incurred by the Network Operator as a result of such remedial works will be charged to the applicant.

### 6.10 Removal and reinstatement

The customer is responsible for the removal and reinstatement of all non-natural surface coverings on the customer’s property, inclusive of those that may or will inhibit the installation of any equipment associated with the works. This includes but is not limited to roads, driveways, footpaths, concrete and paving.

The applicant is responsible for obtaining the necessary project environmental, heritage, native title and vegetation clearance approvals from the relevant authorities, to meet all associated statutory requirements, before any site works can begin. (Refer to Clause 6.12). The applicant must also refer any initial vegetation clearing enquiries to the relevant local council.

### 6.11 Existing customers and affected parties

The applicant shall be responsible for notifying all concerned parties (including other Network Operator customers) affected by the applicants proposed works including the undergrounding of consumer mains.

Where an existing overhead distribution network is to be removed as part of the undergrounding work, the applicant is responsible for the reconnection of other existing Network Operator customers to the underground system.
The applicant shall engage the services of an electrical contractor to undertake these reconnections. All such reconnection work must be completed before the overhead distribution network in the street can be removed.

Options for reconnection of services to existing affected customers may include:

1. Where there is sufficient space at the front boundary of the affected property to install a service pillar, the existing overhead services shall be replaced with underground services. The Network Operator will provide a pillar in an accessible location at the applicant’s cost. The applicant shall be responsible for installing the underground service from the pillar to the existing customer.

2. Where there is insufficient space to install a service pillar, a wall-mounted box will be required. The Network Operator will supply the wall-mounted box to the applicant, who will be responsible for having it installed on the affected building’s facade in an accessible location. A minimum of 4 weeks’ notice is necessary to enable ordering and supply of the wall-mounted boxes.

   The Network Operator will supply and install the underground service cable up to the facade of the building, allowing sufficient cable length to reach the wall mounted box.

   The applicant shall arrange to have the cable fixed to the facade of the building, up to the wall-mounted box. The Network Operator will undertake the final connection of the underground service to the wall-mounted box, in conjunction with the applicant’s electrical contractor.

In Options 1 and 2 above, the applicant shall inform existing customers who are affected, that all wiring downstream of the Network Operator’s point of connection is the customer’s responsibility. That is, if the wiring is damaged, the existing customer is responsible for repairs.

### 6.12 Environmental and heritage requirements

Environmental and heritage impacts shall be investigated and managed by the applicant and their agent. Issues may include but are not limited to the following:

- Aboriginal heritage sites and objects of suspected aboriginal origin
- Acid sulphate soils
- Bio-security - weeds, pests and disease spread (e.g. dieback disease)
- Declared rare flora and threatened ecological communities
- Dust
- Erosion
- Land entry permits
- Native title
- Noise
- Protected wetlands
- Vegetation clearing permits
- Waste management including controlled waste

#### 6.12.1 Network extension

Except in the case of projects in the NWIS or NIS (Refer to Clause 6.12.1.1) a Network Operator, when planning an extension of the distribution network for and on behalf of the customer (applicant), will conduct a preliminary environmental and heritage assessment of any Crown land, public open space, road reserve, or any privately owned property beyond the applicant’s property boundary that may be affected by the proposed works. This forms part of the process of providing an indicative budget estimate of the network extension costs.
Where the preliminary assessment reveals environmental or heritage concerns pertaining to the affected parcel(s) of land, further evaluation of network extension costs will be suspended. The applicant will be formally advised and provided with a specific estimate of costs to address the identified issues.

Should the applicant elect to proceed, payment of the estimated assessment costs is required before the Network Operator will begin a detailed environmental and heritage assessment. The applicant is responsible for reimbursing the Network Operator for all costs incurred in relation to the assessment and acquisition by the Network Operator of any required approvals or clearances. Additionally it should be noted that the outcome of the assessment may result in the network extension work not proceeding.

Once the environmental and heritage issues have been satisfactorily determined and it is deemed that the works can proceed, an indicative budget estimate of the network extension costs will be prepared and provided to the applicant.

### 6.12.1.1 NWIS and NIS

Within the NWIS and NIS the developer/applicant is responsible for obtaining all environmental and heritage approvals. A budget estimate and quote maybe issued to the customer, however ordering of materials and construction of the project will not commence until the developer/applicant can provide proof of environmental and heritage clearances. Should these clearances not be available at the time of payment then Horizon Power reserves the right to revise the quote at the time the proof of clearances are provided and invoice the customer for the difference and for doing additional quotes.

### 6.12.2 Applicant's project

Where the Network Operator is required to undertake work related to the augmentation or extension of the network that may or is located within the boundaries of the applicant’s property, the applicant shall evaluate, manage and complete all statutory environmental and heritage assessment(s), unless advised otherwise in writing by the Network Operator. The applicant shall provide the Network Operator with copies of documentation discharging their assessment responsibilities.

Where the assessment(s) confirms the requirement for environmental and heritage approvals or clearances, the applicant shall apply for and obtain, at no cost to the Network Operator, such approvals and clearances and shall provide copies to the Network Operator before any work is commenced.

The applicant shall advise the Network Operator of any issues either pending or real that may affect the project or the extension of the network at the earliest possible opportunity. Failure to do so may result in significant variation to the costs of the network extension work, or may prevent the project from proceeding.

For additional information on the Network Operator's environmental policy refer to:

- **Horizon Power**: Environmental Policy
- **Western Power**: Environmental Policy

### 6.13 Equipment

Equipment used to interface with the Network Operator’ distribution and transmission network must comply with the Network Operator's requirements and be operationally compatible with those networks.
6.13.1 Distribution Design Catalogue (DDC)
Each Network Operator may choose to provide a Distribution Design Catalogue (DDC) containing details of their approved standard equipment assemblies for the design of underground and overhead distribution networks within their respective networks. The DDC does not encompass construction standards and should be read in conjunction with the Network Operator’s relevant design and construction publications.

- Horizon Power - Distribution Design Catalogue
- Western Power - Distribution Design Catalogue

6.13.2 Western Power equipment

6.13.2.1 Non-standard equipment
Only approved equipment/product(s) as prescribed within Distribution Design Catalogue shall be used when completing a connection to the network. For more information refer to the (DDC) or refer to Western Power’s external website for Non Standard Equipment.

6.13.2.2 Equipment sold by Western Power
Western Power supplies a range of industrial electrical equipment (distribution and transmission) including but not limited to cable, transformers, switchgear, line hardware, underground power accessories, streetlights and general hardware. New equipment is sold subject to the Terms and Conditions of Sale of Material at the time of sale. Second hand equipment may be sold by Western Power to a third party on an ‘as is, where is’ basis.

6.14 Artwork on network assets
Under specific conditions, a Network Operator may permit the application of artwork to elements of their distribution network such as ground mounted kiosks/transformers or a wall used to enclose ground mounted network equipment. Prior approval must be obtained for each and every piece of artwork prior to being applied to the asset. Artwork applied to a network asset without formal approval will be classified as graffiti and dealt with in accordance with the applicable laws. Furthermore, participating Network Operators do not guarantee the permanency of the artwork as the asset concerned may be replaced or repaired without notice rendering the artwork lost or incomplete.

Costs associated with the repair/replacement of applied artwork or for the removal of artwork as instructed by the Network Operator or local government authority shall be borne by the party responsible for its application or maintenance. Where the artwork is removed from the Network Operator’s asset the equipment shall be reinstated in accordance with the Network Operator’s instructions.

6.14.1 Horizon Power equipment
For further information regarding artwork on Horizon Power’s assets refer to Decorative, Fixtures, Signs, Banners and Artwork on Horizon Power’s Assets.

6.14.2 Western Power equipment
For information on Western Power’s requirements and scope of application refer to Standard NS 21-2006 Artwork on Western Power Assets.
6.15  Decorative fixtures, signs and banners on assets
Written approval shall be obtained from the Network Operator for each attachment type and location within the scope of the customer’s application prior to its attachment to the network asset(s).

Additionally there may be other site related factors that are not covered by the Network Operator’s general policies which may preclude the attachment of fixtures, fittings, signs or banners to the Network Operator’s poles, streetlight columns or assets. It is therefore imperative that the customer liaises with the Network Operator prior to making any financial commitment or project decision.

Where the fixture, fitting, sign or banner requires connection to a supply of electricity, the Network Operator will not guarantee continuity of that supply. Additionally the owner of any fixture, fitting, sign or banner shall accept full responsibility for ensuring that all the relevant statutory obligations and requirements pertaining to that installation are met and maintained.

6.15.1  Horizon Power equipment
For further information regarding fixtures, signs and banners on Horizon Power’s Assets refer to Standard Decorative, Fixtures, Signs, Banners and Artwork on Horizon Power’s Assets.

6.15.2  Western Power equipment
Network Standard NS 10-2006.1 defines the requirements for the attachment of fixtures, fittings, signs and banners on Western Power poles, streetlights, columns and other assets within the SWIS.

6.16  Labelling
There are a number of different statutes that stipulate the need and under what specific circumstances electrical equipment requires to be labeled. Labelling serves a number of purposes but is primarily for identification, safety, isolation or a combination of the above.

As a guide to the requirement for labelling the following hierarchical structure should be adopted:

- WAER;
- Australian Standard AS/NZS 3000
- Network Operator standards including:
  - Horizon Power’s Standard on Distribution Equipment Labelling.
  - Western Power’s Network Standard NS 05.

Customer's electrical equipment or installations if located in public open spaces must be labelled where there is a risk of incorrect identification of the installation or equipment with network assets.

Labelled equipment shall, as a minimum, include the name of the responsible organisation or individual, together with their contact information and telephone number.

6.17  Locks
Network Operators may permit meter enclosures and access areas to be locked, provided that a standard approved master key locking system is fitted to the door of the meter enclosure. 7 day 24 hour access to metering and protection equipment must be provided and maintained for access by Network Operator personnel.
In the event that a customer’s locking system is damaged, keys lost or access to the enclosure is unattainable the customer is to contact a licensed locksmith as network personnel are unable to provide this service for reasons of customer and network security.

The following range of locks may be used for enclosures:

- Yale locks
  - Type 490 – 25 Camlock (25 mm body length)
  - Type 490 – 30 Camlock (30 mm body length)
- Lockwood locks
  - Type 691 Cupboard Lock
  - Type 201 Cylinder (to suit night latch)
  - Type 570/2 Cylinder (to suit appropriate lock)
  - Type 847/4 Locking “T” handle

The identified ranges of approved NMK (Network Master Key) padlocks are to be used in the following situations:

- NMK1 padlocks – high security threat areas e.g. CBD (MD1 key ref.)
- NMK2 padlocks – all other areas (RD1 key ref.)

The use of NK6 padlocks to lock distribution electrical network assets or substation gates is **not permitted**. NK6 padlocks may only be used for gates that allow Network Operator access to assets such as farm or stock gates.

Where additional assistance, information or guidance is required refer to the specific Network Operator

- Horizon Power - enquiries@horizonpower-reply.com.au
- Western Power - enquiry@westernpower.com.au

### 6.18 Industry self-connection programs

Network Operators have introduced a number of industry-based schemes designed to enhance and streamline the connection process. These schemes are available to the electrical contracting industry where the individual company can and has demonstrated an ability to provide the designated connection service to a standard acceptable to the Network Operator, EnergySafety and the community.

#### 6.18.1 Horizon Power

For full details of Horizon Power’s connection requirements refer to Horizon Power’s main website or the relevant regional office.

#### 6.18.2 Western Power

For more information on the Western Power programs including Service Apparatus Connections Scheme (SACS), Contractor Connect Scheme, Changeover Scheme or the Portable Builders Supply Scheme refer to the Appendices or Western Power’s main web site. Western Power: Connection schemes

### 6.19 Subdivisions

As stated in the scope of these requirements, network underground distribution schemes are not covered by this Manual. Both Horizon Power and Western Power provide specific information via separate publications known as Underground Distribution Schemes (UDS) Manuals.
These documents seek to inform land developers, designers and installation contractors of the policies, processes, practices, requirements and equipment relating to the provision of electricity services in all new subdivisions connected to a network.

In general terms the manuals cover the relationship, between:

- The Network Operator, whose network a UDS will become a part of; and
- The developer, as the proponent of a subdivision, who requires a UDS to provide a reticulated supply of electricity to the lots in a subdivision.

Such manuals also include explanations on the administrative, design and installation requirements for the provision of electricity infrastructure in subdivisions works consisting of but not limited to the following:

- Low voltage electricity reticulation within a subdivision
- High voltage network extension within a subdivision
- Streetlights within a subdivision
- Distribution substations within a subdivision
- High voltage headwork extension outside a subdivision
- Low voltage headwork extension outside a subdivision
- Upgrade of existing distribution substations outside a subdivision for that subdivision.

**6.19.1 Horizon Power UDS requirements**

For further information and guidance on Horizon Power’s UDS requirements applicable to networks in the NWIS or NIS refer to the [UDS Manual](#) website.

**6.19.2 Western Power UDS requirements**

For full details and information relating to Western Power’s subdivision requirements refer to the [UDS Manual](#) website.

**6.20 Asbestos products**

**6.20.1 General**

Some existing electrical products including meter panels, low voltage pillars, cable ducts/lagging and porcelain fuse holders may contain asbestos material. Before commencing any work on electrical equipment containing or suspected of containing asbestos material it is important to carry out a hazard risk assessment to confirm the presence or otherwise of asbestos.

**6.20.2 Safety precautions**

Any assessment or activity carried out on equipment suspected items of containing asbestos products or material must be undertaken using control measures specified by [Department of Mines, Industry Regulation and Safety (WorkSafe)](#) and the [Australian Safety and Compensation Council](#). This should include, but is not limited to the following to minimise the release of and possible exposure to asbestos fibres:

- [Code of Practice for the Management and Control of Asbestos in Workplaces](NOHSC:2018(2005))

If asbestos contamination is confirmed, the person(s) responsible for the work site and task shall ensure that appropriate Personal Protective Equipment (PPE), handling procedures and work practices are in accordance with the identified guidelines and individual company procedures.
At all times when work is carried out on suspected contaminated products and material, warning signs must be displayed: “Asbestos Related Work in Progress”

**6.20.3 Panels**

The installation and maintenance of meter enclosure and panels is the responsibility of the property owner. Where a meter panel requires upgrading in association with construction works or wiring upgrades, this work, and the associated cost, is the responsibility of the property owner. This includes the supply and installation of new meter panels.

Network Operators do not record asset information relating to privately owned customer equipment, therefore reporting of meter panel (material) information to a Network Operator is not required.

Switchboard and connection upgrades may require the attendance of a service crew for temporary isolation of supply to allow an electrical contractor to undertake the work safely including where required the relocation of revenue meters.

Until July 1988 panels containing asbestos known as Miscolite, Zelemite, Lebah or Asbestos were used.

These panels could generally be identified by their appearance; black in colour, approximately 12 mm to 30 mm thick, with the brand name (in most cases) displayed or stencilled on the back. The asbestos material contained within the panel remains passive until the meter panel is either cut, drilled or damaged in some way. Modification, replacement or removal of asbestos panels must be carried out in accordance with identified operation procedures.

**6.20.4 Asbestos fibre pillars**

Low voltage white asbestos fibre underground distribution uni-pillars (commonly known as URD pillars) were introduced during the mid to late 1970’s as a part of distribution system for new underground sub-division developments.

The chemical makeup of the material used to build these older pillars was a form of asbestos known as chrysotile. These pillars are substantially heavier than the current polyurethane pillars and are easily identified by their light grey cement coloured appearance.

It should be noted that the asbestos material contained in the pillar remains passive until the pillar has either deteriorated through age, weather, or sustained some form of damage. Where the pillar, especially the corners of the cover, have deteriorated or become damaged an asbestos exposure risk may exist if the asbestos fibres are able to break away or become airborne.

Only authorised electrical workers are permitted to work on or within a Network Operator’s pillar including cement fibre and polyurethane types for the proposes of connecting a consumer’s mains cable.

However prior to commencing any work on a cement fibre pillar, the electrical contractor or their authorised electrical worker must complete an on-site hazard risk assessment and visual inspection of the panel or pillar to determine the structural integrity of the product.
If there is a risk of fibres breaking away or becoming airborne, creating a hazard to either the person(s) working on the pillar or to the public (either during or after the work has been completed) then do not proceed with the work.

The Network Operator shall be formally advised of the nature and location of the hazard so that the Network Operator can arrange to have the pillar repaired or replaced.

Where the pillar appears structurally sound the authorised electrical contractor may proceed with the connection or disconnection work. Before removing the cover, dampen down the outside of the pillar with a low pressure water spray. (e.g. plastic spray bottle). Do not use high pressure or a domestic hose directly onto the pillar.

6.20.5 Disposal
After completing the work, place contaminated disposable coveralls, respirator, gloves and any contaminated material into a large plastic bag marked “Caution Asbestos” and deposit in accordance with the requirements at a designated controlled waste site.

For additional information on the steps to be followed when working on equipment that contains, or is suspected of containing, asbestos materials including advice on working with fibreglass to ensure exposure standards are not exceeded please refer to the specific Network Operator’s requirements.

- Horizon Power - Occupational Health and Safety Handbook

6.21 Horizon Power section references
The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either go to the related Clause or the identified online link.

6.21.1 Summary
The Occupational Health and Safety Handbook describes the Horizon Power’s Safety, Health and environmental expectations, policies and procedures to ensure a safe and compliant workforce.

For approval to work on network infrastructure phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

When excavation work is required around network underground, overhead distribution or transmission infrastructure phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

Details of Horizon Power’s environmental policy can be viewed at: Environmental Policy

Horizon Power's Distribution Design Catalogue (DDC) contains details of approved standard equipment arrangements for design of underground and overhead distribution networks within the NWIS and NIS networks.

Decorative, Fixtures, Signs, Banners and Artwork on Horizon Power’s Assets Standard defines the requirements for the attachment of fixtures, signs, banners and artwork on Horizon Power’s network assets.

For full details and information relating to subdivision requirements refer to the UDS Manual located on the external website.

For information on locks and cylinders phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au
6.22 Western Power section references

The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either, go to the related Clause or the identified online link.

6.22.1 Summary

The Electrical System Safety Rules provide a standard set of rules and procedures that govern access to Western Power’s network.

The Work Practices Manual contains specific directions and instructions relating to particular tasks and activities relating to a connection to the network.

To gain approval to work near network infrastructure use either the Working Near Underground and Overhead Powerlines form or contact the Customer Services Centre on 13 10 87. Return completed forms to customer.service@westernpower.com.au

For additional information on the environmental policy refer to: Environmental Policy.

A Distribution Design Catalogue (DDC) containing details of approved standard equipment arrangements for the design of underground and overhead distribution networks within their respective networks.

New equipment is sold subject to the Terms and Conditions of Sale of Material at the time of sale. Second hand equipment may be sold by Western Power to a third party on an ‘as is, where is’ basis.

Standard NS 21-2006 Artwork on Western Power Assets provides additional information on the scope and application of artwork to network assets whereas the Network Standard NS 10-2006.1 defines the requirements for the attachment of fixtures, fittings, signs and banners to poles, streetlight columns and other assets within the SWIS.

For more information on the Western Power programs including Service Apparatus Connections Scheme, Contractor Connect Scheme, Changeover Scheme or the Portable Builders Supply Scheme refer to the Appendices or the web site. www.westernpower.com.au

For full details and information relating to subdivision requirements refer to the UDS Manual located on the external website.
Distribution
Connections Manual

Section seven

Connection and disconnection applications
7 Connection and disconnection applications

7.1 General
The process of obtaining a connection to a Network Operator’s distribution or transmission network may take a number of different forms. For example it may be a new, altered, or upgraded connection or a requirement to reconfigure, modify or remove an existing connection. This Section of the Manual is designed to provide direction on processes applicable to acquiring either a new or upgraded connection or removing an existing connection to the network.

7.2 Conditions of supply
A Network Operator’s connection requirements as contained within these requirements are the conditions of supply. Generic, specific or technical conditions of supply may also be determined or prescribed by one or more of the following:

- Legislation
- Access agreement, Contract or Code
- WAER, Australian Standard or Network Operator Technical Rules
- Connection Agreement or Application.

Conditions of supply may include costs, responsibilities, type, capacity, point of supply, standards to be met and timeframes. It is a prerequisite that to obtain and retain a connection to the network all conditions of supply are to be complied with.

7.3 Availability of supply
Customers must exercise caution prior to purchasing electrical equipment, such as motors, air-conditioning, automated/industrial plant, or three phase devices/appliances, by ensuring that the existing or intended supply to their premises has the capacity and ability to service the required load or if it is a new connection that there is a network connection available to service their proposed new installation.

Availability of a supply is also dependent on the location of the customer’s electrical installation in relation to the Network Operator’s infrastructure and distinct areas of responsibility as defined by the licensed electrical boundaries for those areas. Refer to the Appendices for details of Network Operator’s operational areas.

7.4 When to contact the Network Operator
It is important that early advice and sufficient time be allowed by the customer or their agent to consult with and conclude negotiations on conditions of supply with the Network Operator and to plan and implement the necessary actions to facilitate the customer’s connection.

Conditions of supply may and can vary substantially, dependent on whether it is a new connection, an addition or alteration to an existing electrical installation, an additional load, or if it involves the provision of one or more points of supply.

These conditions may affect the configuration or design of the connection, such as the determination of a point(s) or type of supply; the position of metering or service equipment; point of attachment of an overhead service cable or point of entry of an underground cable; or the position of any transformer or substation on a premise/property.

Adequate written notice of the customer’s requirements must be submitted at the earliest possible opportunity with arrangements made by the customer for payment of all costs associated with the conditions of supply and the connection application.
Prospective customers and their agents should not automatically assume that a connection which satisfies their expectations is available, nor should they sanction or initiate any expenditure, until all negotiations with the Network Operator have been concluded.

Once formal advice has been received as to the conditions under which the Network Operator would agree to connect the customer's load and provisions are made by the customer for the electrical installation of any Network Operator equipment on their property, preparations for a connection can be commenced.

7.5 Contract administration

The customer is responsible for and shall ensure that all works which form a part of their connection responsibility are carried out in accordance with the Network Operator's design and technical requirements as specified in this Manual and any associated publications, relevant regulatory requirements and standards.

7.5.1 Appointment of electrical consultant/contractor

The customer is encouraged to enlist the services of a competent electrical consultant or electrical contractor to ensure that the necessary documentation and associated work is carried out in accordance with the Network Operator's requirements.

7.5.2 Project management

A Network Operator will assign an appropriate level of management for each customer connection, ranging from a connection team for standard pillar installations to the appointment of a specific Construction Project Manager (CPM) for complex or larger connection applications.

Contact information will generally be forwarded to the customer or their nominated agent to facilitate the pillar connection. Where the connection is complex or larger the Network Operator may elect to nominate a Network Designer as their representative to whom all project technical and contractual matters should be referred during the design and quotation phase of the work.

Once the contractual and technical connection arrangements have been finalised and payment for the work has been received, the administration of the connection may be passed to a nominated site Construction Project Manager. The Construction Project Manager will be responsible for scheduling, construction and contractual matters during the construction phase of the work.

7.5.3 Timing and scheduling

Once the customer has completed the preliminary project/contractual requirements and fulfilled their financial obligations to the Network Operator, the installation of the required network infrastructure and point of supply can generally be expected to occur within 4 weeks for small use customers.

For complex/larger connections, the customer should allow a minimum of 12 weeks from the receipt of payment by the Network Operator to the commencement of work. Where the customer has a shorter time line, the Network Operator will endeavour to meet the requested time frames, subject to material availability, workload schedules and equipment accessibility. Installation delays may occur where safe access to site is limited by adverse seasonal conditions, environmental restrictions or as a result of delays beyond the Network Operator’s control. Where delays are anticipated, the Network Operator will liaise with the customer to manage and resolve any issues as soon as is practical.
7.5.4 Warranty of applicant work
There may be cases where the customer has undertaken work associated with the installation, or engaged an agent or contractor to do work on their behalf (e.g. duct installation or trenching). Should future warranty or remedial work be required, it is the customer’s responsibility to arrange and pay for any required corrective work. The customer will need to liaise directly with the contractor and any other parties involved or affected by the work.

7.5.5 Documentation requirements
For all work requests, the Network Operator will require the completion of the appropriate network application forms (Refer to Clauses 7.21 and 7.22) before any instruction, action or quotation can be issued. The Network Operator may ask for further documentation in relation to a specific project including but not limited to:

- Written permission to act on the customer’s behalf, where the applicant is not the customer or owner
- A single line diagram of the installation
- Load details (existing and new)
- Incoming protective device details including the Protection Settings Data Sheet
- The estimated date when supply is required
- A locality plan, including architectural drawings
- A detailed submission for high voltage connections or large/fluctuating loads.

7.6 Standard supply
All new connections are based on the principle of providing a minimum “standard supply” as defined in Section 1. Where there is an existing supply, it should not be assumed that the capacity of that supply or connection is equal to or exceeds “standard supply”.

Should a customer’s peak load exceed that deemed as standard supply, then the additional electrical load or higher voltage requirement may call for the network to be modified to facilitate the additional demand. The costs associated with providing that additional load will be charged to the customer. The customer’s contribution will be dependent on the level of energy consumption. For more information refer to Section 9 on Charging Policies.

The determination of whether or not an electrical installation can be serviced by a standard supply is calculated by the electrical contractor in accordance with the requirements of AS/NZS 3000 and nominated via the submission by the electrical contractor on a Preliminary Notice to the Network Operator.

Communication with the Network Operator is required to determine the supply capability when connection of larger loads or at high voltages is requested.

7.6.1 Horizon Power systems
Horizon Power has a number of remote towns supplied by a single power station. It is important that loads connected to these power stations are balanced. In some locations there are special restrictions on the size of an installation’s total load and of any individual motors that may be connected to the local power supply.

Table 3 depicts the maximum supply per installation for the NWIS (North West Interconnected System) and the NIS (Non-Interconnected System).
For further information and guidance on Horizon Power’s requirements for connecting large sized motors within the network refer to the Technical Rules or email enquiries@horizonpower-reply.com.au.

<table>
<thead>
<tr>
<th>Location</th>
<th>Maximum Single phase supply</th>
<th>Maximum three phase supply (Per phase)</th>
<th>Maximum Motor size (3 phase DOL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argylla</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Beagle Bay</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Bidyadanga</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Broome</td>
<td>63A</td>
<td>32A</td>
<td></td>
</tr>
<tr>
<td>Cambellin / Looma</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Point Samson 1</td>
<td>63A</td>
<td>32A</td>
<td></td>
</tr>
<tr>
<td>Carnarvon</td>
<td>63A</td>
<td>32A</td>
<td></td>
</tr>
<tr>
<td>Coral Bay</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Cue</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Dampier 1</td>
<td>63A</td>
<td>32A</td>
<td></td>
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<tr>
<td>Denham</td>
<td>32A</td>
<td>15A</td>
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</tr>
<tr>
<td>Derby</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Esperance Town</td>
<td>63A</td>
<td>32A</td>
<td></td>
</tr>
<tr>
<td>Esperance Rural</td>
<td>Refer to the Esperance district office ²</td>
<td></td>
<td></td>
</tr>
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<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Fitzroy Crossing</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
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<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Hills Creek</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Hopetoun</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Hopetoun Rural</td>
<td>Refer to the Esperance district office ²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kalumburu</td>
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<td>3kW</td>
</tr>
<tr>
<td>Karatha 1</td>
<td>63A</td>
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<td>3kW</td>
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<td>Marble Bar</td>
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<td>15A</td>
<td>3kW</td>
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<td>15A</td>
<td>3kW</td>
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<tr>
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<tr>
<td>Mount Magnet</td>
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<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Norseman</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
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<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Onslow</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Port and South Hedland ¹</td>
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<tr>
<td>Roebourne ¹</td>
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<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
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<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Wiluna</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Wynndham</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
<tr>
<td>Yalogo</td>
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<tr>
<td>Yarriargra</td>
<td>32A</td>
<td>15A</td>
<td>3kW</td>
</tr>
</tbody>
</table>

Note ¹ Indicates connected to NWIS.  
Note ² For supply to be connected to areas immediately outside the town boundaries or the 33 kV network.

**Table 3:** Horizon Power regional non-interconnected towns
7.7  Distribution connection applications

The process for making an application for a supply is a distinct and separate process from that required for an electricity account. For an electricity account the customer must contact their Retailer as described in Clause 4.3.3.

For a connection to the network the customer or their agent must formally apply to the Network Operator regardless of whether it is an underground or overhead distribution network and irrespective of the availability of an existing point of supply (service pillar) on either the property or an adjacent property. It is recommended that the assistance of an electrical consultant or contractor is enlisted when completing and submitting connection applications.

Generally all new connections will be via an underground service as new overhead connections for lots less than 50 hectares are not be permitted within the NWIS, NIS or SWIS. For a detailed explanation of the Network Operators underground policies please refer to Section 12.2.1.

7.7.1  Residential

For connections that are categorised as a standard supply including underground connections to one or two dwellings that do not require the network to be extended, the completion of the Network Operator online application form Clause 7.7.1.1 is required.

If a customer's premise has a large electrical load or has three-phase equipment installed, assistance should be sought from an electrical consultant or contractor to determine the installation's electricity needs. For non-standard electrical supply the form prescribed in Clause 7.7.1.2 are required.

7.7.1.1  Standard residential application forms

- Horizon Power – Application For An Underground Supply In An Overhead Area
- Western Power - Customer Connections

Note: This Western Power form should be used when requesting or applying for a pillar installation/connection applicable under the Western Power Pole to Pillar scheme.

7.7.1.2  Non-standard residential application forms

- Horizon Power – Connection Application for the Design and Quotation of an Electricity Connection form
- Western Power - Customer Connections

Note: A non-standard residential connection includes: a new, additional or altered supply greater than standard supply, 3 or more connections on an existing lot and 3 or 4 or more connections on a new lot.

7.7.2  Commercial, industrial and primary production

For all commercial, industrial and primary production distribution network connections up to and including 33 kV inclusive of network extensions, the following application forms (Clause 7.7.2.1) are required. These types of connections can be complex therefore it is strongly recommended that the application is completed and submitted following consultation with either an electrical consultant or an electrical contractor. This will ensure that the connection is fully compliant with the Network Operator’s requirements as well as statutory regulations and codes.
7.7.2.1 Non-standard commercial application forms

- **Horizon Power** – [Connection Application for the Design and Quotation of an Electricity Connection form](#)
- **Western Power** - [Customer Connections](#)

Each application will be allocated a Network Operator project number which can be used as a point of reference though out the project period. For Horizon Power the prefix will be either EP, PP or KP and for Western Power the prefix will be either MP, MT, NP, NT, SP or ST.

7.7.3 Rural and semi-rural connections

It should not be assumed that all parts of a Network Operators distribution system is serviced by a three phase supply arrangement.

Due to either regional vastness or the isolated nature/location of the community, portions of the NWIS, NIS and SWIS, networks in typically fringe or regional Western Australia may be reticulated by either a single phase 240 volt or an existing split phase 480 volt distribution system.

Where the customer can demonstrate a specific need, a sole use 480 volt connection may be permitted subject to the availability of an appropriate point of connection and network capacity. Any upgrade of existing customer 480 volt supply may also require an upgrade of the network supply arrangement therefore the customer should consult with the Network Operator to consider alternative cost effective options.

Country or rural customers classified as non-pole to pillar residential or primary producers may be eligible to apply for a connection as a part of the Network Operators individual Supply Extension Scheme. It is strongly recommended that an electrical consultant or an electrical contractor be utilised to determine the installations electricity needs, type of connection required and to complete/submit the appropriate application documentation.

An individual or group of customers seeking an extension may apply to either join an existing SES or may initiate a new scheme. An application can be lodged by submitting the appropriate documentation to the relevant Network Operator.

7.7.3.1 Horizon Power country and rural applications

Supply Extension Schemes operate in a number of regional areas therefore customers purchasing property in a rural area need to confirm if the property being purchased has an annual charge applicable under a Scheme. Completion of a Contributory Extension Scheme Inquiry Form is recommended. To apply for a connection complete and submit a [Supply Extension Scheme Application](#).

7.7.3.2 Western Power country and rural applications

To apply for a connection complete and submit a [Customer Connections](#) or contact Customer Services Centre on 13 10 87.

7.7.4 Temporary supplies

The Occupational Safety and Health Regulations 1996 (Regulation 3.65) require the main contractor of a construction site, where it is practicable to do so, by the time work on the site has reached plate height or the equivalent, electricity has been supplied to the site from a supply authority’s service line or service cable by way of a temporary or permanent connection.
This WorkSafe requirement focuses on noise and environmental issues, created by the use of portable generators to ensure the safety of tradespeople when working on construction sites. As a substantial amount of new construction occurs within new sub-developments it is important to give as much notice as possible as the infrastructure to provide a temporary connection may also be under construction.

Dependent on the nature of the connection, required duration, and the builder’s method of construction there are a variety of temporary connection methods available to the customer. Therefore prior to making an application for a temporary connection, the customer should seek the assistance of their builder or electrical contractor who can provide advice on the advantages of each or assist by completing the appropriate applications for connection.

Should the customer require it, a single account can be created so that the electrical installation’s permanent meter may be used as a temporary supply. On completion of the customer’s installation the meter and the supply can be transferred to the permanent position. Dependent on the scheme and accreditation status of the electrical contractor, the contractor can transfer the meter to the permanent position or arrange for the disconnection of the temporary supply and the transfer of the meter by the Network Operator.

7.7.4.1 Temporary supply applications
- Horizon Power – For temporary supplies use an Application For An Underground Supply In An Overhead Area
- Western Power – refer to Temporary supply options

7.7.5 Unmetered supply
Unmetered supplies are generally available only to local government authorities, government agencies or Network Operator approved providers of specialist services which are located within road reserves.

Examples of unmetered supplies include connections for traffic signals, streetlights, illuminated street signs, railway crossing boom gates, bus shelters and telephone boxes. The supply configuration is limited to 240 volt single-phase supply up to a maximum load of 4.8 KW (20 Amp). Either the customer or their agent can make an application using the following form:

7.7.5.1 Unmetered supply application forms
- Horizon Power - Unmetered Electricity Supply Application form
- Western Power - Customer Services.

7.8 Generation applications

7.8.1 Inverter energy system installations
For the purposes of these requirements an Inverter Energy System (IES) installation is defined as: A Micro or Mini embedded generation installation incorporating an inverter complying with the requirements of AS 4777, Grid connection of energy systems via inverters, Parts 1, 2 and 3. Refer to Section 15 for information pertaining to embedded generation categories.

Systems may consist of one or a combination of generation types including photovoltaic, micro-hydro or wind arrangements up to a maximum, not exceeding 5 kVA single-phase or 30 kVA three-phase.
Inverter energy systems that are to be connected to a Network Operator's distribution network must incorporate a Network Operator approved inverter and a Metering Code compliant metering arrangement. The connection must comply with both statutory and Network Operator’s requirements as confirmed prior to the commencement of installation. The Metering Code requires the installation or correct reconfiguration of an approved bi-directional meter before the connection of an IES to the network.

The system shall not be energised unless the Network Operator has provided formal authority to do so.

The type of application is governed by a range of criteria including but not limited to inverter capacity; type; approval; location; connection method; proposed use; metering configuration and network capacity. Given the technical nature of the equipment and the application processes, it is recommended that the involvement of an approved system designer, electrical consultant/contractor be sought.

Systems that are to be stand-alone with no Network Operator distribution system interconnection, must comply with the requirements of Section 15 with relevant notifications submitted to EnergySafety.

State and Federal Governments may provide support towards the cost of purchase and or installation of renewable energy system to qualifying applicants subject to satisfying specific eligible criteria.

For specific information on programs, rebates and other incentive schemes refer to the Public Utilities Office or Electricity Retailers websites.

All inverter energy system connections must be co-ordinated through customer's Electricity Retailer. Renewable Energy Buyback Schemes (REBS) can be accessed through participating Western Australian Electricity Retailers and selected regional Network Operators.

7.8.1.1 Applications

The customer through their agent is required to validate their inverter energy system against specific Network Operator criteria and register of type tested and approved inverters. Refer to Clause 15.16.3. Where the inverter is listed on the Approved Inverter register the customer may apply for a connection as described in these requirements and Clause 7.20

Applications may be assessed or subjected to a desk top examination or technical assessment by the Network Operator against specific network operational criteria. The Network Operator will advise the customer either electronically or by written notification of the process outcome.

Dependent on the type and intended use of the system the Network Operator may accept, reject or specify particular operational or installation conditions relating to the installation and use of the system which shall be adhered to by the customer and their agent.

Any application that is deemed to be indecipherable or incomplete will not be accepted or processed until such time as the required information and any supporting documentation has been provided to the satisfaction of the Network Operator.

Following modification of the metering equipment in accordance with the stated requirements and conditions of the Network Operator and Electricity Retailer and the connection application has been approved the customer’s agent may proceed with the installation of the system.

On completion of the metering installation and prior to energisation, the customer's agent must notify the Network Operator accordingly.
This mandatory action provides confirmation of the systems operational status and if required readiness for connection or inspection as a part of the Network Operators connection and audit obligations.

The customer's generation capacity and inverter energy system data may be recorded by the appropriate Network Operator for the purposes of network control and power quality management.

Should any part of the inverter or IES equipment change or output capacity increase, approval must be first sought from the Network Operator.

Existing systems that are relocated to new premises shall be treated as a new installation configured and installed to current requirements by an authorised and competent installer following submission and approval of the formal connection Application.

7.8.1.1.1 Horizon Power application process

For specific information on Horizon Power’s requirements and connection arrangements including information and guidance on Renewable Energy Buy-Back Scheme (REBS) please refer to the Renewable Energy Section of their website.

7.8.1.1.2 Western Power application process

Additional information can be obtained from the Western Power Solar PV Systems, section of their website and downloading the relevant solar PV system form.

- Systems up to and including 30 kVA
- Systems >30 kVA to 150 kVA (non-exporting)
- Systems >150 kVA and systems >30 kVA to 150 kVA (exporting)

For more information contact Western Powers customer service centre on 13 10 87 or email embedded.generation@westernpower.com.au

7.8.1.2 General system information

When applying for a connection to a Network Operator the following inverter energy system minimum information is required:

- Customer’s name contact details and postal address
- Site address for the inverter energy system
- Retailer's name where applicable
- Connection/commissioning date
- Inverter details, including make, model, number connected, capacity and kVA rating
- Total generation capacity inclusive of any existing capacity
- Connection method
- Metering configuration and Retailer reference number where required
- Details of any energy storage facilities
- Contractor / engineer / installer’s name and address (contact details)
- Licence / registration / accreditation information of the system designer and installer
- Inverter make and model number as shown on the Network Operator’s inverter approved register
- Protection settings, wiring diagram, accreditation information and compliance “Certificates”
- Customer’s acceptance of the terms and conditions.
The Network Operator may require additional information where a network study or technical review is deemed necessary to assess the connection application.

### 7.8.1.3 Non-approved systems

Connection applications that incorporate inverters which have not been approved and registered will not be accepted for processing by the Network Operator until such time as the customer’s agent can either substantiate and or verify that the inverter has been assessed and certified in accordance with Clause 15.16.3.

Where a non-approved inverter has been connected to a distribution network it shall be disconnected and remain so until such time as the inverter has been technical assessed by the Network Operator, approved and included on the Network Operator's approved inverter register.

### 7.8.1.4 Metering application

The customer is responsible for submitting a separate application to the relevant Electricity Retailer before installing and connecting an inverter energy system to the distribution network. This action is required to facilitate the alteration or installation of Code compliant import/export metering equipment and Electricity Retailer’s terms and conditions.

Changes to the Electricity Industry Metering Code 2012 now require that a newly installed inverter energy system must not be connected until approved metering has been installed by the Network Operator.

This requirement does not prevent an approved system from being installed prior to the meter being changed or reconfigured **provided that the system remains disconnected.**

It is therefore recommended that systems remain physically disconnected until compliant metering equipment is in place however where this is deemed impractical the network operator may accept isolation and tagging of the system’s isolation devices to ensure complete disconnection from the network.

### 7.8.2 Generation installations

For the purposes of these requirements, a general embedded generation installation is defined as: All other embedded generation installations not covered by the requirements of AS 4777. This definition may include but is not necessarily limited to Small, Medium and Large systems:

- Synchronous generating units driven by gas engines, gas turbines or petrol/diesel engines;
- Fuel-cell installations;
- Wind turbine generating units;
- Synchronous and asynchronous generating units driven by hydro turbines.

Medium and Large type connections can be complex and as such Network Operators will not accept a connection application unless the customer has utilised the services of a professionally qualified electrical engineer to aid the customer with the technical details and completion of the application. It is important that an application is submitted to and approved by the Network Operator prior any installation work commencing.

### 7.8.2.1 Horizon Power application process

For further information and guidance on network requirements applicable to the NWIS or NIS phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au.
7.8.2.2 Western Power application process

Information pertaining to Western Power's connection requirements for large scale generation systems can be obtained from their Generator Grid Connection Guide or website at Generator and transmission connections. Application forms can be downloaded from:

- Distribution Generator Application form - 33 kV or below
- Transmission Generator Application form - 66 kV or above
- Transmission load application form – at 66 kV or above

7.9 Three phase supply availability

It should not be assumed that a three phase supply is readily available at all new or existing lots. In some instances the subdivision or lot may have only a single or two phase supply due to network availability or limitations.

In areas zoned “Rural” greater than 4 hectares or “Special Rural” lots sizes of between 1 and 4 hectares the installed infrastructure may be a part of a Single Phase Underground Distribution System (SPUDS) or a Single Phase Underground Rural Supply System (SPURS). Additionally it is not uncommon for regional rural distribution systems to comprise of a single or two phase distribution network or have limited available individual connection capacity.

Therefore it is essential that the type and capacity of the network supply be determined before equipment is purchase or installation work commences.

7.9.1 Horizon Power

Refer to Clause 7.6.1, Table 3 for network capacity information.

7.9.2 Western Power

Examples of where SPUD and SPUR systems have been installed within the SWIS distribution network include but are not limited to: Settlers Hill, Mundijong, Roleystone and Landsdale.

7.10 Transmission connection applications

If the customer's operation or site requires a connection to the Network Operator's transmission network, at 66kV or more, it is essential that the customer secures the services of a professionally qualified electrical engineer to determine the technical terms and conditions of that connection. (Refer to Clause 7.7.3)

7.10.1.1 Horizon Power application process

For further information and guidance on Horizon Power's requirements applicable to networks in the NWIS or NIS phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

7.10.1.2 Western Power application process

More information pertaining to Western Power's connection requirements for large scale generations systems can be obtained from its website at Generator Grid Connection Guide. Western Power application forms can also be downloaded from Transmission Load Application form.

7.11 Types of connection methods

Network Operators utilise a number of methods to affect a connection of a customer’s installation to their distribution network.
The type and configuration of the connection will depend upon the given load and available network infrastructure. The following Figures 6 through 18 are examples of standard connection methods:

### 7.11.1 Underground network connection arrangements

**Figure 6:** Mini pillar

**Figure 7:** Universal pillar

**Figure 8:** UMS pit

**Figure 9:** 100A/200A cut out box

**Figure 10:** MPS substation
Figure 11: Non MPS (cluster) substation

Figure 12: Direct connected customer owned substation

Figure 13: Rural/SPUD transformer supply (1 phase)

7.11.2 Overhead network connection arrangements

Figure 14: Standard overhead connection and PoA

Figure 15: Domestic aerial service cable connection (3 phase)
### 7.12 Types of disconnections applications

#### 7.12.1 Account termination

Customers wishing to terminate their electricity account with an electricity Retailer are required to contact the Retailer who will arrange for a final reading to be made at the premises and an account forwarded for the power consumed at the premises.

The closure of an electricity account with a Retailer does not automatically trigger the removal of the electrical service and Network Operator metering equipment. In most cases the overhead service cable or underground consumer mains to the premises or installation remains energised and in a state of readiness for the next account holder.

Where a complete de-energisation of an installation is required either a temporary or demolition disconnection application (as detailed by the following Sections) should be made. For more information about deactivating an electricity account contact should be made with the relevant Network Operator or electricity Retailer.

#### 7.12.2 Disconnection arrangements

Disconnections are categorised by Network Operators to streamline and ensure that applications are processed in accordance with the customer requirements together with the allocation of appropriate network resources. To ensure that applications are correctly processed with required arrangements and appointments scheduled, a minimum of five working days should be allowed for the application to be processed. Network charges will be applied in accordance with the Network Operator’s charging policies.
To apply for a disconnection or reconnection of a standard supply for overhead and underground connections up to and including 63 A single phase or 32 A three phase the completion of the following Network Operator application form is required:

- **Horizon Power** – [Network Service Request](#)
- **Western Power** – [Customer Connections](#).

Requests for disconnections or reconnections of non-standard supplies rated above 63 A single phase or 32 A three phase will require a Network Operator quotation on receipt of an application from the customer using the one of the following:

- **Horizon Power** – [Network Service Request](#)
- **Western Power** – [Customer Connections](#).

To arrange for a temporary planned disconnection during normal business hours, the completion and submission of the following forms is required:

- **Horizon Power** - [Network Service Request](#)
- **Western Power** - [Customer Connections](#).

Where a disconnection and reconnection is required outside normal working hours, for example to minimise any disruption to business activities or to other network users/services, the customer will be required to submit a:

- **Horizon Power** – [Network Service Request](#)
- **Western Power** – [Customer Connections](#).

### 7.12.3 Temporary disconnections

There are two classifications used by Network Operators to process temporary disconnections for the purpose of managing and restoring services in a timely manner:

1) **Planned work** is generally a customer scheduled non-electrical or electrical activity requiring the disconnection of supply. It may typically include:
   a) **Non-electrical**:
      i) Construction work, painting or swimming pool installations
      ii) Clearing or pruning of trees or vegetation
      iii) Site access for high loads or vehicles.
   b) **Electrical**:
      i) Relocation or upgrade of consumer mains, switchboards or the point of supply/point of attachment.

2) **Un-planned work** requiring the disconnection of supply may include:
   i) Fire damage to customer’s premises
   ii) Faults in main switches or mains connection boxes
   iii) Damaged consumer mains
   iv) Defective customer’s poles or point of attachment.

### 7.12.3.1 Disconnection process

On receipt of a disconnection application or notification of a fault, a Network Operator will, in conjunction with the applicant or property owner, disconnect the electricity supply from either an overhead or underground distribution network. The upper section of the tag will be completed by the designated Network Operator representative and placed inside the main switchboard of the customer’s installation. The tag will show site details, meter number, contact details and reasons for the disconnection.

**Figure 19:** Temporary disconnect tag
It is the customer’s responsibility to engage the services of an electrical contractor to complete any required permanent work or repairs within the specified time period and notify the Network Operator.

**7.12.3.2 Connection process**

**Planned non-electrical work** – Where the electricity supply is disconnected to accommodate a non-electrical planned activity, the applicant or site responsible person shall arrange for the supply to be reconnected by:

- Confirming that the work is complete, the installation is safe and ready for reconnection and formally advising all affected parties that the site is about to be reconnected and energised
- Completing the details in the “Non-electrical Work” section of the “Temporary Disconnection tag”
- Contacting the Network Operator’s representative nominated on the Tag or the Network Operator’s Customer Service Centre advising that the work is complete, safe and ready for reconnection.

**Planned electrical work** - If the disconnection of supply was to facilitate customer requested planned electrical work, the electrical contractor shall arrange for the supply to be reconnected by:

- Confirming that the work is complete, the installation is safe and ready to reconnect and formally advising any affected parties that the site is to be reconnected and energised
- Complete the details in the “Electrical Work” section of the “Temporary Disconnection Tag”
- Contacting the Network Operator’s representative nominated on the Tag or the Network Operator’s Customer Service Centre advising that the work is complete, safe and ready for reconnection
- On completion of the work submit a “Notice of Completion” (within 3 days) to the Network Operator; and
- Provide the customer with an “Electrical Safety Certificate” (within 28 days).

**Un-planned work**- In the event that an installation is disconnected from the supply to permit the rectification of either damaged or faulty equipment associated with the electricity supply, the electrical contractor must arrange for the supply reconnection by:

- Completing permanent repairs; confirming the installation is safe and ready to reconnect and formally advising any affected parties that the site is to be reconnected and energised
- Complete the details in the “Electrical Work” section of the “Temporary Disconnection Tag”
- Contacting the Network Operator Faults and Emergencies Section:
  - Quote the “Indent Report Number” and site address details;
  - State that the fault has been rectified and that a reconnection is required.
- On completion of the work submit a “Notice of Completion” (within 3 days) to the Network Operator; and
- Provide the customer with an “Electrical Safety Certificate” (within 28 days).

**7.12.3.3 Connection**

On receiving advice that the site is ready to reconnect, the Network Operator will return to site, check the “Temporary Disconnection Tag” to confirm the work has been completed, then reconnect and energise the electricity supply.
Should there be any problems the attending Crew can contact the nominated person identified on the tag. Failure to complete the details on the tag may result in connection delays.

Note: Electrical contractors are reminded that unobstructed access to the mains connection box is essential for the reconnection of an overhead service cable. In some cases this may require the removal or modification of one or more steel roofing sheets.

7.12.3.4 Missing tags or fault notes
Where a tag or fault note has been misplaced or lost, an electrical contractor may submit a “Preliminary Notice” and a “Notice of Completion” as an alternate method of requesting a reconnection. In such cases it is important to remember to leave a copy of the notice in the main switchboard for the attending Network Operator Crew.

7.12.4 Demolition disconnection
Before arranging a disconnection for demolition, the customer in whose name the electricity account is held, must contact the relevant electricity retailers to finalise and close the account. The Retailer will provide advice as to the steps required to arrange for the disconnection and removal of Network Operator's service cables and metering equipment.

For example if Synergy is the account Retailer then they will arrange for the disconnection and removal on receipt of a completed “Removal of a Service and Meter” form.

Figure 20: Disconnection for demolition notice

No demolition work can be commenced until the Network Operator has completed the disconnection and a “Disconnected for Demolition Notice” has been placed in the customer's main switchboard.

Once the site has been disconnected the customer must engage the services of an electrical contractor to confirm that the site has no other electrical supply sources.

In overhead areas, disconnection for demolition includes removing the meter and the overhead service cable. In underground areas the Network Operator will disconnect the consumer mains cable at the pillar however will not remove the underground mains cable between the pillar and the installation, as this remains the property and responsibility of the owner.

Some commercial premises, especially those in Perth/Fremantle CBD's and larger Non Interconnected Towns within the NIS may be fed via an underground cable directly from the distribution network in the street. If there is any doubt as to the type of connection, the customer should make an online enquiry or contact the Network Operator in that area.
7.13 Supply upgrades

There are a number of reasons why an electrical installation may require a supply upgrade. Generally most requests can be grouped into one of the following:

1. Increase in capacity above standard supply
2. Conversion of a standard single phase supply to standard three phase supply connection
3. Conversion of a non-standard supply connection from single to three phase
4. Conversion from direct connected to CT connected metering
5. Increase in capacity of a CT connected supply
6. Conversion from a low voltage to high voltage connection.

Item 2 above requires no increase beyond standard supply therefore an application to the Network Operator can be made using a form referenced at Clause 7.7.1.1.

For items 1,3,4,5 and 6 the submission of a form referenced at Clause 7.7.1.2 is required in each case, which will initiate a detailed analysis of connection requirement and costs.

Unless authorised by the relevant Network Operator to undertake changeovers associated with LV underground non CT metered connections, the Network Operator will supply and install the metering equipment, complete all network connections and energise the electrical installation. Refer to appendices or additional information.

The customer should be aware that with an increase in electricity consumption they may become eligible, due to the contestability rules, to choose an electricity Retailer. Refer to Clause 4.4 for more information.

7.14 Conversion to underground power

The State Government, Horizon Power and Western Power are progressively working towards converting existing overhead distribution networks to underground.

By example Horizon Power has initiated the Pilbara Underground Power Project, which will see overhead powerlines progressively placed underground in related Northwest networks. Western Power is progressing the Underground Power Program of works within the SWIS.

Underground power systems provide a range of benefits including a more reliable electricity supply and a network that enhances the appearance of the community and environment.

Pole to pillar connection is the preferred method of connection for all new connections in overhead areas throughout the metropolitan area, major regional centers and towns within the Network Operator’s licensed area.

Pillar installations in residential areas are generally such that one service pillar is shared between two properties. For commercial/industrial properties each green title lot will be provided with an individual service pillar or connection.

The final location of a point of supply is governed by the arrangement of the existing distribution network and the Network Operator’s requirements. However, there may be some latitude for a customer (at the customers cost) to choose an alternative location.

Note: Only one point of supply (e.g. service pillar) is permitted to a freehold title lot. If additional or multiple points of supply are required then an agreement needs to be established between the customer and the Network Operator. Retention of the overhead service to the lot creates a second point of supply and possible electrical hazard for both the electrical industry and emergency services personnel. As a part of the conversion and connection to underground power, the existing overhead service must be removed.

For all online forms go to Clause 7.21 for Horizon Power or 7.23 for Western Power
7.15 Relocations
The applicant/person making the request is responsible for the full cost of any relocation. Each request is quoted individually and costs can vary considerably depending on circumstances.

To apply, completion of the following Network Operator application form is required:

- **Horizon Power** – [Request for Relocation of Horizon Power Assets](#)
- **Western Power** - [Customer Connections](#)

It should also be noted that some aspects of the distribution network are shared with other customers. Therefore consent from all affected parties is required and additional costs may be incurred to relocate customer equipment such as consumer mains cables, service cables and customer poles.

7.16 Subdivisions
The infrastructure and load requirements for subdivisions will vary dependent on the nature and configuration of the proposed development. For example the distribution system for a residential development is different to that required for a commercial or industrial development. For full details relating to subdivisions refer to

- **Horizon Power** – [Underground Distribution Schemes (UDS) Manual](#)
- **Western Power** - [Underground Distribution Schemes (UDS) Manual](#)

7.17 Network and equipment locations
For detailed information pertaining to the location of network equipment and infrastructure please refer to [Sections 12 through to 15](#) in this Manual.

7.18 Application processes for LV distribution connections
Figures 21 & 22 and the following procedures depict the generic steps to be taken when facilitating a connection to the distribution network for both Network Operators. This process may vary depending on the nature of the application and the type of supply required:

1. The customer, in consultation with their agent considers the amount of electricity and type of connection required to satisfy current and future use.
2. The customer engages the services of an electrical contractor either directly or via an agent.
3. **For a Standard Supply:**
   a. The customer/agent/electrical contractor completes and forwards an application for connection to the Network Operator regardless of whether a point of supply (service pillar) is on the lot, an adjacent lot, or not installed at all.
   b. On receipt of an application, the Network Operator will assess the customer’s requirements and provide advice of the connection method and location including associated costs, fees and charges.
3. **For Non-Standard and all commercial, industrial and primary production Supplies:**
   a. The customer/agent/electrical contractor completes and forwards a connection application to the Network Operator, regardless of whether a point of supply (service pillar) is available or not.
   b. The Network Operator will provide a desk top design/estimate to the applicant.
   c. If the estimate is acceptable to the customer, payment of design fees is required prior to the preparation of a formal design and quotation.
d The Network Operator will then prepare a formal design and quotation with an on-site survey and evaluation of existing network capacity to determine ability to provide the required load. (Refer to Section 9 “Charging Polices”).

4 Customer accepts/rejects point of supply (POS) location/quotation and confirms decision to proceed including payment of all costs.

5 Electrical contractor confirms connection method and the agreed POS location.

6 **For Non-Contestable Accounts:**
   a The customer applies to the designated Retailer for an electricity account.

6 **For Contestable Accounts:**
   a The customer chooses a Retailer and applies for an electricity account.

7 Retailer establishes the account and provides the customer with a Customer Reference Number (CRN).

8 The customer forwards details of the CRN either directly to or indirectly via their agent to the electrical contractor.

9 Electrical contractor submits “Preliminary Notice” with CRN prior to commencing the work.

10 Electrical contractor completes the electrical installation work in accordance with the customer’s instructions and to the required technical standards

11 **For Metered Supplies up to and including 100 amps:**
   a Where the customer’s electrical contractor is approved, the EC will fit the meter, connect the customer mains to service pillar and complete the installation
   
   b Where the electrical contractor is not approved or the connection process is outside the contractor’s operational scope, the Network Operator will fit the meter and complete the connection (charges may apply see Section 9)
   
   c Electrical contractor tests, commissions and certifies that the installation is safe and ready for connection with the submission of a “Completion Notice”
   
   d The completed installation is then energised by either the approved electrical contractor or the Network Operator, recording the date of initial energisation onsite

11 **For Metered Supplies above 100 amps:**
   a Where required the electrical contractor submits a separate Preliminary Notice for the CT meter installation
   
   b Dependant on the energisation requirements the electrical contractor completes collectively or separately the general electrical installation and the site main switchboard including CT installation and mains cable connect;
   
   c Electrical contractor collectively or separately tests, commissions and certifies that part of the installation that is safe and ready for connection with the submission of a “Completion Notice”;
   
   d The Network Operator personnel will fit the appropriate metering system, and in conjunction with the electrical contractor shall complete the connection to the point of supply (charges will apply refer to Section 9);
   
   e In conjunction with the electrical contractor and the customer, the Network Operator will energise the installation, recording the date of initial energisation onsite;

12 On completing the electrical work the electrical contractor will supply to the person for whom the work was performed an “Electrical Safety Certificate” certifying that the work has been checked and tested and is safe and compliant.
Figure 21: Typical process for an LV distribution connection <100 amps.
Typical Connection Process for an LV Distribution Supply Over 100 Amps

Figure 22: Typical process for an LV distribution connection > 100 amps
7.19 **Connection process for a HV supply**

Typically an assessment of an electronic HV submission takes approximately four weeks from the date of lodgement. Cost estimates and completion of the analysis will depend on the complexity of the project, construction schedules and the type of equipment to be installed. Figure 23 and the following generic sequence of events depict the process from the time of HV submission lodgement to site energisation.

1. Customer's representative (professionally qualified electrical engineer) formally advises the Network Operator and retailer that a HV proposal (HV submission) is being prepared and that they require the protection relay settings for Network Operator’s upstream protective devices.
2. Customer's representative provides preliminary advice to the Network Operator including: site address, expected maximum demand, the nature of supply and the date for energisation. Where the HV installation and connection is new or an increase in load, a network application form (Clauses 7.21 or 7.22) will be required by the Network Operator.
3. The Network Operator will forward network protection settings to the customer’s representative. If system studies are required for a new connection or a requested increase in load, the customer will be required at this point to supply relevant information to the Network Operator to allow studies to commence.
4. The Network Operator will prepare an estimate of costs based on the supplied customer information and outcomes on any completed network studies.
5. The customer's representative to prepare and lodge the customer’s HV submission.
6. The Network Operator on receipt of the HV submission will conduct a review of the submission to ensure that those sections of the HV submission relating to network connection align with the Network Operator’s requirements. If there are no identified issues relating to the connection, the customer will be advised and the HV submission forwarded to the Network Operator’s connection coordinator.
7. The designated electrical inspector will establish communication and liaise with the customer’s representative or electrical contractor and conduct regular on site progress inspections for the duration of the project, in accordance with the Network Operators inspection system plan.
8. Where a non-conformance is identified with the Network Operator requirements the issue will be brought to the attention of the customer’s representative by way of a letter or an Inspector's Advisory Note.
9. On completion of the HV installation, the customer shall:
   a. arrange for the installation to be tested by a competent testing organisation; and
   b. have the installation certified (WAER section 7) by a professionally qualified electrical engineer;
   c. ensure that the electrical contractor has submitted a Notice of Completion to the Network Operator or EnergySafety dependent on the connection point.
10. The customer shall submit documents stating the type of earthing system installed, together with a statement of compliance to Australian Standards. This shall be done in conjunction with the finalisation of all site operating, maintenance, switching, procedures, processes and manuals.
11. Appropriate staff training shall be completed with required switching authorisations issued to the designated customer representatives.
12. On completion of site commissioning and document verification the designated network inspector and construction project manager will evaluate the installations readiness for connection to the electricity supply including completion of the relevant system and network notifications. Refer to Section 13.
13. The network inspector will liaise with the construction project manager and the customer’s agent to determine a final date for energisation and connection.
Figure 23: Typical process for an HV distribution connection.
7.20 Application processes for inverter energy systems

Figure 24 and the following is a summary of the application and connection process for Micro and Mini IES systems. Details on larger system application processes refer to Clause 7.8.

