Distribution Standard

Kiosk Substations and Switching Stations

Record Number: R1714183

Version: 8.0

Date: June 2025

Authorisations

Action	Name and title	Date
Prepared by	Alex McKay – Senior Substations Engineer	19/06/2025
Reviewed by	Babu Narayanasamy – Principal Design Engineer	19/06/2025
Authorised by	Melissa Taylor – Leader AM Systems and Standards	19/06/2025
Review cycle	5 Years	

Responsibilities

This document is the responsibility of the Asset Management Group, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Asset Management Group with any queries or suggestions.

- Implementation All TasNetworks staff and contractors.
- Compliance All group managers.

Record of revisions

Version	Description	Date
1	Original issue as document R392029	23/02/2016
2	Section 2.4.7: Earthing design process template added. Section 2.4.10.1: Clarified metering arrangement configuration Section: 2.4.15.4: Storm water drainage requirements revised. Inclusion of new storm water drawing KS-211 Section 3.2.1: Drawing KS-344 earth grid grading revised. Section 3.3 Inclusion of reference to precast substation design drawings	30/03/2016
3	Section 2.2.3: Further detail added on equipment types. Section 2.4.5: Additional detail for foundation requirements and designs for sloped ground. Section 2.4.6: Earthing section restructured. Section 2.4.7.1: Protection section and settings revised. Section 2.4.10.1: HV metering section revised Section 2.4.15.4: Storm water and drainage requirements revised Drawing KS-211 added Section 3.2.1: Earth grid grading altered on drawing KS-344 Section 3.2.2: Scaling corrected on drawings KS-355 Section 6: Tables 20, 21, and 22 added listing all approved equipment Section 7: Tables 23, 24 and 25 added listing all standard design drawings Earth rod length increased on drawings KS-309, KS-310, KS-311, KS-312, KS-330, KS-344 and KS-355.	22/01/2021
4	Document title revised to ‘Distribution Design and Construction Standard’	01/02/2021
5	Section 2.4.7: Protection settings in table 18 revised. Tables 19 and 20 added.	21/02/2022
6	Section 6.1, 6.2 and 6.3: Bill of materials numbers listed for equipment. Sections 7.1, 7.2 and 7.3: Bill of material table added to earth grid drawings.	12/09/2022

Version	Description	Date
7	Updated for change of standard kiosks to new manufacturer. Various: All drawing reference tables updated to new drawing numbers. Section 2.2.3.4: Table 7 changed to new configurations Section 2.2.3.6: 240mm^2 and 400mm^2 LV cable removed Section 2.2.3.7: Added to define maximum cable termination sizing Section 2.4.5.3: Clause added regarding direct burial of LV cables Section 2.4.6.7: Revised to provide process clarity Section 2.4.7: LV fuses added Section 5: Requirement for fuse reach calculations added Section 6: Standard equipment tables updated Section 7: Drawings and standard designs updated	5/12/2023
8	Updated for changes to standard kiosk type switching stations All drawings removed from this version of the Standard. To be accessed via the drawing package on TasNetworks' External Website or Drawing Management System.	19/06/2025

Table of Contents

1 Introduction

This Distribution Design and Construction Standard for Kiosk Substations and Switching Stations contains the approved design process considerations and standard designs for the design and construction of kiosk type distribution substations and switching stations on TasNetworks' distribution network.

TasNetworks will update this standard periodically. It is the responsibility of the user of the document to ensure the latest version of this standard is being used.

1.1 Scope

This standard applies only to the following asset types:

- Kiosk substations – Up to 2 MVA
- Mini-kiosk substations
- Kiosk switching stations

All materials used shall comply with TasNetworks' Approved Product List.

New substations will connect to and be supplied from the existing network. The infrastructure at the point of connection may be the existing underground network or the overhead network. The design standard for the applicable infrastructure is provided in the corresponding Distribution Design Standard. References to these standards are provided in section 1.4.4.

The following asset types are not covered by this design standard:

- Building type substations and switching substations – For further detail refer to the Distribution Design Standard for Building Substations
- Underground type substations (Vault) – Discontinued asset type
- Private installations - For further detail refer to the Distribution Design Standard for Planning
- HV Regulators - For further detail refer to the Distribution Design Standard for High Voltage Regulators
- Fence type substations – Discontinued asset type, refer to Appendix A for drawing references
- Overhead systems - For further details refer to the Distribution Design Standard for Overhead systems
- Underground system - For further detail refer to the Distribution Design Standard for Underground System

The application of this design standard applies to both new and existing installations. All new designs shall be fully compliant with this standard unless the TasNetworks Asset Management Group gives prior approval for a non-compliance to occur.

1.2 Definitions

Table 1: Definitions

Term	Definition
ADMD	After Diversity Maximum Demand is the simultaneous maximum demand of a group of customers divided by the number of customers, expressed in kilovolt amperes.
BCA	Building Code of Australia
BCA Class 1	A building classification as defined by the BCA
BCA Class 2	A building classification as defined by the BCA
Building substation	An indoor substation within a permanent building in which working space and passageway(s) are provided. The transformers(s) may be partly or wholly indoors.
CBD	Central business district
Earth	A conductor connected to an earthing system.
Earthing system	A conductive network, typically installed below ground for the purposes of providing a path for fault current.
Earth grid	A copper grid installed in the ground below a kiosk for the purposes of providing a path for fault current.
Easement	A right enjoyed by a party with regard to the land of another party, the exercise of which interferes with normal rights of the owner or occupier of that land.
EMF	Electrical and magnetic field
Fence substation	A ground mounted outdoor substation installed within a fenced enclosure. The equipment may be outdoor or indoor type installed within a weatherproof enclosure
Kiosk substation (Padmount)	A ground mounted substation where all the equipment is installed within a single enclosure. Usually consisting of the enclosure, high voltage switchgear, transformer(s), and low voltage switchboard. The substation is usually supplied as a complete assembly and is installed or replaced as a unit. The equipment is enclosed in a common weatherproof housing with limited access. Provision is made for replacement of individual components.
Mini-kiosk substation	A ground mounted substation of smaller capacity than a standard kiosk. The substation usually consists of an enclosure, high voltage fuses, transformer(s), and low voltage.

Term	Definition
Pre-cast substation	A ground mounted substation where all the equipment is installed within a single enclosure, usually consisting of the enclosure, high voltage switchgear, transformer(s), and low voltage switchboard. The substation enclosure is manufactured usually supplied as a complete assembly and is installed or replaced as a unit. The equipment is enclosed in a common weatherproof housing with limited access. Provision is made for replacement of individual components.
Low density residential	Referred to as the definition in the Local Government Authority documents and BCA
Pole mounted	The substation equipment is outdoor type mounted above ground level on one or more poles.
Ring Main Unit (RMU)	A high voltage switchgear unit. Typically used in a kiosk substation.
Switchgear	Electrical equipment used for connecting and disconnecting electrical infrastructure on the network.
Switching station	A ground mounted outdoor installation used for switching high voltage feeders and supply to HV customers.
Vault or sub-surface substation	The substation installed below ground level. The substation may be stand alone or integrated into another building. Access may be via a hatchway from a road or footpath or by an internal door below ground level. These types of substations are often classed as confined spaces due to their restricted access and egress.
URD	Underground Residential Development

1.3 Asset Records

TasNetworks' distribution records are managed by the Asset Records groups. For the purposes of distribution design, the following applications are relevant:

- NetMaps: Internal Geographic Information System (GIS) which provides details of the electrical network and installed assets specifications. The system can be used to assist in the design process because it provides details of the electrical network superimposed on an aerial street view. Figure 1 is an example of a typical layout view.
- Operational schematics: Schematic drawings of the electrical network providing a detailed view of the distribution HV network interconnection. The network is divided into panels covering a specific network area. Figure 2 is an example of a typical schematic.
- Single Line Diagram: Site specific electrical schematics of both the HV and LV components. This information forms both a critical input to understand the existing infrastructure and a critical deliverable of the design.

Figure 1: NetMap view

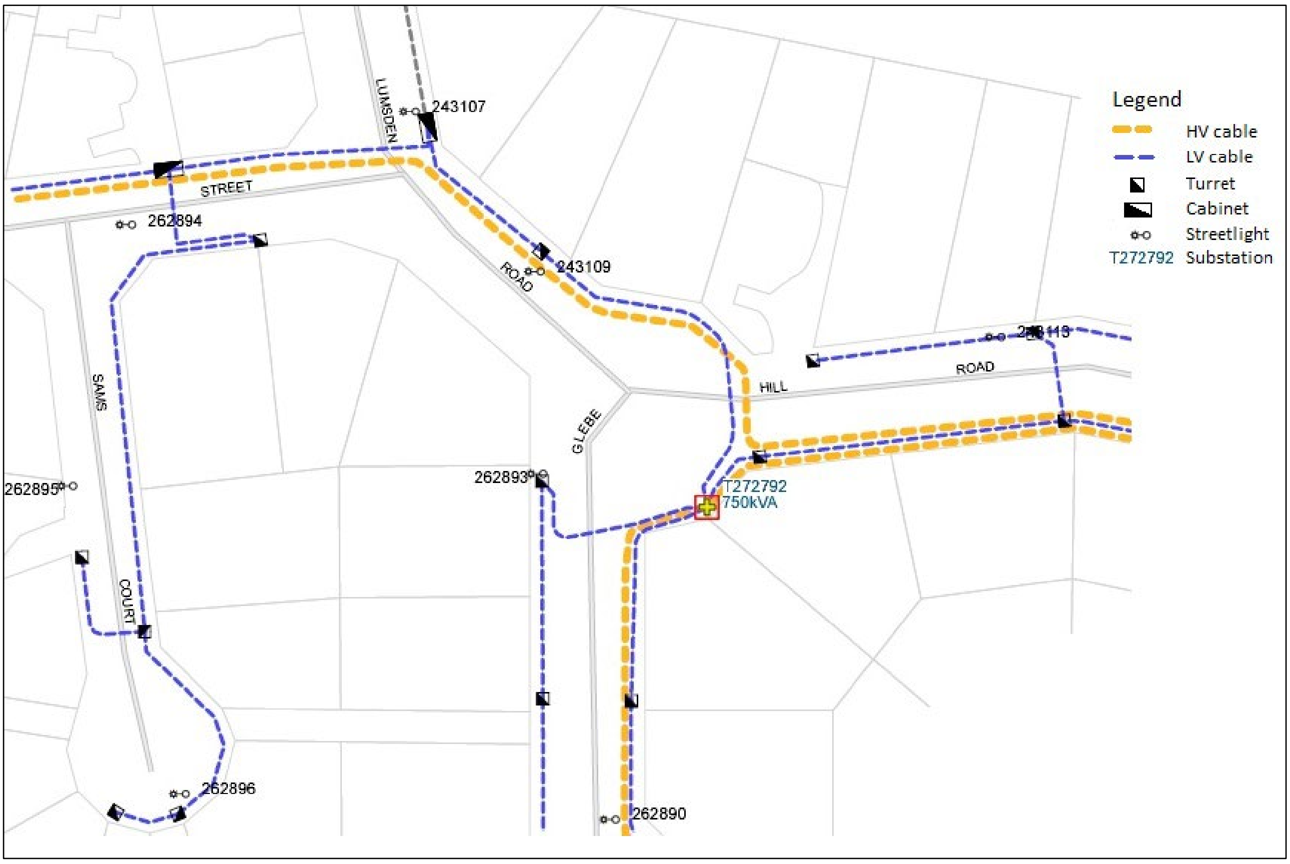
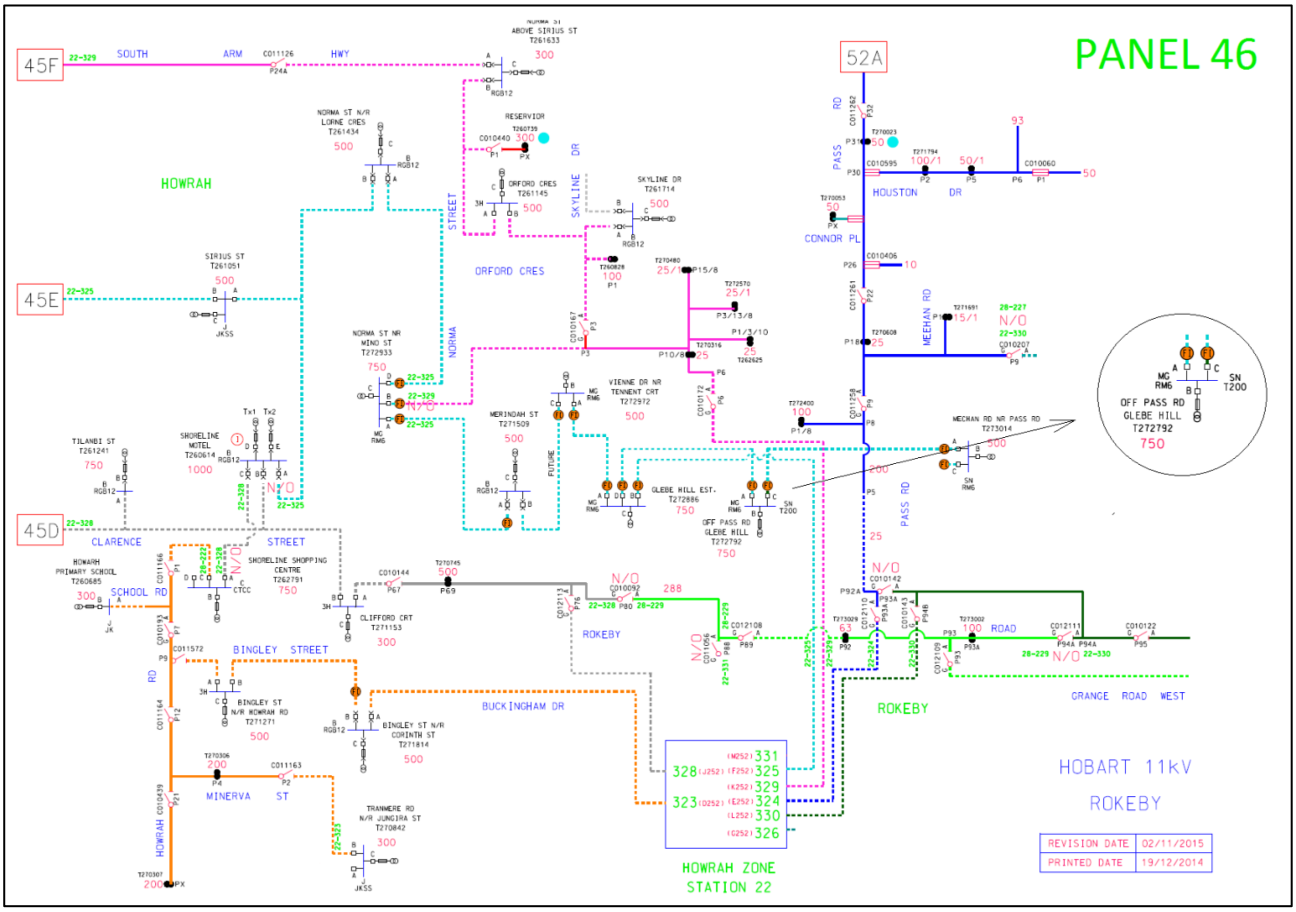


