Substation Labelling and Numbering

Design Standard

DOCUMENT HIERARCHY

This document resides within the Planning component of Western Power's Asset Management System (AMS).

DOCUMENT DATE

This document was last updated February 2024

IMPLEMENTATION DATE

This document came into service January 2024

DOCUMENT CONTROL

Record of endorsement, approval, stakeholders, and notification list is provided in EDM# 48934370 appendix

RESPONSIBILITIES

Western Power's Engineering & Design Function is responsible for this document

CONTACT

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Revision Details

Version	Date	EDM Version	Summary of change
0	07/16	1	Draft Issue
1	07/19	2	First Issue
2	08/22	3	Second Issue – Addresses items 7 to 13 in issues register. Other minor updates.
2	January 2024	5	Standards Online Update

1 Introduction

Consistent labelling of substation plant and equipment supports a safe and efficient, construction, commissioning, maintenance, and operation of the substation over its lifetime.

This Engineering Design Instruction (EDI) outlines the requirements while providing guidance to engineers on what to consider during the design of the labelling and numbering of substations.

1.1 Purpose and scope

This Engineering Design Instruction covers the following topics for zone and terminal substations:

- the naming of substations and the equipment within
- the standard numbering of the substation bays and equipment
- how to apply the numbering within brownfield substations
- labelling requirements
- labelling of equipment within the switchyard
- labelling and numbering of secondary circuits and equipment

1.2 Acronyms

Acronym	Definition

1.3 Definitions

Term	Definition
Engineering Design Instruction (EDI)	Describes in detail a particular type of design. This is the “how” to implement a design with clear boundaries defined.
Network Standard (NS)	A Controlled Technical Document that describes in detail “what” needs to be done in regard to a particular network asset or area of the network. It is typically a mid-level document that may contain 10-30 pages including diagrams and operating parameters. Once approved compliance for all new work is mandatory (allowing for a phase in period), whilst enforcing retrospective compliance for existing assets is determined on a case by - case basis.
SFAIRP	So far as is reasonably practical
CB	Circuit breaker
C.O.M	Construction, Operation and Maintenance
CT	Current transformer
DES	Disconnector with earth switch
DIS	Disconnector

HMR	Hazard Management Register
HV	High Voltage
LV	Low Voltage
RRST	Rapid Response Standby Transformer
VT	Voltage transformer

1.4 References

References which support implementation of this document

Table 1.1 References

Reference No.	Title

2 Supporting Documentation[1]

3 Compliance[2]

This Engineering Design Instruction complies with all higher-level Western Power technical documents and relevant Australian Standards.

This Engineering Design Instruction should encompass all requirements of the relevant Australian Standards which are current at the time of issue. These relevant Australian Standards are listed in Table 3.2 below. A period will be set when the standard needs to be reviewed. If significant changes occur on an Australian Standard which affects safety, then an out of cycle review can be completed.

Table 3.1: Relevant Documentation

Document Title
Engineering Design Instruction – Substation Secondary Systems Design
Network Standard – Naming & Labelling of Substations, Transmission Lines and Distribution Assets

[1] See Western Power Internal Document
[2] See Western Power Internal Document

Document Title
Register - Substation Design Drawings - EXTERNAL Version

The relevant Australian Standards are listed below in Table 3.2.

Table 3.2: Australian Standards

Standard Number	Standard Title
AS/NZS 3000	Electrical installations. (The Wiring Rules)
AS 2067	Substations and high voltage installations exceeding 1kV a.c.
AS 1319	Safety Signs for the Occupational Environment

4 Functional Requirements

This Engineering Design Instruction is intended to be used by Substation Engineering staff and by companies completing outsourced design work for Western Power, as it outlines the Western Power requirements pertaining to earthing design for transmission substations.

5 Safety in Design[3]

When designing substation labelling and numbering, an important consideration must be the end user. The Safety in Design process ensures that the safety of all personnel is a major aspect of the design by ensuring that potential hazards are identified and eliminated or minimised so far as is reasonably practical (SFAIRP).

The substation designer may start identifying hazards by considering appropriate labelling and numbering. Prompt points could be considered such as:

- Are there any unique equipment types that are not covered by template labels and may require investigation into unique labelling and numbering?
- Is the numbering of the equipment logical and easy to follow?

Any identified hazards shall be documented in the Hazard Management Register (HMR) and shall be eliminated, or have risks reduced to ALARP. The HMR and relevant design drawings shall undertake a construction, operation and maintenance (C.O.M) review at relevant stages of the project.

[3] See Western Power Internal Document

6 Overview of the Main Design Elements

There are many variables to consider when designing the labelling and numbering of a substation. Some of these considerations are discussed in detail in this Engineering Design Instruction, others are mentioned because they must be considered but refer to other Engineering Design Instructions for more detail.

The following main elements should be considered when starting new designs. See the relevant chapter for more information:

- Safety in Design – Section 5
- Numbering – Section 7 onwards
- Labelling – Section 10 onwards

7 Substation Naming and Numbering

7.1 Substation Name[4]

All substations shall have a unique name. Substation names shall preferably be one or two words only and shall not relate to a company, company owner or person (note however many existing substations do not comply with this requirement). See Network Standard – Naming & Labelling of Substations, Transmission Lines and Distribution Assets for more information on assigning the substation name. The substation name shall be chosen by Grid Transformation.

When a substation consists of multiple yards, the voltage level(s) of the yard shall be appended to the common substation name, e.g. Northam 132/66 kV and Northam 66/22 kV.

7.2 Substation Identification[5]

The substation identification for all new substations is a three-letter code that is derived from the substation name and should be of the format XXX and registered in the central register "Existing and Future Site names for Substations, Terminals, Power Stations and Regional Sites in Western Australia". Some existing substations use either a two or single letter code. The substation identifier shall be chosen and advised by Grid Transformation.

Substation IDs that could potentially be mistaken for accepted abbreviations for equipment, quantities, etc. shall be avoided. Capel (CAP) is an example where confusion could be made with Capacitor (CAP).