1. Customer chooses an appropriate (IES) in consultation with a consulting engineer, electrical contractor or authorised system designer.

2. Customer’s agent validates IES equipment and installation compliance requirements against Network Operator’s criteria to determine appropriate application and installation pathway.

3. Customer or their agent obtains from their Electricity Retailer:
   a. “reference number”
   b. Where required approval to enter or participate in energy buyback scheme.

4. The customer or their agent submits a Connection application to the relevant Network Operator.

5. The Network Operator processes the application, by:
   i. confirming inverter compliance and certification
   ii. undertaking a technical assessment of the systems functionality against network operational criteria
   iii. determines network penetration levels and power quality requirements
   iv. validates correctness of operation and connection suitability.

6. Network Operator formally notifies the customer on the acceptance or otherwise of the application inclusive of any installation or connection requirements.

7. Customer/agent formally advises Electricity Retailer of intent to connect IES.

8. Retailer requests an upgrade of the metering equipment by the Network Operator.

9. The Network Operator assesses the applicant’s metering arrangement in accordance with the Retailer’s service request.

10. On receipt of a service order from the Retailer, the Network Operator will replace or reprogram the metering equipment in accordance with the Metering Code.

11. Electrical contractor submits an electronic or hard copy Preliminary Notice to the Network Operator providing system and installation details.

12. Electrical contractor/system installer commences the system installation.

13. Customer or their agent submits a separate application to relevant for State/Federal Government agency for financial assistance:

14. On completion of the IES installation and after the installation or modification of the metering equipment the electrical contractor may if authorised connect the system to the distribution network via the customer’s switchboard.

15. The electrical contractor in conjunction with the system installer and the customer, tests and commissions the installation and provides operational training and details on the systems maintenance requirements to the customer.

16. On completion of the commissioning process the electrical contractor submits an electronic or hard copy Notice of Completion and Network Installation Verification to the relevant Network Operator and provides an EnergySafety “Electrical Safety Certificate” to the customer.

17. Subject to the installers’ level of accreditation and the Network Operators inspection requirements the system may be activated if permanent power to the customer’s premises has been connected and energised.

Note: Indecipherable or incomplete Notifications or Applications will not be accepted or processed by the Network Operator.
Typical Connection Process for an Energy Inverter System

Figure 24: Typical process for an inverter energy system.
7.21 Transmission connections

The transmission power systems are complex. The rules governing connection to a Network Operators system can be found in the documents listed below.

Proponents, (eg generators or loads) wanting to connect to the transmission system will require the advice and services of specialist designers and power system analysis engineers in order to design and provide required information to meet the network Operator’s requirements for connection.

- Western Power Generator Grid Connection Guide.

7.22 Horizon Power application forms

7.22.1 General

The following application forms are applicable for upgrades to existing connections or new connections to NWIS or NIS network. The amount of information required and the time taken to process an application will depend on the customer’s supply requirements (based on calculated load).

7.22.2 Applications forms

The Application for Underground Supply in an Overhead Area form is used to install a service cable from the overhead network to the customer’s underground pillar.

The Supply Extension Scheme operates in a number of regional areas. If the customer is purchasing a property in a rural area, it may be that the property has an annual charge applicable under a Scheme which has been operating for a number of years. To find out if this policy applies to the site in question, please complete the online Contributory Extension Scheme Inquiry Form and further information will be provided in due course.

The Supply Extension Scheme Application form is to be used when applying for an extension of an overhead/underground distribution network to new customer under the Supply Extension Scheme (SES) arrangement.

The Network Service Request form can be used to arrange connection or disconnection of power to the customer’s property.

The Request for Quotation for Relocation of Horizon Power Assets form is required when applying for relocation of distribution equipment such as transformers, pillars and overhead lines. Relocation is subject to a suitable alternative location and will be chargeable to the applicant.

The Unmetered Electricity Supply Application form is required for unmetered electricity supply connections in public places. e.g. Traffic-lights, illuminated street signs, local government owned street lights, telecommunication equipment, etc.

The Application for CT Metering Works form is required to arrange for Current Transformer (CT) metering when there will be no increase in demand, e.g. replacement of existing switchboard or metering and disconnection and reconnection of CT metering. See application form for loads requiring new CT installation.

Connection applications are designed to assist Horizon Power to understand the customer’s connection needs and to assess the network infrastructure requirements. The Connection Application for the Design and Quotation of an Electricity Connection form is required for a commercial or industrial property connection, a site where there are more than three domestic dwellings on a single green title lot, a business with new disturbing loads or a business requiring a CT metering connection.
7.23 Western Power application forms

7.23.1 General
The following forms can be downloaded or completed online. If you are unsure about which form to use, further information is available online at: new connections, disconnections, upgrading your power supply, changing to underground power, subdividing or moving infrastructure).

7.23.2 Applications forms
The Customer Connections or Services can be used for:

- Any standard supply underground connection for one, two or three dwellings.
- All WAPC applications,
- Non-standard low or high voltage supply connections or where an extension to either an overhead or underground distribution system is required.
- After-hours disconnect/reconnect, CT metering and LV/HV line isolation/switching
- Overhead applications; temporary supplies; general connections, disconnections and reconnections and upgrades
- Relocation of distribution equipment such as transformers, pillars and overhead lines. Relocation is subject to a suitable alternative location and will be chargeable to the applicant
- Unmetered supply applications such as street light/signs, Local Government and Main Roads equipment of limited supply

The High Load Movement Authorisation Application is required when moving loads higher than 4.3 meters (4.6 meters for livestock vehicles) or wider than 5.5 meters on WA roads.

The Notification of inverter energy system connection form must be completed and signed by the Electrical Contractor who connected the system then attached to the Notice of Completion.

The Working near Underground and Overhead Powerlines form is required when seeking to work on or near underground or overhead network infrastructure.

Prior to the installation of any AMR system, an AMR application form is required to be submitted by the developer/installer. This form must include installation details, the type of AMR system to be used, number of units and the meters required.

A Transmission load application is required when seeking a connection to Western Power’s transmission network.

For relocation of Western Power Transmission assets all initial enquiries should be directed Western Power’s Customer Service Centre on 13 10 87

7.23.3 Generator connection
When seeking to connect a generation system use one of the following:

- IES Applications
- Systems up to and including 30 kVA
- Systems >30 kVA to 150 kVA (non-exporting)
- Systems >150 kVA and systems >30 kVA to 150 kVA (exporting)
- Distribution generator application form – at 33 kV or below
- Transmission generator application form – at 66 kV or above
- Transmission load application form – at 66 kV or above

7.23.4 Processing applications
Western Power will process applications in accordance with the Applications and Queuing Policy. Consumers may be required to contribute to the costs of any works undertaken by Western Power to provide the new/upgraded connection in line with the Contributions Policy.
Distribution Connections Manual

Section eight

Notices and notification
8 Notices and notification of electrical work

8.1 Statutory notices

The Electricity (Licensing) Regulations 1991 places a statutory obligation upon all electrical contractors and electrical workers that prior to and on completion of electrical work the contractor must submit an appropriate notice to the relevant supply authority and customer. These notices form the basis of the regulatory system and the foundation of the safety and compliance structure for the electrical industry in Western Australia. The Regulations make provision for:

- Preliminary Notices
- Completion Notices
- Electrical Safety Certificates

The primary function of these notices is to ensure that all electrical work is installed to an appropriate standard, the network will not be adversely affected and the installation/connection is safe. The notices also serve a range of other functions in that they provide a mechanism for effecting energisation; inspection; metering; electricity account management and in the case of an Electrical Safety Certificate, compliance certification to the customer. Failure to submit a notice at the allotted time may result in the required connection to the network being delayed, refused or disconnected.

The preferred method of notice lodgment for both the Preliminary and Completion Notices to a Network Operator is electronically via facsimile or by a notice system known as “eNotice”. Where hard copy notices are required by the electrical contractor, books of notices can be obtained direct and free from EnergySafety.

8.1.1 Notifiable work

Preliminary and Completion notices are only required for work that is classified as notifiable. The Regulations defines notifiable work as all electrical installation work other than:

(a) maintenance work, unless that work requires the disconnection and reconnection of the supply of electricity to the electrical installation concerned or the replacement of service apparatus; or
(b) the alteration of a final sub-circuit; or
(c) the addition of a single final sub-circuit

8.1.2 Preliminary notice

A Preliminary Notice detailing the extent of the work to be undertaken is required to be submitted to the Network Operator prior to commencement of any notifiable work within the NWIS, NIS or SWIS, unless exempt by Regulation 51 of the Electricity (Licensing) Regulations 1991. Where a ruling (clarification of network requirements) is required by an electrical contractor the notice must be submitted 3 working days before the proposed work is to begin. The Network Operator will endeavour to provide a response within 5 working days on receipt of the notice.

However, in some situations, the connection configuration may be complex or unusual. Therefore electrical contractors need to allow sufficient time for a detailed evaluation of the issues surrounding the customer connection to ensure that a cost effective and practical solution can be achieved.

The other important aspect of the Preliminary Notice is the inclusion of the Retailer’s Customer Reference Number (CRN) on the notice. This number is the vital link between the customer’s Retailer and the Network Operator.

Energisation of the installation will not be permitted where a valid Retailer account has not been established and confirmed by the conveyance of the CRN. A sample copy of the Preliminary Notice can be viewed in the Appendices.
8.1.3 Completion notice
Like the Preliminary Notice, a Notice of Completion must be submitted to the Network Operator for all notifiable work completed within the NWIS, NIS or SWIS within 3 working days of completing the work unless exempt by Regulation 51 of the Electricity (Licensing) Regulations 1991. The notice validates information submitted on the Preliminary Notice (including CRN) and confirms that the work is complete, has been tested, and is ready and safe to be energised.

The notice also signifies to the Retailer that the connection is complete or initiates the final stage of the connection process, which in both cases activates the customer’s electricity account. A sample copy of the Completion Notice can be viewed in the Appendices.

8.1.4 Electrical safety certificate
Any electrical contractor who carries out or causes electrical work to be carried out shall within 28 days of completing the electrical work prepare and deliver to the person for whom the work was performed an Electrical Safety Certificate, certifying that the work has been checked and tested, is safe, compliant and completed to a trade finish.

Electrical Safety Certificates are required for all electrical work including new connections, general electrical installation work, single circuits and maintenance except where exempt by the Electricity (Licensing) Regulations 1991 for the following types of electrical installing work:

- Maintenance work
- Temporary builders supplies
- In House or mine site electrical installing work

Network Operators and EnergySafety do not require a copy of this Certificate. It is a requirement between the electrical contractor and their customer. Contractors must retain a copy of the issued Certificate for a minimum of 5 years as the work may be the subject of an audit or be requested as part of an inspection investigation.

Where a customer/client has not received a Certificate within the allotted timeframe, they should in the first instance contact the responsible electrical contractor. Should this action not produce the required outcome, contact should be made with EnergySafety (08) 9422 5200 where the matter may be considered for further investigation.

An electrical contractor can authorise their electrical worker to complete and deliver to the customer an Electrical Safety Certificate. Each electrical worker must be able to produce on request their authorisation to undertaking this task on behalf of their employer. Authorisation Forms can be obtained from EnergySafety.

8.1.5 Supplies of notices
Electrical contractors and their official representatives can obtain pre-numbered booklets of Preliminary Notices, Completion Notices and Electrical Safety Certificates from EnergySafety.

8.2 Lodgement of notices
8.2.1 Connected to a network
Where there is a requirement to lodge a notice for notifiable work carried out within the NWIS, NIS or SWIS and that work is to be connected to the Network Operator’s distribution network then the required notice shall be either delivered by post, facsimile or by “eNotice”. Facsimile notices should be sent to:

- Horizon Power - Fax: (+61 08) 9159 7288
- Western Power - Energisation Administration Fax: 08 9225 2643

8.2.2 Not connected to a network
Where a notice is required by the Regulations but the installation is not to be connected or the electrical contractor is unsure as to whether the installation will be connected to a Network Operator’s network then the electrical contractor must lodge the required notice with EnergySafety.
An example of such an installation may be a transportable home or piece of mining equipment, which has been manufactured in the metropolitan area but is to be installed outside the NWIS, NIS or SWIS. EnergySafety facsimile notices should be sent to:

- EnergySafety Fax 08 6251 1903

8.3 **EnergySafety ‘eNotice’ lodgement system**

“eNotice” is a web based facility for the electronic lodgement or delivery of Preliminary Notices, Notices of Completion and Electrical Safety Certificates for electrical work. The “eNotice” system is replacing the E-TIC electronic ticket lodgement system originally developed by Western Power.

Further information on the new electronic system can be sourced from EnergySafety or either Network Operator.

8.4 **Date of initial energisation**

On completion of any new installation or unmetered supply service, the responsible electrical worker must test, check and commission the electrical installation to confirm compliance and ensure electrical safety.

The electrical worker must verify that the installation is ready for energisation in accordance with the requirements of WAER clause 6.3 and the notification requirements as shown and prescribed on the Notice of Completion (NoC).

Where the electrical worker is authorised to energise the installation they must record the date of Initial energisation of the Installation (refer to AS/NZS 3000 clause 8.4) at the site, within the test report and on the NoC. The onsite energisation date must be located in a clearly visible position within the switchboard enclosure, not obscured or obstructed, be legible and permanent for the life of the installation.

8.5 **Notices and tags**

In addition to the required statutory notices, Network Operators have a number of other documents and systems to communicate with the industry and the public. Each has a specific task and some cases the notice has a compliance element created by law.

8.5.1 **Inspector’s advice note**

An Inspector’s Advice Note may be issued in response to a request for a service ruling from an electrical contractor on the requirements or parameters relating to a network connection. For example an electrical contractor may be uncertain as to how to configure the installation’s connection or has concerns about the capacity of the network to supply the required load; therefore they can seek a ruling via a notation on the Preliminary Notice.

This note may be used to convey information of a general nature or an instruction from an inspector to either an industry operative or a customer. The content of the note may relate to all or part of the customer’s installation downstream from the point of supply. Compliance with an Inspector’s instruction is mandatory. A sample copy of the Inspector’s Note can be viewed in the Appendices.

8.5.2 **Inspector’s order**

Where the inspector, during the course of an inspection, identifies that the installation is not in accordance with the relevant standards, an Inspector’s Order detailing a defect or items of non-conformance, may be issued to the electrical contractor or person in control of the installation.

When the defect has been rectified, the electrical contractor must return the completed Order to the nearest Network Operator connection or inspection office. Where the non-compliance is categorised as a serious defect, the installation will be re-inspected and a reinspection fee may be applied. Compliance with an Inspector’s Order is mandatory. A sample copy of the Inspectors Order can be viewed in the Appendices.
8.5.3 Defect notification
Network Operators will investigate confirmed incidents of dangerous work or an unsafe electrical installation. This includes defective poles, overhead service cables, damaged service pillars or underground consumer mains. Where an installation is found to be unsafe the following action(s) may be required:

- **Where the installation is connected to electricity supply:**
  - The affected equipment or circuit is to be isolated and tagged
  - A defect notification will be issued to the property resident or owner
  - The affected element of the installation must be rectified by an electrical contractor within 14 days (21 days for country areas)
  - On correction of the defect the electrical contractor is to advise the nearest connection or inspection office.

- **If the installation is not connected to supply:**
  - A defect notification is issued to the property resident or owner if known
  - Appropriate action taken to ensure that the installation cannot be connected to the electricity supply.

Additional information can be obtained from the relevant Network Operator.

8.5.4 Fault service call form
Where a member of the public or a property owner/customer has reported a fault or loss of supply to their installation and a Network Operator’s representative is required to attend, the outcome of the investigation may be recorded on a Fault Service Call form.

The form provides for a number of communication options including actions taken by the Network Operator to restore supply or instructions to the caller/owner for additional actions to be taken in the event that the fault is within the customer’s installation.

Service calls are logged with a unique identifying number (TCMS fault #) so that the caller can contact the Network Operator for further assistance if required. A sample copy of the Fault Service Call can be viewed in the Appendices.

8.5.5 Temporary disconnect tag
Temporary Disconnect Tags are used when coordination is required between the Network Operator and the customer, electrical contractor or building trade to effectively manage disconnection and reconnection. Examples of such situations may include the repair to customer’s equipment such as consumer mains cables or mains connection box or where an incoming service cable requires disconnection to allow a painter to safely complete their work.

In such cases the Network Operator will isolate the supply and tag the installation at the customer’s point of isolation. The tag provides contact and validation information to facilitate the reconnection of the installation once the electrical repairs or trade work is complete. For full details of the process refer to Clause 7.12.3.

8.5.6 Western Power – warning tag “Do not access or alter”
Figure 25 depicts the tag to be used in place of the “Out of service” warning tag when working on service connections and metering. Its purpose is to provide customers with clear instructions regarding their de-energised power supply, including network contact details.
Figure 25: Western Power warning tag.
Distribution
Connections Manual

Section nine

Charging policies
9 Charging policies

9.1 Introduction

This section defines Network Operator’s customer fees and charging policies for the various connection categories. The fees and charging policies are applicable to those customers connected to the Network Operator’s distribution network only. Alternate fees and charging policies are applicable to transmission customers.

9.1.1 Western Power

Western Power is regulated by the ERA through the Network Access Code (Code). The Code requires all network investments to be economic, against which the various charging policies have been designed to achieve.

9.2 Network fees

Network Operators have a range of standard fees and charges that may be applied to a range of specific applications or general situations such as connections, pillar installations, project administration or subdivision design information packages. These network costs are charged to the person, entity or agent making the application for the service. Details of each Network Operator’s fees can be viewed by activating the identified hyperlink.

- Horizon Power - Network Charges
- Western Power - Network Charges

9.2.1 Design fees

The first stage in the design process is the preparation of a desktop estimate which does not generally include a site visit. Estimates are based on information provided by the customer and, where available, stored electronic data of existing distribution infrastructure. The estimate is an indicative financial guide only, valid for a period of 40 days for Horizon Power and 60 days for Western Power and should not be used for detailed financial planning.

Costs associated with environmental, heritage or native title assessments are not considered as a part of this process. Network Operators recommend that the customer undertake a detailed independent analysis of this aspect of their project as they may have a significant impact on the final cost of the connection and network extension. For more detailed information on environmental, heritage or native title assessments refer to Clause 6.12.

The second stage of the process is the preparation of a detailed design quotation and access offer which will incur the payment of up front design fees. The design fee is applied to cover the cost of preparing a full and final design and quotation. The following sub-clauses summaries of how each Network Operator applies fees.

9.2.1.1 Horizon Power design and quotation

Where the customer agrees to proceed beyond the estimate stage, payment of design fees (10% of estimated cost and capped, for details please refer to the regional office) is required prior to the preparation of a formal design and quotation See Figure 26

Horizon Power will prepare a formal design and quotation with an on-site survey and evaluation of existing network capacity to determine ability to provide the required load. Quotation may vary +/- from estimate. If the formal quote is more than 30% above the estimate, the customer is entitled to withdraw and get the design fees returned. If the formal quote is within 30% of the estimate and the customer withdraws Horizon Power will return the fees less any administration costs incurred.

Note: "Horizon Power classifies customers into segments based on criteria such as annual energy consumption and maximum power demand. Contact Horizon Power for clarification on applicable Segment Criteria and Pricing."
9.2.1.2 Western Power design and quotation

Where the customer elects to proceed to the preparation of a detailed design and quotation by selecting the appropriate check box on the DAO application form, Western Power will apply a design fee which is dependent on the complexity of the project. In most cases a standard fee of $1,500.00 will be applied. In all cases the fee is limited to an amount not exceeding the customer’s contribution towards the final cost of connection.

Western Power will prepare a detailed quotation, including but not limited to an on-site survey and evaluation of existing network capacity to determine ability to provide the required load.

It should be noted that quotations may vary +/- from estimates and that the quotation is subject to network terms and conditions which can be viewed online. Refer to DAO application process or Clause 7.7.

If, following detailed design, it is determined that the design fee that has been paid exceeds the amount the consumer is required to pay as a contribution toward final cost of connection, Western Power will refund the difference.

For projects where it is estimated that the final customer contribution is less than $500, there will be no design fee charged for the project. The project will proceed directly to the detailed design and quotation stage where requested by the customer.

9.2.2 Re-Quote fees

Quotations provided in response to a customer’s application have, unless stated otherwise, a validity period of 20 days for Horizon Power and 60 days for Western Power, from the date of the Network Operator’s formal correspondence. Where the validity period expires or the applicant requests a variation to the scope of works or an appraisal of the project costs, a re-quote fee may be levied.
9.3 Charging policies

The following is a list of charging policies applicable to the various customer categories. The charges are applicable for standard connections, as defined in Sections 12 and 13. Where a different connection is required for example to improve supply security or provision of an alternate supply arrangement in response to a customer’s request, costs associated with the alternative additional connection arrangement or network augmentation will be charged at full cost. Customer charging policy categories include:

- Subdivisions
- Individual customer (Standard supply)
- Individual customer (Nonstandard supply and non primary producer)
- Customer more than 25 km from a zone substation (Headwork charge)
- Non urban resident and primary production customer
- Overhead to underground conversions (Pole to pillar)
- Builder and temporary supplies
- Asset relocations
- Unmetered supplies (Telephone, street lighting, traffic lights etc.)
- Equipment hire
- Equipment sale

In addition to the material provided within this Manual, customers need to make themselves aware of all the Network Operators’ policies or guidelines.

- Horizon Power: - Fees and Charges
- Western Power: - Connections and Upgrades.

9.3.1 Subdivisions

Charging policy for subdivision work within the respective distribution networks is covered by the following:


9.3.2 Individual customer (standard supply)

A Network Operator will make provision for a point of supply on or adjacent to a lot, within their respective distribution networks. Where the point of supply is a new underground single phase connection located in the Network Operator’s nominated position no further than 60 m from an existing distribution network and the customer’s consumer mains cable is terminated by an authorised electrical contractor, then there are no connection costs to the customer.

Should a customer require a three phase standard supply then there are additional costs for the connection and related metering equipment. Information for non-contestable customers and the availability of network metering options should be sourced from the relevant Retailer website.

Where the Network Operator is required to provide additional services such as connections or disconnections, additional charges may apply, refer to Clause 9.2 for details.
9.3.3 Individual customer (non-standard supply and non-primary producer)

Where a customer requests a supply or generation connection that is greater than a standard supply or more than 60 m from the existing distribution network, then they are required to pay the full cost for any network augmentation as determined by the following formula:

\[
\text{Capital Contribution} = (\text{Augmentation } S^2 - \text{Network Access } C^3)^1 + \text{Other Applicable } S^2 + \text{Headwork } C^3
\]

<table>
<thead>
<tr>
<th>Note:</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The minimum attainable value (augmentation $^2$-network access $^3$) is 0.</td>
</tr>
<tr>
<td>2</td>
<td>Costs</td>
</tr>
<tr>
<td>3</td>
<td>Charges applicable to Western Power only</td>
</tr>
</tbody>
</table>

9.3.3.1 Augmentation costs

The Network Operator will first determine the total costs of the works to be allocated to the applicant. The percentage of the costs will vary according to:

- **Works to provide the connection.** – Works to provide the connection are required to fit in with the foreseeable future expansion of the network.
- **Multiple applicants** – If the Network Operator receives more than one application for a connection requiring the same network then the first applicant will have first rights to any spare network capacity. However if it works out cheaper for the first applicant, the costs can be apportioned between all applicants. Where the additional applicant(s) do not proceed, the full cost of the augmentation will be allocated to the remaining customer(s). This option is only available before the network construction has been scheduled.

9.3.3.2 Network access charges

This element of the formula applies to Western Power only. Network Access charges will be deducted from the allocated forecast costs. This is the amount expected to be recovered, in the form of network revenue gained from the amount of electricity the customer consumes.

**Note:** The network tariff revenue is less than the Retailers revenue to the customer to supply electricity. The network revenue is the payment to Western Power for the transportation of electricity. The Retailer revenue includes the cost to transport, generate and sell the electricity. The network revenue will be calculated using net present value calculations.

These charges will continue over the commercial life of the works up to 15 years. No network access charges will be allowed for where the new or increased load has an uncertain operational life.

9.3.3.3 Other applicable costs

The Network operator will add any applicable costs incurred from:

- **Connection assets** - The applicant must pay the full cost of any work required to provide the connection assets.
- **Non-capital costs** - Relocation of network assets and items of non-capital works such as reprogramming computer equipment will be charged to the applicant at full cost, as they do not increase the value of the capital base.
- **Works over and above standard works** – If the applicant requests work or equipment that exceeds the Network Operator’s standards for installation or equipment then the difference between Network Operator’s standard and that requested by the applicant will be charge at full cost to the applicant.
9.3.4 Western Power distribution headwork charge

The Distribution Headwork Scheme includes a charge that shares the cost of headwork on an equitable basis between customers, including developers who are seeking a connection to the Western Power’s distribution network in rural and regional parts of Western Australia.

The charge will vary depending on the location of the connection and reflects the average cost incurred by the Western Power when providing additional electricity capacity to the network. The charge does not include the cost of extending the existing network. The scheme does not apply to:

- Installations within the Perth central business district (CBD), metropolitan Perth and the Goldfields areas
- Where the relevant connection point is located less than 25 km’s from a Network Operator zone substation within the network
- Those requiring a direct connection to the transmission system
- Land that is already serviced with an electricity supply, but where there is no residence or business established
- Large commercial applications with a required capacity greater than 1 MVA.
- Full details of the policies can be obtained from Western Power’s Distribution Headwork Scheme policy or referring the schemes information sheets.

9.3.5 Non-urban resident and primary production customer

A Supply Extension Scheme (SES) enables individual or multiple customers, who require a network supply, to share the cost of a network extension provided Access Code and Network Operator criteria is satisfied.

An individual or group of applicants, are eligible to apply to join an established scheme or initiate a new scheme where no active scheme exists for the purposes of extending the network within the SWIS to connect a:

- primary production premises; or
- domestic residential premises on a property to which a pole to pillar connection is not applicable.

The following summary of the Income Tax Assessment Act 1997 defines “primary production” as:

- the cultivation of land
- the maintenance of animals for the purpose of selling them for their bodily produce, including natural increase;
- fishing operations;
- forest operations; or horticulture;

and includes the manufacture of dairy produce by the customer who produced the raw material used in that manufacture.

This definition does not include any business that is involved in the secondary processing of primary produce such as:

- Canning of fruit and making wine (as opposed to grape growing)
- Wood chipping or grain handling, and
- Processing of fish, poultry, and meat and dairy products (where different from primary milk production)

A customer(s) that satisfies the eligibility criteria associated with the establishment of a new scheme will be charged in accordance with the Network Operators policy criteria.

Customer(s) that connect to an existing CES or SES as a new member must contribute to the cost of their connection and any rebate due to the existing scheme member(s) connected as a part of that scheme.

Customers who utilise the Contributions policy funding criteria are not eligible to receive future rebates from customers connected to the same network extension.
SES schemes have a life of 10 years. Requested connections to an existing scheme after the scheme life has elapsed will be treated as a new connection/scheme. It should be noted that there are older schemes known as the Contributory Extension Scheme (CES).

CES ceased to operate in the early 1990’s however new connections are still permitted to existing network extensions as such schemes have a life span of 30 years.

The charges associated with the creation of a new scheme and costs to connect to an existing scheme will be determined by the Network Operator. In addition to the cost of a connection/extension to the network and existing schemes rebates, the customer may also be required to make a contribution to the Headwork charge, as prescribed in Clause 9.3.4. Headwork charges are not refunded when subsequent customers connect to a scheme.

**Note:** Customers that fall outside either policy will be assessed under the individual customer policy described in Clause 9.3.3.

### 9.3.6 Overhead to underground conversions (pole to pillar)

An overhead conversion to an underground supply for domestic premises which is not part of a sub-division will be charged at the pole to pillar rate if the following summarised eligible criteria is met:

- The pillar installation must be in accordance with regulatory and Network Operator requirements
- The pillar is required to supply a number of domestic dwellings or strata lots being:
  - No more than three dwellings requiring a connection within the NIS or NWIS
  - No more than two dwellings requiring a connection within the SWIS
- The supply is classified as standard
- The pillar is placed in the Network Operators nominated position
- The connection is within 60 m of an existing distribution network
- The connection is not for commercial or industrial use
- Any existing overhead connection is removed or converted to underground in a way that does not result in there being multiple points of supply
- The customer does not request an arrangement that requires additional network assets to be installed.

Where the number of permitted connections (as determined by the Network Operator) is exceeded a site main switchboard shall be installed.

The final location of the network point of supply is governed by the arrangement of the existing distribution network and the Network Operator’s requirements. There may be some latitude for a customer to choose an alternative location for a service pillar. Should a non preferred position be required and agreed to by the Network Operator then the full cost of installing the pillar at customer’s alternative location shall be borne by the customer.

Additional costs may also be incurred by the customer for the installation of the consumer’s mains cable and any alterations to the main switchboard.

A full and complete understanding of the Network Operator’s terms and conditions is essential before seeking a connection via this method. Policy details can be obtained from the following network websites:

- **Horizon Power** - Distribution Pole to Pillar Guidelines
- **Western Power** - Pole to Pillar Guideline and Distribution Overhead and Underground Construction in Road Reserves

### 9.3.7 Builders and temporary supplies

Builders and temporary supplies are charged at full cost to install and remove the connection. Temporary and builders supplies are only available for low voltage connections. Please refer to Clause 9.2 for further details on the Network Operators standard charges.
9.3.8 Network relocations
A customer may require an electrical asset to be relocated. The relocation of equipment may include infrastructure such as overhead lines, transformers, poles, cables, stay wires, service pillars, etc. The cost to relocate the equipment can vary significantly dependent on the nature of the infrastructure to be moved and its operational voltage. Relocation costs will be at full cost to the customer.

As the cost associated with relocating transmission systems is generally much higher it is important to understand the difference between transmission and distribution networks. For additional information refer to Section 10 of this Manual or download the (Transmission or Distribution) information sheet available from the Network Operators websites.

9.3.9 Unmetered supplies
Unmetered supplies are available for loads up to 4.8 KW single phase. Equipment similar to traffic signals, streetlights, signs, railway crossing boom gates, bus shelters, and communications equipment are generally suited to this type of supply. The cost of installing the supply is fully recoverable from the customer and assessed individually on application. Suitable applications for unmetered supplies are given Section 7.

9.3.10 Equipment sale
In some situations due to changes to the network configuration or operation, a customer may wish to purchase existing installed Network Operator infrastructure or equipment. The cost and purchase of this equipment will be dealt with on a case by case basis. For further information please contact the relevant Network Operator.

9.4 Payment and refunds
Generally only a single payment option is available to customers. This consists of a full up-front payment of applicable fees and charges at the time the quotation is accepted.

If a project is cancelled at the applicant’s request before it has been completed, the full amount paid will be refunded, less all non-recoverable costs (including environmental/heritage assessments, material and/or labour) incurred by a Network Operator.

Once a project has been completed, full or part payment is non-refundable. That is, no refund is available to the applicant if other customers connect to equipment at some future time.

9.4.1 Western Power project revenue security
When determining if revenue security will be sought Western Power will look at key project risk & commercial considerations including but not limited to:

- Projected load ramping profile
- Projected revenue value (up to 15 years) relative to forecast costs for construction
- Customer type (, SME, Large Commercial/Industrial, Special purpose vehicle)
- Evidence of current load utilisation of “like-for-like” installations (e.g. school, fast-food chain etc.)
- Potential for the new assets to be utilised by other users (primary or secondary) if the requesting customer ceases utilisation
- Presentation of property ownership and/or leasing documentation demonstrating financial obligation to a third party
- Evidence of financial commitment of applicant and its financiers/funders
- As discussed & agreed with customer (case-by-case).

Western Power may require revenue security by the proponent if the network extension and augmentation costs are valued at over $50,000 and the revenue offset is greater than $50,000 for what Western Power considers to be the at risk component.

For example, a project with network extension and augmentation cost of $45,000, which has a revenue offset of $20,000 requires an upfront customer capital contribution of $25,000.
This project would not require revenue security. However; a project with a network extension and augmentation cost of $75,000, which has a revenue offset of $55,000 requires a customer capital contribution of $20,000 would fall into the initial risk criteria for a security assessment. Revenue security will be assessed for return to a customer in accordance with Clause 4.3 of Western Power’s Contribution Policy. For additional information contact the customer service centre on 13 10 87

9.5 Charges and conditions

Charges are calculated on the basis that the applicant has provided all the necessary information to determine the actual cost of the connection or network augmentation. The Network Operator may choose to nominate specific terms, conditions or qualifications applicable to the customer connection application and project via formal correspondence at the time of quotation. Any additional costs arising from incomplete customer information or noncompliance with the Network operator’s terms and conditions will be charged to the customer.

9.6 Western Power’s distribution LV connection headworks scheme

The Distribution Low Voltage Connection Headworks Scheme (DLVCHS) provides a mandatory mechanism for calculating customer connection costs for new or upgraded non-standard low voltage connections within a 25 km radius of a Western Power zone substation which satisfies the requisite economic test.

The test is applied to ensure fairness of application of the DLVCHS charge, as connections requiring significant augmentation costs can adversely impact on the average cost of connection (kVA Rate). Connections costing more than the economic exclusion limit will be charged based on the actual cost of augmentation. The formula used is similar to that previously applied for customer funded works except that the network augmentation cost is now calculated using a fixed dollar value per unit (kVA) of electricity required.

\[
\text{Charge to Customer} = \left( \frac{\text{Cost to Augment Network}}{\text{Network Revenue}} \right) + \text{Full Cost Items}
\]

Cost to augment the network replaced with a kVA charge. (To a Minimum of $0)

Full cost items are those in excess of the minimum supply arrangement or additional works required for approval. These may include network assets such as transformers or pillars not installed in the network preferred location, costs associated with native/EPA title approval or costs relating to higher than normal levels of supply security.

Applications received prior to the implementation date, against which a quotation was provided but not accepted by the customer and had not expired, may be requoted at no cost to the customer with the option available to select whichever is cheaper. Quotations that have expired (90 day period) are subject to the DLVCHS process.

The following new or upgraded connections are not eligible for consideration under this Scheme:

- Connections that do pass the DLVCHS economic test;
- High voltage customers, including large shopping centres or CBD high-rise buildings;
- Non-network capacity projects, such as road widening and asset relocations;
- Subdivisions;
- Domestic connections covered by the Pole to Pillar policy (P2P);
- Connections outside a 25 km radius from a Western Power zone substation;
- Street lighting installations;
- Supply Extension Scheme (SES) connections.

Rates are available on Western Power's website and reviewed annually following an initial 6 month analysis. It should be noted that the published kVA rates should not be used as an estimate of costs as revenue offset and full cost items have not been included.

### 9.7 Horizon Power section references

The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either, go to the related clause or the identified online link.

#### 9.7.1 Summary

To view the range of standard fees and charges that may be applied to specific applications or general situations refer to Horizon Power's [Network Charges](#).

Horizon Power's [Fees and Charges](#) website provides supplementary material which customers need to be aware of in addition to the requirements contained within this Manual.

Subdivision charging policy for work within the respective distribution networks is covered by Horizon Power's [Underground Distribution Schemes Manual](#).

Full details of the Network Operator's Head Works charges can be obtained by contacting Horizon Power on 1800 737 036 or e-mail [enquiries@horizonpower-reply.com.au](mailto:enquiries@horizonpower-reply.com.au)

Horizon Power’s [Distribution Pole to Pillar Guidelines](#) provides a full and complete understanding of the terms and conditions applicable to a pillar installation within an overhead area.

### 9.8 Western Power section references

The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either, go to the related clause or the identified online link.

#### 9.8.1 Summary

To view the range of standard fees and charges that may be applied to specific applications or general situations refer to [Network Charges](#).

Western Power's [website](#) provides supplementary material which customers need to be aware of in addition to the requirements contained within this Manual.

Subdivision charging policy for work within the respective distribution networks is covered by Western Power's [Underground Distribution Schemes Manual](#).

Full details of the Head Works charges can be obtained by viewing Western Power’s [Distribution Headwork Scheme](#) policy or referring to the schemes information sheets.

Pole to pillar policy details can be obtained from the [Pole to Pillar Guideline](#) or by viewing [Distribution Overhead and Underground Construction in Road Reserves](#).
10 Supply characteristics

10.1 Introduction
Horizon Power and Western Power are both Western Australian statutory Corporations and major distributors of electricity in Western Australia. Unless otherwise advised the network operational areas of each entity can be defined by the following:

10.1.1 Horizon Power electricity network
Horizon Power owns and operates two distinct distribution and transmission networks known as the North West Interconnected System (NWIS) and the Non Interconnected System (NIS) servicing isolated towns and communities not connected to the South West Interconnected System (SWIS).

The NIS extends from Esperance and Hopetoun in the south, through the eastern Goldfields (excluding Kalgoorlie), to the Midwest, Gascoyne and Kimberley regions. The NWIS extends from Karratha to Port Hedland.

Power to supply the isolated towns and communities in these areas is obtained from Private Generators (IPPs) and Horizon Power owned Generators with Horizon Power being the primary and only Retailer of electricity associated with these network systems.

The extent of the areas covered by Horizon Power’s networks can be viewed in the appendices.

10.1.2 Western Power electricity network
Western Power owns and operates an interconnected distribution and transmission network known as the South West Interconnected System (SWIS), servicing communities in the south west of Western Australia, stretching from Kalbarri in the north to Kalgoorlie in the east and Albany in the south.

This extensive electricity network consists of approximately 140 transmission substations, 6,750 kilometres of transmission lines and cables and over 83,000 kilometres of overhead and underground distribution infrastructure including 58,000 transformers. Urban and rural customer connections number in excess of 840,000, including residential, commercial, industrial, mining, manufacturing and agricultural sectors.

The extent of the area covered by Western Power’s networks can be viewed in the Appendices.

10.2 Electricity network
Power is received from electricity generators and is fed into the transmission or directly into the distribution network. Substations transform generated energy into suitable voltages for consumption by customers at a range of different voltage levels. Large industrial customers may take a supply at voltages up to 330 kV on the Western Power network and 220 kV on the Horizon Power network while the typical domestic/commercial customer is supplied at 240 V or 415 V.

10.3 Supply
Electricity distributed by Network Operators is in the form of alternating current (AC) at predetermined nominated voltages and frequencies as prescribed by The Electricity Act 1945.

In summary, the Act requires a Network Operator to nominate an operational system voltage and/or a system frequency at which electricity will be provided to the premises of a customer. Therefore the system supply is to function within the limits of ±6 percent of the nominated voltage and where nominated, within the limits of ±2½ percent of the system frequency.

It should be noted that the voltage levels specified in this Manual are the five minute average values measured at the customer’s point of supply. Voltage levels may vary for short periods of time as prescribed in Clause 10.4
10.3.1 Nominal voltage 

**Distribution low voltages** - Is generally provided via a three phase four wire system at a pressure of 240 volt single phase /415 volt three phase. In some country, rural/semi-rural and metropolitan fringe areas, only a single or two phase system may be available delivering 240 or 480 voltages. (Refer to Clause 7.7.3).

**Distribution high voltages** - Distribution voltages include low voltage and high voltages of 6.6 kV, 11 kV, 22 kV, or 33 kV. It should be noted that distribution networks operating at 6.6 kV and 11 kV are used in some regional areas but are semi redundant in the Perth and Fremantle CBD's

**Transmission voltages** – Transmission voltages include 66 kV, 132 kV, 220 kV, 330 kV.

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Network utilization examples (For specific details refer to the relevant Network Operator)</th>
</tr>
</thead>
<tbody>
<tr>
<td>240/ 415 V</td>
<td>LV distribution to residential, commercial and industrial installations. Typically less than 500 m in length from the distribution transformer.</td>
</tr>
<tr>
<td>6.6/ 11 kV</td>
<td>Used in most regional towns and communities throughout the NWIS and NIS with some limited use in and around the Perth and Fremantle CBD’s.</td>
</tr>
<tr>
<td>22 kV</td>
<td>Is the current standard HV distribution network with in the SWIS. Is also used in some regional towns.</td>
</tr>
<tr>
<td>33 kV</td>
<td>The current standard high voltage distribution network for less densely populated country areas.</td>
</tr>
<tr>
<td>66 kV</td>
<td>Transmission voltage to distribute power from terminals to substations.</td>
</tr>
<tr>
<td>132 kV</td>
<td>Transmission voltage to distribute power from terminals to substations.</td>
</tr>
<tr>
<td>220 kV</td>
<td>Transmission voltage.</td>
</tr>
<tr>
<td>330 kV</td>
<td>Transmission voltage.</td>
</tr>
</tbody>
</table>

**Table 4:** Network utilisation within the NWIS, NIS and SWIS.

10.3.2 Nominal frequency

The nominal frequency of supply is 50 Hz. (Hz = 1 Hertz or 1 cycle per second) for both Network Operators. Frequency tolerance limits are dependent on the customer’s geographical location, nature of the supply (either a grid or generator connection) and the operating condition of the supply which may include a lower limit if operating under emergency conditions.

10.4 Network performance parameters

It is the Network Operator’s objective to provide customers with a safe, reliable and high quality electricity supply at an affordable price. Every effort is made to provide customers with a quality electricity supply within the following limits:

For distribution voltages operating below 6.6 kV, plus or minus:

- 6 percent under normal conditions
- 8 percent under maintenance conditions
- 10 percent under emergency conditions.

Operational limits can also vary for high voltage customers where the connection arrangement/contract has been negotiated on an individual basis. Factors to be considered may include the customer’s load demand, reliability of supply requirements, geographic location or other usage factors.

Additionally, the limits cannot be guaranteed since customer supplies can be affected by a range of factors outside the control of Network Operators. For example, lightning strikes to electrical plant, bushfires, equipment failure, vandalism and system disturbances caused by customer equipment can have adverse effects on the quality of supply.
Quality limits are defined in terms of the magnitude of the voltage, deviation from the sinusoidal waveform, magnitude of each phase voltage in comparison to the other phase voltages, the magnitude and frequency of voltage surges, spikes and sags and any harmonic distortion of the network. Awareness of a network power quality deficiency is generally through monitoring of the system and customer contact or complaint.

10.4.1 Horizon Power
For additional information refer to the Technical Rules or contact enquiries@horizonpower-reply.com.au

10.4.2 Western Power
For full details, refer to Clause 2.2.2 of the Technical Rules or Western Powers website section on Power Quality.

10.5 Supply loading
Customers must ensure that each facility or electrical installation that is connected to a Network Operator’s transmission or distribution network, and for which they are responsible, is capable of operation within the performance parameters and standards as set out in these requirements and the Network Operator’s requirements:

- Horizon Power - Technical Rules
- Western Power Technical Rules.

Note: Dependent on network capacity and customer requirements, the Network Operator may nominate variances to these limits to assist customers comply with operational parameters.

10.5.1 Obligations
Customers are obliged to ensure that the operation of their installation and the usage of electricity ensures the:

- Protection equipment installed in the customer’s installation is at all times effectively coordinated with the distribution and transmission network; and
- Distribution and transmission network, inclusive of the quality of supply to other customers is not adversely affected by the actions of the customer and their installation operation.

10.5.2 Maximum demand
The maximum demand in a customer’s installation including mains, sub-mains and final sub-circuits, taking into account the physical distribution and intended usage of electrical equipment in the electrical installation, shall be determined using the methods set out in AS/NZS 3000 Clause 2.2.2 (a) to (d).

The customer shall ensure that their installation’s maximum demand does not exceed the quantum nominated within the “Preliminary Notice” or as stated within the customer’s “Connection Agreement” unless prior approval has been formally granted by the Network Operator.

The customer and their agent(s) shall not submit multiple notices relating to the same electrical installation for the purposes of deliberately underestimating the installation’s total maximum demand. Where such actions are detected, the Network Operator may choose to re-evaluate the customer’s electricity consumption and network infrastructure requirements. Any costs associated with either network modification or reinforcement may be passed onto the customer.

The size of a customer’s load directly affects the type of the supply arrangement and network connection provided. Being the key parameter it must be determined before the network design process can proceed.

A Network Operator may elect to seek additional information from the customer’s electrical consultant or contractor to verify that the requested calculated load is realistic.

Should the requested load be classified as “unrealistically high” the Network Operator may elect to install equipment necessary to cater for that part of the load deemed as realistic.
Should the actual demand exceed the capacity of the installed equipment the Network Operator will review the design and where required install additional equipment to accommodate the load.

### 10.5.3 Non compliance
Where a customer installs or operates any apparatus or equipment the Network Operator considers does or may interfere with the electricity supply quality to others, the Network Operator may require the customer to make appropriate adjustments or alterations to the equipment to remove or sufficiently abate the interference.

The Network Operator may specify a time period for correction and may disconnect supply if the adjustments or alterations are not carried out within the time specified. This requirement applies on initial connection of an installation to the network, and at all times thereafter.

### 10.6 Prospective short circuit current
AS/NZS 3000 requires electrical installations to be designed with consideration given to the prospective short-circuit current under short circuit conditions within the electrical installation.

The prospective short-circuit current at the point of supply will vary dependent on the geographical location of the customer's electrical installation in relation to the distribution system to which it is connected. Factors that affect this variance include the size and impedance of network transformers and the length, size and impedance of network and customer cables supplying the installation.

The WAER makes provision for lower fault ratings for the Service Protection Devices subject to that device satisfying specific criteria. For detailed information on Network Operator declared LV fault levels refer to their Technical Rules or Connection Agreement.

#### 10.6.1 Horizon Power fault levels
For further information regarding Horizon Power’s fault limit requirements in the NWIS or NIS refer the Technical Rules or contact enquiries@horizonpower-reply.com.au

#### 10.6.2 Western Power fault levels
The customer is required to install equipment suitable for the highest network fault levels, specified by the network operator, for that connected voltage level. To ensure protection reach and grading, the minimum fault levels should be requested. Additional information on fault limits and maximum fault currents refer to Clauses 2.5.7 and 2.5.8 of the Technical Rules.

#### 10.6.3 Western Power fault levels for LV supplies > 800 Amps
As per the requirements of AS/NZS 3000 Section 2.5.5 the customer's switchboard protection equipment must be able to detect and clear arcing fault currents for switchboards with a load capacity of 800A or more.

Switchboards with a capacity of 800A or more are typically supplied from either a 630 or 1000 kVA LV network transformer. The minimum fault levels that should be used to ensure appropriate operation of protection equipment is 25% of 25 kA for 3 phase faults within 30 km's of a zone substation.

Where this cannot be achieved the customer agent may propose alternative protection arrangement with the Network Operator in accordance with AS/NZS 3000 Section 2.5.5

### 10.7 Balanced electrical loads
A distribution network is designed to deliver a supply to customers, be that either a single or three phase supply as defined in Clause 7.6. This fundamental principle assists in the process of balancing the load on the network which is an important factor in the delivery of a quality supply to all customers.

Unbalanced loads can cause customer and network difficulties such as incorrect operation or overloading of protection devices and voltage regulation equipment, transformers, cabling, and in some cases the generation of non-characteristic harmonics from electronic loads.
Where the customer’s installation is serviced by a two or three phase supply it is important that the load is balanced equally over all phases. The intent of balancing the load is to minimise the differences between the phase-to-phase supply voltages. Most electrical installations are not equipped with voltmeters, therefore it is acceptable to measure load currents.

An out-of-balance current can be defined as the average difference between the load currents in any two active conductors (excluding the neutral conductor). The customer must therefore ensure for LV connections that the current in each phase of their multi-phase installation does not deviate beyond acceptable limits from the average of the phase currents, measured under both normal and peak operational conditions, by more than:

a) 5 percent for a standard nominal voltage up to and including 1 kV; and  
b) 2 percent for a standard nominal voltage above 1 kV.

Out of balance current deviations are permissible for periods of less than two minutes by up to:

a) 10 percent for a standard nominal voltage up to and including 1 kV; and  
b) 4 percent for a standard nominal voltage above 1 kV.

As a part of the installation commissioning process, regardless of whether it is a new connection or an alteration to the installation’s existing electrical load, the customer shall, through their agent, ensure that their installation complies with this requirement.

### 10.8 Power factor

A customer, unless exempted, shall ensure that the power factor of their electrical installation, measured at the point of supply, is not less than the values provided herein or as agreed with the Network Operator. Dependent on the customer’s contractual agreement, financial penalties may be applied by a Retailer should the customer not achieve agreed power factor limits.

#### 10.8.1 Horizon Power - power factor limits

Horizon Power’s Technical Rules provides further information on power factor requirements in the NWIS or NIS. For specific details e-mail enquiries@horizonpower-reply.com.au

#### 10.8.2 Western Power - power factor limits

The Technical Rules describes the power factor range for loads of less than 1 MVA connected to the distribution system to be 0.8 lagging to 0.8 leading. Where necessary to ensure the satisfactory operation of the distribution system, a different power factor range may be specified in the relevant connection agreement.

Western Power may permit a lower lagging or leading power factor where this will not reduce system security and/or quality of supply, or require a higher lagging or leading power factor to achieve the power transfers required by the load. Power factor ranges to be met by loads connected to the transmission system and those connected to the distribution system, rated at 1MVA or more are to be as shown in Table 5.

<table>
<thead>
<tr>
<th>Supply Voltage (nominal)</th>
<th>Power factor range (half-hour average, unless otherwise specified)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;66 kV</td>
<td>0.9 lagging to 0.9 leading</td>
</tr>
<tr>
<td>66 kV / 132 kV</td>
<td>0.95 lagging to unity</td>
</tr>
<tr>
<td>220 kV / 330 kV</td>
<td>0.96 lagging to unity</td>
</tr>
</tbody>
</table>

**Table 5:** Power factor range for loads 1 MVA and above.
10.8.3 Ripple control and blocking systems
Ripple control signals may be used by the Network Operator as a load control system for the switching of various loads, for example air-conditioning, street lighting or metering equipment. Where it is agreed that power factor correction capacitors are to be installed and the Network Operator uses ripple control, the customer shall cover any costs of installing additional equipment to block the Network Operator’s ripple control signals from either affecting the capacitor banks or reducing the strength of the ripple control signal.

The areas where ripple control is used or is planned to be used, and their operational frequencies, will be made available by the Network Operator.

10.9 Voltage fluctuations
Customers must take all reasonable precautions to prevent adversely affecting the reliability and quality of supply to other customers supplied from the same Network Operator’s distribution network. As a minimum the customer’s electrical installation shall meet the requirements of AS/NZS 61000 including:

- AS/NZS 61000.3.7: “Electromagnetic compatibility (EMC): Limits – Assessment of emission fluctuating loads in MV and HV power systems”
- AS/NZS 61000.3.5: “Electromagnetic compatibility (EMC): Limits – Limitation of voltage fluctuations and flicker in Customer’s Mains power supply systems for equipment rated greater than 16 A
- AS/NZS 61000.3.3: “Electromagnetic compatibility (EMC): Limits – Limitation of voltage changes, voltage fluctuations and flicker in public Customer’s Mains power supply systems, for equipment rated greater than 16 A per phase and not subject to conditional connection.

Additionally the customer’s equipment must not introduce harmonic levels in the network supply voltage in excess of those specified in AS/NZS 61000.3.6: Limits – Assessment of emission limits for distorting loads in MV and HV power systems.

If two or more customers’ electrical installations are connected at the same point on the distribution network, the maximum permissible contribution to voltage fluctuations allowable from each customer shall be determined in proportion to their respective maximum demand, unless otherwise agreed.

Restrictions or special provisions may be imposed for apparatus or equipment which has or may cause adverse power quality issues such as voltage fluctuations or harmonic affects due to a large or fluctuating demand. For example non-linear load control of variable speed motors, gas discharge lighting, arc furnaces, welding machines, x-ray units or frequently started large motors. Similar conditions may be applied to equipment which may cause excessive distortion of the wave shape of the distributor’s system voltage such as rectifiers, frequency converters and load control devices using thyristors or saturable reactors.

The fact that a Network Operator may have accepted or agreed to connect the customer’s apparatus, equipment or electrical installation which is later found to be the cause of interference shall not exempt the customer from complying with these requirements, at the customers expense.

If instructed by the Network Operator, the customer shall arrange for the modification or removal of any apparatus or equipment to eliminate identified disturbances on the network. The Network Operator may disconnect the electricity supply in the event that a customer fails to take corrective action(s).

10.9.1 Voltage transients
Transients are short term variations in the supply voltage caused by temporary disturbances within the customer's installation or on the Network Operator’s transmission or distribution networks. These variations are best described as excursions from the ideal or perfect sine wave shape, lasting for either a very short duration or for several cycles (1 cycle = 20 milliseconds).
Swells and spikes are often referred to as “surges”. Swells are temporary moderate increases in voltage usually lasting from one to several cycles. Spikes are very high magnitude voltage impulses lasting generally for microseconds. Sags or dips are decreases in the peak value of the voltage waveform, usually lasting from one to several cycles.

Transients are often produced within a customer's own installation. The level of occurrences will depend largely on the nature of customer activity. The addition of an air-conditioning load, the starting of large motors or the introduction of large electrical loads to a local network can have an adverse effect on the quality of supply to all users of that network. However, transients can also be introduced though lightning strikes, acts of vandalism or network faults and switching.

Transient voltages can cause disruptions to process-type industries by causing motor contactors to ‘drop-out’. Transient impulses can also affect computers and industrial control systems, and can have a potentially harmful effect on equipment such as electronic communication and entertainment equipment.

It is therefore important that the connection, control and operation of customer electrical loads are closely coordinated with the Network Operator for the benefit of all users of the network. Network Operators cannot accept responsibility for power quality where a transient is created as a result of causes outside of their control such as customer loads or severe environmental factors.

Clause 10.11 provides further information and suggests possible measures to reduce the risk of disruption to plant processes or damage to customer’s equipment.

10.9.2 Flicker
Large customer electricity loads that either vary or are switched regularly can cause voltage variations on the local network. The effects of these load variations can generally be noticed by the illumination levels of incandescent lamps.

10.9.3 Harmonics
Harmonics are sine waves having frequencies which are integer multiples of the fundamental sinusoidal waveforms at a supply frequency of 50 Hz. Harmonics can cause the ideal or perfect voltage sine wave shape to be distorted and typically affect sensitive communication systems and electronic equipment.

Harmonics can be produced by industrial loads such as rectifiers (which convert AC power to DC), inverters (which convert DC power to AC) and non-linear customer loads such as welding sets and arc furnaces all of which can contribute harmonic problems to the network. Modern “transformer-less” power supplies used in computers, electronic light ballasts, variable frequency drives can also produce this affect.

The most obvious symptoms of harmonic issues include:

- Overheated conductors
- Reduced performance and operation of transformers
- Interference with communication systems
- Nuisance tripping of circuit breakers
- Malfunction of UPS systems and generator systems
- Metering problems
- Computer malfunctions
- Overvoltage problems.

The prolonged presence of harmonics currents if left uncorrected will shorten the operational life of sensitive equipment and in some circumstances, cause fires due to the temperature rise in conductors with specific reference to the neutral conductors.
10.9.4 **Volt drop**
Voltage drop downstream of the point of supply shall be in accordance with the requirements of the AS/NZS 3000.

10.9.5 **Neutral voltage rise**
Within an electrical installation that incorporates a MEN earth system it is possible for the voltage in the neutral conductor to rise above earth potential, even though the neutral conductor is earthed at various points. The latent effect of this condition may produce a situation where an individual may receive an electrical shock from metal water pipes/fixtures or metal structures within the installation. Generally causes of this type of fault can be found within a customer’s switchboard, earth or consumer mains installation or may be due to:

- Voltage drop in the neutral
- Heavy current in the neutral conductor due to unbalanced multiphase loads
- High resistance contact of the earth electrode to the surrounding ground
- A high resistance contact in a neutral connection in a neutral conductor used as an earth bonding conductor.
- High resistance in the neutral conductor back to the source (i.e. small conductor)

Neutral voltages should be as close to zero as possible. Voltages up to 6V may be considered acceptable while those above this range will require corrective action.

Any occurrence of an electrical shock must be reported to the Network Operator or EnergySafety. The services of an electrical contractor should then be secured to investigate and rectify the problem. Where a fault remains after a full examination of the customer’s installation the fault should then be reported to the relevant Network Operator as the fault origin may reside within an adjacent property or the local distribution network.

10.9.6 **Horizon Power voltage fluctuations limits**
Horizon Power’s Technical Rules provides further information on fluctuation limits within the NWIS and NIS. For assistance e-mail enquiries@horizonpower-reply.com.au

10.9.7 **Western Power voltage fluctuations limits**
For information on operational parameters refer to Sections 2 and 3 of the Technical Rules

10.10 **Supply reliability**
Network Operators endeavour to provide a continuous supply of electricity. On occasions supply to some customers may need to be disconnected for planned maintenance, network alteration or augmentation activities. At other times unplanned outages may occur resulting in loss of supply to customers.

10.10.1 **Planned supply interruptions**
To maintain the level of reliability and performance expectations, various items of electrical equipment which make up the distribution network must be maintained on a regular basis. Additionally network alterations are carried out to connect new customers to the network or to enhance the quality of supply to existing customers.

During these activities supply may need to be interrupted for the safe completion of the work. Where possible, the Network Operator may provide a backup supply, but this will depend on the nature of the work, and if provided, only to the capacity limit of the existing system.

Network Operators will plan all non-urgent supply interruptions so that customers are fully informed of the intended interruption at least 72 hours prior to the commencement of work. The notification will provide information on the supply interruption time, duration and any actions required to be taken.
Shutowns affecting large commercial and industrial customers, heavy industry, process industry or mining operations will be negotiated on an individual basis. Wherever practicable, shutdowns will be planned to take place at times which will cause minimal disruption to normal business activities.

10.10.2 Unplanned supply interruptions
Unplanned supply interruptions can be caused by events such as customer and network equipment failure, storms, vandalism, vegetation and overloads. Network field personnel will restore supplies to all customers as soon as possible. Depending on the nature and severity of the outage, restoration times can range from a few minutes, hours or days. When supply is lost, the Network Operator will utilise a clearly defined set of strategies to determine the order of repairs and the manner in which supply will be restored.

These requirements take into account both public and crew safety. Faults affecting essential services such as hospitals, and faults affecting the greatest number of customers are given priority. An example of the prioritisation process used to restore supply could be similar to the following:

- Hazardous situations to public safety including fallen or arcing overhead lines and services to critical facilities such as hospitals
- High-voltage transmission lines servicing the network and substations
- Substation sites servicing distribution networks
- Distribution lines and transformer installations
- Localised distribution lines supplying clusters of customers or businesses
- Services to individual customers

The outages and duration for transmission voltage customers are generally less than those for low voltage and high voltage distribution customers. The level of reliability required by a high voltage customer is negotiated on an individual basis.