Figure 2: Typical operational schematic



1.4 Acts, regulations, and standards

1.4.1 Acts and regulations

Designers must consider and comply with any relevant legal or statutory requirements, which may include the following:

- Aboriginal Relics Act 1975
- Electricity Supply Industry Act 1995
- Electricity Supply Industry (Tariff Customers) Regulations 2008
- Workplace Health and Safety Act 2012
- Workplace Health and Safety Code 2012
- Workplace Health and Safety Regulations 2012
- Occupational Licensing Act 2005
- Environmental Management and Pollution Control Act 1994
- Crown Lands Act 1976
- Crown Lands Regulations 2001
- Environmental Management and Pollution Control (Controlled Waste Tracking) Regulations 2010
- Environmental Management and Pollution Control (Waste Management) Regulations 2010
- Forest Practices Act 1985
- Forest Practices Regulations 2007

- Historic Cultural Heritage Act 1995
- Threatened Species Act 1995
- Nature Conservation Act 2002
- Land Use Planning and Approvals Act 1993
- National Parks and Reserves Management Act 2002
- National Parks and Reserved Land Regulations 2009
- State Policies and Projects Act 1993
- State Policy on Water Quality Management 1997
- Weed Management Act 1999
- Wellington Park Act 1993
- Electricity Industry Safety and Administration Act 1997 and Regulations 1999
- Occupational Licensing (Electrical Work) Regulations 2008

For further details on environmental law/regulations, refer to the Environment & Heritage Design and Construction Standard.

Designers shall comply with the Occupational Licensing Code of Practice 2016 (as amended or replaced), including compliance with:

- AS 2067 (Substations and high voltage substations)
- AS/NZS 3000 (Wiring Rules)
- AS/NZS 7000

Any additional obligations imposed by AS 2067, AS/NZS 3000 and AS/NZS 7000 referring to further Australian Standards or documents, including any amendments or revisions of those Australian Standards or documents from time to time.

The above information is a guide only. New designs shall be compliant with all legislative requirements, relevant standards, and guidelines.

1.4.2 Applicable Australian and international, standards and guides

The standards and guidelines listed in Table 2 are some of the common standards and guidelines applicable to substation design. The design must be fully compliant with all applicable standards. The most up to date standard at the time of the project must be used.

Table 2: Standards and guidelines applicable to substation design

Standard	Title
AS 1033.2	High-voltage fuses (for rated voltages exceeding 1000V) - Current-limiting (powder filled) type.
AS 1243	Voltage transformers for measurement and protection
AS 1284	Electricity metering
AS 1319	Safety signs for the occupational environment
AS 1767	Insulating oil for transformers and switchgear
AS 1931	High voltage testing techniques
AS 1939	Degrees of protection provided by enclosures for electrical equipment
AS 2024	High voltage AC switchgear and control gear - Switch-fuse combinations

Standard	Title
AS 2067	Substation and high voltage installations exceeding 1 kV AC
AS 2293.1	Emergency escape lighting and exit signs for buildings - System design, installation, and operation
AS 2374	Power transformers
AS 2374.7	Guide to loading of oil-immersed transformers
AS 2676.2	Guide to the installation, maintenance, testing and replacement of secondary batteries in buildings - Sealed cells
AS/NZS 3000	Electrical Installations "Wiring rules"
AS/NZS 3008	Electrical installations - Selection of cables
AS 3011.2	Electrical installations - Secondary batteries installed in Buildings - Sealed cells
AS/NZS 3835	Telecommunication Assets
AS/NZS 3947	Low voltage switchgear and control gear
AS/NZS 4853	Pipelines
AS 60044.1	Current transformers - Measurement and protection
AS 60157.1	Circuit breakers for distribution circuits-up to and including 1000 Vac and 1200 Vdc
AS/NZS 60265.2	High voltage AC. switchgear and control gear - Switches and switch-disconnectors for rated voltages above 1 kV less than 52 kV
AS 60269	Low voltage fuses - Fuses with enclosed fuse links
AS/NZS 60479.1	Effects of current on human beings and livestock - General aspects
AS 62271	High voltage AC. switchgear and control gear
ENA EG-0	Power System Earthing Guide
ENA EG-1	Substation Earthing Guide
ENA 18-2008	Interim Guideline for the Fire Protection of Electricity Substations
	CIGRE Technical Brochure 537, Guide for Transformer Fire Safety practices
IEEE 979	Guide for Substation Fire Protection
IEE837	Standard for Qualifying Permanent Connections Used in Substation Grounding
NFPA 850	Recommended Practice for Fire Protection for Electric Generating Plants and High Voltage Direct Current converter stations
NUREG 1805	Fire Dynamics Tools (FDT^s) – Quantitative Fire Hazard Analysis Methods for the US Nuclear Regulatory Commission Fire Protection Inspection Program

1.4.3 Applicable regulatory standards

Where a new installation impacts an existing or proposed building, the design must not result in a situation where it creates a noncompliance for the building with the Building Code of Australia.

Table 3: Design and Construction Related Standards

Standard	Title
NCC	National Construction Code Series
	Volume One: Building Code of Australia Class 2 to 9 Buildings
	Volume Two: Building Code of Australia Class 1 and Class 10 Buildings
	Volume Three: Plumbing Code of Australia

1.4.4 TasNetworks standards

Table 4: TasNetworks Standards

Standard	Title
R373312	Distribution Planning Requirements – Underground Residential Developments
R1714183	Distribution Design and Construction Standard - Kiosk Substations and Switching Stations (This standard)
R678169	Distribution Design Standard - Building Substations and Switching Stations
R392089	TasNetworks Distribution Standard – Underground System
R391752	Distribution Design Standard – Public Lighting
R2210388	Distribution Design Standard - Overhead Systems
R1285359	Distribution Standard – Kiosk substation precast concrete enclosure drawings
R393981	Drawing Drafting Standard
R393979	Drawing Management Standard
R502011	Environmental Considerations – Distribution Lines – Design, Construction and Decommissioning
R2314059	Service and Installation Rules

2 Design framework

Distribution designers need to consider various elements including key stakeholders, electrical utility planning, relevant standards, and guides and whole of life cycle management of the design.

2.1 Design implementation

The design may be an iterative process due to the number of design requirements that may be competing with one another, however it shall aim for standardisation wherever possible. The design should assist TasNetworks to achieve a sustainable electrical network by optimal application of technology and ensuring quality of supply. The design should aim to achieve a service life for the installation more than forty years, with a cost-effective solution that meets the needs of both the customer and TasNetworks, and compliance with legislative requirements, including alignment with existing industry guides and standards.

A substation design requires integration with other electrical components; as such, the designer shall have an in-depth knowledge of the associated Australian standards and the relevant TasNetworks standards.

Table 5: TasNetworks standards and purpose

Documentation Title	Description
Distribution Planning Requirements – Underground Residential Developments	Planning requirements for the design and construction of underground residential developments.
Distribution Network Planning Manual	Framework to meet the Planning strategy
Distribution Planning Requirements	Distribution system design manual subset, which stipulates planning requirements for specific development types to meet the Planning strategy e.g., Planning Requirements for Underground Residential Subdivisions.
Distribution Design and Construction Standard – Kiosk Substations	Design standard for kiosk substations and switching stations.
Distribution Design Standard – Overhead	Design standard for overhead installations
Distribution Design Standard – Underground System	Design standard for Underground assets
Distribution Design standard – Public Lighting	Design standard for public lighting
Distribution Design Standard – Building Substations and Switching Stations	Design standard for Building Substations and Switching Stations
Distribution Construction specification – URD	Detailed civil construction framework to meet the design requirements for Urban Residential Developments

Documentation Title	Description
Distribution Electrical specification – URD	Detailed electrical construction framework to meet the design requirements for Urban Residential Developments
Distribution Design Standard – Public Lighting	Detailed Design framework for public lighting assets to meet the Design System strategy
Environmental Considerations – Distribution Lines – Design, Construction and Decommissioning	Detailed environmental considerations
Service and Installation Rules	Defines the minimum requirements for connecting to TasNetworks' low voltage (LV) distribution network.

2.2 Design methodology

2.2.1 Assessment of new connection

2.2.1.1 Customer load requirements

To determine the electrical network capacity, the calculation of the maximum demand of a new development is required. Appendix C of AS3000 shall be used as guidance to calculate the maximum demand of a site/s, in conjunction with TasNetworks planning standards. When the load requirements are not known at the time of initial discussions, the load can be assessed by analysing the purpose of the building/dwelling allotment, i.e., size and type.

In general, with the exception of rural and remote areas, load demands greater than 200 kVA will require a new electrical transformer installation. Where the load demand lies between 100 and 200 kVA the designer shall review other electrical elements which are predominately associated with the availability of LV reticulation.

2.2.1.2 TasNetworks planning requirements.

The new connection load demand calculation allows the designer to review the available electrical network options to align with TasNetworks planning requirements.

The planning requirements cover the critical elements for a sustainable electrical network and the designer should consider the following:

- Revise the calculated load demand to include potential future load for the area, street lighting, ADMD (if required) calculations and temporary augmentation of the electrical infrastructure during both planned and unplanned outages.
- Existing electrical infrastructure – Overhead or underground networks can dictate the efficiency of new electrical reticulation as the norm to follow and allow the designer to correctly size the HV and LV cables to allow for the intended load and TasNetworks' planned and unplanned outages.
- Type of load – the designer shall review the type of load associated with the new design, to ensure specific requirements are met (i.e., a sawmill or pump will have – high start stop loads - versus a shopping centre/residential development – which will have a more static load).
- Local Government Authorities – Councils have varying mandatory requirements relating to electrical infrastructure, which can exceed the requirements of Australian Standards and TasNetworks design standards and planning directives.

- Requirements for specific areas such as Critical Infrastructure (CBD), High Density Commercial, Urban, High Density Rural and Low Density Rural – details on the specific requirements for these areas can be found in section 2.2.5 (in general the various areas require the network augmentation to be designed radially for capacity calculations up to 1000 kVA subject to portable generator availability). Capacity calculations more than 1000 kVA require integration to the HV backbone, a detailed assessment of upstream zone substation capacity and feeder ratings to be reviewed.
- The size of the development with respect to total surface area (small, medium, and large) and any staged development for the area is also a crucial consideration that will influence the end design.

2.2.2 Site selection

The selection of a suitable location for the kiosk requires an assessment of, but not limited to the following criteria:

- Proximity to load (typically the LV reticulation should not exceed a 300-metre radius from the HV source, which shall be verified in the detailed electrical design, considering limitations e.g., fuse reach, during typical network configurations).
- Easement requirements – Minimum one metre beyond the substation earth grid perimeter and a vertical height easement to allow TasNetworks to replace substation when required.
- Future network expansion – i.e., parallel transformer for increased load.
- Fire risk
- The risk of environmental harm from potential spillage and leaks of hazardous substances.
- Presence of threatened species habitat or threatened vegetation communities.
- Weed presence and associated risks of spread and or management responses required.
- Sea level rise – as identified by Local Government Planning Schemes and State modelling in the Coastal Inundation layers available on LIST map.
- Erosion risks such as soil dispersion, risk of landslip, soils acid sulphate soils, and risk of sediment due to planned works.
- Presence of Significant trees and protection of associated root zones.
- Presence of Aboriginal Heritage
- Presence of Cultural Heritage
- Earthing considerations (refer to section 2.4.5 for further details)
- Separation from existing underground infrastructure (e.g., gas, water, and communication).
- Aesthetics
- Access and Operational clearances.
- Noise
- Ground conditions – slope, flooding level, soil structure, soil resistivity, temperature, and wind extremes.
- Safety from inadvertent damage by vehicles or other commercial or industrial work processes in the vicinity.
- EMF impact
- Hazardous locations as specified in AS 3000.
- The substation must not be in a position where it will negatively impact the existing sightlines for road users or pedestrians e.g., cars approaching intersections or exiting driveways.

- The designer should allow for multiple options to be made available for the site selection and documented in a compliance/cost trade off matrix for the key stakeholders to review.

2.2.3 Equipment selection

2.2.3.1 Environmental conditions

Kiosk substations are available in a variety of enclosure types, those being:

- Steel enclosure
- Marine grade steel or aluminium
- Mini-kiosk

Local environmental conditions may make some types more suitable than others.

Kiosk substations with a steel enclosure are TasNetworks standard type, consideration to other Kiosk substation types will be at the discretion of TasNetworks Asset Management Group.

A steel substation enclosure has several advantages:

- Relatively inexpensive.
- Faster installation and commissioning.
- Uniform installation leading to minimised spare stockholdings and simplified construction.
- Relatively unobtrusive visual impact and can be coloured/painted to blend in with environment as required.

Marine graded enclosures are beneficial in locations that are near the coast or a site with high pollution levels e.g., a large industrial. Where a kiosk is installed within 100 metres of the coast or a site with high pollution levels, a kiosk with a marine grade enclosure shall be used.

Mini-kiosk substations have a smaller footprint, but their use needs to be with consideration of the upstream HV network configuration. These kiosk type substations do not have HV switchgear and rely on the upstream protection to clear the HV faults. As such, unless a separated upstream pole mounted air break switch or fuse arrangement is incorporated into the design, the feeder breaker protection scheme will be the first scheme to see a high voltage fault and may result in a complete feeder outage. The intended use of this type of substation is in low density areas with large blocks (greater than 1 acre) where underground electrical reticulation is required.

