Part of Energy Queensland

Substation Standard

Standard for Substation Equipment Identification

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

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This document sets out the general requirements for substation electrical design drawings with respect to equipment identification codes, voltage colours for single line operating diagrams, indicator light colours, small wire numbering and small wire colouring.

Keywords: Function Code, Location Code, Equipment Identification.

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1 Overview

1.1 Purpose

This document provides guidance on the identification of substation equipment both inside the control room and in the yard of a substation.

1.2 Scope

This standard shall be applied to all greenfield substation projects and where total substation replacement is occurring. Brownfield substation projects should consider using this standard when significate plant is being upgraded. Should the decision be made to use this standard for a Brownfield project this standard shall be applied to the entire site.

This standard was updated after the formation of Energy Queensland. Prior to this, each legacy organisation had their own identification methods developed based on different standards, philosophies and practices. The intention of this standard was to provide where possible one complete system for both Ergon Energy & Energex Substation Equipment based on current Australian and International Standards.

These standards have been revised, redesignated and withdrawn over the years to align with international standards. Annex F: Historical Overview of Standards has been added to detail how these changes have occurred.

2 References

2.1 Legislation, Regulations, Rules, and Codes

Document	Type
Electricity Act 1994 (Qld)	Legislation
Electricity Regulation 2006 (Qld)	Regulation
Electrical Safety Act 2002 (Qld)	Legislation
Electrical Safety Code of Practice – Works, 2020 (Queensland Government)	Code
Electrical Safety Regulation 2013 (Qld)	Regulation
Queensland WH&S Regulation 2011	Regulation
Queensland Work Health and Safety Act 2011	Legislation

2.2 Controlled Documents

Document	Alternative Doc ID
Standard for Panel Wiring - 2938164	STNW3021

2.3 Other Sources

(AS 2067, 2016), Substations and high voltage installations exceeding 1 kV a.c.

(AS 3000, 2018), Electrical installation – Buildings, structures and premises

(AS/NZS 60076.1, 2014), Power Transformers

(IEC 81346-1, 2009) Superseded – IEC 61346-1, 1996, Industrial systems, installations and equipment and industrial products – Structuring principles and references designations – part 1 Basic rules

(IEC 81346-2, 2019) Superseded – IEC 61346-2, 2009, Industrial systems, installations and equipment and industrial products – Structuring principles and references designations – part 2 Classification of objects and codes for classes

(IEC 60073, 2002), Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators

(IEC 60757, 1983), Code for designation of colours

(IEEE Std C37.2, 2008), Electrical Power System Device Function Number, Acronyms, and Contact Designations

CIGRE Technical Brochure 585, June 14th, Circuit Configuration Optimization – Developed by Joint Working Group B3/C1/C2.14

ID&TS-DRM-MAN-A461888, Powerlink – SDM3 Drawing Management - ID&TS-DRM-MAN-A461888

Substation Operational Designation Scheme - South East

3 Definitions and Abbreviations

3.1 Definitions

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

Shall	The word shall is to be understood as mandatory
Should	The word should is to be understood as non-mandatory, i.e. advisory or recommended
'A', 'N'	Within the code positions an "A" represents an identification letter and "N" represents a numeral. The number of A's or N's shown are the maximum allocated for the given position and aren't required to be completely filled unless otherwise stated.
Bay (of a substation)	feeder bays, transformer bays, bus coupler bays, etc. (IEV 605-02-09)
Busbar	A low impedance conductor to which several electric circuits can be separately connected (IEV 605-02-01)
Busbars	The busbar represents the central point in the substation. It collects and distributes the power through the incoming and outgoing feeders. The circuit configuration and the number of busbars will be selected according to the importance of a substation, that is, its required reliability and availability in the network. It is therefore essential to clear any fault on a busbar as quickly as possible. The number of busbars with or without transfer bus is a factor for the flexibility and security of the substation. (Cigre TB 585)
Busbar sections	The part of a busbar located between two switching devices (or disconnectors) put in series or between a switching device and the end of the busbar (IEV 605-02-08) Typically, they constitute an operation zone of a substation with associated controls and protection.

Busbar sections are defined to be either side of a busbar section circuit breaker or (in special operational circumstances) nominated disconnectors.

3.2 Abbreviations

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

AC	Alternating Current
AR	Auto Reclose
AVR	Automatic Voltage Regulation
VRR	Voltage Regulating Relay
CAD	Computer Aided Design
CB	Circuit Breaker
CT	Current Transformer
DC	Direct Current
HMI	Human Machine Interface
HV	High Voltage
LED	Light Emitting Diode
LLW	Live Line Working
LV	Low Voltage
MCB	Miniature Circuit Breaker
OLTC	On Load Tap Changer
SEF	Sensitive Earth Fault
SCADA	Supervisory Control and Data Acquisition
SWER	Single Wire Earth Return
UFLS	Under Frequency Load Shedding
VT	Voltage Transformer

4 Deviations from Standard

The following procedure shall be adhered to when deviating from this standard:

- Where it is considered that a different identification arrangement is required for an electrical design drawing then approval shall be sought for the deviation from the Manager Substation Standards.
- Where a brownfield site deviates from this standard, the Project Owner shall have the final decision.

Refer Annex G for Brownfield Equipment Identification Considerations.

5 Equipment Identification

5.1 Component Identification

Each component within the substation shall be uniquely identified using DESIGNATION BLOCKS according to the IEC 81346-1 and this document.

Designation block 1: (=), is used as a FUNCTION CODE.