4 See Western Power Internal Document
5 See Western Power Internal Document

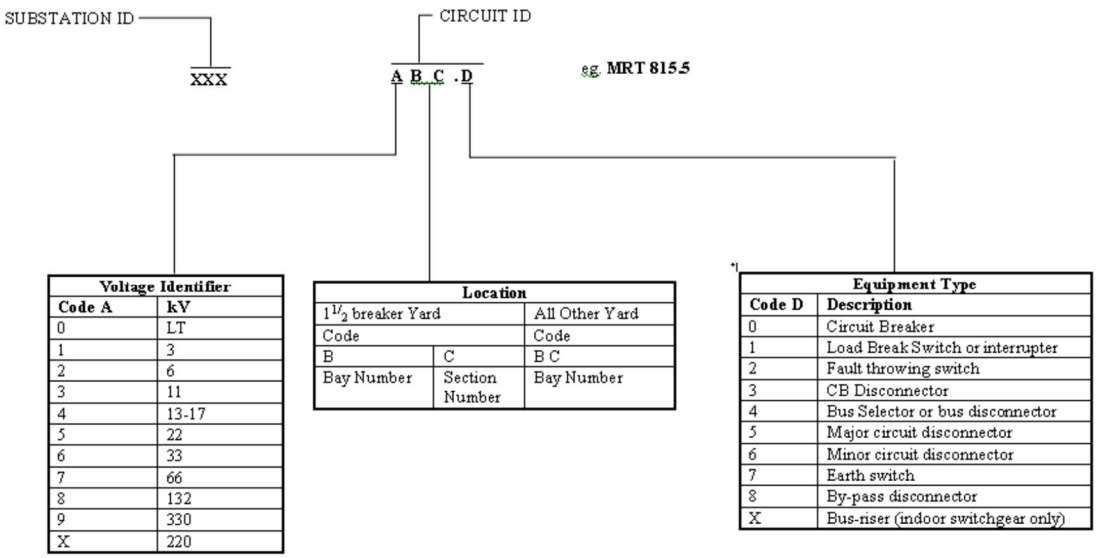
8 Circuit Numbering[6]

Each circuit shall have a Circuit ID that is unique within the substation. The Circuit ID shall generally be of the format **XXX ABC**, as indicated in Figure , where:

a) **XXX** – is the Substation ID – refer Section 7.2
b) **A** – is the Voltage Identifier – refer to Figure 8.1
c) **BC** – is the Location Identifier – refer to Figure 8.2

Each piece of equipment in a circuit shall have a Switch ID which is unique within the circuit. The Switch ID shall generally be of the form **XXX ABC.D** where:

d) **D** – is the Equipment Type Identifier – refer to Figure



Voltage Identifier	
Code A	**kV**
0	LT
1	3
2	6
3	11
4	13-17
5	22
6	33
7	66
8	132
9	330
X	220

Location		
$1^1/_2$ breaker Yard		All Other Yard
Code		Code
B	C	B C
Bay Number	Section Number	Bay Number

Equipment Type	
Code D	**Description**
0	Circuit Breaker
1	Load Break Switch or interrupter
2	Fault throwing switch
3	CB Disconnector
4	Bus Selector or bus disconnector
5	Major circuit disconnector
6	Minor circuit disconnector
7	Earth switch
8	By-pass disconnector
X	Bus-riser (indoor switchgear only)

Figure 8.1: Circuit Identification Structure

In some specific cases, further qualifiers may need to be appended to the standard Switch ID to ensure uniqueness.

Equipment type ‘ABC.6’ is used for voltage transformers which can be disconnected and are located on indoor switchboards.

It is the responsibility of the Design Engineer to select the Circuit ID to be used for any changes to an existing substation or the initial allocation in the case of a new substation.

8.1 Voltage Identifier

Voltage identifiers shall be taken from Figure 8.1: Circuit Identification Structure.

[6] See Western Power Internal Document

8.2 Location identifier

8.2.1 Breaker and a half yards[7]

As per Figure 8.1, 'B' shall be the bay number and 'C' shall be the section number for breaker and a half yards. If more than 9 bays are required, or more than 9 sections are required for a particular bay, then the Grid Transformation section shall be consulted. It may be possible to extend the bay numbering to 10, 11 etc resulting in a 4 digit circuit ID (ie 8113.0 being the middle 132kV circuit breaker in bay 11), such as Southern Terminal 132kV switchyard.

Bay section numbering in breaker and a half yards shall be as shown in Figure 8.2.

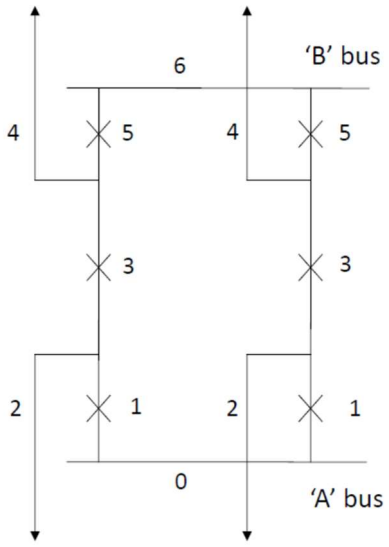


Figure 8.2: Section number allocation for breaker and a half terminal yards

8.2.2 All other yard layouts

In all other yard types (mesh, single bus and double bus), 'B' and 'C' shall both be used for bay number, i.e. catering for up to 99 bays.

8.2.3 Busbars and related equipment[8]

For single bus switchyards, the busbar Circuit ID shall use the location identifier '00'. The same applies for double bus switchyards however the equipment shall be suffixed 'A' or 'B' to indicate which busbar the equipment is connected to. No other circuits shall use a location identifier of '00'. Equipment that is associated with a busbar, but is not within a particular bay, shall also be given the location identifier '00'.

[7] See Western Power Internal Document
[8] See Western Power Internal Document

For breaker and a half switchyards, equipment that is associated with a busbar, but is located within a particular bay, shall use the appropriate bay location, with section number 0 for the A busbar or 6 for the B busbar.

8.2.4 New Substations[9]

In new substations, provision shall be made for future extensions of circuits at the 'lowest bay number' end of the busbar. Where it is known in advance how many circuits will be required in future extensions, sufficient bay numbers shall be left unallocated.

In outdoor yards where bays are left unused along the length of the busbar, the appropriate bay numbers shall remain unallocated to cater for future installation of circuits.