2.2.3.2 Substation capacity

Kiosk type substations are available in several standard sizes ranging from 100 kVA to 2000 kVA. (Substations greater than 2000 kVA are available but are not approved for use in the TasNetworks system). For kiosks at 11 kV and 22 kV the range is as follows:

- 500 kVA
- 750 kVA
- 1000 kVA
- 1500 kVA
- 2000 kVA

For Mini-kiosks the range is as follows:

- 100kVA – 11kV or 22 kV
- 150kVA – 11kV
- 200 kVA – 22kV

Section 6 - Equipment contains full details on the standard configurations of kiosk substations approved for use in the TasNetworks system.

To finalise the capacity of the substation i.e., the number and size of the transformers, it may also be necessary to determine the level of supply security required by the customer. If redundancy of supply is required, the use of multiple transformers in a building type substation may be preferable to a kiosk type. For adjacent substation installations, additional considerations in relation to clearances for fire/explosion and operational/access compliance shall be completed by the designer.

Unless prescribed during customer connection capability investigations by TasNetworks' Network Planning team, the transformer loading at the time of connection should be no greater than 80% of the transformer rating. The initial utilisation factor allows for the connection of future customer load to the substation. Alternative transformer utilisations shall be referred to TasNetworks' Network Planning team. Refer to TasNetworks Distribution System Design Standard for the specific transformer standard size and number to be used with the required calculated load as described in 2.2.1.

Kiosk substation transformers used on the distribution network have 4-6% transformer impedance and tapping range +10% to -5% in 2.5% steps.

TasNetworks HV and LV voltage constraints can be referenced from the Planning Requirements URD.

At the time of commissioning the construction service provider shall ensure the voltage range specified in TasNetworks planning requirements is adhered.

2.2.3.3 High voltage switchboards

<u>Substations</u>

High voltage switchboards for substations shall either be a Ring Main Unit (RMU) or a composite switchboard.

Kiosk substations shall use an RMU for the HV switchgear. The RMU must be a 2, 3 or 4-way unit, with line switches for the feeder connections, and a circuit breaker for the supply to the transformer.

A 2-way ring main unit may only be used where there is only one HV feeder and there will be no future expansion of the HV network from the location.

A 3-way ring main unit, with a line switch on each end of the switchboard and a circuit breaker in the centre position, shall be used as the standard arrangement. A 3-way RMU is suitable for use in all substation enclosures.

A 4-way ring main unit, with three line switches and one circuit breaker shall be used where three HV feeder connections are required, or capacity needs to be provided for expansion at a later stage. The circuit breaker shall reside in one of the two centre positions. The 4-way RMU is only suitable for use in larger enclosures.

Mini-kiosks do not contain high voltage switchboards. The high voltage supply is direct connected to substation transformer via a fuse.

<u>Switching stations</u>

The switchboard in a switching station may be either an RMU or modular switchgear. The switchgear type and arrangement will be dependent on the site requirements.

An RMU can be a more economical solution in network locations where limited protection functionality is required for the installation e.g., only over current and earth fault protection and no feeder protection.

2.2.3.4 Low voltage switchboards

Low voltage switchboards in kiosk substations shall comply with TasNetworks' low voltage switchboard design standard. Each switchboard has a customer distribution board which is used for the connection of customer load. LV distribution boards are available in the configurations listed in Table 6.

Table 6: **LV distribution boards for kiosk capacities 500-2000 kVA**

Configuration	Isolator	Board Rating	Fuse Switches	Circuit Breaker
500 & 750 kVA	2000A	1400A	4x 630A Fuses	N/A
750 kVA	2000A	1600A	2x 630A Fuses	1x 1000A CB
1000 kVA	2000A	1600A	2x 630A Fuses	1x 1600A CB
1500 kVA	3200A	2400A	2x 630A Fuses	1x 2000A CB
1500 kVA	3200A	2400A	5x 630A Fuses	N/A
2000 kVA	4000A	3200A	1x 630A Fuses	1x 3200A CB

Table 7: Mini-kiosk capacities (100-200 kVA)

Configuration	Circuit breakers
1-way	400 A x1
2-way	250 A x2
3-way	250 A x3

2.2.3.5 Phase sequence

The phase sequence of TasNetworks' electrical network varies across the state. The designer shall determine the phase sequence relevant to the area* under design. They shall ensure the purchase order for the Kiosk substation equipment reflects the correct phase sequence or that the available unit may be phase swapped to the correct sequence.

*Note: for external designers, TasNetworks will confirm the phase sequence relevant to the area for design.

2.2.3.6 Cable selection

The designer shall determine the number of feeders, rating, and lengths for both the HV and LV reticulation. TasNetworks' standard feeder cable size (depending on application) for both 11 and 22 kV are 185 mm^2 and 240 mm^2 3 core, XLPE insulated individual copper screened and HDPE sheath.

TasNetworks' standard cable size for LV reticulation is 185 or 300 mm^2, 4 core XLPE insulated.

For further details refer to TasNetworks' Distribution Design Standard for Underground System and TasNetworks Planning Requirements.

2.2.3.7 Maximum LV cable termination sizing

Cable termination sizing is limited by the enclosure size and consideration of safety factors, such as manual handling, clearance between phases, and mechanical stress upon the LV board. To ensure the safety of field crews and longevity of the asset there is a restriction on the size and number of cables that may be terminated into a standard TasNetworks kiosk. Table 8 gives the details of these limitations.

The designer shall inform the customer of the maximum size and total number of cores where a customer intends to terminate their mains directly to a circuit breaker inside a TasNetworks kiosk.

Deviations from the below table must be approved by TasNetworks' Principal Design Engineer or Asset Management Substations Team.

Table 8: Maximum cable sizing

Kiosk rating	LV protection device	Maximum cores	Maximum cable size
500 or 750 kVA	630A Fuse switch	1 per phase	300mm2
750 kVA	1000A NS1000N CB	4 per phase	300mm2
1000 kVA	1600A NS1600N CB	4 per phase	300mm2
1500 kVA	2000A NS2000N CB	4 per phase	400mm2
2000 kVA	3200A NS3200N CB	4 per phase	400mm2

2.2.3.8 Kiosk substation exclusion

There are some situations where a kiosk substation may not be suitable. These include, but are not limited to:

- Locations within the Critical Infrastructure Zone – kiosk substations shall not be used for locations within this zone, due to requirements of supply redundancy and other specific technical requirements. If the planned connection is within the zone this will be advised by TasNetworks Network Planning Team during the customer connection enquiry phase.
- Locations with space restrictions - this is particularly an issue in the CBD environment where building footprints often take up the full area of the available land. In this situation an integrated building substation may be the only feasible option.
- Load requirements more than 2000 kVA – for loads above 2000 kVA a multi-transformer installation may be required. This may take the form of a multiple kiosk installation or an integrated building substation, depending on the installation.
- Visual, noise or other environmental issues in sensitive areas may result in the kiosk substation not being suitable for the intended location.

2.2.4 Safety in design

Designers shall consider and comply with all safety requirements to exercise due diligence in assessing design work, including under the Work Health and Safety Act 2012. The elements to consider include:

- Early identification of hazards and assessing risk associated in the design process, construction phase, operating and maintenance phase and the decommissioning and demolition phase.
- Elimination of identified risks as so far as reasonably practicable or the minimisation of these risks throughout the entire lifecycle of the plant, substance, or structure
- Consultation and communication of the assessment outcomes through formal documentation

The safety in design process integrates the above elements into an industry recognised framework, with the focus on early identification of risk often yielding an easier and cheaper outcome to the design rather than making changes during further stages. The designer shall complete a safety in design report for each new design, where the safety in design content detail shall be proportional to the complexity of the design.

2.2.5 Electrical design

The electrical design stage collates the information from the previous stages to develop a detailed design. The designer shall incorporate the design in both drawing and reporting form where applicable and shall cover the elements listed below:

2.2.5.1 Site conditions

The following items are the minimum requirements for construction and operation of TasNetworks owned substations. These items should be negotiated with the site owner/s prior to any commitments being made by TasNetworks to supply electricity to the site.

- An electrical infrastructure easement is required over all TasNetworks owned equipment installed on, over or under private property, council land, schools, reserve roads/Crown land and TasRail corridors.
- Vehicle access to the substation site must be available year-round in all weather conditions to allow for repairs and/or maintenance.
- 24-hour access must be available to all TasNetworks owned equipment.
- All equipment installed behind locked gates, in locked buildings or other secured areas must be accessible by utilising a standard TasNetworks issued substation lock.

2.2.5.2 Arrangement

The site arrangement should consider the following:

- Where not prescribed by the Distribution Planning Requirements, the most appropriate HV/LV network arrangement based on the neighbouring network to which the substation will be connected.
- Location – the HV and LV reticulation interconnection can be dependent on TasNetworks' reliability areas classification such as Critical Infrastructure (CBD), High Density Commercial, Urban, High Density Rural and Low Density Rural. Refer to TasNetworks Planning Requirements for further details.

2.2.5.3 Urban environments

Substations in urban environments may require additional considerations for a number of reasons:

- Additional protection and automation is often required in urban substations particularly in CBD environments. This may be due to the requirements to supply critical customers (hospitals etc.) or due to higher regulated security of supply requirements.
- New substations installed within the Hobart CBD and some areas of the northern suburbs of Hobart may need the inclusion of a unitised protection scheme to maintain high reliability requirements of the CBD area.
- Substations in urban environments typically have significant contact with the general public and as such particular attention should be given to safety with regard to earthing systems and fire safety zones.

2.2.5.4 Rural environments

Substations in rural environments demand additional consideration for a number of reasons:

- Rural substations are generally a stand-alone installation and as such the earthing requirements are often more difficult to achieve.
- The greater the distance from urban centres the greater the response time to faults and failures, particularly with ground mounted substations.
- Rural substations may be installed at the ends of long overhead feeders and so attention should be given to ensuring that:
  - The current carrying capacity and voltage drop on the HV and LV system is checked for compliance, which shall include inputs such as transformer type, unbalance factor, Cable Confidence Factor, Volt Drop Confidence Factor, Transformer Confidence Factor in regard to ADMD. Generally, the LV cables lengths should be kept to a minimum to counteract the increased voltage drop. For further information on the preferred LV reticulation configuration, refer to TasNetworks Planning Requirements.
  - The upstream protection from the substation is checked and upgraded if required. For example, EDO fuses may need upgrading or replacing to ensure correct protection operation and discrimination is achieved.
  - Care should be taken to ensure the installation does not pose a risk of ferro-resonance. For any new kiosk station to be fed from the overhead network, it should be assumed that upstream protective devices will need to be upgraded to three phased ganged operable devices to prevent ferro-resonance.
  - The fault level is calculated to ensure protection devices operate as intended.

In rural environments where an underground network is to be installed, if the load can be provided by a Mini-kiosk, then the installation of one over a standard kiosk may be a more cost-effective solution.

2.2.5.5 Electrical specification

The electrical design shall cover the following criteria:

- Confirm voltage drop acceptability.
- Equipment and ratings
- Protection and control functions
  - Circuit breakers (type and size).
  - Fuse sizing and confirmation of appropriate fuse reach.
  - Links or dis-connectors required for the customer.
  - Whether or not the customer’s switchboard will be contiguous with the substation.
- Selection of the correct earthing arrangement and verification of its suitability, or design of the earthing system. Development of the testing requirements to confirm its suitability and compliance with the requirements of AS2067. The earthing design and testing requirements will vary depending on the location and method of interconnection of the substation. Refer to Section 2.4.6.for further information.
- Confirmation that EMF levels are within acceptable limits.
- Determine HV metering requirements if applicable.
- Lighting requirements
- Confirmation that the ventilation is compliant and not affected by site selection or surrounding infrastructure.
- Equipment labelling

- Development of detailed electrical design drawings and documentation as per Section 4 (single line diagram, equipment general arrangement, etc.)

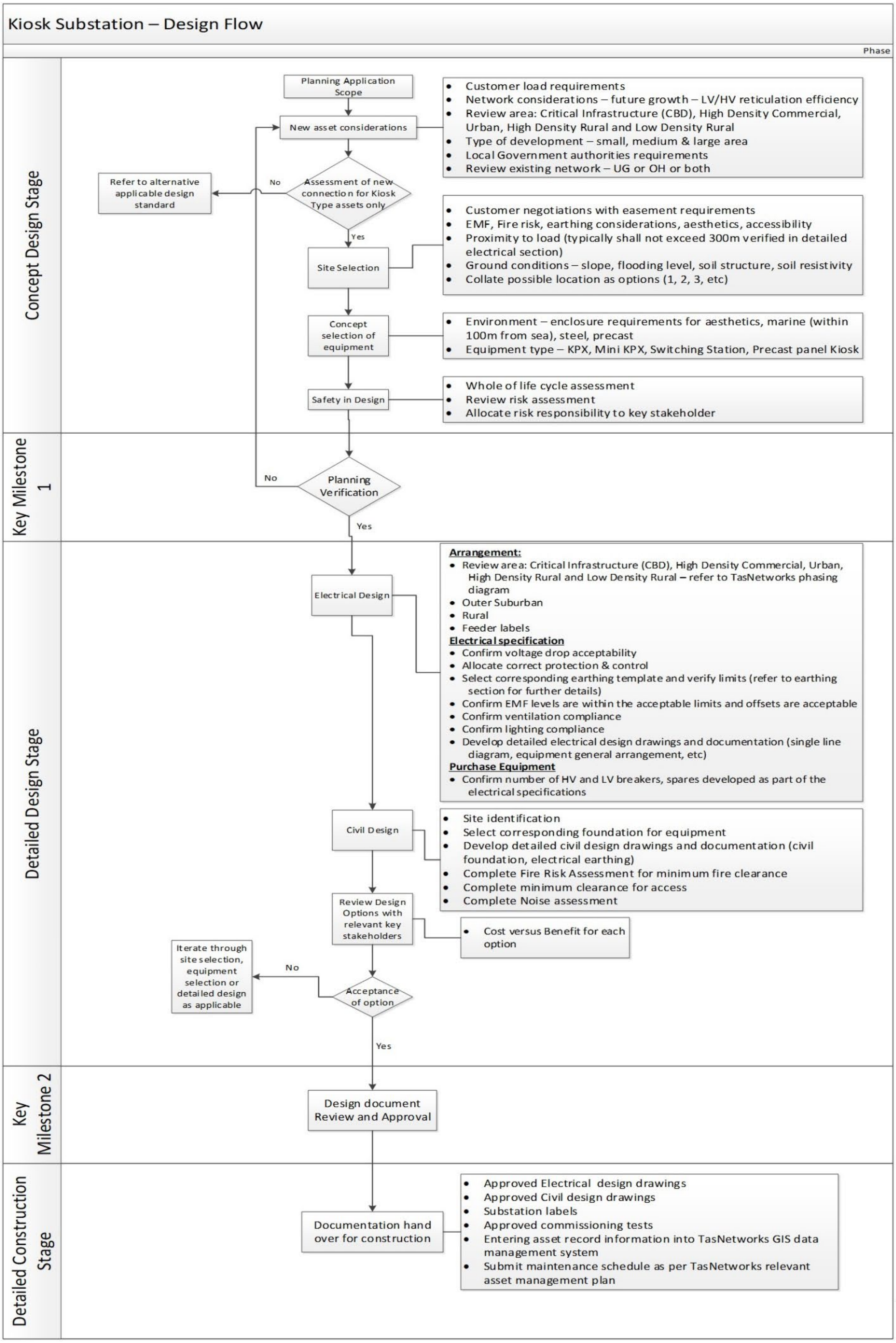
2.2.6 Civil design

The civil design should cover the following criteria:

- Determination of the foundations for the equipment being used.
- Development of detailed civil design, drawings, and documentation as per Section 4, including
  - Civil foundations
  - Earthing system
- Completion of fire risk assessment for minimum fire clearance
- Completion of minimum clearance for access and operation
- Completion of noise assessment
- Determine retaining walls, batters, and drainage (as required)
- Completion of landscaping and aesthetics requirements
- Confirm substation safety signs and equipment identification.
- Evaluation of hazardous locations and environmentally sensitive areas

2.3 Design methodology process flow

Figure 3: Design methodology process flow



2.4 Detailed design requirements

2.4.1 Voltage drop calculations

The designer shall calculate the voltage drop for all design options and worst-case transformer location. The voltage tolerance shall comply with TasNetworks' Planning Requirements. The designer may need to complete an iterative process of changing the feeder routes or lengths to meet the voltage drop and conductor thermal constraints. For further details on TasNetworks' voltage drop criteria, refer to TasNetworks Distribution Underground System Design Standard.

2.4.2 Hazardous locations

Substation equipment and access routes must not be within an area that is classified as a Hazardous Area as specified in the AS/NZ 3000:2007 Wiring Rules Section 1.4.11 & 7.7.

Hazardous areas are defined as areas where flammable or combustible materials are produced, prepared, processed, handled, stored, or otherwise exist and may give rise to an explosive atmosphere. The operational and fire separation distances provided in Section 2.4.3 are not applicable for these locations.

Any proposed substation in this environment shall require prior approval from TasNetworks Asset Management Group.

2.4.3 Fire protection

A fire risk assessment shall be completed by the designer and included as part of the design documentation. Where necessary the fire risk mitigation measures shall be incorporated into the design. The fire risk assessment and derived protection mechanisms shall meet the requirements of AS2067.

A fire risk assessment shall include the following:

- Fire protection mechanisms
- Benefit versus Cost analysis
- Usage of the adjacent building and structure - residential/commercial building or electrical equipment
- Fire emergency response capability – rural areas may need to consider further separation distances
- Likelihood and consequence of fire events
- Underground reticulation such as gas mains
- Environmental sensitivity

New kiosk substation designs shall meet the fire mitigation requirements using passive systems to minimise the spread of fire from one delineated zone to another to reduce the overall area risk of damage. Examples of passive fire protection measures include, but not limited to:

- Providing the minimum fire separation distances from fire source
- Fire separation walls and fire barriers.
- Fire stopping and fire dampers to penetrations within fire barriers.
- Self-closing fire doors to openings in fire separation walls and fire barriers.
- Oil containment/bunding.
- Usage of less flammable insulating transformer fluid

The design process shall ensure an acceptable fire separation distance by utilising heat flux calculation principles produced by standard fire pool sources as outlined in IEEE979, which includes:

- Property and quantity of insulating oil
- Size of the potential oil spill, including site gradient
- Material of adjacent building to be protected
- Fire rated walls or barriers
- Fire suppression measures provided
- Prevailing winds

Table 6.1 of AS2067 may be used as a minimum guide for spacing. As an example, consider a standard kiosk substation with metal enclosure and ≤ 1000 litres of oil, in a low-density residential area. If the surrounding buildings are of Class 1 (typically residential dwelling that is habitable) or Class 10 (typically swimming pool or carport, which are not habitable) of the BCA, the kiosk may be situated no closer than six metres.

Table 9 provides a list of sample guides for the minimum fire clearance zones around kiosk substations. The designer shall ensure that the clearance zones are adequate for the local environment where the substation is being installed. In situation where hazardous or flammable material are present an increased clearance may be required.

Table 9: Minimum fire clearance zones for kiosk substations

Description	Drawing Id.
Kiosk substation - Non fire rated enclosure	KS-200
Switching station - Non fire rated enclosure	KS-202
Kiosk substation - Fire rated enclosure	KS-203

The design process shall determine the fire protection mechanisms required as a result of the fire risk assessment and they shall be documented in the design deliverables.

2.4.4 Oil containment systems

Where the electrical equipment being used contains insulating oil, the installation design shall be compliant with the requirements of AS2067.

TasNetworks’ approved kiosks contain an integrated oil containment system.

2.4.5 Civil

2.4.5.1 Plinth

Kiosks and switching stations shall be installed on top of a concrete plinth. A standard design exists for the different size kiosks and switching. These designs are listed in Table 10.

The plinth shall be installed directly above the engineered foundation.

Table 10: TasNetworks standard plinth designs

Enclosure Type		Drawing
Tyree models	500 kVA w/ IDI	KS-302
	750 & 1000 kVA w/ IDI	KS-303
	750 kVA w/ IIDI	KS-304
	1500 & 2000 kVA w/ IDI or IIDI	KS-304
Legacy models	Schneider 3/05	KS-302
	Schneider 3/10	KS-303
	Schneider 4/15	KS-304
	Schneider 4/20	KS-305
	Mini-kiosk	KS-327
	Switching station	KS-341

2.4.5.2 Foundation

The kiosk/switching station foundation shall be designed to ensure the integrity of the foundation is retained for the life of the installation, typically 50 to 60 years.

The foundation shall be designed to accommodate the load of the installation and any additional loads that may be placed on it over its life.

Foundations shall be designed to accommodate the following for the life of the installation without the need for maintenance or remedial work:

- Local ground conditions.
- Local environmental conditions.
- Impervious to variations in the ground surrounding the installation.
- Natural water flows without subsidence or erosion.

As part of the design, the designer shall determine the ground bearing capacity at the preferred location. The ground bearing capacity is necessary to determine the requirements for the foundation design.

2.4.5.3 Ground bearing capacity

The following process shall be applied for assessing the ground bearing capacity:

1. Where a substation will be installed in a location where the original ground level is being altered, the site assessment must be undertaken when the final ground conditions and levels are present at the location.

2. Determination of the local ground conditions shall be undertaken through a site inspection and testing of the load bearing capacity of the ground. The testing shall be undertaken at all four corners of where the kiosk would be located. Note: At minimum, site specific DCP testing shall be completed to determine the load bearing capacity of the ground. Estimation of soil conditions using commonly available mapped soil data is not acceptable.

3. The DCP test results shall be used to determine if one of the standard foundations can be used or an engineered solution is necessary. Standard kiosk foundation designs are only

suitable for use where the ground bearing capacity is greater than 126 kPa (DCP > 3). Where the ground bearing capacity is less than 126 kPa they must not be used. The standard designs shall only be used where they can be used without alteration.

4. Where the ground conditions are not suitable for one of the standard designs, an alternative design shall be developed that meets the requirements of this standard. The design must receive certification of its suitability and compliance with relevant standards prior to its use.

2.4.5.4 Standard foundations

Table 11 provides details of the drawings covering both the standard foundation arrangements and designs.

Table 11: TasNetworks standard foundation arrangements and designs

Enclosure Type		Design drawing	Arrangement drawing
Tyree models	500 kVA w/ IDI	D-809-0049-SD-001	KS-208
	750 & 1000 kVA w/ IDI	D-809-0051-SD-001	
	750 kVA w/ IIDI	D-809-0054-SD-001	
	1500 & 2000 kVA w/ IDI or IIDI	D-809-0054-SD-001	
Legacy models	Schneider 3/05	KS-317	
	Schneider 3/10	KS-360	
	Schneider 4/15 and 4/20	KS-318	
	Mini-kiosk	KS-332	KS-209
	Switching station	KS-346	KS-210

2.4.5.5 Conduits

Conduits shall be installed in the civil foundations below the kiosk/switching station during construction to provide for the installation of the high voltage and low voltage cable after the kiosk/switching station has been installed.

The conduit positions vary depending on the size of the kiosk/switching station and configuration of the equipment within it. At the time of installation all conduits shall be installed. The number of conduits installed shall be sufficient to allow for the full capacity of the substation to be utilised.

Due to larger sized customer mains cables or uncontrollable variables on the site, it may be necessary to direct bury the LV cables terminating into the kiosk substation. The designer may assess the installation and make this decision in consultation with TasNetworks' Principal Design Engineer. If the choice is made to direct bury the cables, then care must be taken to remove the minimum possible engineered fill from the kiosk foundation during install. The trench and foundation shall be reinstated in accordance with the civil and trench section designs, ensuring adequate compaction of the fill such that the foundation will still meet design life requirements as stated in section 2.4.5.2.

The conduit arrangements for the substations are provided in Table .

Table 12: TasNetworks standard conduit designs

Kiosk Type		Drawing
Tyree models	500 kVA w/ IDI & 4x Fuse Switch	D-809-0050-SD-001
	750 kVA w/ IDI & 4x Fuse Switch	D-809-0052-SD-001
	750 kVA w/ IIDI & 4x Fuse Switch	D-809-0055-SD-001
	750/1000 kVA w/ IDI & CB + 2x Fuse Switch	D-809-0052-SD-002
	1500/2000 kVA w/ IDI/IIDI & CB + 2x Fuse Switch	D-809-0055-SD-001
Legacy models	Schneider 3/05	KS-313
	Schneider 3/10	KS-314
	Schneider 4/15	KS-315
	Schneider 4/20	KS-316
	Mini-kiosk	KS-331
	Switching station	KS-345

2.4.5.6 Drainage

The design shall provide adequate drainage at the site to ensure that water is appropriately drained from the site and does not pool in the vicinity of the installation or enter the kiosk. Site drainage shall meet the following requirements:

- Where the ground around the substation slopes down towards the substation, appropriate drainage shall be installed to ensure that water flows away from the substation. Open drains are the preferred arrangement.
- Drains shall not introduce uneven surfaces or slopes that may become a trip hazard to the operational area at the site. Drains shall not be installed within 1 metre of the substation enclosure.
- Drainage works shall consider the erosive potential of the soil and where they are located on disperse soils, appropriate control measures such as silt fencing, drain socks and battering shall be used.
- Site drainage shall be designed to ensure that water runoff does not negatively impact upon adjacent properties.
- The site drainage shall also consider the implications of the potential flow into waterways and avoid directing flow into waterways.
- Storm water outlets shall not be located in close proximity to the substation. (Minimum separation 20 metres). Storm water outlets beyond the minimum separation shall not drain towards the substation location.
- Where there is a change in elevation across the road, the substation shall be located on the highest elevation level. Drawing KS-211 provides an example of road crossing with varying elevations with both suitable and unsuitable locations for the installation of a substation.

Drawing KS-206 provides details of a standard drainage design.

2.4.5.7 Sloped ground - Retaining walls and batters

Sites requiring retaining walls and/or batters should be avoided unless there are no reasonable alternatives.

Where the ground slope is less than 1:3 a batter may be created to cover the height differential between the original ground level and the level area where the kiosk will reside. Where the slope is greater than 1:3 a retaining wall shall be installed. Standard designs have been developed for this situation and are listed in Table .

Table 13: Standard designs for sloped ground

Description	Situation	Drawing
Batter and drainage layout	Ground slope < 1:3	KS-206
Retaining walls up to 600 mm high	Up to 600 mm high	KS-207
Retaining walls 600 mm to 1000 mm high	600 mm to 1000 mm	D-KS1-0212-SD-0001
Retaining walls 1000 mm to 1500 mm high	1000 mm to 1500 mm	D-KS1-0213-SD-0001
Retaining walls 1000 mm to 1500 mm high (Compact)[1]	1000 mm to 1500 mm	D-KS1-0214-SD-0001

Note 1: The compact design shall only be used where there is insufficient space available for standard design D-KS1-0213-SD-001 to be used.

Where the standard designs will not cover the situation and an alternative design is required, it shall meet the following requirements:

- Retaining walls and batters shall encompass as a minimum the length of the perimeter necessary to ensure there are no step transitions from the top level of the kiosk foundation to the original surface level surrounding the site.
- They must be constructed to the engineering requirements of the local council and the relevant Australian Standards (including AS 3798 and AS 4678).
- They must be suitably drained where necessary to prevent undermining of the retaining wall/batter for the life of the installation, with drainage directing water away from the site.
- Where retaining walls are to be used a suitable foundation shall be installed that will support the wall for the life of the installation.
- Walls must be constructed of non-perishable and secured (non-removable) material such as concrete or brick. Other material may be suitable; however, if they are used, an Engineering Certificate from a suitably qualified structural engineer is required.
- Backfill must be compacted and be of suitable clean material free from large solid material over 50 mm in diameter.
- Retaining walls greater than 1 metre in height shall have an Engineering Certificate and handrail included as part of the design/installation, independent of the construction material. The designer shall ensure the retaining wall will not disrupt natural ventilation of the kiosk substation.
- Retaining walls under 1 metre in height do not require Engineering Certificates or handrail provided they are more than 1.5 metres away from:
  - the substation enclosure.
  - roads or areas where vehicles may traverse.
  - other structures e.g., buildings or walls

- other underground services e.g. water or gas pipes.

