



Part of Energy Queensland

Standard STNW3389

Standard for Electrical Design and Construction Requirements for Chamber Substations

These standards created and made available are for the construction of Ergon Energy infrastructure. These standards ensure meeting of Ergon Energy's requirements. External companies should not use these standards to construct non-Ergon Energy assets.

If this standard is a printed version, to ensure compliance, reference must be made to the Ergon Energy internet site www.ergon.com.au to obtain the latest version.

Approver	Carmelo Noel GM Asset Standards	
If RPEQ Sign-off required insert details below.		
Certified Person Name and Position Title		Registration Number
Greg Caldwell		12482
Manager Line Standards & Ratings		

Abstract: This Standard provides minimum electrical design and construction requirements for the establishment of new Chamber Substations with ratings up to and including 22kV. This Standard applies to Surface, Elevated, Upper Level and Basement Chamber Substations, Switching Station Chambers and Chambers for High Voltage Customer Connections.

Keywords: Chamber Substation, Substation, Indoor

Standard for Electrical Design and Construction Requirements for Chamber Substations



CONTENTS

1	Overview	5
1.1	Purpose	5
1.2	Scope	5
2	References	6
2.1	Legislation, Regulations, Rules, and Codes	6
2.2	Controlled Documents.....	6
2.3	Other Sources	6
3	Definitions and Abbreviations	7
3.1	Definitions	7
3.2	Abbreviations	7
4	General Information and Requirements.....	8
4.1	Safety	8
4.2	Design Life and Maintenance Periods.....	8
4.3	Danger Signs and Substation Signage.....	8
4.4	Substation Locking and Security	8
4.5	Application of Network Standards to Alterations at Existing Chamber Substations.....	8
5	Substation Types	9
5.1	General.....	9
5.2	Rating and Fault Level	10
6	Substation Electrical Design and Construction – General Information.....	12
6.1	Ergon Energy Substation Drawings.....	12
6.2	Environmental Constraints	12
6.3	Electromagnetic Fields (EMF)	12
6.4	Confined Spaces.....	12
7	Equipment Layout, Space and Clearance Requirements	13
7.1	Transformers	13
7.2	HV Switches	15
7.3	Low Voltage Switchboard.....	16
7.4	Cabling	16
7.5	SCADA Equipment	17
7.6	Protection Panels.....	18
7.7	Protection Battery and Battery Charger.....	19
7.8	Circuit Fault Indicators (CFIs).....	19

Standard for Electrical Design and Construction Requirements for Chamber Substations



8	High Voltage Switchgear – Installation	19
9	Transformers – Installation	20
10	Transformers – Cabling	20
11	Low Voltage Switchboards – Design and Installation.....	21
	11.1 General.....	21
	11.2 Labelling	21
	11.3 Phasing.....	21
12	Cable Suppliers for the Substations Chamber to the Customer’s Switch room	22
	12.1 Cable Supplies – General	22
13	Substation Earthing	22
	13.1 General.....	22
	13.2 Earthing Arrangement	22
	13.3 Earth Electrodes	23
	13.4 Substations Earth Bar	23
	13.5 Equipment Earthing	24
14	Substation Lighting and General Power	26
	14.1 Substation Service (Light and Power Distribution) Board	26
	14.2 Light and Power Circuits	26
	14.3 Power Outlets	26
	14.4 Lighting	26
15	Basement Substations Additional Requirements	28
	15.1 General.....	28
	15.2 Hatch Covers	28
	15.3 Fire Equipment and Ventilation	28
	15.4 Buildings Below Potential Water Table.....	28
	15.5 Cable Entry Conduits	28
16	Upper Level Substations Additional Requirements	28
	16.1 General.....	28
	16.2 Transformers	28
	16.3 Cable Risers	28
	16.4 Equipment Delivery	29
17	Chambers for Control of Supply to High Voltage Customer Installations – Special Requirements	29
18	Areas of Special Care	29
	18.1 HV and LV Cable Installation	29

Standard for Electrical Design and Construction Requirements for Chamber Substations



18.2	Stainless Steel Bolts and Set Screws – Lubrication of Threads.....	30
19	Information Plan	30
19.1	Requirement	30
Appendix A		32
Informative		32
Information Plan.....		32

FIGURES

Figure 1: Ring Main Fuse Switch Substation.....	9
Figure 2: Ring Main Isolator Circuit Breaker Substation	10

TABLES

Table 1 - Nominal Three-phase Fault Levels.....	10
Table 2: Cross Sectional Area and Number of Cables	20

Standard for Electrical Design and Construction Requirements for Chamber Substations



1 Overview

1.1 Purpose

The Network Standard specifies Ergon Energy's requirements for the electrical design, construction and equipping of distribution Chamber Substations, for supply of electricity to premises. The requirements of this Standard shall apply throughout Ergon Energy's supply area.

Requirements are included for distribution Chamber Substations designed to provide customers with nominal three-phase four-wire 433 / 250 volt AC supply.

As an alternative to 433 / 250 volt supply, high voltage supply may be available for customers who meet the required conditions (refer to Queensland Electricity Connection and Metering Manual, Clause 2.12). High Voltage supply is not covered by this Standard and shall be negotiated and designed on an individual basis.

The design and construction requirements specified in this Network Standard are intended to satisfy electrical performance and economy requirements and to meet all statutory obligations. The substations specified utilise readily available components which have demonstrated reliability.

1.2 Scope

This Network Standard applies to the electrical design, construction and equipping of distribution Chamber Substations. The requirements of this Standard apply to new Substation installations and the refurbishment of existing substations.

This Network Standard:

- Applies to nominal 11kV / 22kV primary voltage systems
- Applies to nominal 433 / 250 volt distribution systems
- Applies to chambers used for control points and for control of supply to high voltage customers connections
- Does not apply to SWER systems
- Does not apply to nominal primary voltage systems higher than 22 kV
- Does not apply to Zone or Bulk Supply Substations, 11 kV regulators or auto transformers

Note
Special arrangements will be made for voltages higher than 22kV in consultation with Engineering Standards & Technology

Substation civil design and civil construction are not covered in this Standard.

The requirements of all relevant Australian Standards, the Building Code of Australia as applicable and all statutory bodies are regarded as minimum requirements for the establishment or refurbishment of Chamber Substations. Where this document exceeds those requirements, this document is to become the minimum standard acceptable to Ergon Energy.

Standard for Electrical Design and Construction Requirements for Chamber Substations



2 References

2.1 Legislation, Regulations, Rules, and Codes

This document refers to the following:

Document	Type
Building Code of Australia (BCA) (Aus)	Code
<i>Electricity Safety Act 1994</i> (Qld)	Legislation
Electricity Regulation 2013 (Qld)	Regulation
Electrical Safety Act 2002 (Qld)	Legislation
Electrical Safety Code of Practice – Works, 2020 (Queensland Government)	Code
Electrical Safety Regulation 2013 (Qld)	Regulation
Ergon Energy Distribution Annual Planning Report (DAPR)	Reference

2.2 Controlled Documents

Document	Alternative Doc ID
Electricity Entity Requirements - Working Near Overhead and Underground Electric Lines - 2915457	
Guideline for Adoption of CMEN Earthing System - 2916850	
Queensland Electricity Connection Manual - 2912908	
Standard for Panel Wiring - 2938164	STNW3021
Standard for Site Selection and Construction Design Requirements for Chamber Substations - 2933331	STNW3390
Standard for Substation Lighting - 2949685	STNW3040
Standard for Substation Signage - 2941554	STNW3037