10.10.3 Emergency response generators

10.10.3.1 Horizon Power
Horizon Power does not have Emergency Response Generators as part of its fleet however in the case of extended outages due to storms and cyclones there are contingency plans in place for individual sites to obtain emergency generation capacity where required. For more information phone 1800 737 036 or refer to Customer Charter

10.10.3.2 Western Power
Western Power has a fleet of Emergency Response Generators designated for the purposes of providing back-up power during planned and emergency power interruptions. Dependent on the type of fault or supply interruption these generators can be utilised to reduce the length of the interruption and minimise the level of inconvenience to customers.

For more information on Emergency Response Generators or for information on Public Interruption Information download the document via the identified link or contact the Customer Service Centre on 13 10 87.

10.11 Customers’ responsibilities

10.11.1 General
A customer’s responsibly is to ensure that the equipment they intend to use is correctly rated for the supply voltage and that it has a tolerance suited to the Network Operator’s supply limits. If there is any doubt, the customer should refer to the specific equipment instruction manual or product information guide for that piece of equipment, contact the manufacturer, Retailer, their electrical contractor or electrical consultant for assistance.
10.11.2 Using equipment from outside Australia
Customers intending to purchase or use equipment manufactured from outside Australia on Western Australian distribution networks must first confirm with the manufacturer or Retailer that the equipment complies with the Network Operator’s minimum supply requirements and the applicable Australian Standard for that equipment.

10.11.3 Purchasing and protection of sensitive equipment
Computers, electronic communication and entertainment equipment, including some white and brown goods can be susceptible to damage caused by transients and voltage fluctuations in the power supply. Customers intending to purchase this type of equipment should first confirm with the manufacturer that it is capable of satisfactory operation without additional protection.

Should the equipment be incapable of operating within the required limits of the distribution network without additional protection, or the customer has concerns, then the installation of appropriate voltage conditioning devices and surge protection is advised. This will reduce the risk of damage from any voltage variations in the power supply.

10.11.4 Customer with disturbing loads
Customers intending to install electrical or electronic equipment which is likely to cause unacceptable disturbances on the Network Operator's distribution network must advise the Network Operator prior to installation. Examples of disturbing loads include:

- Power converters (e.g. rectifiers, inverters, variable motor speed drives etc)
- Arcing devices (e.g. are furnaces, discharge lamps, welding equipment, etc.)
- Magnetic core equipment (e.g. voltage regulating transformers, large motors, etc.)
- Power factor correcting equipment (e.g. capacitors, reactors, etc.)

The Network Operator will advise on any remedial action required before installation or negotiate a special agreement for the supply. This requirement applies to all users including residential, commercial and industrial customers.

10.11.5 Starting currents
Unless authorised, equipment shall be of a type provided with a suitable current-limiting device so that the maximum inrush current complies with Tables 6 & 7. Maximum Allowable Inrush Currents (A):

10.11.5.1 Single Phase (240 v)

| Cities and major regional centres: | 45 A |
| Other locations (SWIS) | 18 A |

Note: For Horizon Power refer to section 7.6.1 Table 3

**Table 6:** Starting currents single phase (240 v)

10.11.5.2 Three Phase (415 v)

| All areas: | Up to 1.5 kW |
| 13 A | 8.6A Per kW |
| 33A | 1.5 - 6.0 kW |
| | Plus 3.2 A per kW greater than 6.0 kW |

Note: For Horizon Power refer to section 7.6.1 Table 3

**Table 7:** Starting currents three phase (415 v)
Inrush current means the peak instantaneous value of current drawn by the equipment when energised. A Network Operator may consider and connect loads above these limits following formal application by the customer.

Additionally the customer must liaise with the relevant Network Operator to confirm the conditions for connection of any installation where any item of electrical equipment exceeding 60 kW demand on a NWIS or NIS network or 75 kW demand on the SWIS network.

10.11.5.3 Single phase appliances
Appliances with a rating exceeding 5 kW (20A) (or 13.5 kW for ranges, ovens, and hotplates) shall not be connected unless:

- Switching arrangements are incorporated preventing the loading of any one switching operation exceeding 20A and imposing a minimum 20 mS delay between successive switching operations (on or off); or
- As approved by the Network Operator.

10.11.5.4 Rural single phase loads (at 240 or 480 volt)
Special restrictions apply to the size of motors and other devices that produce inrush currents when energised and connected to rural networks.

240-volt single-phase motors may be started “direct on line” (DOL) and 480-volt single-phase motors up to 7.5 kW may be started DOL where the installation is served by a sole use transformer 25 kVA or larger. This is provided that the inrush current does not exceed the values given below in Table 8:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Maximum Inrush</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Phase 240 Volt</td>
<td>40 A</td>
</tr>
<tr>
<td>Single Phase 480 volt (50 kVA supply)</td>
<td>85.25 A</td>
</tr>
</tbody>
</table>

Table 8: Inrush currents rural single phase loads (240 or 480 volt)

10.11.6 Insurance and warranty
Most insurance companies will provide cover against damage to electrical and electronic equipment due to storms, fires and motor fusion. Customers are advised to check the extent of cover in their individual policies.

Customers are also advised to check the conditions of the manufacturer’s warranty when purchasing new equipment. For example, with some computer or business equipment the warranty is only valid if the power to the equipment is provided via an approved power conditioner.

10.12 Customer supply critical installations
Customers who have electrical installations:

- where momentary or prolonged loss of supply would jeopardise the health, safety or security of one or more persons or may cause damage to equipment, commercial processes, food, or loss of revenue
- susceptible to disruptions or damage caused by transients, high or low voltage levels, voltage unbalance levels or harmonic levels

Should seek professional advice from an electrical consultant or contractor on the need to install additional equipment to minimise disturbances such as uninterruptible power supplies, under-voltage motor protection, powerline conditioners, harmonic filters, or similar. This would typically apply to customers with critical plant processes, large computer or control systems, medical equipment (including home dialysis machines) or bulk cold food storage facilities.
10.12.1 Residential life support sensitive customers
Where there is a reliance on a continuous supply of electricity to run critical medical equipment such as dialysis, heart/lung or life support machines, both Horizon Power and Western Power encourage the user to register with their designated Retailer as a Life Support Sensitive Customer. It is also recommended that the applicant discusses and implements an appropriate secondary backup plan with their doctor or medical service provider to deal with any extended power interruption should it occur. To register the customer should complete the following for:

10.12.1.1 Horizon Power operated networks
For further information regarding Horizon Power’s services within the NWIS or RNIS phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au or reference Horizon Power’s Customer Charter.

10.12.1.2 Western Power operated networks
Log on to Life support account application form from the Synergy website or for further information, phone Synergy on 13 13 53.

10.12.2 Commercial/industrial sensitive customers
Commercial and industrial customers can apply to become a “Sensitive Customer” where there is a high risk that an extended power interruption will result in adverse economic, health, environmental or public safety consequences. Network Operators will evaluate each Sensitive Customer application based on the Risk Management Australian Standard AS 4360. Applicants are required to complete a risk matrix as part of their application.

10.12.2.1 Horizon Power operated networks
To register complete the “Application for Life Support Identification” form and submit via the address/fax number provided within the form.

10.12.2.2 Western Power operated networks
To register complete the Commercial/industrial sensitive customer application form including the risk matrix.

10.13 Manufacturers’ responsibilities
Manufacturers and Retailers of equipment intended for the Australian market must ensure that both their organisation and their equipment conform to the relevant state and national Acts, Regulations, Standards, Codes and these requirements including but not limited to the Trade Practices Act, the Fair Trading Act, the Electricity Act Regulations and applicable Australian Standards.

Electrical or electronic equipment falling within the prescribed list of items as defined by the Department of Mines, Industry Regulation and Safety shall be tested and approved in accordance with the Departments requirements and shall bear the designated approval number.

Manufacturers or Retailers of electrical or electronic equipment which may be susceptible to damage caused by voltage variations and transient impulses normally encountered in the supply system must inform prospective buyers of the requirement for further protection.
10.14 Claims against a network operator

In general, a Network Operator is not liable for any damage to customer’s equipment or consequential loss if:

- There has been no negligence on the Network Operator’s part
- Events or circumstances were beyond the Network Operator’s control
- The damage or loss was caused by:
  - the equipment being defective, not operating in accordance with manufacturers specifications or non-compliant with recognised standards
  - misuse, wear and tear, lack of maintenance, improper installation or similar
  - Third party interference to the electricity system including motor vehicle collisions with power poles or network equipment
  - Environmental or weather-related causes

Each claim will be investigated to determine the cause of the damage or loss. If the Network Operator is deemed liable, then the Network Operator will endeavour to assist customers meet the costs of repairs. For full information including the Network Operator’s terms and conditions applicable to assistance options please refer to their respective websites.

10.14.1 Horizon Power claims

For further information regarding Horizon Power’s claims processes refer to the Residential or Business section of the public website or phone 1800 737 036. To lodge a claim, please complete a Customer’s Damage Report claim form.

Customers affected by power outages lasting 12 continuous hours or more may be eligible to receive an $80 payment under the Extended Outage Payment Scheme.

10.14.2 Western Power claims

For further information regarding Western Power’s claims processes please refer to their website Compensation for Damage or contact the Customer Service Centre 13 10 87 or to lodge a claim, please complete the Customer Damage Report form.

Customers experiencing a long power interruption (for 12 consecutive hours or longer) may be also be eligible for an $80 compensation payment.

10.15 Horizon Power section references

The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either go to related clause or the identified online link.

10.15.1 Summary

Monitoring of a network power quality and performance parameters is generally through monitoring of the system, customer contact or complaint. For further information regarding Horizon Power’s fault limits, fluctuation limits, short circuit restrictions and power factor requirements phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

In the event of extended outages due to storms and cyclones contingency plans in place for individual sites to obtain emergency generation capacity where required. For more information, phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au.

For information regarding sensitive loads within the NWIS or NIS refer to Horizon Power’s website or complete a Community/Industry Critical Customer Application form including the risk matrix.

For further information regarding Horizon Power’s claims processes refer to the Residential or Business section of the public website or phone 1800 737 036. To lodge a claim, please complete a Customer’s Damage Report claim form.
Customers affected by power outages lasting 12 continuous hours or more may be eligible to receive an $80 payment under the Extended Outage Payment Scheme.

For further information regarding fault limits, fluctuation limits, short circuit restrictions and power factor requirements refer to the Technical Rules.

10.16    Western Power section references

The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either go to related clause or the identified online link.

10.16.1    Summary

Monitoring of a network power quality and performance parameters is generally through monitoring of the system, customer contact or complaint. For more information please refer to the Western Power’s Power Quality section on their website.

For further information regarding fault limits, fluctuation limits, short circuit restrictions and power factor requirements refer to the Technical Rules.

For more information on Emergency Response Generators or for information on Public Interruption Information download the document via the identified link or contact the Customer Service Centre on 13 10 87.

Where there is a reliance on a continuous supply of electricity to run critical medical equipment occur log on to Life support account application form from the Synergy website or for further information, phone Synergy on 13 13 53.

Commercial and industrial customers can apply to become a “Sensitive Customer”. To register complete the Commercial/industrial sensitive customer application form including the risk matrix.

For further information regarding Western Power’s claims processes please refer to the website Compensation for Damage or contact the Customer Service Centre 13 10 87 or to lodge a claim, please complete the Customer Damage Report form.

Customers experiencing a long power interruption (for 12 consecutive hours or longer) may be also be eligible for an $80 compensation payment.
Distribution
Connections Manual

Section eleven

Metering
11 Metering

11.1 General metering arrangements

This section specifies the Network Operators requirements for the supply, installation and maintenance of metering and service equipment. It is to be read in conjunction with the Electricity Industry (Metering) Code 2012 and the WAER.

11.1.1 Metering obligations

As prescribed by the Metering Code, there must be metering equipment installed at every connection point to a Network Operator’s distribution network excluding those connection points (Code type 7) which are classified as un-metered supplies.

The metering equipment and metering installation must be suitable for the range of operating conditions to which it will be exposed and operate within the defined limits for that metering equipment as specified in the approved metrology procedure.

Except for un-metered supplies, the metering point for a revenue metering installation must be readily accessible and located as prescribed by these requirements. Compliance ensures accessibility for Network Operator staff when ascertaining the performance of the metering equipment.

The customer shall provide and maintain facilities to accommodate the installation, operation and maintenance of the Network Operator’s metering equipment in a manner that ensures the correct functionality and security of the equipment.

Network Operators are not “required to maintain any metering equipment owned by the user or the user's customer. For example: Equipment owned by the user or its customer might include CTs, meter panels and secondary wiring installed as part of a switchboard.” For more information refer to Clause 3.5(7) of the Meter Code.

11.1.2 Alterations and additions

Where the customer initiates an alteration, addition or relocation of existing metering equipment, the altered metering arrangement shall be upgraded to comply with these requirements and applicable current standards.

For single direct connected meter installations the electrical contractor shall remove any meter related neutral links as only loop in loop out wiring configurations for single direct connected installations are permitted.

The electrical contractor shall ensure that the earthing system of the electrical installation complies with the WAER, these requirements and the AS/NZS 3000. The operational existence of the installation’s MEN connection at the customer’s neutral link shall be confirmed before the installation is reenergised. The preferred method to confirm the connection of MEN is by way of an Earth Loop Impedance test.

Network and customer metering and protection equipment forming all or part of a customer switchboard installed on un-enclosed or asbestos panels supported by timber frames or surrounds shall be upgraded to current requirements.

Where existing asbestos meter panels are upgraded or removed, the consumer shall ensure that any existing asbestos material is removed in accordance with WorkSafe’s guideline “Asbestos Code of Practice”. No asbestos material shall remain in the vicinity of the metering equipment.

11.1.3 Maintenance, repairs and replacement

Where an item of equipment (other than the Network Operator’s kWh meter) identified at Clause 11.1.7, for which the customer has responsibility, becomes damaged, defective or unserviceable, the customer shall initiate the appropriate action(s) to have the item(s) of equipment repaired or replaced.
Should the work necessitate the disconnection and reconnection of supply, the customer through their electrical contractor shall coordinate the required activities with the Network Operator. Clause 6.18 provides further information on levels of responsibilities for authorised electrical contractors including those electrical contractors authorised to carry out network disconnections and reconnections. Electrical contractors must have the Network Operator approval as a part of an accredited scheme before accessing distribution network equipment.

11.1.4 Metering installation
Meter mounting facilities shall be provided as prescribed in Clause 11.3.2: Metering facilities shall be of a type and in a location, accessible and prepared for the meter installation in accordance with these requirements. However, facilities which are equal to or deliver superior outcomes than these requirements may be considered in accordance with Clause 3.5. All metering installations, enclosures, surrounds, panels, and supplementary equipment shall:

- Comply with the relevant Australian/IEC standard(s) applicable at the time of manufacture
- Comply with WAER requirements
- Comply with the relevant Electricity Regulations, Metering Codes and the requirements applicable at the time of connection to the electricity supply network
- Be suitable for use under normal service conditions at the nominated operational voltage

11.1.5 Installing metering equipment
A person must not install a metering installation or connect metering equipment to a distribution network unless that person is:

- The Network Operator employee; or
- A registered electrical contractor authorised to undertake this type of work as prescribed by the Service Apparatus Connections Scheme or Contractor Connect Schemes.

11.1.6 Unauthorised access to metering equipment
Each metering installation connected to the network shall be secured by means of devices or methods which, when installed to the standard of good electricity industry practice, shall hinder unauthorised access to the metering installation and enable unauthorised access to be detected. All locks and locking systems utilised must be of a master key type as approved by the Network Operator.

It is an offence to alter, tamper or interfere with metering equipment as detailed in Clause 3.8. This includes unauthorised connection of meter and/or service apparatus and acts of vandalism.

11.1.7 Stakeholder responsibilities
In summary the customer is responsible for the supply and installation of all service equipment, switchboards, meter panels, enclosures etc. The revenue meter remains the property of the Network Operator.

The customer shall supply, install and maintain:

- Service and meter protective devices, including meter fuse bases/holders fuse cartridges and meter circuit breakers,
- Boundary fuse bases/holders and fuse cartridges
- Current and voltage transformers
- Service neutral/active links including those for master metered panels
- Meter enclosure and panel
- Switchgear enclosure
- Consumer mains
- Associated wiring and connections
- Labels.
The electrical contractor shall:

- Assess the maximum demand to determine the correct selection of metering equipment, service protection and consumer mains cable
- Where accredited by a Network Operator, obtain, install and connect direct-connected metering for supplies up to 100A; and
- Where the maximum demand exceeds 100A per phase for separately metered parts of an installation, install all current/voltage transformers and arrange for the metering to be installed by the Network Operator.

The network operator shall supply, maintain and, where engaged, install:

- Revenue meters but not the panels, wiring or enclosures.
- Where required supply and install CT meters to a customer’s CT metering equipment.

11.2 Tariffs and metering

The customer or their agent shall consult with the customer’s Retailer at the earliest opportunity prior to connection to establish an account and determine retail tariffs for the specific electrical installation. Details of current tariffs are available from the various Electricity Retailer websites.

11.3 Meter panels

11.3.1 Size

Meter panels shall as a minimum be sized in accordance with the requirements of this Manual including Clauses 11.9.2 and 11.13 and be adequate to accommodate the metering equipment to be installed upon it.

11.3.2 Installation

Meter panels shall be installed:

- Within a suitable metering enclosure adjacent to the customer’s switchboard; or
- Within a suitable meter only enclosure; or
- On facilities that are acceptable to the Network Operator; and
- Where located within an enclosure, the enclosure lid must be capable of being opened to an angle of not less than 90 degrees from the closed position with all metering equipment installed.

11.3.3 Materials

Meter panels shall be constructed of insulating material:

- To an equal or better standard than that required by the AS/NZS 3000 for switchboards
- Constructed of material that will maintain a structural and dimensional fit after the metering equipment has been installed
- Suitable for its intended use and environment, including exposure to weather and ultra violet light if exposed during daylight hours.

11.3.4 Wiring holes

Wiring holes manufactured in meter panels shall be prepared so as to:

- Suit each particular metering installation or as prescribed within this Section
- Accommodate the Network Operator’s metering equipment and where required meter fuses
- The network service protective devices
- Enable free movement of cables through the panel and termination of the conductor/s without damage to the cable insulation or equipment
New meter panels shall have no exposed holes, other than those required for mounting of meter/protection devices and cable access. Any un-used holes in existing panels must be sealed if there is a likely hood of either direct or indirect contact with live parts as defined by AS/NZS 3000. In all cases unsealed panel holes must satisfy a minimum protection rating of IP2X.

11.3.5 Wiring
All cables shall be manufactured in accordance with AS/NZS 5000. Meter panel wiring shall be installed in accordance with these requirements or to the metering provider specifications and to Australian Standards AS/NZS 3000, AS 3008 and AS/NZS 3439.

The use of hard drawn copper, aluminium, braided, flexible or neutral screened cables for meter panel wiring is not acceptable.

Wiring shall be designed and installed to withstand any thermal and magnetic effects on the conductors. Where provision is made to hinge or remove a panel, conductors connected to electrical equipment on the panel shall be:

- Of sufficient free length to allow the panel to be moved into an inspection or workable position
- Suitably fixed or otherwise retained in position to avoid undue movement or stress on electrical equipment at equipment terminals
- Arranged to prevent undue pressure on electrical equipment mounted behind the panel
- Appropriately secured and protected when installed on hinged panels

Wiring not intended to be connected to metering equipment shall not enter the area directly behind the meter panel(s) unless contained within a physically separate wiring duct or conduit located in a rear corner of the enclosure or surround such that it does not obstruct the meter wiring space.

Unused meter panel wiring must be removed or, where this is not possible, terminated in accordance with AS/NZS 3000. Acceptable methods to comply with these requirements include the fitting of all intended metering equipment to the panel at the same time, or to ensure unused wiring is appropriately insulated and terminated at the rear of the panel or within a junction box. Refer to later clauses within this section for specific wiring details for direct connected and CT metering arrangements.

11.3.5.1 Magnetic Screening
In order to avoid the adverse effect on meters, from magnetic fields, adequate spacing is required between the meters and large current-carrying conductors as show in Table 9.

<table>
<thead>
<tr>
<th>Maximum Current in Conductor Nearest to Meter (Amps)</th>
<th>Minimum Spacing between Conductor and Meter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>150</td>
<td>Nil</td>
</tr>
<tr>
<td>200</td>
<td>100</td>
</tr>
<tr>
<td>400</td>
<td>500</td>
</tr>
<tr>
<td>600</td>
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<td>1000</td>
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<td>2000</td>
<td>1400</td>
</tr>
<tr>
<td>3000</td>
<td>1700</td>
</tr>
<tr>
<td>4000</td>
<td>2000</td>
</tr>
</tbody>
</table>

*Table 9: Minimum spacing for unscreened meter enclosure*

Where spacing cannot be achieved magnetic screening must be installed around the meter. Screening shall be of a ferrous material, not less than 0.76 mm thick. The meter box must be totally enclosed around the meter, e.g. enclosed top, bottom, sides and back extending level with the front of the meter and provide a space behind the meter panel in accordance with Clause 11.4.5. It is important that the enclosure is in one piece. See Figure 27:
Figure 27: Magnetic screening

A bushed 32 mm minimum diameter hole is required to provide access for CT secondary wiring.

11.3.6 Panel arrangements
Standard meter panel arrangements for direct-wired meters are as detailed in Clause 11.9.2.

11.3.7 Fixing and sealing
Meter panels shall be:

- Mounted to the enclosure by the vertical edges of the panel
- Equipped with hinges where the panel size exceeds
  - 450 mm by 450 mm
  - 600 mm by 400 mm for CT metering
- Secured in the closed position by suitable non-corroding fasteners which require the use of a tool to release the panel. Refer to Clause 11.6.2.

11.3.8 Labelling
Labelling shall be in accordance with the requirements of Clause 6.16 of this Manual.

11.4 Metering equipment/protection enclosures

11.4.1 General
Surrounds, meter boxes and switchboard assemblies installed to support or house network metering and protection equipment shall be constructed, and designed:

- To ensure that under normal operation, contact cannot be made with live parts
- So as to prevent the entry of water and minimise spread of fire
- With sufficient stability and strength to withstand distortion and contain any mechanical or electrical energy which may be produced under both normal and fault conditions
- To ensure compliance with operational, functional and regulatory clearances of the electrical and metering equipment to the metering surround, box or switchboard assembly
- In a manner and mounted in a position that does not permit exposure of the mounted metering or switchboard equipment to direct sunlight, weather, salt or dust-laden air, corrosive atmospheres or adverse environment conditions
- To ensure that metering or switchboard equipment is protected from mechanical damage and vandalism
- So that any hinges or fixings used to support the meter panel(s) will be of adequate strength to support the weight of the panel(s) and equipment thereon when in either the opened and closed position
To ensure that the movement of the meter panel is not obstructed in any way by the meter
surround, box, assembly mounting, or by the fixings/device(s) used to retain the panel when
in the opened and closed positions
Where the meter panel is hinged, the fixings or the device(s) used to retain the panel shall
be aligned so as to ensure the operational correctness of the equipment mounted on the
panel.

11.4.2 Meter surrounds
Where an existing switchboard and or metering panel is fixed to a timber or similar surround,
located on a building external wall it is permissible to retain this configuration as long as:
- The installation’s metering equipment or consumer main cable are not to be modified,
  altered, upgraded, relocated or converted to an underground supply
- The location of the metering equipment complies with these requirements
- The installation is safe and does not expose the user or others to hazards
- The installation’s earthing system complies with all current requirements and Standards
  including the:
  - Main earth conductor, earth stake and MEN connection
  - Bonding of both plumbing systems and any exposed metal
  - System and equipment earths
- The required clearances as prescribed by this Manual AS/NZS 3000 and AS/NZS 3439 are
  maintained as a minimum.

The installation of metering equipment on unenclosed panels fixed to surrounds is not permitted for
new connections.

Note: It is Horizon Power’s preference that all meters and related equipment be installed within an
appropriate metering enclosure.

11.4.3 Meter boxes
A meter box shall take the form of a fully enclosed cabinet/compartment, accommodating the meter
panel, metering equipment and may also contain a separated customer’s switchboard.
Where service and metering equipment is installed in a box externally on a building or pole in an
isolated and unattended location, the enclosure must be constructed of material of sufficient strength to
achieve protection against vandalism, weather and other external factors.
The box shall be manufactured and fabricated from sheet steel with a minimum thickness of 1.0 mm,
galvanised and treated to protect the box against both the effects of environment and construction. As
an alternative the box may be manufactured from sheet aluminium with a minimum thickness of 2.0
mm. All metal work shall be free from sharp edges and corners.
Boxes shall be constructed and mounted so as to provide a minimum degree of protection to a rating of
IP 24. Where the box is fixed to a pole the following additional measures shall be taken to ensure the
integrity of the IP rating. Cable access between:
- A circular or square pole and the box shall be via a conduit coupling or welded nipple. The use
  of sealant or adhesive style productions will not be permitted as a means of establishing a
  permanent seal between the box and the pole.
- A square pole and the box shall be via a bushed and sealed aperture.
Where required ventilation and draining shall be provided to:
- Minimise fluctuations in temperature and humidity
- Provide an exit point for moisture that may collect within a box
- Restrict the entry of insects and vermin
11.4.4 Switchboard assembly
A switchboard frame, compartment or cabinet may take the form of open, dead front or enclosed assembly designed and constructed to support or house network metering/protection and customer electrical equipment in accordance with AS/NZS 3000, AS 3439 and these requirements.

11.4.5 Clearances
Clearances shall be sufficient to ensure adequate:
- space for the installation of equipment and associated wiring; and
- safe access to all metering/protection equipment

In addition to the requirements of AS/NZS 3000 and AS 3439 the following minimum clearances shall be maintained:
- The internal width and height (excluding panel supports) shall be no smaller than the required panel size
- Clearance from the front of the meter panel to the inside of the door in the closed position shall be a minimum of 175 mm
- Clearance from the back of the meter panel to the rear of the surround, box or assembly shall be a minimum of 75 mm minimum.

When determining clearance requirements, cable bending radiiuses as prescribed in AS 3008 shall be considered to ensure that the cables are not under stress when installed, fixed in place and terminated.

Note: (Horizon Power only) The rear clearance from the back of the meter panel to the rear of the enclosure shall be at least 150 mm for conductors greater than 16 mm² up to 35 mm²

11.4.6 Installation
Where the enclosure is to be recessed or built into a wall it must be designed and constructed to be able to support the surrounding wall without distortion and where that wall is of a brick construction the enclosure shall suit standard brick courses.

For pole mounted enclosures the top must be angled or sloped to direct water or moisture away from the door. Conduits or cable entries must not enter the enclosure from the top.

Fixings used to secure the enclosure shall ensure that the enclosure cannot be dislodged from its supporting structure by any reasonable force and where located externally will prevent the entry of water or moisture.

All enclosures shall be fitted with a hinged door, catch and retainer. A minimum of two (2) hinges shall be fitted, consisting of a robust lift type, constructed from a non-corroding material.

The door catch shall retain the door in the closed position under all conditions that can reasonably be expected and a retainer shall be fitted, securing the door in an open position, enabling work to be performed on the meter panel and equipment safely, without interference.

Panel supports shall be provided in all enclosures presenting a full 25 mm clear surface for the purpose of fixing the panel(s) along each vertical edge.

11.4.7 Earthing
Earthing of enclosure shall comply with the requirements of AS/NZS 3000 and AS/NZS 3439. In addition, earthing facilities shall be fitted to surrounds and boxes, behind the customer's switchboard panel providing as a minimum a:
- 6 mm non-corrosive stud welded in position and complete with a nut, flat and spring washers; or
- 6 mm captive nut and bolt complete with flat and spring washers; or
- Earth bar/link secured to the enclosure.
11.4.8 Locks, locking systems and viewing windows
Where meters are located within a locked meter-box / cabinet or enclosed area, an approved Network Operator master locking system must be fitted, allowing network personnel access to the metering equipment at all times. Where an approved Network Operator locking system is fitted a viewing window is optional. For more information refer to Clause 6.17.

The disengaging of electronic security systems or customer provision of mechanical aids to obtain access or read meters is not acceptable.

11.4.9 Labelling
Labelling shall be in accordance with the requirements of Clause 6.16 and as prescribed in Section 3.5 of WAER, Section 5 of AS/NZS 3439 and as required within AS/NZS 3000. Labelling including Manufacturer’s details shall be clearly visible and remain legible for the life of the equipment and the installation.

Labels shall not be located or inscribed into meters or meter covers. Labelling located or scribed directly onto meters can damage the external surfaces of the meter and therefore render it unserviceable for relocation or exchange.

11.4.9.1 Single dwelling
Every single dwelling switchboard shall be equipped with a label in accordance with Section 3.5 of the WAER that shall clearly identify the board’s point of supply.

11.4.9.2 Multiple dwelling
Each dwelling switchboard in a multiple installation shall be labelled in accordance with these requirements and shall clearly identify the building, service protection device and meter installation for that dwelling inclusive of that board’s point of supply. Corresponding marking shall also be made on the mains cables for each dwelling at the meter panel location to enable present and future identification of conductors.

11.5 Metering equipment location

11.5.1 General
Unless specified otherwise by these requirements or the Network Operator, network service and metering equipment (metering equipment) shall be located:

a) not be more 30 metres (route length) from the point of supply where the consumer mains cable is electrically unprotected; and
b) on the principal frontage of the premises (but not more than 1 metre down any side wall) facing a road, laneway or access way that has been gazetted or classified as the official address for that building or premises.

Metering equipment shall not be located on or adjacent to a non-gazetted road, laneway or access way.

Service and metering equipment shall be accessible from the street level of the building or one floor above or below street level for multi-storey buildings. Where the service protection device/meter protection device(s) is to be located inside the premises, the customer shall arrange for the protection device(s) to be accessible to the Network Operator and emergency services personnel.

Where the metering equipment cannot be accessed, an AMR system shall be installed. Regardless of whether an AMR system is installed, metering equipment shall be located in a common area within the site.

Grouping of individual service and metering equipment is not permitted except where prescribed by Clauses 11.11 and 11.12.
Adequate space shall be provided and maintained in front of the enclosure to enable the metering equipment to be operated, maintained or replaced. The space shall:

a) provide minimum horizontal and vertical clearances as prescribed by AS/NZS 3000 Clause 2.9.2.2 and AS 2067;

b) enable the door or panel to be opened or removed safely;

c) ensure that the SPD, service/metering equipment and main switch is mounted in the same manner as prescribed by AS/NZS 3000 Clause 2.3.3.3 for main switches;

d) ensure metal enclosures are situated so that contact with adjacent conductive surfaces such as metal posts, bollards or fencing do not constitute an earth hazard to any person approaching or required to working on the enclosure, supports or associated electrical equipment.

As shown in Figures 28 and 29 the height of meter panels from the immediate finished floor or ground level to the bottom edge of the panel shall not be less than:

- 1200 mm for a single direct connected and gas/electrical combo metering arrangement
- 900 mm for multiple master metering arrangement (minimum height of 600 mm)
- 900 mm in all other cases

![Figure 28: Typical meter panel mounting heights](image)

![Figure 29: Typical multiple meter panel mounting heights](image)
11.5.2 **Access requirements**

A Network Operator is required to monitor the performance of their service and metering equipment for the purposes of operation and maintenance. Right of access provisions are prescribed in Section 43 (1) of the Energy Operators (Power’s) Act 1979.

Service and metering equipment shall be:

- located
  - in a non-hazardous accessible area (Refer to Clause 11.5.8);
  - so that Network Operator and emergencies services personnel have unimpeded access (24 hours 7 days per week);
  - not in areas enclosing animals/livestock, behind gates/fences/barriers or in front of stiles;
  - accessible without having to enter the dwelling or traverse areas not normally open to the public (Refer to Clause 11.5.8);
  - accessible in multiple domestic/commercial installations when the building is locked.

Where agreed with the Network Operator, metering equipment with remote reading facilities may be located in a secure common area within the site provided access can be appropriately coordinated.

11.5.3 **Single domestic/commercial lots**

Service and metering equipment for a single lot with a gazetted frontage and lot area up to 2500 m² shall be located in accordance with the requirements of Clauses 11.5.1 and 11.5.2. For lots larger than 2500 m² refer to Clause 11.5.6.

11.5.4 **Battle-axe block lots**

Service and metering equipment for a battle-axe lot with no gazetted frontage, other than a driveway or part thereof, shall be located in accordance with Clauses 11.5.1 and 11.5.2 in a position on the principal frontage as close as practical to the entry of the premises so that the metering equipment location is readily identifiable and accessible. Where these requirements cannot be satisfied, refer to Clause 11.5.6 for location details.

11.5.5 **Multiple domestic/commercial lots**

Multiple occupancy lots shall have the service and metering equipment readily accessible at all times and be located in accordance with the requirements of Clauses 11.11 and 11.12.

Service and metering equipment shall be so arranged to allow the supply to an individual premises or the combined installation to be de-energised at any time. This requirement may be varied by agreement with the Network Operator should the property have more than one point of supply.

11.5.6 **Semi-rural and rural lots**

Service and metering equipment shall be located in accordance with the requirements of Clauses 11.5.1 and 11.5.2. Where these requirements cannot be achieved, the service and metering equipment shall be located adjacent to the point of supply:

- inside and on the customer’s property boundary where the distribution network is situated within the road reserve; or
- in a position acceptable to the Network Operator where the distribution network traverses the customer’s rural property. (Refer to **Section 12** for guidance).

A Network Operator may permit a customer who resides in an isolated area or has an approved metering arrangement which is inaccessible, to self-read via a hard copy card system, communication link or online internet service.
11.5.7 Remote metering

“Individual metering equipment and the associated service protection device may be located on the property front boundary where the customer’s main switchboard is not more than 30 metres (consumer mains cable route length) from that metering equipment. Remote metering is limited to an installation consisting of a single self-contained separate building.

Remote metering arrangements are not be used for multiple/distributed master metering installations. Earthing of a remote metering enclosure shall be in accordance with the WAER, AS/NZS 3000 and these requirements. See Figure 30. Equipment and enclosure installation shall comply with these requirements.

![Diagram of remote metering setup]

**Note:** Where the meter enclosure is remotely mounted from the main switchboard, the enclosure shall be earthed by soldering to the load neutral a conductor with a cross sectional area not less than the consumer main conductors. Conductor to the earth electrode as per AS/NZS 3000.

**Note:** Where the meter enclosure and main switchboard are mounted on the same metal-framed structure, an earth conductor of the same size as the load neutral conductor shall be installed from the main switchboard to the meter enclosure. Conductor to the earth electrode as per AS/NZS 3000.

**Figure 30:** Typical earthing arrangement for remote metering
11.5.8 **Unsuitable locations**
Switchboard-mounted service and metering equipment shall not be located:

- Over stairways or ramps, in passageways or corridors, confined spaces, or in fire-isolated stairways
- In vehicle docks, driveways, factory passageways where the equipment or a person working on it would not be effectively protected
- In locations subject to flooding, fumes, vibration, dampness, or dust, which may cause deterioration of equipment or unsatisfactory working conditions
- In hazardous or prohibited locations as defined in the AS/NZS 3000
- In close proximity to, or over, machinery or open-type switchgear
- Where the normal ambient temperature exceeds 50 degrees C
- Where there is insufficient light or exposure to direct sunlight
- Where projections are a hazard or access is restricted by vegetation
- In pool or spa areas or areas containing water features
- In carports or enclosed verandas
- In areas to which access is normally restricted – for security, health or other reasons (this would include areas in which animals are kept for security reasons)
- In areas enclosing animals
- Behind a fence, unless with an unlocked, suitably positioned gate
- Near gas cylinders (refer to AS/NZ 2430.3.4) or gas services.
- Where the use of a ladder is necessary to access network equipment.

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**Figure 31:** Freehold (Single) residential lot meter location examples
Optional meter positions

Freehold property boundaries

Easement

Consumer mains not to exceed 30m

Freehold boundaries

Consumer mains

Meter

Sub - Mains

Gazetted Road

Figure 32: Freehold (Single) residential battle axe lot meter location examples

Optional meter positions

Freehold property boundaries

Easement

Consumer mains not to exceed 30m

Freehold boundaries

Consumer mains

Meter

Sub - Mains

Gazetted Road

Figure 33: Freehold (Single) residential (>2500 sqm) lot meter location example
Figure 34: Strata (Duplex) residential lot meter location examples

Figure 35: Strata (Multi) residential lot meter location examples
11.6 Equipment

11.6.1 Prohibited connections
Customer equipment including any ancillary equipment associated with the customer’s installation or devices that consume or measure electricity must not be connected to the supply side of Network Operator metering equipment unless approved by the Network Operator for the purposes of data collection, protection or control.

Customer electrical apparatus/equipment shall not be installed on a meter panel or within the boundaries of Network Operator’s CT metering panel where this type of metering is installed. This does not include metering equipment supplied by or measuring equipment formally approved by the Network Operator.

11.6.2 On panels and within enclosures
Equipment must be securely fixed to meter panels in accordance with AS/NZS 3439 and the AS/NZS 3000.

Fixing screws and fasteners shall be as short as practical and not protrude through the rear of the panel in a manner that could damage conductors, or create un-earthed condition. Fixings with a self-drilling needle point tip are not permitted. “The use silicone based, adhesive or other such material to insulate fixings or equipment supports is not permitted.”

Customer supplied metering equipment installed on the metering panel shall not in any way compromise or affect the integrity, accuracy or performance of the Network Operator’s metering equipment.

11.6.3 Neutral and active links
Neutral and active links shall comply with these requirements and AS/NZS 3000 Clause 2.9.4. In summary links shall:

- Be insulated from earth;
- Be fitted with a cover suitable for sealing where direct contact is possible;
- Have a separate terminal for each conductor;
- Have a current rating not less than the current carrying capacity of the incoming conductor;
- Be easily accessible and safe to work on;
- Be labelled.

Where the links are mounted on the rear of a panel, the panel shall be hinged.

11.6.4 Meter equipment protection and main switches
Meter protection and Service Protection Device (SPDs) shall comply with the requirements of Sections 6 of the WAER and these requirements. The SPD shall be installed on the line side of all direct connected meters and CT metering equipment in addition to the installation of a main switch(s) for all customer installations supplied at low voltage.

The purpose of a SPD and meter fuse(s) is to provide:

- An electrical point of isolation
- Metering equipment protection,
- Safe replacement of metering equipment

The SPD and or meter fuse does not replace the installation main switch and shall not be deemed as circuit protection for the customer’s electrical installation, equipment, mains cables and circuitry.

The SPD or where applicable, meter fuse(s) for each meter must be located within the main switchboard mounted on the meter panel directly adjacent to the meter. Network Operators will not accept a meter protection device located under or through an escutcheon cover or grouped together where not adjacent to each individual meter.
SPDs used in LV installations and the main switch used in HV installations must be a fault current limiting device with an interrupting capacity adequate for the prospective short circuit current of the installation.

The customer's SPD must grade with the Network Operator's upstream protective device. It is the customer's responsibility to determine the appropriate settings for their SPD. The Network Operator will on request provide a time-current curve for the upstream network protection device with the quotation to allow the applicant to determine their SPD settings.

Where the site's maximum demand load exceeds 100A and is CT-metered, the customer must provide the Network Operator with the following information on the SPD intended to be used. The Protection Settings Data Sheet (See Appendices) is to be used for this purpose. The following is required to ensure that grading is achieved with the Network Operator's upstream protection:

- SPD type and rating
- Protective device types and setting ranges
- Current transformer class and tapping ratios
- Proposed SPD settings
- Time current curves showing protection grading with the upstream protection device.

Where the SPD protection settings can be varied the customer shall engage a suitably qualified electrical contractor to apply and test the protection settings on the customer's SPD. A grading margin (operating time interval) is necessary between the minor relay/circuit breaker (closest to the fault) and the major relay/circuit breaker (next relay to minor relay on the source side of the fault) to ensure discrimination. i.e. that only the minimum number of circuit breakers operate to clear a fault.

The minimum protection grading steps are 0.2 seconds for LV. For HV connections the following shall apply:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Grading Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₁ ≤ 0.75 sec</td>
<td>T₂ ≥ (T₁ + 0.30) sec</td>
</tr>
<tr>
<td>0.75 sec &lt; T₁ ≤ 1.50 sec</td>
<td>T₂ ≥ (T₁ + 0.40) sec</td>
</tr>
<tr>
<td>1.50 sec &lt; T₁ ≤ 2.00 sec</td>
<td>T₂ ≥ (T₁ + 0.50) sec</td>
</tr>
</tbody>
</table>

Where these grading margins cannot be achieved, protection settings will need to be agreed in consultation with the Network Operators protection group.

Once testing and commissioning has been completed, the applicant shall return the Protection Settings Data Sheet to the Network Operator's Construction Project Manager.

### 11.6.4.1 Sole use and district substations

In addition to the requirements of Section 14 the SPD and main switch, for sole-use substations need not be duplicated. For supplies taken from district substations, the SPD for the customer's installation shall be a circuit breaker, fitted with over-current protection.

### 11.6.4.2 Additional requirements for LV connections

The customer shall install mechanical interlocking to prevent paralleling of 2 MVA transformer groups via the customer's LV switchboards.

### 11.6.4.3 Additional requirements for HV connections

Where the customer has a HV supply, the control of the high voltage installation incoming point of supply must comply with the fault level for the appropriate voltage, as prescribed in Section 13 of these requirements. The control and protection of outgoing high voltage circuits shall comply with the Network Operators specific network connection arrangements and applicable industry standards including but not limited to AS/NZS 3000 and AS 2067.
11.6.5 Sealing of meter equipment
Service equipment including meters, service links, fuses and service protection devices installed on the supply side of the connection point shall be provided with robust sealing facilities for fitting seals. Only persons authorised to do so by the Network Operator may fit or remove seals to network metering and service equipment, using Network Operator approved sealing cord and crimp seals. Removed seals shall not be reused.

Should any person suspect or have evidence that metering equipment has been tampered with they must immediately advise the Network Operator’s Metering Services or the Customer Service Centre.

11.6.5.1 Horizon Power reporting
For reporting assistance phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

11.6.5.2 Western Power reporting
For reporting assistance contact 13 10 87 or email: Western Power enquiries.

11.7 Fault current levels for metering equipment
In all cases the metering and related service equipment shall be designed, selected and installed to comply with the WAER, these requirements and cater for the maximum permissible fault current for that installation.

11.8 Metering systems and arrangements
The installation of mixed metering systems such as combinations of multiple master and distributed master metering on the same site is not permitted. These types of arrangements can create confusion or hazardous situations for network employees, service crews and emergency services personnel. Where a metering point has a minimum of 4 meters, alternative arrangements may be permitted subject to approval.

11.8.1 General metering types
There are a number of different metering configurations and types that can be utilised by the customer including both LV and HV metering systems. The maximum load that can be LV-metered is 2 MVA. Customers should seek assistance from their Retailer, electrical consultant or electrical contractor prior to applying for a metering system.

In Accordance with the Metering Code import/export meter must be installed where bi-directional (consumption & generation) flow occurs at the metering point. Bi-directional metering shall be in place prior to the connection and energisation (commissioning) of the generation system. Examples of metering systems include:

- **Direct wired metering** - The most common form of metering for single and 3 phase loads up to 100A per phase. Generally used in residential and small commercial installations and available in a range of voltages.
- **Remotely located direct wired metering** - General used for residential installations where security is an issue.
- **Automated meter reading (AMR)** - Generally used for remote reading of loads in situations where the installation has security precincts, geographical configuration of the site, or for practical reasons. This type of metering system may be applied to a single residential installation, to multi-unit villages or high-rise apartment buildings with mixed residential and commercial use.
- **Master subsidiary metering** - A master meter is provided to meter the entire development. Subsequent sub-meters are installed, maintained and read by the customer. The developer is responsible for funding the installation of the system.
• **Multiple master metering** - Where there is a requirement to measure and record multiple loads such as residential units on a single lot. Meters are usually grouped and can be either multiple direct connected loads or CT metered systems. Remote reading facilities shall be provided where prescribed within Clause 11.11

• **Distributed master metering** - Applies to direct connected master meters and CT connected meters, distributed throughout an installation. The meters shall not be grouped. Remote reading facilities shall be provided where prescribed within Clause 11.12

  **Note:** Distributed master metering - Not available in Horizon Power networks.

• **Current transformer (CT) connected metering** - Commonly used in most commercial and industrial installations. Used whenever the installation is connected at low voltage for loads exceeding 100A and up to 3750A per phase

• **High voltage metering** - Used where the LV current exceeds 3750A or the customer supplies their own transformer(s) and associated HV switchgear.

• **High voltage transmission metering** - Used in situations where the installation load is connected at transmission voltages

• **Summation metering** - Where there are two or more sources of supply, usually at high voltage to an installation. Each source will be metered and the contributions added together to produce a single energy consumption reading for the site. Remote reading facilities are required

• **Supply quality monitoring** - A customer may request the installation of a functionality metering system to monitor the quality of the electricity supply to an installation. Arrangements for this type of metering system including the delivery of power quality report must be negotiated for each site with the Network Operator on a case-by-case basis

### 11.8.2 Horizon Power metering types

• **Sub metering** - Master metering is provided to meter consumers directly billed by Horizon Power. Sub meters are those where a consumer on-charges or records the consumption of another consumer beyond Horizon Power’s supply meter. These meters are installed, maintained and read by the consumer.

• **Pre-paid metering** - This type of metering is mainly used at isolated indigenous communities. The consumer pays for a card to activate a meter to allow power usage up to the value of electricity pre-paid. Generally not available for use within the SWIS.

  **Note:** Distributed master metering - Not available in Horizon Power networks.

### 11.8.3 Western Power metering types

• **Time of use metering** - Where a residential and small commercial customer requires reading of multi-tariffs for off peak and normal consumption periods. Note new electronic meters can be reprogrammed to accommodate this function (fees may apply). There are also a number of older style meters still in service that have an auxiliary single phase circuit for switching loads up to 31.5 A such as hot water units, reticulation or pump systems.

### 11.8.4 Un-acceptable metering types

The following metering systems are no longer acceptable:

• **Whole-of-site metering** – The combination of a site master meter, upstream of multiple individual customer meters and unmetered house services.

• **Plug-In meters** - used as a master meter option (Effective from the 1 January 2007).
11.8.5 Existing meter locations
A Network Operator may have, under certain previous supply arrangements, permitted the installation of metering equipment at the rear of a premise or in a nonstandard location. The Network Operator may allow this equipment to remain in its current location providing the:

- Equipment is accessible and can read in accordance with the Metering Code or by alternative agreement with the respective utility.
- Impacted authorities are consulted and agree to allow the equipment to remain in the nonstandard locations including those located at the rear of a premises.

11.9 Direct connected metering

11.9.1 General
For electrical loads less than or equal to 100A per active conductor, a direct connected metering system shall be used. When using a direct connected metering system, the customer shall arrange for the installation and termination of the revenue meter.

11.9.2 Meter panels
The standard panel sizes acceptable for direct wired meters shall be as shown in Table 10:

- 450 mm high by 225 mm wide with a minimum thickness of 6 mm; or
- 450 mm high by 450 mm wide with a minimum thickness of 6 mm.

<table>
<thead>
<tr>
<th>Number of Meters</th>
<th>Number and size of Meter Panels</th>
<th>Meter Phase Link</th>
<th>Meter Neutral link</th>
<th>Meter Protection</th>
<th>Service Protection(SPD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 100 A</td>
<td>1 x (450 x 225 x 6)</td>
<td>Not required</td>
<td>Not required</td>
<td>Not required</td>
<td>Required</td>
</tr>
<tr>
<td>2 x 100 A</td>
<td>1 x (450 x 450 x 6) or 2 x (450 x 225 x 6)</td>
<td>Not required</td>
<td>1 x 165 A</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>3 x 100 A</td>
<td>1 x (450 x 450 x 6) or 1 x (450 x 225 x 6) or 3 x (450 x 225 x 6)</td>
<td>3 x 165A</td>
<td>1 x 165 A</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>4 x 100 A</td>
<td>2 x (450 x 450 x 6) or 4 x (450 x 225 x 6)</td>
<td>3 x 165 A</td>
<td>2 x 165 A</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>5 x 100 A</td>
<td>2 x (450 x 450 x 6) or 1 x (450 x 225 x 6) or 5 x (450 x 225 x 6)</td>
<td>3 x 165 A</td>
<td>2 x 165 A</td>
<td>Required</td>
<td>Required</td>
</tr>
<tr>
<td>&gt; 5 x 100 A</td>
<td>Multiples of previous sizes</td>
<td></td>
<td></td>
<td>Required</td>
<td>Required</td>
</tr>
</tbody>
</table>

Note: Maximum conductor size is 35 mm
Refer to Clause 11.3.6 for specific Network Operator requirements

Table 10: Direct wired meter panel arrangements

A Network Operator will accept the following alternative arrangement for a standard 450 mm x 450 mm panel.

- Horizon Power up to 2 (Elster) single phase and three phase electronic meters

It must be noted that due to the available space on the meter panel, this arrangement may not allow for future conversion to three-phase.

Due to problems experienced with various tariff meters being of different physical sizes and customers requiring metering upgrades, meters located behind or through escutcheon cover panels will not be accepted.
### 11.9.3 Panel wiring configurations

Cables shall be of stranded copper conductors and be:

- Not less than 16 mm$^2$ (7/1.70) for meters with a maximum current limited by an SPD or Meter Protection Device with a rating of up to 80A or
- Not less than 25 mm$^2$ (19/1.35) for meters with a maximum current limited by an SPD or Meter Protection Device with a rating of up to 100A.
- For multiple master metering arrangements and distributed master metering house services meters, a neutral reference meter cable system shall be installed. The neutral reference cable shall be not less than 2.5 mm$^2$ (7/0.67) stranded cable.

In multiple-meter installations, it must be possible to remove any meter without interrupting the continuity of the installation’s neutral connection or supply continuity to other customers.

![Typical panel layout.](image)

**Figure 36:** Typical single phase direct connected meter configuration.

![Typical panel layout.](image)

**Figure 37:** Typical three phase direct connected meter configuration.

### 11.9.4 Protection

Each direct connected meter shall have individual meter protection as prescribed by these requirements and the WAER. For a single meter installation, the SPD can be the meter protection.

Where there are multiple meters downstream of the SPD, individual meter protection via a specific meter fuse shall be provided. A set of spare fuse cartridges are to be provided at each point of protection for restoration of the power supply.
11.9.5 Conversion of subsidiary meters to master meters

The electrical contractor is to submit a Preliminary Notice to the Network Operator, detailing the work to be completed. New customer connection application forms must be submitted with the Preliminary Notice for each new master metered account. A changeover appointment will be coordinated via the Network Operator with the electrical contractor.

11.10 Time of use metering (SWIS network only)

“Time of use” metering allows the customer to take advantage of variable consumption electricity chargeable rates depending on when the electricity was used. Different periods (blocks of time within a 24 hour daily structure) are set to accommodate variances in electricity costs such as “peak”, “off peak” “weekday shoulder” and “weekend shoulder”. All energy consumed in the installation is charged at the rate applicable to the time block in which it was consumed.

11.10.1 Existing connections

Electronic meters currently used throughout the SWIS are capable of measuring “time of use” and can be reconfigured to suit this requirement. In a number of existing installations (Figures 38 and 39) a mechanical style meter may have been installed which has an internal clock to energise a separate internal 31.5A auxiliary circuit (switched circuit) during off-peak periods. These meters are no longer available for new or upgraded connections.

Such meters may remain in service where they have already been installed however all new applications for time of use metering will be serviced by an electronic meter that can be programmed to measure the total load consumed across all tariff periods.

Figure 38: Superseded ToU single phase direct connected meter.

Figure 39: Superseded ToU three phase direct connected meter.
11.10.2 New connections
For all new electrical installations Western Power’s standard electronic meter is used for both standard tariff and time of use tariff applications. Refer to Figures 36 and 37 for connection details. Activation of the time of use function requires programming of the meter to record consumption during the various tariff periods (fees may apply). Where the customer requires an electrical load to be automatically switched during shoulder or off-peak periods, control of the load will need to be by either the customer’s appliance or equipment. Appliances that don’t have an inbuilt control function will need to have appropriate timing devices installed by a suitably qualified person.

11.11 Multiple master metering

11.11.1 General
A multiple master metering system Figures 40 through, 44 provides metering options for domestic and commercial customers in single/multi-storey developments regardless of whether the units have ground level access. Service and metering equipment shall be housed collectively as prescribed by Clause 11.11.4.

11.11.2 Installation requirements
Where the units are for domestic use, they shall be self-contained with facilities for maintenance and fault finding incorporated into the installation, to provide security of supply for each and every customer.

The site main switchboard/multiple master metering enclosure shall be installed in a common area not be more than 30 metres (consumer mains cable route length) from the point of supply.

The enclosure shall not be installed within the wall(s) of one or more of the individual units.

The site main switchboard and metering equipment shall be mounted and be accessible 24 hours 7 days per week. (Refer to Clauses 11.5.1 and 11.5.2).

Access to the metering equipment must not be hindered by a locked gate or other barrier (refer to clause 11.5.2) unless an AMR system is installed. Where access is restricted and an AMR system is installed, meters are required to be located in a common area within the site.

It is essential that each unit in the installation be legibly labelled at the unit and at each associated portion of the electrical installation. The numbering shall correspond with the layout plan of the development. This requirement is to avoid discrepancies due to units being re-numbered after energisation.

Connection of supply is not to proceed until the numbering system is in place. Before submitting the Completion Notice the electrical contractor shall confirm that:

- labels are on all main switches, sub-main protection, distribution boards and unit numbers (at unit main entrance) and that labelling corresponds with each other and the site plan; and
- each sub-main supplies the correct unit as shown on the site plan.”

11.11.3 Panels
Meter and link panels shall be supplied, and installed by the customer’s electrical contractor in accordance with these requirements. A link panel shall be provided where the main switch is installed on the line side of the metering equipment and there are more than 6 meters. The link panel may accommodate the SPD, main switch, active and neutral links and sub-main protection as is appropriate.

11.11.4 Meters
It is preferred that the site main switchboard and the complete master metering system be sited at the same location. Where the site main switchboard and master metering equipment is located at same position all associated equipment shall be housed in the same enclosure.
Where the master metering equipment is to be located away from the main switchboard, the following conditions shall be applied:

- all master metering equipment shall be located collectively and housed in the same enclosure;
- where more than one master meter location is required, the number of master meters at each location shall not be less than 4 (four). Each group of meters shall be housed in the same enclosure;
- for individual free standing or fire divided multi-ownership properties, the master meter position(s) shall be located in common property, accessible to Network Operator personnel;
- switch/meter equipment enclosure(s) shall not be mounted on the outside of any premises unless separated by a fire wall;
- in multi-storey installations, master meters shall be grouped either on each or alternate floors or in the building’s common area or foyer accessible to Network Operator personnel;
- unless approved by the Network Operator only one common-service account will be permitted for each complete multiple master metering installation.

The common service meter shall be located in the upper left hand corner of the meter panel and the common service main switch in the corresponding position on the site main switchboard.

### 11.11.5 Wiring configurations

Consumer mains and sub-mains (metered or unmetered) shall be installed in accordance with these requirements, WAER and AS/NZS 3000.

Cabling to those portions of the installation and each individual unit that have a ground floor shall be installed underground via conduits or where in multistorey buildings via fire isolated ducts. Underground un-metered sub-mains shall be appropriately rated in accordance with the AS/NZS 3000, have circuit protection, and be installed:

- directly from the main switchboard or from a distribution board(s), or tee off box(s) in accordance with AS/NZS 3000 and AS/NZS 3439
- parallel to and within 1 metre of the property boundary, to a point level with the building alignment. At this point the mains are to be installed directly to the building
- to ensure security of supply to all tenancies
- complete with permanent and legible identification at all points within the distribution system.

If distribution boards, or tee off boxes are used they shall be suitably located in common property and physically protected.

In addition to the above, sub-mains installed in multistorey buildings comprising of installations at different levels shall be appropriately rated in accordance with the AS/NZS 3000, have short circuit protection, and be installed:

- to each installation in suitable fire isolated ducts, located in the common area(s)
- together with other metered or unmetered sub-mains within a common enclosure
- where required have a suitable means of teeing off to each tenancy
- in a manner that allows one or more sub-mains to be readily replaced.

Unmetered aerial supplies are not permitted.

Unmetered switchboard wiring must be segregated from the metered wiring so that the metered and unmetered sections can be clearly distinguished.

Throughout the entire installation, all terminations or points of origin for sub-mains shall be accessible and readily available for testing and isolation. Underground joints or junctions are not permitted. All terminations shall be suitably marked to clearly identify the unit/s served and the origin of the supply.
**Notes**

“MP” - Meter protection in accordance with WAER and Network Operator requirements.

“MS” - Switching, isolation and protective devices in accordance with AS/NZS 3000.

Meters supplied by the Network Operator or Service Provider.

**Figure 40:** Typical multiple master meter layout under 100A

![Diagram of typical multiple master meter layout](image)

**Notes**

1. “MP” - Meter Protection
2. “SPD” - Service Protection Device
3. Meters grouped together in the Site main switchboard
4. Main switches and circuit protection as per AS/NZS 3000, WAER and WADCM

**Figure 41:** Generic multiple master metering wiring diagram under 100A

![Diagram of generic multiple master metering wiring](image)
Network Operator
Point of Supply
(pillar, Lv frame)

Consumer
Mains

Service
protection
device

SPD

Meter

Motor fuses

Main Switchboard

Notes
“MP” - Meter protection in accordance
with WAER and Network Operator
requirements.

“MS” - Switching, isolation and
protective devices in accordance with
AS/NZS 3000.

Meters supplied by the Network
Operator Service Provider.

Figure 42: Typical multiple master metering layout over 100A

Notes: 1. “MP” - Meter protection in accordance
with WAER and Network Operator
requirements.

“MS” - Switching, isolation and
protective devices in accordance with
AS/NZS 3000.

Meters supplied by the Network
Operator Service Provider.

Figure 43: Generic multiple master metering wiring diagram over 100A
11.11.6 Protection
The electrical installation shall have a service protection device(s) as prescribed by WAER, AS/NZS 3000 and these requirements. Where the electrical installation’s maximum demand exceeds 100A the SPD shall be a circuit breaker rated to accommodate the demand.

Each un-metered sub-main shall be protected at its origin by an approved type of enclosed (HRC) fuse or circuit breaker as required by the AS/NZS 3000. Each individual meter shall be protected with an approved type of enclosed (HRC) fuse.

Sub-mains to distribution boards or tee off boxes shall have protection rated to ensure effective discrimination when in series with other protective devices. As a guide satisfactory discrimination may be achieved when the current rating of the downstream device is no larger than half the rating of the preceding device.

A set of spare fuse cartridges are to be provided at each point of protection for restoration of the power supply. This shall apply regardless of whether the point of supply of the individual unit sub-main is at a switchboard, sub-board or tee-off point.

![Diagram of electrical protection system]

**Notes**
Consumer Main Switch(s) must include overcurrent & short circuit protection for the sub mains.

“MP” - Meter protection in accordance with WAER and Network Operator requirements.

“MS, CE” - Switching, isolation and protective devices in accordance with AS/NZS 3000.

Meters supplied by the Network Operator or Service Provider.