- For kiosks sites not on public land or reserves, the site owner/customer is responsible for ongoing maintenance of the retaining walls, batter, handrails etc.
- The designer shall ensure the retaining wall and batter are clearly identified on the design drawings for future maintenance.

2.4.6 Earthing

The requirements for substation earthing have been adopted from 'Section 8 - Earthing Systems' of AS 2067:2016. This is to ensure the design for the earthing system meets the minimum performance requirements based on Australian Standards. ENA EG0 methodologies may also be used as a reference for making risk-based assessments using the ALARA (ALARP) principle.

The design criteria, as defined in AS 2067, is to ensure acceptable safety for persons within the zone of influence of the substation's earthing system, with legitimate access allowed for, in accordance with the risk assessment principles outlined in ENA earthing guide EG0. This approach should be considered by the designer as a minimum. Additional guidance on the design and installation of substation earthing systems can be gained from other published documents such as, but not limited to, ENA EG1, AS 60479.1 and IEEE 837.

Standard earth grid designs have been developed for kiosk substations, but their suitability in each instance shall be verified through the application of the earthing design process defined in this section of the standard. When the design process identifies the standard designs are not suitable for the intended location, then the standard design may be either modified or an alternative design developed to achieve compliance with the minimum requirements for an earthing design, as defined by this standard and the related standards and guidelines listed in Table .

2.4.6.1 Standards related to earthing system design

The standards listed in Table should be referred to for guidance on earthing requirements. Not all these standards may be relevant to the specific situation, with the most appropriate standard(s) used.

Table 14: Summary of earthing related standards/guides

Standard	Description	Specific Application	Applicable Scenarios
AS 2067	Substations and high voltage installations exceeding 1 kV AC	Earthing requirements for substation design process (applies to principles outlined in EG0).	All substation earthing systems.
AS/NZS 60479.1	Effects of current on human beings and livestock - General aspects	Earthing requirements for the development of safety limits	Public and Operator safety limits
AS/NZS 3000	Low Voltage Installations	Earthing requirements for low voltage installations, with guidance for HV sites.	Customer and private installations.

Standard	Description	Specific Application	Applicable Scenarios
AS/NZS 3835	Telecommunication Assets	Rules governing earth potential rise and voltage transfer onto telecommunication assets.	Earthing systems near telecommunication pits or exchanges.
AS/NZS 4853	Pipelines	Rules governing earth potential rise and voltage transfer onto pipeline assets.	Earthing systems near conductive metallic pipeline appurtenances.
AS/NZS 1768	Lightning	Guidance and risk management for lightning protection, scope includes the earthing of lightning arrestors.	Earthing of Lightning protection.
ENA EG0	Risk Management Principles	This document outlines the entire earthing design process as required by AS2067.	All earthing systems.
ENA EG1	Substation Earthing Guide	Further design guidance and specific formulae for modelling an earthing system.	All earthing systems.

2.4.6.2 Earthing design process

The development of a suitable earthing system design shall follow the design process defined in Figure 4.

The design process provides three alternative paths based on the confidence level for the standard earth grid designs defined in Section 2.4.6.4 being suitable for use. The confidence levels are defined by several local network and environmental factors and are listed in descending order.

Zone 1: Kiosk substation is close to the zone substation (source) or within a highly built-up area and meets the following subset criteria:

- Has a continuous metallic path back to the zone substation (by cable screens and/or LV neutral) providing good coupling back to the zone substation
- Has common bonded HV and LV earthing, and is bonded to a large MEN network; and
- Installed in uniform and low soil resistivity ≤100 Ωm (computed soil model based on site measurements)
- Has a maximum applicable fault level ≤2.5 kA
- Has a corresponding clearing time for maximum applicable fault level ≤0.5 sec (primary).

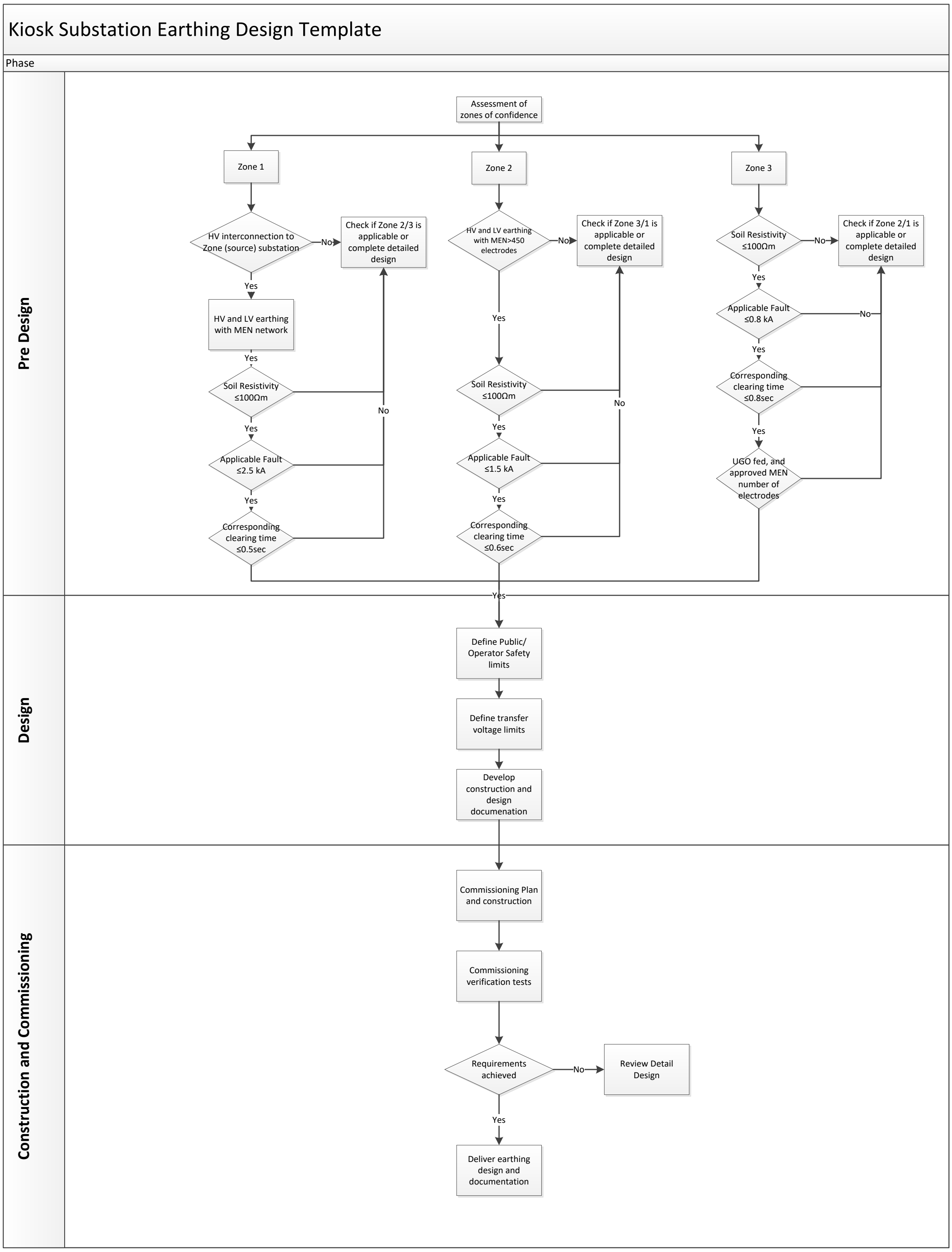
Zone 2: Kiosk Substation is within an urban subdivision with existing LV network and meets the following criteria:

- Has no continuous metallic path back to the zone substation via cable screens or dedicated LV connections
- A limited or sparse MEN network (less than 450 MEN connections consisting of 1 m earth electrodes)
- Uniform soil resistivity ≤100 Ωm (computed soil model based on site measurements); and
- Maximum applicable fault level ≤1.5 kA
- Corresponding clearing time for maximum applicable fault level ≤0.6 sec (primary).

Zone 3: Developing Urban Residential or Rural areas fed by overhead to underground HV feeders with no existing LV Network and meets the following criteria:

- Uniform soil resistivity ≤100 Ωm (computed soil model based on site measurements)
- Maximum applicable fault level ≤0.8 kA
- Corresponding clearing time for maximum applicable fault level ≤0.8 sec (primary)
- The extent and number of the MEN network to be proven using either:
  - HB219 (as referenced by AS2067) section 3.5 calculations assuming 1 m MEN electrodes or an equivalent methodology
    Or
  - Industry recognised earthing analytical software such as SES – MALZ module.

Figure 4: Earth design process flow



2.4.6.3 High risk earthing conditions

The earthing system design shall not require the use of separated HV and LV earth systems without written approval from TasNetworks' Asset Management Group.

The standard earth grid designs are not suitable for use in location where any of the high-risk attributes below are present:

- The site is installed in a surface layer of very high resistivity soil such as extremely rocky ground or sand; or
- Potential hazards (transfer and inductive coupling) are identified within 5 metres of the site or other infrastructure exists that might be influenced by the earthing system, such as:
  - pipelines
  - metallic fences
  - railway lines
  - communication lines
  - buildings
  - the substation supplies or will be installed adjacent to high public congregational areas e.g., bus stops, swimming pools, parks, shopping centres, etc.

It is the responsibility of the designer to verify compliance of the template earth grid design, regardless of the zone of confidence the design site is situated in.

2.4.6.4 Earthing design considerations

The design of an earthing system for a substation needs to consider a variety of criteria to ensure fault currents can be safely dissipated to earth. Existing Australian Standards and best industry practice (in the form of guidelines) require a holistic prudent approach which is appropriate for the benefit versus cost for these types of installations.

Public and Operator Safety: The earthing design limits shall be initially developed using AS 60479.1 and the designer is required to provide a high-level methodology to derive these limits with AS 60479.1.

ENA EG-0 may also be used, if determined suitable by the designer. The analysis should consider a risk cost benefit analysis using the principles of contact scenario assessment where there is the likelihood of personal contact with nearby infrastructure during the time of an earth fault at the site. The assessment of what is “nearby” will generally depend on the amount of earthing at a site, bonding arrangements, soil resistivity and the fall of potential profile of the soil. As a rule of thumb, infrastructure within 10m of an HV earth should be considered.

Two scenario categories are defined by EG0 which should be considered. These are:

- Individual risk assessment: The annual risk of fatality for an exposed individual. The risk associated with an individual is usually calculated for a single hypothetical person who is a member of the exposed population. Individual risk assessments do not account for the danger to an exposed population as a whole [EG-0].
- Societal risk assessment: The risk associated with multiple, simultaneous fatalities within an exposed population. When considering the impact on society it is usual to consider the annual impact upon a 'typical segment' of society. Societal risk may be a determining factor in the acceptability of the risk associated with a hazard for areas where many people congregate.

When assessing a site, designers should identify any societal risks. These will exist in heavily populated areas where people congregate on objects such as hand railings or fences.

Table 15: Typical representative contact scenarios as defined by EG0

Contact Scenario	Description	Contacts / Yr (seconds)
MEN Contact	Contact with LV MEN interconnected metalwork (for example, household taps)	2000 Contact / yr (for 4 seconds)
Backyard	An area with a contactable metallic structure (for example: fence, gate) subject to induced voltage gradients. This structure may become live due to earth fault current flow through the soil.	416 Contacts / yr (for 4 seconds)
Urban Interface	Infrastructure outside normal public thoroughfare with low frequency of direct contact by a given person.	100 Contacts / yr (for 4 seconds)
Remote	A location where the contact frequency is sufficiently low that the probability of personal contact is less than the target probability of fatality. In this case no touch voltage target is required.	10 Contacts / yr (for 4 seconds)

Crush rock layer and bitumen shall not be used as the first measure to derive safety limit calculations. Surface layer alterations shall be incorporated in a detailed earth design to ensure the correct applicability of the risk mitigation measures.

Development of EG-0 limits shall be calculated using ENA's Argon software, or an alternative equivalent to ensure the correct EG-0 process is completed. The development of safety limits shall incorporate the benefit of further risk reductions options by determining if the cost of mitigation is grossly disproportionate to the cost of risk reduction benefit.

Fault inputs: Fault study information shall be provided by TasNetworks for each specific site (assumed zero impedance fault) and shall include:

- Identification of HV fault locations (sources).
- Phase to earth fault level (zero sequence impedance) in amps.
- Vector or angle information sufficient to recalculate the earth fault level for a given series impedance, and to calculate the X/R ratio.
- Three phase fault level in amps.
- Protection curve settings associated with remote primary protection such as feeder or upstream ABS for each fault level.

The designer shall allow for the fault current DC offset using TasNetworks' fault information. The designer shall allow for fault iteration calculations to determine the actual fault level based on the localised system resistance.

The designer shall use the worst-case ultimate earth fault scenario possible on the site to complete the earthing study.

Buried Earth arrangement: TasNetworks' template design is only applicable for HV/LV combined earth grid, which uses the local MEN to assist with HV earthing performance. The buried horizontal bare conductors shall be placed under the substation area (min 500 mm below finished ground level) to provide surface gradient control. The designer shall be responsible for ensuring that sufficient earthing is provided to minimise the effects of step and touch voltages, within the zone of influence of the substation, including transfer voltages to the MEN system. The buried earth system incorporates a grading ring that extends approximately 1.6 metres beyond the HV and LV end doors and 1 m around the sides of the substation enclosure. The designer shall appropriately select the localised template earth grid based on the asset installation dimensions. Minimum size for primary equipment earth tails is 70 mm^2.

Earthing conductors: The specific size of the earth conductor is based on the specific fault conditions present at the site. Guidance on the conductor sizing calculations can be obtained from ENA EG-1. Hard Drawn bare stranded copper conductor is preferred for buried earthing conductors, while insulated Yellow/Green stranded copper conductors is preferred for HV earth tail connections. The minimum size of earthing conductors for primary equipment earth tails is 70 mm^2.

Earthing connections: All earth grid and equipment earthing joints shall be type tested compression connections. All earth grid and equipment earthing jointing methods shall be verified to comply with the intent of IEEE 837. Test certificates for proprietary items shall be provided by the supplier and confirmed to carry the maximum fault current for earth fault scenarios and back up clearing times. Buried earthing joints shall be crimped using Burndy or equivalent earth connections. It is recommended that one-hole, heavy duty, fault rated and sealed palm lugs are used for primary equipment connections, hexagonally crimped to the earth conductor, such as FCI-Hylugs or equivalent. As minimum the transformer shall have two earth connections diagonally opposite, the HV switchgear enclosure shall be earthed, and the LV enclosure shall be earthed. All equipment earthing tails and buried earth tails shall be labelled in accordance with AS/NZS 3000 and AS 2067. The designer shall ensure manufacturer's earthing connections are adequate for the earthing system design.