The FUNCTION CODES shall normally be used to identify all the components that together perform a major function e.g. switching, transforming, controlling or schemes not covered by switching such as bus zone. The function code groupings shall be shown on the plant data sheet for the project.

Designation block 2: (+), is the LOCATION CODE.

The LOCATION CODE identifies the physical location of a component within the substation. It is not necessarily related to functional aspects.

Designation block 3: (–), is the ITEM DESIGNATION.

The ITEM DESIGNATIONS shall be used to describe the functional type and detailed application of the component. For consistency and to take advantage of the replication ability of CAD systems, a component performing a particular function shall take the same ITEM DESIGNATION within each panel, even if they form part of another functional system, e.g. bus zone CTs. In this example, a drawing for the bus zone protection shall require the full FUNCTION CODE and ITEM DESIGNATION to be shown in order to uniquely identify each CT.

Designation block 4: (:), is the TERMINAL CODE.

The TERMINAL CODE qualifier shall be used where appropriate. The code can be used alone or appended to an item code (–) or a location code (+) as necessary.

The full code for equipment identification would rarely be used as it would usually be unnecessary to show the function or location codes more than once on the same drawing.

Table 1: Code Abbreviation Example

FULL CODE	ABBREVIATED CODE
+1A1 =FA01 -Q00	-Q00

For a single designation block, if no confusion can arise, the initial prefix sign or qualifier may be omitted. Similarly, when the item designators appear in tables, for example wiring tables, the columns may be arranged so that the qualifiers can be omitted.

It is permissible and, on occasions, desirable to identify an item within an item e.g. sub-rack A08 containing a relay J51 could be identified as –A08–J51. If no confusion can arise the intermediate qualifier(s) may be omitted giving a short notation of the code e.g. –A08J51.

The coding shall only be as long as it needs to be to uniquely identify equipment and its function and location. Any sub codes are therefore not required in every situation and are only used where further classification is required. This is shown in the definitions of the blocks with the statement ‘when used’ given in brackets.

The letters “I” and “O” should not be used within identification codes as they cause confusion and misunderstandings with the numbers 0 and 1.

5.2 Function Code: (=)

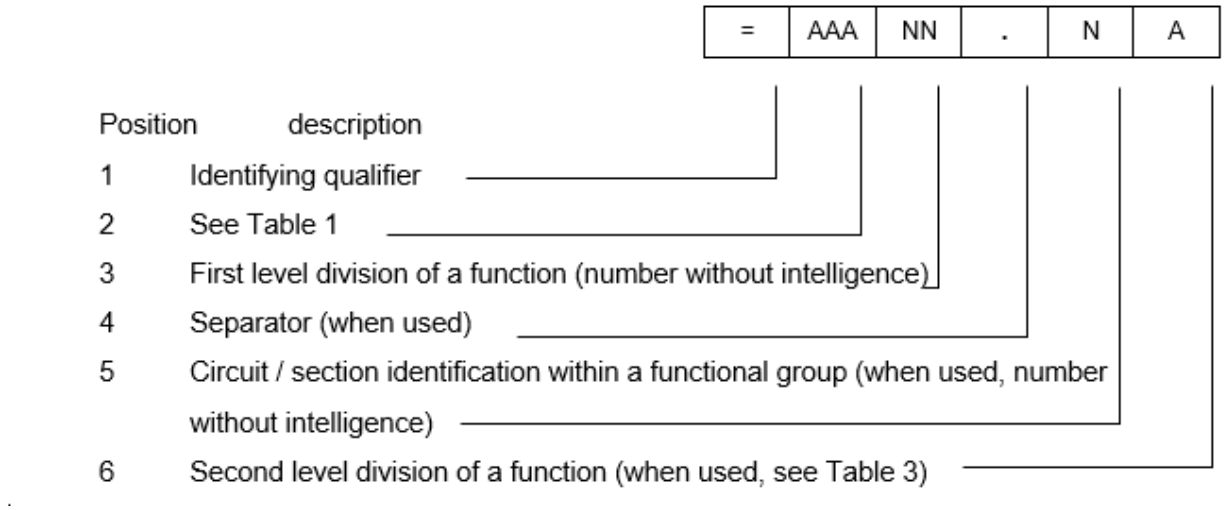


Table 2: Position 2 of the Function Code

LETTER	FUNCTION
A	SPARE
BA	SWITCHING FUNCTION at > 330 kV
CA	SWITCHING FUNCTION at 330 kV or 275 kV or 220kV
DA	SWITCHING FUNCTION at 132 kV
DB	SWITCHING FUNCTION at 110 kV
EA	SWITCHING FUNCTION at 66 kV
EB	SWITCHING FUNCTION at 33 kV
FA	SWITCHING FUNCTION at 22 kV
FB	SWITCHING FUNCTION at 11 kV
GA	SWITCHING FUNCTION at 6.6 kV
GB	SWITCHING FUNCTION at 3.3 kV
GC	SWITCHING FUNCTION at 1.0 kV ≤ to nominal voltage < 3.3 kV
GD	SWITCHING FUNCTION < 1.0kV (excluding Aux equipment)
HX	A.C. AUXILIARY SUPPLIES
JX	D.C. SUPPLIES
KX	VT SUPPLIES
LX	SYSTEM / SUBSTATION WIDE CONTROL AND PROTECTION including: • Load Management / Load Control / Audio Frequency Load Control (AFLC) • Sensitive Earth Fault (SEF) Protection Check Schemes • Frame Leakage Protection Check Schemes • Summated Back-Up Neutral Earth Fault Protection