8.2.5 Existing Substations

When new circuits are added to a substation, the ultimate Single Line Diagram should be followed. In general:

a) When adding a new bay at the 'highest bay number' end, the existing numbering sequence can be followed, allowing gaps, if necessary, for any future bay insertions.
b) When adding a new bay to the 'lowest bay number' end, however, the Design Engineer may be forced to allocate a bay number that is out of sequence with existing bay numbers. In this case the new bay number selected should be at least ten (10) bays higher than any existing to:

i) Allow for logical extension of the existing bays and
ii) To highlight the fact that the bay is out of sequence.

9 Equipment Type Naming and Numbering

Equipment Type numbering shall be taken from Figure 8.1. In many arrangements additional suffixes need to be appended to the equipment type identifier to uniquely identify a piece of equipment.

9.1 General Equipment Naming[10]

Naming for any new equipment which is not listed in Section 9 shall be verified and endorsed by the Substation Design Principal Electrical Design Engineer.

The primary plant item sets the naming and labelling requirements and all secondary cubicle labelling shall follow the primary plant identifier to ensure assets are consistently labelled.

General primary equipment naming is listed below:

[9] See Western Power Internal Document
[10] See Western Power Internal Document

Table 9.1: General primary equipment naming

Identifier	Definition	Identifier	Definition
DIS	Disconnector	DES	Disconnector with Earth Switch
VT	Voltage Transformer	CT	Current Transformer
T	Transformer	CB	Circuit Breaker
CBC	Combined Current Transformer & Circuit Breaker	RE	Reactor
SA	Surge Arrestor	SPI	Station Post Insulator
EC	Earthing Compensator / Earthing Transformer	CAP	Capacitor Bank
STATCOM	Static Synchronous Compensator	ES	Earth Switch
SVC	Static VAR Compensator	RRST	Rapid Response Spare Transformer
CCV	Combined Current & Voltage Transformer		

9.2 Disconnectors

9.2.1 Busbar Selector Disconnectors[11]

For double busbar yards, the equipment identifier is suffixed by an ‘a’ or ‘b’, etc. to show the busbar they relate to. For single busbar and breaker and a half yards the busbar disconnectors require no suffix.

9.2.2 Bus Section Disconnectors12

For layouts that have more than one bus section disconnector in a single bay, e.g. either side of a bus section circuit breaker, the equipment identifier is suffixed by ‘a1’, ‘a2’, ‘b1’ or ‘b2’, etc. This denotes the name of the bus section to which they are connected. In all other cases, bus section disconnectors do not require suffixes.

9.2.3 CB Disconnectors[13]

For breaker and a half arrangements where there is more than one CB disconnector in a bay section, the equipment identifiers are suffixed by ‘a’ or ‘b’ to show which busbar they are closest to.

9.3 Earth Switches

9.3.1 Outdoor / HV GIS / Hybrid Earth Switches

In all cases a line side earth switch shall not have a suffix. All other earth switches shall follow the following requirements:

11 See Western Power Internal Document
12 See Western Power Internal Document
13 See Western Power Internal Document

- In substations with more than one busbar, where two earth switches are in a single bay or bay section, they shall be appended with an ‘a’, or ‘b’, etc. to show the busbar to which they are closest. Where one of these is a line side earth switch, it will not have a suffix, as explained above.
- In single busbar substations with more than two earth switches per bay or bay section (e.g. some GIS installations), earth switches shall be suffixed from A onwards, with suffix A being used for the earth switch closest to the busbar.
- In double busbar substations with more than two earth switches per bay or bay section (e.g. some GIS installations), suffix A shall be used for the earth switch associated with the A busbar disconnector, suffix B shall be used for the earth switch associated with the B busbar disconnector, any further earth switches in the bay shall be suffixed from C onwards, with the exception of the line earth switch which has no suffix.

Where the above requirements are not clear or do not apply to a specific installation, Substation Design group shall be consulted for approval.

9.3.2 Indoor Switchboard Earth Switches[14]

Where the circuit or busbar is earthed through the circuit breaker, the circuit breaker retains its normal equipment ID, e.g. ABC.0. The earth switch on the busbar side of the circuit breaker is typically part of a 3-position switch. The earth switch part of this 3-position switch is given the equipment ID ABC.7. The disconnector operating part of the 3-position switch is given equipment ID ABC.4.

Where the circuit or busbar is earthed through separate fault-make earth switches, these shall have separate Equipment IDs.

Busbar earth switches shall be appended with the busbar ID. i.e. ABC.7a1. For circuit earth switches, a suffix shall not be used. i.e. ABC.7.

9.4 Double Cable Feeders

The Equipment Identifier for the rear circuit components shall be suffixed with ‘r’ and the front circuit components with an ‘f’. ‘Front’ and ‘rear’ are determined when viewing the cables while facing the front of the switchboard.

9.5 Capacitor Bank Circuit Breakers

For arrangements with two capacitor banks on one circuit, with a common main circuit breaker and a dedicated circuit breaker on one bank only, the following shall apply:

- The main / common circuit breaker shall have no suffix, e.g. 520.0
- The capacitors shall have the same identifier, with suffixes ‘a’, ‘b’, etc.
- The minor circuit breaker shall be suffixed as per the associated capacitor, e.g. 520.0b
- The disconnector shall be suffixed as per the associated capacitor.

[14] See Western Power Internal Document

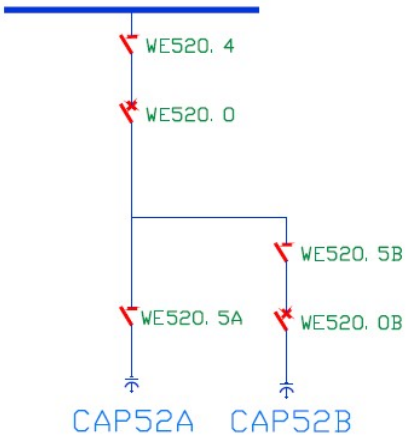


Figure 9.1: Welshpool Substation – Shared Circuit CAP Bank Arrangement

9.6 Three Position Disconnectors / Earth Switches in GIS

GIS generally contains three position disconnector / earth switches with 'ON / OFF / EARTH' positions. These three position switches shall have two Switch IDs – one for the disconnector function and one for the earth switch function. See Figure 9.2 below for an example. The naming convention shall be decided in consultation between Substation Design standards group and Network Operations.