HV Cable screens: The HV cable screen forms an integral part of TasNetworks' earthing system design. The metallic screens of cables are designed to provide an effective earth return path for fault current resulting from failed equipment and cables. For an Urban Residential Development, the HV screen shall be bonded at both the substation and remote earth point. The remote earth may be a distribution substation, underground to overhead earth electrodes, cabinets, or Zone substation (source) assets. The earthing termination at the remote HV asset is dependent on the plant fitted to the corresponding HV asset. The designer shall communicate with TasNetworks for each asset to ensure bonding requirements of the HV screens have been adhered to.

CMEN: TasNetworks' template earth design shall be connected to a combined multiple earth system, where the MEN link shall be incorporated and be visible within the kiosk substation LV board. An additional insulated dedicated earth cable along the LV cable trench may be utilised for LV contingency purposes. The designer shall clearly show the location and extent of the dedicated earth conductor on the associated earthing drawings. For large or integrated LV systems, the designer shall ensure the LV neutrals are connected across LV open points. For earthing system designs that extend beyond the template design scope, additional requirements such as separated LV and HV earthing may be incorporated and will require the MEN link to be isolated. For further information regarding separated LV and HV requirements, refer to Section 8 of AS 2067 and liaise with the TasNetworks' Asset Management Group.

Soil resistivity: TasNetworks preferred method for soil resistivity testing is the Wenner four electrode method. The testing requirements e.g., traverse measurements and measurement separation shall be determined based on information required to support the design and/or safety limits. Site constraints and the size of the earthing system may also influence the approach for undertaken the testing. As a minimum for design purposes, two traverses shall be performed up to a spacing of 32 metres.

The soil resistivity traverse results shall account for the characteristic trends of the native soil conditions and any deviations between the traverse results shall be clarified by the designer to determine if the measurements are suitable for design purposes. Testing shall be undertaken in a location as near as practical to the site and chosen to minimise interference from existing known above/underground metallic infrastructures. Details on the testing methodology can be obtained from ENA EG1.

Site conditions shall be recorded at the time of testing including weather conditions, temperature, and soil moisture content. Any relevant visual observations of the soil type being tested shall also be recorded.

Telecommunication assets: The earthing system design shall consider the interaction of telecommunications infrastructure, as both HV electrical installations and telecommunication assets must co-exist in the same environment as they provide services to the same customers. The proximity of the earthing system may give rise to Low Frequency Induction (LFI) and Earth Potential Rise (EPR) affecting telecommunication systems under high voltage fault conditions on the electricity network. These voltages are short in duration but can reach dangerous levels. The voltage rise that will appear at the earth under fault conditions is dependent on the earthing design, fault levels and soil resistivity. The design shall determine if the applicable protection of telecommunication network users, personnel and plant external telecommunications assets isolation devices are required in accordance with AS 3835, namely if the 430 and 1000 V contour locations are present. If isolation devices are required, the designer must ensure that relevant telecommunications companies are advised, with reasonable notice, of details of the protection requirements and the resolution of this matter is a joint responsibility of both parties.

Metallic pipelines: The earthing system design shall consider the effects on metallic pipelines such as, and not limited to, water reticulation and gas pipelines. In the event there are metallic pipeline installations; the new installations are recommended to use non-conductive pipes near the new HV installation. It is recommended the installation meets the requirements set out in AS 4853:2012 to develop the appropriate safety limits.

Continuity testing: The recommended measuring method is the 4-wire Continuity Test method, where the continuity measurement shall be referenced to the common HV or LV earth bar for each metallic item within the substation. Alternative testing methods need to be consulted and approved by TasNetworks.

2.4.6.5 Standard Designs

Standard earthing designs have been developed for both kiosk substations and switching stations. These standard designs may not be suitable for all situations due to site specific factors e.g., limited interconnectivity with surrounding network earthing system, poor soil conditions, or potential hazards in the local proximity.

It is the responsibility of the designer, through the application of the design process to ensure the standard earth grid design is suitable for the intended location. The standard designs are defined in Table .

Where the standard designs are not suitable the design shall either be revised to achieve compliance, or an alternative design developed that provides compliance with the requirements of this standard.

Table 16: Standard earth grid designs

Enclosure Type		Drawing
All	Earth connection diagram	KS-308
Tyree models	500 kVA w/ IDI	KS-309
	750 & 1000 kVA w/ IDI	KS-310
	750 kVA w/ IIDI	KS-311
	1500 & 2000 kVA w/ IDI or IIDI	KS-311
Legacy models	Schneider 3/05	KS-309
	Schneider 3/10	KS-310
	Schneider 4/15	KS-311
	Schneider 4/20	KS-312
	Mini-kiosk	KS-330
	Switching station earth connection diagram	KS-343
	Switching station 3/4-way RMU	KS-344
	Switching station 3-way RM6	KS-355

2.4.6.6 Documentation

The earthing system design shall be presented in a detailed package which is to include layout drawings indicating location of buried conductors, conductor size, insulation surface thickness (if applicable), grounding rods and earthing tails to metallic structures. The designer shall submit a design report detailing all inputs, assumptions, calculations, graphical model outputs and commission test program.

2.4.6.7 Verification of earthing design

During the installation and commissioning process, the constructor shall determine the validity and compliance of the earthing design to ensure safety requirements are met and thus certify compliance. This shall be achieved by testing as per TasNetworks Electrical Testing Specification Pre-commissioning & Commissioning – Underground Developments Standard (R0000390068).

At a minimum standard earth testing shall include:

- Visual inspection of the following, with photo evidence recorded:
    a. Design compliance and as-built drawing accuracy.
    b. Condition of earthing conductors, connections, and joints. For the earth grid this shall occur prior to back-filling.
    c. Condition of earthing electrodes or driven stakes.
    d. Presence and condition of earthing bonds, for example to kiosk doors.
    e. Presence of transfer hazards, for example metallic fences.
- Continuity testing using a four wire DC resistance meter of all connections or joints.
- Measurement of earth grid resistance using fall of potential method.

If the results of first stage earth testing are non-compliant, this shall be reported in the first instance to TasNetworks Field Engineering Team. The results shall be reviewed and mitigated by subsequent coordinated works between the designer and installer, in consultation with TasNetworks. These further works may include additional testing and design assessment or require the provision of a detailed earthing design.

The designer, TasNetworks Design Engineers, Field Engineering or Asset Management Substations Team may specify that current injection testing be performed as necessary to validate compliance of the earthing design. In this instance current injection testing will be used to determine earth potential rise, current distribution, and hazard levels such as step, touch, and transfer potential.

Specification of injection testing will typically occur if compliance of the earthing design is indeterminate during the design earthing assessment or first stage testing, a non-standard earthing design is proposed, or the kiosk is to be placed in a high-risk location. If any further testing is specified, compliance of the earthing design is contingent upon the completion and satisfactory results of these tests.

Testing shall be carried out by an appropriately qualified and accredited worker that is compliant with TasNetworks' HSEQ Policies and Procedures and Power System Safety Rules. All testing shall be conducted in accordance with TasNetworks Standards, AS 2067, ENA EG 1, and ENA EG 0. A commissioning schedule for the HV energisation of electrical installation must be followed in accordance with AS2067-2008.

2.4.7 Protection

2.4.7.1 HV protection

Kiosk substation transformers shall be protected by a circuit breaker on the high voltage supply side of the transformer. Historically fusing was typically utilised for transformer sizes up to and including 1000 kVA, with circuit breaker protection used for transformers in excess of 1000 kVA.

A circuit breaker shall be used for HV protection due to benefits it provides over fuse protection. Circuit breaker protection shall comply with TasNetworks' Approved Product List.

The HV protection setting shall ensure that it adequately clears a fault on all equipment downstream of the HV circuit breaker to the next protection device. The HV protection setting shall ensure coordination with any upstream protection to ensure that all faults are cleared prior to any upstream protective devices operating.

The VIP40 protection relay is the standard equipment for new installations for the monitoring and clearance of faults downstream of the HV circuit breaker. Their protection settings shall be in accordance with Table .

Existing kiosk substations on the network may have a VIP30, 40, or 45 relay installed. The settings for these relays are provided in tables below.

Table 17: HV Circuit breaker protection settings – VIP40

Voltage (V)	**11**	**11**	**11**	**11**	**11**	**22**	**22**	**22**	**22**	**22**
Transformer kVA	500	750	1000	1500	2000	500	750	1000	1500	2000
VIP40 200A setting Is(A)	45	45	55	85	105	20	20	30	45	55
VIP40 100A setting Is(A)	40	50	60	80	OL	21	21	25	40	50
Discrimination with the LV CB	OFF									

Table 18: HV circuit breaker protection settings – VIP45 (Existing installations only)

Voltage (V)		**11**	**11**	**11**	**11**	**11**	**22**	**22**	**22**	**22**	**22**
Transformer kVA		500	750	1000	1500	2000	500	750	1000	1500	2000
VIP45 - 200A relay settings	I > set point	45	45	55	85	105	20	20	30	45	55
	0.2 * I > set point	9	9	11	17	21	4	4	6	9	11
	Io > set point	15	15	15	25	25	5	5	8	15	15
	to > set point	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Configuration	EF Inrush Delay ON; Discrimination with the LV CB OFF;									
VIP45 - 100A relay settings	I > set point	40	50	60	80	OL	21	21	25	40	50
	0.2 * I > set point	8	10	12	16	OL	4.2	4.2	5	8	10
	Io > set point	8	12	12	20	OL	5	5	5	8	12
	to > set point	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Configuration	EF Inrush Delay ON; Discrimination with the LV CB OFF;									

Table 19: HV Circuit breaker protection settings – VIP30 (Existing installations only)

Voltage (V)	**11**	**11**	**11**	**11**	**11**	**22**	**22**	**22**	**22**	**22**
Transformer kVA	500	750	1000	1500	2000	500	750	1000	1500	2000
VIP30 S1-S3 setting Is (A)	45	45	55	90	115	20	20	30	45	55
VIP30 S1-S2 setting Is (A)	46	46	56	OL	OL	22	22	28	46	56
Discrimination with the LV CB	OFF									

2.4.7.2 LV protection

The LV circuits from the substation shall be protected by LV circuit breakers for capacities of 1000A or greater. Feeds up to and including 630A may be protected by fuses. The LV protection devices must be installed on the LV switchboard installed in the kiosk.

The LV protection timings must provide coordination with the upstream HV protection to ensure that LV faults are detected and cleared without disruption to the HV supply.

All LV fuses and circuit breakers shall be sized or set to protect the outgoing LV cable from the kiosk substation LV switchboard. The maximum rating of LV fuses installed to protect TasNetworks' standard LV cables shall comply with Table 20. For LV feeds with fused protection, the designer shall also calculate the reach of the protection device to ensure that in potential network configurations there shall be no unprotected sections.

TasNetworks' preferred protection devices are installed as standard in all models of kiosk covered by this standard. Departures from standard protection devices shall be at the discretion of TasNetworks' Asset Management Group.

Table 20: Standard LV fuse sizes for TasNetworks' standard LV cables

Cable Size	185 mm^2	240 mm^2	300 mm^2	400 mm^2
Direct buried fuse rating	315 A	355 A	425 A	500 A
In duct fuse rating[1]	250 A	315 A	355 A	400 A
Rated voltage	500 V AC	500 V AC	500 V AC	500 V AC
Fuse size	NH 3	NH 3	NH 3	NH 3
Operating class	gG/gL	gG/gL	gG/gL	gG/gL

Note 1: Continuous current derating of cables shall be in accordance with TasNetworks Distribution Standard – Underground System.

2.4.7.3 Mini-kiosk protection

Mini-kiosk substation transformers shall be protected by a fuse on the high voltage supply side of the transformer.

The HV protection setting shall ensure that it adequately clears a fault on all equipment downstream of the circuit breaker to the next protection device.

2.4.7.4 Switching station protection

Switching stations used as network switching devices are not required to have the capability to detect and clear HV feeder faults.

Where the switching station is the point of connection to a high voltage customer, capability shall be provided at the switching station to detect and clear faults on the customer's installation from the network.

2.4.8 Control Systems

Remote control systems are not installed in kiosk substations or switching stations as standard equipment.

Where there is a requirement to install a remote-control system, it shall be provided using TasNetworks' standard equipment. The designer shall consult with TasNetworks' Protection and Control team for support as required.

2.4.9 High voltage equipment ventilation

The designer shall ensure the manufacturer's recommended ventilation level is maintained, to avoid de-rating the design capacity of the transformer. This includes but is not limited to reviewing the site constraints to ensure that adjacent buildings, infrastructure and retaining walls do not negatively jeopardise the natural ventilation requirements for the kiosk substation.

Typically, the cross-sectional area for natural inlet and outlet ventilation shall be no less than 0.3 m^2 per 750 kVA transformer capacity, and the minimum value for all substations shall be no less than 0.3 m^2.

Natural ventilation using the inlet and outlet ventilation enclosure arrangement should be the method used for ventilation because it minimises maintenance requirements. If the site location is prone to onerous dust conditions, the ventilation system shall be fitted with filters and the designer shall ensure the system friction loss does not adversely affect the ventilation flow requirements for the substation transformer. All alternative ventilation arrangements to natural ventilation shall be consulted and approved by TasNetworks.

Where pre-cast kiosk enclosures are used the designer shall ensure the ventilation requirements previously stated are achieved. Where necessary for fire protection purposes, the designer may choose to incorporate FLR 120/120/120 fire dampers with fusible links on the ventilation inlet and outlet of the substation.

For further details on TasNetworks' HV equipment ventilation refer to the manufacturer data sheet.