LETTER	FUNCTION
	• Under Frequency Load Shedding (UFLS) Control Schemes
MX	REACTIVE POWER COMPENSATION, CAPACITOR BANKS
NC	NETWORK CONNECTION SKID
NX	NEUTRAL EARTHING IMPEDANCES
PA	POWER GENERATION PLANT – COMPRESSED AIR SYSTEM
PE	POWER GENERATION PLANT – ELECTRICAL
PF	POWER GENERATION PLANT – FUEL
PG	POWER GENERATION PLANT and BESS Units – GENERATION
PH	POWER GENERATION PLANT – WATER SYSTEM
PL	POWER GENERATION PLANT – LUBE SYSTEM
PS	POWER GENERATION PLANT – STEAM SYSTEM
PW	POWER GENERATION PLANT – WASTE SYSTEM
QX	REVENUE AND STATISTICAL METERING
R	BUS ZONE PROTECTION (suffixed with voltage code)
S	CIRCUIT BREAKER FAIL SCHEME (suffixed with voltage code)
TX	POWER TRANSFORMER
UX	AUXILIARY EQUIPMENT
V	SPARE
W	SPARE
XX	CONTROL AND INDICATION (e.g. SCADA)
YA	COMMUNICATIONS - STRUCTURE
YB	COMMUNICATIONS - BUILDING
YC	CUSTOMER ACCESS NETWORK
YE	AGGREGATE E
YF	COMMUNICATIONS - FIBRE
YH	LAND MOBILE RADIO HANDSETS
YI	COMMUNICATIONS - DATA MODEM
YL	LAND MOBILE RADIO NETWORK
YM	AGGREGATE M
YP	POINT OF PRESENCE
YR	COMMUNICATIONS - RADIO
YS	AGGREGATE S
YT	TRANSIT

LETTER	FUNCTION
YW	COMMUNICATIONS - CELLULAR
YX	COMMUNICATIONS - COMMON
Z	SPARE

Table 3: Position 6 of the Function Code

LETTER	DESCRIPTION
A	Measurement and Metering Equipment
C	Control Indication and Associated Auxiliary Equipment
S	Protection Signalling and Inter-trip Equipment
X	"X" Protection or Associated Equipment
Y	"Y" Protection or Associated Equipment

The letter used for SWER voltages shall be the three-phase voltage letter as given in Table 2, i.e. for a SWER voltage of 19.1 kV the letter 'EB' (as in 33 kV) shall be used.

When differentiating between switching voltage levels covered by the same first letter, it shall be as per Table 2. For voltages above 66kV the voltage codes are not differentiated in this manner, as they are not used in Ergon Operational Numbering system. The Powerlink Queensland Operational numbering system is used for voltages above 66 kV.

This method is used to identify equipment voltage levels for Bus Zone Protection and Circuit Breaker Fail Schemes, e.g. =REA for Bus Zone Protection at 66 kV, =SFB for Circuit Breaker Fail Scheme at 11 kV.

The =LX function code is for SYSTEM / SUBSTATION WIDE CONTROL AND PROTECTION BAYs including:

- Load Management / Load Control / Audio Frequency Load Control (AFLC)
- Sensitive Earth Fault (SEF) Protection Check Schemes
- Frame Leakage Protection Check Schemes
- Summated Back-Up Neutral Earth Fault Protection
- Under Frequency Load Shedding (UFLS) Control Schemes

If a substation has a Load Control Bay this will be designated =LX01. If the same substation has a Substation Wide Control and Protection bay, this will be designated =LX02. If a substation has no Load Control Bay but does have a Substation Wide Control and Protection Bay, this will be designated =LX01.

The =LX function code is used for Summated Backup Neutral Earth Fault Protection Schemes. These older summated schemes joined Current Transformers from two or more power transformer neutrals, usually in the same circuits as Frame Leakage Check schemes and Sensitive Earth Fault Check schemes. They typically provide backup protection for LV feeders, busbars and transformers, tripping all transformer CBs and clearing all supply to the LV feeders. This function aligns with a Substation Wide Control and Protection Scheme.

However, the =TX function code shall be used for Back-up Neutral Earth Fault relays that align with the latest protection schemes from the Protection Standard STNW1002, having one (1) BU NEF relay for each one (1) Transformer.

For a breaker and a half arrangement, each breaker and a half scheme shall be initially numbered with a single digit (e.g. 1, 2, 3, etc.). A second digit shall be added to uniquely identify each breaker section, numbered 1 for the bus 1 breaker, 2 for the bus 2 breaker and 3 for the middle breaker. Refer to Figure 1.

For all function codes the position 3 number shall be two digits with a leading zero if necessary.

Function code boundaries should be indicated on the single line diagrams by a faint dashed line clearly indicating the boundary of the function code in situations where further clarification is desired.

Below are examples of Function Coding with Figure 1 and Figure 2 also showing graphic examples of function code allocation.