2.3 Other Sources

Document number or location	Type
AS/NZS 3000: 2007, Electrical installations (Wiring Rules)	Australian Standard
AS/NZS 3003: 2011, Electrical installations – Patient area	Australian Standard
AS/NZS 3439.2: 2002, Low-voltage switchgear and control gear assemblies – Part 2	Australian Standard

Standard for Electrical Design and Construction Requirements for Chamber Substations



AS/NZS 4325-1:1995, Compression and Mechanical connectors for power cables with copper or aluminium conductors – Test methods and requirements	Australian Standard
AS 1319: 1994, Safety signs for the occupational environment	Australian Standard
AS 1566: 1997, Copper and copper alloys – Rolled flat products	Australian Standard
AS 2067: 2008, Substations and High Voltage Installations Exceeding 1kV a.c.	Australian Standard
AS 2738.2: 1984, Copper and copper alloys – Compositions and designations of refinery products, wrought products, ingots and castings	Australian Standard
AS 4169: 2004, Electroplated coatings – Tin and tin alloys	Australian Standard
BS EN 61238-1:2003, Compression and mechanical connectors for power cables for rated voltages up to 36 kV (Um = 42 kV). Test methods and requirements	British Standard
ENA DOC 001: 2008, National Electricity Network Safety Code	Industry Standard
IEC 1238-1, Part 1: Test methods & requirements, Compression & Mechanical Connectors for Power Cables	International Standard

3 Definitions and Abbreviations

3.1 Definitions

For the purposes of this standard, the following definitions apply.

Approved Materials	Approved Materials means materials acceptable to Ergon Energy, purchased from suppliers satisfying Ergon Energy's Quality Assurance requirements or materials which have been supplied by or purchased from Ergon Energy.
Chamber Substation	A Chamber Substation is a building or part of a building that contains electrical equipment which receives a Primary Voltage and provides 415/240V supply
Switching Station	A Chamber which has HV Switchgear only for the control of a Chamber Substation which does not have unimpeded personnel access for the street, such as Upper Level Chamber Substations.

3.2 Abbreviations

This list does not include well-known unambiguous abbreviations, or abbreviations defined at their first occurrence within the text.

Standard for Electrical Design and Construction Requirements for Chamber Substations



BCA	Building Code of Australia
CT	Current Transformer

4 General Information and Requirements

4.1 Safety

All work must be carried out in accordance with Queensland's Electrical Safety Act and the National Electricity Network Safety Code (ENA DOC 01-2008). If there is any conflict between the requirements of these documents, Queensland's Electrical Safety Act shall prevail.

The installation of cables for underground to overhead terminations (UGOHs), and the installation of substation equipment by crane or other lifting device, near or in the vicinity of exposed high or low voltage mains must (at least) comply with the requirements of the Work Health and Safety Act 2011 (QLD) together with the Work Health and Safety Regulation 2011 (QLD), and the minimum safe working clearances detailed in Queensland's Electrical Safety Act, and documents referred to in the Act.

Network Standard STNW3390 requires that a Chamber Substation and its access route must not be within an area that is deemed to be a confined space. However under certain conditions, parts of existing Chamber Substations or Switching Stations may potentially be subject to atmospheric contamination (or oxygen deficiency). They then become classified as 'confined spaces' under the Work Health and Safety Regulation 2011 (QLD).

4.2 Design Life and Maintenance Periods

The substation target design life of 50 years sets particular requirements for the careful selection of materials and equipment and for high standards of workmanship.

The quality of work and materials supplied must be adequate for the substation to meet or exceed its design life and maintenance performance requirements.

4.3 Danger Signs and Substation Signage

All substations shall be provided Site Identification, Danger Signs and other Safety warnings signs in accordance with the requirements of ES000901R148 *Workplace Signage* and AS 2067.

4.4 Substation Locking and Security

Substations shall be fitted with locks and handles to suit direction of opening as indicated on the substation drawing and the requirements of STNW3390 *Standard for Site Selection, Civil Design and Construction Requirements for Chamber Substations*, Clause 7.1.8.

4.5 Application of Network Standards to Alterations at Existing Chamber Substations

When existing substations are to have alterations or refurbishments carried out, opportunities should be taken, where reasonably economically and technically practicable, for the substations to be brought up to current Network Standard requirements. Otherwise a risk assessment shall be conducted to identify residual risk and the implications for Ergon Energy's determination.

Standard for Electrical Design and Construction Requirements for Chamber Substations



5 Substation Types

5.1 General

Distribution substations generally obtain their supply from the primary distribution system, which is a three-phase three-wire AC system with a nominal system voltage of 11 kV (11,000 volts) or 22 kV (22,000 volts).

In all cases the substation output is a nominal 433 volts three-phase four-wire AC supply.

Distribution substations are connected to the 11 kV / 22 kV systems by the use of a ring main isolator and earth switch (I & E Switch). The substations can either be part of a ring feed network (preference) or a radial feed.

5.1.1 Ring Main Fuse Switch (RMFS) Substation

This type of substation is equipped with up to three (3) transformers with rating of up to 1000 kVA each. The transformer/s are connected to the bus linking the feeder switches by a fuse switch combination as generally shown in Figure 1.

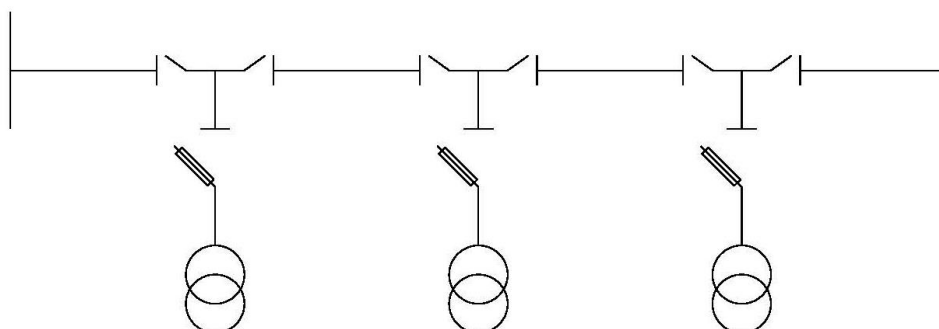


Figure 1: Ring Main Fuse Switch Substation

The low voltage switchboard is equipped with switch / disconnectors for each transformer. Circuit breakers and / or fuses provide customer supplies of rating 400A, 630A, 800A, 1000A, 1200A or 1600A. Fused network distributors rated at 400A may also be supplied from the low voltage switchboard. Two or three transformer substations are also equipped with a LV bus section switch / disconnector which are normally open.

Standard for Electrical Design and Construction Requirements for Chamber Substations

5.1.2 Ring Main Isolator Circuit Breaker (RMICB) Substation

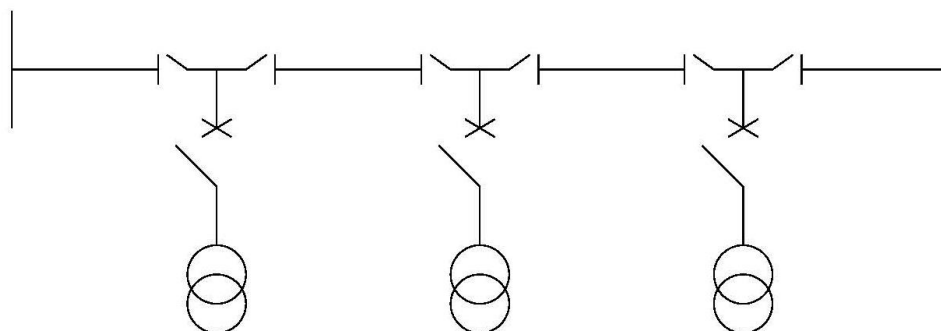


Figure 2: Ring Main Isolator Circuit Breaker Substation

This type of substation is equipped with up to three (3) transformers each rated at 1500kVA. The transformer/s are connected to the bus linking the feeder switches by a circuit breaker as generally shown in Figure 2.