2.4.10 Electrical and Magnetic Field (EMF)

Each design shall consider the effects of EMF and the associated limits for personnel in accordance with ICNIRP Guidelines for limits exposure to magnetic and electric fields and AS 2067 Appendix D. The following methods may be applied and documented to confirm an EMF study:

- Confirmation of relatively balanced phases on HV and LV circuits to minimise the net current and the resulting magnetic fields
- Reduce electrical currents by incorporating energy efficient equipment for large electrical loads
- Avoid earth or neutral loops having large distances to the HV and LV phases
- Avoid single core HV or LV cable phase arrangements. If single core cables must be installed, then use trefoil arrangement for the cables to increase cancellation effects by reducing distance between the insulated phases within the same circuit
- Increase distance for known public areas to sources of EMF, where the levels and duration are expected to exceed the acceptable exposure criteria in accordance with ICNIRP
- Shielding of EMF sources (least effective method and should be avoided)

The designer shall ensure the use of metallic items such as concrete reinforcement, for the purposes earthing performance, does not inadvertently create a source of magnetic fields.

2.4.11 High voltage metering

Where high voltage metering is required for a new customer connection it shall be installed in the customer's installation. Metering equipment must not be installed in TasNetworks owned switching station/substations.

2.4.12 Access and operational clearance

The designer shall ensure the clearances around the substation are suitable for the specific civil requirements and electrical requirements (refer to the relevant sections for further details). The designer shall ensure access and operational clearances comply with the intent of AS 2067 with respect to avoidance of road vehicle damage to the equipment.

The designer shall ensure the kiosk site has unimpeded access for TasNetworks personnel and heavy vehicles entering from a public street, with access available 24 hours per day, 7 days a week.

2.4.13 Environmental assessment

The designer shall ensure an environmental assessment of various components is completed in accordance with the TasNetworks' Environment and Heritage Design and Construction Standard. Including, but not limited to:

- The risk of environmental harm from potential spillage and leaks of hazardous substances
- Presence of threatened species and habitat or threatened vegetation communities
- Weed presence and associated risks of spread and or management responses required

- Sea level rise – as identified by Local Government Planning Schemes and State modelling in the Coastal Inundation layers available on LIST map
- Erosion risks i.e., are the soils dispersive; is landslip a risk; or are the soils acid sulphate soils. Is there a risk that sediment from the planned works will enter waterways?
- Presence of significant trees and protection of associated root zones
- Presence of Aboriginal Heritage
- Presence of Cultural Heritage

2.4.14 Noise assessment

Transformers within substations generate noise at a frequency of 100 Hz and higher order harmonics. This noise is typically audible/intrusive when background noise levels are low e.g., at night.

It is the responsibility of the designer to ensure that the design complies with the relevant standards. The designer shall ensure compliance to local government authority requirements, Tasmanian Environment Protection Authority, AS 1055.1 and AS 60076.10.

Where noise mitigation may be required care shall be taken to ensure the mitigation measures do not obstruct the ventilation and impact on the capability of the cooling system and capacity of the substation.

2.4.15 Safety signs

The consequences of unauthorised access to the high voltage and low voltage equipment contained within the substation can be extremely serious and it is necessary to install suitable notices to access points warning of the dangers.

Danger signs must be installed on the outside of all access doors or compartment hatches.

The signs must meet TasNetworks' current requirements and comply with AS1319 and AS3000 section 8.11. The design, size and location of the signs must comply with drawing KS 319, KS-336, KS-347, KS-358 or KS-333.

For kiosk substations and switching stations the safety signs are normally preinstalled by the supplier.

For precast kiosk enclosures the design is required to include the safety signs. The signs' locations shall be as per drawing KS-319. The signs must be installed prior to installation of the substation.

3 Equipment identification and labelling

All equipment where a physical change of state may occur during operational activities e.g., circuit breakers, switches and fuses shall have a unique identifier and be appropriately labelled.

The design and constructed substation shall include clear and permanent labelling of the following equipment:

- The kiosk substation/switching station enclosure.
- HV line switches, circuit breakers, fuse switches.
- LV circuit breakers, fuse switches.
- Earthing tails and MEN link.

Operational manuals and single line diagram drawings shall also be produced and installed in the kiosk. These documents shall be adequately protected to withstand the local environmental conditions.

3.1 Site identification

The substation/switching station shall be identified by an identification plate affixed to the outside of it. The identification plate shall be an aluminium plate riveted to the outside of enclosure doors on the HV end.

The identifier for the substation/switching station must be unique and comprise of a six-digit number prefixed by the letter ‘T’. The first two numbers represent the network area that the substation/switching station is being installed in.

The identification plate shall be provided by TasNetworks.

3.2 Circuit breakers, line switches and fuses

High voltage equipment shall be identified with a single capital letter. The first item of equipment shall start with the letter ‘A’. Designation shall be in alphabetical order from left to right e.g. A, B, C etc.

3.3 HV Circuit source/destinations

All high voltage circuits entering or leaving the substation shall have a descriptor that defines their source/destination on the network. Descriptions shall be written in full where possible.

3.4 Circuit breakers, switches, and fuses

Low voltage equipment shall be identified with a single lower-case letter. The first item of equipment shall start with the letter ‘a’. Designations shall be in alphabetical order from left to right, e.g., a, b, c etc.

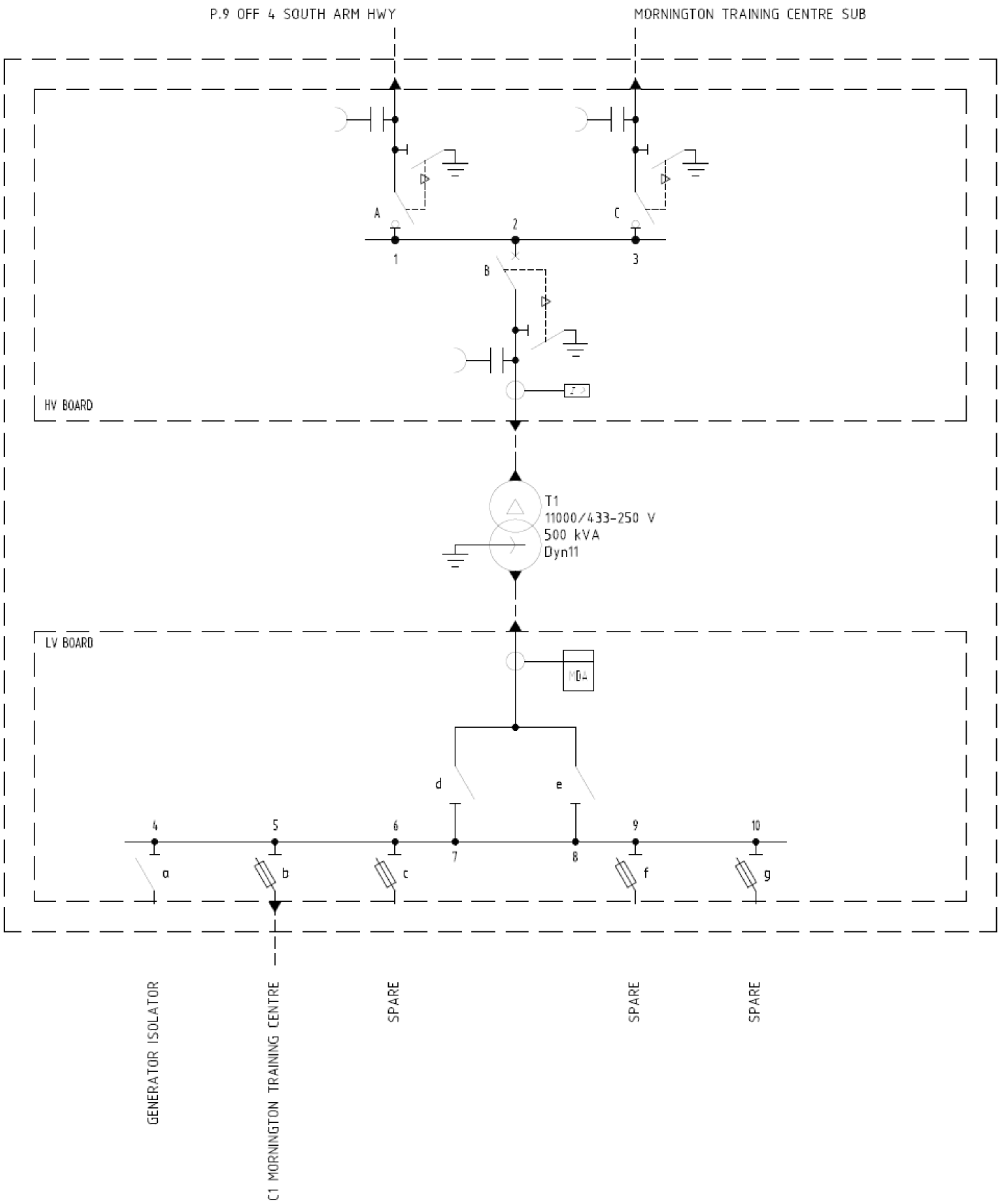
Where an empty slot exists in a switchboard it shall be treated as if a protection device exists in that location e.g., if the second slot from the left is empty, then the circuit breakers installed shall be labelled a,’ ‘, c, d etc.

3.5 LV Circuit destinations

All low voltage circuits that provide a supply external to the substation shall have a descriptor that defines their destination on the network. Descriptions shall be written in full where possible.

3.6 Example substation schematic

Figure 5: Kiosk substation single line diagram



4 Design deliverables

The designer shall ensure that the kiosk design consists of the following documents as a minimum:

- TasNetworks – Contractor work order or equivalent project scope/material/schedule
- TasNetworks – Order confirmation of kiosk type from manufacturer, or reservation record for stock items
- TasNetworks – Order confirmation of all equipment or equivalent
- TasNetworks – Determination of HV fault current and associated protection clearance times
- TasNetworks – Environmental impact assessment or equivalent
- Drawings:
    - Project drawing register with reviewer and approval sign off
    - Proposed site and location plan (with dimensions to all other infrastructure)
    - Drawing references for the underground system design
    - Detailed underground plan
    - Before You Dig Australia asset information
    - Single line diagram
    - Connection diagram
    - Detailed civil foundations (specific for the site)
    - Earthing arrangement
    - Kiosk plinth
    - Conduit locations
    - Civil augmentation i.e., retaining walls/batters/drainage (specific for the site)
- Detailed documents/reports:
    - Safety in Design report
    - Voltage drop calculations
    - Protection settings
    - Manufacturer equipment rating
    - Project approval
    - Communication references such as emails and letters
    - Earthing safety compliance review
    - Civil structural (if applicable)
    - Evidence of easement on title or electrical infrastructure easement

The designer shall ensure the design deliverables are legible and submitted in electronic form to comply with TasNetworks' relevant standard (i.e., Drafting Standard)

4.1 Design check list

Design component	TasNetworks relevant Standards Clause	Australian Standards/ Guide referenced	Drawing/ Report reference	Completed/ Actioned Yes/No/NA	Additional Comments
New Asset considerations	Ref section 2.2.1				
Site selection	Ref section 2.2.2				
Equipment selection	Ref section 2.2.3				
Safety in Design sign off	Ref section 2.2.4				
Detailed Electrical Design review/approval	Ref section 2.2.3, 2.2.5, 2.4 and 3.				
Fire risk management	Ref section 2.4.3				
Detailed Civil Design review/approval	Ref section 2.2.65				
Design options Cost versus Benefit sign off					
Documentation hand over for construction	Ref section 4 and 4.1				

5 Drawing standards and content

The designer shall ensure all design drawings reflect the format requirements outlined in TasNetworks' Design Drafting Standard. In addition, the designer shall ensure the content and the number (including titles) of drawings to reflect the minimum level of detail summarised below:

- Kiosk/Mini-Kiosk/Switching station plan drawings to include:
  - development staging (if applicable)
  - location of roads and footpaths
  - lot boundaries
  - lot driveways
  - location for new and existing assets with offsets to existing infrastructure e.g. roads, fences, buildings, etc.
  - specific site contours
  - easement locations
  - cable routes with easement locations
  - fire risk assessment zone

- Kiosk/Mini-Kiosk/Switching station plan electrical drawings to include:
  - substation single line diagram
  - HV and LV cable single line diagram
  - Protection settings including fuse selection and fuse reach
  - connection diagram
  - connection diagram for earthing system

- Kiosk/Mini-Kiosk/Switching station plan civil drawings to include:
  - site specific foundation details (including local site conditions – slope of ground)
  - plinth details
  - conduit details
  - earthing system
  - retaining walls, batters, and drainage (site specific)

- Underground system drawings to comply with the requirements of the Distribution Design Standard Underground System Section 4.

- Kiosk/Mini-Kiosk/Switching station plan Critical Design Information drawings to include:
  - full list of drawings referenced in the kiosk asset.

6 Equipment

6.1 Kiosk substations

Table 21 contains the approved list of standard kiosk substations for use on TasNetworks' distribution network, divided into 11 and 22kV respectively. Usage of a non-standard design shall only be considered where a standard configuration is not technically feasible. Usage of non-standard designs shall be at the discretion and approval of TasNetworks' Principal Design Engineer, or Asset Management Substations Team. Table 22 contains a list of legacy substation configurations for reference purposes.