Examples:

=DA01	132 kV Bay 1
=EA01	66 kV Bay 1
=EB01	33 kV Bay 1
=FA01	22 kV Bay 1
=FB01	11 kV Bay 1
=TX01	Transformer 1
=TX02	Transformer 2
=QX01	Metering Panel 1
=EA04.1	66 kV Bay 4, Section 1
=EB02.1	33 kV Bay 2, Protection 1
=FA01.2.1	22 kV Bay 1, Section 2, Protection 1
=REA01	Bus Zone Protection 1 at 66 kV
=RFB02	Bus Zone Protection 2 at 11 kV
=LX01	Load Control Bay
=LX02	Frame Leakage Check Scheme

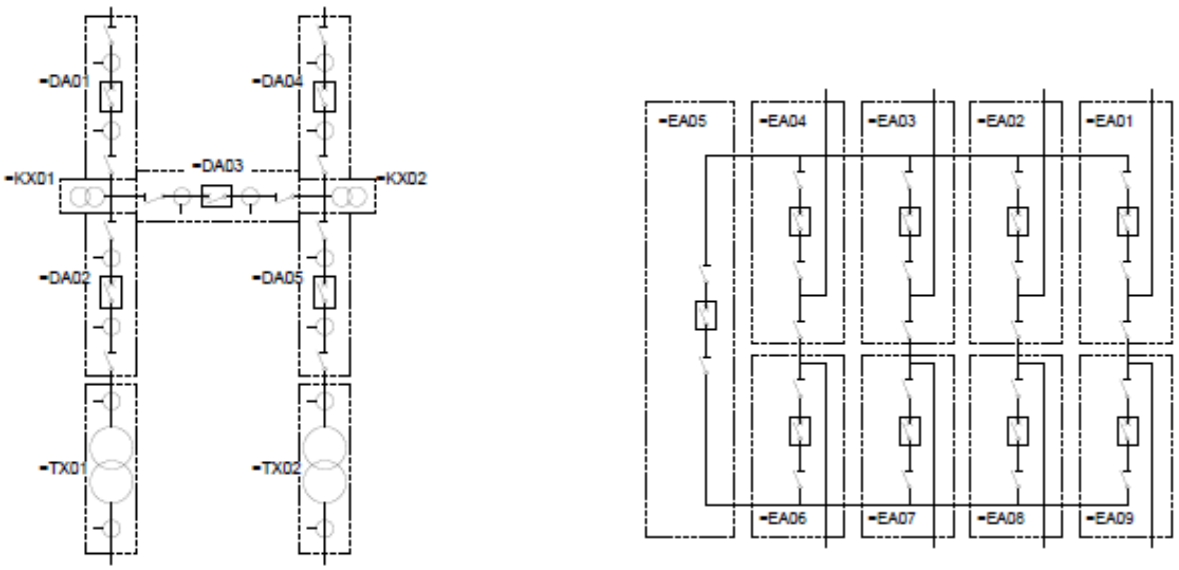


Figure 1: Function Coding for an 'H' Configuration Substation & Function Coding for a Folded Bus Substation

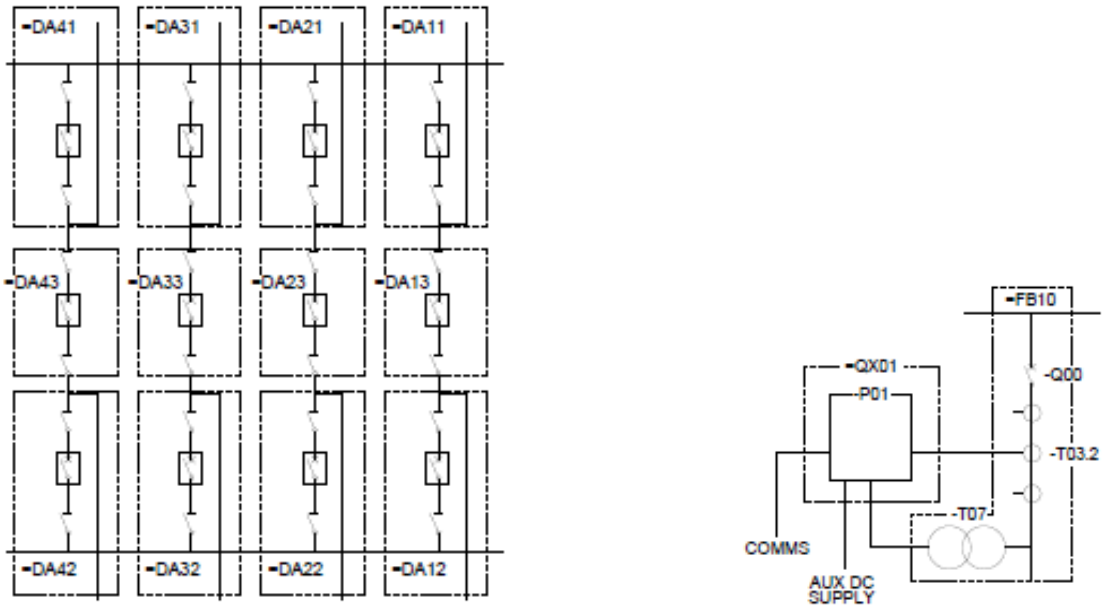


Figure 2 Function Coding for a Breaker and a Half Arrangement & Revenue Metering

5.3 Location Code: (+)

The LOCATION CODE shall be used as shown below.