For all these substations the low voltage switchboard is equipped with switch / disconnectors for each transformer. Circuit breakers and / or fuses provide customer supplies of ratings 400A, 630A, 800A, 1000A, 1200A, 1600A or 3200A. Fused network distributors rated at 400A may also be supplied from the low voltage switchboard. Two or three transformer substations are also equipped with a LV bus section switch / disconnector which are normally open.

5.2 Rating and Fault Level

The nominal three-phase fault levels for the various standard distribution options are listed in Table 1. The nominal transformer impedance voltage is selected to limit the fault current at the LV board to the value or less than the value specified in the table.

Table 1 - Nominal Three-phase Fault Levels

Nominal Primary System Voltage See Note (d) See Note (e)	Transformer Size (kVA) See Note (a) See Note (b)	Nominal Transformer Impedance %	Nominal Prospective Short Circuit Current at Substation Low Voltage Board See Note (a) See Note (b) See Note (c)
11 kV	500kVA	4.0%	50kA
	750kVA	5.0%	50kA
	1000kVA	5.0%	50kA
	1500kVA	6.25%	50kA
22 kV	500kVA	4.0%	50kA

Standard for Electrical Design and Construction Requirements for Chamber Substations



	1000kVA	5.0%	50kA
	1500kVA	6.25%	50kA

Note

- (a). All equipment installed in the substations must be designed to meet the maximum fault level for the substations when equipped to its maximum capacity. For example, if 2 x 1500kVA transformers are installed in a 3 x 1500kVA chamber substation, the substation shall be equipped with equipment with a fault rating suitable for the 3 x 1500kVA transformers.
- (b). The nominal prospective short circuit currents at the substation low voltage board, as quoted in Table 1, and in Note (c), refer to the maximum point of supply values, relevant for calculations for equipment fault duty. They are not relevant for calculations of consumers' mains length limitations. In these cases, if calculations are required, the minimum fault levels specified by Ergon Energy must be used.
- (c). Refer also to Queensland Electricity Connection and Metering Manual, Clause 2.8. This clause states that prospective fault levels may be obtained by contacting Ergon Energy. The customer's installation designer shall be responsible for ensuring that equipment fault duty is sufficient for the short circuit current at the point of supply.
- (d). 11kV system prospective fault levels are typically in the range of 13 kA, however in some areas prospective fault levels may approach 20 kA. For 11 KV switchgear fault level requirements, refer to Ergon Energy.
- (e). 22kV system prospective fault levels are typically in the range of 13kA, however in some areas prospective fault levels may approach 20kA. For 22kV switchgear fault levels requirements, refer to Ergon Energy.

Standard for Electrical Design and Construction Requirements for Chamber Substations



6 Substation Electrical Design and Construction – General Information

Refer also to the civil design requirements as specified in Distribution Network Standard STNW3390 *Site Selection, Civil Design and Construction Requirements for Chamber Substations*.

6.1 Ergon Energy Substation Drawings

Drawings not available from the Ergon Energy website can be requested either through the Customer Connection Officer or the Assessment Officer. Drawings are generally provided in electronic PDF format. Clause 2.2 lists reference drawings for the electrical constructions of Chamber Substations.

The minimum design clearances and requirements indicated in Clause 7 take precedence over any lesser design clearances, requirements or arrangements of equipment shown on the drawings listed in Clause 2.2 of this Network Standard.

6.2 Environmental Constraints

Electrical design of Chamber Substations must comply with EPA (the Environment Protection Authority) requirements.

Where oil filled equipment is used, the chamber shall be designed to contain oil spills within the chamber as detailed in STNW3390 *Site Selection, Civil Design and Construction Requirements for Chamber Substations*. In this regard all conduits, whether used or not used, shall be sealed to prevent water ingress to the substation and oil egress from the substation.

6.3 Electromagnetic Fields (EMF)

Substations shall be designed and constructed so as to minimise magnetic fields within and external to the substation chamber. This is achieved by locating heavy current low voltage conductors away from walls and ceilings and by bundling conductors where possible, i.e. by laying A, B and C phases and neutral together as a group rather than in different ducts or in flat formation.

Site selection of the substation may also be important in reducing EMF in some situations. A substation shall not be located adjacent to, above, or below operating theatres or similar areas where sensitive instrumentation is to be installed. (Refer to AS / NZS 3003)

Any request for EMF shielding shall be accompanied by a report from an approved EMF consultant determining the extent of shielding required. Shielding can be incorporated within walls, floor and ceiling of substation chambers, but installation inside substation chambers is not permitted. Installation of shielding shall be subject to Ergon's acceptance and at the building owner's expense. Shielding is less effective than bundling of conductors and increasing the separation distance from the conductors.

Loads with high third harmonic content (or multiples of the third harmonic) increase the difficulty of minimising EMF.

6.4 Confined Spaces

Refer to STNW3390 Clauses 2.1 and 4.2 regarding confined spaces, and to Clause 4.1 of this Network Standard regarding confined spaces.

Standard for Electrical Design and Construction Requirements for Chamber Substations



7 Equipment Layout, Space and Clearance Requirements

Substation equipment and supporting structures, etc. shall be located with due regard to safety of personnel working in the substation. In addition, all designs shall (at least) comply with the minimum safe working clearances detailed in AS 2067. Equipment shall be located such that any one item of equipment may be removed from the substation with the remaining equipment in service and under load. In this regard, a crane or other lifting devices clearance should be considered when locating equipment.

The minimum design clearances and requirements in this Clause as depicted in Ergon Energy drawing 1056083-01 shall be adhered to.

7.1 Transformers

The space to be provided for each oil filled transformer, in chambers designed for oil filled transformers, must be not less than 2300 mm x 2000 mm. Note that the 2000 mm dimension includes space for the high voltage cabling and supports etc. and for the low voltage cabling and supports.

The space to be provided for each dry type transformer, in chambers designed for dry type transformers, must be not less than 2300 mm x 2000 mm.

Important
Oil filled transformers are not permitted in Elevated, Upper Level and Basement chamber substations. For these Chamber Substations dry-type transformers must be used.

Transformer spaces must be separated from walls, ventilation equipment, other equipment, pit edges or obstructions by at least 1000 mm. Each transformer space must be separated from other transformer spaces by at least 1000 mm. Increased separation distances shall be required in accordance with the requirements of AS 2067 Clause 6.7.2, Table 6.1. If these minimum separation distances are met there is no requirement to have a fire / blast barrier between transformers. For other arrangements contract Ergon Energy.

Transformers including their connecting cables, cable supports, current transformers (CTs) and CT supports, connection covers etc. must be physically located totally within their designated spaces. The clearances of 1000 mm must be maintained after providing for the required bending radius of cables.

Provision for installation of low voltage transformer tails shall be made by means of cable trenches in the substation floor or cable trays. Preference is for a single cable trench or cable tray from the low voltage pit and the transformers.

Provision for installation of high voltage transformer tails shall be made by means of cable trenches in the substation floor or cable trays from the high voltage switchgear pit. Preference is for a single HV cable trench in the floor or cable tray between the transformers and the high voltage switchgear pit. The HV cable trench or tray should be separate from the LV cable trench or tray.