11.11.7 Commercial installations
Paralleling links are an arrangement of links that connect load conductors between the meter and customer’s main switchboard. This arrangement enables Network Operators to meter adjacent tenancies either separately or in parallel and may be suitable in buildings where:

- partitions are not of a permanent nature and may be relocated to cater for the tenant requiring additional floor space;
- the likelihood that suites may be re-arranged, (two suites initially separately metered and occupied, are taken over by a single tenant).

Where installed, paralleling links are to be provided by the customer but only on approval of the Network Operator.
Links shall be located behind a removable panel and provided with sealing facilities. Cables between the meter, the paralleling links and the customer’s main switchboard shall be either double insulated or enclosed in conduit or ducts.

11.11.8 Alternative metering arrangements for ancillary accommodation
The preferred metering arrangement for ancillary accommodation (e.g. granny flats) is to install a private sub meter. Should the customer require a network metering arrangement, a multiple master metering system may be permitted subject to all of the following criteria being satisfied:

1. There is only one point of supply to the parent lot (single green title or strata development)
2. The point of supply is preferably underground
3. The load (total calculated maximum demand) for all of the proposed and existing metered installations does not exceed standard supply (or a DAO will be required).
4. The combined output capacity of all installed renewable energy infrastructure is in accordance with the Network Operators requirements including Sections 7 and 15
5. A readily accessible multiple master metering site main switchboard is installed in accordance with Clause 11.11 (Distributed master metering will not be accepted)
6. Each metered installation has its own unique registered address.
7. Each meter has its own Retailer account applicable to that registered address.
8. The new and altered installations are compliant with the Metering Code, WAER, these requirements, AS/NZS 3000 and relevant legislation and Standards.

Alternatively the customer may choose to install a privately owned sub meter as prescribed in Clause 11.17.

11.12 Distributed master metering
Distributed master metering connection and metering arrangements are not permitted to be connected to Horizons Power’s North West Interconnected System (NWIS) and Non-Interconnected Systems (NIS).

11.12.1 General
Distributed master metering Figures 44 and 45 allows for each customer to have their own master meter located at their respective unit within a group of units. This form of metering applies only to units with an effective fire division from the other units of the installation.

This metering arrangement is not available for

- multi-storey developments where all the units do not have ground level access. Where there is single-storey units in the development the single storey units may be metered by distributed master metering and the multi-storey units by multiple master metering
- ancillary accommodation (Refer to Clause 11.11.8).

11.12.2 Installation requirements
A distributed master metered installation shall have only one point of supply. The site main switchboard shall be located not more than 30 metres (consumer mains cable route length) from the point of supply.

Service and metering equipment shall be located in accordance with Clauses 11.5.1 and 11.5.2 in a position on the principal frontage as close as practical to the entry of each premise so that the metering equipment is readily identifiable and accessible. Where the installation cannot satisfy these requirements, refer to Clause 11.11 for meter location details.

Grouping of individual distributed master meters and their enclosures in either a single or multiple location(s) is not permitted (refer to Clause 11.11 Multiple Master Metering). Only one distributed master metering meter enclosure will be permitted per single premise or common wall face.
The site main switchboard and individual service and metering equipment shall be accessible to Network Operator personnel without the necessity to traverse property occupied by others or hindered by a gate or other barrier. (Refer to Clause 11.5.2).

If a common service is required (e.g. water reticulation pumps, lighting circuits) it must originate from and be metered at the site main switchboard, unless a prior alternative arrangement has been sought and approved by the Network Operator.

The electrical installation associated within one dwelling shall not extend into the area of another dwelling.

Where the units are for domestic use, they must be self-contained. Facilities for maintenance and fault finding shall be incorporated in the installation, to provide security of supply for each and every customer.

Permanent identification of each unit must be clearly displayed and be readily identifiable from the common access way. At the construction stage, the electrical contractor is required to mark the lot and unit number of each dwelling inside the respective meter enclosure.

### 11.12.3 Panels

Meter panels shall be supplied and installed by the customer’s electrical contractor in accordance with these requirements. The customer’s switchboard for each unit may be located within the meter enclosure at the respective unit.

### 11.12.4 Wiring configurations

The installation of consumer mains and sub mains both metered and unmetered shall be installed in accordance with these requirements, WAER and AS/NZS 3000. Cabling shall be:

- be appropriately rated in accordance with AS 3008, installed underground and provided with circuit protection;
- installed directly from the site main switchboard or via a distribution board(s) or tee off box(s);
- parallel to and within 1 metre of the property boundary, to a point level with the building alignment. At this point the mains are to be installed directly to the building;
- so as to ensure security of supply to all parts of the installation;
- installed so as to allow one or more sub-mains to be readily replaced;
- complete with permanent and legible identification at all points within the distribution system.

Where distribution boards or tee off boxes are used they shall be suitably located in common property and physically protected.

Unmetered aerial supplies are not permitted.

Unmetered switchboard wiring must be segregated from the metered wiring so that the metered and unmetered sections can be clearly distinguished.

Throughout the entire installation, all terminations or points of origin for sub-mains shall be accessible and readily available for testing and isolation. Underground joints or junctions are not permitted. All terminations shall be suitably marked to clearly identify the unit/s served and the origin of the supply.
Notes - Consumer Main Switch(s) must include overcurrent & short circuit protection for the sub mains.

“MP” - Meter protection in accordance with WAER and Network Operator requirements.

“MS, CE” - Switching, isolation and protective devices in accordance with AS/NZS 3000.

Notes:  
1. “MP” - Meter Protection  
2. “SPD” - Service Protection Device  
3. “SMS” - Site Main Switch (where required)  
4. “SP” - Submain Protection  
5. Meter installation as per the WADCM  
6. Main switches, circuit protection and earthing as per AS/NZS 3000, WAER and WADCM

Figure 45: Typical WP distributed master metering layout

Figure 46: Generic WP distributed master metering wiring diagram
Figure 47: Generic WP distributed master metering wiring diagram with DB

11.12.5 Protection
The electrical installation shall have a service protection device as prescribed by the WAER, AS/NZS 3000 and these requirements. Where the electrical installation’s maximum demand exceeds 100A the SPD shall be a circuit breaker rate to accommodate the demand.

Each un-metered sub-main shall be protected at its origin by an approved type of enclosed (HRC) fuse or circuit breaker as required by the AS/NZS 3000.

Each individual meter shall be protected with an approved type of enclosed (HRC) fuse.

Sub-mains to distribution boards or tee off boxes shall have protection rated to ensure effective discrimination when in series with other protective devices. As a guide satisfactory discrimination may generally be achieved when the current rating of the downstream device is no larger than half the rating of preceding device.

A set of spare fuse cartridges are to be provided at each point of protection for restoration of the power supply. This shall apply regardless of whether the point of supply of the individual unit sub-main is at a switchboard, sub-board or tee-off point.

11.12.6 Converting to HV meter reading
Distributed-master metering system allows each customer within a collective environment, to have an individual master meter located at the respective unit within that group of units. Common examples of such arrangements include apartment buildings, retirement villages or shopping centre. Billing arrangements in such instances are undertaken by the electricity retailer direct to each individual customer.
An alternative arrangement for larger installations is a single high voltage (HV) master metering system with privately owned and read LV sub meters used at the individual customer level. The HV meter measures the installation’s total consumption supplied through the incoming HV feeder. In this case the electricity retailer will provide a single account to the responsible administrative body or representative group.

Where a customer wishes to upgrade the electricity supply arrangements and convert the metering system to a single master (HV) metering configuration, a number of factors must be considered and implemented to ensure an effective transition of the metering requirements.

It is probable that the new HV metering arrangement has little in common with the redundant metering system including account/customer names or National Metering Identifier (NMI) numbers. It is therefore imperative that the HV metering applicant (customer) and their electrical contractor ensures that:

- A single new customer account is created and all affected parties advised;
- All existing billing accounts are closed with respective electricity retailers;
- Renewable energy buy back scheme operators are advised;
- All existing redundant meters are disconnected and returned to the relevant Network Operator;
- Existing and new wiring arrangements are compliant with current requirements.

### 11.13 LV current transformer (CT) metering

Where the calculated maximum demand of any separately metered portion of an electrical installation is greater than 100A LV per active conductor (both for single and three phase installations), current transformer (CT) metering is required. The customer is required to provide and install the CTs, the voltage circuit to the meters (including protection for this circuit) and facilities for mounting the meters.

The Network Operator will install and terminate the meter(s) on-site. Where High Voltage (HV) metering is required, the supply and installation of the metering equipment will be as specified in the connection agreement.

#### 11.13.1 General

CT metered switchboards are to be provided complete with Network Operator approved current transformers, meter panels, communication links where required, wiring and ancillary equipment installed on site.

The switchboard owner is responsible for the ongoing maintenance of the switchboard metering equipment except the meters and any communication equipment installed by the Network Operator.

In the design of the customer’s installation, it is necessary to ensure that switchboards, switch-rooms, metering arrangements and electrical layouts meet the customer’s present and foreseeable future requirements.

Current Transformers (CT’s) and Meter Panels (MP’s) are to be an integral part of the customer's electrical switchboard and shall be purchased and installed by the customer’s electrical contractor.

The customer is required to arrange for the installation and termination of the revenue meters with the Network Operator. The meter(s) always remain the property of the Network Operator.

Switchboard manufacturers are requested to inform the switchboard purchaser that the current transformers and meter panels are part of the switchboard and that ownership and maintenance resides with the switchboard owner.
11.13.2 **Sourcing of materials**
The switchboard manufacturer may purchase the relevant materials from any supplier. However, the materials must be in accordance with the technical requirements of the Network Operator. If during an on-site commissioning of the metering system it is found that inferior components have been used, the connection of the premise to the distribution network may be delayed until appropriate replacement components have been installed in the switchboard.

11.13.3 **Meter panels**
In general, the customer's installation shall provide for an enclosure, with vertical panel supports, suitable to accommodate a meter panel area of 600 mm high by 600 mm wide. Provision is also required for the separate mounting and connection facilities for the current transformers and ancillary equipment. The metering installation will be on two panels consisting of:

- Foot panel, 600 mm wide by 200 mm high, containing the terminations for the current transformers and the potential wires;
- Meter panel, 600 mm wide by 400 mm high to mount one meter.

The drawings referenced in this clause show the hole locations for drilling purposes. The meter panel material shall comply with Australian Standards AS/NZS 3000 and AS/NZS 3439. For installations that are fitted with ‘S’, ‘T’ and ‘W’ type current transformers, a meter panel with provision for a single meter shall be used.

11.13.4 **Wiring configurations**
The wiring of the panels shall be as detailed on drawing M98 – 2001 for a single material panel. The conductors must be installed and cabled using cable ties with each conductor routed through its appropriate hole in each panel. The cables shall be of stranded copper conductors and for the current transformer, wiring shall be 4 mm (7/0.85 mm) cross sectional area; for the potential, wiring shall be a minimum 2.5 mm (7/0.67 mm) cross sectional area.

Unterminated cable ends on the panel shall not be stripped until the meter is fitted to the panel. The insulation of any cable shall not be removed further than is necessary to enter and extend to the full length of the hole and to be firmly connected in the Test Block. Each cable shall be marked with a ferule as per the applicable drawing. Unless feruled correctly, acceptance may be denied.

A minimum 32 mm conduit shall be provided to convey the current transformer and potential wiring between the current transformer chamber and the meter foot panel position. Drawing M98 – 2000 shows the electrical schematic of the connections between the current transformers and potential wires and the meter panel.

Meters may be installed in an enclosure separate from the switchboard containing the current transformers provided the secondary wiring does not exceed 10 metres from the CT terminals to the meter terminals.

11.13.5 **Protection**
The service protection device (SPD) shall comply with these requirements and Section 6 of the WAER comprising of a circuit breaker(s) of appropriate rating for single or three-phase configurations installed by the customer.

Where there are two or more transformers in parallel, the SPD overload protection must be set to prevent damage to the Network Operator's upstream equipment in the event of one SPD tripping or being switched off in error.
Notes
Consumer Main Switch(s) must include overcurrent & short circuit protection for the sub mains.
“MP” - Meter protection in accordance with WAER and Network Operator requirements.
“MS, CE” - Switching, isolation and protective devices in accordance with AS/NZS 3000.
Meters supplied by the Network Operator or Service Provider.

Figure 48: Typical CT metering layout

It should be noted in the Figure 49 above that it may be difficult to grade and have effective discrimination between the SPD if the main switch is fitted with over-current and short-circuit protection to protect the sub mains. The design shall be such that the SPD grades and discriminates against the Network Operator’s protection equipment. The main switch protection may be set to values similar to SPD if discrimination with Sub Boards cannot be obtained.
It is recommended that consideration be given to placing the SPD, Metering and Main Switch/s on main switchboard as an alternative to this arrangement. This will negate the requirement for an additional switchboard.

11.13.6 Current transformers

For low voltage current transformer metering, three types of current transformer, ‘S’, ‘T’ and ‘W’, may be used to provide coverage of loads from 100A to 3750A.

These current transformers are of a single tap arrangement and have an extended range to 200% of their rating. Table 11 shows the operating range and accuracy of class ‘S’, ‘T’ and ‘W’ current transformers.

<table>
<thead>
<tr>
<th>CT Type</th>
<th>Ratios</th>
<th>Primary Current Range</th>
<th>Primary kVA Range</th>
<th>Accuracy Class</th>
<th>Secondary Current Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>200 extended to 400</td>
<td>5 – 400A</td>
<td>3.5 - 287</td>
<td>0.5 ME 2</td>
<td>5</td>
</tr>
<tr>
<td>T</td>
<td>800 extended to 1600</td>
<td>16 – 1600A</td>
<td>14.5 - 1150</td>
<td>0.5 ME 2</td>
<td>5</td>
</tr>
<tr>
<td>W</td>
<td>1500 extended to 3750</td>
<td>37.5 – 3750A</td>
<td>27 - 2695</td>
<td>0.5 ME 2.5</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 11: Operating range and accuracy of current transformers

The secondary terminals of the CTs are to be short-circuited to prevent inadvertent damage and electric shock. Network Operator personnel will remove the short circuit bridges when commissioning the metering installation.
11.13.6.1 Current transformer mounting and access
Adequate clearances are to be provided to allow access for the mounting of the current transformers. Data sheets for each of the current transformers used by the Network Operators are included in drawing M98 – 2004. The mounting plate shall be:

- Fitted with 6 mm or 8 mm captive nuts; or
- At least 5 mm thick and be drilled and tapped to suit 6 mm or 8 mm screws.

Current transformers shall be mounted so that the secondary terminals are always accessible to the Network Operator staff while the switchboard is energised. The CT’s shall be mounted with the polarity marks P1, L or the red spot on the current transformer always facing the incoming supply. A minimum clearance of 12 mm shall be maintained between the secondary terminal cover of the current transformer and the inside of the cubicle door or removable panel. Any escutcheon cover with metering equipment behind must not be obstructed by a switch that has to be operated before the cover can be removed.

Note Current transformers associated with customer measuring equipment shall not be mounted upstream of any Network Operator metering equipment or within the boundaries of the CT metering panel.

11.13.6.2 Current transformer removable busbar links insert
Removable busbar links are to be provided to enable the current transformers to be installed or changed. The busbars each side of the removable links must be firmly supported on suitable insulators capable of withstanding the stress from prospective fault currents. Where multiple busbars are used, a suitable arrangement of the current transformers is required to facilitate the removal of the busbars.

Drawing M98 – 2005 shows some typical layouts of the current transformers. Table 12 (below) shows the size and maximum number of busbars that will fit through the ‘S’, ‘T’ and ‘W’ type transformers. The busbars must be of adequate size to accept the full surface area of the terminating lug.

<table>
<thead>
<tr>
<th>Current Transformer Type</th>
<th>Busbars Maximum Size of Removable Busbar Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>2 x 25 mm x 6 mm</td>
</tr>
<tr>
<td>T</td>
<td>2 x 64 mm x 6 mm</td>
</tr>
<tr>
<td>W</td>
<td>4 x 100 mm x 6 mm</td>
</tr>
</tbody>
</table>

Table 12: Size and maximum number of busbars

11.13.7 Voltage circuit protection
The customer shall provide and install the potential fuses and fault limiters, which shall be either:

- A current limiting (HRC) type NS to AS 60269.1 2005 ‘Low voltage fuses – uses with enclosed fuse-links’ Parts 1 and 30, in an enclosure with class IP2X to AS 1939 ‘Degrees of protection provided by enclosures for electrical equipment (IP Code)’, or
- Class G current limiting (HRC) fuse links in a modular fuse holder complying with IEC 60269 – Part 2.

The fuses shall be installed so that they are extracted away from the face of the panel and towards the operator with a clearance of between 100 mm (minimum) to 300 mm (maximum) between the panel and the enclosure door.
11.13.7.1 Fault current limiters
A set of fault current limiters shall be installed and:

- Mounted directly on the busbar on the supply side of the current transformer
- Terminal connected from the busbar to the supply side of the fuse-bar
- Suitable for the fitting a 32 A HRC cartridge
- Fused by switchboard manufacturer before leaving the workshop; and
- Capable of being sealed by the Network Operator.

Drawing M98 – 2003 shows the layout of the fault current limiters.

11.13.7.2 Potential fuses
A suitable mounting bracket for the potential fuses must be provided within the vicinity of the metering current transformers and must be in an accessible and safe position. The fuses are to be clear of all cable and terminations and must have adequate clearance from the live busbars to enable sealing to be carried out safely.

HRC fuses shall be:

- Installed by the switchboard manufacturer and used as potential fuses
- Fused with links rated for 6 A in each potential fuse
- Have a fuse block assembly capable of sealed by the Network Operator

Drawing M98 – 2006 shows the potential fuse block arrangement.

11.13.8 Safety
In the instance where the switchboard has been installed on site and is energised before the installation of the meters, the following checks on completion of the installation of metering equipment in the switchboard must be carried out for reasons of safety:

- No fuse link elements are to be fitted to the potential fuse cartridges
- All current transformer links on the test block are to be shorted
- All potential links on the test block are to be open

Note: Where at all possible no switchboard is to be energised before the meter(s) are fitted and all units sealed.

11.13.9 Conversion of direct connected meters to CT metering
When the load at an existing installation or separately metered part of that installation exceeds 100A, the metering must be converted from whole current direct metering to current transformer (CT) metering.

11.13.9.1 Load increase
The electrical contractor is to submit to Network Operator a Preliminary Notice together with a Network Operator connection application (See Clauses 7.21 and 7.22) which details the work to be completed and the parameters of the load increase. The Network Operator will review the capacity of the available network and advise the electrical contractor what (if any) upgrading or augmentation is required to be carried out. This may include the installation of a sub-station.

11.13.9.2 No load increase
When there is no increase in assessed load at an installation, the electrical contractor is to submit a Preliminary Notice to the Network Operator detailing the work to be completed. If the CT meter requires changing (tariff purposes) a connection application form (Clauses 7.21 and 7.22) is to be completed and submitted to the Network Operator together with the Preliminary Notice.
11.13.10 Multiple master CT metered installations

In the case of multiple master current transformer metered installations Figure 51, provision shall be made for the isolation of supply to each individual customer. The main switch or switches must be capable of being locked and sealed in the open (off) position by the Network Operator.

The means of securing a switch in the open (off) position may involve additional components that will prevent the switch being operated. This arrangement will work for most switchgear and control assemblies. However, for some types of air circuit breakers, (ACB’s) with handle lock attachments, this requirement can often be defeated by the removal of an escutcheon plate, as the clip-in is fitted on the escutcheon. In these situations, any escutcheon panels that are fitted with locking mechanisms must be capable of being secured by the Network Operator. This may be achieved by holes being drilled in locating pins provided to support or retain the escutcheon plate in position when the fixing screws are removed.

These arrangements, however, do not preclude the application of an alternative method of isolation, subject to approval of the Network Operator. A separate meter panel is required for each current transformer operated meter. This may also necessitate separate applications for magnetic screening between the kWh meter and active conductors with current carrying capacity of 150A or greater.

![Diagram of typical multiple master CT metering and sub-board layout](image-url)
11.14 Automated meter reading systems

11.14.1 General

An Automated Meter Reading System (AMR) is a system that enables Network Operators to remotely read multiple revenue meters throughout a property using an IT data collection system.

A Network Operator may offer a strata owner or developer of a property the option of installing an AMR system at their property subject to the Network Operators terms and conditions. For additional information, contact the relevant Network Operator for the currently approved and authorised AMR systems.

**Note:** With effect from 1 January 2015 Western Power will accept applications for the installation of an AMR system only for a property for which:

- there is (or there is intended to be constructed) a multiple residential or commercial strata premises with more than one level;
- electricity is (or is to be) supplied to the premises through multiple master metering points with Type 6 revenue meters; and
- Western Power, in its discretion, assess that an AMR system provides the most economic and risk free method of data collection.

11.14.2 Application to install an AMR system

The installation of an AMR requires the submission of an AMR application form (refer to Section 7) by the strata owner or developer and must include all relevant installation details including but not limited to strata scheme arrangement, cable routes, reticulation drawings, number of strata units to be metered and read. The application is to be accompanied by the applicable applicant fees.
Once the AMR application is received, the Network Operator will review the technical compliance of the proposed AMR system and advise the customer of the result of the review as soon as practicable.

It is crucial that the AMR application is submitted as early as possible to avoid delays in the review and approval of the AMR application and installation of the appropriate metering equipment.

11.14.3 Charges
Once the AMR application is received and approved by the Network Operator a quotation will be issued to the customer with all costs associated with the Network Operator’s testing the installed commissioned AMR to ensure that it:

a) has been installed in accordance with the applicable technical requirements;
b) is compatible and operates appropriately with network automated meter reading technology; and
c) can reasonably be used by the Network Operator for automated data collection for the performance of its functions.

All costs associated with the installation of an AMR and the maintenance, upgrades and failures of the system are to be borne solely by the customer. The costs associated with the repairs and maintenance of the revenue meters shall be borne by the Network Operator (except where the repair or maintenance is due to an act of the customer or its agents).

11.14.4 Technical requirements
The proposed AMR system must be compatible with the automated meter reading technology that is, or will be, supported by the Network Operator and shall comply with the requirements of the WAER, AS/NZS 3000, WADCM and any other Network Operator requirements.

11.14.5 Installation
Network metering equipment associated with an AMR system will be installed by Network Operator or their approved contractor.

The customer or their agent must perform all of the works and supply all of the equipment required to install the AMR system approved by Network Operator. The customer is also responsible for the supply and installation of all supporting services and equipment required for the AMR system including but not limited to, phone lines, remote communications systems and cabling.

In cases where revenue meters and associated equipment are located in an area that is not (or not readily) accessible to Network personnel, a Network approved key/entry device housing box fitted with a Network approved lock, must supplied and installed to allow access by Network personnel to perform Network Operator functions.

11.14.6 Ownership and maintenance
It is the responsibility of the customer to ensure that the AMR system is functioning correctly and that the Network Operator is obtaining accurate meter data.

The AMR system remains at all times the property of the customer. The maintenance of the installed AMR system and associated equipment is the responsibility of the customer.

The installed revenue meter at the premises remains the property of the Network Operator.

The Network Operator reserves the right to upgrade its data collection system and AMR technology as required. In such cases, the customer shall at its cost, upgrade their AMR system to ensure compatibility with the Network Operator data collection system or return the property to a manual visual meter read system.
11.14.7 Terms and conditions
The installation, operation and maintenance by the customer is subject to the Network Operators terms and conditions which shall be adhered to by the strata developer/owner/operator and all occupants. Details of the Network Operators terms and conditions can be obtained from:

Horizon Power For specific information customers should phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au


11.14.8 Summary of AMR meter types
For specific information pertaining to tariffs, the customer should contact their electricity retailer.

11.14.8.1 Register read meter
These are the common revenue meters use for residential properties (single and three-phase direct connect) and read with the basic registers. The basic registers to be read will depend on customer's tariff. The most common registers are the “all time register” (total kWh) and time of use registers (TOU; peak, off-peak, high shoulder and low shoulder).

11.14.8.2 Interval read meter
These are the commercial and industrial customer where regulations require the downloading of interval data for billing purposes rather than the register reads. The required interval data will depend on the customer's tariff and this may require the kWh and kVArh interval data.

11.14.8.3 Import / export Meter
The current meters (both register and interval read) have the bi-directional capability to measure and record import and export kWh.

11.14.8.4 Summary of Horizon Power AMR meter types
For specific information pertaining to tariffs and approved meter types Horizon Power customers should phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au Please note that “time of use” metering is not available from Horizon Power

11.14.8.5 Summary of Western Power AMR meter types
For specific information pertaining to AMR systems contact Metering Services and for tariff information the customer should contact their energy Retailer.

11.15 HV metering

11.15.1 High Voltage metered installations
Where high voltage metering is required, the Network Operator will provide a quotation, inclusive of the costs to provide, install and commission the metering equipment. Queries about metering, including details of installation facilities, should be referred to the Network Operator’s Network Designer.

An electrical submission, certified by a professionally qualified electrical engineer must be submitted to the Network Operator for all intended high voltage installations. High voltage metering arrangements are to be discussed with the Network Operator at the project design stage.

11.15.2 Meter panels
For indoor HV metering, the Network Operator will install a metering panel on the internal wall of the switch room. The applicant shall install appropriately sized ducts or PVC conduits between the high voltage metering unit (within the HV switchboard) and the meter panel.
For outdoor HV metering the Network Operator will install the meter panel in the metering kiosk for ground mounted HV switchgear, or in the metering cubicle for overhead HV switchgear. For additional detail refer to:

- Horizon Power’s: - Distribution Construction Standard – Section “G” drawings.
- Western Power’s: - Distribution Substation Plant Manual – Section 3 drawings.

### 11.15.3 Communication links for HV or time of use metering

All HV-metered customers and certain LV-metered customers will be required to install communication equipment to allow the tariff meters to be read remotely.

If the site is within the range of the mobile telephone network or the Network Operator’s meter radio network, then this technology shall be used. The Network Operator will arrange for the installation of the necessary equipment at the customer’s cost. Where a mobile or radio network is not available, the applicant will be responsible for arranging the installation of a direct dial, two-pair telephone line at the substation for remote reading of the meters.

### 11.15.4 High Voltage master metering systems

Only one High Voltage (HV) point of supply will be provided for a development or integral development. An integral development can be a development with multiple green titles but cannot be a development divided by a gazetted road.

Separate HV feeders within the development or integral development can be individually master metered from the point of supply. Distributed HV master metering is not permitted in a development or integral development.

All HV equipment, including metering equipment, not at the point of supply will be considered a private network, with the customer being responsible for operating and maintaining the private network.

Individual HV master metered installations must not be interconnected in a development or integral development. Appropriate electrical separation and fire segregation must be maintained between each master metered HV installation.

Individual master metered HV customers assessed as being contestable may choose their Retailer under the open access policy.

### 11.16 Metering for inverter energy systems

Customers are required to make provision for the measurement of both energy consumed, where connected to a distribution network (imported) and energy generated by their renewable energy system (exported) through the installation of a bi-directional meter. Most electronic meter types once programmed have the capacity to accommodate bi-directional flow.

Enquiries on existing metering installation (meter type(s)) and costs associated with meter upgrades, installation and programming should be directed to the customer’s Electricity Retailer.

For installations with a mechanical style meter(s) the metering system must be upgraded in accordance with the metering code and the Network Operators Requirements.

### 11.17 Subsidiary metering guidelines

Subsidiary meter (sub meter) is the common term used for a private electricity meter installed downstream of the network revenue meter. These sub meters do not form part of the regulated electricity industry in WA and therefore deemed to be private.

The Electricity Industry (Metering) Code 2012 provides for the rights, obligations and responsibilities for Code participants and rules relating to revenue metering installations. Sub meters are not covered by the Metering Code however their installation and use is regulated by the principles of electricity industry best practice and installation standards established by the Electricity Act 1945.
The **WAER** states that the revenue service and metering equipment shall comply with the relevant Network Operators requirements.

These requirements stipulate the boundaries, within the electrical installation that defines the Network Operators responsibility and that of the customer. For metering the customer’s responsibility commences at the Network Operators meter load terminals and continues downstream within the customer’s property. Connections downstream from the revenue meter, including sub meters, are the responsibility of the customer. The following sub clauses and diagrams illustrate common sub metering arrangements:

### 11.17.1 Options

#### 11.17.1.1 Residential properties with ancillary accommodation

Ancillary accommodation (commonly known as granny flats) generally incorporate a private meter installed on a free standing or semi-detached building located on the same green/strata titled lot. *(Clause 11.11 multiple master metering provides for an alternative network arrangement)*

![Diagram](image1.png)

**Figure 53:** Typical sub meter layout (domestic)

#### 11.17.1.2 Apartment buildings & shopping centres

Apartment buildings and shopping centres may have multiple tenants. If the building or shopping centre is metered with a single master meter (typically LV CT or HV metering), the meters (tenants’ individual meters) downstream of the network master meter are deemed to be private sub metering.

![Diagram](image2.png)

**Figure 54:** Typical sub meter arrangement (commercial)

#### 11.11.1.3 Power stations

Power stations are typically metered at transmission high voltages (HV) which is the revenue metering point. At the generators’ site; each generator unit may have their own individual separate metering arrangement, which is deemed to be private sub metering.
11.17.2 Location
A sub meter may exist in multiple residences where the electricity is supplied through one revenue meter. Examples where sub meters exist may include but not limited to residential housing complexes with multiple dwellings units, town houses, flats or duplexes. Sub meters may also be used in commercial business to measure power consumption on separate sections or floors. Sub meters are located downstream of the revenue meter and measure electricity consumption for each individual customer’s installation.

11.17.3 Ownership and installation
As stated sub meters do not form part of the Network Operators distribution or transmission network. Owners, operators of residential or commercial operations wishing the install private sub meters will need to purchase metering equipment directly from a meter vendor. The meter shall be installed by a licensed electrical contractor in accordance with the applicable regulations, codes and standards.

Such metering arrangements may also include meters that have or are to be been purchased from a Network Operator when a customer’s multiple master revenue meters is converted to sub meters following the installation of a single master revenue meter. For multiple revenue meters that have been or are to be converted to single revenue meter;

- The customer has the option to purchase the existing network meters for sub metering purposes from the Network Operator. On receipt of payment, field personnel will attend the site and place “private meter” stickers on all sub meters finalising transfer of ownership;
- Customers have the option to have their electrical contractor remove the redundant network meters and returned them to the Network Operator. These sub meters may only be removed once the main revenue meter has been installed, commissioned and registered with the retailer and the Network Operator.

11.17.4 Maintenance
The owners of sub meters are responsible for the maintenance of their meters. Network Operators have no statutory/regulatory or any market obligations to maintain sub meters, even if they were previously owned by that Network Operator. Sub meter owners may engage the services of an electrical contractor or metering vendor to maintain the sub meters. They may also engage the services of an independent testing laboratory to test and calibrate the sub meters.

Figure 55: Typical sub meter layout for power stations
11.17.5 Purchasing and supply
Network Operators do not supply or provide sub meters to customers.
Where a customer has a requirement for a new or replacement sub meter, this may be obtained from any meter supplier or manufacturer of their choice. Most electricity meter suppliers are capable of supplying the same meters for sub metering purposes.

11.17.6 Sub meter reading
Network Operators do not read sub meters. Customers with sub meters requiring sub meter reading must engage the services of a private meter reader if they are not able to read it themselves.

11.18 Relocation of existing metering point
The electrical contractor is to submit a Preliminary Notice to the Network Operator, detailing the work to be completed and requesting a ruling where required. A changeover appointment will then be coordinated by the Network Operator with the electrical contractor.
Alternatively a Network Operator authorised electrical contractor can relocate direct connected metering equipment as a part of the “Meter Change Over Scheme”, where supply is via an underground service. For more information on a Network Operator’s Changeover Scheme refer to Clause 6.18

11.19 National meter identifier (NMI)
The National Metering Identifier (NMI) provides a unique identifier for each connection point within the National Electrical Market (NEM). It provides an index against which essential data can be managed and is considered crucial to the accurate management of:
- Customer registration
- Customer transfer
- Connection point or change of control
- Data aggregation
- Data transfer.

Network Operators, as the Local Network Service Providers, are responsible for allocating NMIs within their respective distribution networks to customer connection points and for maintaining a register of those allocations in the WA market. The NMI must be associated with a transmission node identity (TNI). The TNI is a four digit alphanumeric code, which starts with a W for Western Australia.
As an example the Western Power NMI range (8001000000 to 8020999999) allocation will be applied in accordance with the Nation Electricity Market Management Company Limited (NEMMCO) NMI procedures and guidelines as authorised by the National Electricity Code.
Once the NMI number has been allocated to a connection point the number will not change with a change of customer, customer details or registration details.

11.20 Meter energisation
An authorised electrical contractor or their approved electrical worker may operate an SPD to check the operation of the meter(s) where direct connected meter(s) are installed. On completion of this work, either the fusible element(s) shall be removed or the circuit breaker(s) returned to the “off” position and tagged.
A caution tag shall be attached to the SPD that indicates only the Network Operator authorised representative may remove the tag and energise the installation. This will be done on receipt of the Notice of Completion from the electrical contractor.
An electrical contractor accredited as a part of the Contractor Connect Scheme may leave an installation energised on completion of the required commissioning processes.
11.21 Meter distribution
For new installations, authorised electrical contractors can obtain direct connected meters from a number of meter distribution outlets located throughout Western Australia. Where six or more meters are required, a Network Operator may choose to arrange delivery of the meters. It should be noted that meters cannot be collected personally from the Network Operator offices and existing meters can only be changed by a network accredited electrical contractor.

11.21.1 Western Power distribution points
Details of the meter distribution points and access to Western Power’s Meter Order Form can be obtained from Western Power’s website.

11.21.2 Emergency conditions
Under emergency conditions, an electrical contractor may operate the SPD or otherwise isolate the installation from the low voltage electricity supply to ensure their own, occupants’ and the public’s safety. Care shall be exercised not to unnecessarily isolate any emergency equipment such as fire-fighting services or evacuation aids. Further information can be obtained from Section 8 of the WAER.

11.22 Horizon Power section references
The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either go to related clause or the identified online link.

11.22.1 Summary
Should anyone suspect or have evidence that metering equipment has been tampered with the concern must be immediately reported to Horizon Power phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

11.23 Western Power section references
The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either go to the related clause or the identified online link.

11.23.1 Summary
Should anyone suspect or have evidence that metering equipment has been tampered with, the concern must be immediately reported to the Western Power’s Metering Services or the Customer Services Centre on 13 10 87 or email: Western Power enquiries.

Electrical contractors with either Service Apparatus Connections Scheme or Contractor Connect accreditation can obtain direct connected meters from a number of meter distribution outlets located throughout Western Australia. Details of the meter distribution points and access to Western Power’s Meter Order Form can be obtained from Western Power’s website.

11.24 Drawing list
11.24.1 CT metering
Low voltage CT metering drawings can be viewed at Appendix “K”

11.24.2 Distribution substation technical requirements
Note: Although drawing numbers for each Network Operator are the same the requirements and content may differ. To access the Network Operator substation drawings please refer to:

- Horizon Power Distribution Construction Standard - Section “G” drawings.
- Western Power Distribution Substation Plant Manual
Distribution
Connections Manual

Section twelve

Low voltage distribution supply
12 Low voltage distribution supply

12.1 Services

The Network Operator shall determine how a customer’s installation is to be connected to its distribution network including the location of the point of supply and, where required, the point of attachment. Availability of a particular configuration of service may be restricted by the capacity of the network or by conditions at or near the site.

The service provided will be designed to accommodate the customer’s calculated maximum demand at the time of application and, unless requested otherwise, will be a standard supply as described in Clause 7.6.

The Network Operator may require the customer to provide, at their expense, facilities for the installation of service cables including but not limited to ducts, conduits, anchorage points, supports, equipment enclosures, structures, site works and associated supplementary equipment. The customer shall provide adequate mounting and installation facilities for network service equipment in accordance with these requirements and the WAER.

The customer and their agent shall inform themselves of the Network Operator’s terms and conditions relating to and associated with the installation of a point of supply and the requirements for a connection to the Network Operator’s distribution network. The Network Operator reserves the right to use the point of supply for the provision of an electrical supply to an adjacent property(s).

12.2 Type of connection

In general all new services provided from a low voltage distribution network will be underground. Retention of an existing overhead supply is permitted where the overhead distribution network remains in operation however the provision of a new or upgraded overhead connection is subject to the approval of the relevant Network Operator.

12.2.1 Network Operator connection policy

12.2.1.1 Horizon Power policy

The following statement provides guidance on the application of Horizon Power’s policy for the provision of a connection within both the NWIS and NIS distribution networks:

1) All new connections shall be underground within a:
   a) Western Australian Planning Commission (WAPC) subdivision
   b) Town as depicted in the NWIS and NIS service area map (Appendices B)
   c) Farm land/paddock, crown land, main road verge where the supply originates from a transformer installed within these areas.

2) New overhead connections will only be permitted to existing lots
   a) in areas other than those above in point 1
   b) or where the ground conditions (i.e. rock) are such that or the remoteness of the connection makes the installation of a underground connection commercially unviable
   c) And Horizon Power and the customer agree to install an overhead connection.

3) An upgraded overhead connection will not be permitted. However if electrical work is required to the existing supply within the premise, the existing overhead supply can remain if:
   a) The POS or POA is not required to be relocated
   b) The capacity is not upgraded requiring a new service cable i.e. 6 mm – 16 mm – 95 mm ABC – 150 mm ABC.
12.2.1.2 Western Power policy

The following statement provides guidance on the application of Western Power’s policy for the provision of a connection within the SWIS:

1) All new connections shall be underground within a:
   a) Western Australian Planning Commission (WAPC) subdivision
   b) City, metropolitan area or town as defined by Clause 12.2.2
   c) Paddock where the supply originates from a transformer installed within the paddock

2) A new overhead connection will only be permitted to existing lots in small country towns where
   a) The capacity of the connection is limited to a Standard Supply as defined in Clause 7.6.
   b) There are no safety concerns and all operational clearances are achieved
   c) Geographical conditions are such that the installation of a underground connection is technically or commercially unviable
   d) Connection is not within the boundaries of a city, metropolitan area or town as defined by Clause 12.2.2
   e) Area is reticulated by an existing overhead network; and
   f) Lot was created prior to 2001 (refer to Clause 12.2.1.3)

3) An upgraded overhead connection will only be permitted where the:
   a) Installation has an existing overhead connection
   b) Capacity of the upgrade does not exceed Standard Supply as defined in Clause 7.6.
   c) Existing overhead network can accommodate the additional load
   d) There are no safety concerns and all operational clearances are achieved
   e) Multiple points of supply requirements of Clause 12.3 are adhered to

4) For connection requirements associated with a property amalgamation or subdivision refer to the UDS manual.

5) An existing overhead connection may be retained where the property is renovated as long as the supply capacity is not altered and current overhead safety requirements/clearances are achieved

12.2.1.3 Lots created during or after 2001

In 2001, mandatory underground connections within the SWIS were introduced or extended:

- In residential, commercial and industrial overhead reticulated areas in the greater Perth metropolitan area and applied whenever a new construction occurred or whenever an existing site was redeveloped or whenever a new lot was created
- For residential and commercial/industrial overhead reticulated areas in country areas and applied whenever a new lot was created.

In 2002, mandatory underground connections for overhead reticulated areas within the SWIS were extended to include rural non town areas and applied whenever a new construction occurred or whenever an existing site was redeveloped and or a transformer was required on the lot.

12.2.2 Definition of city, metropolitan area or town

The Code of Conduct for the Supply of Electricity to Small Use Customers (the Code) defines a metropolitan area as the:

a) Region described in Schedule 3 of the Planning and Development Act 2005 (This refers to the Perth metropolitan area)
b) Local government district of Mandurah
c) Local government district of Murray; and
d) Town sites, as constituted under Section 26 of the Land Administration Act 1997, of: Albany, Bunbury, Geraldton, Kalgoorlie, Karratha, Port Hedland and South Hedland.

In addition to the above, Horizon Power considers the following towns to be covered by the same definition: Broome, Carnarvon, Derby, Esperance and Kununurra.
Horizon Power and Western Power define a small country town as being one which is outside the boundaries of the above definition.

12.2.3 Connection of services

Consumer mains cables required to be connected to a service protective device, point of supply or metering equipment shall be of a size, type and material compatible with the Network Operator’s equipment and terminals.

Service and metering equipment rated at 100A or less is designed to terminate and accommodate multiple stranded copper cables therefore hard drawn copper, steel wire armoured, aluminium, braided flexible or neutral screened cables shall not be used for panel wiring or consumer mains.

The size of conductors that can be connected into service equipment such as pillars, pits and metering terminals may be limited. Refer to Section 11 for further information. Only compliant conductors shall be connected to a distribution network. The Network Operator shall be consulted where the suitability of the proposed connection facility is in doubt.

Segregation of electrical services shall comply with these requirements, WAER Sections 3 and 9 and AS/NZS 3000.

12.2.4 Number of connections

12.2.4.1 Per lot

The Network Operator will generally only provide one point of supply to an individual freehold lot, strata or survey strata unless specific circumstances justify more than one and safety concerns have been satisfied. For more information refer to Clause 12.3 and Section 3.6 of WAER.

12.2.4.2 Per service pillar

A maximum of two freehold lots may be connected to a single service pillar.

Where an existing freehold title lot is subdivided into strata lots, the Network Operator may require in accordance with their respective UDS requirements, the installation of a main switchboard (MSB). This condition ensures adequate termination capacity for all users both current and future.

12.2.4.3 Easements

In certain circumstances the creation or application of an easement may be necessary to ensure access to the distribution network point of supply is available. Refer to Clause 6.8.

12.2.5 Overhead (point of supply)

The customer shall provide a Point of Supply (PoS) and a Point of Attachment (PoA) located either on the premises or a consumer pole to accommodate the connection of an overhead service cable extended from the distribution network. The customer’s point of supply terminals shall mean the terminals nominated by the Network Operator within a:

1) Pole or building mounted Mains Connection Box:
   a) For single and multicore cables having a minimum of two layers of non-metallic insulation
   b) Where maximum demand does not exceed 100A for NWIS or NIS connection or 140A for a SWIS connection; and
   c) The installation is not CT metered
   d) To suit overhead service cable conductors ranging in size up to 16 mm copper

2) Pole mounted customer Boundary Fuse(s) for:
   a) Single insulated consumer’s mains installed in metallic enclosures
   b) The installation is CT metered; or
   c) Where the maximum demand exceeds 100A for NWIS or NIS connection or 140A for a SWIS connection
3) Pole mounted transformer arrangement for 240/415 volt rural supplies. (Note: A Network Operator may elect to install a ground mounted pillar for a 240/415 volt connection)

4) Pole mounted transformer arrangement for 480 volt rural supplies. (Note: A Network Operator may elect to install a ground mounted transformer for a higher capacity 480 volt connection)

12.2.6 Underground (point of supply)

The Point of Supply (PoS) for an underground customer’s connection will be the load or customer supply terminals contained within the distribution network equipment provided.

For residential lots requiring a standard connection, the point of supply will generally be a mini or universal service pillar, located in a position which allows a single point of supply to the property and the adjoining freehold title or survey strata lot. For industrial and commercial lots an individual point of supply will be provided utilising a universal pillar, kiosk, frame or substation.

1) Point of supply customer terminals shall mean the terminals nominated by the Network Operator in:
   a) Mini pillars, being the load side of the 35 mm tunnels within the pillar
   b) Universal pillars (uni-pillars) being the load side of the 35 mm tunnels or the designated bus bar for larger consumer cables up to a maximum size of 1 x 300 mm per phase. Fuse protection is generally not provided at uni-pillars unless it is deemed necessary by the Network Operator
   c) Wall mounted pillars or cut out boxes, being the load side terminals of the fuse unit for consumer cables up to a maximum size of 35 mm in 100A box and 120 mm in 200A box
   d) UMS pillar/pits, being the load side of the 20A red spot fuse in a pillar or the load side of the TYCO 30A fuse holder kit in a pit. Consumer mains cable shall not exceed 16mm
   e) LV frames or kiosks, being the load side terminals of the fuse switch, LV link, or Disconnect Unit for consumer cables up to a maximum size of 630 mm dependent on the size, level of protection and type of connection equipment
   f) Transformers, the terminals specified in Clause 14.4.9
   g) Substation switchgear the terminals specified in Clause 14.4.9

12.2.7 Location

On receipt of a connection application as specified in Section 7, the Network Operator may nominate in accordance with these requirements the location of the point of supply. Where the location of the point of supply is not acceptable to the customer, an alternative location may be negotiated with the Network Operator subject to satisfying network compliance requirements.

Where it is agreed to provide a point of supply in an alternative location for a residential connection, the full cost of that alternative arrangement shall be borne by the customer unless that arrangement provides uninhibited access for other current or future domestic users. For commercial and industrial connections, all costs incurred by the Network Operator to supply and install the agreed alternative arrangement shall be borne by the customer.

The customer is responsible for consulting with all affected parties including owners of adjoining properties where an alternative or modified connection arrangement is sought and that arrangement may or will affect those parties.

The customer shall obtain formal consent or approval from each and every party affected by the alternative arrangement prior to finalising their connection application with the Network Operator.

12.2.8 Access

The Network Operator’s point of supply and the customer’s point of attachment shall be readily accessible to the Network Operator’s operational personnel with unimpeded access 24 hours and 7 days a week.

Where access to a Network Operator’s point of supply is restricted, obstructed or not available the Network Operator must be advised. For Horizon Power calls should be to 1800 267 926 and for Western Power calls should be directed to 13 10 87.
12.3  Multiple points of supply

Clause 3.6.1 of the WAER states that “a Network Operator will provide only one point of supply to an individual freehold lot, crown land title or survey strata plan unless unusual circumstances justify more than one and safety concerns are satisfied”.

It is the preference of both Network Operators not to have or create an environment where a site is supplied from more than one point of supply. However it is understood that there may be occasions where it is either unsafe or impractical to maintain this policy. Therefore a Network Operator may, on receipt of an application, consider the installation of a second or multiple points of supply.

Where approval is granted for the installation of an additional or multiple points of supply, the Network Operator will formally advise the customer of any additional requirements or conditions additional those specified by WAER that must be met.

On receipt of that advice the customer shall:

- Confirm acceptance of and a commitment to comply with the requirements of the WAER in particular Clause 3.6 and any additional conditions specified by the Network Operator
- Where the customer is not the land owner the customer shall formally advise the land owner of the statutory and installation specific requirements. The customer shall obtain from the land owner and provide to the Network Operator, formal confirmation that the land owner is prepared to accept these terms and conditions
- Ensure that both the electrical consultant and electrical contractor is aware of the proposed multiple points of supply arrangement and that they are aware of their obligations to ensure compliance with the WAER and the Network Operator conditions.

The Network Operator will not issue a quotation to the customer until compliance confirmation of the aforementioned items has been provided including lodgement and acceptance of Landgate documentation.

12.3.1  Zone diagram

The WAER calls for the preparation and posting of a zone diagram which depicts the electrical and geographical boundaries of each zone in relation to the whole site. The zone diagram shall be prepared by a competent person and contain as a minimum those items specified in WAER including details of all switchboards, points of supply and information on the electrical relationships of the equipment within the zones.

Figure 56 depicts a typical drawing indicating the basic requirements. It is recommended that a draft of the zone diagram be provided to the designated Network Operator Design Officer for information before seeking to progress to the next stage of the application and lodgement process.

Copies of the final customer signed diagram shall be forwarded by the customer to the relevant Local Authorities/State Government Agencies and placed in the specified locations as determined by the WAER.
Mandatory notes
1. This diagram defines the electrical zones associated with each point of supply (connection); on the site in accordance with the requirements of the WAER.
2. A permanently fixed legible and indelible copy of this diagram shall be placed in each main switchboard and sub-boards as required by the WAER.

Information to customers
3. Customer may incorporate this information into a electrical site plan and display at the main switchboard.
4. Zone diagrams shall comply with the WAER and the Network Operators requirements.

Figure 56: Sample zone diagram.

12.3.2 Notification 70A
The “Notification under Section 70A form (N1)” form is available from Landgate and is required to be completed to the satisfaction of that Agency. When completing the section 'Factors Affecting the use or enjoyment of the Land' applicants are encouraged to contact the relevant Network Operator to discuss and draft appropriate compliant language.

The completed application shall be lodged with Landgate who will provide a lodgement receipt to the applicant/representative. This receipt is considered, by the Network Operator, proof of lodgement, hence compliance with that WAER requirement.

12.3.3 Customer responsibilities
It is the customer’s responsibility through their agent to ensure compliance with the requirements of this clause. This is an essential safety requirement as the existence of a second or multiple points of supply can create electrical hazards if not correctly managed.

12.4 Overhead distribution systems

12.4.1 General
These requirements shall apply to all overhead services provided to a customer's installation from a Network Operator’s overhead distribution network where:

- The route of the overhead service cable or the position of the point of attachment or consumer pole is changed to address safety concerns or operational issues
- Work is required due to a customer installation failure or action that results in the replacement of the overhead service cable or customer equipment
- Work is required due to the failure of the service cable or distribution network equipment
- Service cable clearances requires maintenance, rectification or upgrading
- Approval has been given for a new or upgraded overhead service connection
Should there be an inability to achieve operational clearances the provisions of these requirements are such that if the customer seeks an alteration or upgrade of their connection requirements beyond that deemed as standard supply, the overhead connection to the distribution network shall be converted to underground. The replacement or relocation of an overhead service cable is subject to agreement with the Network Operator.

A Network Operator will maintain an existing overhead service cable and connection where:

- The area is serviced by overhead distribution network
- Supply is available to suit the load and the customer’s load does not exceed the rating of service cable
- The position and type of the PoS and PoA used is acceptable to the Network Operator
- Service cable spans do not exceed those specified within these requirements or as approved by the Network Operator in accordance with AS/NZS 3000
- Clearances are achieved and maintained.

Customers or their agents must not seek to access, climb or permit persons, material or equipment involved in the performance of a work activity to enter the ‘danger zone’ around powerlines at any time. Any works carried out in the vicinity of overhead lines or poles shall be carried out in accordance with requirements as prescribed in Section 6.

12.4.2 Point of attachment (PoA)
The customer is responsible for provision, installation and maintenance of all equipment necessary for the establishment of the PoA. The Network Operator may specify conditions for the position of the PoA where there are safety or compliance concerns.

12.4.3 PoA definition
The Point of Attachment (PoA) is the point where the overhead service cable is attached or anchored to the customer's installation or pole.

12.4.4 PoA suitability
AS/NZS 3000 specifies the requirements for supports, struts and extensions to structures including poles and posts used to support overhead conductors. The PoA, whether it is a bracket or strut attached to a structure, or a customer private pole, must be of sufficient strength to support the load applied by the overhead service cable.

12.4.5 PoA access
In addition to the requirements of this Section, the PoS and the PoA shall be safely accessible in accordance with the WAER and the Occupational Health and Safety Regulations. Access shall not be restricted by any portion of the customer’s premises or require network/electrical personnel to climb over or onto a roof or other structure to gain access to the PoS or PoA.

Provision of un-obstructed access shall be provided and maintained by the customer so that the PoS and PoA can be safely accessed and worked on, including the installation and maintenance of the overhead service cable(s):

- From a vehicle mounted telescopic elevated work platform of a type that is able to traverse domestic driveways where practical
- In all cases for a person standing on a portable extension ladder located upon the ground in an area that is both stable and free from obstructions
12.4.6 PoA location

The position of a customer’s PoA for an overhead service cable shall:

- Ensure compliance with the requirements of Clauses 12.4.6.2, 12.4.6.3 and 12.4.13 (Spans and clearances)
- Limit the length of service cable from the overhead LV network to the customer’s property to:
  - 30 metres where the POA is located on a building or structure for connections within the SWIS, NWIS and NIS networks
  - 18 metres where the POA is located on a pole for connections within the SWIS network
- Originate from a suitable LV overhead distribution network within 100 metres of the PoA
- Ensure the service cable does not cross over or enter a hazardous zone(s) of swimming pool, spas or water feature as defined by AS/NZS 3000
- Maintain prescribed clearances from and over:
  - Trafficable areas (refer to table 3.7 AS/NZS 7000)
  - Structures, roofs, verandas, sheds or garden/household equipment
  - Vegetation
  - Other utility services including telecommunication conductors and equipment.

In all cases the PoA must be located to achieve or exceed the minimum overhead service cable clearances as detailed in this Section, WAER and AS/NZS 7000.

**Figure 57:** Typical overhead supply arrangement example 1

**Figure 58:** Typical overhead supply arrangement example 2
Where clearances cannot be achieved through the use of an alternative route or the installation of a consumer pole on the customer’s property to divert or raise the overhead service cable away from the hazard, the supply shall be installed underground.

It is the customer’s responsibility to maintain, within their property, prescribed vegetation clearances from overhead service cables. Should the customer fail to do so the Network Operator may, in accordance with the regulations, choose to clear the vegetation at the customer’s expense or disconnect the supply until such time as the hazard is removed.

12.4.6.1 Service cables crossing an adjoining property

An overhead service cable shall not cross over or into an adjoining property unless a suitable easement is obtained by the customer over such property or it is for the purposes of attachment to a common use consumer pole located on a common boundary. Refer to Clause 12.4.8.4 for additional information on common use consumer poles.

12.4.6.2 PoA position on buildings

The location of a PoA on a building shall be along the principal frontage of the building, as close as practical to the corner of the structure and facing the overhead distribution network pole from where the overhead service cable is to originate.

The PoA shall be positioned so as to ensure a minimum ground clearance of 2.5 metres is maintained between the finished ground or floor level and the mains connection box or the lowest point of the service cable drop loop but no higher than 7 metres from the finished ground or floor level.

A minimum clearance of 1 metre shall be maintained where the overhead service cable passes near the corner of a building or its guttering. A service cable shall not be within 1 metre of a non-opening window or area accessible from the boundary of the balcony measured radially up to a height of 2.5 metres above the surface normally accessible for pedestrian activity. For opening windows and doorways where the top of window/door is:

- Less than 2.5 m above floor level the PoA shall not be within an area 1 m from bottom and sides of window/door and extending to 3.0 m above floor level
- Greater than 2.5 m above floor level and under 3.0 m from floor level, PoA shall not be within 1 m from sides and bottom of window/door
- Greater than 2.5 m above floor level and above 3.0 m from floor level, PoA shall not be within 1 m from sides and top of window/door

Figure 59 and Table 13 is an extract from AS/NZS 7000 depicting the clearances for overhead service cables and structures.
**Figure 59:** Extract from AS/NZS 7000

<table>
<thead>
<tr>
<th>Clearance</th>
<th>Under &lt; 1000v</th>
<th>U &gt; 1000v</th>
<th>1000V &lt; U ≤ 33kV</th>
<th>33kV &lt; U ≤ 132kV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulated</td>
<td>2.7</td>
<td>3.7</td>
<td>2.7</td>
<td>4.5</td>
</tr>
<tr>
<td>Bare Neutral</td>
<td>2.7</td>
<td>3.7</td>
<td>2.7</td>
<td>4.5</td>
</tr>
<tr>
<td>Bare Active</td>
<td>2.7</td>
<td>3.7</td>
<td>2.7</td>
<td>4.5</td>
</tr>
<tr>
<td>Insulated with earthed screen</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bare or covered</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bare</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertically above those parts of any structure normally accessible to persons</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertically above those parts of any structure not normally accessible to persons but on which a person can stand.</td>
<td>B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In any direction (other than vertically above) from those parts of any structure normally accessible to persons, or from any part not normally accessible to persons but on which a person can stand.</td>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In any direction from those parts of any structure not normally accessible to persons.</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In any direction from the ground.</td>
<td>G</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
1. For information pertaining to voltages above 132 kV refer to 3.8 of AS/NZS 7000.
2. This should not be taken as meaning only literal vertical. The actual clearance may also extend outwards in an arc until it intersects with the relevant “C” dimension.
3. This clearance can be further reduced to allow for termination at the point of supply.

| Note: | Illustration (b) applies if the height of the railing (or similar) plus distance B is greater than distance A. |
The location of the network poles in the street and other consumer pole/s supplying adjacent properties shall be taken into consideration when determining the route of an overhead service cable together with the need for service protection, especially for rural supplies. Refer to Clause 6.5.3

12.4.6.3 PoA on poles
The maximum height permitted for a point of attachment on a pole is 7 metres from the finished ground level and positioned so as to ensure that the minimum ground clearances as specified in Clause 12.4.13 are achieved.

A maximum of two PoA will be permitted on a single customer’s pole. If the destination of the service lead(s) is unclear, both PoA are to be permanently and indelibly labelled to identify the installation being serviced. The point of supply shall be located as prescribed by Clause 12.4.11.

12.4.7 Service brackets
The customer shall make structural provision for the installation and maintenance of a rigid attachment (service bracket) for securing the overhead service cable onto their building.

Service brackets shall be installed in accordance with the manufacturer’s installation instructions. Brackets shall be securely fixed to the structure by means of nuts and bolts. The use of fixings such as coach screws or nails in timber and loxins, tiger bolts or similar masonry anchors in brick or concrete is not acceptable as the fixing may become dislodged due to deterioration of the fixing or building material with use or age.

The part of the structure used to fix the service bracket shall be of sufficient strength for the additional load (minimum 2250 N applied at the pin) and where necessary reinforced to support the load of the overhead service cable under expected climatic conditions. The use of any extension or part of a building structure as a substitute for the purposes of providing a PoA will not be accepted.

Unless using a long span raiser bracket specifically designed for the purpose, PoA fixtures shall be designed and manufactured for the most direct service cable take off from the overhead distribution network. A PoA should not be subjected to a side pull angle of more than 30 degrees.

Service brackets shall be designed, dimensioned and manufactured as specified and shown in Figures 60 and 61.

Alternative arrangements may be used as long as the bracket has been designed in accordance with good engineering practice and AS/NZS 3000 to accommodate the applied stresses of the service apparatus.

12.4.7.1 Standard service bracket (Type 1, 2, and 3)
This type of bracket generally attaches directly to a building or structure, providing a point of attachment for an overhead service cable at the point where the bracket is fixed. It may be used when a minimum clearance of 2.5 metres from the PoA or the lowest point of the service cable drop to the finished ground or floor level can be achieved and maintained.

12.4.7.2 Standard raiser bracket (Type 4)
These brackets are to be used when the height of the overhead service cable needs to be raised to ensure minimum clearances are maintained.

12.4.7.3 Long span raiser bracket (Type 5)
In some older installations a long span raiser bracket may have been attached to a building or structure to achieve a higher point of attachment for an overhead service cable. These types of brackets should be checked for structural soundness and replaced where required.
12.4.7.4 ABC universal brackets
Where an LV Aerial Bundle Cable (ABC) is used in lieu of open aerials as the service connection, the customer will be required to install a standard universal bracket as shown in Figure 61. These brackets shall be bolted or welded to a substantial structural member of the customer’s building, facia or consumer pole.

12.4.7.5 Service bracket pin
The pin is defined as that part of a service bracket or consumer pole which accepts the service cable anchoring device. The overhead service cable may be fixed to the pin by either a clamp and wedge combination or insulator placed over the pin and secured in place by a split pin.

The pin shall be a 12 mm minimum diameter mild steel rod welded to the service bracket or customer pole, complete with a 5 mm diameter hole, drilled through the rod, 6 mm down from the end. The pin shall be constructed so as to retain a service cable throughout an arc of 30 degrees in all directions from the normal without interfering with access to connection boxes or removal of their covers.
12.4.8 Consumer poles
Customer consumer poles and private power lines located within the customer’s property are the responsibility of the property owner and occupier. Consumer and private poles shall be constructed and installed in accordance with the WAER, applicable industry standards, network operator specifications and these requirements.