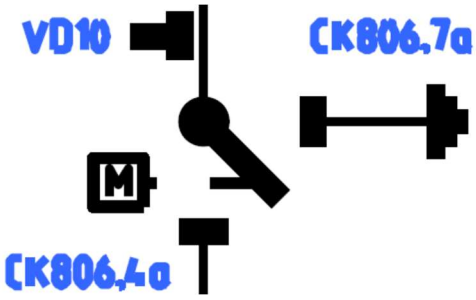


Figure 9.2: Three position switch at Cook Street Substation

9.7 Feeders at Country Substations

Where a busbar disconnector is used to join adjacent feeders providing a transfer arrangement, the disconnector shall have an equipment type identifier of .8 and shall take the lower of the two adjoining location identifiers.

Other bypass or transfer bus disconnectors, such as the 132kV bypass disconnectors at MOR also use this identifier, e.g 801.8.

9.8 Busbars[15]

Busbars shall be labelled as per the following requirements:

- Single busbars shall be referred to by their voltage level and the letter 'A', e.g. '22 kV A busbar'.
- Where multiple busbars of the same voltage exist in a substation, as opposed to multiple bus sections of a single busbar, each busbar shall be identified by a unique letter. The first busbar shall use 'A', e.g. a substation with two 132 kV busbars would have busbars '132 kV A busbar' and '132 kV B busbar'.
- Double busbar indoor switchboards shall have busbars referred to as 'upper / lower' or 'front / rear', depending on the physical arrangement of the switchgear.
- For double busbar switchboards supplied by dual secondary transformers (for example HAY, MIL, SPK, JTE, CK), the ultimate configuration consists of three sections of switchboard comprising 4 busbars each. These busbars are identified A,B,C,D (T1 section), E,F,G,H (T2 section), and P,Q,R,S (T3 section).
- Busbars with multiple bus sections shall have each section identified by the busbar identifier suffixed with a single integer, e.g. a single 22 kV busbar split into five bus sections would have bus sections '22 kV A1 busbar', '22 kV A2 busbar', etc. The complete busbar in this case will still be referred to as the '22 kV A busbar'.
- Substations with a 'Main' and 'Transfer' busbar arrangement shall have the main busbar suffixed with 'Main' and the transfer busbar with 'Transfer', e.g. '22 kV Main busbar' and '22 kV Transfer busbar'.

9.9 Transformers

9.9.1 General

Transformer IDs shall be of the form **Tn**, where '**n**' is the transformer number. Transformers shall be numbered sequentially from left to right when standing in the access road, e.g. standing on the LV side of the transformer (transformer secondary winding), facing the HV switchyard.

If an additional transformer(s) may be installed in future between existing transformers, then sufficient numbering shall be left available.

Where an additional transformer is to be installed to the left of T1, the new transformer will be given an ID at least ten (10) higher than the highest existing number to highlight that the new transformer is out of sequence. Although previously used at Canning Vale substation, the use of T0 is no longer approved.

9.9.2 Terminal Stations[16]

For new terminal stations, the convention of having unique transformer numbers, **Tn**, shall be maintained. Qualifiers such as 'SU' (Step-Up) or circuit numbers shall not be used. When

[15] See Western Power Internal Document
[16] See Western Power Internal Document

expanding existing terminal stations which use qualifiers such as SU (step-up), SD (step-down) and BT (bus-tie) the existing naming convention should be followed.

In some cases, due to yard arrangement and number of transformers, the “left to right’ naming convention may not be appropriate. In these cases, approval from the Substation Design Principal Electrical Design Engineer is required.

9.9.3 Earthing Compensators

Earthing compensators shall be numbered to coincide with their associated power transformer, e.g. Earthing compensator 3 is connected to T3.

9.9.4 Station Transformers

Station, local supply, transformers should be numbered sequentially, Station Transformer No 1, Station transformer No 2, etc. to allow association with the supplying circuit number.

9.10 Capacitors and Reactors

Capacitors shall be assigned an identifier of the form ‘CAPXY’, where ‘X’ is the Voltage Identifier (see Figure), and ‘Y’ is a unique integer starting at ‘1’. Three 11 kV capacitors in a substation would thus be referred to as ‘CAP31’, ‘CAP32’, and ‘CAP33’.

Where a single bank needs to be split into uniquely identifiable portions, e.g. one bank is split across two circuits – separate ‘Out of Balance’ protection schemes are required. A suffix of ‘A’, ‘B’, ‘C’, etc. shall be used to uniquely identify the banks. As an example, two split 11 kV capacitors, i.e. four circuits, would be ‘CAP31A’, ‘CAP31B’, ‘CAP32A’ and ‘CAP32B’.

Reactors shall follow a similar scheme, using the prefix ‘RE’ rather than ‘CAP’.

9.11 Static Synchronous Compensator

Static Synchronous Compensators shall be assigned an identifier of the form ‘STATCOMXY’, where ‘X’ is the Voltage Identifier (see Figure), and ‘Y’ is a unique integer starting at ‘1’. This requirement follows the naming of Capacitors and Reactors.

10 Labelling Requirements

10.1 General Requirements

In general, all outdoor labels are typically on a 1.0 mm or 1.6mm thick aluminium plate with a white reflective, class 2, background as per the requirements of AS/NZS 1906.1 and black ‘Series C’ lettering, as per the requirements of AS 1744. Template and example drawings of substation labelling or numbering can be found in the Register -Substation Design Drawings - EXTERNAL Version.

All secondary indoor labels shall be engraved with black lettering on a white background, e.g. Romark, unless otherwise specified.

For each substation a 'Label Location' and 'Label Schedule' drawing needs to be provided.

Labels must not be placed on items that can be removed like covers or removable panels.

10.1.1 Label Location[17]

A label location drawing shall be produced for each substation. This drawing is a plan view of the switchyard with each label identified by a number.

10.1.2 Label Inscription

Individual label inscription details shall be provided on site specific 'Label Inscription Schedules. This 'schedule' lists, for each label, the inscription drawing number and total number required.

10.1.3 On Site Label Fixing

Labels shall be located in accordance with the substation specific 'Label Location' drawing, in conjunction with 'Equipment Requiring Identification' – Appendix A.