Transformer cable trenches must be covered with floor plates. Transformer cable trenches must not be located where the floor plates will be under the wheels of any transformer, when the transformer

Standard for Electrical Design and Construction Requirements for Chamber Substations



is within its designated transformer space. Floor plates must be able to be removed without having to move any transformer or other item of equipment.

Transformer cable trays must be located so that the clearances set out in this Network Standard are not encroached. All cable tray and cable tray support brackets must be earthed by a minimum 70mm cable.

At each transformer, the end of the high voltage and low voltage cable trenches or trays shall be located immediately inside the designated transformer space and centrally under their respective cable termination points on the transformer. The cable trench shall extend into the designated transformer space and its width may be splayed etc, sufficiently to allow sufficient space for cable bending radii and to ensure that cables do not rest on sharp trench edges etc. Where cable trays terminate, or cables exit the cable trays any sharp edges of the trays shall be suitably protected to ensure that cables do not rest on them.

The LV cable trench or tray shall have sufficient space to allow for earth cables, signal cables and protection cables.

All cable trenches or trays must be clear of the path required for installation or removal of any transformer.

Transformers must not be placed directly under ventilation duct openings.

Sufficient clearance is required over the top of each transformer to allow for in-situ maintenance. With the exception of fire damper trip wires, no item of equipment or installation or obstruction is to be placed over a designated transformer space. (Note also that the minimum height of the substation chamber is 3200 mm.)

The positioning of transformers in any type of chamber must satisfy the following requirements:

- no other equipment or structures or cables associated with other transformers or equipment are required to be moved to enable any transformer to be installed or removed, and
- no other transformer or other equipment or cables associated with other transformers or equipment are required to be de-energised to enable any transformer to be installed or removed, and
- unless otherwise agreed by Ergon Energy, the movement of the transformer to or from the allocated access door or hatch is achievable by means of a straight pull route, and in accordance with Clause 10 of STNW3390 *Standard for Site Selection, Civil Design and Construction Requirements for Chamber Substations*, and
- clearance of not less than 1100 mm will be maintained from low voltage switchboard equipment, high voltage switchgear, protection equipment, protection battery installation and equipment, at all stages in the movement of any transformer.

In surface chambers and elevated chambers, the transformers are to be located directly in front of the transformer access doors. If an oil containment ramp is required (i.e. because the substation is equipped with oil filled transformers), the transformers are to be located at the bottom of the oil containment ramp (i.e. approximately 1000 mm from the doors), unless otherwise approved in writing by Ergon Energy. Approval for alternative transformer locations will not be given by Ergon Energy unless:

- ventilation requirements and effectiveness are not reduced, and

Standard for Electrical Design and Construction Requirements for Chamber Substations



- each transformer can be conveniently moved, to the satisfaction of Ergon Energy, to its allocated doorway, and
- suitable equipment handling facilities are installed in the chamber, as described in Clause 10 of STNW3390 *Standard for Site Selection, Civil Design and Construction Requirements for Chamber Substations*, and
- the positioning requirements as listed above for any type of chamber are satisfied.

7.2 HV Switches

High voltage switchgear should be positioned so that its operating side faces away from any associated transformer and must be readily accessible from personnel doors. Switchgear shall be positioned so that the Switching Operator has sufficient space to operate the equipment, minimum 1000mm clear space.

In addition to satisfying the specific positioning requirements for Ring Main Unit switchgear as indicated below, the positioning of HV switches in any type of chamber must also satisfy the following requirements:

- there must be sufficient clear space to manoeuvre each switch between its position on the HV pit and the personnel access door which is designed to be also suitable for equipment access,
- no other equipment or structure or cables not directly associated with the high voltage switch are required to be moved to enable the high voltage switch to be installed or removed, and
- clearance of not less than 1100 mm will be maintained from low voltage switchboard equipment, protection equipment, protection battery installation and equipment, at all stages in the movement of any high voltage switch.

Sufficient clearance is required over the top of each switch unit to allow in-situ maintenance. (Note also that the minimum height of the substation chamber is 3200 mm.)

Cable access is to be from the front bottom. Suitable clearance for cable terminations and bending radius must be allowed.

WARNING

Oil filled switchgear is not permitted to be used in chamber substations of any type.

7.2.1 Ring Main Units

High voltage switches shall be positioned so that their operating side is not the nearest side to the associated transformer. The operating-side edge of the pit is referred to in this Section as the “front edge”.

HV pits shall be designed with dimension suitable to accommodate the bending radii of cables. As much as practicable, the switchgear should be positioned wholly behind the front edge of the pit, and

Standard for Electrical Design and Construction Requirements for Chamber Substations



centrally over the pit. Such designs should be submitted to Ergon Energy for consideration prior to design approval.

The HV pit and HV switchgear must be positioned such that the following clearances are achieved:

- Not less than 1500 mm between the front edge of the pit or the front of the HV switchgear and any wall or obstruction, whichever is the least
- Not less than 2000 mm between the front edge of the pit or the front of the HV switchgear and the front of a LV switchboard (whichever is the least) including equipment on protection panels forming an extension of the low voltage switchboard. (This allows for 1000 mm of covered LV pit plus 1000 mm of solid floor between the HV and LV switchgear.
- Not less than the switchgear's manufacture's recommendation from the back of the HV switchgear and any wall or obstruction
- Not less than the switchgear's manufacture's recommendation from the side of the HV switchgear and any wall or obstruction

The minimum clearances are to be achieved with all cable connection boxes and ancillary equipment items fitted.

Any sections of high voltage pits not covered by switchgear must be covered with floor plates. Refer STNW3390 for details on floor plates.

7.3 Low Voltage Switchboard

A low voltage switchboard, rated at 415 volt, 50 Hz is required in each Chamber Substation for all Ergon Energy's chamber substation. The low voltage switchboard shall have a load break switch for each transformer. Refer Clause 12 of this Network Standard for requirements.

The low voltage switchboard shall be positioned, over a low voltage pit, and supported on pit steelwork.

There must be a minimum clearance of 250 mm between the chamber wall behind the switchboard and the rear of the switchboard. The chamber wall behind the low voltage switchboard may have projections, such as columns, provided that the minimum clearance of 250 mm to the switchboard is maintained.

No part of the low voltage switchboard or its components or equipment is to be closer than 1100 mm to the nearest access doorway or opening.

A clear passageway or operating clearance of 1500 mm shall be allowed in front of the switchboard.

The switchboard shall not be located where it would obstruct equipment removal from the substation.

The space above and behind the low voltage switchboard, must be clear of any ventilation duct or louvre opening. Light fittings if mounted on the wall behind the switchboard shall be offset with consideration of the need to maintain or replace them.

7.4 Cabling

Cables to be used within the substation chamber shall be multi-stranded copper (See Note) with PVC or XLPE insulation.

Standard for Electrical Design and Construction Requirements for Chamber Substations



Note
This does not preclude aluminium conductor cables to or from the low voltage network or high voltage network.

Cables entering and leaving the substation chamber are to be in conduits as per the Underground Construction Manual. Cable reticulation within the substation chamber is to be via a pit and trench system for surface and basement substations and cable trays for elevated substations. Where possible, cables should be run in a trefoil configuration to reduce electromagnetic interference (EMF).

Floor trenches / cable trays must be constructed to take into account the bending radius of cables and other factors relating to the cable design, e.g. cable ratings, and must be constructed in accordance with the requirements of STNW3390.