Overhead electrical infrastructure must be regularly inspected, maintained in good condition and kept clear of hazards/vegetation. A proactive maintenance program prevents power interruptions, protects the electrical installation, will reduce potential bushfires/accidents and possible compensation liabilities.

For additional information refer to EnergySafety’s brochure entitled “Private power poles and lines”
12.4.8.1 Location
The customer shall install a pole at no cost to the Network Operator when:

- Overhead service cable ground clearances as specified by AS 7000 cannot be achieved or maintained
- Loads on fittings exceed equipment specifications and capabilities
- Overhead service cable spans exceed acceptable limits (refer to Clauses 12.4.6 and 12.4.13)
- The overhead service cable crosses over or passes too close to hazards such as a pool, water features or other building/structures
- A Network Operator fault note has been served on the customer or premise owner.

Consumer poles shall be located on the customer's property, generally as close as is practical to the property front street alignment boundary in accordance with the requirements of Clause 12.4.6. The pole shall be located so that the consumer's mains cable does not encroach into the road reserve or neighbouring properties. Consumer poles servicing a battle axe lot(s) shall be located on the boundary of the gazetted road servicing both properties.

12.4.8.2 Construction
Poles shall be securely embedded in a concrete foundation designed to prevent deflection from the vertical caused by the unbalanced force exerted by the overhead service cable. The overhead service support structure must be capable of withstanding the load imposed by the service cables.

Customer poles in non-cyclonic areas shall comply with AS/NZS 3000, the Network Operators requirements and be capable of withstanding a horizontal force of 2250 N applied 5.2 metres above ground without the deflection at the point of application exceeding 230 mm. There shall be no permanent deformation.

A galvanized steel pipe of 114 mm OD with a minimum wall thickness of 4.5 mm installed in accordance with AS/NZS 3000 Appendix “D” would generally meet this strength requirement. Refer to example shown in Figure 62.

The pole shall be capped and sealed at the top, with holes for the entry or exit of cables constructed and sealed to prevent the ingress of moisture into the pole. When constructed offsite the entire assembly shall be hot-dip galvanized. The customer remains responsible for the continuing care and maintenance of the consumer pole(s) for the life of the installation. Pins shall be equivalent to those specified at Clause 12.4.7.5.

Consumer poles installed to support and terminate aerial conductors for supplies in excess of 63A single or 32A three phase shall be designed and manufactured in accordance with the AS/NZS 3000 and the Network Operators requirements. Where a pole is required to have a cross arm for the termination of the Network Operator aerials, the pole shall be fitted with a collar which will:

- Prevent the cross arm from slipping down the pole; and
- Permit the cross arm to be rotated to align with the take off point from the overhead distribution network.

12.4.8.3 Horizon Power requirements
In addition to the requirements of Clause 12.4.8.2 a customer or point of attachment pole used in areas subject to cyclonic weather conditions shall comply with and satisfy the following minimum dimension requirements:

- Full length = 6780.0 mm
- Height above ground = 5500.0 mm
- Overall diameter = 168.3 mm
- Wall thickness = 6.4 mm

For concrete foundation of poles, quickset concrete is not be used.
In all cases the customer or their agent must confirm with the Network Operator’s local district office located with the respective NWIS or NIS network area to ensure the proposed pole conforms to local requirements before installation.

**Figure 62:** Typical Consumer pole layout
12.4.8.4 Common customer poles

When a common consumer pole is used to service two adjoining lots the following additional conditions shall apply:

- A maximum of two consumer mains only is allowed
- The pole must be positioned as close as practical to the common boundary of the two lots and the boundary with the road reserve
- Supplies to either property shall not exceed 63 A single or 32 A three phase
- Each mains connection box shall be indelibly labelled to identify that the installation is being serviced.

Formal written consent shall be obtained from the owner of a consumer pole, where joint or shared use is proposed, acknowledging and permitting joint use of and access to the common use pole. A copy of the acknowledgement should accompany the connection application when forwarded to the Network Operator.

12.4.9 Equipment on poles

Consumer poles and network “carry over poles” are specifically designed for the purposes of conveying and supporting an overhead service cable from the overhead distribution network to the customer’s premises.

Modification through the placement, attachment or alteration of a pole to accommodate unrelated items may change the pole’s engineering parameters, thereby adversely affecting its integrity, structure and strength. Examples of such equipment may include:

- Lighting and light sensing or switching equipment
- Signage, banners and related fixtures, fittings or supports
- Fencing, letter boxes or other customer owned structures with the exception of customer owned switchboards
- Vegetation or supports

Customer owned equipment not associated with the overhead service cable must not be installed or fixed to any Network Operator carry over pole. This requirement shall also apply to a consumer pole unless the pole has been engineered accordingly and the installer is confident that there are no safety issues. The Network Operator may require evidence to substantiate that the structural integrity of a modified pole has not been compromised.

Decorative fixtures, signs, banners or artwork may under certain limited circumstances be attached to a Network Operator’s street distribution poles, street light poles or applied to other distribution assets. For further information on the requirements refer to Clauses 6.14 and 6.15.

12.4.10 Corrosion resistance

The corrosion resistance of all components of a service bracket or steel customer’s pole shall be not less than that provided by galvanising in accordance with:

- AS 4680 Hot Dipped Galvanised (Zinc) Coatings on Fabricated Ferrous Articles
- AS 4791 Hot Dipped Galvanised (Zinc) Coatings on Open Section Ferrous Articles
- AS 4792 Hot Dipped Galvanised (Zinc) Coatings on Hollow Section Ferrous Articles

12.4.11 Point of supply

The customer shall provide, adjacent to and as close as is practical to the point of attachment, a point of supply (PoS) suitable for the purposes of securely terminating both the overhead service cable and the consumer mains in a form acceptable to the Network Operator.
No temporary or permanent structure shall be erected (such as a carport or veranda) beneath the PoS which may prevent access from a location on the ground immediately beneath the PoS. The PoS shall be such that it:

- Provides customer terminals with an electrical rating as prescribed by these requirements or the installed consumer mains, whichever is the greater
- Is a size and type compatible with both the incoming service cable and outgoing consumer mains
- Has terminals in fixed positions to accept both incoming and outgoing cables in individual tunnels or lugs
- Provides adequate insulation and protection against direct contact with live parts in accordance with AS/NZS 3000
- Is positioned to allow for the safe removal of covers, links, fuses or cables without risk to the network personnel
- Is located as close as practical to but not exceeding 500 mm from the PoA

The customer is responsible for providing and maintaining the PoS and the consumer’s mains together with any related equipment downstream from the point of supply to the customer's main switchboard as specified at Section 11.

12.4.11.1 Mains connection boxes

Where the customer provides a mains connection box to establish the PoS, the customer and their electrical contractor is reminded that unobstructed access to the device is an essential requirement for the disconnection/reconnection of the overhead service cable. In some cases this may require the modification to the roof line especially where steel sheeting is used.

Additionally, to reduce problems associated with pollution and harsh environmental conditions such as those experienced in coastal areas, all mains connection boxes shall be fitted with manufacturer supplied shrouds. This is to prevent moisture or dust built up within the mains connection box resulting in failure of or tracking across the terminals.

12.4.11.2 Boundary fuses

Boundary fuses shall be provided, installed and maintained by the customer. The table below and the associated footnotes indicate where boundary fuses are required and what type is to be used:

<table>
<thead>
<tr>
<th>Type of Supply System</th>
<th>Type of Boundary Fuse</th>
<th>See Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerial</td>
<td>Outdoor</td>
<td>a, b</td>
</tr>
<tr>
<td>Aerial</td>
<td>Indoor</td>
<td>c</td>
</tr>
<tr>
<td>Underground</td>
<td>Indoor</td>
<td>c</td>
</tr>
</tbody>
</table>

**Table 14:** Type of boundary fuse

Footnotes to **Table 14**

a) Outdoor boundary fuses are required for:
   i. Single insulated consumer mains in metallic enclosures including conduits poles and goose necks; and
   ii. Installations that are CT metered or which have a maximum demand exceeding 100A for Horizon Power and 140A Western Power connections.

b) The enclosed fuse-link size for outdoor boundary fuses is to be suitable for approximately twice the current carrying capacity of the consumer's mains.

c) Boundary fuses are not required if the consumer mains emanate from:
   i. A service protection device within a substation and the main switch is a CFS unit or a moulded case ACB; or


ii. An isolator, removable link or LV transformer terminals within the substation. When this occurs, the consumer mains are to be as short as practical and the main switchboard must be contiguous within the substation. The type of main switch is to be discussed with the Network Operator.

**Note:** Removable links or an isolator may be required within the main switchboard preceding the main switch.

Indoor boundary fuse types and fuse link sizes shall comply with the following Table 15:

<table>
<thead>
<tr>
<th>Installation Maximum Demand</th>
<th>Fuse Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>MD not in excess of 63A</td>
<td>100A GEC back connected RS 100 fuse holder with a type “T” 100/150 or 160 motor start fuse link or similar, to AS 2005 or BS 88.</td>
</tr>
<tr>
<td>MD between 63A and 140A</td>
<td>200 A GEC back connected RS 200 fuse holder with a type “T” 200 fuse link or similar, to AS 2005 or BS 88.</td>
</tr>
</tbody>
</table>

**Table 15:** Western Power indoor boundary fuses

Where the customer supplies the boundary fuse, they shall also provide a full set of spare fuses in a location accessible to both the customers’ electrical contractor and network personnel.

### 12.4.12 Prevention of conductor insulation damage

There shall be no sharp edges or projections on any external or internal surfaces that the service cable or consumer mains cable may come in contact with. If the mains connection box or boundary fuse(s) are mounted on a plate(s), the plate(s) shall not protrude beyond the edge of the mains connection box or fuse.

The service and poles brackets shall be constructed and installed in a manner to enable the overhead service cable and equipment to maintain required clearances when in situ. There shall be sufficient clearances provided to allow equipment access covers or fuses to be removed without the necessity for the covers or fuses to come into contact with the service cable or supports.

### 12.4.13 Spans and clearances

Subject to the requirements of Clause 12.4.6.2, the height of supports required to ensure that network overhead service cable are installed and maintained at the correct height shall be determined by the minimum clearances as defined by the Network Operator and AS/NZS 7000.

Unless specified to the contrary, clearance requirements for customer owned aerial electrical infrastructure including aerial sub-mains and supports shall comply with AS/NZS 3000.

Overhead service cables, PoS and PoA shall be installed so that a clearance of 600 mm or more is maintained from any overhead telephone, cable television or other telecommunication service, where present.

The maximum permitted length (span) for an overhead service cable is 30 metres unless specified otherwise by the relevant Network Operator. This ensures that the operational parameters of the cable including strength and conductor sag are not exceeded under normal operating conditions.

In certain circumstances such as the widening of a gazetted road, the Network Operator may approve the extension of the length (span) subject to the:

- Span distances not exceeding those specified in AS/NZS 3000, AS 7000; and
- Required clearances are achieved and maintained; and
- Where required, anchorage points are strengthened to support any additional load

The Network Operator will determine the final location of all network poles and supports in coordination with the relevant government authorities and affected parties.
12.4.14 Disconnections, repairs, replacement, or upgrades

12.4.14.1 Application

**New and upgraded installations** - Generally no new or upgraded overhead connections greater than standard supply will be permitted within the SWIS. Connections of this type in the NWIS and NIS are to be converted to underground.

**Installation alterations** - The retention of an existing overhead connection will be permitted as long as the electrical installation’s maximum demand is not increased, the installation’s consumer mains and main switchboard comply with current standards and there are no issues of safety.

**Customer instigated actions** - Reinstatement or replacement of an overhead service cable due to a customer installation fault, negligence or damage will, where ever possible, be initiated as long as the connection operational parameters remain unchanged and it is safe to do so.

Where a condition, fault or hazard is present or identified within the customer’s electrical installation that would render the installation unsafe if reconnected to the distribution network, the service will not be re-established until rectification has occurred. This requirement shall also apply to applications for a temporarily disconnection of an overhead service cable, regardless of the reasons stated for that temporary service.

**Network Operator instigated actions** - Overhead service cables that are rendered unserviceable due a distribution network fault, deemed defective or requiring replacement will be replaced by the Network Operator in accordance with current standards. A customer may be required to supply and install a new PoA and or consumer pole to achieve required clearances or where avoidance of existing hazardous zone is necessary.

**New pools, spa or water feature installations** - Customers wishing to install or request a temporary disconnection of an overhead service cable to facilitate the installation of a pool, spa or water feature shall ensure that the route and location of the reinstated overhead service cable complies with current standards and clearances. Service cables shall not enter, cross or pass over restricted zones or within 3.5 metres of the water measured outwards from the edge of the pool, spa or water feature. (Refer to Section 4 of WAER).

12.4.14.2 Compliance costs

Work related to the repair, replacement, relocation, upgrade or reinstatement of an overhead service cable and/or associated customer equipment may incur costs of varying degrees for either or both the customer and the Network Operator. Costs shall be attributed to the party that instigated or requested the work in accordance with the following principles:

**Customer** - The customer shall be responsible for all costs incurred including those of the Network Operator as a result of any modification or alteration (including temporary disconnection) made to the electrical installation or due to any structural change to the customer’s installation that renders the installation non-compliant with current standards.

Where the overhead service cable requires repair or replacement due to or caused by the customer or the customer’s equipment, or event/action on the customer’s property, the customer shall cover all costs pertaining to that work including any costs for work and equipment required to upgrade the installation to comply with current standards.

**Network Operator** - Overhead service cables requiring repair, replacement or upgrade due to either cable failure or as a part of a scheduled maintenance will be installed or reinstated by the Network Operator. Customer equipment compliance costs associated with the work shall be borne by the customer.
12.4.15 **Temporary disconnections**  
The Network Operator’s temporary disconnection notification and tagging system is designed to assist the electrical and construction industries safely manage customer requested or fault related disconnections and reconnections of electrical installations from the low voltage distribution network.

This system applies to both disconnections and reconnections of aerial service cables or underground consumer mains at the pillar when facilitating customer planned maintenance/construction work or in response to unplanned fault rectification. For full details of the system refer to [Section 7](#).

12.4.16 **Swimming pools, spas and water features**  
Overhead service cables connecting a customer’s installation to a distribution network shall not be installed, reinstated or remain in place where that service cable enters or crosses over a pool, spa or water feature zone as defined by AS/NZS 3000. Refer to WAER Section 4.

This policy shall apply to all situations where the overhead service cable and the associated customers equipment requires repair, replacement, relocation, upgrading or temporary disconnection/reconnection.

Customer’s equipment includes consumer mains cable, mains connection box, point of attachment, poles and those actions including replacement, relocation or upgrading of the customer’s main switchboard.

12.4.17 **Temporary arrangement in the event of a failed service**  
The Network Operator may install or the customer may be required to arrange for the installation of a temporary supply. In such cases the supply shall be installed in accordance with the requirements of Section 8 of the [WAER](#).

If it is deemed by network personnel that the reinstatement of a permanent connection or temporary supply to the distribution network re-establishes a hazard or creates additional safety concerns, the Network Operator may elect to leave the customer’s installation disconnected until such time as the hazard is removed or rectified.

12.4.18 **Existing customers and affected parties**  
Where existing service or aerial sub mains cables are to be removed as part of an upgrade or subdivision work, the developer is responsible for the reconnection of existing Network Operator aerial-connected customers to the distribution network at the developers cost. Refer to the relevant Network Operator for complete details.

12.4.19 **Service cable replacement program**  
Both Horizon Power and Western Power (metropolitan area only) have implemented Overhead Service cable Replacement Programs designed to ensure that customer installations that have not been scheduled for a network upgrade have a safe overhead service lead connection.

In some instances this may require the replacement of the overhead service cable, point of attachment and or point of supply where deemed defective or unserviceable. The installation of a network carry over or customer consumer pole may also be required to ensure the overhead service cable is at the compliant height above trafficable areas or structures or diverted away from identified hazards.

Costs associated with the installation and replacement of the overhead service cable will be borne by the Network Operator.

Where the Network Operator identifies an unsafe or non-compliant situation associated with the customer’s installation, the Network Operator may issue a fault notice identifying the hazard or defective equipment to the customer, who will be required to undertake the necessary rectification/modification at their cost.
Alternatively, the customer may choose to convert their overhead connection to underground at their cost as a part of this program. This initiative is being progressively rolled out in affected areas. Customers will be formally advised in advance of any supply or service interruption.

12.5 Underground distribution systems

12.5.1 General

Except in circumstances prescribed in Clause 12.2 of this Manual all customer connections to a low voltage distribution network will be underground to a point of supply provided by the Network Operator.

These requirements shall apply to all underground services provided to a customer’s installation from either the overhead or underground distribution network where:

- Approval has been given for a new connection to either an existing overhead or existing/new underground distribution network
- An overhead service is converted to underground
- An existing underground connection and associated equipment requires maintenance, rectification, alteration, modification or an upgrade

The Network Operator will provide and maintain a point of supply for an underground connection to a customer’s premise where:

- The area is serviced by either an overhead or underground distribution network physically capable of servicing the requested connection
- There is sufficient capacity within the network to accommodate the customer’s requested maximum demand
- The position and type of the PoS to be used is acceptable to the Network Operator
- There are no operational issues, hazards or safety concerns that may or will adversely affect either the customer’s installation or the network including members of the public and operational personnel
- The installation and connection complies with the relevant codes, standards and these requirements.

Any work carried out in the vicinity of underground cables in road reserves, public open space or crown land must completed in accordance with Section 6. “Dial Before You Dig” (Telephone 1100) must be consulted to obtain information on the location of any underground assets before any works involving excavations are commenced.

12.5.2 Point of supply (PoS)

The Network Operator shall arrange for either the installation of or shall grant access to an appropriate point of supply which may be a pillar, panel, frame or substation to facilitate the connection of a customer’s installation. The customer is responsible for providing and maintaining the electrical installation downstream from the point of supply (excluding network meters) to the customer’s main switchboard and beyond as specified in Section 11.

The Network Operator will generally only provide one pillar to serve two residential lots. Industrial or commercial lots will be provided with an individual supply, either from a universal pillar or a substation/transformer connection.

It is acknowledged that in certain circumstances the use of an above ground point of supply may not be possible due to either limited space, unstable environmental conditions or because to do so would in itself present a hazard either to pedestrians or traffic. In such cases the Network Operator may choose to install a ground level pit or wall mounted frame or box.
12.5.3 Location
The Network Operator will determine the location of the point of supply which in most cases shall be sited at the junction of the street and common property boundaries.

Above ground assets including mini/uni-pillars, pits and low voltage frames shall be located at ground level 300 mm above 100 year flood level, on the low side of any boundary retaining wall and not in an unsafe/non accessible position.

Network service equipment including mini/uni-pillars and pits shall not be installed within water feature hazardous zones as defined by Section 6 of AS/NZS 3000 or behind retaining walls. A Network Operator may provide an exception where a retaining wall is low (generally 300 mm) and does not interfere with network cable/ducts and 24/7 access is provided.

The customer is required to keep access to the point of supply where it is installed on their property, free from obstructions and maintain appropriate ground levels around the equipment and over consumer mains. Refer to Clause 12.2.8.

Where retaining walls are integrated into the customer’s development, the walls shall incorporate a setback of sufficient dimensions to allow safe work on the distribution pillar, pit or connection equipment. Alternatively, provision shall be made for the installation of a surface or recessed wall-mounted connection panel.

Heavy-duty PVC conduits shall be provided by the customer in accordance with the Network Operator’s requirements to facilitate future consumer mains and street cable installation into distribution network connection equipment. This is particularly important where access to the point of supply may be restricted due to its location within a multiple level development or near trafficable areas.

Where the point of supply is located near or adjacent to trafficable areas the position shall be as prescribed by the Network Operator. The equipment shall be protected by approved robust bollards with non-corrosive outer surfaces or other protection devices such as high integrity concrete or steel crash barriers. Rope barriers are not deemed as adequate protection.

For additional information refer to the Network Operator’s policies for ‘Ground Mounted Equipment’.

The point of supply shall be positioned so as not to create a hazard or potentially impede or interfere with normal pedestrian or vehicle movements.

Mini pillars, universal pillars and pits shall be located so that the centre of the pillar or pit is within an area not more than 500 mm from the front boundary and from the common boundary of the adjacent property, so long as this is practical. (Refer to Figure 63)

Pillars and pits will only be permitted in a gazetted laneway where there are no other roads in the vicinity, or it is necessary because high retaining walls along the front property boundary prevents safe access for operational and maintenance purposes.

Figure 63: Pillar location and exclusion zone requirements.

Pillars or pits may be located to the side of a shared driveway servicing a multiple battle axe freehold lot. This may require the creation of an easement to ensure access is available to the point of supply for all affected lots. Refer to Clause 6.8 for easement information.
Additional information on Service Provider lot entry arrangements Addendum 1 of the Utility Service Providers Code of Practice provides drawings indicating location of utility service provisions from road reserves to lots without retaining walls or with retaining walls less than 1.1 m high at the services location.

100A and 200A wall mounted pillars or boxes, must be located and mounted in accordance with the directions provided on the design drawing(s) or as directed by the Network Operator.

The electrical contractor shall ensure that there is clear unobstructed access provided to safely remove the box cover and to operate the link(s)/fuse(s) contained within the box.

Recessed mounted panels may be approved for use as a point of supply in lieu of pillars where a customer’s premises is built out to the street boundary or the structure incorporates parapet walls or high frontal retaining walls across the entire front boundary. The location of the panel(s) shall be in accordance with the design drawings and shall have heavy-duty conduits of sufficient diameter, length and number installed to enable the installation of distribution network cables and the consumer mains for all associated properties.

The location of kiosks, frames and substations shall be as prescribed in Section 14 of this Manual. Where such equipment is installed in a car park, it is preferable that the equipment be placed in a corner rather than central to the car park. In any case it shall be installed so that vehicle movement cannot impact upon it.

The preferred method of protection for network equipment is to provide a 3 metre set back from a 150 mm high curb to prevent the overhang of a vehicle from impacting the equipment. Bollards may be used as an additional means of protection and shall be set at a minimum distance of 1 metre from the equipment and spaced as prescribed by the Network Operator.

Consideration shall be given as to whether the installation presents an unacceptable step/touch hazard in the event of a fault.

12.5.3.1 Horizon Power policy

For further information and guidance on Horizon Power’s requirements phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

12.5.3.2 Western Power policy

For additional information relating to the installation of or location of Western Power ground mounted equipment, refer to policy document Locating Ground Mounted Equipment or contact the relevant Western Power Project Construction Manager.

12.5.4 Inappropriate point of supply connection

Final pillar, transformer, kiosk or substation positions will be determined by the Network Operator. Prior to the installation of the consumer mains the customer or their agent must confirm:

- The point of supply location
- A connection application has been submitted
- All fees and charges have been paid
- That the point of supply is a legitimate connection point as prescribed by WAER
- There is sufficient available termination capacity.

Cables installed and connected to an incorrect point of supply that breaches these requirements, may contravene statutory regulations and can create a safety issue. Where an inappropriate connection has been made, the installation must be disconnected, and consumer mains re-routed to the correct position at the customer’s or agent’s expense. For additional information refer to WAER Clause 3.4.

Failure to take remedial action can result in Network Operator connection scheme deregistered and proceedings being instigated against the offending party(s).
12.5.5 Access
In addition to the requirements of Clause 12.2.8, the point of supply must not be located behind a locked security fence or gate unless the customer has installed an approved network master key system. The customer must ensure that their fence or security arrangements do not impede the Network Operator’s access requirements.

Under no circumstances shall a customer or their agent enter a substation or transformer enclosure, without specific written approval and permission from the Network Operator in accordance with the Network Operator’s procedure for acquiring a “Substation Entry Authority”. Refer to Section 14.

12.5.5.1 Exclusion zones
An exclusion zone shall be maintained around network equipment to allow network staff, emergency personnel and electrical contractors sufficient room to gain access to or remove covers from network equipment, and to provide a safe working environment while operating switches, links, or fuses, completing or removing service connections or carrying out maintenance tasks.

The zone shall be maintained free from structures, obstructions and hazards including but not limited to customer buildings, pools, spas, water features, fences, letter boxes, vegetation, garden features, ornamental paths, or any other item that may restrict access to or hinder the safe operation of the equipment.

The exclusion zone created around pillars and pits shall include a radial area extending 500 mm in the horizontal plain from the centre of the pillar or pit and uninhibited in the vertical plain. Refer to Figure 63. Zones in and around substation arrangements shall be as prescribed in Section 14 of this Manual, relevant Australian Standards and the Building Code of Australia.

Failure to maintain the required clearances may result in the Network Operator issuing orders to the customer to meet compliance requirements.

12.5.5.2 Excavation near transformers
Where consumer cables are to be installed near or in a substation or transformer enclosure, no excavation work greater than 300 mm in depth within 3 metres of the substation or transformer enclosure shall be commenced before the cable route has been approved by and advice regarding the substation earthing system obtained from the Network Operator’s Project Construction Manager. Transformers not installed on culverts shall be secured and stabilised during any excavation works to prevent the equipment from moving or falling.

12.5.5.3 Minimum separation of services
Clause 3.11.5 and Table 3.7 of AS/NZS 3000 specifies the requirements for minimum separation of services and clearances including the electrical and mechanical protection clearances from electrical cables and earthing electrodes. In summary, other utility service shall not pass through or be located within the exclusion zone for both mini and universal pillars. A 500 mm separation and service exclusion zone shall be created and maintained around low voltage earthing electrodes from other services including water services, sanitary drainage and gas. This zone shall be extended to 600 mm for stormwater drainage services. Refer also to Clause 12.6.6

12.5.6 Network pillar identification
Pillars utilise triangular keyed cover locking bolts and bearing the embossed logo of a Network Operator on the cover, are deemed to form a part of that Network Operator’s distribution network.

These features identify and distinguish network electricity distribution systems from private/non network systems. Using network marked pillar(s) for private distribution systems has the potential to confuse network and industry personnel and therefore compromises network/public safety.

Network Operator pillars bearing their company logo with keyed triangular cover locking bolts shall not be used for private/non network electricity distribution systems.
Developers and their electrical contractors must ensure that only plain dome covers and “Allen” type cover bolts are used. Where such equipment has been used for an existing installation the logos and other identify features must be removed and the cover bolts changed to a non network type keyed bolt.

12.5.7 Pillar or pit not installed
Common reasons for a pillar or pit not having been installed can be attributed to a delay or failure to submit a connection application, sites not being pegged or the construction of a customer's premises proceeding more quickly than the surrounding services infrastructure.

12.5.7.1 Pillars in overhead areas
In areas reticulated with an overhead distribution system the electrical contractor should check with the owner or builder to verify that an application for a connection has been made. If confirmed, the electrical contractor should note the Network Operator’s reference or project number and submit the Preliminary Notice, then proceed as normal once the pillar location is known.

If no application has been made then the owner or their agent must complete the appropriate application form. Where the application is successfully submitted electronically a receipt number will be provided which can be used as a point of reference for all future matters associated with the connection. On receipt of an application, the Network Operator will arrange for the installation and energisation of a pillar, including provision to the applicant of the relevant installation information and contact details for the designated pillar installer.

The applicant should confirm the point of supply, pillar location with the Network Operator and the electrical contractor before the consumer mains are installed. The Network Operator will liaise with and notify the applicant when the pillar installation is complete.

Where the electrical contractor has the appropriate connection approvals they shall then connect the consumer mains, fit the meter and complete the installation; including testing and submission of the relevant notices. If not approved the Network Operator will complete the connections and energise the site. Charges may be applied where the Network Operator is required to fit the meter and complete the connection of the consumer mains.

12.5.7.2 Pillar in new underground sub-divisions of 4 lots or more
The installation of pillars and network distribution infrastructure in new sub-divisions consisting of 4 or more lots is undertaken by a developer. If the pillar is either not installed or not energised, the owner or their agent must check with the developer to determine why. The owner or their agent will need to liaise with the developer to confirm the location of the pillar, installation timeframe and date of energisation.

Once the pillar is installed and energised, it is the developer’s responsibility to notify the owner or their agent so that the installation can be connected to the underground network by the electrical contractor. Refer to the Network Operators UDS Manual.

12.5.8 Pillar or pit not energised
To prevent a customer’s installation becoming unknowingly energised when the Network Operator activates the supply to a pillar, electrical contractors must not connect consumer mains into pillar terminals if those terminals have not been energised. The electrical contractor through their client shall determine who is responsible for the pillar installation and then take the appropriate course of action.
12.5.8.1 Pillars in existing overhead areas
1) The owner or their agent should obtain from the Network Operator, if unknown, the reference or project number applicable to the connection application
2) The owner or their agent will need to liaise with the Network Operator to confirm a timeframe or date for energising the pillar which must be then conveyed to all affected parties
3) The Network Operator will notify the owner or their agent when the pillar has been energised
4) Following confirmation of the pillar energisation, the electrical contractor shall then complete the connection process in accordance with their level of connection authorisation

12.5.8.2 Pillars in new underground sub-divisions of 4 lots or more
1) The owner or their agent to check with the developer of the sub-division to determine why the pillar has not energised
2) Developer to arrange for the energisation of the pillar
3) Developer shall then notify the owner or their agent when the pillar has been energised
4) Following the confirmation of energisation by the developer the electrical contractor shall then complete the connection process in accordance with their level of connection authorisation.

12.6 Consumer mains

12.6.1 General
Electrical work associated with the installation and maintenance of consumer mains shall be carried out in accordance with the WAER, AS/NZS 3000, AS/NZS 3008 and this Manual. Un-metered sub-mains shall be considered as consumer mains for the purposes of this Section.

The Network Operator reserves the right to determine the location of the customer's point of supply, and the method for termination of consumer mains to that PoS where the requirements are not specified.

Where an installation is connected to an overhead network distribution system via a service cable the connection shall be deemed to be unprotected for the purposes of determining compliance with AS/NZS 3000 cl 3.9.7.1.2.

PVC/PVC cable installed in HD conduit in deemed to satisfy this requirement.

12.6.2 Consumer main sizes
The size of consumer mains shall be selected in accordance with the requirements of the WAER, AS/NZS 3000, AS/NZS 3008 and these requirements.

Subject to the requirements of Clause 11.9.3, (which permits a larger conduct for pre-wired panels), the size of consumer mains conductors shall be constant from the point of supply (mains connections box for an overhead connection or pillar terminals for underground connections to the customer's main switch.

The WAER states that any conductor forming a portion of the consumer's mains shall have a cross sectional area, for copper conductors, of not less than 10 mm for single phase and 6 mm for three phase and a minimum current-carrying capacity of:

<table>
<thead>
<tr>
<th>Single domestic installations</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-phase</td>
<td>63 A</td>
</tr>
<tr>
<td>Multi-phase</td>
<td>32 A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multiple installations which incorporate a domestic installation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-phase</td>
<td>63 A</td>
</tr>
<tr>
<td>Multi-phase</td>
<td>63 A</td>
</tr>
</tbody>
</table>

Table 16: Consumer main sizes
For the purpose of calculating current-carrying capacity for wiring systems installed in the roof space of buildings it shall be assumed that thermal insulation, if not currently installed, will be installed at some point in the future. Refer to WAER Section 9

Cables installed within a consumer pole shall be classified as being enclosed in air.

**12.6.2.1 Paralleling of conductors**

It is permissible to convert a three phase consumer mains cable to single phase by connecting the conductors in parallel. The cable shall be de-rated for two circuits in parallel with the appropriate coloured sleeving fitted over the outer sheath of the conductors at each end for the purposes of phase and neutral identification.

The use of earthing conductors as either an active or neutral conductor is strictly forbidden regardless of the circumstance.

**12.6.3 Voltage drop/rise**

For the purposes of calculating voltage drop, the assessed component across the consumer’s mains shall be calculated in accordance with AS/NZS 3000 and 3008 part 1. Refer to Clause 15.12 and 15.16 for further information on voltage rise.

**12.6.4 Acceptable wiring systems**

**12.6.4.1 Connected to overhead distribution system**

The customer’s (PoS) and (PoA) may be located either on a consumer pole or on the principal frontage of a building. The customer’s main switchboard (MSB) may be located adjacent to or remote from the point of supply. Therefore the consumer mains may be installed:

- Internally or externally on the consumer pole
- Unenclosed in air at the point of supply if UV stabilised
- Underground from the pole to the MSB
- Internally within building roof space, brick cavity, cladding or stud wall
- Externally on a building wall or structure

Prior to the release of the 2007 edition of AS/NZS 3000, Network Operators accepted unprotected double PVC insulation wiring systems as a means of connection from the overhead PoS to the MSB where the cable was not installed underground or in metal conduit. Single insulated cables in metal conduits could be used as consumer mains as long as rated service fuses were installed and maintained by the customer.

These types of cable installations are no longer permitted for new connections and where maintenance is required on these cable configurations, it is strongly recommended that the wiring system be replaced and upgraded to conform to the current requirements.

In all cases the electrical contractor shall assume that, unless formally advised otherwise, an incoming overhead service cable is not protected by network service fuses.

**12.6.4.2 Existing overhead installations**

Single insulated unsheathed cables shall not be installed in steel conduit or customer poles or unenclosed in air at the point of supply. Double insulated PVC cables are acceptable within steel consumer poles as long as cable entry and exit points are appropriately bushed and sealed to protect the cable and prevent moisture from entering.

Existing single insulated cables installed in PVC conduit externally on a pole within a building structure or roof space are permitted to remain in service as long as it satisfies the installation standards applicable when first installed and are confirmed as being operationally safe.
Where maintenance is required on existing consumer mains installations the electrical contractor shall ensure that the following requirements have been implemented:

- Cables are identified “electrical orange” either by enclosure colour, cable sheath or by permanent banding at each termination point and at intervals of 2 metres along the cable route where it is accessible
- All conductors forming a part of the consumer mains installation shall be enclosed within one sheath or specific enclosure
- The consumer main installation shall be fixed and retained in a permanent position in accessible parts of the installation
- Both single and double insulated consumer main cables shall be enclosed in UV stabilised conduit and fittings, free from mechanical damage where the cables:
  - Enter the mains connection box mounted on a raiser bracket
  - Are within 2.5 metres of the finished ground level or open to view
  - Are installed on the exterior of a building, structure or under open eaves
  - Are installed on the outside of the customer’s pole

Single insulated cables installed in steel conduit goose necks shall be protected by boundary fuses or preferably upgraded to comply with current standards. Where extensive maintenance is required the Network Operator may require the customer to convert to an underground supply.

12.6.4.3 Connected to underground distribution system

The customer’s point of supply may be located within either a pillar, LV frame/kiosk or within a substation. As for overhead systems the customer’s main switchboard (MSB) may be located adjacent to or remote from the point of supply. The configuration of underground consumer mains is dependent on whether the:

- Cable(s) are protected or unprotected at the point on the supply
- Size of the load
- Method of connection to the point of supply
- Location of the MSB.

Underground consumer’s mains shall be selected and installed in accordance with the requirements of the WAER, AS/NZS 3000 and AS/NZS 3008. Steel wire armoured cable, Category “B” systems as defined by the AS/NZS 3000 and the use of multi-stranded flexible or braided cable as consumer mains are not permitted under any circumstances.

The use of quick set or drying concrete as a part of a Category “C” wiring system shall not be used for the purposes of encasement over or around electrical conduits as such products can have a detrimental or damaging effect on the electrical installation.

12.6.4.4 Connections within substations or switch-rooms

In addition to the requirements of this Section the consumer mains shall be supplied and installed by the customer in accordance with the requirements of Clause 14.4.9. Special arrangements may apply to customer’s installations incorporating multiple transformers. The details will generally be provided as a part of the connection negotiations or agreement.
12.6.4.5 Consumer main upgrade minimum requirements

The following minimum installation requirements are to be completed when initiating an upgrade of a customer’s consumer mains cable installation. This includes retro-undergrounding work, single to three phase conversions and consumer mains cable replacements.

1) The MEN connection is located on and confirmed at the customer’s neutral link.
2) Where the installed consumer mains cable is equal to or larger than 16 mm$^2$, the main earth conductor is upgraded to a minimum size of 6 mm$^2$ or larger.
3) Where the installed consumer mains cable is 10 mm$^2$ or smaller, the continuity and condition of the main earth conductor to the water pipe and if installed, the earth electrode, is proven.
4) Minimum rear meter panel clearances shall be confirmed (refer to Clause 11.4.3).
5) A service protective device (fuse or circuit breaker) is installed on the meter panel.
6) All existing metal conduits associated with the main switchboard is bonded to earth.
7) All metallic switchboards and meter enclosures boxes are bonded to earth with a bonding conductor not less than the size of the incoming neutral conductor. (Note: The load neutral conductor must be the same size as the incoming line neutral conductor
8) Customer DIN kits are to be bonded to earth.

Note:
- The upgraded consumer’s mains and associated electrical installation work shall comply with the current requirements of AS/NZS 3000, the WAER and this Manual.
- The point of attachment shall be in accordance with Section 12.
- Any existing internal electrical work, other than that listed above, is deemed to comply, provided it is in accordance with the minimum wiring standards applicable at the time of installation and deemed safe to remain connected.
- The Network kWh meter must be phased out prior to re-energising the installation.
- A load test or earth loop impedance test is to be applied to the installation to ensure continuity and effectiveness of the incoming neutral conductor.
- Phase rotation on three phase installations must be checked prior to and after the new consumer mains cable are installed to ensure rotation direction remains the same.
- The consumer mains are to be labelled in accordance with the WAER Clause 3.5 including house or lot number.
- The route of the underground mains is identified on a plan located in the main switchboard

12.6.5 Location

The customer is responsible for ensuring that common property or easements are created to ensure access is available and to allow consumer mains to be connected to the point of supply and/or sub-mains to be connected to the site main switchboard. Refer to Clause 6.8.

Consumer mains associated with one lot shall not extend into an adjacent lot except where required to be connect into the PoS located on the adjacent property boundary.

Consumer mains may only cross into a road reserve when required to be connected to a point of supply or substation located within that reserve or when the Council (LGA) or the relevant Government Authority grants approval for the installation of an unmetered supply. Consumer mains shall not be installed in or across a gazetted road way.

Underground cables shall run parallel to or perpendicular to the property boundaries and shall be within 1 metre of those boundaries. For multiple unit developments underground cables may be installed immediately alongside or under access ways or driveways servicing the associated installation.

The customer is responsible for locating all other services prior to the installation of the consumer’s mains and costs pertaining to trenching, backfilling, reinstatement and any other associated costs applicable to the installation of underground consumer’s mains.
Prior to the installation of any underground cable the customer shall confirm all final finished ground levels to ensure that cables are buried to the correct depth. Failure to do so may result in reworking of the installation to the required standard at the customer’s cost.

### 12.6.6 Separation from other services

Low Voltage underground wiring systems shall be spaced in accordance with AS/NZS 3000 Table 3.7 and Clause 3.9.8.4. Where cables are installed in road reserves, separation for other services shall be in accordance with the Utility Providers Code of Practice. Refer to Clause 6.6 for details.

The installation of gas master meters is governed by the requirements of the Gas Standards Act 1972 and Gas Standards (Gas fitting and Consumer Gas Installations) Regulations.

In summary the Regulations state that a gas master meter must not be installed in:

- a room primarily designed to house electrical meters or switchgear; or
- closer than one metre to electrical equipment capable of providing a source of ignition of the gas metered or to an electric meter, unless the gas meter and the electrical equipment or electric meter, as the case may be, are installed in separate and adequately ventilated housings each of which is sealed from the other.

For detailed information on the requirements refer to either the Act or contact EnergySafety.

### 12.6.7 Identification of consumer’s mains

In addition to the requirements of both WAER and AS/NZS 3000 all conductors at customer’s terminals and metering facilities shall be colour coded to clearly and permanently identify each active conductor and the neutral conductor. This shall include the customer’s terminals, the service protective devices and the incoming supply to the metering enclosure. The use of Insulation tape is not an accepted means of identification.

The outer sheath of a new multi-core consumer mains cable or conduit containing a consumer mains cable(s) shall be orange in colour. Where there is an existing exposed consumer mains cable installation the cable or conduit shall be clearly identified at 2 metre intervals by labelling or permanent orange banding.

#### 12.6.7.1 Neutral identification

In all cases the neutral conductor shall be a black conductor or a conductor with black sleeve. Where sleeving is required, it is to extend for single core cables, 300 mm back from the termination point and for multiple core cables from the glove to the termination point within the connection facility.

#### 12.6.7.2 Active identification

In all cases the active conductor shall be an active colour or a conductor sleeved with an active colour as permitted by AS/NZS 3000. Where sleeving is required, it is to extend for single core cables 300 mm back from the termination point and for multiple core cables from the glove to the termination point within the connection facility.

#### 12.6.7.3 Phase identification

In the case of polyphase supplies, the consumer mains shall be permanently identified to confirm individual phase colours. Where the active conductors as described in Clause 12.6.7.2 are not the correct phase colours, a minimum length of 100 mm sleeving in the correct phase colour shall be used to identify the conductor at the termination point.

#### 12.6.7.4 Underground locations

Underground cables shall be marked and recorded in accordance with Clause 3.11.4 of AS/NZS 3000 and the WAER.
12.6.7.5 Labelling
Generally consumer mains shall be labelled as prescribed in Clause 12.9. A Network Operator may accept marking the outer sheath of consumer mains cable with an indelible marker where there is insufficient space within a pillar or pit to fit a durable tag. The label shall be clearly visible and positioned so as to be legible without having to manipulate the cable.

12.6.8 Jointing consumers mains
Joints in consumer mains are generally not permitted unless approved by the Network Operator. If jointing is unavoidable and approval has been granted, the electrical contractor may join a consumer mains cable by means of an epoxy jointing kit. The location of the joint(s) shall be recorded on the site “as installed” drawings.

12.6.9 Termination of consumers mains
All cables, terminals and equipment shall be treated as “LIVE” until such time as each individual person preparing to work on a cable, terminal, or piece of equipment personally tests and proves the status of the installation. Only those persons authorised by the Network Operator to terminate cables within distribution network equipment shall do so.

Generally all low voltage consumer cable entry points into distribution network equipment shall be supplied from underneath either via a conduit, service duct or steel/concrete base or culvert. No entry holes, unless approved by the Network Operator, shall be made in the bases or housings of network equipment.

Consumer mains cable shall be enclosed in rigid or flexible heavy duty conduit at the point of entry into a network pillar or pit. Where the final connection is completed by the Network Operator the cable and conduit tail shall be installed alongside the pillar or pit with enough length to enable installation and allow the wiring system to be positioned as required to suite connection conditions.

All cable and duct entry points shall be sealed to prevent the spread of liquids and vermin through the conduit or ducting system into network equipment.

Consumer’s mains shall be of sufficient continuous length to effect a connection between the customer’s main switchboard and the point of supply without the need for joints or undue stress being placed on the cable and terminations.

12.6.9.1 Balanced loads
Customer installations serviced by either a two or three phase supply shall have the electrical load balanced equally over all phases. The intent of balancing the load is to minimise the differences between the phase-to-phase supply voltages. Loads shall be balanced in accordance with the requirements of Clause 10.7.

12.6.9.2 Single phase pillar connection formula
The following formula may be used as a general rule for determining the appropriate phase connection within a distribution pillar for a single phase consumer’s mains cables:

Divide the street/lot number by 3 to determine the phase connection (result). Where the street/lot number is less than 3 treat the number as the result. Table 17

- Equal division 0 = Red Phase
- Remainder of 1 = White Phase
- Remainder of 2 = Blue Phase
### Table 17: Example single phase pillar connection formula

<table>
<thead>
<tr>
<th>St/lot#</th>
<th>Division</th>
<th>Result</th>
<th>Phase</th>
<th>St/lot#</th>
<th>Division</th>
<th>Result</th>
<th>Phase</th>
</tr>
</thead>
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<tr>
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<td>3</td>
<td>0</td>
<td>Red</td>
<td>31</td>
<td>3</td>
<td>1</td>
<td>White</td>
</tr>
<tr>
<td>32</td>
<td>3</td>
<td>2</td>
<td>Blue</td>
<td>33</td>
<td>3</td>
<td>0</td>
<td>Red</td>
</tr>
<tr>
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<td>3</td>
<td>1</td>
<td>White</td>
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<td>0</td>
<td>Red</td>
<td>37</td>
<td>3</td>
<td>1</td>
<td>White</td>
</tr>
<tr>
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<td>2</td>
<td>Blue</td>
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<td>1</td>
<td>White</td>
<td>41</td>
<td>3</td>
<td>2</td>
<td>Blue</td>
</tr>
</tbody>
</table>

#### 12.6.9.3 Connection authorization

Subject to meeting specific eligibility criteria a Network Operator may authorise an electrical contractor to insert and or terminate the consumer mains at the connection point in a pillar or pit, where the connection is for direct wired metered installations up to and including 100A.

Contractors authorised to terminate consumer mains on Horizon Power networks may only do so when directed to by Horizon Power. Every termination must be preceded by an instruction from Horizon Power.

If the electrical contractor is not authorised to terminate consumer mains at the point of supply the final connection of a consumers mains shall be completed by the Network Operator staff (fees may apply). For pillar or pit consumer main cable terminations, tails of sufficient length (approximately 1 metre) shall be located adjacent to the pillar or pit.

The cable shall be marked as specified. The cable end at the point of supply shall be sealed and protected by means equivalent to double insulation and in accordance with AS/NZS 3000 to prevent inadvertent contact with live parts.

The consumer mains cable at the customer’s switchboard shall be terminated with both the SPD and the customer's main switch tagged and locked in a de-energised state (OFF position) before a connection application is made.

All consumer main cable terminations at the point of supply for installations above 100A including all CT metering installations, will be completed by Network Operator personnel in conjunction with the customer’s electrical contractor. The electrical contractor shall provide sufficient personnel to assist with the termination process and shall provide suitable cable lugs and associated ancillary equipment including crimping tools at no cost to the Network Operator.

#### 12.6.9.4 Tunnel terminations

Where a multi-point terminal block is provided in network equipment, only one wire of a consumers mains cable shall be terminated in each tunnel of the terminal block. If there is insufficient vacant tunnels to complete the termination the electrical contractor shall complete the connection as detailed in Clause 12.6.9.8.

When completing a connection at a mains connection box, service protection device, meter fuse, meter or related service equipment, stranded cables ends shall be twisted and if required doubled up before insertion into the terminal. The terminal screws must be tight and the cable pulled to prove that a secure connection has been made.

#### 12.6.9.5 Parallel terminations

Doubling up of consumer mains cables cores in one terminal tunnel is not permitted as it is deemed unsafe and can potentially affect the supply to other customers. Where unavoidable it is permissible to double up street light circuit conductors but not with conductors associated with the customer premises.
12.6.9.6 Horizon Power termination references
For further information and guidance on Horizon Power’s termination requirements phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

12.6.9.7 Western Power termination references
Cable entry and termination details can be obtained from Western Power’s Distribution Construction Standards Handbook or the Distribution Substation Plant Manual.

12.6.9.8 Insufficient pillar terminals
Where an electrical contractor is authorised to carry out connections within a pillar, the contractor shall confirm that there is adequate connection capacity to terminate the consumer's main cable. Clause 5.5 of WAER requires that each cable core is terminated in an individual tunnel of a terminal block.

Where there is an insufficient number of neutral terminals, authorised electrical contractors may install an additional Alstom CB6 neutral terminal block. The Network Operator will, on application, fit additional neutral terminals for non-approved electrical contractors.

If there are an insufficient number of active terminals, electrical contractors shall in all cases notify the Network Operator who will arrange for the installation of additional terminals to facilitate the connection of the consumer mains by either the approved electrical contractor or the Network Operator.

Only approved equipment as described will be permitted for use in pillars and pits. Under no circumstances shall an electrical contractor install circuit breakers or fuses in a network pillar or pit. Where additional active terminals are required they shall only be fitted by the Network Operator.

12.6.9.9 Testing
Customer installations connected to a Network Operator’s distribution network shall be tested in accordance with the requirements of AS 4741 and the test results recorded prior to that portion of the network or customer’s installation being energised.

Dependant on the specific requirements of an individual Network Operator, testing of connections completed by non-network personnel must be either witnessed or the test results logged using data recording instruments as specified by that Network Operator. For specific requirements pertaining to network “Service Apparatus Connections Scheme” and “Contractor Connect” Schemes please refer to the appendices at the rear of this Manual or to the Networks Operator’s Website.

12.6.10 Minimum insulation resistance
The insulation resistance between conductors and between conductors and earth of consumer’s mains shall comply with the minimum requirements of AS/NZS 3000.

12.6.11 Notification
Where an electrical contractor or their authorised representative completes the termination of consumers mains, the contractor shall provide the Network Operator with details of the point of supply as described in WAER Clause 3.5.2, and the location of the pillar or network pole, linkage to site meters, meter numbers and the installation address.

12.7 Protection
12.7.1 Service protection devices
For specific information regarding the installation requirements for meter protection and service protection devices please refer to the WAER and Sections 11 and 14 in this Manual.
12.8 **Cable ducts and conduits**
Ducts and conduits installed for the purposes of providing access for customer or network cables dependent on the cable’s function and location shall be installed in accordance with the relevant Network Operators requirements (Refer to clause 6.9)

12.9 **Labelling**
Clause 3.5 of WAER specifies that in addition to the requirements of AS/NZS 3000, consumer mains, switchboards and external customer electrical equipment shall be labelled to identify the origin or destination of its supply source.

Labels shall be made of non-conducting material, able to withstand ultra violet radiation, extreme weather and vandalism. They shall be indelible, durable, legible and suitably secured.

12.10 **Underground conversion**
To ensure that delays are not experienced when seeking to facilitate a changeover from an overhead service cable connection to an underground connection it is recommended that the following steps are taken:

1) The customer or their agent shall confirm the submission of a valid connection application and obtain from the Network Operator a receipt, reference or project number for the application

2) The owner’s agent should liaise with the Network Operator to determine the timeframe for the installation of the point of supply or pillar and date for energisation

3) Once a program of events is known the electrical contractor shall submit a Preliminary Notice, requesting a changeover and appointment to convert the existing overhead supply to underground. (The reference number must be noted on the Preliminary Notice)

4) The Network Operator will facilitate the arrangements for changeover or conversion

5) Prior to the allotted date the electrical contractor shall complete the installation of the new consumer mains (see Clause 12.6.9)

6) The electrical contractor in conjunction with the Network Operator crew shall facilitate the changeover inclusive of the
   a) removal of the existing overhead service cable by the Network Operator
   b) Subject to level of authorisation and where required the EC shall install the network meter

7) Following energisation of the new underground point of supply the electrical contractor shall complete the connection process in accordance with their level of connection authorisation and then submit the relevant notices

8) Fees will be applied where the Network Operator is required to fit the meter and complete the connection of the consumer mains for the installation.

12.11 **Special LV supply arrangements**

12.11.1 **Standby/emergency supply**
Customers may install a temporary standby/emergency power supply subject to compliance with these requirements and the WAER.

12.11.2 **Common loads**
Two customers may provide separate supplies to a common load such as a bore installed on the property boundary. Wiring shall be arranged so that only one supply can service the load at any one time and the two supplies cannot be interconnected. Refer to Section 9 of the WAER for further information.
12.11.3 Short term events
On application to the Network Operator a temporary supply arrangement for a fete, concert, exhibition or similar open-air short-term event, may be provided via a connection to the distribution network subject to that portion of the network having sufficient capacity.

The organisers shall arrange for an electrical contractor to assess the maximum demand and submit a Preliminary Notice to the Network Operator.

If the demand is such that supply cannot be obtained from a permanent supply point on the property, the Preliminary Notice should request a short-term supply, indicate the estimated maximum demand and state the period for which supply will be needed.

If it is proposed to use temporary on-site generators, either to supply the entire demand or to supplement a Network Operator supply, this shall be noted on the Preliminary Notice.

If the event is held outside an area served by a Network Operator, the Preliminary Notice must be submitted to EnergySafety.

The electrical installation shall comply with these requirements, WAER, AS/NZS 3000, AS/NZS 3002 and applicable legislation, codes and related Australian Standards.

Extreme care shall be taken not to create an electrical hazard from two points of supply at one location/site. Where two points of supply are present, the requirements of WAER Clause 3.6 shall be applied.

12.11.4 Builders supplies
It is a requirement of the Occupational Safety and Health Regulations 1996 (Regulation 3.65) that where “it is practical to do so, that by the time the work on the site has reached plate height or the equivalent, electricity has been supplied to the site from a supply authority's service cable or service cable by way of a temporary or permanent connection”.

In addition to these requirements temporary power supplies shall be installed in accordance with the relevant legislation, Standards and Codes including but not limited to WAER, AS/NZS 3000 and AS 3012.

Subject to the availability of suitable network distribution system near the construction site and any specific local requirements, a customer may request a temporary power supply connection via one of the following options:

- Underground portable builder’s supply pole and switchboard
- Temporary independent construction switchboard
- Permanent switchboard and meter position
- Overhead customer pole and switchboard
- Temporary low voltage frame connection

Additionally the use of electricity on construction sites must comply with statutory requirements administered by EnergySafety and WorkSafe WA including but not limited to the protection of circuits by RCDs, testing of protective devices and tagging of electrical equipment.

Only one temporary power supply connection may be made to a point of supply on a lot. Multiple temporary points of supply are not permitted. All site power must originate from the one customer switchboard connected to the point of supply and shall not cross into an adjoining lot.

To avoid the existence of multiple points of supply to a site the temporary supply shall be disconnected at the time of connection of the permanent supply, unless prior arrangements have been made by the customer for the retention of the supply and appropriate safety procedures as specified by WAER in Sections 3.6 and these requirements are implemented.

An Inverter Energy System must not be connected to a customers’ installation that is either supplied by or connected to a temporary builders or non-permanent electricity supply.
12.11.4.1 Portable builder's supply (stub) pole
This type of supply generally consists of network service and metering equipment, together with customer equipment and power outlets, installed in an enclosure mounted on a steel post. The pole and enclosure must be located inside the customer's property boundary, adjacent to a network service pillar outside the pillar exclusion zone.

The supply pole may be moved from site to site by an approved electrical contractor as and when required. Construction of portable builder supply poles and approval to operate this type of temporary supply service is subject to prior Network Operator approval. The Scheme's eligible criterion has been upgraded, now requiring all operators to be Contractor Connect approved. For details of the Scheme refer to the Clause 6.18.

12.11.4.2 Temporary, independent switchboards
Where one or more temporary switchboards are installed for the purposes of supplying temporary construction power, the switchboards must be physically independent of the building or buildings under construction. The main electricity supply to the first switchboard is to be wherever possible fed from a service pillar.

Care must be taken with regard to the position, physical protection, and identification of the switchboard(s) and supply cables to ensure and avoid the creation of electrical hazards or damage during the construction phases of the project.

No part of the permanent electrical installation is to be used for this type of temporary power arrangement or energised prior to the:

- Completion of the building’s basic structure including roof, ceiling and walls
- A Notice of Completion has been submitted for that portion of the work which is to be energised; and
- The temporary supply has been disconnected

12.11.4.3 Use of permanent installation
Elements of the permanent electrical installation may be used to provide a temporary electrical supply for construction purposes, subject to fulfilling the conditions as specified in these requirements. In summary those conditions require:

- Permanent consumer mains and main switchboard, including meters to be installed
- Service and consumer mains cable routes identified in accordance with WAER and AS/NZS 3000
- Point of supply and main switchboard to be clearly identified as being “Live”
- Individual construction supplies shall originate from one or more socket outlets installed on the main switchboard
- Use of permanent electrical installation and circuits to supply temporary power is not permitted however it is acceptable to install a temporary sub-main to an external temporary construction switchboard from the permanent main switchboard
- Any temporary wiring to be physically and electrically isolated from the permanent electrical installation
- Any exposed portion of the live permanent electrical installation to be protected from the adverse effects of construction activity and environmental influences (enclosed)
- Any electrical work either temporary or permanent shall be carried out with the supply switched off and secured
- Permanent installation is not energised until the building work reaches practical completion or is secure and has been checked and tested
- Submission of a Notice of Completion for the portion of the work to be energised in accordance with the Electricity (Licensing) Regulations 1991.
12.11.4.4 Customer pole and switchboard in an overhead area

In limited situations the Network Operator may provide a temporary overhead connection to a temporary consumer pole for the purposes of providing a temporary power supply. The pole and switchboard construction and installation shall be as prescribed in these requirements.

12.11.4.5 Temporary low voltage frame connections

Subject to receipt of a customer’s formal application, a Network Operator may permit the connection of a temporary power supply to a low voltage network distribution frame for the purposes of supplying temporary power to a construction site. The temporary supply shall be:

- As prescribed by the appropriate standards including but not limited to WAER, AS/NZS 3000, AS 3012 and these requirements;
- Via a consumers mains cable rated to the connected LV frame circuited protection and AS 3008
- Through a SPD with a kA rating equal to or greater than the network fault rating for single network transformer configuration
- Connected (disconnected) to the LV frame by Network Operator personnel
- Such that no second or multiple point(s) of supply are created to the lot

12.11.5 Un-metered supplies

An un-metered connection and supply is available to specific customers subject to the conditions and requirements as detailed by the Network Operator.

The customer is responsible for ensuring that the Network Operator’s criteria are met and for providing formal acknowledgement of their compliance and acceptance of the Network Operators terms and conditions.

An un-metered supply (UMS) may be provided for customer’s electrical equipment or device where the following criterion is satisfied:

- The energy usage is consistent and can be readily estimated
- The customer’s equipment or device requires a single phase connection where the maximum load does not exceed the Network Operators limits of either 1.0 kW or 4.8 kW
- The load is not subject to customer controlled variations (i.e. water pumping or air conditioning)
- The required supply is not of a short duration (i.e. fetes, fairs and festive lighting)
- The point of supply for the customer’s equipment/device is installed on public land or within a road reserve
- The customer’s equipment/device is on the same side of the road, visible from and no more than 25 metres from the designated point of supply
- The consumer’s mains cable supplying the customer’s equipment/device is installed underground
- Each un-metered supply is effectively labelled in accordance with the requirements of WAER, AS/NZS 3000 and the Network Operator’s requirements
- It is not physically practical or commercial viable to install a meter (optional)

12.11.5.1 Horizon Power requirements

For further information and guidance on Horizon Power’s requirements please refer to their Unmetered Supply Policy.

12.11.5.2 Western Power requirements

Western Power has published the Un-metered Supply Guideline which outlines the criteria to be met and defines the required network standard together supply terms and conditions.
12.12  **Horizon Power section references**
The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either go to the related clause or the identified online link.

12.12.1  **Summary**
For further information and guidance on Horizon Power’s requirements for
- Ground mounted equipment
- Termination requirements
- Cable ducts and conduits
Phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

Additional cable entry and termination detail can obtained from Distribution Construction Standard, and Distribution Design Catalogue.

Horizon Power has published an [Unmetered Supply Policy](#) which outlines the criteria to be met and defines the required network standard together supply terms and conditions.

12.13  **Western Power section references**
The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either go to the related clause or the identified online link.

12.13.1  **Summary**
For additional information relating to the installation of or location of Western Power ground mounted equipment, refer to the policy document [Locating Ground Mounted Equipment](#) or contact the relevant Western Power Project Construction Manager.