The following notes are to appear on all substation specific "Label Location" drawings:

1. Fixing to be decided at the time of installation, however, method of fixing shall be of permanent nature.
2. If fixing to a suitable surface, e.g. galvanised steel, a double sided tape is to be used. Refer to the Substation Electrical Construction Technical Specification for approved fixing tape.
3. If label location does not permit use of double sided tape, label is to be suitably drilled and fixed to support structure using aluminium flat bar and stainless steel screws as required.
4. Labels on fences are to be attached using suitable aluminium wire.
5. All labels shall be mounted at approximately 1600mm to the centre of the sign.
6. Disconnector and earth switch labels shall be in full view of operator when standing on the operating position.

10.2 Primary Labelling[18]

The labelling of equipment shall always follow the primary plant numbering. The primary labels shall be designed and listed on the primary label schedule and shall comply with the following requirements:

[17] See Western Power Internal Document
[18] See Western Power Internal Document

- Switching points (circuit breakers, disconnectors and earth switches) shall be labelled with the Substation abbreviation and switching point number (as listed in Section 8), see sections 10.2.2 – 10.2.8.
- All other labels must follow the primary plant labelling convention listed in sections 10.2.9 – 10.2.14 below.
- Phase marker discs shall be installed on both sides of all circuit breakers, disconnectors and busbar support structures.

10.2.1 Transformer[19]

For all power transformers the label shall be as follows:

1. No. n

Where n is the transformer number.

10.2.2 Circuit Breakers

If the circuit breaker is directly associated with a transformer or line then labelling shall be:

- XXX ABC.0
- TX HV or LN X1

If the circuit breaker is not directly associated with a transformer or line (ie feeders or 1.5 CBs) then labelling shall be:

- XXX ABC.0

Where 'XXX' is the substation identifier, 'ABC' is the circuit number, 'X' is the transformer number and 'LN X1' is the line identifier and number (for example EP 81).

10.2.3 Busbar Disconnectors

If the disconnector is directly connected to a busbar then labelling shall be:

- XXX ABC.4

10.2.4 Major Disconnectors

A major circuit disconnector is a disconnector which can be used to isolate a major circuit such as a transmission line or a transformer.

If the disconnector is directly associated with a line then labelling shall be:

- XXX ABC.5
- LN X1

[19] See Western Power Internal Document

For all other major disconnectors the label shall be:

- XXX ABC.5

10.2.5 Bay Disconnectors

Bay disconnectors are used in double busbar and breaker and a half switchyards used to isolate circuit breakers and current transformers for maintenance purposes.

Bay disconnector labelling shall be:

- XXX ABC.3

10.2.6 Earth Switch

If the earth switch is directly associated with a line then labelling shall be:

- XXX ABC.7
- LN X1

For all other earth switches the label shall be:

- XXX ABC.7

10.2.7 Minor Disconnector

Minor disconnectors are sometimes used to isolate minor items of primary plant such as voltage transformers.

For all minor disconnectors the label shall be:

- XXX ABC.6

10.2.8 Drop Out Fuse

For all drop out fuses the label shall be:

- XXX ABC.1

10.2.9 Earthing Transformer

Three lines are used for Earthing Transformers with the requirements below:

- TRANSF. No. X
- EARTHING
- COMP.

Where 'X' is the transformer number detailed in Section 9.9.3 e.g 1, 2…etc

10.2.10 Capacitor Bank

Two lines are used for Capacitor Banks with the requirements below:

- CAPACITOR
- XY

Where ‘X’, ‘ Y’, is the Capacitor Bank number detailed in Section 9.10 e.g 32A

10.2.11 Reactor Bank

Two lines are used for Reactor Banks with the requirements below:

- REACTOR
- XY

Where ‘X’, ‘ Y’, is the Reactor Bank number detailed in Section 9.10 e.g 32A

10.2.12 Outdoor Power Distribution Panel

Three lines are used for Outdoor Power Distribution Panels with the requirements below:

- BAYS X & Y
- POWER DIST.
- PANEL

Where ‘X’ and ‘Y’ are the bay numbers which are serviced by the power distribution panel, e.g 5 & 6

10.2.13 Instrument Voltage Transformer

Two lines are used for Instrument Voltage Transformers with the requirements below:

- VT MARSH BOX
- CCT ABC
- LINE or BAY

Where ‘A’, ‘B’, ‘C’ is the circuit number detailed in Section 8. e.g 931
The third line is only required for circuits where there are both line and bay VTs on either side of the line disconnector which have the same circuit number.

10.2.14 Instrument Current Transformer

Two lines are used for Instrument Current Transformers with the requirements below:

- CT MARSH BOX
- CCT ABC

Where ‘A’, ‘B’, ‘C’ is the circuit number detailed in Section 8. e.g 931

10.2.15 Dangerous Goods

The following labels must be completed for all dangerous goods:

- 'COMBUSTIBLE LIQUID C1' sign is installed for all mineral oil filled transformers (where oil volume >10kL)
- 'COMBUSTIBLE LIQUID C2' sign is installed for all ester filled transformers (where oil volume >10kL)
- 'NON-FLAMMABLE NON-TOXIC GAS 2' (where SF6 > 40kg) is installed on all relevant plant items.
- 'HAZCHEM' sign is installed at the entrance to the site. This sign shall be installed on a dedicated post just inside the main pedestrian gate so it is clearly visible to personnel entering the site.

Refer to Appendix A for the required label location and outline.

10.3 Secondary Labelling[20]

Labels are part of the cubicle material list and label schedule for new designs. There may be a separate label schedule with older designs.

Labelling must conform to the following general rules:

- All items in a cubicle must be labelled
- The label must be clearly visible and readable from a standing position in front of the cubicle
- Labels for items in the upper part of the cubicle shall be below the item. Labels for items mounted in the lower part of the cubicle shall be above the item. A height of approximately 36 RU (from the bottom of the door) is the point at which the position of the label is determined. This can vary because the dimensions of the plates can vary. Plate details should allow space for labels above and below the equipment when possible. It must be clear which labels apply to which equipment.
- Protection 1 (P1) and protection 2 (P2) must be clearly labelled and easily identifiable. If P1 and P2 are on the same cubicle then the labels should be between the two protections. Arrows on the labels point up (P1) or down (P2).
- If there are multiple circuits in the same cubicle, then each circuit must be clearly identified with a circuit label mounted above the circuit.
- Swing frame cubicles – cubicle and protection labels must be installed on the front and back of the swing frame and in the back of the cubicles.
- Dexion racks – protection labels must be installed on the front and back of dexion racks.
- IEC61850 – terminal strips must be labelled with the circuit number and the terminal strip number. It must be clear which terminal strip is associated with which circuit.
- Label sizes are selected from the Standard Drawing – Labels – Details – Equipment Label Dimensions.