In cable risers, cables are to be securely cleated to the wall with commercial cable cleats spaced according to manufacture recommendation but not more than one metre. Cleats should be free from sharp edges and burrs. To prevent local heating of cables caused by eddy currents, cleat halves should be fixed together using non-ferrous nuts, washers and bolts. Cable cleats can be directly bolted to cable riser walls or via Unistrut type channels.

Surface wiring or surface mounted conduits are not permitted unless the cables are enclosed in PVC conduits or equivalent strength plastic toughing.

Plastic troughing may be permitted for enclosure of protection cables, but only in the following situations and subject to all of the following limitations:

- Troughing is permitted only in unexposed locations where the troughing would not impede access for personnel and would not be at risk of damage or dislocation during movement or maintenance of equipment, such as transformers, switchgear, switchboards or cables.
- Troughing or troughing covers are not permitted to have joints, except at 90° changes in direction.
- Troughing may only be installed in vertical runs, except for horizontal runs which are both behind and at or below the base level of low voltage switchboard panels, or short horizontal runs not exceeding 1 metre in length from wall mounted protection panels.

Protection and metering wiring is not permitted in high voltage cable trenches, trays, ducting or conduits.

7.5 SCADA Equipment

There is no present requirement for SCADA equipment to be fitted in a Chamber Substation. Where Ergon Energy determines that SCADA equipment is required, details of the required equipment shall be specified.

SCADA equipment where specified for the chamber substations shall not be located in any position, where it is likely to be damaged, as a result of equipment being moved within the chamber. Cabinets containing SCADA equipment should have a minimum 1500mm clear space in front of each item.

Standard for Electrical Design and Construction Requirements for Chamber Substations



7.6 Protection Panels

Protection panels, where required, must comply with the current Ergon Energy approved designs, and may be:

- free standing cabinet mounted against a wall, or
- wall mounted panel.

7.6.1 Free Standing Protection Cabinets

Free standing protection cabinets, either single cabinets or groups of two cabinets maximum, are to be mounted against a wall. In all installations, free standing cabinets must be solidly attached to the floor so as to be shockproof. The cabinets shall be arranged such that the hinged side of each cabinet is external to the group to ensure relays when mounted on the front door do not impact adjacent relays when the doors are opened.

Free standing protection cabinets must have the following clearances:

- not less than 1500 mm clear space in front of equipment on the protection cabinet(s),
- not less than 1000mm clear space at the sides of the cabinet or cabinet group.

7.6.2 Wall Mounted Protection Panels

Wall mounted protection panels must be mounted on a solid masonry wall with four (4) x M12 fasteners and be mounted so as to be shockproof.

The top of any wall mounted protection panel must be 1850 mm above the adjacent floor level.

A clear space of not less than 1500 mm shall be allowed in front of any equipment mounted on a protection panel. Refer also to Clause 7.2, for additional clearance requirements from high voltage switchgear.

Wall mounted protection panels must not be located above or below any other equipment or obstructions. This includes equipment or obstructions offset by less than 500 mm from a vertical line at either side of the panel.

The spacing between wall mounted protection panels, and other equipment or obstructions, must also comply with the following requirements:

- the minimum distance between a closed wall mounted protection panel including housing and supports, and any fixed obstruction, such as a side wall, must be not less than the width of the panel, and
- the minimum distance between closed wall mounted protection panels including housings and supports must be not less than the width of the larger of the panels, and
- except as indicated in the previous point, the distance between a closed wall mounted protection panel including equipment on the panel, housing and supports, and any movable obstruction, such as any part of a door in any opened position, must be not less than 1000 mm.

Clearances associated with all protection panels & cabinets must also comply with any additional requirements for spacing from other items of equipment, such as HV switches, transformers, and LV switchboard.

Standard for Electrical Design and Construction Requirements for Chamber Substations



7.7 Protection Battery and Battery Charger

Where a battery is required for protection equipment, the positioning requirements and clearances for the installation comprising protection battery and battery charger are equivalent to the positioning requirements and clearances for wall mounted protection panels, as described in Clause 7.6, excepting that the top of the batteries must be not more than 1200 mm above the adjacent floor level. The 48V DC charger shall be nominally at 1500mm above adjacent floor level.

In addition to these requirements, the protection battery must not be located in close proximity to protection panels or control equipment (eg SCADA) where vapour from the battery could increase the risk of corrosion.

The battery trickle charger shall be located as close as practicable to the battery, but with clearance of not less than 300 mm from the side of the battery. The battery trickle charger must not be located over or under the battery.

The battery test box shall be mounted adjacent to the substation access door, which is readily visible and accessible, and connected to the end of the DC circuit remote from the battery.

7.8 Circuit Fault Indicators (CFIs)

HV Switchgear used by Ergon Energy is supplied with Circuit Fault Indicators (CFIs) fitted to the HV Switchgear.

It is generally preferred that outgoing cable/s is connected to the switch/es with the circuit fault indicators. However, where this is not practicable the incoming cable/s may be connected to the switch/es with the CFIs.

8 High Voltage Switchgear – Installation

Refer also to Clause 7 - **Error! Reference source not found.** The switchgear shall be mounted in accordance with the substation layout drawing. High voltage switches shall be positioned so that the operating side is not the nearest side to the associated transformer. The switchgear shall be anchored with M12 bolts when mounted on a steel channel.

A complete set of operation handles for each high voltage switchgear unit shall be provided.

Each item of high voltage switchgear, including the transformer circuit breakers or fuse switches, the “in-line” isolators and the earthing switches, shall be labelled in accordance with current regional labelling requirements.

Standard for Electrical Design and Construction Requirements for Chamber Substations



9 Transformers – Installation

Refer also to Section 7 – Equipment Layout, Space and Clearance Requirements. The transformers shall be located in accordance with the substation layout drawings, and the wheels shall be locked by the studs provided, placing the wheels in the storage position or by other means approved by Ergon Energy. The outside of the transformer wheels must be located at least 100 mm from the closest edge of the low voltage cable trench rebate.

Each transformer shall be labelled in accordance with current regional requirements.

10 Transformers – Cabling

The cross-sectional area and the number of cables per phase for the HV and LV connections of each transformer shall be in accordance with Table 2 below. Alternative cable sizes and configurations can be used with approval from Ergon Energy.

Table 2: Cross Sectional Area and Number of Cables

Transformer Size	High Voltage			Low Voltage		
	Cable Cross Sectional Area mm ²	Number of cables per phase	Cable type	Cable Cross Sectional Area mm ²	Number of cables per phase	Cable Type
500kVA	35	1	TR-XLPE, Copper	185	2	Polymeric insulated (XPPE or EPR), Copper
750kVA	35	1	TR-XLPE, Copper	185	3	Polymeric insulated (XPPE or EPR), Copper
1000kVA	35	1	TR-XLPE, Copper	185	4	Polymeric insulated (XPPE or EPR), Copper
1500kVA	35	1	TR-XLPE, Copper	185	6	Polymeric insulated (XPPE or EPR), Copper

The cross-sectional area and type of HV cable for the connection of the chamber substation to Ergon Energy's 11kV / 22kV network shall be determined by Ergon Energy and shall be dependent on the

Standard for Electrical Design and Construction Requirements for Chamber Substations



on the cable type and cross-sectional area of the 11kV / 22kV feeders to which the substations is to be connected.

11 Low Voltage Switchboards – Design and Installation

11.1 General

Refer also to Section **Error! Reference source not found.** – Equipment Layout, Space and Clearance Requirements.