Table 21: Standard kiosk configurations

Voltage	SAP Material Number	Tyree Part Number	Transformer				HV Switchboard		LV Switchboard			
			Rating (kVA)	Nominal Transformer Impedance	Phase cross-over	Oil Vol. (L)	Primary Config.	Relay	Rating (A)	Fuse Switches	Circuit Breaker	Transformer Isolator
11kV	419406	500K4TN01	500	4%	Yes	545	RM6 – IDI	VIP40 – 200A	1400	4x 630A		2000A Non-ganged
	419409	750K4TN01	750	5%	Yes	965	RM6 – IDI	VIP40 – 200A	1400	4x 630A		2000A Non-ganged
	419412	750K4TN05	750	5%	Yes	1160	RM6 – IIDI	VIP40 – 200A	1400	4x 630A		2000A Non-ganged
	419415	750K4TN02	750	5%	Yes	965	RM6 – IDI	VIP40 – 200A	1600	2x 630A	1000A	2000A Ganged
	419418	1000K4TN01	1000	5%	Yes	845	RM6 – IDI	VIP40 – 200A	1600	2x 630A	1600A	2000A Ganged
	419421	1500K4TN01	1500	6%	Yes	1370	RM6 – IDI	VIP40 – 200A	2400	2x 630A	2000A	3200A Ganged
	419430	2000K4TN01	2000	6%	Yes	1540	RM6 – IIDI	VIP40 - 200A	3200	1x 630A	3200A	4000A Ganged
22kV	419407	500K5TN01	500	4%	No	550	RM6 – IDI	VIP40 – 200A	1400	4x 630A		2000A Non-ganged
	419410	750K5TN01	750	5%	No	1020	RM6 – IDI	VIP40 – 200A	1400	4x 630A		2000A Non-ganged
	419413	750K5TN03	750	5%	No	1150	RM6 – IIDI	VIP40 – 200A	1400	4x 630A		2000A Non-ganged
	419416	750K5TN02	750	5%	No	1020	RM6 – IDI	VIP40 – 200A	1600	2x 630A	1000A	2000A Ganged
	419419	1000K5TN01	1000	5%	No	795	RM6 – IDI	VIP40 – 200A	1600	2x 630A	1600A	2000A Ganged
	419422	1500K5TN01	1500	6%	No	1495	RM6 – IDI	VIP40 – 200A	2400	2x 630A	2000A	3200A Ganged
	419431	2000K5TN01	2000	6%	No	1500	RM6 – IIDI	VIP40 - 200A	3200	1x 630A	3200A	4000A Ganged

Table 22: Legacy kiosk configurations

Voltage (kV)	Enclosure Type	Load Rating (kVA)	HV Switchboard[1]	LV Switchboard	Preferred Option (pre-2024)	Available with 11kV phase crossover
11 & 22	3/05	500	RM6 I+D	1250A switchboard		
			RM6 I+D+I	4 x 630A CB	Preferred	Yes
	3/10	500	RM6 I+D	1250A switchboard		
		750	RM6 I+D+I	4 x 630A CB	Preferred	Yes
				2 x 630A + 1 x 1000A CB	Preferred	Yes
				1 x 1250A CB		
		1000	RM6 I+D	2500A switchboard		
			RM6 I+D+I	4 x 630A CB		
				5 x 630A CB		
				2 x 630A + 1 x 1250A CB		
				2 x 630A + 1 x 1600A CB		
				3 x 630A + 1 x 1000A CB		
				1 x 2500A CB		
	4/15	500	RM6 I+D	1250A switchboard		
		750	RM6 I+D+I	4 x 630A CB	Preferred	Yes
			RM6 II+D+I	2 x 630A + 1 x 1000A CB		
				1 x 1250A CB	Preferred	Yes
		1000	RM6 I+D	2500A switchboard		
		1500	RM6 I+D+I	4 x 630A CB		
			RM6 II+D+I	5 x 630A CB		
				2 x 630A + 1 x 1250A CB		
				2 x 630A + 1 x 1600A CB	Preferred	Yes
				3 x 630A + 1 x 1000A CB		
				1 x 2500A CB		
	4/20	2000	Special order			
	Remote control unit			Schneider T300		

Note 1: All the HV switchboards listed for an enclosure size can be used with any of the LV switchboard options listed.

6.2 SAP bill of materials

The SAP[1] bill of materials for commonly used kiosks configurations is listed in Table 23. The Bill of Materials (BOM) comprises of the kiosk substation and the components required for constructing the standard earthing system.

The BOMs do not include the HV and LV conduits, concrete plinth, or padlocks.

Table 23: Kiosk substation and earthing system

BOM	Description
730100	KS Tyr 11-500-IDI-4x630FU X/O
730101	KS Tyr 11-750-IDI-4x630FU X/O
730102	KS Tyr 11-750-IIDI-4x630FU X/O
730103	KS Tyr 11-750-IDI-2x630FU+1x1000CB X/O
730104	KS Tyr 11-1000-IDI-2x630FU+1x1600CB X/O
730105	KS Tyr 11-1500-IDI-2x630FU+1x2000CB X/O
730106	KS Tyr 11-2000-IIDI-1x630FU+1x3200CB X/O
730107	KS Tyr 22-500-IDI-4x630FU
730108	KS Tyr 22-750-IDI-4x630FU
730109	KS Tyr 22-750-IIDI-4x630FU
730110	KS Tyr 22-750-IDI-2x630FU+1x1000CB
730111	KS Tyr 22-1000-IDI-2x630FU+1x1600CB
730112	KS Tyr 22-1500-IDI-2x630FU+1x2000CB
730113	KS Tyr 22-2000-IIDI-1x630FU+1x3200CB

Note: X/O indicates that the kiosk substation is provided with phase-crossover.

[1] SAP is the system used by TasNetworks for works management. The system contains a register of the standard equipment used by TasNetworks for undertaking work on its network.

6.3 Mini Kiosk Substations (KPX[2])

Table 24: Approved Mini kiosk substation configurations

Voltage (kV)	Load Rating (kVA)	HV Switchboard	LV Switchboard
11 & 22	100	N/A	1 x 630A CB 2 x 630A CB 3 x 630A CB
11	150		
22	200		

The SAP bill of materials for commonly used mini-kiosk configurations is listed in Table 25. The Bill of Materials (BOM) comprises of the mini- kiosk substation and the components required for constructing the standard earthing system.

The BOMs do not include the HV and LV conduits, concrete plinth, or padlocks.

Table 25: Mini-kiosk substation and earthing system

BOM	Description
730015	KS Sch KPX2-11-150-3x250
730016	KS Sch KPX2-22-100-3x250

6.4 Switching stations

Table 26: Switching station configurations

Enclosure Type	Voltage (kV)	HV Switchboard Config.	SAP Material Number
Schneider RM6 - RMU	11	BIBI	990601
		IIDI	990603
		IDI	990605
		IIII	990607
		III	990609
	22	BIBI	990600
		IIDI	990602
		IDI	990604
		IIII	990606
		III	990608
SM6 (Legacy)	11 & 22	SM6 2I+D SM6 3I+D	N/A (Legacy)

Switching station kiosks are not carried as stock items due to their infrequent use and possible variations in configuration to meet customer requirements. Consequently, BOMs do not exist for the combined switching station and earthing system assemblies.

The BOM for the components to construct the earthing system alone, for the standard enclosure sizes are listed in Table 27.

Table 27: Switching station earthing system

BOM	Description
730031	KS Earthing system Switch stn 3-4 RMU

6.5 Substations and switching station locks

Table 28 provides the material numbers and quantities required for the kiosks and switching stations.

Table 28: Kiosk substation locks

Equipment	Network Area	Material Id.	Description	Kiosk	Mini-kiosk	Switching station
Doors	Hobart	71545	Padlock 38mm x 8mm LAE145	4	1	1
	Launceston	71543	Padlock 38mm x 8mm L284	4	1	1
	Rural	71540	Padlock 38mm x 8mm 20395	4	1	1
HV switchboard Earth switches	Statewide	71533	Padlock 38mm x 4.8mm LSW	3[1]		3[1]

Note 1: Quantity is for a 3-way RMU

7 Drawings and standard designs

The standard designs for kiosk substations, switching stations and mini-kiosk are provided in Table 29, Table 31, and Table 33 . It is the responsibility of the user to ensure that the latest version of the drawing is being used. The latest versions are available from TasNetworks' Drawing Management System or TasNetworks' Developer's Toolkit.

Table 29: Kiosk substation standard designs

Description	Drawing Id.
Guide for site selection	KS-300
General arrangement – Tyree Kiosks	D-809-0047-SD-001
One line diagram template – Tyree Kiosk w/ 4x Fuse Switch	D-TXX-XXXX-OL-001
One line diagram template – Tyree Kiosk w/ CB + 2x Fuse Switch	D-TXX-XXXX-OL-001
One line diagram – Sheet 1 of 2 - Tyree Kiosks w/ 4x Fuse Switch	D-809-0048-SD-001
One line diagram – Sheet 2 of 2 - Tyree Kiosks w/ 4x Fuse Switch	D-809-0048-SD-002
One line diagram – Sheet 1 of 2 - Tyree Kiosks w/ CB + 2x Fuse Switch	D-809-0053-SD-001
One line diagram – Sheet 2 of 2 - Tyree Kiosks w/ CB + 2x Fuse Switch	D-809-0053-SD-002
Earth connection diagram	KS-308
Civil foundations – Tyree 500 kVA	D-809-0049-SD-001
Conduit detail – Tyree 500 kVA	D-809-0050-SD-001
Earth grid and fittings - Tyree 500 kVA and Sch KPX 3/05 Kiosks	KS-309
Plinth details – Tyree 500 kVA and Schneider KPX 3/05 Kiosks	KS-302
Plinth lifting details - Tyree 500 kVA and Schneider KPX 3/05 Kiosks	KS-320
Civil foundations – Tyree 750 and 1000 kVA	D-809-0051-SD-001
Conduit detail – 750 kVA w/ 4x Fuse Switch	D-809-0052-SD-001
Conduit detail – 750/1000 kVA w/ CB + 2x Fuse Switch	D-809-0052-SD-002
Conduit detail – 750 kVA w/ IIDI HV Switchgear	D-809-0058-LY-001
Earth grid and fittings - Tyree 750/1000 kVA and Sch KPX 3/10 Kiosks	KS-310
Plinth details - Tyree 750/1000 kVA and Sch KPX 3/10 Kiosks	KS-303
Plinth lifting details - Tyree 750/1000 kVA and Sch KPX 3/10 Kiosks	KS-322
Civil foundations – Tyree 1500/2000 kVA & 750 kVA IIDI	D-809-0054-SD-001
Conduit detail – Tyree 1500/2000 kVA	D-809-0055-SD-001
Earth grid and fittings - Tyree 1500/2000 kVA, 750 kVA IIDI, & KPX 4/15 Kiosks	KS-311
Plinth details - Tyree 1500/2000 kVA, 750 kVA IIDI, & KPX 4/15 Kiosks	KS-304
Plinth lifting details - Tyree 1500/2000 kVA, 750 kVA IIDI, & KPX 4/15 Kiosks	KS-323
Safety signs – Tyree 500, 750, 1000 kVA and Sch KPX 3/05, 3/10	KS-319
Safety signs – Tyree 1500, 2000 kVA and Sch KPX 4/15, 4/20	KS-336
Batter and drainage layout - Ground slope < 1:3	KS-206

Description	Drawing Id.
Retaining walls up to 600 mm high	KS-207
Retaining walls 600 mm to 1000 mm high	D-KS1-0212-SD-0001
Retaining walls 1000 mm to 1500 mm high	D-KS1-0213-SD-0001
Retaining walls 1000 mm to 1500 mm high (Compact)	D-KS1-0214-SD-0001
Kiosk Fire Protection Guide – Non-fire Rated Enclosure	KS-200
Kiosk Fire Protection Guide – Non-fire Rated Enclosure w/o combustible liquids	KS-202
Kiosk Fire Protection Guide – Fire Rated Enclosure	KS-203
Kiosk Substation 3D Foundation Layout	KS-208

Table 30: Kiosk substation legacy designs

Description	Drawing Id.
General arrangement - Schneider KPX	KS-301
One line diagram – Sheet 1 of 2 - Schneider KPX	KS-306
One line diagram – Sheet 2 of 2 - Schneider KPX	KS-307
Equipment details - Schneider KPX	KS-321
Civil foundations – Schneider KPX 3/05 Kiosk[1]	KS-317
Conduit detail – Schneider KPX 3/05 Kiosk[1]	KS-313
Civil foundations – Schneider KPX 3/10 Kiosk[1]	KS-360
Conduit detail – Schneider KPX 3/10 Kiosk[1]	KS-314
Civil foundations – Schneider KPX 4/15 Kiosk[1]	KS-318
Conduit detail – Schneider KPX 4/15 Kiosk[1]	KS-315
Civil foundations – Schneider KPX 4/20 Kiosk	KS-318
Conduit detail – Schneider KPX 4/20 Kiosk	KS-316
Earth grid and fittings - Schneider KPX 4/20 Kiosk	KS-312
Plinth details – Schneider KPX 4/20 Kiosk	KS-305
Plinth lifting details - Schneider KPX 4/20 Kiosk	KS-324
Kiosk Fire Protection Guide – Outdoor Type (Legacy)	KS-201

Note 1: For Schneider KPX units in sizes 3/05, 3/10, and 4/15, the applicable Earth Grid, Plinth Details and Plinth Lifting Details drawings are found in the Table 29: Kiosk substation standard designs as the new designs for standard units are backwards compatible in these sizes only.

Table 31: Switching station designs

Description	Drawing Id.
Guide for site selection - 3-4 RMU	KS-339
General arrangement - 3-4 RMU	KS-340
One line diagram template – RM6 11kV[1]	D-TXX-XXXX-OL-001

Description	Drawing Id.
One line diagram template – RM6 22kV[1]	D-TXX-XXXX-OL-001
Earth connection diagram	KS-343
Civil foundations – 3-4 RMU	KS-346
Conduit detail – 3-4 RMU	KS-345
Earth grid and fittings 3-4 RMU	KS-344
Plinth details – 3-4 RMU	KS-341
Plinth lifting arrangement details – 3-4 RMU	KS-348
Safety signs – 3-4 RMU	KS-347
Switching Station 3-4 RMU 3D Foundation Layout	KS-210
Kiosk Fire Protection Guide – Non-fire Rated Enclosure w/o combustible liquids	KS-202

[1]Note: Switching station one line diagram templates are provided as kiosk templates. As the RM6 unit is used across both assets the transformer and LV switchgear may be removed to generate the one line diagram for switching stations.

Table 32: Legacy switching station designs

Description	Drawing Id.
General arrangement – 3 Bay SM6	KS-351
One line diagram – 3 Bay SM6	KS-353
Civil foundations – 3 Bay SM6	KS-357
Conduit detail – 3 Bay SM6	KS-356
Earth grid and fittings – 3 Bay SM6	KS-355
Plinth details – 3 Bay SM6	KS-352
Plinth lifting arrangement details – 3 Bay SM6	KS-359
Safety signs – 3 Bay SM6	KS-358

Table 33: Mini kiosk (KPX[2]) standard designs

Description	Drawing Id.
Guide for site selection	KS-325
Kiosks details	KS-326
Schneider KPX2 Equipment details	KS-334
Electrical schematic	KS-328
Earth grid and fittings	KS-330
Plinth details	KS-327
Plinth lifting arrangement details	KS-335
Conduit detail	KS-331

Description	**Drawing Id.**
Civil foundations	KS-332
Safety signs	KS-333
Mini Kiosk Substation 3D Foundation Layout	KS-209