[20] See Western Power Internal Document

- Commas in the material list label description are used to distinguish lines on the label

  e.g. SF1014, 805.0 / T1
  SF1014 is on the first line
  805.0 / T1 is on the second line

- Secondary labelling must follow primary labelling.
- Labels must not be fixed to removable duct covers.
- If necessary, standoff brackets can be used to mount labels.

10.3.1 Cubicle Labels

IEC61850 cubicle labels must follow the IEC61850 naming convention.
Each protection cubicle label requires the:

- Cubicle name
- IEC61850 cubicle designation

e.g. 132kV PROTECTION 1 CUBICLE 1
E8F1UH1

10.3.1.1 Field Cubicle

The field cubicle shall be labelled and called up on the primary outdoor label schedule. Note that indoor protection labels are not suitable for use on the exterior of field cubicles.
There is a minimum of three lines on the field cubicle outdoor label. Each field cubicle label requires the:

- Cubicle name
- Circuit numbers and types
- IEC61850 cubicle designation

As an example, if there are 3 protection cubicles in the relay room, the field cubicle containing the field relays for the 801 line and 803 transformer would be labelled:

132kV PROTECTION 1 FIELD CUBICLE
801 LINE & 803 T1
E8F1UH4

10.3.1.2 Combined Cubicle

Combined cubicles have both P1 and P2 equipment in the same cubicle. P1 equipment will be located in the upper half of the cubicle and P2 equipment located in the lower half. The label for the combined cubicle requires the:

- Voltage
- 'Combined Protection Cubicle'

e.g. 132kV COMBINED PROTECTION CUBICLE

Sub cubicle labels will appear between the two protection areas. Arrows on the P1 label point up to P1 and arrows on the P2 label point down to P2. The sub cubicle labels require:

- Sub cubicle name
- IEC61850 sub cubicle designation.

e.g. As an example, in the 132 kV relay room there are three existing protection 1 cubicles and two protection 2 cubicles. The sub cubicle labels for the sub cubicles would be:
Upper area: ↑22kV PROTECTION 1 - E8F1UH4↑
Lower area: ↓22kV PROTECTION 2 - E8F2UH3↓

10.3.2 Protection Scheme Circuit Labels

10.3.2.1 Front of Swing Frame and Rear Terminal Strip

Each protection scheme must be labelled to indicate its location in the cubicle. This labelling must be located above the protection scheme with arrows pointing down. This labelling must be available on the front of the swing frame and on the rear terminal strip area. The label must indicate:

- Circuit number or type
- Type of circuit
- IEC61850 circuit designation

e.g. ↓503 FEEDER – E5Q03F1↓

10.3.2.2 Swing Frame Rear Door Labels

A label containing the IEC61850 circuit number is required on the inside edge of the rear of the swing frame door. This label must clearly identify the circuit when the swing frame door is open and viewed from the back.
e.g. E5Q03F1

Where there are multiple protection circuits in a row then a side arrow is required to identify the circuit.
e.g. ← E5Q15F2 E5Q14F2 →

10.3.3 Terminal Strip Labels

Each terminal strip shall have a label holder and a label which identifies the terminals. These labels are shown above the terminal strips on the drawing.
e.g. XD10

10.3.4 Protection Equipment Labels

10.3.4.1 Protection Relay

Each protection relay must have a label that clearly describes and identifies the protection relay. Information required on the label must appear on the schematics where the relay first appears. The relay description is not required on the label. The relay label must contain:

- Item designator (e.g. KF1009)
- Circuit number or type (e.g. 914, 132 kV Busbar)
- Circuit type and protection number (e.g. LN1, GM1, FDR1)
- The relay IEC61850 address if the relay sends or receives goose messages
- The main relay functions

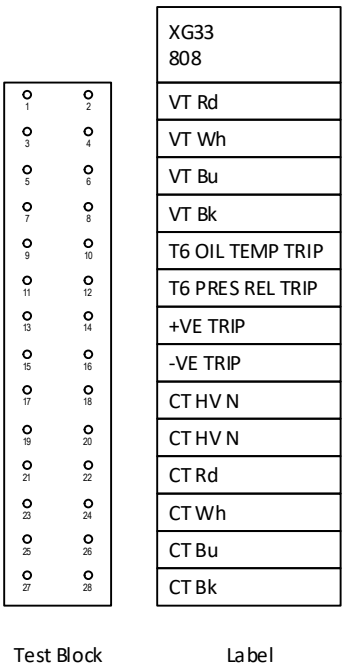
e.g. KF13 914 LN1
E9Q14F1KF13
DIFF, DIST, DIR EF, SYN CHECK, HSSPAR, 911.0 CB FAIL, TCS

10.3.4.2 Test Blocks

Test block labels shall contain the:

- Item designator
- Circuit or plant
- Test block isolating functions

Example:



10.3.4.3 Links

The link labels on the protection panel can accommodate 5 lines. The 5 lines are defined as follows:

- Line 1 – Item designator
- Line 2 – Isolated plant (signal destination)
- Line 3 – Input element function being isolated (signal destination)
- Line 4 – In parenthesis, the plant associated with the signal source
- Line 5 – In parenthesis, the output contact function associated with the signal source

All 5 lines may not be required to make the label. Generally, all 5 lines are required when the output contact function is required (e.g. PROT TRIP versus CB FAIL TRIP).

Example 1:
The X1130 link found in the 801 line protection 1 schematic isolates 132 kV bus zone trip relay from the circuit breaker fail trip originating from the line protection relay.

X1130	Item designator
132 kV BZ	Isolated plant (signal destination)
BZ1T	Input element being isolated (signal destination)
(801 LN1)	Originating plant (signal source)
(CB FAIL TRIP)	Output contact function (signal source)

Example 2:
The X1 link found in the protection 1 AC schematic isolates the A1 no volt relay from the A1 bus voltage. It is located between the MCB and the no volt relay.