A low voltage switchboard, rated at 415 volt, 50 Hz is required in each Chamber Substation for all Ergon Energy's chamber substation. The low voltage switchboard is to be equipped with switch / disconnectors for each transformer. The switch / disconnectors for each transformer shall be rated to match 150% of the nameplate rating of the transformer. Circuit breakers and / or fuses provide customer supplies of rating 400A, 630A, 800A, 1000A, 1200A, 1600A or 3200A. Fused network distributors rated at 400A may also be supplied from the low voltage switchboard. Two or three transformer substations are also equipped with a LV bus section switch / disconnecter which are normally open.

The LV switchboard shall be located within the substation chamber with the minimum allowable clearances as specified in Clause 7.

11.2 Labelling

All distributor circuits, and all items of equipment on the low voltage switchboard, shall be labelled.

All secondary control and protection wiring shall be fitted with approved cable ferrules and wire numbers in accordance with STNW3021 *Standard for Panel Wiring*.

11.3 Phasing

For LV switchboards the phase sequence of the low voltage switchboard shall be A B C corresponding to Top, Middle & Bottom busbars. Where either rolls or crosses of the LV connections are required, these are to be performed in the cables to the transformer terminals and not in the LV distributor cables.

The connections within the substation together with its high and low voltage cabling must "phase" with the surrounding high and low voltage networks. Phasing of the substation means the orientation of the high and low voltage cables and connections will exactly match with the phase orientation of the surrounding network.

The design of the cable installation shall be such that it will phase with either the existing and / or the new primary and secondary distribution systems.

The phasing of the new substation will be tested by Ergon Energy at the time of commissioning.

Standard for Electrical Design and Construction Requirements for Chamber Substations



12 Cable Suppliers for the Substations Chamber to the Customer's Switch room

12.1 Cable Supplies – General

The substation general layout design must provide for the cables from the Chamber Substation to the customer's switch room to be installed in a generally direct route and in an arrangement satisfactory to Ergon Energy.

13 Substation Earthing

13.1 General

The substation earthing shall be arranged so that:

- the step and touch voltage limits will not be exceeded,
- the flow of fault current will not be restricted due to excessive resistance of the earthing circuit, and
- the short-time current carrying capacity of the earthing conductors and electrodes will not be exceeded.

The integrity of the substation earthing system is critical in providing a safe electricity supply. The earthing system must comply with the requirements STNW3390 *Site Selection, Civil Design and Construction Requirement for Chamber Substations*.

Unless directed otherwise by Ergon Energy the MEN system of earthing shall be installed throughout the supply network. The preferred earthing system for chamber substations is the CMEN system which utilises common HV and LV earthing system. For requirements to apply the CMEN earthing system refer to NA000403R481 *Guideline for the Adoption of CMEN Earthing System*.

All unbonded exposed metal work within the substation shall be electrically bonded to the earthing system. This includes metal doors and reinforcing in the floor. If a part cannot be adequately bonded, it will be constructed from suitable insulating materials instead of metal.

The earthing system is to be a stand-alone type, not connected to building reinforcement bars with the exception of reinforcing in the floors and walls of the substation enclosure which should be electrically separate from the remainder of the building. It must be well clear of building lighting protection systems and should not be connected to the earth bar of any switchboard, other than the earth bar inside the substation.

Special consideration should be given to any potentially hazardous situation arising from metallic structures in contact with or near the substation. Such structures include but are not limited to metallic fences, swimming pools, flammable gas or liquid storage tanks, electric railway lines, pipelines, high voltage substations, high voltage transmission lines, operating theatres or similar facilities, communication centres, pits, pillars, and metallic sheathed communication cables.

13.2 Earthing Arrangement

A combined system of earthing shall be used consisting of electrodes. The electrodes shall be located so as to minimise the interaction effects between them. The minimum number of electrodes

Standard for Electrical Design and Construction Requirements for Chamber Substations



for each Chamber Substations is 4, additional electrodes shall be provided where necessary to meet the earthing design.

There shall be a minimum of two (2) independent connections between the earth electrodes and the substation earth bar. The cable between the earth electrodes and the substation earth bar shall be a minimum 120mm² CU or sized accordingly to meet the fault current of the substation, whichever is the larger.

Where Ergon Energy specifies a direct earthing system, multiple earthing conductors are to be provided from the customer's main switch room earth bar to Ergon Energy's substation earth bar. Under this arrangement no MEN connections between neutral and earth is to be made within the customer's installation. Note labelling requirements of AS/NZS 3000 clause 5.5.1.3 will be required at each direct earth conductor termination point with the following wording.

WARNING: 'MAIN ELECTRICAL EARTHING CONDUCTORS FOR CUSTOMER'S DIRECT EARTHED INSTALLATION - DO NOT DISCONNECT'

Substations supplying electric traction installations or located on sites owned or controlled by electric traction organisations, may require special earthing arrangements. In these situations, any special arrangements required will be specified on a case by case basis by Ergon Energy.

13.3 Earth Electrodes

The earth grids shall consist of a deep electrode system interconnected with earthing cable. The location of all earth electrodes shall be fully dimensioned on the layout of equipment drawing for each chamber type substation.

13.4 Substations Earth Bar

In each Chamber Substation and in each Switching Station, an earth bar shall be installed, in accordance with the following specifications.

The substation earth bar shall be located approximately 300 mm above the substation floor level, on a wall adjacent to the low voltage switchboard, but not directly behind the low voltage switchboard. The substation earth bar must not be located where it would impede access to the low voltage pit, and must not be located where it would cause a hazard to personnel. The earth bar must not intrude into the minimum required clearances for personnel and equipment, as specified elsewhere in this Network Standard and STNW3390 *Site Selection, Civil Design and Construction Requirement for Chamber Substations*

The Switching Station earth bar shall be located on the wall, in a location where it would not create an access hazard, near the high voltage switches and the cable entry point, and approximately 300 mm above the Switching Station floor level.

The earth bar shall be suitably spaced to provide a clearance from the wall of not less than 60 mm and not more than 100 mm, to enable the cable lug bolts to be inserted and removed from the wall side of the bar. The bar shall be not less than 1000 mm long, manufactured from a single piece of 100 mm x 6.3 mm tin-plated copper, complying with the following specifications:

- The bar shall be hard drawn high conductivity copper.
- The surface of the bar shall be clean, smooth and free from defects which are detrimental to its use.

Standard for Electrical Design and Construction Requirements for Chamber Substations



- Manufacturing tolerance shall comply with Table 3 of AS 1566 – 1997.
- The bar shall have 1 mm radius at corners.
- The bar shall be of copper alloy 110, electrolytic tough pitch copper as designated in AS 2738.2 – 1984 and of temper designation to AS 1566 / 110-M.
- The bar shall be tin plated all round with minimum coating thickness of 10 micrometres for service condition Number 2 as stipulated by AS 4169 - 1994 and matt finish.

In a Switching Station or in a Chamber Substation the earth electrodes cables shall be independently connected to the respective earth bar.

Each upper-level substation, or substation near its Switching Station, shall have the substation earth bar connected to the control point earth bar with 2 x 120 mm² stranded copper Green / Yellow PVC or polyethylene insulated cables.

At each transformer, all metalwork that is not attached to the transformer, including high voltage and low voltage cable support brackets, must be earthed to the transformer earth bar, with 70 mm² copper conductor Green / Yellow single insulated PVC or polyethylene insulated cables.

At each transformer, the neutral bushing shall be connected to the transformer earth bar with 2 x 70mm² copper conductor Green / Yellow single insulated PVC or polyethylene insulated cables.