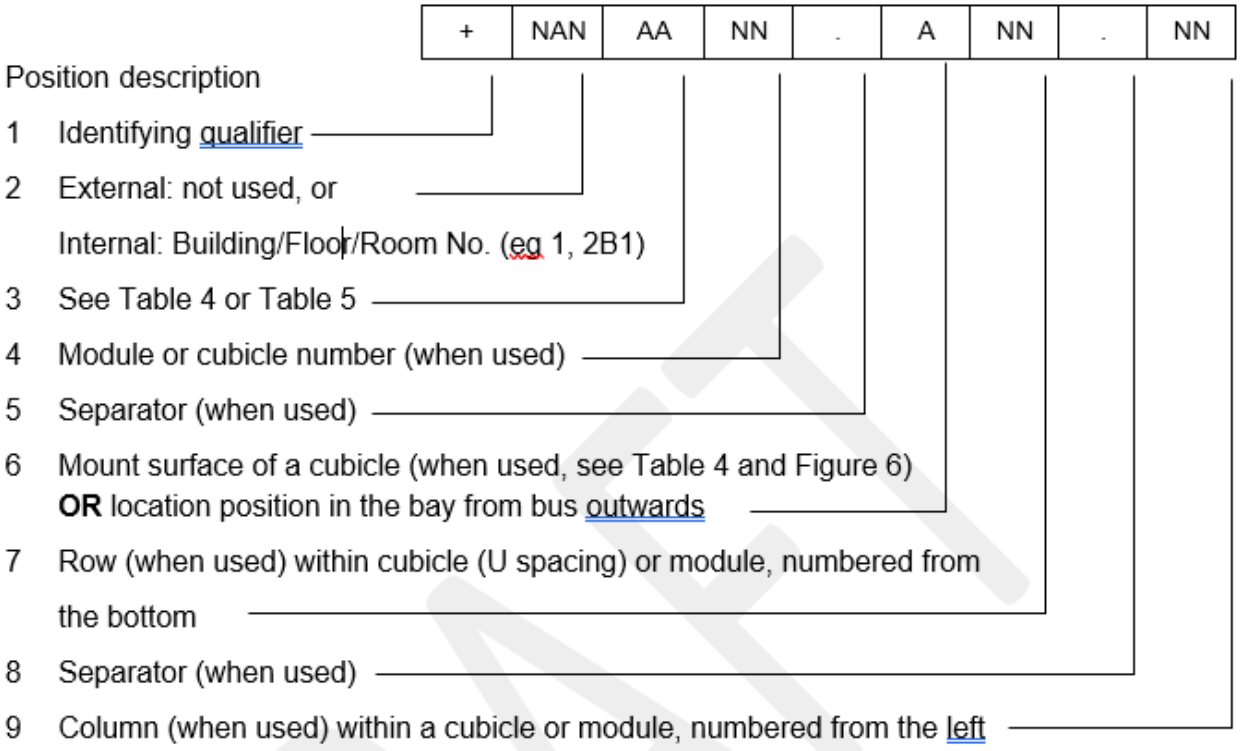


Table 4: Position 3 of the Location Code Internal Equipment

LETTER	INTERPRETATION
Internal	
A - Z	CUBICLE ROW IN THE ROOM

Table 5: Position 3 of the Location Code External Equipment

LETTER	INTERPRETATION
External	
A	SPARE
BA	> 330 kV SWITCHYARD AREA
CA	330 or 275 or 220 kV SWITCHYARD AREA
DA	132 kV SWITCHYARD AREA
DB	110 kV SWITCHYARD AREA
EA	66 kV SWITCHYARD AREA
EB	33 kV SWITCHYARD AREA
FA	22 kV SWITCHYARD AREA
FB	11 kV SWITCHYARD AREA

LETTER	INTERPRETATION
GA	6.6 kV SWITCHYARD AREA
GB	3.3 kV SWITCHYARD AREA
GC	1.0 kV ≤ to nominal voltage < 3.3 kV SWITCHYARD AREA
GD	<1 kV SWITCHYARD AREA
PA	POWER GENERATION PLANT – COMPRESSED AIR SYSTEM
MX	REACTIVE POWER COMPENSATION, CAPACITOR BANKS
NC	NETWORK CONNECTION SKID
NX	NEUTRAL EARTHING IMPEDANCES
PE	POWER GENERATION PLANT – ELECTRICAL
PF	POWER GENERATION PLANT – FUEL
PG	POWER GENERATION PLANT and BESS Units – GENERATION
PH	POWER GENERATION PLANT – WATER SYSTEM
PL	POWER GENERATION PLANT – LUBE SYSTEM
PS	POWER GENERATION PLANT – STEAM SYSTEM
PW	POWER GENERATION PLANT – WASTE SYSTEM
R	BUSBARS (suffixed with voltage codes BA-GC above)
TX	POWER TRANSFORMER AREA
UX	AUXILIARY EQUIPMENT LOCATIONS (other than in buildings or bays)

The location code number position 4 should be allocated to follow the function code numbering for external areas, padded with a leading zero if necessary.

If a substation has multiple modular control buildings, the first number in the location code is for building number, followed by alphabet character for level (where multi-storey), then followed by room number. If there is only one building this is not required. Rows of abutted cubicles shall be coded together from left to right as per the general arrangement plan view refer figure 4, preferably clockwise in the room. Surface Rows (U-Spacing) are coded from bottom to top of the cubicle.

Below are examples of Location Coding with Figure 3, Figure 4 and Figure 5 also showing graphic examples of location code allocation.

Examples:

+UX01	Equipment in area 1, which is located other than in buildings or bays
+TX02	Transformer 2 area
+EA02	66 kV Switchyard Bay 2 area
+1A4.D24.10	Control building room 1, row A, cubicle 4, surface D, row 24, column 10
+11C2	Modular Control building 1, room 1, row C, cubicle 2
+2B1A4.D24.10	Control building 2, Floor B, room 1, row A, cubicle 4, surface D, row 24, column 10