Additional cable entry and termination detail can obtained from Western Power’s [Distribution Construction Standards Handbook](#), Distribution Customer Connection Requirements, Distribution Design Catalogue and [Distribution Substation Plant Manual](#)

Western Power has published an [Un-metered Supply Guideline](#) which outlines the criteria to be met and defines the required network standard together supply terms and conditions.
Distribution Connections Manual

Section thirteen

High voltage distribution supply
13 High voltage distribution supply

13.1 Scope

This Section of the Manual, details the requirements for the connection of a customer’s electrical installation at distribution voltages up to and including 33 kV. These connections types are dependent on a range of factors including but not limited to operational tariffs, network availability/access and customer load characteristics/requirements.

The intent of this Section is to ensure that a customer’s high voltage installation:

- Utilises equipment that is fit for the purpose
- Is safe for operational personnel and not hazardous to members of the general public
- Operates in a manner that does not adversely affect the distribution network or other users connected to the network
- Is maintained in accordance with the Safety Guideline and these requirements

The customer shall appoint appropriately qualified and skilled person(s) who shall be responsible for the design, construction, commissioning, operation and maintenance of the HV installation. Switching and maintenance of high voltage installations must only be undertaken by persons trained, qualified and skilled to do so. (Refer to Clause 13.12.6.).

Customers to be supplied at transmission voltages of 66 kV and above are outside the scope of these requirements. The relevant Network Operator should be contacted for assistance and information regarding connections at transmission voltages.

The requirements in this Section are to be read in conjunction with the WAER, “Guidelines for the Safe management of high voltage electrical installations” (the Safety Guideline), AS/NZS 3000, AS 2067, these requirements and shall be applied to all new installations including alterations and additions to existing installations.

13.2 Responsibilities and contractual arrangements

Customers requiring a new or increased network supply at high voltage are required to enter into a:

- Formal contract or agreement with the customer’s Electricity Retailer
- Specific connection agreement or contract with the relevant Network Operator.

The provision of a high voltage connection will depend on:

- Supply network availability and constraints
- Compliance by the customer with
  - Regulatory requirements including but not limited to the Safety Guideline
  - The Network Operator’s engineering requirements, operational procedures and applicable management plan(s)
- Acceptance by the customer of any direct costs including fees, deposits, charges or capital contributions as required by the Network Operator
- Generation capacity at stations within the NIS network
- The location of the connection in relation to an Electrical License Area Boundary (ELB)
- Acceptance by the customer of any indirect or ongoing costs associated with:
  - Transformer energy losses
  - Purchase of high voltage operational, testing and maintenance equipment that ensures the safety of personnel and the installation
  - Provision of spare equipment
  - Insurance, interest and depreciation
  - Ensuring that the high voltage installation is adequately maintained and repaired to ensure any malfunction does not create a safety hazard or cause interference to the electricity supply network
Where the proposed new supply arrangement includes generation or co-generation systems, then a separate application for the generation component is required inclusive of supply and generation protection arrangements, load and generation details and contract conditions.

For existing supply arrangements an application is required where:

- a load increase is proposed
- the proposed load(s) exceed the existing contract or agreement
- an electrical installation is proposed that incorporates the addition of generation, grid connected inverter, co-generation, or alternate source/point of supply
- supply negotiated and allocated to a developer is less than the proposed load(s); and
- extra phases or capacity to an electrical installation is sought or the proposed type of supply is not available

13.3 Customer expenditure
The customer should not incur any equipment, construction or installation expense until an application has been lodged and formal response received from the Network Operator advising on the availability of a suitable HV supply, point of supply together and any conditions relating to the provision of that supply.

This requirement also applies to existing installations where alterations or additions dictate, augmentation of the distribution network or modification of the point of supply.

13.4 Supply parameters
The Network Operator will negotiate the type of supply and the voltage of supply with regard to the proximity of its low/high voltage distribution network to the customer's requested point of supply and the nature of the customer's load. The Network Operator will nominate the supply voltage during connection negotiations.

Where a customer supplied transformer is connected to a Network Operator's distribution system, the transformer's voltage tappings should be the same as those specified for the distribution network. This will enable the customer's electrical installation's voltage level to mirror those available from the distribution network.

13.4.1 Individual network parameters

13.4.1.1 Horizon Power
Connections to Horizon Power's high voltage distribution networks will be either at 6.6 kV, 11 kV, 22 kV, 33 kV at 50 Hertz (cycles per second). The customer is required to contact the local Regional Office to determine the type of supply available.

13.4.1.2 Western Power
Connections to Western Power’s high voltage distribution network will be at either 22 kV or 33 kV at a nominal frequency of 50 Hertz (cycles per second).

High voltage distribution networks at 6.6 kV and 11 kV are semi-redundant and limited to systems in and around the Perth and Fremantle CBDs. Connections at 6.6 kV and 11 kV in these areas are still permitted and shall comply with these requirements.

13.5 Connection arrangements
The normal supply arrangement will be via a single high voltage feeder and Point of Supply (PoS) to the customer's property including customer developments on one or more adjacent titles or a multi-tenanted developments, whether it be a staged development or not.

Property owners or customers with multiple PoS, will generally be required to rationalise these PoS to one point when a major upgrade or addition to the installation is undertaken. This also applies where properties with individual PoS are combined into one development.
The customer is required to pay all costs associated with the provision of the PoS. Agreement shall be reached on the PoS arrangements with the Network Operator before any work is commenced.

The customer’s high voltage installation shall commence at the PoS, which will be the connection point agreed between the customer and the Network Operator. Typically the PoS may be taken as being one of the following:

- Bus sectionaliser or isolator load terminals within a Network Operators HV switchgear assemble for an indoor ground mounted substation
- Isolator load terminals within the Network Operators HV switchgear and metering unit for outdoor ground mounted substation
- Load terminals of the Network Operator’s overhead switch and metering unit
- HV terminals as nominated in the access agreement
- As otherwise determined by the Network Operator.

Dependent on the nature of the customer’s load and security levels, the Network Operator may provide an additional high voltage feeder to the PoS. Provision of an additional feeder to the PoS is subject to:

- Magnitude of the customer’s load
- Position/location of the distribution network in relation to the customer’s load
- Access arrangements for network and customer personnel
- All operational and safety concerns have been addressed
- Appropriate electrical and mechanical systems being implemented to ensure compliance with the Network Operator’s requirements for paralleling of high voltage feeders

13.5.1 Control of incoming HV supply

As a minimum, the electrical installation must have a single main switch for each incoming supply. The main switch or switches shall be fitted with a protection system which is compatible with the Network Operators HV protection system. Refer to Clause 13.9 for details of equipment requirements.

13.5.1.1 Paralleling of HV supplies

Where it is agreed and is technically feasible, Western Power may permit paralleling of their high voltage feeders, to allow for the transfer of or switching from one feeder to the other without interrupting the customer’s supply.

Such arrangements are subject to the installation of additional protection at the substation and the customer’s installation which shall be at the customer’s expense.

Paralleling of high voltage feeders is not permitted on Horizon Power networks.

13.5.2 Back-feeds

Where the possibility exists within a customer’s electrical installation for current to back-feed into the distribution network or for earth potential rise, then appropriate steps shall be taken by the customer to prevent such occurrences. The customer shall provide detailed information in the customer’s HV submission as to how it is proposed to prevent such occurrences.

13.5.2 Power factor correction

Significant benefits can be gained by improving the power factor of the customer’s electrical installation include reduced electricity costs, increased plant load capacity and utilisation including improved voltage regulation.

Improvement of power factor can be achieved by the installation of capacitors, however where incorrectly installed, serious problems may arise such as overcompensation, generation of excessive harmonics, or creation of over voltage transients. These problems can affect the quality of the electricity supply, both in the customer's installation and in the installations of others.
Compliance is required with the relevant parts of AS/NZS 61000 Electromagnetic Compatibility (EMC) with respect to harmonic limits and voltage fluctuation limits during steady state operation and switching conditions.

The customer should allow for power factor correction equipment in the initial design to ensure correct maintenance of power factor at all metering points is in accordance with these requirements.

Power factor correction proposals shall include a single line diagram, calculations and other documentation to demonstrate compliance with these requirements. The information submitted must include:

- Equipment ratings
- Capacitor switching step sizes
- Harmonic current and voltage content at the PoS
- Natural resonant frequency of the installation
- Magnitude and duration of inrush currents and transient voltages during switching
- Details of any capacitor protective devices

Power factor correction installations shall be designed to prevent motor self excitation to ensure that back-generation into the HV network does not occur. All capacitors shall be independent self discharging (not via fuses), and shall be provided with appropriate earthing facilities in accordance with AS 2067 or as directed by the Network Operator.

Switchgear used for capacitor bank fault breaking/making, switching and isolation may have a more onerous duty cycle than that used on general circuits, and therefore shall be suitably rated for capacitive currents, fault levels, and possible associated over voltages.

All power factor correction equipment shall comply with relevant Australian Standards with an appropriate allowance for over voltages and over currents due to harmonics, resonance and power factor.

Designers of the power factor correction equipment should also consider harmonic levels created by the installation itself or which may exist in the distribution network. Such harmonics may harm the capacitors, and the capacitors should be protected by suitable harmonic blocking.

The use of power factor correction without detuning reactors can increase the risk of damage from harmonics and the incidence of litigation from other customers. Although detuning reactors may not completely nullify these effects, they may assist in significantly reducing the risks.

Switching and fault isolation equipment shall operate on all phases simultaneously.

**13.5.2.1 Fault isolation**

Protection schemes that rapidly detect and isolate faults in the power factor correction installation so as not to adversely impact on the network should be used. Phase voltage imbalance protection across the capacitors shall also be provided.

**13.5.2.2 Resonance mitigation**

Appropriate measures shall be employed to avoid resonance within the network and to limit in-rush currents. These measures may include de-tuning reactors and resistors. The impedance values of this equipment shall be provided with sufficient adjustment capability (for example, ± 20%) to cater for future network impedance changes that may arise from transformer tap changes or network feeder changes.

To prevent ferro-resonance, all HV switching must incorporate three phase ganged switches.

**13.5.2.3 Switching steps**

On LV circuits, automatic control of capacitors shall not exceed 50 kVar steps. On HV circuits the allowable step size will depend on compliance with power quality limits.
13.5.2.4 Labels
Prominent labels advising customer and Network Operator personnel of the correct application method and discharge time duration to avoid electrical hazard shall be provided.

13.6 Conversion from low voltage to high voltage supply
Customers wishing to convert a low voltage supply to high voltage must negotiate the terms, conditions and method of connection with the Network Operator before finalising the installation’s design, HV Submission, purchase of any equipment or commencement of construction.

The conversion of a customer’s supply to high voltage may involve the transfer of ownership of network assets or may require the modification of existing high voltage equipment to comply with current electrical technical or safety standards. Options to be considered should include the following:

- Replacement of the Network Operator’s substation and other assets or purchase of this equipment, and
- Any costs associated with converting the installation for compliance with applicable standards

13.7 Installation design and submissions

13.7.1 Preliminary information
Considerable planning time may be necessary for the Network Operator to assess and implement required augmentation or extensions of their distribution system to accommodate the proposed high voltage installation. This is particularly so where the proposed load is large or is located in a remote and un-reticulated area.

The customer, at the earliest possible opportunity, is required to provide the following preliminary information to the Network Operator and advise their nominated Retailer of their need for a high voltage supply:

- A single line diagram of the proposed installation
- An overall site plan showing the location of the HV equipment
- The preferred point of supply (in the case of a new installation)
- Existing point(s) of supply (in the case of an altered or upgraded installation)
- The anticipated cumulative maximum demand (MVA) required for the whole installation inclusive of all new or upgraded elements of the connection
- Cumulative capacity and type of all proposed on-site generation
- Any disturbing loads (e.g. large motors, arc furnaces, etc.)

Before preparing a full HV submission the customer’s agent should obtain from the Network Operator details of the availability and electrical characteristics of the network including generation capacity, to avoid issues arising from designs or equipment being found by the Network Operator to be unsuitable for connection.

13.7.2 Submission and design (HV submission)
Where the Network Operator has agreed in principle to supply a new, altered or upgraded high voltage installation and or connection, the customer’s agent is required to lodge a detailed HV design proposal, commonly called an “HV Submission”. The HV Submission shall contain detailed information for the complete HV installation both new and existing so that a comprehensive understanding of the customer’s requirements can be considered.

The following sub-clauses have been developed to assist and guide electrical consultants and industry though the HV Submission process. These requirements are applicable for all connection applications in the range of 1 kV to 33 kV. For supply connections at voltages greater than 33 kV inquiries should be directed to the Network Operator.
13.7.3 **Standard format for submission of a HV proposal**

In general, the following standard information is required for all Submissions.

- **A cover page** including the project name, the Network Operator reference number, the name of the person who has prepared the submission and the name and membership details (number) of the professionally qualified electrical engineer who has certified the submission.
- **A synopsis of the project** including a brief description of the project including proposed load requirements.
- **The body of the submission** addressing all items identified in this clause. Should an item not be relevant (for example fuse protection details when a circuit breaker is to be used) then this must be explicitly noted in the submission.
- **Any necessary appendices** including operational procedures, maintenance schedules, drawings, protection grading curves and equipment data sheets.

It is a Network Operator requirement that a customer’s HV Submission be submitted using one of the following two methods. Option 1 is the preferred method for delivery and lodgement. HV Submissions must be forwarded in their entirety and certified by a professionally qualified electrical engineer. All documents must be certified and submitted even if previously supplied to the Network Operator.

13.7.3.1 **Option one electronic submission**

The completed Submission, including related appendices should be lodged via email to the designated Network Operator Project Manager assigned to the project. The following file formats are the only acceptable methods for submission.

- Acrobat (PDF)
- MS Office compatible

Unless prior approval has been granted by the Project Manager, any submission that does not comply with these formats will not be accepted and assessed.

13.7.3.2 **Option two hardcopy submission**

Where the customer’s agent elects to prepare a hardcopy submission, it is to be lodged in the following format:

- Submit three (3) copies of the proposal to the Network Operator
- The entire submission must be securely fastened and suitable for scanning
- Unless otherwise approved the maximum page size shall be no greater than A3

It should be noted that hardcopy submissions generally take longer to process and assess than submissions submitted electronically.

13.7.4 **HV submission outline**

The following outline is to be read in conjunction with the WAER and the Safety Guideline. A customer’s HV installation must be designed by persons with engineering competence and qualifications with a practical understanding of the effects of voltages in excess of 1 kV, high load implications and fault currents.

The HV Submission shall be certified by a professionally qualified electrical engineer and submitted to the Network Operator for consideration, before equipment is purchased and any construction commenced. The following details are to be included in the submission.

13.7.4.1 **Site plan**

A locality plan shall be included, specifying the address of the installation and a geographic layout of major plant items including main switch room, metering equipment, generating units and point of supply.
13.7.4.2 Single line diagram
A single line diagram showing all the principal components, detailed information on voltage levels, protection devices, earth switches, switching operations, winding configurations and fault level gradients. The diagram must show the delineation between Network Operator equipment and the proposed customer’s equipment.

13.7.4.3 Load details
The submission must include system voltages, load details, maximum demand, load characteristics, power factor correction measures, large motor starting information and details on other disturbing loads or special requirements.

The submission must also include information on duty cycles for large items of plant and the expected operating regime for the installation. Details of disturbing loads must be shown including calculations for voltage fluctuations and total voltage harmonic distortion caused by the customer’s installation.

Any disturbance to the network must meet the standards stipulated by the Network Operator including but not limited to power quality and general operational conditions for individual customers.

13.7.4.4 Protection and control of incoming supplies
The design submission must include details of fault levels assigned throughout the installation with calculations of the protection relay settings. General information on the protection equipment to be installed shall include:

1) A control and protection schematic diagram of the incoming circuit protection(s)
2) Proposed location
3) Type of protection including make and model number
4) Rated voltage and current
5) Rated insulation level (lightning impulse withstand level)
6) Minimum clearances in air - between phases and to earth
7) Type of closing mechanism;
   a) Whether trip free or fixed trip and with lock–out preventing closing
   b) Rated supply and /or pressure of closing mechanism
   c) Details of any interlocking systems

In addition to the general detail requirements if the main switch is one or more HV switch-fuse units the submission must confirm:

8) Rated short circuit making and breaking current of the fuses
9) Current-time characteristic curves

In addition to the general detail requirements if the main switch is a circuit breaker or re-closer the submission must include:

10) Details of protection relays used, including:
    a) Make and type
    b) Setting range
    c) Characteristic curves drawn for the selected settings
    d) Thermal ratings of input circuit
    e) Tripping and control supply details

11) Protection current transformer details including:
    a) Make and type
    b) Primary and secondary current rating
    c) CT class
    d) Short time rating
12) Length and size of secondary circuit wiring or confirmation that total secondary impedance (including wiring impedance) does not go above the maximum secondary impedance that can be driven at the stated CT accuracy.

Where batteries are used to operate the circuit breaker’s trip mechanism, details shall also be provided on:

13) Automatic charging equipment
14) Battery-condition indicators
15) Under voltage alarm

Note: CTs which utilise primary voltage tappings for ratio changes or CTs located within a transformer tank or bushings are not accepted. Additionally it is preferred that CT for overcurrent protection is located on the supply side of the circuit breaker.

The submission must also demonstrate safe grading with the Network Operator’s upstream protection as per Clause 11.6.4. Both the Network Operator and the customer protection equipment time current curves shall be plotted and show that grading is achieved.

13.7.4.5 Next line of protection

The submission must include all protection details inclusive of the Network Operator’s settings for their protective equipment which is available from the Project Manager assigned to the project. Both the Network Operator and the customer’s time current curves must be shown to illustrate that upstream and downstream grading can be and is achieved. Refer to Clause 11.6.4

Note: Protection settings shall be provided to the Network Operator before energisation. Any subsequent change must be provided to the Network Operator before the change is implemented.

13.7.4.6 Voltage transformers

Voltage transformer details shall include as a minimum:

1) Make and type
2) Rated transformation ratios
3) Primary voltage rating
4) Secondary voltage rating(s)
5) Type classification and category of performance
6) Rated output and burden
7) Accuracy class or classification
8) Rated voltage factor and rated duration
9) Primary connections and secondary winding configuration

13.7.4.7 Current transformers

Current transformer details shall include as a minimum:

1) Make and type
2) Rated transformation ratios
3) Primary current rating
4) Secondary current rating
5) Type classification and accuracy classification
6) Accuracy limit factor
7) Rated burden
8) Primary connections and secondary winding configuration

13.7.4.8 Metering

The metering arrangement is to be discussed with the Network Operator with details of the Network Operators requirements to be included in the Submission.
13.7.4.9 Earthing system

The customer’s earthing system must be designed and installed in a manner that ensures compliance with the Network Operator’s technical requirements and where specified the relevant Australian standards including but not limited to AS 2067 and AS/NZS 3000. The Submission must provide details of customer’s installation earthing system with accompanying schematic arrangements.

13.7.4.10 High voltage motors

Details that are to be included in the submission shall include:

1) Manufacturer
2) Type of motor(s) and if induction type motor – cage or wound rotor
3) Rated power (kW or HP)
4) Rated voltage
5) Rated current
6) Method of starting to be employed
7) Frequency of starting
8) Starting torque in terms of the rated load torque and the maximum starting current which may be taken from the supply with the starting apparatus in the circuit
9) If thyristor control equipment is proposed then details relating to the harmonic current generation

13.7.4.11 Transformers

It is recommended that power transformers be purchased in accordance with the Network Operator specifications to ensure compatibility with Network Operator’s HV equipment. Therefore submission must include details of the following:

1) Manufacturer
2) Rated voltages and tapping range
3) Oil Capacity
4) Noise rating (db)
5) Rating (kVA)
6) Lightning impulse withstand level
7) Vector group symbol
8) Insulating medium
9) High voltage winding and earthing configuration
10) Types of connection

13.7.4.12 Generators

Details that are to be included in the submission shall include:

1) Manufacturer
2) Type of generator
3) Rated output
4) Rated voltage
5) Rated current
6) Synchronous, transient and sub transient reactance. (if generator is connected to the supply system through a solid state inverter indicate three phase short circuit current at output side of inverter)
7) Generator neutral earthing system
8) Type of excitation
9) Voltage regulation
10) Speed regulation
13.7.4.13 Underground Cables
Details that are to be included in the submission shall include:

1) Manufacturer
2) Voltage designation
3) Number of cores
4) Conductor material, size of all active neutral conductors
5) Type of insulation
6) Construction details
7) Type of terminations proposed
8) Fault withstand rating of core and screen
9) Proposed method of installation including mechanical protection
10) Earth screen details for each end of any incoming supply cable.

13.7.4.14 Overhead lines and supports
Overhead lines and their supports shall be designed and constructed in accordance with the AS/NZS 7000 and the Network Operator’s guidelines and requirements. Details to be included in the submission shall include:

1) Asset design life
2) Wind region
3) Selected line security
4) Ambient temperature
5) Maximum operating temperature
6) Type of conductor Conductor’s stringing tension
7) Ground line profile
8) Loading vs. capacity assessment on overhead line components
9) Line simulation (i.e. ground clearance, phase-to-phase clearance, etc)
10) Equipment and pole labelling conventions

13.7.4.15 Conforming technical standards
Contained within the submission must be a complete list and description of the specific technical standards to which the installation and associated equipment will conform.

As a part of the submission the certifying professionally qualified electrical engineer shall certify that the HV design and proposed installation conforms and complies with the applicable Regulations, Codes, Standards and Network Operator requirements.

13.7.4.16 Commissioning of protective device
The customer shall provide an estimated date for the preliminary commissioning of the protection devices.

13.7.4.17 Installation commissioning and supply availability
The customer shall provide an estimated timeframe and date for connection and energisation of supply including an indication of the nature (temporary or permanent) of the supply. If the supply is temporary, the submission should indicate the size of the temporary supply (where less than the permanent supply) and the date the permanent supply is required. The permanent supply date should be realistic and cognisant of the supply configuration and work required for its provision.
13.7.4.18 Environmental
Dependant on location and requirements of the relevant state and local government authorities the customer may be required to undertake environmental impact studies.

Where required by the Network Operator, the applicant shall provide details of equipment oil capacities and noise levels to permit an analysis of proposed control and containment measures or determination of site location restrictions and requirements.

The placement of transformers is to be in accordance with:

- These requirements and applicable Network Operator technical requirements for substations and underground distribution schemes including:
  - Horizon Power’s: - Distribution Design Rules.
  - Western Power’s: - Distribution Substation Plant Manual.
- Underground Distribution Schemes Manual
- Applicable legislation including but not limited to Western Australian Environmental Protection (Noise) Regulations 1997.

Note: For specific network environmental mitigation requirements refer to the relevant Network Operator

13.7.4.19 Operational procedures and equipment maintenance
The submission shall include the name of the person who will be responsible for the operation of the installation together with a synopsis of how the customer intends to prepared, deliver, implement and maintain the required operational procedures.

The customer is required to establish detailed operational and maintenance manual(s) in accordance with the WAER, the Safety Guideline and the relevant Australian standards (refer to AS 2467). For additional information refer to Clause 13.12

13.8 Applications and connection process
Typically a network impact assessment of an electronic HV Submission takes approximately four weeks from the date of lodgement. Cost estimates will depend on the complexity of the project, installation construction schedules and the type of equipment to be installed. For further information pertaining to the connection process and for details of the required application forms please refer to Section 7 of this Manual.

13.9 Equipment

13.9.1 Equipment requirements
The supply type, voltage, protection, earthing and metering arrangements of a customer’s high voltage installation must comply with the applicable regulations, codes of practice, guidelines relevant standards and aligned with the Network Operator’s connection requirements. Prior to placing orders for equipment, the customer must discuss the installation’s protection requirements with the Network Operator. The short-circuit current which may occur in an installation is dependent upon:

- The prospective fault level at the point of supply
- Any contribution which may be made by large rotating electrical plant connected within the installation
- Impedances within the installation

Unless otherwise advised in writing, the customer shall install high voltage switchgear, transformers, conductors, associated equipment and earthing systems that satisfy minimum fault level requirements and be capable of withstanding the maximum fault current which may be imposed for the duration of at least one second and in some instances for three seconds. Refer to Clause 10.6 for fault level details.
The protection equipment and control schemes associated with the customer’s installation shall be maintained and tested for correct operation in accordance with the WAER, the Safety Guidelines and the Network Operator’s instructions.

13.9.2 Substation installation requirements

Typically any low voltage supply over 250A in the metropolitan area will require the connection to or installation of a substation. For country areas outside town centres and towns within the NIS, a substation will be required in most situations. Section 14 of this Manual describes the requirements and customer responsibilities for the installation of a new or modified/upgraded substation.

13.9.3 Main switch or switches

An electrical installation must have a single main control for each incoming supply.

The main switch at the main switchboard must isolate both the consumer's installation and the generation supply(s) from the Network Operator's high voltage distribution system. As a minimum the main switch or switches shall consist of an automatic circuit breaker capable of making and breaking the minimum and maximum prospective fault currents on all three phases and equipped with earth fault and over-current protection. The main switch or switches shall be:

- Located in accordance with the Network Operators technical requirements and as near as possible to the customer’s point of supply
- Positioned after the metering transformers
- Readily accessible to the Network Operator and customer authorised personnel
- Able to operate simultaneously in all active conductors
- Able to be locked in the open position. The locking device(s) must be capable of accepting the Network Operator’s locking system

The customer’s protection device(s) and HV main switch(s) shall be fitted with a protection system which is compatible with the HV network protection system and grades with the Network Operator’s protection device(s).

Where more than one high voltage supply is provided to a customer, the main switches shall be interlocked in such a manner that paralleling of the high voltage supplies shall not be possible unless agreed to by the Network Operator.

Single or multiple switch fuses, fitted with three phase tripping and operating in all phases simultaneously, may be used to protect and isolate individual transformers where the transformer rating does not exceed 1 MVA.

Alternatively the Network Operator may approve the use of single or multiple switch fuses, reclosers or pole-top switches with fuses for smaller HV installations subject to network compatibility and appropriate fault level limitations.

13.9.4 Circuit breakers

All circuit breakers shall be fitted with at least three phase over current and earth fault protection that incorporates three phase tripping (lockout) as a minimum. The Network Operator may require more complex protection arrangements, in particular cases to meet acceptable protection performance criteria and required protection performance levels. It is preferred that current transformers for over current protection be located on the supply side of the main circuit breaker.
13.9.5 Protection settings
The customer’s protection systems shall be designed to coordinate with the HV feeder protection. The settings applied to the protection relays shall discriminate with the Network Operator’s protective equipment to ensure that, for faults in the electrical installation, the customer’s circuit breaker operates before the HV network protective equipment. The customer is required to contact the relevant Network Operator for the required settings.

Feeder protection settings may be changed from time to time. Customers with an HV supply will be advised of any permanent changes. It is the customer’s responsibility to ensure that correct coordination with HV feeder protection settings is maintained after being advised of the changes by the Network Operator. The Network Operator will not be responsible for any costs incurred in making such changes.

Any modification or change to the agreed customer installation protection settings or equipment shall be subject to the acceptance of the Network Operator prior to any change, and protection setting points shall be labelled accordingly.

Protection settings and equipment shall be subject to the acceptance of the Network Operator prior to commissioning.

The customer shall test the main protection system at the time of commissioning the installation and certify that the performance and protection settings, meet the design parameters. Details of the current HV feeder protection settings can be obtained from the Network Operator. Refer to Clause 11.6.4

13.9.6 Cabling
13.9.6.1 Underground
Selection of cable sizes, types and termination methods shall be undertaken in consultation with the Network Operator. Cable selection should take into account the possibility of future load growth and be adequate for the maximum prospective fault level. The high voltage underground cables shall be installed in accordance with the Network Operator’s requirements.

- **Horizon Power** cable installations - Cables installed within NIS areas shall be termite protected and shall comply with Underground Cable Installation Manual.
- **Western Power** cable installations - Underground cable installations within the SWIS shall comply with the Underground Cable Installation Manual.

After installation and before activation, the cables shall be tested in accordance with the relevant industry standards/Network Operator requirements and certified by the customer’s agent for service.

13.9.6.2 Overhead lines
Overhead lines and their supports shall be designed and constructed in accordance with the AS/NZS 7000 and the Network Operator’s guidelines and requirements.

13.9.6.3 As constructed drawings
On completion of the cable network the customer shall prepare and make available detailed “as constructed” drawings recording the route, depth of laying/height above ground, type of supports, cable type, voltages and other relevant information for the use by all persons concerned with the operation of the installation and property.
13.9.7 Earthing systems
Installations required to be earthed shall conform to the requirements as prescribed by the Network Operator and Section 14 of this Manual.

The preferred earthing system is the “combined earthing system” where the high voltage and low voltage equipment is earthed to a common terminal bar. If the requirements of the combined earthing system cannot be achieved, then separate earthing systems may be considered following consultation with and approval by the relevant Network Operator.

Earthed primary neutral windings are not permitted on any transformer of the nominal supply voltage. It is recommended that the customer use Delta–Star transformers to comply with this requirement.

Attention should be given to the management of “step and touch” potentials that may occur under earth fault conditions associated with any earthing system installed within a customer’s installation.

Particular attention should be paid to the separation of independent earthing systems and the proximity of earthed infrastructure such as metallic fences, buildings and buried external services so as to avoid the possibility of hazardous step and touch potentials. External services (e.g. water pipes, communication circuits) must be suitably electrically isolated to avoid hazardous transfer potentials. Refer to Clause 12.6.6

13.9.7.1 Communication equipment
Where a telecommunication pit is identified within the 15 m radial zone of an existing HV earth, it is recommended that an early evaluation of the asset in undertaken prior to determine the extent of the hazard. As a minimum the following should be considered:

1) Confirm whose assets existed at the site
2) Perform EPR evaluation
3) Notify Telco (Telstra) of any co-existing assets
4) Evaluation of relocation costs (as provided by Telco)

13.9.7.2 HV power lines, cables and earths in proximity of metallic pipes
Earth Potential Rise (EPR) between the HV earth and metallic pipeline may occur during an earth fault. Alternating current on a HV power line or cable can induce a low frequency voltage (Low Frequency Induction LFI) on a parallel metallic pipeline. This electrical affect can occur on both buried and above ground metallic pipes.

Where HV power lines, cables and earths are to be installed in proximity of metallic pipeline(s), the installer must assess EPR and LFI on the pipeline in accordance with Australian Standard AS 4853 and any design standard specified by the pipeline owner (e.g. Alinta, Water Corporation etc).

The assessment must include the following steps:

1) Perform the required assessment to determine the voltage contour from proposed HV earth.
2) Use the voltage contour distance to request DBYD information.
3) Determine any metallic pipelines and/or appurtenances are within the calculated voltage contour distance.

Where the assessment identifies a hazard then a detailed assessment report shall be prepared and sent to the pipeline owner for approval prior to the commencement of any related construction or installation. Both the assessment report and the approval from the pipeline owner must be provided to the Network Operator for consideration.

13.9.7.3 Metallic fences
All metallic substation fences, doors or enclosures shall be connected to the earthing system and grading ring as prescribed by the Network Operator in accordance with Section 14. Where prescribed by the Network Operator steel reinforcing in the substation floor and walls shall be connected to the common earth terminal bar.
13.9.8 **High voltage metering**

High voltage metering arrangements are to be discussed with the Network Operator during the project design stage. Where high voltage metering is required, the Network Operator will provide a quotation, inclusive of the costs to provide, install and commission the metering equipment.

For general information on HV metering requirements refer to Clause 11.15 of this Manual or for specific project assistance regarding metering, or installation contact should be made with the relevant Network Designer.

13.10 **Electrical installations on public land**

The Network Operator must be contacted prior to consolidating any proposal to install an electrical installation on public/crown land or extending wiring and equipment from an electrical installation into or across public/crown land. (Refer to Clause 6.12)

13.11 **Inspection, testing and commissioning**

On the completion of a new, upgraded or modified installation, the customer shall meet the cost of and arrange for the high voltage installation and all equipment to be tested onsite as prescribed by the WAER, Safety Guideline, manufacturer, applicable Australian Standards including AS 2067 and the Network Operator's requirements.

These tests shall be performed by a competent testing organisation in accordance with the WAER. Test results of all high voltage electrical equipment up to and including the main switch shall be recorded and submitted to the Network Operator prior to supply being made available.

The Network Operator reserves the right to witness testing. The Network Operator may choose not connect the whole, or any part, of a high voltage installation which in the Network Operator's opinion does not comply or is unsatisfactory for connection to the distribution network.

13.12 **Safety**

The customer is responsible for the operation and ongoing maintenance of their High Voltage Installation (HVI), including any switching of the customer’s equipment.

A customer is not permitted to operate Network Operator owned equipment unless expressly mentioned in the Customer Switching Agreement or is directed by the Network Operator.

The customer shall nominate a responsible person to operate and maintain their high voltage installation and establish effective operating procedures/maintenance together with the provision of appropriately trained and authorised operators/personnel. Customer personnel shall be supplied or have access to appropriate safety equipment to ensure the safe operation and performance of the high voltage installation. Unless specifically contracted, the Network Operator will not provide personnel or equipment for such purposes.

13.12.1 **HV operation manuals and safety management plan**

Each customer high voltage installation shall have a set of operational procedures incorporated into their High Voltage Installation Safety Management Plan. The safety management plan shall coordinate with the customers’ maintenance plan.

The procedures and plan shall address, as a minimum, the requirements of the WAER, Safety Guideline, relevant legislation, codes and Australian standards. The following summarises the above:

- Isolation procedures including work permits locking testing and tagging
- Personnel competencies, electrical access and switching authorisations
- Barriers for electrical, mechanical and personal protection
- Access to rotating machines and discharging of deactivated apparatus
- Earthing and short circuit requirements
- Provision and use of personal protective clothing and safety equipment
Training, education and worksite safety briefings
Internal and external communication requirements including emergency personnel and the
Network Operator contact points
Emergency and evacuation procedures.

The customer through their responsible person shall update and maintain the procedures, plans
and related programs and if requested provide copies to the Network Operator and state
government agencies including EnergySafety or WorkSafe.

Additionally the responsible person shall provide a copy of the procedures and plan to each
employee, switching operator or contractor engaged in activities within the HV installation. Each
person in receipt of the procedures and plan shall make themselves fully aware of the requirements
and shall acknowledge an assurance to comply with the requirements.

13.12.2 Access
The responsible person shall ensure 24 hour 7 day access to suitably trained, competent and
authorised High Voltage personnel to undertake switching operations for the purposes of inspection
load shedding, routine maintenance or emergency repair of the incoming high voltage supply cable or
equipment.

The responsible person must provide “access permits” to facilitate the movement and monitoring of all
personnel accessing the electrical installation, to perform work and to ensure all such persons are clear
prior to re-energising the installation.

Customer and Network personnel are required to have the appropriate training, qualifications,
access authorities and consent prior to entering a customer’s or Network Operator’s switch room.

The responsible person must provide, in accordance with their safety management plan, appropriate
barriers that clearly identify isolated, proven de-energised and earthed sections of the high voltage
installation on which work can safely be performed.

13.12.3 Operating equipment
Appropriate rated and tested High Voltage safety apparatus including but not limited to the
following:

- Testing equipment to prove the that HV mains and apparatus has been deactivated
- Operating sticks,
- Portable earthing equipment
- Personal protective equipment and HV gloves
- Insulating mats, barriers and signs
- Tags and locks

shall be made readily available on site by the responsible person for use by their operator(s) and
where required the Network Operator personnel in accordance with the customer’s high voltage
operating procedures and applicable legislation.

All operating equipment shall be maintained by the responsible person in a safe, fit-for-purpose
condition for use at any time.

The equipment shall be housed in labelled storage facilities, provided by the responsible person
located as close as practicable to the point of use.

13.12.4 Operational diagram
A single line schematic of the complete installation showing all aspects of the high voltage installation
(including normally open points) shall be provided in a suitable prominent and permanently displayed
enclosure adjacent to all control and isolating switches within the electrical installation.

Where items of switchgear or equipment are remote from the main installation, the operating diagram
shall also be permanently displayed at these locations.
13.12.5 Customer switching agreement

The customer/responsible person may be required to establish a Customer Switching Agreement (the Agreement) with the relevant Network Operator. It is preferable that the Agreement is finalised at the same time as the connection agreement. Refer Clause 13.12.6 for contact details.

The Agreement may specify the customer/responsible person's obligations and responsibilities when undertaking switching activities within the specified HV installation/network. Switching shall be in accordance with the agreed procedures and where required Network Operator directives.

The Agreement shall include provisions to ensure that the responsible person only performs switching operations on customer owned equipment as listed in the Agreement. The responsible person is not permitted to operate Network Operator owned equipment unless expressly mentioned in the Agreement or as directed by the Network Operator.

The Agreement shall also contain, where applicable, provisions that enable the Network Operator to operate customer owned equipment as nominated by the responsible person.

The responsible person shall ensure that the Agreement is kept up to date. Where a change is sought or made, the responsible person shall formally notify the Network Operator at the earliest possible opportunity via the contact point listed at Clause 13.12.6.

13.12.6 High voltage switching

The responsible person shall ensure that high voltage switches, other than control switches designated for the use of plant operators, shall be operated by persons selected, trained and authorised by the responsible person.

The responsible person shall ensure that their switching operator(s) are fully conversant with the HV installation operational procedures, safety management plan and the Network Operators requirements.

The responsible person shall ensure that their switching operators are trained and regularly assessed as competent, by registered training organisation (RTO), to perform the roles for which they are responsible including but not limited to the use of:

- Equipment operation
- Personal protective equipment
- High voltage testing equipment
- High voltage earthing apparatus designed to facilitate the earthing of all types of high voltage equipment within the installation
- Insulating mats, screens and other similar equipment necessary for the safe operation of the high voltage installation.

The switching operator shall coordinate their activities with the Network Operator and, where required, be responsible for the issuing of access permits authorising persons to work on isolated and earthed sections of the installation.

The responsible person shall establish (before commissioning) and maintain a register of all authorised persons with details of switching competencies and any restrictions.

The responsible person shall provide their contact details inclusive of Name, Position, Number and E-mail address to the relevant Network Operator. If the contact details of the responsible person change, the Network Operator must be formally notified, as soon as is practical, but no later than one month from the date of the change.

Notifications shall be sent to the following address:
13.12.6.1 Horizon Power
Horizon Power, Head Office
Stovehill Road, Karratha WA 6714 Ph:
(08) 9159 7250 Fax: (08) 9159 7288
(Head Office) karratha@horizonpower.com.au

13.12.6.2 Western Power
Network Operations Manager
System Operations, Western Power
GPO Box L921, Perth WA 6842:
cd.operational.capacity@westernpower.com.au

13.12.7 Safety signs
Appropriate warning and safety signage shall be installed in accordance with the requirements WAER, the Safety guideline, AS 2067, AS/NZS 3000 and AS 1319.

In each location where HV equipment is present within the customer’s installation a durable safety poster shall be displayed in a prominent and permanent position which outlines resuscitation methods and provides instruction in the release of persons from contact with live conductors.

13.13 Final connection requirements
The customer, through their agent shall ensure that they have submitted the following details to the Network Operator prior to seeking final connection of the HV installation:

- Final single line diagram
- Agreed maximum demand
- Main switch arrangements and specification
- Protection settings.

Before final connection is made the customer’s agent shall provide to the Network Operator:

- Confirmation that the customer has safety operating procedures and maintenance plan
- Test results for the equipment between the point of supply and main switch including but not limited to:
  - Commissioning and test certificates/reports for trip tests on the incoming circuit breaker(s)
  - Copy of HV Metering VT and CT test certificates
- Final certification of the commissioned installation
- A duly completed and signed ‘Notice of Completion’
- Contact details of the customer’s responsible person
- Clearances and authorisations from the customer and the Network Operator to energise the installation.

In the case of network connections, satisfactory test results of all HV electrical equipment between the point of supply and the main switch shall be recorded and submitted to the Network Operator prior to permanent supply being made available.

These tests shall be performed by a competent testing organisation acceptable to the Network Operator.

Final certification is required by a professionally qualified electrical engineer that the ‘as commissioned’ installation complies with the design and all relevant technical requirements. A copy of the final certification shall be given to the Network Operator (where connected to a network). Refer to WAER Clause 7.3
13.14 Maintenance

A customer who takes a supply at high voltage shall ensure through their responsible person that their high voltage installation:

- Safely performs the functions for which it is designed and intended
- Operates in accordance with the manufacturer requirements
- Is maintained in good order
- In the event of a fault or malfunction shall not create a hazard or cause interference to the Network Operator’s distribution network.

The responsible person shall implement the customer’s maintenance plan for the HV installation including the main incoming circuit breaker and protection system.

The responsible person shall inform the Network Operator of any changes to the connection especially where there is an absence of network monitoring and control within the customer HV installation by the Network Operator’s control centre.

The protection and control systems associated with the installation shall be tested for correct operation in accordance with the manufacturer’s specifications and customer’s maintenance plan. The responsible person shall keep records of maintenance tests, and make them available to EnergySafety and the Network Operator upon request.

The customer’s agent shall provide to the customer a written maintenance plan for the HV installation including the main incoming circuit breaker and protection system as a part of the commission process and before supply is made available to the installation.

Maintenance programs, frequencies and operations for particular item(s) of plant should be planned in accordance with the Safety Guideline and in consultation with the manufacturer and the Network Operator.

When conducting inspections of HV equipment the following should be considered:

- External insulation
- Internal insulation including oil where appropriate
- Contacts, interrupting devices and connections
- Earthing systems and connections
- Operating mechanisms and their lubrication
- Weather seals and gaskets
- Protective finishes and signs of corrosion.
- Moving parts and conductor joints, internal cleanliness, recommended clearances, and setting/effectiveness of the close/open operations
- Legibility of labels and signage

Due consideration should be given to site conditions, with particular regard to airborne contaminants and dust. Periodic inspections of switch rooms and switchgear enclosures are required to ensure:

- Lighting is adequate and if artificial operational
- Equipment labelling and operational diagrams are correct and legible
- Where installed any ventilation or fire suppression system are fully operational
- Emergency exits are not obstructed and panic release mechanisms are operational
- No ingress of moisture or water or intrusion by rodents, birds or insects
- Presence and legibility of safety signs

Periodic inspections/examinations may give guidance on the intervals that should be allowed to elapse between future inspections, examination and overhaul operations with reference to particular operating conditions.
The following publications should be considered during the development of an ongoing maintenance regime:

- AS 2067 ‘Substations and high voltage installations exceeding 1000 kV a.c’
- AS 1940 ‘The storage and handling of flammable and combustible liquids’
- AS 2467 ‘Maintenance of electrical switchgear’
- AS 1851 ‘Routine service of fire protection systems and equipment’
- AS 1883 ‘Guide to maintenance and supervision of insulating oils in service’
- AS 1767 ‘Insulating oil for transformers and switchgear’
- IEC 61230 Live Working – Portable equipment for earthing or earthing and short-circuiting
- WA Electrical Requirements.
- Guidelines for the Safe management of high voltage electrical installations

Before any installation maintenance work is carried out the affected portion of the installation must be deactivated, tested to confirm its status then earthed. The responsible person shall provide suitable direct earthing equipment, or use equipment with in-built earthing facilities.

Where the customer/operator requires access to a network installation or part thereof for the purposes of maintenance and inspection appropriate access arrangements shall be made with the relevant Network Operator.

13.15 Customer HV installation audits

As suggested by the Safety Guideline the responsible person should as part of their effective safety management plan conduct periodic audits of the HV installation to ensure the:

- Operational procedures and site safety management plan are relevant, up-to-date and applied in practice.
- Switching operator registers are valid and current
- HV installation maintenance plans are being followed and maintenance records are being maintained.
- Any HV installation augmentation has been appropriately integrated.
- Compliance with switching agreements.

Audits are to be conducted in accordance with the WAER
Distribution Connections Manual

Section fourteen

Substation installation requirements
14 Substation installation requirements

14.1 General connection requirements

This Section of the Manual describes the requirements and customer responsibilities where a new substation is to be installed or an existing substation is to be modified or upgraded.

Typically any connection over 250A in metropolitan areas will require the connection to or installation of a substation on the customer’s property. The substation will always include a transformer and may, in some cases, include high voltage switchgear.

In country and regional areas outside town centres a substation will be required in most situations.

This Section shall be applied in conjunction with the Network Operator’s technical requirements for customer connections and substations.

14.1.1 Horizon Power requirements

This Section shall be applied in conjunction with Distribution Construction Standard (Section “G” drawings).

14.1.2 Western Power requirements

The Section shall be applied in conjunction with Distribution Substation Plant Manual.

14.2 Substation types

The decision to install a district or sole use substation always remains with the Network Operator and not the customer. The decision as to which type of substation will be installed is dependent on a number of factors including but not limited to:

- Size of the customer’s requested load
- Proposed location of the customer’s load centre on the property, and distance from the property and distribution network
- Type and nature of the customer’s load (disturbing or passive)
- Nature and capacity of the existing distribution or transmission network
- The need for LV street feeds to or from the substation for the purposes of providing:
  - A back up supply to the customer’s installation
  - Future capacity and growth in the immediate area
  - Additional capacity to accommodate any growth in the customer’s load
  - The customer’s supply reliability and security requirements.

For both district and sole use substations, the Network Operator owns, operates and maintains the network equipment. Where HV switchgear is required for a district or sole use substation, the setback limits for the switchgear are shown in the relevant HV Network Operator substation technical drawings. (Refer to Clause 14.1)

The following Sections define the various types of substations and their applications:

14.2.1 District substation

A district substation is defined as one with LV connections to the street mains. In most cases, it is limited to 2 MVA and is available to customers whose electrical load will not cause interference to other customers connected to the same LV distribution network. The substation should ideally be located within the property on the street boundary. A maximum setback of 30 metres (to limit LV volt drop on street feeds) is permitted.

14.2.2 Sole use substation

A sole use substation is defined as one with no LV connections to the street mains and supply is used exclusively by a single customer and in most cases, it is limited to 2 MVA.
A sole use substation is available to customers who satisfy one or more of the following criteria:

- The customer’s electrical load may be classified as a disturbing load
- The site is large with the load located more than 30 metres from the property boundary (Refer to the Note 1)
- The site location is such that a LV feed to the street will never be required
- The required electrical load either now or in the future will require all of the respective transformer capacity.

Should the eligibility criteria change the Network Operator may consider converting a sole use substation into a district substation to service a new load subject to the following conditions:

- The substation that was once servicing a disturbing load is no longer doing so; and
- The existing customer is utilising all of the transformer’s capacity but there is sufficient room in the enclosure to house an additional transformer or replace the original with a larger unit.

Note 1: Network HV feeder cables located on the customer’s property require extra mechanical protection. Therefore feeder cables shall be kept as short as possible with the HV equipment located on the property boundary for all Horizon Power connections and within 5 metres of the property boundary for all Western Power connections.

There is no limitation on the length of transformer cables extending from the HV switchgear into the customer’s property.

14.2.3 Customer owned substation

A customer owned substation is defined as one from which the customer takes supply on a HV tariff. The customer owns and is responsible for all equipment (e.g. transformers, fuses, circuit breakers etc.) other than the Network Operator’s metering equipment and any Network Operator HV switchgear connecting the substation to the network.

Where an HV metering unit is installed, the output terminals are the point of supply. Under some circumstances, a customer owned substation may be provided with low voltage metering even though an HV tariff is applicable. The placement of HV switchgear and transformers shall be as prescribed in Clause 14.4.2 with point of supply for these connections determined by the Network Operator.

14.3 Substation arrangements

The customer is responsible for the construction of customer owned substations and fire rated substations. In specific situations as described in Clause 14.3.3 the Network Operator will install a package substation arrangement.

14.3.1 Modular package substation (MPS)

A modular package substation (Figure 64) comes complete with a single transformer and LV switchgear. It is housed in a self-contained metal enclosure and is installed on an inverted, direct buried concrete culvert. If HV switchgear is required, this is also housed in a self-contained metal enclosure which is installed adjacent to the transformer on a direct buried steel mounting frame.

Modular package substations are specifically designed to be used as district substations. They are not fire rated, configured or suitable for use as a sole use substation. The largest size transformer that can be used in the MPS configuration is 630 kVA.
14.3.2 **Non modular package substation**

A non MPS arrangement (Figure 65) comprises a combination of one or more transformers plus LV and HV switchgear as required. Each of these items is a separate component housed in a self-contained metal enclosure. The transformer is installed on an inverted, direct buried concrete culvert. The LV and HV switchgear enclosures are installed on direct buried steel mounting frames. Non MPS components are not installed as a single package. They can be installed either as a “cluster” substation or in a fire rated enclosure. In the case of fire rated enclosures, the culvert and switchgear mounting frames are not required.

Non MPS arrangements can be used as both district and sole use substations comprising multiple transformers, up to and including individual units 1000 kVA in size.

**Figure 65:** Non modular package (cluster) substation arrangement

14.3.3 **Choice of MPS or non-MPS arrangements**

The MPS arrangement is the preferred arrangement for a district substation where a single transformer is required. The substation does not need to be fire rated unless required by substation proximity to buildings, hazardous areas or property lines. The maximum transformer size (initially or in the future) is not to exceed 630 kVA. MPS and non-MPS arrangements do not require the construction of an enclosure for the substation.

Where a sole use substation is required, or multiple transformers are required, or the substation is to be fire rated, or there is a possibility that a future upgrade of the 630 kVA transformer will be necessary, a non MPS arrangement must be used.
14.3.4 Customer-owned substation arrangements

Where a customer owned substation is to be installed, neither a MPS nor the non-MPS arrangement is appropriate. The Network Operator will provide extendable or non-extendable HV switchgear necessary for connection to the network. This equipment shall be installed in a switchroom constructed by the customer, along with the customer’s own HV switchgear.

Customer constructed substations shall be designed to withstand, without damage, the maximum currents which may flow through the installation under fault conditions.

There are three types of customer owned substations suitable for HV switchgear installations. These are:

- Indoor Ground Mounted Switchgear where a switchroom must be constructed
- Outdoor Ground Mounted Switchgear, and
- Outdoor Aerial Switchgear.

14.3.4.1 HV indoor ground mounted switchgear

Where the customer’s installed capacity exceeds 4 MVA, a HV indoor ground mounted switchgear arrangement shall be used.

The customer shall supply and install adequately rated high voltage main switches and a connection suitable for coupling to the Network Operator’s HV metering unit/s.

Although the use of switchgear identical to the Network Operator’s standard range of equipment is preferred, customers may purchase and install switchgear of a different make.

In such cases, to enable connection of the customer’s switchgear to the Network Operator’s switchgear, a cable connection is required for termination of the customer’s switchgear.

Details of the Network Operator’s standard range and types of switchgear are available on application.

Where the customer’s switchgear is the same type as that used by the Network Operator, then subject to approval the connection may be made or retained via a bus-section switch disconnector.

Refer to the relevant Network Operator to determine the availability of this connection option.

The customer is responsible for supplying and installing support structures for the Network Operator’s HV switchgear, metering unit and customer HV switchgear in the switch room. Support structure fabrication details are specified within the respective Network Operators substation technical requirements.

Where the customer’s installed capacity exceeds 4 MVA, the load shall be supplied from two fire segregated switchboards. The load shall be, as close as possible, distributed evenly across both switchboards.

Customer future loads shall be considered when determining the switchboard design. In cases, where the Network Operator has a bus section, switches between two switchboards (i.e. Above 4 MVA installed capacity) operating the bus section, mechanical interlocking, using the Castell keyed system, is required to prevent closed ring operation via the customer’s switchboards. Paralleling of the customer’s switchboards is only permitted under the direction of the Network Operator.

If the Network Operator operates with the bus section switch normally closed, mechanical interlocking is required to ensure that paralleling of the customer’s switchboards can only occur when the bus section switch is closed.
14.3.4.2 HV outdoor ground mounted switchgear

Where the customer's installed capacity is 4 MVA or less, HV outdoor ground mounted switchgear can be considered. A customer owned HV outdoor ground mounted substation cannot be upgraded for loads above 4 MVA. In the event that the customer's load does increase above 4 MVA, the substation must be converted to a HV indoor ground mounted substation, contained within a switch room, built by the customer.

All HV switchgear equipment shall be installed in free-standing cabinets in a cluster configuration. The customer's HV switchgear cabinet/s shall be fitted with the Network Operator's locking system to facilitate 24 hour 7 day access for Network Operator personnel.

![HV outdoor ground mounted equipment](image)

Figure 66: HV outdoor ground mounted equipment

14.3.4.3 HV outdoor aerial mounted switchgear

In situations where the customer's substation is to be installed in a rural area, this arrangement can be considered but only in areas with widespread overhead networks can this option be used. This option is not available for use with metropolitan areas or regional centres.

Re-closers or pole-top switches with fuses may be used in the following situations covering smaller HV installations, subject to fault level limitations:

- Re-closers (fitted with three-phase over current and earth fault protection but no auto reclose provision) may be used to control the HV aerial supply to a consumer's small HV installation
- Pole top switches with integral drop-out (expulsion) fuses may be used to control a HV aerial supply to individual, pole mounted transformers with a rating not exceeding 315 kVA.

The consumer shall ensure the fuses or protection settings in the main switch coordinate with the up-stream protection of the Network Operator. Changes to settings shall not be made without the Network Operator's prior approval.

The customer shall supply and install adequately rated HV main switches for connection to the Network Operator HV metering unit. If a recloser is used by the customer as the main switch, then the auto recloser must be disabled.
14.4 Common installation conditions for substations

14.4.1 Application
The following clauses describe the conditions common to all substation installations, regardless of whether or not the customer is required to construct the enclosure or switchroom for the substation.

14.4.2 General conditions
The Network Operator will provide drawings showing the required size and general arrangement of the site and substation enclosure. The customer is responsible for preparing detailed designs and for the submission of three sets of architectural drawings to the Network Operator’s engineer for review prior to commencement of construction.

It should be noted that the Network Operator takes no responsibility for any structural design as the review only covers Network Operator’s clearance and access requirements. In general enclosures shall:

- Be designed to the Network Operator’s requirements for the installation of electrical plant and its safe operation
- Comply with the Building Code of Australia and Local Government Authority requirements. The customer is responsible for apply for and obtaining the necessary approvals
- Have trench surfaces and enclosure floors sealed to retard dust and moisture
- Contain no building or other services apart from those shown on the drawings provided by the Network Operator
- The finished floor level (FFL) of the substation enclosure shall not be lower the surrounding FFL or ground level
- Be maintained in good repair by the owner/operator of the installation in accordance with best industry practice, applicable regulations, codes, guidelines and standards.
14.4.3 Substation enclosures
The customer shall construct a two hour fire rated enclosure in the following situations where a:

- Network Operator substation is to be constructed inside a building
- Network Operator substation is to have more than two transformers
- Customer owned substation/switchroom is to be installed
- Substation is located within an area defined by Building Code of Australia as restricted.

In all other situations, the substation shall be designed and constructed to protect and safeguard adjacent buildings from fires originating within the substation.

Fire risk zones shall be measured from either the:

- Outer edge of all electrical equipment within the substation area; or
- From the external edge of any non fire rated section of a substation enclosure.

The Network Operator’s distribution technical requirements provides specific guidance on substation fire risk zones for a variety of situations inclusive of those illustrated by

- BCA Volume two (Part 3.7) and Volume one (Part C2); and
- AS 2067 clause 6.7 and Appendix “C”.

No essential public fire escapes or access/exit shall pass through or open into a fire risk zone created by the establishment of a substation enclosure.

In all cases where another structure/building conflicts with the fire risk zone around a substation, the choice exists for the customer to either construct a fire rated enclosure for the substation or to fire rate the other structure/building within the fire risk zone subject to the consent of all affected parties.

Agreement shall be reached with the Network Operator on this issue before the design is submitted as this will determine whether or not the customer must provide a fire rated enclosure.

In commercial or industrial situations where the customer requires the substation to be installed within the fire risk zone of a property side boundary, a fire rated enclosure maybe required to protect against the event of a building being constructed on the adjoining property within the substation fire risk zone.

Local Government, BCA and AS 2067 requirements shall be considered by the customer when determining whether a fire rated enclosure is required in relation to minimum building setbacks and distance to the property side/rear boundaries.

14.4.4 Hazardous areas
Adequate separation and clearances must be maintained not only to avoid the transfer of fire from a substation but also to protect the substation from fire originating from within or from an adjacent hazardous area. Common hazardous areas or materials include but are not limited to:

- Combustible buildings,
- Flammable building products
- Stored materials,
- Fencing surfaces,
- Facilities that store, dispense or refill
  - Petrol and diesel fuels
  - Liquefied petroleum gas (LPG)
  - Compressed natural gas (CNG)
- Motor vehicle battery charging
- Exchange stations
- Vegetation
Additional detailed information is contained within the following publications:

- AS 1940: The storage and handling of flammable and combustible liquids
- AS 2067: Substations and High Voltage Installations Exceeding 1 kV a.c.
- AS 2419.1: Fire Hydrant Installations Part 1
- AS/NZS 3000: Electrical Installations
- AS/NZS 60079.10.1: Classification of Areas – Explosive Gas Atmospheres
- Building Code of Australia (BCA)

14.4.4.1 Storage of flammable material

Collection and storage of flammable material adjacent to electrical equipment and substation enclosures such as flammable liquids/items, gas cylinders and rubbish, must be actively discouraged particularly in areas designated for personnel/vehicle access or evacuation.

Under no circumstances shall hazardous or flammable material be stored within the confines of a Network Operator’s or customer’s substation including areas designated as a fire risk zone.

14.4.4.2 Fire hydrant installations

Australian Standard 2419.1—“Fire Hydrant Installations”, requires that fire hydrants and brigade booster assemblies, be located in a position at least 10 metres from any high voltage main electrical distribution equipment including transformers and switchboards.

14.4.4.3 Separation from petroleum and gas installations

As a guide, based on conservative worse case scenarios, a minimum clearance of 8m shall be provided from any Network Operator electrical distribution equipment to a customer’s commercial installation containing petroleum/gas storage or dispensing facilities.

Clearances will vary dependant on the related environment, activity, nature of the hazard and location of the ignition source. For example:

- A petrol station requires a 4 m minimum horizontal clearance from petrol bowsers in an outdoor facility and an 8 m clearance in an indoor facility.
- An addition a 1 m clearance is required beyond the full extension of a vehicle filling hose.
- A 4 m lateral clearance must be provided to fill, dipping points and vapour vent pipes for underground petrol tanks.
- LPG dispensing units, the horizontal clearance for an outdoor facility must be 6 m beyond the full extension of the vehicle filler hose which in practice generally means 8 m from the LPG bowser.

Where the 8 m clearance cannot be achieved or there are safety concerns, appropriate specialist technical advice must be obtained prior to commencing any development of the site or construction activity. For specific detailed direction relating to separation requires refer to the references listed in Clause 14.4.4.

It should be noted that the hazards associated with diesel fuel and CNG have been classified as being the same as for petrol and LPG although it is understood that diesel in not as volatile as petrol and the requirements for CNG dispensing units is not as onerous.

14.4.5 Alarm systems

The installation of fire alarm and fixed fire suppression systems may be a condition for building approval as determined by the relevant government authority, an operational condition required by the network operator or fitted at the discretion of the customer / building owner.