Where a substation is near another substation, or near an unassociated Switching Station with or without an earth electrode system, the earth bars in each chamber shall, wherever practicable, be connected together with 2 x 120 mm² stranded copper Green / Yellow PVC or polythene insulated cables. This interconnection must not be made if one or both of the chambers has a segregated earthing system or is associated with a traction system.

Connections to the Substation earth bar or Switching Station earth bar must be made with bolts, washers and nuts of the sizes specified in the drawings. Where the bolt size is not specified, the bolt and bar hole must be of an appropriate size consistent with the diameter of the hole in the lug being attached. Each cable lug must be separately connected under its own bolt or bolts. Cable lugs must be connected directly to the bar. Connection extension pieces, such as bar stubs, flags, etc must not be used. Slotted lugs are not permitted. Full hole tinned copper solid barrel compression lugs must be used. Lugs must be affixed to the cable with an approved crimping tool and die suitable for the cable size and lug. Bolts, washers and nuts must be stainless steel grade 316. Brass bolts must not be used.

The location of the Substation earth bar (and Switching Station earth bar, where applicable), must be shown on the substation plans.

13.5 Equipment Earthing

Substation equipment earths shall be connected to the substation earth bar, and control point equipment earths shall be connected to the control point earth bar, in accordance with the following specifications.

Each installed item in the following list shall be separately connected as specified to the respective earth bar, with one (or more where indicated), 70 mm² copper conductor Green / Yellow insulated PVC or polyethylene earthing cable:

- connection from electrodes,

Standard for Electrical Design and Construction Requirements for Chamber Substations



- a separate set of 2 x 185 mm² cables from each transformer tank, or 2 x 70 mm² cables where a single transformer substation of 1000kVA rating or less,
- a separate set of 2 x 70mm² cables from each transformer neutral bushing and the transformer earth bar,
- a separate set of 2 x 70 mm² cables from each transformer earth bar,
- connection to the LV switchboard frame earth by 2 x 70 mm² cables,
- connections to nearby substations and unassociated Switching Stations (refer to Clause 13.4),
- separate earth cables (2 x 70 mm² cables) from each item of high voltage switchgear; or two earthing cables (2 x 70 mm² cables), being the ends of an earthing loop around all high voltage switchgear earth bars.

The substation Service (light & power distribution) switchboard shall be separately connected to the substation earth bar with 16mm² copper conductor Green / Yellow single insulated PVC or polyethylene earthing cable.

The following shall be separately connected to the substation earth bar with 6mm² copper conductor Green / Yellow single insulated PVC or polyethylene earthing cable:

- For protection panels which do not form part of the low voltage switchboard: one separate cable for each protection panel, or two cables being the ends of an earthing loop formed by interconnecting all protection panels in a group with 6mm² copper conductor.
- Other panels or groups of panels or equipment required to be earthed (e.g. SCADA panels).

Each cable connected to the substation earth bar or Switching Station earth bar shall be adequately labelled to indicate its origin.

At each item of high voltage switchgear, a switchgear earth bar is to be installed for connection of switchgear frame earths and high voltage cable metallic sheath or screen wire earths. The switchgear earth bars are to be not less than 40 mm x 6.3 mm tin-plated copper, complying with the specifications in Clause 13.4. The bars shall be of adequate length for the connections required.

The earth bar at each item of high voltage switchgear shall be either,

- connected directly to the substation earth bar, or Switching Station earth bar, as applicable, with 2 x 70 mm² cables, or
- connected into an earthing loop formed by interconnecting all high voltage switchgear earth bars with 70 mm² cables.

Connections to the switchgear earth bars must be made with bolts, washers and nuts of the sizes specified in the drawings. Where the bolt size is not specified, the bolt and bar hole must be of an appropriate size consistent with the diameter of the hole in the lug being attached. Each cable lug must be separately connected under its own bolt or bolts. Cable lugs must be connected directly to the bar. Connection extension pieces, such as bar stubs, flags, etc must not be used. Slotted lugs are not permitted. Full hole tinned copper solid barrel compression lugs, Ergon Energy approved tinned copper braids with specially formed lugs, or Ergon Energy approved mechanical cable lugs, must be used. Where compression lugs are used, they shall be installed strictly in accordance with

Standard for Electrical Design and Construction Requirements for Chamber Substations



the manufacturer's specification for crimping dies, number of crimps and position of crimps. Bolts, washers, and nuts must be stainless steel grade 316. Brass bolts must not be used.

14 Substation Lighting and General Power

14.1 Substation Service (Light and Power Distribution) Board

Lighting and general power for Chamber and Switching Stations is to be provided from a distribution board supplied from the customer's metered supply and be connected through the essential building services main switch (where provided). The distribution board is to contain Miniature Circuit Breakers (MCBs) or Fault Current Limiting (FCL) fuses of a suitable capacity and fault duty. The substation light and power distribution board shall be labelled.

Light and power for a Switching Station is generally to originate from the associated substation, which is to provide supply through sub-mains to a suitable wall mounted sub-distribution board in the Switching Station. Separate dedicated circuits for Switching Stations lighting and power requirements are to be provided from the sub-distribution board, as specified for Chamber Substations. Where there is another substation in the same premises adjacent and closer to the Switching Station than the associated substation, the sub-mains for light and power for the Switching Station may originate from the adjacent substation, provided suitable labelling is attached at each end of the circuit.

14.2 Light and Power Circuits

The substation lighting and power system is installed and maintained by the customer at no cost to Ergon Energy. Light and power circuits shall be wired in accordance with AS/NZS 3000. PVC conduits shall be used when single insulated cable is selected for the wiring of the light and power circuits. Double insulated cable if selected shall be installed on cable tray or PVC duct with cover.

Battery chargers, as specified in Clause 7.7, are to be provided for protection equipment in substations with high voltage and/or low voltage circuit breakers.

The battery chargers shall be supplied by permanently connected separate dedicated circuits, from the distribution board.

14.3 Power Outlets

General power is to be provided for a minimum of one single-phase, double, 10 amp 240 volt general purpose outlet. This power outlet shall be located on the Service Board unless it forms part of the standard LV board design and shall be supplied from a dedicated circuit. Depending on the equipment installed in the substation, a three-phase outlet may also be required.

All GPOs must be protected by an RCD.

14.4 Lighting

The substation and associated chambers are to be provided with lighting sufficient to ensure an adequate level of illumination. Lighting shall be installed and provide a minimum illumination accordance with the requirements of STNW3040 *Standard for Substation Lighting*, Table 1, Switchgear room.

Standard for Electrical Design and Construction Requirements for Chamber Substations



Light fittings are to be positioned where they will not be susceptible to damage, and where the fittings and their associated conduits do not interfere with doors, hatchways, cables, ventilation ducts, trip wires or other pieces of equipment in the Chamber Substation. Light fittings must be wall mounted or ceiling mounted. Wall mounted lights shall be installed such that the centreline of the light fitting is 2200 mm above floor level. Hanging ceiling mounted lights from chain supports or similar are permitted where cable trays obscure light from the fitting. Hanging lights are to hang no lower than the bottom of the cable trays.

For multi-transformer chambers with doorway type personnel access, lights are to be controlled by two-way heavy-duty switches positioned adjacent to each doorway. For single transformer chambers a single light switch shall be provided adjacent to the entrance door closest to the low voltage board.

For hatchway type personnel access, a suitable limit switch is to be positioned under each hatchway and is to operate when the hatch cover is opened, to activate the lighting in the chamber below that hatch cover only.

In the chamber below each hatch cover, a two-way heavy-duty switch is to be installed to control the lights in the substation chamber and access passageways.