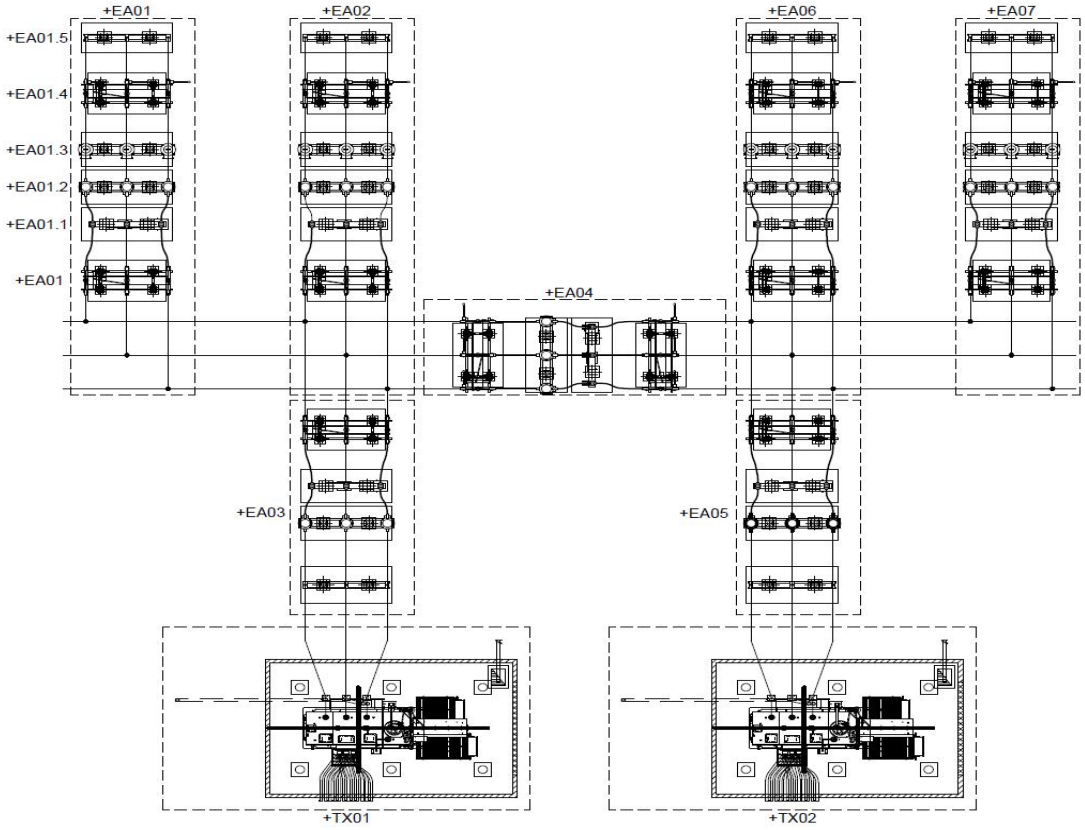


Figure 3: Location Coding for Outside a Control Building

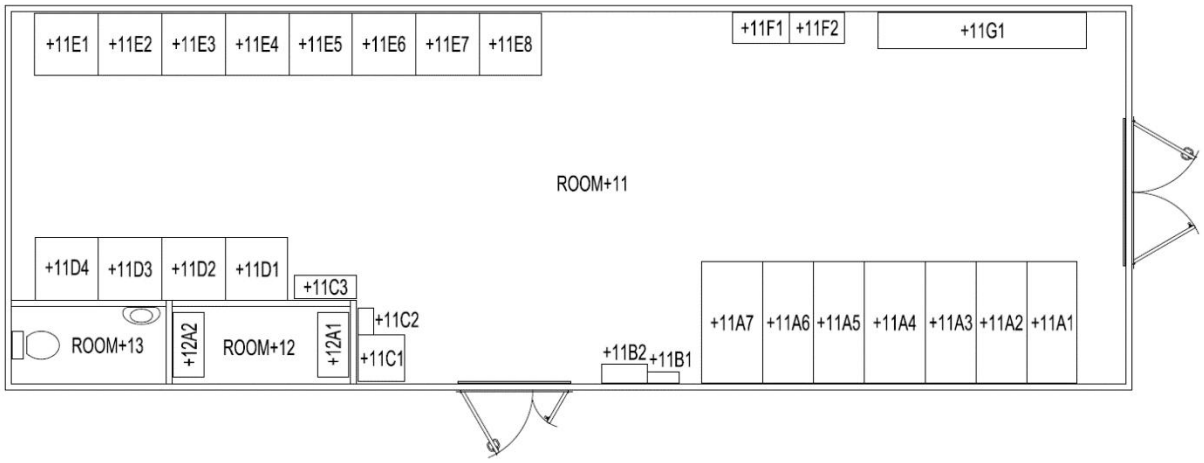


Figure 4 Location Coding for Inside a Control Building

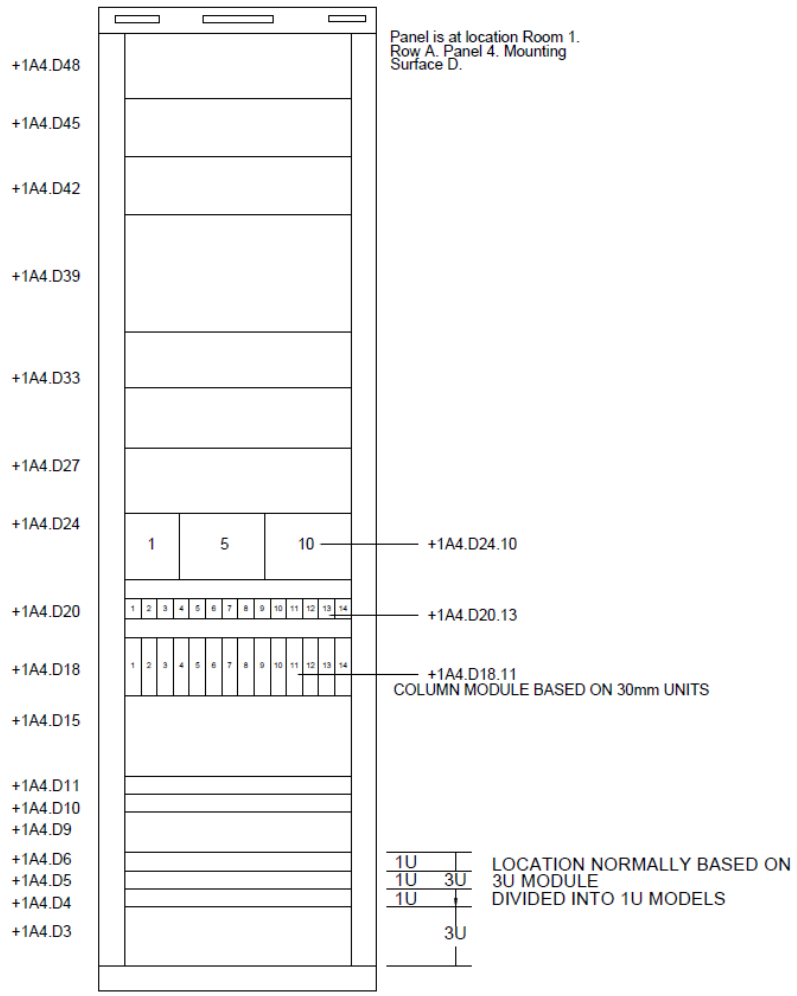


Figure 5: Location Coding within an Assembly in a Cubicle

Rack layout location letters for cubicle surfaces of a typical floor standing cubicle, looking at the front of the cubicle, shall be generally applied as given in Table 6.

Table 6: Location Letters for Cubicle Surfaces

CUBICLE SURFACE	LOCATION LETTER
Left hand side	A
Back	B
Right hand side	C
Front	D
Floor or ground	G
Roof or top	R
Internal surfaces	Alphabetically labelled in a general clockwise direction with the next available letter