X1	Item designator
A1 KF1	Isolated plant (signal destination)
NVI	Input element being isolated (signal destination)
(A1 FC1)	Originating plant (signal source)
(MCB)	Output contact function (signal source)

10.3.4.4 Test Normal Switches

Test normal switches require the:

- Item designator
- TPS test normal switches labels also require the communication circuit identification

Example:
TPS test normal switch label

SF1116	Item designator
CIRCID 7061	Communications circuit ID

10.3.4.5 Control Switches

Examples include Trip / Neutral / Close (circuit breakers) and Open / Neutral / Close (disconnectors) switches. Switch labels require the:

- Item designator
- Plant being controlled or the plant being isolated

Example:
Switch SF1133 controls the 801.0 circuit breaker which is used to switch the WT 81 line.

SF1133	Item designator
CK801.0 / WT81	Controlled and isolated plant

10.3.4.6 Other Switches

Other switch labels require the:

- Item designator
- Switch function

Example:

Auto reclose on / off switch

SF1133	Item designator
Auto Reclose	Switch Function

10.3.4.7 Sockets

Socket labels require the:

- Item designator
- Socket function

Example:

X42	Item designator
RRST P1 AC	Socket Function

10.3.4.8 MCB

MCB labels require the

- Item designator
- MCB function

Example:

FC6	Item designator
DIST 2	MCB Function

10.3.5 Distribution Boards

10.3.5.1 415V AC C/O Main Distribution Board

- Name of distribution board
- Unique location of distribution board
- IEC61850 designation

e.g. 415V AC C/O MAIN DISTRIBUTION BOARD
RELAY ROOM
E415WC1

10.3.5.2 415 AC Distribution Sub Board

- Name of distribution board
- Unique location of distribution board
- IEC61850 designation

e.g. 415 AC DISTRIBUTION SUB BOARD
SWITCHROOM 2
E415WC2

10.3.5.3 110V DC Battery Paralleling Board

- Name of distribution board
- Unique location of distribution board
- IEC61850 designation

e.g. 110V DC BATTERY PARALLELING BOARD
RELAY ROOM
E110WC1

10.4 Building Labelling

The specific labelling requirements for switchrooms and relay rooms are detailed in this section.

Labelling requirements for building fire systems shall comply with the Oil Containment and Fire Protection EDI and AS1319.

10.4.1 Relay Room[21]

Each door of the relay room shall be labelled with the words 'Relay Room'. The combined mandatory requirements/hazard warning sign shall also be placed on the outside of all relay room doors.

Battery room doors must be labelled 'Battery Room' and display the following signs 'Danger – Risk of Explosion' and 'Notice – Eye Protection Must Be Worn'. Signage shall be in accordance with AS1319 - Safety Signs for the Occupational Environment.

Standard white on green EXIT signs shall be installed on the inside of all external doors or doors forming part of the escape route. In addition, illuminated exit signs shall be installed above each door with a battery backup for safe evacuation of personnel in the event of an AC mains failure.

[21] See Western Power Internal Document

10.4.2 Switchroom[22]

Each door of the relay room shall be labelled with the relevant switchroom number ie 'Switchroom #'. The combined mandatory requirements/hazard warning sign shall also be placed on the outside of all switchroom doors and the SF6 warning sign shall be used for all switchboards containing SF6.

Inside the switchroom, the SF6 warning signs shall be placed at each end of each section where access may be gained to cable trenches, cable spaces etc. Signage shall be in accordance with AS1319 - Safety Signs for the Occupational Environment.

Standard white on green EXIT signs shall be installed on the inside of all external doors or doors forming part of the escape route. In addition, illuminated exit signs shall be installed above each door with a battery backup for safe evacuation of personnel in the event of an AC mains failure.

On the switchboard, each panel shall be labelled with the feeder circuit, equipment number and main function. E.g Y343 FEEDER, Y340 BUS SECTION TO CABLE D1 – B3.

10.5 Perimeter Fence and Gate Labelling

Danger High Voltage and Warning Electric Fence (where an electric fence is installed) labels shall be placed on the outside of the perimeter fence. Location and spacing of these labels are shown in Appendix A.

Each entry gate shall display only the Danger High Voltage sign. No other signs should be placed on entry gates as it may introduce a safety hazard if the wind causes gates to swing into people or vehicles.

Warning Electric Fence labels and the Substation Location Entry Sign shall be placed on the fence adjacent to the substation gates.

Labels which are installed on the outer side of the substation perimeter fence shall be resin coated to improve longevity and reduce damage from graffiti. Labels should be UV-resistant, fade free, anti-graffiti, anti-glare and marine grade. The recommended manufacturer and product for labels on the outer side of the substation perimeter fence is Identimark U3, or an otherwise approved equivalent. These signs include the Danger High Voltage, Warning Electric Fence and Substation Location Entry Sign.

11 Drawings

Template and example drawings of substation labelling or numbering can be found in the Register -Substation Design Drawings - EXTERNAL Version.

This register is provided to external consultants as a reference for Substation Standard and Template drawings.

[22] See Western Power Internal Document

Appendix A: Equipment Requiring Identification[23]

Table A.1 Labels required for Zone and Terminal Yards

EQUIPMENT TYPE	METHOD OF NUMBERING / LABELLING	LOCATION GUIDANCE
Switchyard Perimeter Fence	DANGER — HIGH VOLTAGE	Labels to be fixed to outside of fence, 6 meter from each corner and along each face of fence at centres not exceeding 20 meters. No less than one "Danger" label to be positioned on each face of fence.
	WARNING ELECTRIC FENCE	Labels shall be fixed on both sides of fence (i)At each gate (ii)At each access point (ti) At intervals not exceeding 10 m (iv) Adjacent to each sign relating to chemical hazards for the information of the emergency services.
Switchyard Entry Gate	DANGER — HIGH VOLTAGE	Mounted on gate — no other signs to be mounted on any gate.
	SUBSTATION LOCATION ENTRY SIGN	Mounted on Fence next to gate
	WARNING ELECTRIC FENCE	Labels shall be fixed: (i) Adjacent to each sign relating to chemical hazards for the information of the emergency services.