All fittings and wiring are to be in accordance with AS/NZS 3000.

14.4.1 Emergency Lighting

Emergency lighting shall be provided in all chamber substations, switching stations and access ways. Emergency lighting and exit signs shall be designed and installed in accordance with the Building Code of Australia and AS 2293.

The emergency lighting should be turned on / off either when the when the normal lighting system is turned on/off or with motion sensors, i.e. turned on when the substation is attended. This requirement does not apply to access ways which are shared and may be used as part of the normal building operations.

Emergency lighting shall be designed to provide a minimum duration after loss of supply of 1.5 hours. The emergency services wiring shall be kept independent of all other wiring and equipment but shall be connected to one normal lighting circuit within the same room so as a failure on normal lighting will activate the emergency lighting.

Emergency lighting shall be operated periodically to ensure operation and as such test facilities shall be provided in the distribution board for the substation.

Standard for Electrical Design and Construction Requirements for Chamber Substations



15 Basement Substations Additional Requirements

15.1 General

No oil filled switchgear and transformers shall be installed in Basement Substations.

15.2 Hatch Covers

On completion of the substation, the equipment hatch cover shall be sealed to achieve weatherproof finish and meet the requirements of STNW3390.

15.3 Fire Equipment and Ventilation

No service shall be installed in the substation ventilation ducts. The substations shall be equipped with a mechanical operated system for tripping of fire damper fitted to the opening of each substation ventilation duct. The tripping mechanism design and installation shall ensure that moving parts do not fall onto live equipment. No other equipment, fitting or conduits shall interfere with the operation of the mechanical tripping of the dampers.

15.4 Buildings Below Potential Water Table

Refer to STNW3390 *Site Selection, Civil Design and Construction Requirements for Chamber Substations* Clause 10.3 for additional requirements for buildings below potential water table.

15.5 Cable Entry Conduits

All cable entry conduits, including both unused conduits and conduits containing cables are to be sealed against water entry to the basement and oil egress from the substation.

16 Upper Level Substations Additional Requirements

16.1 General

No oil filled switchgear and transformers shall be installed in upper level chamber substations.

16.2 Transformers

Only Dry type transformers shall be used in upper level substations.

16.3 Cable Risers

The cable riser installation shall comply with the requirements of STNW3390 *Site Selection, Civil Design and Construction Requirements for Chamber Substations*.

The substation earth shall be installed in the footprint below the high voltage Switching Station. The earth cables between the Upper Level Substation and its Switching Station are to be run a cable riser, which links the two rooms. One earth cable shall be bare and saddled to the unistrut, and one earth cable shall be insulated.

The cleating of the high voltage and earthing cables shall be detailed in the design drawing for the cable riser installation.

Standard for Electrical Design and Construction Requirements for Chamber Substations



Where a cable riser does not directly enter the associated substation and / or Switching Station conduits shall be installed between:

- the lower end of the cable riser and the Switching Station and / or
- the upper end of the cable riser and the substation.

All doors accessing cable risers shall be labelled with a suitable danger sign conforming to AS1319 with the words “DANGER HIGH VOLTAGE CABLES INSIDE”. The doors shall also be fitted with an Ergon Energy approved keying system.

16.4 Equipment Delivery

Upper level substations require different method of equipment delivery than surface and basement chamber substations.

Refer to Section 6 of STNW3390 *Site Selection, Civil Design and Construction Requirements for Chamber Substations* for further information.

17 Chambers for Control of Supply to High Voltage Customer Installations – Special Requirements

The requirements for supply to high voltage customer installations, as included in [2912908](#) Queensland Electricity Connection and Metering Manual, must first be satisfied before supply will be provided at high voltage.

Where Ergon Energy agrees to the provision of supply at high voltage from equipment installed in a chamber, Ergon Energy’s space and equipment requirements will be negotiated on a case by case basis.

A chamber for control of supply to a high voltage customer installation must be equipped with a lighting installation and a power installation similar to that required for a chamber substation (Refer Clause 14).

18 Areas of Special Care

The experience of Ergon Energy and of other supply authorities has shown that certain aspects of substation projects require special care so as to avoid reliability and / or maintenance problems. Attention is drawn to these areas so that they can ensure that special care is given during construction.

18.1 HV and LV Cable Installation

The low voltage network distributors and the high voltage cables from the substation to the dedicated roadway shall be installed in accordance with Ergon Underground Distribution Construction Manual.

The high voltage cables shall be installed in the cable trenches provided. Where the high voltage cables emerge from trenches at the transformers, the cables shall be supported.

The low voltage cables shall be installed in the cable trenches provided for transformer tails or in ducts for network low voltage distributor cables.

Standard for Electrical Design and Construction Requirements for Chamber Substations



High voltage and low voltage cables shall not be installed in a common duct or cable trenches.

The high voltage cables shall be installed into the cable end box of the high voltage switch in such a manner that the earth fault indicator CTs can be installed over the single core cables and that the current in each of the single core cables can be easily measured using a “tong ammeter”.

Wherever practicable the low voltage cables shall be installed at the transformer and LV switchboard in such a manner that the current in each of the single core cables can be easily measured using a “tong ammeter”.

Split barrel spade and pin crimp lugs and push on spade type terminations are NOT permitted on protection or control circuits.

18.2 Stainless Steel Bolts and Set Screws – Lubrication of Threads

Before installation of each stainless steel bolt or set-screw, the thread shall be lubricated with specially formulated anti-seize grease containing nickel (eg Loctite Nickel Anti-Seize, or equivalent).

Where the lubricating grease will be in contact with an electrical insulating medium (eg heatshrink), the supplier of the insulating medium shall be consulted to ensure product compatibility.

19 Information Plan

An A4 size Information Plan as detailed below shall be framed and securely mounted in a suitable readily viewable position within the substation or control point chamber immediately adjacent to each personnel access door for multi transformer substations or one only for single transformer substations.

19.1 Requirement

The Information Plan (Refer **Error! Reference source not found.** for an example) is a drawing that indicates the location of the substations or control point in the building, location and Method of access for personnel and equipment into the chamber and emergency equipment located in the chamber.

The Information Plan is to be A4 sized. Multiple Information Plans for a large project may be drawn. This drawing does not have to be drawn to scale; however, if the information conveyed is too small to be legible Ergon Energy will request a larger scale.

The Information Plan will contain the following information:

- A sub-title block which has the Ergon Energy substation or Switching Station number, the geographic location of the chamber and provision for the addition of the Ergon Energy drawing number assigned to the Layout Drawing of the Substation or Switching Station. A blank rectangular space, 70mm wide x 20mm high is to be left below the subtitle block for the drawing number.
- A site plan is required which gives a clear indication of the position of the chamber on the site relative to surrounding access roads.
- A plan view showing the substation or control point layout and the position of fire extinguishers, water service and, if present, telephone, batteries and emergency push buttons. The drawing is to clear and simply show the personnel access such that there can be no doubt as to the method of access, ie door or hatch, and must indicate the surrounds

Standard for Electrical Design and Construction Requirements for Chamber Substations



to the access ways from the street so that their positions are readily recognisable at all times. The transformer doors or hatch are to be treated in similar manner to the personnel access.

- The equipment and services mentioned above should be depicted on the plan view by symbols. A legend of the symbols used is to be on the drawing.
- If oil filled equipment is present in the chamber, the drawing is to have a statement in bold print saying. **THIS SUBSTATION (OR SWITCHING STATION) CONTAINS OIL.**

Standard for Electrical Design and Construction Requirements for Chamber Substations

Appendix A

Informative

Information Plan