Alarm systems for non-fire rated distribution substations, may be required or installed by the customer, which shall comply with the Building Code of Australia and any additional requirements of the Network Operator. For fire rated substation alarm and extinguishing system installation requirements refer to Clause 14.6.4.
14.4.6 Site requirements and preparation

There are a range of variables that may impact on the finished ground levels around a network site including but not limited to the following geographical, environmental and climatic factors:

- Site soil types, content, compaction and stabilisation
- Position of the site in terms of elevation above flood levels and located in relation to coastal or inland environments
- Prevailing weather conditions including ambient temperatures and levels of precipitation;
- Drainage
- The existence of or use of existing or introduced vegetation/natural ground cover
- The use or need for retaining walls
- Size and overall weight of the structure in terms of the prevailing ground conditions

The following conditions shall apply to all substation sites:

1) A suitable site shall be provided at no cost to the Network Operator by the land owner/customer where the establishment of a substation is required;
2) The entire site area as shown on the Network Operator’s drawing(s) shall be retained for the Network Operator’s sole use, unhindered by any obstructions that may affect normal operations and maintenance;
3) The customer shall provide architectural drawings of the proposed site, including areas adjacent to it, for approval prior to commencing any construction of the substation;
4) The site cannot be lower than the finished level of the surrounding lots and the adjacent road carriageways. It should be noted that in rural regions the finished level of carriageways may be higher than that of the surrounding areas to allow for natural drainage from the carriageway;
5) Substations shall not be built in water courses. The site shall be located not less 500 mm above the 100-year flood level, pegged, compacted and levelled to an out of plane tolerance of ±10 mm by the customer, who shall also ensure that no other service(s) are constructed either on, under or in close proximity to the site;
6) The site shall be suitably prepared and the ground stabilised by the removal of any vegetation, a layer of top soil to the depth of 100 mm applied followed by backfilling of the site with a layer of sand. If the site contains materials other than sand (e.g. rock, clay or building materials), the customer is responsible for excavating and backfilling the site with clean compacted sand to a depth of 1 metre;
7) The site shall be compacted to a blow count of 8 per 300 mm using a standard penetrometer for sand not containing gravel sized material. In all cases, a compaction certificate shall be supplied to the Network Operator’s representative;
8) In the event that the site is higher than the finished levels of neighbouring areas, retaining walls, access steps and drainage shall be provided by the customer at no cost to the Network Operator. This work shall be certified by a professional Civil Engineer (NPER);
9) If batters are required they shall be provided with a finish that prevents wind and water erosion, including kerbing or similar low profile retaining structures around the lower edge to maintain batter material. Where retaining walls, access steps, screens and/or batters are installed, the land requirements shall be increased to accommodate these associated features and any associated footings. Footings for such structures or adjacent properties shall not encroach into the substation area. A signed certificate of verification is required from a registered NPER civil engineer verifying that the substation retaining walls are structural sound and/or battered slopes are suitable for their purpose;
10) Where required bollards and kerbing shall be installed in accordance with Network Operator’s standards for Ground Mounted Equipment.
11) If the site is located in a car park or is close to traffic flow, after all equipment is installed the customer shall install bollards, concrete kerbing and other protective structures around the site boundary as prescribed by the Network Operator.

12) Following the installation of all substation equipment, exposed surface areas at the site shall be stabilised to mitigate against the effects of erosion. Crushed limestone, blue metal (10 -25 mm aggregate) or other approved stabilising material shall be laid around each item of equipment in accordance with the Network Operators technical requirements.

13) Laid materials shall be removable to allow access to cables and equipment.

14) Soil treatments shall be completed to the satisfaction of the Network Operator.

14.4.7 Access

14.4.7.1 Site

Access to substation sites shall be suitable for heavy vehicles (GVM exceeding 4.5 tonne) to enable construction, maintenance and operation of the substation. The slope of the substation access road or driveway should not exceed a ratio of 1:10. For additional information and guidance on ramp gradients refer to AS 2890 Clause 2.5.

It is essential that the immediate area around the substation is level to facilitate the installation, removal or replacement of the transformers, switchgear and related substation equipment.

Where the required access conditions cannot be achieved due to specific site restrictions or space limitations the customer or their agent must liaise with the Network Operator to facilitate an alternative acceptable access arrangement.

14.4.7.2 Gatic cover access

Where the use of ‘gatic’ pits and cover(s) are approved for use:

- Access to the substation via a the clear opening with minimum dimensions of 2500 mm x 2000 mm shall be maintained
- Within the building, the minimum ceiling height above the ‘gatic’ cover shall be 3.3 m.
- Lifting eyes or a monorail shall be designed and installed by the customer to allow for the installation of Network Operator plant. (Refer to the network operator construction drawing details)
- Outside the building, there shall be suitable access provided for a crane from the street or right of way with no obstructions above the ‘gatic’ cover.

14.4.7.3 Equipment

Access to a substation shall be suitable for heavy plant. If a transformer is to be installed, an allowance shall be made for its installation (i.e. size and weight). Refer to the Network Operators technical requirements for dimensions, size and weight details.

14.4.7.4 Personnel

Direct access to all substations shall be provided for Network Operator personnel, 24 hours per day, 7 days per week even where the substation is located within a building or more than 30 metres from a property boundary.
14.4.8 Sizing of transformers
The maximum discrete load that can be supplied from a district substation is the nameplate rating of the transformer. The transformer overload/cyclic rating capability is not to be taken into account when selecting the minimum transformer size required.

The maximum discrete load that can be supplied from a sole use substation is nominally the nameplate rating of the transformer. However, in selecting the minimum transformer size, the overload/cyclic rating capability of the transformer can be taken into account based on the specific load profile of the customer.

14.4.9 Point of supply and consumer mains
The customer shall provide and install the consumer mains cable from the customer’s main switchboard (MSB) to the Network Operator’s designated point of supply (PoS). These cables shall:
- Preferably be copper due to smaller lug sizes
- Installed in PVC ducts
- Take the shortest possible route from the PoS to the MSB, not crossing underneath any Network Operator equipment.

Consumer mains cable including neutral conductors, switchboards, main switches and SPD’s shall comply with the Network Operators technical requirements. The maximum size of consumer mains that can be terminated to a district or sole use substation is prescribed by the relevant Network Operator’s technical requirements.

The Network Operator may approve the use of double insulated single core cables, installed on cable tray where access to terminations permits, the MSB is contiguous, the supply originates from the substation and no further mechanical protection is required. The use of bus duct or busways may also be subject to Network Operator consideration and approval.

14.4.9.1 District substations
Where the customer’s main switchboard is remote from the substation, the consumer mains cable must have overcurrent and short circuit protection. To ensure grading with upstream protection, the customer’s maximum load shall be in accordance with the Network Operator’s technical requirements.

Where higher loads are required, the MSB shall be contiguous with the substation so that links may be used for connection to the Network Operator’s LV switchboard.

14.4.9.2 Sole use substations
In all cases, the customer’s main switchboard shall be contiguous with the substation, with the consumer mains connected to the MSB from the LV terminals on the network transformer.

The customer’s service protection devices shall be withdrawable.

14.4.10 General earthing requirements
Substation earthing systems shall be installed in accordance with the applicable industry standards, WAER, and substation earthing arrangements as illustrated by the Network Operator’s substation compatible unit drawings.

Earthing shall be installed within substation to minimise the potential for earthed metal parts to become energised via the passage of any fault current. The system shall provide a return path for the fault current to be detected and rapidly disconnected from the system.

The effectiveness of the earth system is dependent on the ability of the earth components to maintain a low potential difference between the exposed metallic parts of the substation installation and the remote earth. The system must also be suitably rated to withstand the magnitude of any prospective fault current.
14.4.10.1 General conditions
The following requirements shall apply to all District and Sole Use substation installations:

- All earthing conductors used shall be bare copper and sized in accordance with AS 2067
- Flexible connections from metallic parts onto the main earth conductor must either be a stranded copper conductor with green yellow PVC insulation or a flexible copper braided connection
- Two (or more if required) deep driven earth electrodes are to be installed and connected to the main earth conductor, in every substation regardless of the number of transformers installed
- The earth electrodes are to be placed as shown on the relevant compatible unit drawing
- All connections shall be crimped. Mechanical clamps may be used as an alternative subject to prior approval
- All flat copper bar surfaces shall be suitably prepared and cleaned before any bolted connection is made
- Earth connections are to be made from the following metallic parts onto the main earth conductor:
  - Star point of delta-star transformers
  - HV cable metallic sheaths (via a copper flexible braid)
  - Any LV cable metallic sheaths used
  - HV switchgear earth/bar connections
  - Transformer earth lug
  - LV distribution Frame earth bar
  - Metallic transformer or HV switchgear enclosures (If in cluster formations)
  - Pole top isolation switch handles and operator earth mats or loops
- Connections shall be tagged and labelled at the earth bar end to clearly indicate what they are connected to
- The substation earthing grid shall be buried 150 mm (500 mm for Horizon Power) below the substation finished ground level.

Refer to Clauses 14.5 and 14.6 for additional specific earthing requirements for both fire and non-fire rated substation installations.

14.4.10.2 System testing and commissioning
The earthing installation shall be tested and commissioned in accordance with the requirements of, AS 2067, AS/NZS 3000 and as specified by the Network Operator. Test results shall be made available to Construction Project Manager.

14.4.10.3 Metallic screens and fencing
Metallic screening or boundary fencing adjacent to substations is not recommended and is to be avoided where ever possible. However, if a customer/developer insists on metallic screening or boundary fencing and to create safety awareness for future land owners the following minimum requirements are to be adopted.

**Horizon Power**

The use of metallic screen fencing is not recommended. When a customer requires a conductive fence to be installed in close proximity to a substation a 2 metre separation from the substation earth grid and the conductive fence is required.

The requirements of AS 2067 and AS/NZS 3000 shall apply and approval of the proposed earthing arrangement shall be obtained from the Network Operator’s Project Manager prior to installation.
Western Power

Based on the network connection point for each project Western Power will advise if metallic fences will pose a step-touch voltage risk or not. Unless exempted by Western Power step-touch voltages on metallic fences on the substation site boundary shall be considered in an EPR (Earth Potential Rise) study for every substation.

The step-touch voltages shall be assessed assuming that a metallic fence will be erected on the substation site boundary unless the site is located inside a building.

If an exemption is granted, the customer or developer shall record this exemption in the project records as the outcome of the metallic fence step-touch voltage assessment by Western Power.

**NOTE:** EPR studies may still be required for other metallic structures/services around the substation site such as metallic pipelines, telecommunication services, etc.

If no exemption is granted for metallic fences, an EPR study shall be carried out to assess step-touch voltages on metallic fences for the substation(s) in that subdivision stage/project. It shall be assumed that a metallic fence is installed on the Western Power site boundary but not connected to the substation earthing.

For such fences the subdivision/substation(s) earthing shall be designed to meet tolerable step-touch voltage limits of AS 2067. The EPR study shall be undertaken using the fault levels and protection settings provided by Western Power. An EPR report detailing any mitigation needed to meet tolerable voltage limits on the fence is to be submitted to Western Power for consideration.

The EPR study will have one of two outcomes;

1) The substation earthing has been designed such that step-touch voltages on the fence are within tolerable voltage limits and metallic fences will not pose a step-touch voltage risk.

2) The step-touch voltages limits on the metallic fence cannot be met, then one of the following options can be used;
   a. The substation site boundary can be increased such that the step-touch limits on the metallic fence are met at the new substation site boundary, or
   b. The developer shall install a masonry property boundary fence at the same time as the installation of the substation. This masonry fence is required on all sides of the substation adjoining private property and extending along the private property boundaries to the point where step-touch voltages on the property boundary fence are within limits.

**NOTE:** These options shall not be used to mitigate step-touch voltages for the power system earthing design of the Western Power substation site.

Western Power may consider a customer/developers alternative solution.

14.4.11 **Vegetation screens**

Where the customer chooses to use vegetation as a form of natural screening for either aesthetic or operational reasons the customer shall comply with fire zone requirements. An appropriate vegetation management plan shall be developed and implemented to ensure the safe operation of the installation and the safety of network staff and the community.

The selection of vegetation shall be such that any introduced flora is not hazardous to persons, livestock, the installation or the environment. Where screens are manufactured from natural or combustible products they must not compromise the safety of the installation or firefighting personnel in event of a fire.
14.4.12 Metering

14.4.12.1 Low voltage metering
Generally the maximum electrical load that can be LV-metered is 2 MVA. Refer to Section 11 for full details of LV metering arrangements.

14.4.12.2 High voltage metering
Where high voltage metering is required, the Network Operator will provide a quotation, inclusive of the costs to provide, install and commission of the metering equipment. Refer to Section 11 for further information including details of indoor and outdoor metering units.

Queries about metering, including details of installation facilities, should be referred to the Network Designer or Construction Project Manager.

14.4.13 Requirement for a contiguous switchboard
Where a customer is fed from a fused LV supply out of a Network Operator district substation, the magnitude of the load is limited so that the customer’s main switch will grade with the Network Operator’s LV fuse.

The maximum size Network Operator LV fuses which can be used is in turn dependent on the transformer rating/voltage (and in some cases whether the transformer is protected by HV dropout fuses or a RMU fuse switch). Should the cable to the customer’s point of supply be protected by a fuse, the customer's switchboard can be remote from the substation.

Where a customer is fed from a district substation and the magnitude of the load is such that the customer’s main switch cannot grade with the maximum size LV fuse which can be used with the transformer, the customer will be supplied either from links or a disconnect unit (depending on the magnitude of the load). In this configuration the main switchboard shall be contiguous with the substation.

Where a customer is fed from a sole use substation, the customer is connected directly to the LV bushings of the transformer. In this case the cable to the customer's point of supply is not protected therefore the main switchboard must be contiguous with the substation, to limit the amount of unprotected cable exposed to damage.

For the customer’s switchboard to be considered as contiguous and where:

- The substation is screened, the switchboard shall be against the exterior of the screening
- A substation enclosure is constructed, the switchboard shall be against the exterior wall of the enclosure
- There is no screening or enclosure the switchboard must be immediately adjacent to the edge of the substation site boundary but not more than 1 metre from the point of supply.

For addition specific information on customer switchboard locations refer to the documents listed at Clause 14.

14.5 Conditions non fire rated substation enclosures

14.5.1 Application
This Section describes the additional conditions to those specified in Clause 14.4 which apply specifically to situations where the Network Operator does not require the customer to construct a fire rated enclosure for a substation.

14.5.2 Site requirements and preparation
Refer to Clause 14.4 for details site requirements preparation.
14.5.3 Earthing requirements for non fire rated substations
The Network Operator will undertake all earthing requirements for district and sole use substations except where the substation is installed as a part of a subdivision development. Refer to the Network Operator’s UDS Manual for further details.

14.5.4 Screening
Where a MPS or non MPS cluster arrangement is installed, the Network Operator has no requirement for screening around the site. The customer may elect to install screening (preferably not metallic) for aesthetic or other reasons in which case the screening shall be the customer’s responsibility.

If the customer chooses to install screening, approval shall be obtained from the Network Operator prior to its erection. If approved, the following conditions shall apply:

- In general, any type of non-metallic screening is permissible (e.g., vegetation, fencing, masonry walls, etc). The Network Operator will provide drawings showing indicative permissible screening arrangements for the site
- Where full screening is proposed, two openings are required with dimensions as shown on the network drawing. The openings do not require doors, however, if the customer elects to install doors they shall be hinged to open both inwards and outwards, with no self-locking. The outward opening of the doors shall be unobstructed with no physical barriers within a 2 metre radius of an opened door. If locking is required, the Network Operator padlocks are to be used. Doors do not need to be fitted with labels
- Where a roof is to be fitted to a screened enclosure, the customer must liaise with the Network Operator to address any natural ventilation, access and future equipment maintenance issues
- Screening shall be installed only after the Network Operator has completed all work on site. This is to ensure that the screening does not interfere with installation work nor become undermined by any network excavation
- No part of the screening or associated foundations/supports shall intrude within the substation site as shown on the appropriate drawing
- The customer shall be responsible for ongoing maintenance of the screening
- Unless specifically negotiated otherwise with the Network Operator, screening and any associated foundations or supports shall not extend more than 550 mm below finished ground level to ensure protection of cables entering and exiting the site.

14.6 Conditions for fire rated substation enclosures

14.6.1 Application
This Section describes the additional conditions to those specified in Clause 14.4 which apply specifically to situations where the Network Operator requires the customer to construct a fire rated enclosure for a substation. It is the customer’s responsibility to ensure that all of these conditions are met which may be audited by the Network Operator. Refer to Appendix “L” for check list details.

For customer owned substations or where a Network Operator substation is required to be fire rated, the customer is responsible for the construction of the substation enclosure in accordance with the Network Operator’s specifications and drawings.

No essential public access/exit/escape shall pass through or open into the fire risk zone. Generally, no other structure or building is permitted within the substation fire risk zone unless it has a two hour fire rating.

The application of this requirement may be varied dependent on the nature and use of the structure/building. For example, a structure constructed of non-combustible materials being used to store non-combustible material can be located within a substation fire risk zone without the need for fire rating.
However, if the structure is used for some form of continuous activity or stores combustible materials, then either the building or substation shall be fire rated. In all cases where another structure/building conflicts with the fire risk zone around a substation, the choice exists as to whether to construct a fire rated enclosure around the substation or to fire rate the other structure/building within the fire risk zone.

14.6.2 General construction requirements
In addition to this Manual's general requirements, enclosures shall:

- Be designed by a chartered structural engineer to resist loads and forces as outlined in AS/NZS 1170
- Have a minimum ceiling height of 2.5 metres, roof to be dust tight and all storm water guttering to be external to the room
- Have trench surfaces and floors sealed for the purposes of waterproofing the treated surfaces and sealing concrete to control dust
- Have no more than two transformers in the same enclosure, with transformer pairs fire segregated

14.6.3 Earthing requirements for fire rated substations

14.6.3.1 District and sole use substations
The Network Operator will undertake all earthing requirements for district and sole use substations. The customer shall arrange with the Network Operator to have the earth electrodes installed in the enclosure floor before pouring the concrete.

If earth electrodes cannot be installed in the enclosure, the customer shall supply and install earth pits, conduits and earth wire outside the enclosure to the Network Operator's requirements. Pits to be 450 mm x 450 mm x 500 mm deep fitted with brass covers embossed "Name POWER MAIN EARTH".

14.6.3.2 Customer-owned substations
For indoor ground mounted switchgear substations, the earthing systems in the switch room shall be installed by the customer. In situations where outdoor ground mounted switchgear is used, the Network Operator will install the earth grid around the network switchgear and the customer will be responsible for the installation of the earth grid around their switchgear. The customer is to provide suitable termination facilities for the connection of the distribution earth grid and shall liaise with the Network Operator to ensure both earthing grids are connected together.

The customer shall install a minimum of two earth electrodes. When a switchroom is constructed, the earth electrodes are to be installed in the trench. If there are two separate trenches, then a minimum of one electrode is required in each trench, with a 75 mm conduit installed between trenches to allow interconnection of electrodes. For detail on earthing requirements refer to the documents listed at Clause 14.1.

Where the customer purchases from the Network Operator a substation to convert to a HV tariff, it is the customer's responsibility to ensure the substation earthing complies with the Network Operators requirements.
14.6.4 Fire alarms and extinguishing systems
In line with AS 2067 Clause 6.7.1.6, at least one portable manually operated fire extinguisher suitable for suppressing an electrical fire should be installed in an easily accessible location external to (or immediately internal to) the entry to each switch room compartment.

Where required by the Building Code of Australia or Network Operator, two hour fire rated substations shall be fitted with fire alarms supplied and installed by the customer. The system shall:

- Alarm to the customer
- Comply with the requirements of the Building Code of Australia and any additional requirements specified by the local government authority and Network Operator
- Shall not include any water sprinkler system or mechanism

Where fire extinguishing or suppression system equipment is installed to ensure Code compliance, the customer shall provide details of the system to the Network Operator. Refer to Clause 13.14 for details relating to maintenance of systems and equipment.

14.6.5 Oil containment
Any fire rated enclosure housing a transformer shall have a brick bund installed at least 75 mm high at every door location. The bund/s are intended to contain any oil spilled from the transformer and shall be installed after installation of the transformer(s).

14.6.6 Doors and locks
Doors for a fire rated substation enclosure shall comply with the following requirements:

- Doors and all associated hardware shall be fire rated to AS/NZS 1905 and in accordance with the BCA.
- Where switchgear is installed in a substation enclosure with self closing/locking doors, the doors shall be fitted with panic release bars supplied and installed by the customer. If double doors are used, the panic bar is required only on the active leaf. Note in these cases, two unrestricted exits from the enclosure are required
- Exits shall not open directly onto trafficable areas
- All doors shall be fitted with external door handles with 'Lockwood' night latch. The night latch shall be key operated externally and fitted with standard Network Operator barrels
- Meter enclosures shall be fitted with standard Network Operator padlocks. If the customer requires access to the meters they should request a customer lock, which is keyed to the Network Operator's master key system. Customer access lock requests shall be directed to the Network Operator's representative
- The customer shall fit labels complying with AS 2067, AS 1319 and the Network Operators requirements including:
  - Enclosure external doors are to be labelled “Name POWER SUBSTATION”;
  - Main distribution board switchroom door shall be labelled “MAIN ELECTRICAL SWITCHROOM”;
  - All doors are to be fitted with danger signs which include the words “DANGER HIGH VOLTAGE”.
14.6.7 Ventilation

The preferred approach should be wherever possible by natural ventilation for substation chamber and equipment rooms.

This methodology minimises the risk of transformer or equipment failure caused by overheating due to mechanical and electrical malfunction of installed ventilation systems.

Mechanical ventilation systems (permanent or temporary) shall be designed to take into consideration smoke removal from the building. They shall be so arranged that inspection and maintenance can be carried out even when the electrical equipment is energized.

Basement chamber substations shall be provided with dedicated inlet and outlet ventilation ducts terminating outside the building.

Adequate vent openings shall be provided for pressure relief for all roofed enclosures to prevent structural damage in the event of an explosion. In substations where a transformer is installed, the normal transformer ventilation will meet this requirement.

For substations where only switchgear is installed, pressure relief vent/s shall be installed and all vents shall be fitted with external louvres for security.

Where natural cross flow ventilation for transformers cannot be achieved, and forced draught ventilation is required, the customer shall supply and install fans, ducting and weather proof outlet grilles as required by the Network Operator.

Individual ducts are required for each transformer. Grilles shall be of a robust construction with low air resistance. Refer to the Network Operator technical requirements for substation ventilation for fan details and associated sub distribution board schematics. Air flow values are the minimum acceptable requirement.

If the ducting passes over the top of the transformer, the ceiling height of the enclosure shall be increased in accordance with the Network Operators technical requirements for substation enclosure construction.

Fire dampened vents shall be installed as prescribed by the Network Operator. They shall be fitted with rotating type blades held in the open position by two thermal links in parallel and shall conform to AS 1682 and AS/NZS 1668.

In a district substation, the Network Operator will install the distribution board and connect the fan, where as in a sole use substation this shall be the customer’s responsibility.
14.6.8 Trenches, ducts and other penetrations

The customer is responsible for the supply and installation of all trench covers in removable sections. Covers shall be:

- Supplied and installed in accordance with the Network Operator and manufacturer requirements.
- Resistant to the effects of fauna and environmental conditions:
- Structural supported by braces installed in front of electrical equipment where cut to allow cables to enter.
- Supports shall not hinder cable installation.
- Fixed in place to prevent movement under foot but allow for removal and replacement when required to for maintenance and cable installation.

Retro fitting of covers may require modification of both the trench rebate and supports to ensure that covers sit flush with the floor and the switchgear/RMU mounting structures.

Where ducts or other penetrations enter the trench or enclosure, the customer shall fit removable watertight seals to both ends of the installed ducts or penetrations prior to hand over. The seals shall be water and oil tight before and after cable installation. Network Operator personnel will reseal all ducts or penetrations after installation of network cables.

Where ducts are installed between fire segregated switch-rooms, the customer shall seal the ducts after the installation of all cables to maintain the required fire rating.

The Network Operator may require the installation of a cable pulling eye in the trench where a direct cable pull is not available or the enclosure is more than 20 metres from the street boundary. The eye shall be suitable for a working load of 30 kN, to a safety (multiplying) factor of 2.

14.6.9 Light and power

For district substations housed in an enclosure, the Network Operator will supply and install in the enclosure, all general and emergency lighting fixtures, GPO’s and all associated minor wiring necessary for their operation.

For sole use and customer owned substations, the customer is responsible for the above as the Network Operator has no LV supply within the substation. The installation of ventilation and fans in a sole use substation is the responsibility of the customer.

Lighting requirements shall be as prescribed by Clause 5.1.6 of AS 2067, which in summary requires accessible indoor and outdoor installations to be provided with suitable lighting for routine operations.

Lighting levels shall be as agreed with the Network Operator. Emergency/auxiliary lighting shall be provided where deemed necessary by the Network Operator; which can be either a fixed installation or portable equipment. Refer to AS/NZS 1680 for guidance on lighting levels.

14.6.10 Wiring

Electrical wiring associated with ventilation, lighting and general power shall be installed in accordance with the Electricity (Licensing) Regulations and the AS/NZS 3000.

Where requested a copy of both the Completion Notice and Electrical Safety Certificate shall be provided to the Network Operator on completion of this work.

14.6.11 Fire rated certification

A Network Operator may request from the customer/owner certification that the completed installation complies with the relevant sections of the WAER, Network Operators technical requirements for distribution substations, Building Code of Australia and applicable Australian Standards to ensure substation fire rated requirements are achieved.
14.7 **Horizon Power section references**

The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either go to the related clause or the identified online link.

14.7.1 **Summary**

For further information and guidance on Horizon Power’s NWIS and NIS licensed areas and requirements phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

This Section of the manual is to be read in conjunction with Horizon Power's [Distribution Design Rules and Distribution Construction Standard - Section “G” drawings](#).

14.8 **Western Power section references**

The following is a summary of the various references made within this Section of the Manual. For specific information on a related subject either go to related clause or the identified online link.

14.8.1 **Summary**

This Section of the manual is to read in conjunction with Western Power’s [Distribution Substation Plant Manual](#) (DSPM).
Distribution
Connections Manual

Section fifteen

Generation
15 **Alternative sources of supply or generation**

Installations must be designed and installed by competent persons who have the required skills, knowledge and understanding of the effects of generation sources on the operation of customer installations and distribution networks. The safety of employees working in the installation and on the network must be protected.

Consideration must be given to voltage control, power import and export limits, synchronising and islanding, metering, re-closing and fault levels.

A Network Operator may refuse to connect or choose to disconnect a customer’s generating equipment from the distribution network if:

- The equipment is deemed unsafe to network staff, system users or industry operatives
- The continued operation of the equipment is considered dangerous to the integrity of the distribution network
- Its use adversely affects other customers or network supply quality
- It is non-compliant with regulatory and network requirements.

15.1 **Definitions**

15.1.1 **Language**

**Bumpless transfer** The make-before-break transfer of a load between the distribution system and an islanded generating unit (or vice versa) where the time for which the generating unit is operated in parallel with the distribution system is limited.

**Generation system** A system or method of generating electricity comprising one or more generating units.

**Generating unit** The equipment used to generate electricity inclusive of all related equipment essential to its functioning as a single entity.

**Parallel generation** The operation of a generation system in parallel with the normal operation of the distribution network supply (could be continuous or occasional).

15.1.2 **Stand-alone generation system**

A stand-alone generation system is defined as a self-contained generating unit or units providing the only source of electricity, independent of any Network Operator electricity network.

The system may consist of one or a combination of generating units incorporating engine driven, renewable, or storage energy systems installed and maintained by the customer.

Stand-alone generation systems are generally used in remote areas (Remote Area Power Supply RAPS) to provide power to a customer's installation which is not serviced by a Network Operator's distribution or transmission network or where there is no cost effective network access.

15.1.3 **Alternative supply generation system**

A generation system comprised of one or more generating unit or units incorporating a changeover switching mechanism to provide an alternative source of electricity in event of a failure of the network supply inclusive of:

- Emergency supply, to maintain operation of the installation, or part thereof, for safety reasons.
- Standby supply to maintain normal operation of the electrical installation, or part thereof.
- Supplementary electricity supply

The system may consist of one or a combination of generating units incorporating engine driven, or renewable energy systems installed and maintained by the customer.
15.1.4 Parallel generation system

Included in this classification are generation systems directly connected to a Network Operator’s distribution network as opposed to a transmission network. These systems may consist of one or a combination of engine driven, renewable or inverter energy systems installed and maintained by the customer for the purposes of providing:

- An alternative energy source
- Load reduction.
- Parallel operation with a network supply.

15.2 Generation categories

Defining generation system categories assists Network Operators and proponents develop assessment criteria and processes, therefore ensuring that the requirements for different sized systems are consistently managed and communicated to customers, industry, network personnel and related government agencies.

<table>
<thead>
<tr>
<th>Classification Band</th>
<th>Technical Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro ¹</td>
<td>AS 4777 compliant systems rated up to and including 5 kVA; single phase or multiple phase connection to the low voltage network via the customer service connection.</td>
</tr>
<tr>
<td>Mini ¹</td>
<td>AS 4777 compliant systems rated greater than 5 kVA and up to 30 kVA; Three phase connection to the low voltage network via the customer service connection.</td>
</tr>
<tr>
<td>Small ²/³ (Low Voltage)</td>
<td>Systems greater than 30 kVA up to 150 kVA connected to the LV network. (Typically with more than 1 customer on the network).</td>
</tr>
<tr>
<td>Small ² (High Voltage)</td>
<td>Systems greater than 30 kVA up to 1 MW connected via transformers to a HV customer connection point.</td>
</tr>
<tr>
<td>Medium</td>
<td>Having a nameplate rating greater than 1 MW but no more than 5 MW and connected to the high voltage (HV) network.</td>
</tr>
<tr>
<td>Large</td>
<td>Having a nameplate rating greater than 5 MW.</td>
</tr>
</tbody>
</table>

**Table 18:** Generation categories

**Note**¹. Micro and Mini generation categories are based on the manufacturer’s published AC power rating/output values for:

- Maximum power, or
- Maximum and nominal power where the values are the same, or
- Nominal power where the maximum value is not published.

**Note**². Small generation categories are based on the total combined AC power rating/output for the combined generation installation.

**Note**³. Non inverter connected generation systems less than 30 kVA, installed within the NIS, NWIS and SWIS shall comply with the relevant Network Operator’s Technical Rules.
15.3 Customer/agent responsibilities

Generation system installations, connected to a Network Operators distribution network shall comply with but not limited to following:

- The Electricity Act, and subsidiary legislation
- The Metering Code 2012
- Relevant statutory and regulatory requirements
- The requirements of Clause 15.3.1
- The Network Operators requirements
- The relevant Electricity Retailer
- Customer connection agreement
- Good electricity industry practice and the Manufacturers requirement

The customer is responsible for the installation and maintenance of the generation system and for all costs incurred by the Network Operator resulting from the installation of that generation system. This may include the provision of equipment to record the operation of the plant and or the control/protection of the distribution network where required by the Network Operator. The customer and their agent(s) shall ensure that they are fully aware of their obligations and any conditions pertinent to the installation of generation equipment and system.

15.3.1 Installation

The generation system installation shall comply with but not limited to:

- AS2067, AS/NZS 3000, AS 3008 and AS/NZS 3100
- Applicable system Codes and Standards including but limited to:
  - AS/NZS 4777 parts 1, 2 and 3
  - AS/NZS 5033
  - AS 2790, AS 3009, AS/NZS 3010, and AS/NZS4509
  - AS 1940 and AS 4086,
- The Network Operators Technical Rules
- WAER and these requirements

Where the system is to be a stand-alone generation system with no existing or future intended network interconnection the installation shall comply with the State Regulator (EnergySafety) requirements.

A customer and their agent shall not connect any form of generation system to a network unless the Network Operator has first granted approval to do so.

The customer is responsible for arranging (via their nominated Retailer) for the installation of new or upgraded metering equipment, (see Clause 15.11) including commissioning and for all ongoing system inspections.

15.3.2 Compliance and monitoring

The owner/operator shall:

- Maintain the generation system in a safe and functional condition
- Ensure that the generation system complies at all times with these requirements and those of the entities identified in Clause 15.3
- Not alter or interfere with the Network Operator’s equipment located at the supply address
- Seek approval from the Network Operator prior to altering the capacity of the generation system including those parts that may alter the system’s operation or functionality
- Not connect un-metered loads upstream of the network metering equipment
- Ensure that the owner/operator’s personnel, servants or agents who carry out any work or maintenance on the installation or any other part of the owner/operator’s electrical equipment are appropriately qualified, skilled and where required licensed to do so
- Shall retain all Certificate(s) issued in respect of that work.
15.3.3 Connection applications
Where a generation system is proposed, an application is required by the relevant Network Operator at the earliest possible opportunity and in all cases prior to connection. Where the customer wishes to enter into an energy buy back scheme similar early advice shall be provided to the relevant Electricity Retailer. Refer to Clause 7.8 for application details and forms.

Where there is no generation system network connection, the customer’s agent shall notify EnergySafety via the submission of a “Preliminary Notice” and “Notice of Completion”.

A Network Operator may wish to undertake an analysis or investigation of the generation system proposal before connection to confirm that the proposed connection will not adversely impact the integrity, safety and security of the network or other network users. Generally all generation systems installed in the metropolitan area and systems with a capacity of 1.5 kVA or larger installed in regional areas will be subjected to this process.

Unless otherwise stated in the Network Operators terms and conditions the validity period for a generation system connection application shall be 90 days from the date of Network Operator approval

15.3.3.1 Installation restrictions
A Network Operator’s approval to connect a generation system does not negate the need for the customer/operator to seek and obtain other approvals from relevant federal, state, local authorities and Electricity Retailers.

It is essential to identify any installation restrictions or requirements with the applicable agency(s) prior to applying for, purchasing, installing or commissioning a generation system.

15.3.4 System changes or alterations
Any alteration or modification of a generation system including increased output capacity, configuration, component upgrade or modification shall first be approved by the relevant Network Operator before any change is implemented.

Where a generation system is installed and connected to an existing electrical installation and that part of the existing electrical installation is or requires modification/augmentation, the completed work on the altered electrical installation shall comply with current technical and safety Codes and Standards.

Generation system relocations undertaken by the customer shall be treated as a new installation. For more information refer to Clause 7.8

Should the owner/operator intend to voluntarily disconnect their generation system from the network, formal notice shall be given to both the Network Operator and Electricity Retailer.

15.4 Customer equipment and appliances
Any technical analysis or investigation carried out by a Network Operator to determine the suitability of a customer’s generation system connection to their distribution network does not include an evaluation or consideration of the effect of that system on the customers electrical installation, equipment or appliances.

It is the customer’s responsibility to seek advice from an appropriately trained, qualified and competent service provider to determine the effects, adverse or otherwise, of the generation system on the customer’s electrical installation and on the equipment or appliances connected to that installation.
15.5 System designers and installers

Given the technical nature of the equipment, connection and application process it is recommended that the involvement of an electrical consultant or contractor be sought for Micro and Mini generation systems.

Applications for systems larger than 30 kVA, all distribution HV applications and transmission applications shall be prepared and submitted on behalf of the owner/operator by a professionally qualified electrical engineer.

Where the nominal pressure (voltage) of the system exceeds 50 volts AC or 120 volts ripple free DC, the installation and connection of the generation system shall be completed by a competent and licensed electrical contractor.

Additionally it should be noted that eligibility criteria associated with the provision of government or state agency grants and rebates may require the system installer to be the holder of specific generation system qualifications or additional endorsements.

15.6 Generation licence requirement

Generation systems generating less than 30 MW of capacity or classified as Micro or Mini do not require a “Generation Licence” however these systems shall be listed with the relevant Network Operator and Retailer. For more information pertaining to generation licenses refer to the Economic Regulation Authority

15.7 Connection arrangements

15.7.1 Connection

The aggregate output capacity of all generation systems installed downstream of the point of supply shall not exceed the operational capacity of the network service apparatus or customer’s electrical equipment connected to that apparatus.

It is preferable that the generation system is connected to the installation main switchboard. Where this is not possible due to distance or cost considerations, the nearest distribution board may be used as a point of connection as long as compliance is achieved.

The generation system connection shall be via a dedicated circuit complying with the requirements of the Network Operators technical requirements AS/NZS 3000 and AS 3008.

Cabling connecting the generator(s) to the installation switchboard including all cables between that switchboard and associated distribution board(s) shall be sized to address voltage rise/drop requirements and be capable of carrying the full rated output capacity of the generation system.

Segregation of wiring systems conveying different voltage levels shall be suitably maintained in accordance with AS/NZS 3000 utilising installation methods described in this Manual with particular attention given to circuits conveying DC voltages.

15.7.2 Isolation

The main switch(s) on the customer’s main switchboard shall isolate the customer’s installation and connected generation from the Network Operator’s distribution system. Refer to AS/NZS 3000 Clauses 2.3 and 7.3
15.7.3 Switching and fuse devices
All devices shall be suitably rated for the required duty and voltage type. Switching devices shall be lockable in the OFF position.

Where the source is DC, switches shall be DC rated and double pole, operating simultaneously in both the positive and negative conductors of the DC source.

AC rated devices shall not be used to control DC circuits. Where a DC fuse switch is used the fuse contacts shall be touch safe from both energy sources when in the open position.

15.7.4 Residual current devices (RCD's)
Generation systems shall be connected to the electrical installation on the distribution network side of any customer or installation residual current device(s).

15.7.5 Security of operational settings
Where operational settings are applied via a keypad or switches, adequate security shall be employed to prevent tampering or inadvertent/unauthorised changes to these settings. A suitable lock or password system shall be used. The Network Operator shall approve changes to settings prior to implementation.

15.8 Fault Protection
All equipment within the installation shall be adequately protected from electrical faults originating from either the customer's installation or the Network Operator's distribution system.

The fault contributions from the installation at each point of supply shall not exceed the values agreed between the owner/operator and the Network Operator as stated in the connection agreement.

When operating a generation system in a stand-alone configuration additional system augmentation may be required to achieve the required fault ratings and appropriate level of protection.

15.9 Interlocks and change over
Where a generation system is installed for the purposes of providing an alternative supply to the customer's premises the standby/emergency systems shall not be used or operated in parallel with the Network Operator's distribution network. The connection arrangement shall ensure that it is not possible for the alternative generation system to be connected to the network or permit the service and metering equipment to be energised in the event of an intentional or unintentional loss or partial loss of the connected network supply.

All devices within the installation capable of interconnecting the alternative generation equipment to the Network Operator's distribution network shall be adequately interlocked to reduce the risk of an out-of-synchronism fault and to prevent unintended paralleling with the Network Operator's distribution network.

Switching can be via either direct (electronically) or by suitable interlocking devices to prevent the simultaneous connection of the alternative supply to the distribution network. The opening or closing of any associated switchgear door or cover shall not affect or control the interlocking system.

Additionally alternative generation systems shall not rely on a communication signal from the Network Operator to initiate, operate or maintain a customer's alternative power supply.

Where the alternative system automatically comes into operation on the loss of network supply, a means of isolating the alternative supply shall also be provided. Switchgear to facilitate the manual or automatic changeover shall be located on or adjacent to the switchboard controlling that part of the electrical installation to be supplied from the alternative supply.
A changeover switch shall provide isolation between the generating unit and the Network Operator's distribution system. It shall be permanently wired and may incorporate an intermediate "off" position. If the changeover switch has an intermediate "off" position, it may be used in place of the main switch of the installation. Otherwise, a separate main switch (or switches) shall be provided.

The neutral shall not be switched or broken on the distribution supply (upstream) side of the M.E.N. connection. Refer AS/NZS 3000 Section 7

Changeover switches shall comply with AS 60947.6.1 Automatic Transfer Switches and Equipment and contactors or circuit breakers for automatic changeover shall meet the requirements of AS/NZS 3010.1.

15.10 Islanding prevention and protection schemes

All protection settings and schemes to the extent that they may affect the Network Operators network shall coordinate and grade with the Network Operator’s protection apparatus.

Prevention and protection schemes shall be installed in accordance with the Network Operators Technical Rules and applicable Codes and Standards as referenced in Clause 15.3

The generation system shall disconnect automatically from the network for any of the following events:

- Loss of network stability;
- Loss of network supply;
- Detection of network/customer fault conditions
- Power export exceeding agreed limits;
- Generator pole slip.

Where the generation system has the required network protection infrastructure and protocols, the system may continue to supply the consumer’s internal installation during loss of network supply. Reconnection to the distribution network shall be in accordance with the Network Operator’s Technical Rules.

It should not be assumed that standard electrical installation practices and islanding protection will be adequate for larger generation systems or for those systems located on the fringe or outside the major part of a distribution network.

The Network Operator may require the customer to install within their installation, additional protection measures to ensure the effective protection of personnel, infrastructure and the operation of the distribution network and customer’s system. Addition mitigation options may include but be not limited to:

- Augmentation of the network or the customer’s infrastructure
- Neutral voltage displacement (NVD) relays
- Inter-trips (IT)
- Negative phase sequence (NPS) protection
- Other anti-islanding relay options

15.11 Metering, monitoring, control and data-acquisition

The customer/operator is responsible for arranging for the installation of or changes to their metering equipment via a separate application to the relevant Electricity Retailer

No generation system shall be connected to a distribution network prior to the installation of new or upgraded Code compliant import/export metering equipment as approved by the Network Operator. Refer to Sections 7 and 11

The generator owner/operator shall where required enable monitoring of the installation and appropriate control of switches by the Network Operator to safeguard its personnel, the public and the network.
Costs associated with the installation of new or modification of existing metering arrangements, switchboard enclosures, reprogramming of suitable existing metering equipment or the supply and installation of new import/export metering shall be borne by the customer. In all cases the metering equipment shall be as specified and remain the property of the Network Operator.

The availability of buy back tariffs should be discussed with the Electricity Retailer.

Appropriate non-hazardous area(s) and equipment housing shall be established and maintained within the customer’s installation to accommodate the Network Operator’s metering, control and data-acquisition equipment. (Refer to Section 11).

15.12 Power quality

Network Operators are charged with the responsibility of ensuring the quality of supply to all customers as prescribed in Section 10.

Modification to a customer’s electrical installation may be required to ensure voltage levels or imbalances are avoided both in the installation and in the network.

Where unacceptable operational parameters are identified or discovered, the Network Operator may require or perform a power quality investigation to determine the cause and specify an appropriate course(s) of action including the upgrade or disconnection of the offending installation or equipment.

15.12.1 Network connection limits

The maximum amount of generation that can be connected to any Low voltage network is determined by the network characteristics and the ability of that network to meet the performance requirements of the responsible Network Operator.

A detailed evaluation may be required to ensure that the voltage performance requirements of the network is not compromised when the system is either generating, off line or not available. If an application for additional generation results in the network limits being exceeded, the Network Operator may:

- Reject the application as presented, therefore disallowing the network connection; or
- Consider a downsized generation system that ensures network performance limits are maintained; or
- Require a upgrade of the customer connection and effected portion of the network to accommodate the installation of the proposed generation system that ensures network performance is not jeopardised

For Horizon Power the maximum limits will depend on where the generation system is to be installed and to network. The customer/operator shall check with Horizon Power to confirm the limits of the specific network(s).

For Western Power the general guideline used for the maximum generation connected to the SWIS LV distribution network is 30% of the transformer capacity or 30% of the LV feeder capacity measured in kVA. The maximum generation capacity is limited to the customer connection. For standard supply arrangements this limit shall be 5 kVA for single phase and 15 kVA for three phase.

15.12.2 Voltage drop

When considering the volt drop along network feeders and infrastructure, the power provided by the generation system is not deducted from the customer’s maximum demand.

The network is designed assuming that customer generator system is not available, power quality limits can be maintained and maximum loads can be supplied. This ensures the network capacity is not exceeded should the system be removed from service.
15.12.3 Voltage rise
It is a network requirement that voltage rise across the network and customer’s installation shall not exceed the Network Operators specified limits for the rated voltage. Modification to the customer’s electrical installation inclusive of consumer installation or mains may be required to ensure voltage levels or imbalances are avoided both in the installation and in the network.

15.12.4 Power factor
Clause 10.8 details the Network Operators power factor requirements for both generator and connected loads.

15.13 Labelling
The customer's general electrical installation and generation system shall be labelled in accordance with these requirements and AS 1319
System installers when applying signage and labelling shall consider the fundamental safety and operational purpose for each and where required vary the terminology to ensure a clear understanding is delivered. In summary labels and signage shall be:

- In English
- Constructed of appropriate durable materials suitable for the location and adequate for the purpose
- Fixed in a manner that ensures the sign/label remains in place for the life of the equipment and is appropriate for the location
- Legible with a letter size appropriate for the location
- Clearly visible and indelible
- Effectively maintained to deliver the appropriate warning/instructional statement.

Signs and labels shall not be obscured by placement or location so that the meaning or warning is lost or incorrectly conveyed. As a guide lettering height should be 5 mm for upper case and 4 mm for lower case, per metre of viewing distance.

All switches and control devices shall be labelled to confirm their functionality and relationship with the generation system and the Network Operator’s distribution network. If the system is connected to a sub board, all up-stream (i.e. towards the main switchboard) switches and switchboards shall also be labelled.

Multiple sources of supply, incorporating automatic or manual switching shall have prominent labels and signage placed both at the source and point of supply informing operational staff of:

- The existence and location of each source of supply
- Type(s) of supply
- Point(s) of isolation
- Shut down and isolation procedures
- Type of and location of the switching operation
- The priority sequence for each supply.

15.14 Commissioning and maintenance
The customer/operator is responsible for system commissioning, maintenance and all ongoing inspections.
15.14.1 Commissioning
The generation system shall be tested and commissioned by a competent electrical engineer/contractor following the installation of the Code compliant metering equipment. The commissioning process shall as a minimum confirm and verify that:

- The installation complies with the required standards and operational requirements and is fit for the purpose
- Functions correctly within the specified operational ranges
- Required switches and protection devices are installed and functional
- Islanding protection operates in accordance with stated network parameters
- Signage, and labelling comply with the applicable codes, standards and these requirements
- Operational manuals, shut down procedure and diagrams have been validated and checked to ensure they accurately reflect the installed system
- Shutdown procedures are prominently displayed.
- For system over 30 kVA commissioning shall be in accordance with the applicable Codes and Standards and certified by a professionally qualified electrical engineer.

Where the customer has entered into an agreement to export energy, the Electricity Retailer may require the system owner/operator to provide confirmation that the generation system has been installed, tested and commissioned by an approved electrical contractor in accordance with relevant technical and operational requirements.

15.14.2 Operational manual
As a part of the commissioning process the customer/operator shall be provided with an system operation and technical manual together with sufficient on site instruction/training to inform and transfer to the customer/operator a clear understanding of the:

- Obligations and responsibilities associated with operating the generation system
- Operating principles, component identification and functionality
- Safety features and modes of operation
- Energisation and isolation procedures
- Operational relationship with the Network Operators network
- Care and maintenance requirements

It is the customer/operator's responsibility to ensure that they are informed and understand the operation and functionality of their generation system and that the system is maintained in accordance with the manufacturer's, Network Operator's and where applicable the Retailer's requirements. The customer/operator shall not subsequently modify the generation system without first notifying and gaining approval from the Network Operator and Electricity Retailer.

15.14.3 Shut down procedure
Each generation system shall have a shutdown procedure, describing the shutdown and emergency processes to be implemented by the system operator, network staff and emergency services personnel. As a minimum, the procedure shall be prominently displayed in the following locations:

- Main switchboard; and
- The switchboard to which the system is directly connected to; and
- Fire panel (where available, typically in large buildings)

The procedure may also include information relating to the start-up procedures.
15.14.4 Maintenance
The Network Operator and the Electricity Retailer may elect to inspect the generation system from time to time to ensure continued compliance. In the event that the Network Operator considers that the installation poses a threat to safety, quality of supply or to the integrity of the distribution system the Network Operator may restrict the use of or disconnect the system.

Protection systems shall be tested for correct functionality at regular intervals in accordance with the manufacturer’s requirements. The customer/operator shall engage the services of a suitably competent service provider to conduct these tests. Results of tests shall be certified by the service provider and retained by the customer/operator for provision to the Regulator, Electricity Retailer or Network Operator when requested.

15.15 Additional requirements for parallel connected generation
A direct connected generation system is defined as all generation systems not covered by the requirements of AS 4777 – “Grid connection of energy systems via inverters”.

This definition may include but is not limited to Small, Medium and Large systems consisting of:
- Synchronous generating units driven by gas engines, gas turbines or petrol/diesel engines;
- Large fuel-cell installations
- Wind turbine generating units
- Synchronous and asynchronous generating units.

Direct connected generation systems including both export or non-export systems connected to operate in parallel with a Network Operator's distribution network shall comply with these requirements.

15.15.1 Application and connection
Small to Large connection applications shall be prepared utilised the services of a professionally qualified electrical engineer with generation industry experience to aid the customer with the technical details and completion of the application.

An application shall be is submitted to and approved by the Network Operator prior to the commencement of any installation work. For more information refer to Clause 7.8.

Each application will be individually assessed by the relevant the Network Operator for connection suitability and compliance with regulatory and Network Operator requirements.

15.15.1.1 Horizon Power policy
For further information and guidance on Horizon Power’s connection requirements to the NWIS and NIS distribution network reference shall be made to the Horizon Power’s Technical Rules or contact made by e-mailing enquiries@horizonpower-reply.com.au

15.15.1.2 Western Power policy
The Generator Grid Connection Guide provides background information on aspects of power systems that are particularly pertinent to Western Power’s distribution network. The guide provides a high level overview of the requirements for connecting a generator to the SWIS. The guide is intended to assist in understanding the requirements of Western Power’s Technical Rules but does not replace the requirements.
15.15.2 Design and installation
The installation shall be designed to control and limit any damage produced by a generator failure. Direct connected generation systems shall be mechanically and electrically isolated from the distribution network supply where it is not a cogeneration system. The system shall be protected against weather, dampness, fire and over-current.

Conductors shall be suitably segregated and spaced from all the other conductors of the electrical installation, to limit any damage to the customer's electrical installation if an internal generator fault occurs. The correct sizing of both the earth and neutral conductors is essential for permanently connected generator equipment as these conductors may carry substantial fault currents. Refer to AS/NZS 3000 and AS 2067 for specific information.

15.15.3 Multiple generators
Customers must discuss the method of connection with the relevant Network Operator where multiple generators are to be connected in parallel.

Methods will vary dependent the size of the site and whether or not all the generators are to be connected at the same switchboard. Larger sites may have generation units at multiple locations, whereas smaller sites may have generation units located in one position. Refer to Clause 15.9 and AS 3010 for changeover requirements.

It should be noted that harmonic currents may be produced by these generator arrangements through the neutral conductor. Where dissimilar generators are operated in parallel, steps shall be taken to limit the circulating current in the neutral connection between the generators.

15.16 Additional requirements for inverter connected generation
The term 'inverter energy system' (IES) as used in this Manual has the same meaning as in AS 4777. An inverter energy system installation is defined as: A Micro or Mini generation installation incorporating an inverter complying with the requirements of AS 4777, Grid connection of energy systems via inverters, Parts 1, 2 and 3.

This definition includes systems which are connected to a distribution network by an approved (dc/ac sine wave) inverter. Systems may include stand-alone, standby or parallel systems but not necessarily limited to:

- Photovoltaic (solar panels) installations
- Small wind turbine generating unit;
- Micro Hydro generating units
- Battery storage inverter systems

Systems complying with AS 4777 up to a maximum of 5 kVA single phase or 30 kVA three phase may be connected to a distribution network if approved by the relevant Network Operator and where required by the Retailer.

Note: Additional information pertaining to Horizon Power's connection requirements can be viewed at Technical Requirements for Renewable Energy Systems to Low Voltage Networks.
15.16.1 Additional requirements
The following requirements are in addition to the requirements contained within this Section of the Manual.

A customer/operator shall advise and apply to the relevant Network Operator when contemplating the connection of an IES to a distribution network.

IES systems can be technical and complex therefore it is recommended that the expertise and knowledge of an experienced system designer and installer is sought by the customer to determine the appropriate type, size and installation requirements for the given location.

Dependent on the inverter size, generation capacity, location and Network Operator requirements the customer may need to enter into negotiations with the Network Operator before proceeding with any detailed design, placement of orders for equipment or letting of contracts. This will avoid costs to the customer arising from designs or equipment identified as being unsuitable for connection to the respective distribution network.

15.16.2 Energy exporting
Generally Network Operators are not able to enter into direct energy buyback agreements.

Customers wishing to offset part or all of their electricity needs by exporting (selling), to an Electricity Retailer, any excess energy produced by their system, need to enter into a separate agreement with their Retailer prior to having their system connected to the network.

15.16.3 Approved inverters
The inverter and protection equipment shall be certified (Cause 15.16.3.1) by a recognised testing laboratory and approved by the relevant Network Operator prior to being connected to their distribution network.

It is the manufacturer's or their agent’s responsibility to formally seek approval and to ensure that the inverter's certification remains current. Inverters that do not have both independent certification and Network Operator approval shall not be or remain connected to the distribution network.

Where an inverter has been previously approved by a Network Operator but subsequently modified or altered, the inverter as required by the approval protocols shall be retested by a recognised testing laboratory then resubmitted to the Network Operator for evaluation and approval.

If endorsed, the modified inverter may then be added to the Network Operator’s approved register. For more information please refer to the relevant Network Operator:

- Horizon Power - Technical requirements
- Western Power – Approved Inverters.

Should a manufacturer remove an inverter from production or sale they shall formally advise the Network Operator so that the model can be deregistered.

For the purposes of these requirements an approved inverter means an inverter that has been:

- Manufactured to the required Australian Standards
- Tested by a NATA (National Association of Testing Authority) recognised testing laboratory
- Certified as being compliant with AS 4777, AS/NZS 3100 and IEC 62109
- Issued with the appropriate accreditation certificate(s)
- Accepted as complying with the Network Operators operational and functional requirements
- Registered and publicly listed with the Network Operator responsible for the distribution network to which the inverter is intended to be connected.
Manufacturers seeking approval for a series of inverters with different capacities but with the same operational specification/parameters may submit to the Network Operator, for approval and registration of the inverter range, certification applicable to one unit within the series accompanied by the relevant details of each unit within the range. This can be demonstrated through the provision of a Certificate of Suitability issued by the appropriate government agency or recognised private organisation.

**Note:** AS 5033 2012 stipulates that inverter eligibility criteria will change to include IEC 62109. Manufacturers and installers shall check with the relevant Network Operator to confirm compliance requirements.

**15.16.3.1 Certification**

To achieve certification the following is required:

- A “Certificate of Compliance” with supporting test results issued by a NATA recognised testing laboratory confirming conformity with the AS 4777 suite of standards; and
- A “Certificate of Suitability” confirming compliance with AS/NZS 3100 and IEC 62109 issued from or approved by an Australian Electrical Regulatory Authority for electrical equipment categorised as 'non-declared articles'.

Mutual recognition arrangements exist across Australian state and territorial boundaries for Electrical Regulatory Authorities and between NATA recognised testing laboratories therefore Certificates issued by one entity should be recognised by other participating entities.

Manufacturers and suppliers shall ensure that product certification is maintained and remains current. Should product certification expire or lapse the Network Operator shall be advised immediately with appropriate actions taken where certification is to be retained. Details of certification renewal shall be forwarded to the Network Operator at the earliest possible opportunity.

**15.16.3.2 Non-certified systems**

Where a non-approved inverter has been connected to a distribution network it shall be disconnected and remain so until such time as the inverter has been approved and included on the Network Operators register of approved inverters. Refer to Clause 7.8

**15.16.4 Compliance**

In addition to the general requirements contained within this Section a customer’s inverter energy system shall comply with:

- IEC 62109 Safety of power converters for use in photovoltaic power systems
- AS 62040 Uninterruptible power systems (UPS)

**15.16.5 Application and connection**

An application shall be is submitted to and approved by the Network Operator prior to the commencement of any installation work. For more information refer to Clause 7.20
15.16.6 Inverter energy system capacity

It shall be assumed that the full rated capacity of the inverter is capable of being exported to the distribution system.

The nominal network voltages and maximum IES capacities for standard supply arrangements shall be as shown in Table 19:

<table>
<thead>
<tr>
<th>Nominal voltage</th>
<th>Maximum Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>240 V (single phase)</td>
<td>5 kVA</td>
</tr>
<tr>
<td>480 V (two phase)</td>
<td>Refer to Note¹</td>
</tr>
<tr>
<td>415 V (three phase)</td>
<td>15 kVA</td>
</tr>
</tbody>
</table>

Note¹: As for single phase systems but subject to Network Operator individual assessment.

A Network Operator may carry out a connection assessment of any inverter energy system to confirm that the required power performance standards will and are being met when the system is operating at its full rated capacity including:

- Single phase PV connections rated greater than 5 kVA, and
- 415 V three phase connections with more than 2.5 kVA imbalance between any two phases

15.16.7 Operational parameters

15.16.7.1 Voltage limits

Inverter voltage limits shall be set in accordance with the equipment capabilities and AS 4777. In all circumstances the inverter energy system shall remain connected for voltage variations within the limits shown in Table 20 unless otherwise agreed by the Network Operator. The network voltage range is based on 10-minute averages of the RMS value in accordance with AS 61000.3.100 - 2011.

<table>
<thead>
<tr>
<th>Nominal voltage</th>
<th>Lower limit</th>
<th>Upper limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>240 V</td>
<td>226 V</td>
<td>254 V</td>
</tr>
<tr>
<td>415 V</td>
<td>390 V</td>
<td>440 V</td>
</tr>
</tbody>
</table>

Table 20: Low voltage distribution system voltage limits

15.16.7.2 Frequency limits

Inverter frequency limits shall be set in accordance with the equipment capabilities and AS 4777. In all circumstances the inverter energy system shall remain connected for frequency variations between 47.5 Hz and 52 Hz unless otherwise agreed by Network Operator.

15.16.8 Connection and wiring

IES wiring shall be installed in accordance with the requirements of Clause 15.3. Adequate protection from UV and mechanical damage shall be provided in accordance with AS/NZS 3000 including Clauses 3.3.2.11 and 3.9 with additional protected provided for array wiring as prescribed by AS/NZS 5033.
15.16.8.1 Consumer mains

Industry best practice dictates that voltage rise across the customer’s electrical installation should not exceed 1% and it is a network requirement that voltage rise across the network service cable shall not exceed 1% of the rated voltage.

Voltage rise may occur where the power exported from the inverter causes the voltage at the switchboard to rise beyond the level normally expected if no load was present at that point.

Modification to the customer’s electrical installation may be required to ensure voltage levels or imbalances are maintained within the installation.

15.16.8.2 Array and sub array

PV string, array and sub-array wiring shall be selected and sized in accordance with the requirements prescribed by AS/NZS 3000 and AS/NZS 5033 with specific regard to:

- Location and required levels of protection;
- Over current protection ratings where in use (including AS/NZS 5033 Table 4.2);
- Maximum normal operating current (including AS/NZS 5033 Table 4.2);
- Voltage drop and prospective fault current.

15.16.8.3 Connection

Wiring connecting the IES to the installation shall be rated to accommodate the full rated output of the inverter. It is preferable for the system be connected to the buildings main switchboard. Refer to Clause 15.7.

15.16.8.4 Earthing arrangements

Where a PV array has the capability of delivering voltages greater than ELV all exposed metal module frames shall be earthed. Additional if the array wiring is not protected in conduit or ducting, the array mounting frames shall be earthed.

Exposed conductive parts including structural metalwork (e.g. module frames, structures) shall be bonded to earth via an earthing conductor complying with AS/NZS 3000 with a minimum cross-sectional area of 4mm² connected directly to the installation’s earthing system.