EQUIPMENT TYPE	METHOD OF NUMBERING / LABELLING	LOCATION GUIDANCE
Relay Room Entry Doors	RELAY ROOM	
	COMBINED MANDATORY REQUIREMENTS / HAZARD WARNING SIGN	
Inside Relay Room		SSTZ1/4/9000/1
		All external doors shall have a standard 'white on green' EXIT' sign on the inside of the door.
Inside any Switchyard Entry Gate	COMBINED MANDATORY REQUIREMENTS / HAZARD WARNING SIGN	To be mounted on 'Mandatory / Hazard Entry' sign post — SS1/19/0/607/1
	HAZCHEM EMERGENCY CONTACT SIGN	To be mounted on 'Mandatory / Hazard Entry' sign post — SS1/19/0/607/1
Battery Room	BATTERY ROOM	Towards top of all entry doors
	DANGER - RISK OF EXPLOSION	All entry doors — beneath 'BATTERY ROOM' label
	NOTICE — EYE PROTECTION MUST BE WORN	All entry doors — beneath 'DANGER — RISK OF EXPLOSION' label
	ELECTROLYTE BURNS	On wall above eye wash basin, approximately 1.5 m from floor
Earth Lead Storage Container	CAUTION ...	On door of container at approximately eye level. Correct label for site application to be listed by designer.
Switch Room Entry Door	SWITCH ROOM #	

[23] See Western Power Internal Document

EQUIPMENT TYPE	METHOD OF NUMBERING / LABELLING	LOCATION GUIDANCE
	COMBINED MANDATORY REQUIREMENTS / HAZARD WARNING SIGN	
	SF6 - WARNING	When applicable — GIS switchgear in use. On door just below other signs
Inside Switch Room	SF6— CAUTION	When applicable — GIS switchgear in use. Sign shall be installed at each end of each section of switch board where access may be gained to cables trench, cable space, soak well, etc.
		All external doors shall have a standard 'white on green' EXIT' sign on the inside of the door.
All Disconnectors	Switch ID	Mechanism box door. An additional label is required on side of mechanism box if label on door is not facing: (i)Substation Road (Zone Substation) (ii)Relay Room (Terminal Yard)
	Phase Markers	Label to be located on primary plant support structure beneath relevant phase on both sides of plant.
Circuit Breakers	Switch ID	Mechanism box door. An additional label is required on side of mechanism box if label on door is not facing: (i)Substation Road (Zone Substation) (ii)Relay Room (Terminal Yard)

EQUIPMENT TYPE	METHOD OF NUMBERING / LABELLING	LOCATION GUIDANCE
	Phase Markers	Label to be located on primary plant support structure beneath relevant phase on both sides of plant
	NON-FLAMMABLE NON-TOXIC GAS	At all SF6 filled circuit breakers with a gas capacity of > 40 kg.
Earth Switches		Earth Switch label shall be at eye level and in full view of operator when standing in the operating position.
Earthing Compensator		Label to be visible from substation road.
Station Transformer		Label to be in full view of operator when standing in the operating position.
Capacitor Bank (Rack type — chain wire fence)	CAP #	Chain wire gate — an additional label is required if gate is not facing substation road
	DANGER — HIGH VOLTAGE	Chain wire fence
	DANGER ...	Chain wire gate
	DANGER — DO NOT ENTER...	Chain wire fence next to gate
Capacitor Bank (Cubicle Type)	CAP #	Cubicle Door
	DANGER ...	Cubicle Door
Reactor Bank (Fenced)	RE #	Chain wire gate — an additional label is required if gate is not facing substation road
	DANGER — HIGH VOLTAGE	Chain wire fence
	DANGER ...	Chain wire fence next to gate

EQUIPMENT TYPE	METHOD OF NUMBERING / LABELLING	LOCATION GUIDANCE
CT or VT marshalling Box	Switch ID	Label mounted on marshalling box door if sufficient space or above box on support structure.
Power Transformer	No #	Label to be located on tap changer control panel door. An additional label is to be fixed to the cooler bank if tap changer control panel door does not face substation road. When enclosed in a noise enclosure, a replicated label shall be located on the enclosure door.
	GPO	Label to be located on tap changer control panel door.
	COMBUSTIBLE LIQUIDS SIGN	Label to be located on transformers
Busbar	BUSBAR #	Label to be fixed to the centre phase of each busbar structure
Restricted access to vehicular traffic on switch yard roadway when electrical clearance is not in accordance with AS2067	DANGER — RESTRICTED VEHICLE ACCESS	Location of signs is dependant on specific substation requirements, but could be mounted on height restriction barrier or on chain wire barrier across substation road entrance to restricted area.

EQUIPMENT TYPE	METHOD OF NUMBERING / LABELLING	LOCATION GUIDANCE
Required only in substations where specific chemical or other local hazard necessitates evacuation procedure	e.g. EVACUATION PROCEDURE	Sign to be installed inside each relay / switch room in a prominent location. Location of sign to be indicated on substation specific 'Label Location' drawing.
Lighting Masts		Label to be visible from substation road.
Where 415 / 240 V AC is present in cubicles, etc.	DANGER 415/250 VAC	Where 415/240 V is available in panels, cubicles, etc. sign to be visible on the door / panel and on opening of door / panel. A similar self-adhesive alternative is acceptable for indoor cubicles.
Cable Entries	Phase Markers	Label to be located near connection point on structure.
Secondary Labelling	SSTTV/4/9xxxx SSTTV/14/9xxxx SSYYV/4/4/xxxx SSTTV/4/9xxxx SSTTV/14/9xxxx	Shall be easily viewable. iii.Equipment below eye level — labels mounted above them, iv.Equipment *above* eye level — labels mounted below them. v.Rear mounted labels shall indicate the reference number only, unless otherwise indicated.
Local Supply Fuse Switch	Switch ID	Label to be mounted at eye level in a prominent position.

Table A.2: Labels required for Terminal Yards only

EQUIPMENT TYPE	METHOD OF NUMBERING / LABELLING	LOCATION GUIDANCE
Bay Area	BAY #	Label to be located on each side of all A-Frame structures to indicate bay area
AC/DC Power Distribution Board	BAY # & # POWER DISTR. PANEL	Label to be located on door of panel
Cable Marshalling Box	Switch ID	Label to be located on door of panel
A-Frame Ladder (Not used for new sites - if required to retrofit to brownfield site with climbable A-frame ladder)		Label to be located on A-Frame in a prominent position to personnel about to climb the ladder
Power Transformer associated with generator	No #	Label to be located on tap changer control panel door. An additional label is to be fixed to the cooler bank if tap changer control panel door does not face substation road.

Appendix B: Approval Record and Document Control[24]

[24] See Western Power Internal Document