The letter A shall always refer to the left-hand side as viewed from the front of the cubicle. All other surfaces shall be labelled in a general clockwise direction, as viewed in plan view, around the outside and circling inward, including any internal surfaces. Where required, equipment shall be given the location code letter of the surface on which it is mounted.

If a swing rack is used inside, but not on, the front door, it belongs to another plane and must be labelled with a letter other than D. The swing rack shall then be given the next available letter. If the rack is hung directly off the back of the door, it shall have the D code.

The allocation of letters to a cubicle shall be clearly shown on a key diagram similar to Figure 6 for all panel layout drawings referencing such numbers.

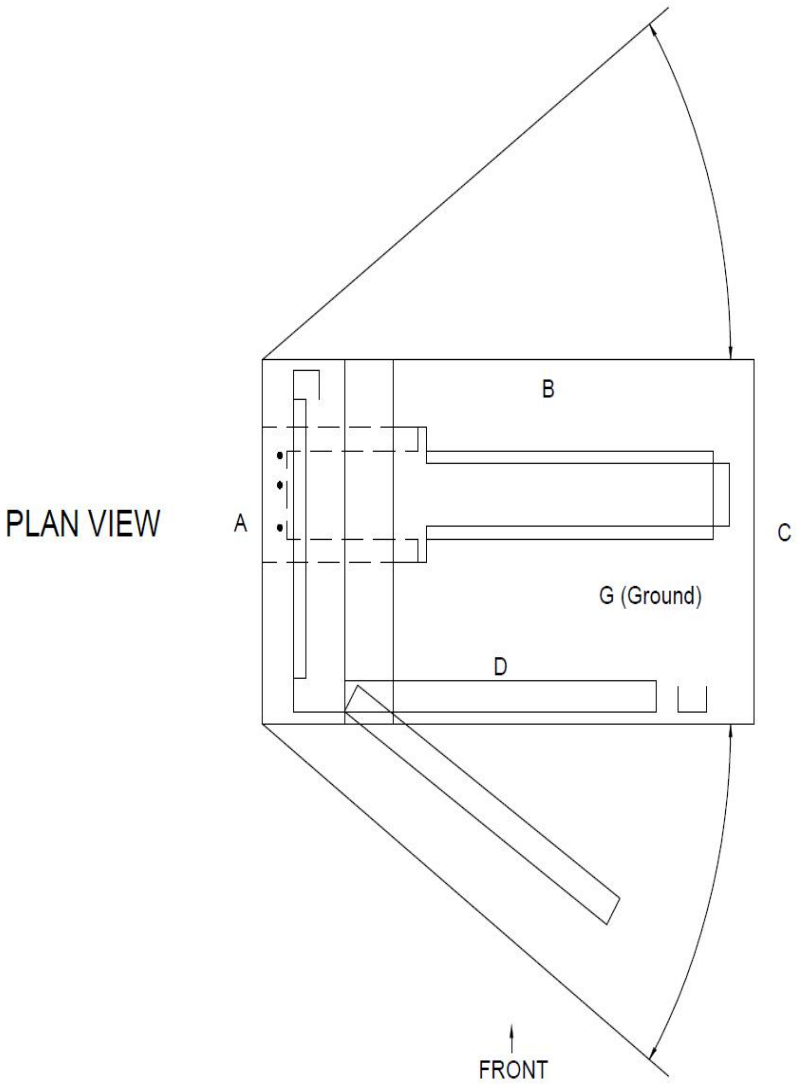


Figure 6: Location Coding for Cubicle Surfaces (Plan View)

5.4 Item Designation: (-)

The ITEM CODE shall be used as shown below.