If the exposed conductive parts of a PV array are exposed to lightning, the bonding conductor shall have a minimum cross-sectional area of 16mm² copper or equivalent. Refer to AS/NZS 5033

15.16.8.5 Wiring segregation and identification

PV array and sub array cabling installed in or on buildings shall be either distinctively manufactured and permanently embossed to identify their function or distinctively marked with coloured labels bearing the words ‘SOLAR’ attached at intervals not exceeding 2 metres.

Where installed in conduit or duct, the wiring enclosure shall be labelled ‘SOLAR’ at each end and at each change in direction.

15.16.9 Schematic diagram

The Network Operator may require as a part of the application process details of the connection arrangement especially for systems:

- Larger than 2.5 kVA.
- With battery storage capabilities or facilities
- Non PV systems.

On completion and commissioning of the installation an accurate single sided wiring diagram of the installation showing all equipment and switches shall be affixed adjacent the inverter system or incorporated into the users technical manual. The following Figure 69 is an example of a typical connection diagram.
15.16.10 Isolation and protection

There shall be a visible and accessible method of ensuring that the inverter energy system can be disconnected from the distribution network and disconnected from the customer's installation.

Figure 69 provides an example diagram of inverter energy system protection, isolation and connection arrangement.

15.16.10.1 Over-current protection

Over-current protection shall be provided at the inverter energy system in accordance with AS 4777 unless otherwise agreed to by the Network Operator.

15.16.10.2 Isolation

Isolation and protection shall be installed in accordance with the requirements of AS/NZS3000, AS 4777 and AS/NZS 5033, irrespective of where the inverter energy system circuit emanates from. In summary the following shall be installed:

- Main switch (normal supply) – To isolate the entire installation from the distribution system
- Main switch (solar supply) – To isolate and protect the inverter energy system
- Inverter isolation switch (inverter AC isolator) - To isolate the inverter output to the customer's installation.
- Source isolation switch (PV array DC isolator) – Located as close to the inverter as possible to isolate the source from the inverter.

15.16.10.3 PV array switching and fuse devices

PV array and sub array devices shall be supplied and installed in accordance with the requirements of AS/NZS 5033.

Switch devices shall as a minimum:

- Be rated for DC use
- Not be polarity sensitive
- Have a voltage rating equal to, or greater than, that specified by AS/NZS 5033
- Not have exposed metallic live parts in the connected or disconnected state
- Provide a degree of protection suitable for the location and not less than that specified by AS/NZS 5033
Fuse devices shall as a minimum:

- Be rated for DC use
- Have a voltage rating equal to, or greater than, that specified by AS/NZS 5033
- Be rated to interrupt the full load and prospective fault currents from the PV array and any other connected power sources (e.g. batteries, generators and the grid). Note: When fuses are provided for fault current protection, the use of fused switch dis-connectors (fuse-combination units) is recommended.
- Provide a degree of protection suitable for the location and not less than that specified by AS/NZS 5033

15.16.11 Safety

15.16.11.1 Restricted access to PV arrays

PV arrays for installation on domestic dwellings shall not have Voc array maximum voltages greater than 600 Vdc. For non-domestic installations where the PV array maximum voltage exceeds 600 Vdc the entire PV array including associated equipment, wiring and protection, shall be constructed so that access is restricted to authorised persons only.

In determining appropriate measures to restrict unauthorised access, the following factors should be considered:

- Type and method of restriction (e.g. by location, structure, fencing or permanent barriers)
- Minimum heights and clearances
- Material specification (e.g. rigidity, permanence, durability stability and aperture size).
- Signage

15.16.11.2 Fire safety

Customers/operators of IES should consider the implications of electrical or mechanical damage to the PV array’s mains cable and wiring systems in the event of a fire or other significant adverse event. A potential exists for emergency services personnel and industry operatives to receive an electric shock through direct or indirect contact via water spray with a full or partially operational PV array and wiring.

In addition to the requirements of AS/NZS 3000 and AS 5033 one of the following or combination of installation methods should be considered as a part of the installation methodology to limit any hazard potential:

- External installation of the Inverter in an accessible and obvious location
- Automatic isolation of the PV array(s) mains cable at the source
- Use of highly visible external wiring systems
- Fire resistant internal wiring systems (WS52W) as prescribed by AS/NZS 3013 within roof spaces or accessible areas

15.16.12 Commissioning

In addition to the general requirements for system commissioning the service provider shall confirm that the:

- Completed installation complies with AS 4777 and AS/NZS 5033.
- Islanding protection operates correctly,
  - disconnecting the inverter energy system from the network within 2 seconds
  - reconnecting following restoration of normal supply is greater than 1 minute
- Operational manual, shut down procedure and diagrams accurately reflect the installed system
- Owner/operator understands their obligations and responsibilities

15.16.13 Labelling and signage guide

The system installation shall in addition to the general requirements be labelled in accordance with AS 4777, AS/NZS 5033 and IEC 62109. Label examples are shown in Figure 70
15.16.13.1 Switches
Labelled shall display and confirm the functionality and relationship between the inverter energy system and the distribution network. If the Inverter energy system is connected to a sub board, all up-stream (i.e. towards the main switchboard) switches and switchboards shall also be labelled.

15.16.13.2 Inverter energy system
Systems shall include warning signage to clearly indicate the existence of multiple supplies and identify which circuits are affected by those supplies. Signage shall describe the type of generation source and as a minimum be placed in the following locations:
- On the switchboard that has the inverter energy system directly connected to it
- On all switchboards including main switchboard and distribution board(s) between the main switchboard and the board that has the inverter energy system directly connected to it
- In the meter enclosure containing the Network Operator’s metering equipment

15.16.13.3 Junction boxes (solar)
A sign containing the words “WARNING HAZARDOUS D.C. VOLTAGES” shall be attached to the PV array and any PV sub array junction boxes.

15.16.13.4 Fire and emergency information
Where a PV array with a rated output greater than 500 W or voltage greater than 50 V DC is installed on a building and has a rated output greater than 500 W or a DC voltage greater than 50 V warning labels complying with AS/NZS 5033 shall be installed next to the meter enclosure and the building’s main switchboard.

A clearly visible circular (minimum 70 mm diameter) green reflector sign with the letters “PV” is to be placed on or immediately adjacent to the installations meter box and switchboard to warn emergency services personnel.

15.16.13.5 Shut down procedure
A shutdown procedure as prescribed by AS/NZS 5033 and AS/NZS 4509 shall be provided at the switchboard to which the system is directly connected to.

15.16.13.6 IES sample signage
The following figures provide examples of signage. It is indicative of the signage specified by the relevant Australian Standards.

To be located on the switchboard to which the inverter is connected (Refer AS 4777-2005 Cl 5.5.2.).

Colour: Yellow with black lettering

To be located on the main switchboard and all intermediate distribution boards where inverter is connected to a distribution board. (Refer AS 4777 - 2005 Cl 5.5.3.).

Colour: Yellow with black lettering
To be located on the main switchboard when the inverter location is not adjacent to switchboard. *(Refer AS 4777 - 2005 Cl 5.5.1)*

**Colour:** White with black lettering

**INVERTER LOCATED AT**

---

Label for the Normal Supply Main Switch on the switchboard or distribution board to which the Inverter energy system is connected. *(Refer AS 4777 - 2005 Cl 5.5.2).*

**Colour:** White with black lettering

**MAIN SWITCH**

**(NORMAL SUPPLY)**

---

Label for the Inverter Supply Main Switch on the switchboard or distribution board to which the Inverter energy system is connected. *(Refer AS 4777 - 2005 Cl 5.5.2).*

**Colour:** White with black lettering

**MAIN SWITCH**

**(SOLAR SUPPLY)**

---

PV Array Isolator label. *(Refer AS/NZS 5033 - 2012 Cl 5.5.2).*

**Colour:** White with black lettering

**PV ARRAY**

**D.C. ISOLATOR**

---

Warning label located next to inverter. *(Refer AS AS/NZS 5033 - 2012 Cl 5.5.2 & Cl 4.4.1.3).*

**Colour:** Yellow with black lettering

**WARNING**

**MULTIPLE D.C. SOURCES**

**TURN OFF ALL D.C. SOURCES ISOLATORS TO ISOLATE EQUIPMENT**

---

AC inverter Isolator label *(Refer AS/NZS 3000 - 2007 Cl 2.3.4).*

**Colour:** White with black lettering

**A.C. INVERTER**

**ISOLATOR**

---

Warning sign for main switchboard where a inverter energy system incorporates a UPS supply. *(Refer AS 4777 – 2005 Cl 5.6.5).*

**Colour:** Yellow with black lettering

**WARNING**

**UPS CONNECTED**

**FOLLOW SHUTDOWN PROCEDURE**
### UPS supply label located on the UPS switchboard or load centre.

*(Refer AS 4777 - 2005 Cl 5.6).*

<table>
<thead>
<tr>
<th>Colour: White with black lettering</th>
<th>MAIN SWITCH (UPS SUPPLY)</th>
</tr>
</thead>
</table>

### Emergency services information sign nominating type of energy source and location.

*(Refer AS/NZS 5033 - 2012 Cl 5.4).*

<table>
<thead>
<tr>
<th>Colour: Red with white lettering</th>
<th>SOLAR ARRAY ON ROOF</th>
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<tbody>
<tr>
<td></td>
<td>Open Circuit Voltage V</td>
</tr>
<tr>
<td></td>
<td>Short Circuit Current A</td>
</tr>
</tbody>
</table>

### Emergency services information sign located on or immediately adjacent to the meter box and main switchboard.

*(Refer AS/NZS 5033 - 2012 Cl 5.4).*

<table>
<thead>
<tr>
<th>Colour: Green with white lettering</th>
<th>PV</th>
</tr>
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</table>

### PV Array and Sub-Array junction and marshalling box label.

*(Refer AS/NZS 5033 - 2012 Cl 5.3.2).*

<table>
<thead>
<tr>
<th>Colour: Yellow with black lettering</th>
<th>WARNING HAZARDOUS D.C. VOLTAGES</th>
</tr>
</thead>
</table>

### Warning sign for systems over 600 V, located on access door or gate.

*(Refer AS/NZS 5033 – 2012 Cl 5.5.3).*

<table>
<thead>
<tr>
<th>Colour: Yellow with black lettering</th>
<th>WARNING HAZARDOUS VOLTAGE AUTHORISED ACCESS ONLY</th>
</tr>
</thead>
</table>
**SHUT DOWN PROCEDURE**

1. Turn off the **Main Switch (Solar Supply)** located at the installation switchboard.
2. Turn off the **Inverter Main Switch** located at or near the inverter.
3. Turn off the **PV Array D.C. Isolator** located next to or near the inverter.

**WARNING**

PV array D.C. isolators do not de-energise the PV array and array cabling.

**Figure 70:** Labelling examples

### 15.17 Portable Generation systems

Portable generation systems may be temporarily connected to a customer's installation provided that the system cannot be directly or indirectly connected to the distribution network. The method of connection shall be in accordance with AS/NZS 3000 and AS 2709. This requirement is essential as there are no adequate protective mechanisms for the control of islanding or automatic disconnect/reconnection of the portable generation systems.

### 15.18 Transmission connected generation systems

Generator operators shall seek the advice and services of professionally qualified electrical engineer with specialist power system experience in order to provide required data and meet the Network Operator's requirements for connection.

#### 15.18.1 Horizon Power policy

For further information and guidance on Horizon Power's connection requirements to the NWIS and NIS networks reference shall be made to the network Technical Rules or contact made by e-mailing enquiries@horizonpower-reply.com.au

#### 15.18.2 Western Power policy

The Generator Grid Connection Guide provides background information on aspects of power systems that are particularly pertinent to Western Power's transmission network and gives a high level overview of the requirements to connect a generator to the SWIS. The guide is intended to assist in understanding the requirements of Western Power's Technical Rules but does not replace the requirements.

#### 15.18.3 Application and connection

Small to Large connections shall be prepared utilised the services of a professionally qualified electrical engineer with generation industry experience to aid the customer with the technical details and completion of the application.

It is important that an application is submitted to and approved by the Network Operator prior any installation work commencing. For more information refer to Clauses 7.8 and 7.10
Distribution Connections Manual

Appendices
### Appendix A. Manual amendments

<table>
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<td>1 June 2010</td>
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For details of amendments numbers 01, 02, and 03 refer to the WADCM amendment repository.

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<td>Addendum #2</td>
<td>16th December 2015</td>
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<td>1st October 2016</td>
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<td>1st May 2019</td>
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<td>1st February 2020</td>
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### AMENDMENT NUMBER 05

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<tr>
<td>9.3.6</td>
<td>® Clause amended Where the number of permitted connections (as determined by the Network Operator) is exceeded a site main switchboard <strong>shall</strong> must be installed. so that there are no more than two consumer main connections from a single survey strata plan to a pillar on the plan or to a pillar on an adjacent plan or lot. Alternatively, a customer within the SWIS may request, at their additional expense, the installation of a dedicated pillar to service a strata development up to four lots.</td>
</tr>
<tr>
<td>11.5.1</td>
<td>® Reference to remote meter height withdrawn.</td>
</tr>
<tr>
<td>Fig 30</td>
<td>® Diagram amended. Reference to 30m max distance removed and replace by boundary.</td>
</tr>
<tr>
<td>Fig 31, 32, 33, 34, &amp; 35</td>
<td>® Figure amended to align with Strata switchboard guideline</td>
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<tr>
<td>12.2.4.2</td>
<td>® A maximum of two dwellings freehold lots may be connected to a single service pillar. Where an existing freehold title lot is subdivided into three or more strata lots the Network Operator may require in accordance with their respective UDS requirements, the installation of a main switchboard (MSB) or an approved network dedicated pillar must be installed. This condition ensures adequate termination capacity for all users both current and future, by limiting the number of connections from any strata development to two.</td>
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### AMENDMENT NUMBER 05

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<td>All</td>
<td>® References to EnergySafety and WorkSafe reviewed and where required aligned with public presentation.</td>
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<tr>
<td>1.2</td>
<td>® Definition for “Pillar” amended with the last sentence withdrawn.</td>
</tr>
<tr>
<td></td>
<td>® Definition for “Standard supply” amended with the words “three phase” inserted in the third dot point</td>
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<td></td>
<td>® Definition for SoC Amend to read DMIRS SoC (EnergySafety and WorkSafe) Operational Sections within the Department of Mines, Industry Regulation and Safety, Commence established to monitor industry standards of safety and protection for workers industry and the community.</td>
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### 1.3

© The following acronyms and abbreviations amended or added to the existing clause:
- **DCS** - Distribution Construction Standard
- **DCSH** - Distribution Construction Standards Handbook
- **DCCCR** - Distribution Customer Connection Requirements
- **DDC** - Distribution Design Catalogue
- **P2P** - Distribution Pole to Pillar Guidelines
- **DDR** - Distribution Design Rules
- **DSM** - Distribution Substation Manual
- **DSPM** - Distribution Substation Plant Manual
- **UCIM** - Underground Cable Installation Manual
- **UDS** - Underground Distribution Schemes Manual
- **UMS** - Un-metered Supply Policy
- **WADCM** - Western Australian Distribution Connection Manual

### 1.4.3

© The following references added or amended to read
- **Documents published by Horizon Power**
  - Distribution Construction Standards Manual
  - Distribution Design Rules

### 1.4.4

© A new reference added and the 7th dot point reference amended
- **Documents published by Western Power**
  - Distribution Customer Connection Requirements
  - Distribution Substation Plant Manual

### 3.6.3.1 & 3.6.3.3

© The reference and clause pertaining to *Network Operator’s Customer Service Charter* deleted
© New reference and description for *Electricity Networks Access Code 2004* inserted

**The Code**

Establishes the framework for third party access to electricity transmission and distribution networks with the objective of promoting economical efficient investment in, operation and use of, networks and services of networks in Western Australia.

### 3.6.3.4

© Last sentence in the clause deleted

For more information about Network Operator’s compliance commitment, please refer to the organisation’s Customer Service Charter.

### 6.9.2

© 1st and 2nd paragraphs amended to read

**Installation of ducts**

All ducts shall have a minimum cover of 750 mm to the top of the duct and be bedded in sand for a minimum distance of 150 mm below the lowest duct, and 150 mm above the highest duct. No ducts shall be installed with more than 1100 mm cover unless required to have sufficient clearance from other services. The Network Operator must shall be consulted and give permission prior to ducts being installed below the maximum requirement.

In general ducts are to be laid in horizontal formation up to four in number, and thereafter in tier formation. For road-crossing ducts, the length of the ducts should be the road width plus 1000 mm minimum projection either side of the kerb.

For specific detailed information on network installation requirements refer to the relevant sections of the Network Operator’s UCIM, DCS, and DSM technical requirements manuals.
### Section 8

- **Horizon Power:**
  - Distribution Design Rules - DDR
  - Distribution Construction Standard - DCS
  - Underground Cable Installation Manual - UCIM
  - Underground Distribution Scheme Manual - UDS
- **Western Power:**
  - Distribution Construction Standard Handbook - DCSH
  - Distribution Substation Plant Manual - DSPM
  - Underground Cable Installation Manual - UCIM
  - Underground Distribution Scheme Manual - UDS

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<thead>
<tr>
<th>Page 306 of 333</th>
</tr>
</thead>
</table>

### 8.2.1

- All references to “fault note” replaced with “defect notification”
- The reference to E-TIC replaced with ‘eNotice’.

### 8.3

- The existing clause amended to read:
  
  'eNotice' is a web based facility for the electronic lodgement or delivery of Preliminary Notices, Notices of Completion and Electrical Safety Certificates for electrical work.
  
  The ‘eNotice system is replacing the E-TIC electronic ticket lodgement system originally developed by Western Power and now used by most Network Operators. The system allows Preliminary and Completion Notices to be submitted electronically by participating electrical contractors through a Network Operator’s external website.
  
  Once the notices are submitted via this format they are downloaded into the Network Operator’s computer system, validated and automatically processed. With each successful lodgement E-TIC creates a receipt number that can be used by the applicant as a point of reference.
  
  E-TIC is officially recognised as an approved method for lodgement for notices. The system offers a range of advantages, to assist electrical contractors with their statutory obligations. For more information about the system and the qualifying criteria please refer to the relevant Network Operator.

### 11.5.7

- In the 1st sentence the word “front” inserted after the word “property”

### 11.6.2

- In the 3rd sentence the words “supplied metering” inserted after the word “customer”

### 11.6.4.3

- The clause amended to read:

  **Additional requirements for HV connections**

  Where the customer has taken a HV supply, the control of the high voltage installation incoming point of supply must comply with the a-fault level for the appropriate voltage, as prescribed in Section 13 of these requirements. The control and protection of outgoing high voltage circuits shall comply with the Network Operators specific network connection arrangements and applicable industry standards including but not limited to AS/NZS 3000 and AS 2067.

### 11.15.2

- The clause amended to read:

  **Meter panels**

  For indoor HV metering, the Network Operator will install a metering panel on the internal wall of the switch room. The applicant shall install appropriately sized 75 mm diameter ducts or 80 mm PVC conduits between the high voltage metering unit (within the HV switchboard) and the meter panel. Drawings DSM-3-22A and DSM 3-22B shows details of these requirements.
For outdoor HV metering the Network Operator will install the meter panel in the metering kiosk for ground mounted HV switchgear, or in the metering cubicle for overhead HV switchgear. For additional details refer to:

- Horizon Power’s: - Distribution Construction Standard - Section “G” Drawings.
- Western Power’s: - Distribution Substation Plant Manual – Section 3.

Drawings DSM 3-25 and DSM 3-27 show details of these arrangements.

11.24.2 The clause amended to read

Western Power termination references
Where a consumer cable enters a pit, the consumer mains installation and terminations within substations shall be as specified in Section 14:

- Where semi enclosed, enter from underneath (Drawing U 30); or
- Where fully enclosed, via the aperture or ducting system provided (Drawing LU 52)

Additional cable entry and termination details can be obtained from Western Power’s Distribution Construction Standards Handbook, Distribution Design Catalogue or the Distribution Substation Plant Manual or refer to Western Power Drawings for:

- Mini pillars U8, U23/2
- Universal pillars U9, S8, UDS 6-4
- Pits U23/1, U30
- Wall (Cut out) boxes U20 (100 A) U21 (200 A)
- Kiosks and substation arrangements; U27, Section 14 of this Manual

12.8 The clause amended to read

Cable ducts and conduits
Ducts and conduits installed for the purposes of providing access for customer or network cables dependent on the cable’s function and location shall be installed in accordance with the relevant Network Operators requirements (Refer to clause 6.9), including the AS/NZS 3000, WAER and these requirements.

12.8.1 Horizon Power requirements
For further information and guidance on Horizon Power’s requirements phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

12.8.2 Western Power requirements
In addition to Clause 12.8 the requirements of the following Western Power publications shall be adhered to for installations undertaken within the SWIS:

- Underground Distribution Schemes Manual
- Underground Cable Installation Manual
- Distribution Substation Manual

12.12.1 The following statement inserted before the last paragraph

Additional cable entry and termination detail can obtained from Horizon Power’s Distribution Construction Standard, and Distribution Design Catalogue.

12.13.1 The 2nd paragraph amended to read

Additional cable entry and termination detail can obtained from Western Power’s Distribution Construction Standards Handbook, Distribution Customer Connection Requirements, Distribution Design Catalogue and Distribution Substation Plant Manual.
<table>
<thead>
<tr>
<th>Page</th>
<th>Text</th>
</tr>
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</table>
| 13.7.4.9 | **Earthing system**
The customer’s earthing system must be designed and installed in a manner that ensures compliance with the Network Operator’s technical requirements and where specified the relevant Australian standards including but not limited to AS 2067 and AS/NZS 3000. The Submission must provide details of customer’s installation earthing system with accompanying schematic arrangements. |
| 13.7.4.18 | **Environmental**
The placement of transformers is to be in accordance with:
- These requirements and applicable Network Operator technical requirements for substations and underground distribution schemes manuals, including:
  - Horizon Power’s: - Distribution Design Rules.
  - Western Power’s: - Distribution Substation Plant Manual.
  - Underground Distribution Schemes manual the DSM and UDS
- Australian Standards including AS 2067 and AS/NZS 3000
Applicable legislation including but not limited to the Western Australian Environmental Protection (Noise) Regulations 1997. |
| 13.9.3 | **Main switch or switches**
Located in accordance with the Network Operators technical requirements Distribution Substation Manual and as near as possible to the customer’s point of supply; |
| 13.9.7 | **Earthing systems**
Installations required to be earthed shall conform to the requirements for earthing as prescribed by Network Operator AS/NZS 2067, AS/NZS 3000 and Section 14 of this Manual. |
| 13.9.7.3 | **Metallic fences**
All metallic substation fences, doors or enclosures shall be connected to the earthing system and a grading ring as prescribed by the Network Operator in accordance with AS 2067 and Section 14. Where prescribed by the Network Operator steel reinforcing in the substation floor and or walls shall could be connected to the common earth terminal bar. |
| 14.1 | **General connection supply requirements**
This Section of the Manual describes the requirements and customer responsibilities where a new substation is to be installed or an existing substation is to be modified or upgraded.
Typically any supply connection over 250 A in metropolitan areas will require the connection to or installation of a substation on the customer’s property. The substation will always include a transformer and may, in some cases, include high voltage switchgear.
In country and regional areas outside town centres a substation will be required in most situations.
This Section shall be applied in conjunction with the Network Operator’s technical requirements for customer connections and substations. |
14.1.1 © The clause amended to read
Horizon Power requirements
This Section shall be applied in conjunction with Distribution Construction Standard. (G-Section Drawings) Substation Manual

14.1.2 © The clause amended to read
Western Power requirements
The Section shall be applied in conjunction with Distribution Substation Plant Manual

14.2 © The last paragraph amended to read
Substation types
For both district and sole use substations, the Network Operator owns, operates and maintains the equipment. Where HV switchgear is required for a district or sole use substation, the setback limits for the switchgear are shown in provided on the relevant appropriate HV Network Operator substation technical Arrangement drawings in the Network Operator’s DSM. (Refer to Clause 14.19)

14.3.4.1 © The clause amended to read
HV indoor ground mounted switchgear
Where the customer’s installed capacity exceeds 4 MVA, a HV indoor ground mounted switchgear arrangement shall be used. Drawings DSM-3-22B shows two design options detailing the requirements for the switch room.

The customer shall supply and install adequately rated high voltage main switches and a connection suitable for coupling to the Network Operator’s HV metering unit/s.

Although the use of switchgear identical to the Network Operator’s standard range of equipment is preferred, customers may purchase and install switchgear of a different make.

In such cases, to enable connection of the customer’s switchgear to the Network Operator’s switchgear, a cable connection is required will be provided to the customer for termination of the customer’s switchgear as specified in drawing DSM-3-22B.

Details of the Network Operator’s standard range and types of switchgear are available on application.

Where the customer’s selected type of switchgear is the same type as that used by the Network Operator, then subject to approval the connection may be made or retained via a bus-section switch disconnector. Refer to the relevant Network Operator to determine the availability of this connection option as specified in drawing DSM-3-22.

The customer is responsible for supplying and installing support structures for the Network Operator’s HV switchgear, metering unit and customer HV switchgear in the switch room. Support structure fabrication details are specified within the respective Network Operators substation technical requirements, in Western Power drawing DSM-6-07 with installation details provided in drawings DSM-3-22B.

Where the customer’s installed capacity exceeds 4 MVA, the load shall be supplied from two fire segregated switchboards. The load shall be, as close as possible, distributed evenly across both switchboards.

Customer future loads should be considered when determining the switchboard design. In cases, where the Network Operator has a bus section, switches between two switchboards (i.e. Above 4 MVA installed capacity) operating the bus section, mechanical interlocking, using the Castell keyed system, is required to prevent closed ring operation via the customer’s switchboards. Paralleling of the customer’s switchboards is only permitted under the direction of the Network Operator.

If the Network Operator operates with the bus section switch normally closed, mechanical interlocking is required to ensure that paralleling...
### 14.3.4.2

The 2nd paragraph amended to read

**HV outdoor ground mounted switchgear**

All HV switchgear equipment shall be installed in free-standing cabinets in a cluster configuration. Drawing DSM-3-23 shows details of this arrangement.

---

### 14.3.4.3

The last paragraph amended to read

**HV outdoor aerial mounted switchgear**

The customer shall supply and install adequately rated HV main switches for connection to the Network Operator HV metering unit. If a recloser is used by the customer as the main switch, then the auto recloser must be disabled. Drawing DSM-3-24 shows details of this arrangement.

---

### 14.4.3

The clause amended to read

**Substation enclosures**

The customer shall construct a two hour fire rated enclosure in the following situations where a:

- Network Operator substation is to be constructed inside a building.
- Network Operator substation is to have more than two transformers.
- Customer owned substation/switchroom is to be installed.
- Substation is located within an area defined by Building Code of Australia as restricted.

In all other situations, the substation shall be designed and constructed to protect and safeguard adjacent buildings from fires originating within the substation.

Fire risk zones **shall be** measured from either the:

- Outer edge of all electrical equipment within the substation area; or
- From the external edge of any non fire rated section of a substation enclosure.

The Building Code of Australia details the requirements for fire separation inclusive of the distances between buildings. In summary for Class 1 and 10 (residential situations) the distance is up to 1.8 m and for Class 2 to 9 (commercial or industrial situations) the distance is up to 6 metres. Refer to BCA Volume two (Part 3.7) and Volume one (Part C2) for specific requirements.

In addition to the BCA requirements, AS 2067 Clause 6.7 and Appendix “C” provides information on fire and explosion risk zones for various types of equipment.

The Network Operator’s distribution Substation technical requirements Manual Section 5 provides specific guidance on substation fire risk zones for a variety of situations including those illustrated by applicable to

- the BCA Volume two (Part 3.7) and Volume one (Part C2); and
- AS 2067 Clause 6.7 and Appendix “C”.

No essential public fire escapes or access/exits shall pass through or open into a fire risk zone created by the establishment of a substation enclosure.

In all cases where another structure/building conflicts with the fire risk zone around a substation, the choice exists for the customer to either construct a fire rated enclosure for the substation or to fire rate the other structure/building within the fire risk zone subject to the consent of all affected parties.

Agreement shall be reached with the Network Operator on this issue before the design is submitted as this will determine whether or not the customer must provide a fire rated enclosure.

In commercial or industrial situations where the customer requires the substation to be installed within the fire risk zone of a property side boundary, a fire rated enclosure maybe required to protect against the event of a building being constructed on the adjoining property within the substation fire risk zone.

Local government, BCA and AS 2067 requirements must be considered by the customer when determining the appropriateness of the site and whether a fire rated enclosure is required in relation to minimum building setbacks and the distances to the property side/rear boundaries. Local government should also be contacted to determine building setbacks which may also impact on distance requirements.
Example: In a commercial area with no minimum building setbacks, a substation is proposed to be built 4 m from the side property boundary. BCA Clause C3.2 indicates that the substation would not require a 2 hr fire rated enclosure as it is 3 m from the property boundary. The requirement of any building constructed on the adjoining property would also need to have a 3 m clearance or be fire rating according to BCA Specification C1.1 mitigating the risk of the substation fire risk zone. An enclosure with 2 hr fire rated walls, roof, doors and vents has no fire risk zone. Fire rating requirements shall also comply with the BCA and any Local Government Authority building restrictions.

| 14.4.6 | Item 12 amended to read Site requirements and preparation 12) Following the installation of all substation equipment, exposed surface areas at the site shall be stabilised to mitigate against the effects of erosion. Crushed limestone, blue metal (10 -25 mm aggregate) or other approved stabilising material shall be laid around each item of equipment in accordance with the Network Operators technical requirements to a depth of 50 mm and to a width not exceeding 450 mm |
| 14.4.7.2 | The clause amended to read Gatic cover access Where the use of ‘gatic’ pits and cover(s) are approved for are to be installed: • And access to the substation is via a gatic’ cover, the clear opening with minimum dimensions are to be a minimum of 2500 mm x 2000 mm shall be maintained. • Within inside the building, the minimum clear ceiling height above the ‘gatic’ cover shall be is 3.3 m. • Lifting eyes or a monorail shall be designed and installed by the customer to allow for the installation of Network Operator plant. (Refer to Network Operator substation See drawings DSM-6-05 for details) Outside the building, there shall be suitable access provided for a crane from the street or right of way with no obstructions above the pit and ‘gatic’ cover. For Horizon Power DSM requirement e-mail enquiries@horizonpower-reply.com.au |
| 14.4.7.3 | The clause amended to read Access to a substation shall be suitable for heavy plant. If a transformer is to be installed, an allowance shall be made for its installation (i.e., size and weight). Refer to the Network Operators technical requirements for General dimensions, size are 1500 mm high x 1900 mm wide x 1600 mm long, with and weight details mass of 5 tonnes. |
| 14.4.9 | The clause amended to read Point of supply and consumer mains The customer shall provide and install the consumer mains cable from the customer’s main switchboard (MSB) to the Network Operator’s designated point of supply (PoS). These cables shall: • Preferably be copper due to smaller lug sizes |
- Installed in PVC ducts
- Take the shortest possible route from the PoS to the MSB, not crossing underneath any Network Operator equipment.

Consumer mains cable including neutral conductors, switchboards, main switches and SPD’s shall comply with the Network Operator’s technical requirements WAER and AS/NZS 3000. The maximum size of consumer mains that can be terminated within to a district or sole use substation is prescribed by the relevant Network Operator’s technical requirements, shown on the relevant drawings in Section 1 of the DSM.

The Network Operator may approve the use of double insulated single core cables, installed on cable tray where access to terminations permits, the MSB is contiguous, the supply originates from the substation and no further mechanical protection is required. The use of bus duct or busways may also be used subject to Network Operator consideration and approval.

| 14.4.9.1 | ☀ The 1st paragraph amended to read
| **District substations** Where the customer’s main switchboard is remote from the substation, the consumer mains cable must have overcurrent and short circuit protection. To ensure grading with upstream protection, the customer’s maximum load shall be in accordance with the Network Operator's Distribution Substation Manual technical requirements. |

| 14.4.10 | ☀ The 1st and 2nd paragraphs amended to read
| **General earthing requirements** All Substation earthing systems shall be installed in accordance with the applicable industry standards, WAER AS 2067, AS/NZS 3000, these requirements and substation earthing arrangements as illustrated by on the relevant Network Operator’s compatible unit drawings (DSM)

Earthing shall be installed within a substation to minimise the potential rise of earthed metal parts to which may become energised via the passage of any a-fault current. The system shall and to provide a return path for the fault currents thereby allowing these fault currents to be detected sensed and rapidly disconnected from the network and installation system.

| 14.4.10.1 | ☀ The clause amended to read
| **General conditions** The following requirements shall apply to all District and Sole Use substation installations:
- All earthing conductors used shall be bare copper, and sized in accordance with AS 2067
- Flexible connections from metallic parts onto the main earth conductor must either be a stranded copper conductor with green yellow PVC insulation or a flexible copper braided connection
- Two (or more if required) deep driven earth electrodes are to be installed and connected to the main earth conductor, in every substation regardless of the number of transformers installed
- The earth electrodes are to be placed as illustrated shown on by the relevant network compatible unit drawing:
- All connections shall be crimped. Mechanical clamps may be used as an alternative subject to prior approval
- All flat copper bar surfaces shall be suitably prepared and cleaned before any bolted connection is made
- Earth connections are to be made from the following metallic parts onto the main earth conductor:
  - Star point of delta-star transformers
  - HV cable metallic sheaths (via a copper flexible braid)
  - Any LV cable metallic sheaths used
  - HV switchgear earth/bar connections
  - Transformer earth lug
  - LV distribution Frame earth bar
- Metallic transformer or HV switchgear enclosures (If in cluster formations)
- Pole top isolation switch handles and operator earth mats or loops
- Items as required by AS 2067 and AS/NZS 3000
- Connections shall be tagged and labelled at the earth bar end to clearly indicate what they are connected to.
- The substation earthing grid shall be buried 150 mm (500 mm for Horizon Power) below the substation finished ground level.

Refer to Clauses 14.5 and 14.6 for additional specific earthing requirements for both fire and non-fire rated substation installations.

14.4.10.2 The clause amended to read

System testing and commissioning

The earthing installation shall be tested and commissioned as specified by the Network Operator, in line accordance with the requirements of, AS 2067 and AS/NZS 3000, and as specified by the Network Operator. Test results shall be shall be made available to Network Construction Project Manager.

14.4.13 The last two paragraphs amended to read

Requirement for a contiguous switchboard

Where a customer is fed from a sole use substation, the customer is connected directly to the LV bushings of the transformer. In this case the cable to the customer’s point of supply is not protected therefore the main switchboard must be contiguous with the substation, to limit the amount of unprotected cable which may be exposed to damage.

Drawings DSM 1-07 to DSM 1-09 provide examples for sole use installations.

For the customer’s switchboard to be considered as contiguous and where:
- The substation is screened, the switchboard shall be against the exterior of the screening
- A substation enclosure is constructed, the switchboard shall be against the exterior wall of the enclosure
- There is no screening or enclosure the switchboard must be immediately adjacent to the edge of the substation site boundary but not more than 1 metre from the point of supply.

Section 3 of the DSM details the For addition specific information on customer switchboard locations refer to the documents listed at Clause 14.1 the Network Operator technical requirements listed for .

14.6.2 The last two paragraphs amended to read

Customer-owned substations

The customer shall install a minimum of two earth electrodes. When a switchroom is constructed, the earth electrodes are to be installed in the trench. If there are two separate trenches, then a minimum of one electrode is required in each trench, with a 75 mm conduit installed between trenches to allow interconnection of electrodes. For details of the earthing requirements refer to the documents listed at Clause 14.1 are specified in substation drawing DSM 6.12 or DSM 6.06.

Where the customer purchases from the Network Operator a substation to convert to a HV tariff, it is the customer’s responsibility to ensure the substation earthing complies with the Network Operators requirements, current AS 2067 and AS/NZS 3000.

14.6.4 The 1st sentence amended to read

Fire alarms and extinguishing systems

In line accordance with AS 2067 Clause 6.7.1.65, at least one portable manually operated fire extinguisher suitable for suppressing an electrical fire should all be installed in an easily accessible location external to (or immediately internal to) the entry to each switch room compartment.

14.6.6 The last sub dot points amended to read

Doors and locks
- Enclosure external doors are shall to be labelled “Name: POWER SUBSTATION”;
- Main distribution board switchroom door shall be labelled “MAIN ELECTRICAL SWITCHROOM”;
- All doors are also to be fitted with danger signs which include the words “DANGER HIGH VOLTAGE”
### 14.6.7 Ventilation

The preferred approach should be wherever possible by natural ventilation for able to use natural ventilation wherever possible. Substation chambers and equipment rooms should be provided with good natural ventilation throughout.

This methodology minimises the risk of transformer or equipment failure caused by overheating due to mechanical and electrical malfunction of installed ventilation systems.

Mechanical ventilation systems (permanent or temporary) shall be designed to take into consideration smoke removal from the building. They shall be so arranged that inspection and maintenance can be carried out even when the electrical equipment is energized.

Basement chamber substations shall be provided with dedicated inlet and outlet ventilation ducts terminating outside the building.

Adequate vent openings shall be provided for pressure relief for in all roofed enclosures to prevent structural damage in the event of an explosion. In substations where a transformer is installed, the normal transformer ventilation will meet this requirement.

For substations where only switchgear is installed, pressure relief vent/s shall be installed and all vents shall be fitted with external louvres for security.

Where natural cross flow ventilation for transformers cannot be achieved, and forced draught ventilation is required, the customer shall supply and install fans, ducting and weather proof outlet grilles as required by the Network Operator.

Individual ducts are required for each transformer. Grilles shall be of a robust construction with and low air resistance. Refer to the Network Operator substations technical documents listed at Clause 14.1 drawing DSM-6-02 for fan details and DSM-6-03 for the associated sub distribution board schematics. Air flow values are the minimum acceptable requirements.

If the ducting passes over the top of the transformer, the ceiling height of the enclosure shall be increased in accordance with the Network Operators technical requirements for substation enclosure construction to a minimum of 3 metres.

Fire dampened vents shall be installed as prescribed by the Network Operator shown on substation drawings. They shall be fitted with rotating type blades held in the open position by two thermal links in parallel and shall conform to AS 1682 and AS/NZS 1668.

In a district substation, the Network Operator will install the distribution board and connect the fan, where as in a sole use substation this shall be is the customer’s responsibility.

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### 14.6.8 Trenches, ducts and other penetrations

The customer is responsible for the supply and installation of all trench covers in removable sections. Covers shall be:

- Supplied and installed in accordance with the Network Operators and manufacturers requirements.
- Resistant to the effects of fauna and environmental conditions.
- Constructed from one of the following materials:
  - Steel grated Web forge C253MP (Horizon Power DSM-6-10) or equivalent seated on a 55 mm wide x 30 mm deep rebate or;
  - F38 fibreglass Reinforced Polyester (Western Power) seated on 40 mm wide x 38 mm deep rebate or purpose built framework.
- Covers shall be designed and installed in accordance with AS 1657 and the BCA.
- Galvanised steel e- Structural supported by braces, shall be installed in front of electrical equipment where the trench covers are cut to allow cables to enter.
- Structural supports shall not hinder cable installation.
The trench covers shall be fixed in place to prevent movement under foot but allow for removal and replacement where required for maintenance and cable installation.

Retro fitting of Fibreglass Reinforced Polyester panels covers may require modification of both the trench rebate and supports, to ensure that covers sit flush with the floor and the switchgear/RMU mounting structurers.

Where ducts or other penetrations enter the trench or enclosure, the customer shall fit removable watertight seals to both ends of the installed ducts or penetrations prior to hand over. The seals shall be water and oil tight before and after cable installation.

Network Operator personnel will reseal all ducts or penetrations after installation of network cables.

Where ducts are installed between fire segregated switch-rooms, the customer shall seal the ducts after the installation of all cables to maintain the required fire rating.

14.6.9
The last paragraph amended to read

**Light and power**
Lighting levels shall be as agreed with the Network Operator. Emergency/auxiliary lighting shall be provided where deemed necessary by the Network Operator; which can be either a fixed installation or portable equipment. Refer to AS/NZS 1680 for guidance on lighting levels.

14.6.11
The clause amended to read

**Fire rated certification**
A Network Operator may request from the customer/owner certification that the completed installation complies with the relevant sections of the WAER, WA Distribution Connections Manual, Distribution Substation Manual, Network Operators technical requirements for distribution substations Manual, Building Code of Australia and applicable Australian Standards and to ensure substation fire rated requirements have been achieved.

Refer to Appendix “L” for details of individual Network Operator requirements.

14.7.1
The clause amended to read

**Summary**
For further information and guidance on Horizon Power’s NWIS and NIS licensed areas and requirements phone 1800 737 036 or e-mail enquiries@horizonpower-reply.com.au

This section of the manual is to be read in conjunction with Horizon Power’s Distribution Design Rules and Distribution Construction Standard. (DSM).

14.8.1
The clause amended to read

**Summary**
This Section of the manual must be applied in conjunction with Western Power’s Distribution Substation Plant Manual (DSM).

14.9
Entire clause deleted

**14.9 Drawing list**

*Note: Although drawing numbers for each Network Operator are the same the requirements and content may differ. To access the Network Operator DSM drawings please refer to their respective websites. For*

- **Horizon Power** Distribution Substation Manual
- **Western Power** Distribution Substation Manual
- DSM 1.10 Customer HV Metering
- DSM 3.22B Customer-Owned Substation HV Indoor Ground Mounted SWGR — Cable Connection (WP Schneider HV Switchgear)
- DSM 3.23 Customer-owned Substation HV Outdoor Ground Mounted SWGR
Appendix “L”

® Example Substation Check list withdrawn subject to revision during the next full revision

Document End
Appendix B. Horizon Power’s NWIS and NIS distribution networks

The NIS extends from Esperance and Hopetoun in the south, through the eastern Goldfields (excluding Kalgoorlie), to the Midwest, Gascoyne and Kimberley regions. The NWIS extends from Karratha to Port Hedland.
Appendix C. Western Power’s SWIS distribution network

The South West Interconnected System (SWIS) is the biggest interconnected network in WA. The SWIS consists of nearly 88,000 kilometres of powerlines stretching from Kalbarri in the north to Kalgoorlie in the east and south to Albany.
Appendix D. Service Apparatus Connections Scheme

As of the 1st January 2013, the connection process known as the “Service Connect Scheme” has been discontinued by both Horizon Power and Western Power.

All connections within the NWIS and NIS after this date are to be completed by Horizon Power.

Connections within the SWIS previously completed by Service Connect accredited electrical contractors and workers must now be completed by persons authorised under Western Power's Service Apparatus Connection Scheme" (SACS)

SACS complies with Electricity Regulations 1947 and takes into account recommendations provided by EnergySafety. The new Scheme applies to single direct wired metering installations not exceeding 100 Amps, including distributed master metering. SACS permits accredited electrical workers to:

- Terminate customer's consumer mains into an energised mini pillar or universal pillar for a new installation (safety observer required for uni-pillar and mini-pillars with exposed accessible un-insulated parts).
- Obtain a new direct wired kWh meter from a meter distributor, as per the SACS meter installation rules.
- Install and terminate a direct wired kWh meter at a new customer’s installation, for single and distributed master metering installations.
- Disconnect temporary builder's supplies and return temporary meters to Forrestfield Metering within 3 days.
- Operate the service protection device - SPD (fuse or circuit breaker) at the meter panel to carry out the required testing of the kWh meter (see section on testing).
- Place an Out of Service Tag on the service protection device

The Scheme does not apply to:

- Current transformer (CT) metered installations. For these installations Western Power's Metering Branch technicians are to be engaged.
- Multi-master metering arrangements.
- Energisation of builder's supplies.
- Overhead service connections or meter changeovers from temporary positions to permanent positions.

**IMPORTANT: The Scheme does not permit an installation to be left energised. Only Western Power and authorised personnel may energise the installation.**

To permanently energise the meter a SACS only contractor must not directly engage the services of a Contractor Connect Contractor but instead contact Western Power who will arrange for the meter to be energised. The SACS contractor can nominate a Contractor Connect Contractor to energise the installation though Western Power reserves the right to allocate any Contractor Connect provider to the job. Preliminary and Completion notices must be submitted by both contractors.

For all enquiries pertaining to network connections please refer to the respective Network Operator.

- **Horizon Power** – enquiries@horizonpower-reply.com.au
- **Western Power** - Service Apparatus Connection Scheme
Appendix E. Contractor connect scheme

As of the 1st January 2013, the connection process known as the “Contractor Connect Scheme” has been discontinued by Horizon Power. All connections within the NWIS and NIS after this date are to be completed by Horizon Power.

For connections within the SWIS the Contractor Connect Scheme will continue to allow accredited electrical contractors to connect and energise installations on behalf of Western Power upon completion and testing of the work.

This Scheme is limited to installations connected via an underground service to a service pillar, where the maximum demand does not exceed 100 amperes (direct wired metering).

The Scheme does not include direct connections to a Network Operator’s overhead network but does permit connections to services pillars connected to the overhead network. (Refer to the pole to pillar scheme.)

The electrical contractor is required to take responsibility for the consumer mains and main switchboard including MEN connection and submit appropriate Preliminary and Completion Notices. The contractor is also responsible for testing and commissioning the electrical installation in accordance with the Network Operators requirements. Installation test results shall be recorded on a Service Connection Test Form. Copies of the forms are freely available from the participating Network Operator website.

For all enquiries pertaining to network connections please refer to the respective Network Operator.

- Horizon Power – enquiries@horizonpower-reply.com.au
- Western Power - Contractor Connect Scheme
Appendix F. Contractor authorised changeover scheme

Western Power may authorise an electrical contractor who is accredited as a part of a Contractor Connect Scheme, to carry out consumer main and metering changeovers. This authorisation will include the disconnection of supply; upgrading consumer mains; change of network meters and re-energising of supply including single to three phase changeovers.

Western Power may also permit authorised electrical contractors to relocate builder’s supply pole meters to the permanent installation under stringent conditions.

All service changeover work is limited to installations that are supplied direct from an underground pillar or where the work does not involve the disconnection of over-head service cables and where the installation’s maximum demand does not exceed 100 amperes (direct wired meters). Changeovers involving Current Transformer (CT) metered installations are not permitted.

This Scheme does not permit electrical contractors to change faulty meters, as this task is a Western Power responsibility.

In expanding the changeover process to allow authorised electrical contractors to perform this work, the electrical contractor must recognise the importance of maintaining the security of network revenue meter. Electrical contractors are to make themselves aware of their obligations and the Western Power’s terms and conditions in relation to changeovers and processes that allow for tracking of meters.

For all enquiries pertaining to network connections and changeovers please refer to the respective Network Operator...

- Horizon Power – enquiries@horizonpower-reply.com.au
- Western Power - Authorised Changeover Scheme.
Appendix G. Portable builders supply scheme

Portable Builders Supply Pole Scheme enables authorised electrical contractors who are accredited as a part of the Contractor Connect Scheme to connect, energise, disconnect and rotate builder’s supply poles between building sites supplied via an underground service pillar or pit.

The scheme does not apply to installations supplied by an overhead service. Overhead connections require the submission of a network services application for a metered supply to the site.

Prior to being issued with meters, the electrical contractor must be registered with this Scheme. Once approved, electrical contractors can construct and registered builder’s supply poles. A network kWh meter will be issued and logged to an electrical contractor who is then regarded as the customer for that meter.

The electrical contractor connects the builder’s supply pole into Western Power service pillar on site and then leaves the supply energised. As the builder’s supply pole is moved between sites, the meter remains within the enclosure.

Each time the pole is moved, the electrical contractor must submit the required notices for each new address with notation in the comments section “PBS – No mains or metering required”.

The electrical contractor must provide 6 monthly meter readings to the Western Power for all meters issued to the company as a part of this scheme. The electrical contractor being the Western Power’s customer is responsible for the meter at all times, including any costs incurred as a result of theft or damage to the meter.

The Western Power reserves the right to remove any non-complying electrical contractor from the Scheme and require the return of all meters issued.

For all enquiries pertaining to network connections and builders supplies please refer to the respective Network Operator.

- **Horizon Power** – [enquiries@horizonpower-reply.com.au](mailto:enquiries@horizonpower-reply.com.au)
- **Western Power** - [Potable Builders Supply Scheme](#)
## Appendix H. Regulatory forms

### Preliminary Notice

**No. 2064533**

This Notice must be completed and sent to the relevant network operator at the required time, as prescribed in the *Electricity (Licensing) Regulations 1991*.

### 1. Details of installation, network operator and retailer

<table>
<thead>
<tr>
<th>Nature of install. name</th>
<th>retailer's name</th>
<th>Lot No.</th>
<th>Unit No.</th>
<th>Street No.</th>
<th>Street name</th>
<th>Suburb/Vecr</th>
<th>Post code</th>
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</table>

**Directions please provide sufficient information:**

|-----------------------|----------|---------------------------------|----------|

### 2. Details of proposed electrical work (indicate number of items in each category unless indicated otherwise)

<table>
<thead>
<tr>
<th>Category</th>
<th>No. lighting points</th>
<th>No. 10 amp socket outlets</th>
<th>No. switch outlets to &gt; 10A amp</th>
<th>No. switch outlets to &lt; 10A amp</th>
<th>No. variable outlets</th>
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<tbody>
<tr>
<td>Consumers mains size (kVA)</td>
<td>No. meters</td>
<td>No. motor</td>
<td>No. appliance equipment</td>
<td>No. air conditioning/ refrigeration equipment</td>
<td>No. ceiling/penetrant plates</td>
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</tbody>
</table>

**Does the installation include extensive electrical work?**

<table>
<thead>
<tr>
<th>Work included?</th>
<th>Is there equipment in hazardous area?</th>
<th>Is FPE used?</th>
<th>Other fixed electrical equipment (please list rating):</th>
</tr>
</thead>
<tbody>
<tr>
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<td>No</td>
<td>Yes</td>
<td>Other fixed electrical equipment (please list rating):</td>
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</table>

<table>
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<th></th>
<th>Single phase</th>
<th>Three phase</th>
<th>LV motor controllers</th>
<th>Other (please list):</th>
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</table>

<table>
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<th>Single to three phase</th>
<th>Safety shutters</th>
<th>New consumers meters</th>
<th>Term. consumer meters</th>
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<th></th>
<th>Domestic</th>
<th>Commercial</th>
<th>Special installation</th>
<th>Testing center</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>No. of points of supply (NEA 1.3.1)</th>
<th>No. of wires</th>
<th>No. of consumers meters</th>
</tr>
</thead>
</table>

**Comment:**

### 3. General information

- **Is a ruling required for the work?**
  - No [ ] Yes [ ]

- **In what electrical work are you not responsible?**
  - No [ ] Yes [ ]

- **Is network operator attendance requested?**
  - No [ ] Yes [ ]

---

**Please do not write in this area**

---

**For submission of Preliminary Notice**

- **Name:**
- **Signature:**

**Details of electrical contractor/line-houses electrical installer**

- **Business Name:**
- **Business Address:**
- **Phone Number:**
- **Facsimile Number:**
- **EDNR Licence No.:**

---

**EDWA DIV 1 0101**
Government of Western Australia
Department of Commerce

Notice of Completion

No. 2064533

This notice must be completed and sent to the relevant network operator at the required time, as prescribed in the Electricity (Licensing) Regulations 1997.

1 Details of Installation, network operator and retailer

<table>
<thead>
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<th>Name</th>
<th>Address</th>
<th>Post code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner's name</td>
<td>Network operator name</td>
<td>Site No.</td>
<td>Ref No.</td>
</tr>
<tr>
<td>Lot No.</td>
<td>Unit No.</td>
<td>Street No.</td>
<td>Street name</td>
</tr>
<tr>
<td>Directions (please provide sufficient information)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2 Details of proposed electrical work (indicate number of items in each category unless otherwise stated)

<table>
<thead>
<tr>
<th>Description</th>
<th>No. of items</th>
<th>Details of equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Does the installation include alternative energy supplied? (tick if yes)

For new connection (SN): Single phase | Three phase | Direct current | HF connection | Other details |

For multiple connections (SN): Single to three phase | Three to phase |

For multiple connections (in kW): Light industrial | Mining | Underground | Other details |

3 General information (please tick appropriate boxes. If “yes” to any of the questions, provide details)

<table>
<thead>
<tr>
<th>Question</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is a ruling required for this work?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is there any electrical work for which you are not responsible?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is network operator attendance required?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4 Certification of electrical installing work (please tick appropriate boxes)

<table>
<thead>
<tr>
<th>Question</th>
<th>No</th>
<th>Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are you aware of any parts of the electrical installation that do not meet the requirements of the Electricity (Licensing) Regulations 1997 or are defective?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Does the installation fully comply with Part 2 of the “Working Rules” and Part 1 of “Regulation” in the Electricity (Licensing) Regulations 1997?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has the electrical installation subject to this notice been connected to the electricity supply?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is the electrical installation subject to this notice safe and ready to be connected?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The electrical installation subject to this notice has been checked and tested and found to comply with the Electricity (Licensing) Regulations 1997, by the following electrician: Name (please print):</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Details of Licences

<table>
<thead>
<tr>
<th>Name</th>
<th>Signature</th>
</tr>
</thead>
</table>

Details of electrical contractor/foreman electrical installer

<table>
<thead>
<tr>
<th>Details</th>
<th>Name</th>
<th>Address</th>
<th>Phone Number</th>
</tr>
</thead>
</table>

Notice of Completion — Original — Network Operator Copy

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Appendix I. Inspection notices

Inspectors’ Order

Issued under the authority of

Owner/Occupier/Builder Name:

Installation Address:

Electrical Contractor’s Name:

& Licence No.:

Electrical Worker’s Name:

& Licence No.:

To the Occupier/Owner

☐ The electrical installation of the above address does not comply with Electricity (Licensing) Regulations.

☐ Electricity to the described part/portion/house of the installation has been disconnected and is not to be reconnected until the electrical supply is visible to the Electricity Act and Regulations and is safe and any other requirements of the Inspector have been complied with.

☐ Please arrange for your Electrical Contractor to complete the work detailed below.

☐ The work detailed below must be completed before ___/___/___.

To the Electrical Contractor/In-House Licence Holder

☐ After completing this work specified in this order, return this order with the bottom section duly completed before the ___/___/___ to Western Power.

☐ Submit a Preliminary Application of Completion to Western Power for the electrical installation which is required by this order.

☐ A Re-inspection fee of $35.00 is required.

WORK REQUIRED

AS/NZS 3000 MAER Preference DEF OEE REF

Signature of Electrical Contractor/ Nominated Electrical Worker

Date: ___/___/___

Name of Electrical Contractor/Nominated Electrical Worker (or Business name)

Electrical Contractor’s Licence No.

(include CO or IH prefix)

Electrical Worker’s Licence No. (or

Electrical Contractor/In-House Licence Holder)

E W

FAX Number:

Inspector Signature: Inspector Name: Office: Phone No.: Date: ___/___/___

Certification-EC/IH Licence Holder or Nominated Electrical Worker to Complete and return as specified above.

I certify that the electrical work carried out at the above installation and subject of this note has been carried out in accordance with Electricity (Licensing) Regulations 1991 has been checked and tested and is safe for connection to electricity supply.

Signature of Electrical Contractor/ Nominated Electrical Worker

Date: ___/___/___

Name of Electrical Contractor/Nominated Electrical Worker (or Business name)

Electrical Contractor’s Licence No.

(include CO or IH prefix)

Electrical Worker’s Licence No. (or

Electrical Contractor/In-House Licence Holder)

E W

FAX Number:

Western Power’s Copy - to be retained by WESTERN POWER

UA 1971 03/09
**Protection Settings Data Sheet**

This form is required for all installations with CT metering (over 100 Amps)

**Section 1:** Complete this section and send to Western Power’s Network Designer

- Western Power Reference DQM # ………………..
- Energy Customer Name ……………………………………………………………………………………………
- Energy Customers Address ………………………………………………………………………………………
- Electrical Consultant/Contractor’s Name ………………………………………………………………………
- Electrical Consultant/Contractor’s Address ………………………………………………………………………

<table>
<thead>
<tr>
<th>SERVICE PROTECTION DEVICE (SPD) over 100Amps</th>
<th>OVER CURRENT</th>
<th>EARTH FAULT (if installed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type (e.g. poles, trip unit)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breaking Capacity [kAmps - RMS]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated Current [Amps – RMS]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjustable Setting Range</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proposed Current Set Point [Amps]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CURRENT TRANSFORMER INFORMATION**

| Current Transformer Class                   |              |
| Current Transformer Tapping Ratio           |              |

**Section 2:** The following is to be supplied, signed off, to Western Power’s Construction Project Manager at completion of commissioning.

| PROTECTION SETTING ON COMMISSIONING         |              |
| Over Current Amps Set point [Amps]         |              |
| Earth Fault Amps Set point [Amps]          |              |

A graph of the time current curves showing the SPD protection grading with Western Power’s upstream protection (as supplied by WP) is to be attached.

WP’s Construction Project Manager must return this data sheet and protection curves to the project file for future reference after acceptance of protection settings applied by customer.

**Signature having verified settings**

Energy Customer’s Representative (Electrical Contractor) …………………………………………………..
Appendix K. Network drawings

- Bus bar mounted current fault limiters
- 32 Amp MRC cartridge capable of being sealed fitted as per drawing M98-2003

Notes:
1. All CT secondary wiring 4mm² 7/0.25 stranded conductor insulated, marked as per identifying labels.
2. All voltage wiring 2.5mm² 7/0.27 stranded conductor insulated, marked as per identifying labels.
3. Red dot on CT's faces the incoming supply.
4. All metering equipment to be fitted before the main switch.

Current taps:
- S type 200/5 M32
- T type 800/5 M32
- W type 1500/5 M32

Wire colours:
- Red - E10, Blue - F50
- D11, D51, D101, D105
- White - E10, Black - E70
- D21, D210

Low voltage CT metering circuit diagram
NOTE:
1. ALL EQUIPMENT SHOWN IS FRONT CONNECTED.
2. ALL CURRENT TRANSFORMER WIRING TO BE 2.5mm² (7/0.65) STRANDED COPPER (CONDUCTORS INSULATED), MARKED AS PER IDENTIFYING PEARLS.
3. ALL WIRING IS LAID-UP AND CABLED AT REAR OF PANELS.
4. UNTERMINATED CABLE TAILS AT THE METER POSITIONS SHALL BE 250mm LONG.
5. ALL VOLTAGE WIRING TO BE 2.5mm² (7/0.65) STRANDED COPPER (CONDUCTORS INSULATED), MARKED AS PER IDENTIFYING PEARLS.
FAULT CURRENT LIMITERS

1. FAULT CURRENT LIMITERS (ASSOCIATED WITH THE POTENTIAL RIFLES)
2. ARE TO BE INSTALLED ON THE LINE SIDE OF THE (T)
3. MOUNTED DIRECTLY ON THE BUSBARS ON THE LINE SIDE OF THE K'S
4. TERMINAL CONNECTED FROM THE BUSBAR TO THE LINE SIDE OF FUSE BASE
5. SUITABLE FOR THE FIXING OF A 32mm HRC CARTRIDGE
6. CAPABLE OF BEING SEALED BY WESTERN POWER
All dimensions are in millimetres
RECOMMENDED MINIMUM CLEARANCES AND MOUNTING ARRANGEMENTS FOR SINGLE BUSBARS

All dimensions in Millimetres
Note:
1. The location of the mounting bracket should be in the vicinity of the metering current transformers and must be in an accessible and safe position.
2. The fuses are to be clear of all cables and terminations and must maintain adequate clearance from live bus bars to enable the seating procedure to be safely carried out.
Appendix L. Example Substation Check list

Check list withdrawn