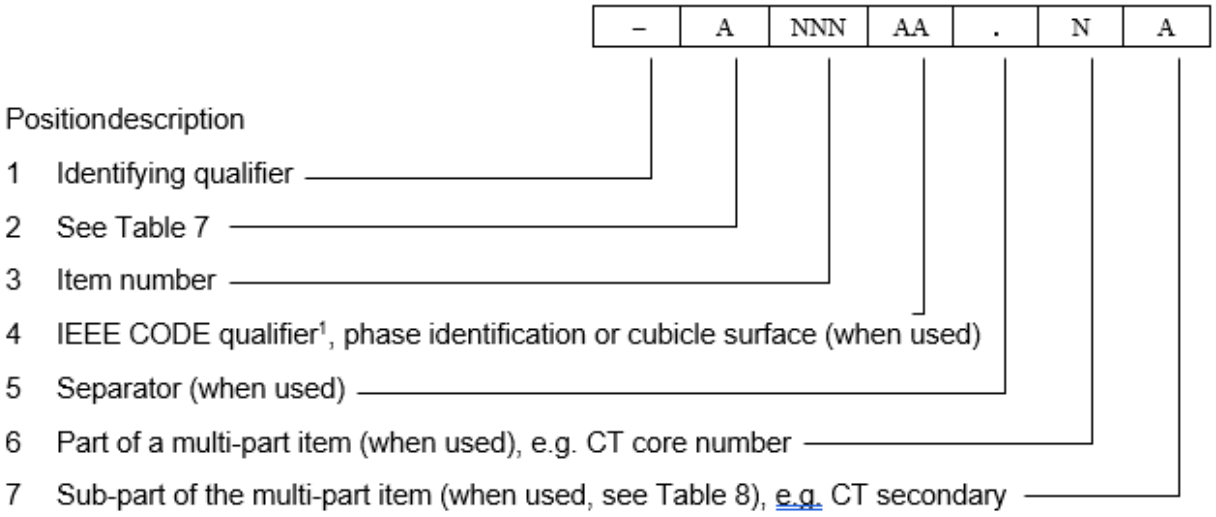


Table 7: Position 2 of the Item Code

LETTER	FUNCTION
A	ASSEMBLY, OUTDOOR CUBICLE, TERMINAL BLOCKS, RTUs
B	TRANSDUCER, NON-ELECTRICAL TO ELECT. OR VICE VERSA
C	CAPACITORS
D	DATA STORAGE/RECORDING, BINARY ELEMENTS
E	HEATERS, LIGHTS, FANS, MECHANICAL FILTERS
F	PROTECTIVE DEVICES, FUSES, MCBs
G	GENERATORS, BATTERIES AND CHARGERS, POWER SUPPLIES, INVERTERS, CONVERTERS
H	SIGNALLING DEVICES, E.G. LIGHTS, LEDs
J	PROTECTION RELAYS
K	AUXILIARY RELAYS, CONTACTORS, TIME RELAYS, LATCH RELAYS, AVR RELAYS
L	INDUCTORS, LINE TRAPS, REACTORS
M	MOTORS
N	AMPLIFIERS, ANALOGUE EQUIPMENT
P	MEASURING AND TEST EQUIPMENT, RECORDING METERING, INDICATING INSTRUMENTS
Q	CIRCUIT BREAKERS, DISCONNECTORS (ISOLATORS), EARTHING SWITCHES, HV LINKS

LETTER	FUNCTION
R	RESISTORS, SHUNTS
S	SWITCHES, PUSH BUTTONS, LIMIT SWITCHES, THERMOSTATS (CONTROL CIRCUITS)
T	POWER TRANSFORMERS & REGULATORS CURRENT TRANSFORMERS VOLTAGE TRANSFORMERS EARTHING TRANSFORMERS
U	ELECTRICAL TRANSDUCERS, MODULATORS, POWER LINE CARRIER & COMMUNICATIONS
V	TUBES, DIODES, TRANSISTORS AND SEMICONDUCTOR DEVICES
W	CABLES, BUSBARS, ANTENNAE, WAVEGUIDES
X	LINKS, TEST SOCKETS/PLUGS
Y	ELECTRICALLY OPERATED MECHANICAL DEVICES
Z	ELECTRICAL FILTERS, SPARK / SURGE SUPPRESSION

Table 8: Position 7 of the Item Code

LETTER	DESCRIPTION
P	Primary
S	Secondary

The meaning of each item code, including all suffixes, shall be designated on the drawings in which they are used.

For protection relays (item letter J), position 3 shall use the IEEE Standard for Device Designation (IEEE Std C37.2, 2022). For auxiliary relays (item letter K), position 3 shall also use the IEEE designation. For relays not defined in the IEEE standard, the numbers 95-102 shall be used. A reference list for the preferred allocation of codes in the range 95-102 is provided in **Error! Reference source not found.**. A quick reference guide to the IEEE device designation numbers is given in **Error! Reference source not found.**. The IEEE code shall not be used with any other item designation letters.

When numbering equipment (position 3, except for item letters J and K), items closest to an adjacent bus should be given the lowest number.

For all devices, position 3 numbering shall be at least two digits padded with a leading zero if necessary.

For item letters Q (isolators, etc.) and T (transformers) only, position 3 shall be numbered by its device type as given by Table 9. If the number of any particular item needs to extend outside the ranges given in Table 9, then multiples of ten shall be added to the range e.g. –Q10, –Q15, –T13, –T17, etc.

Table 9: Position 3 of the Item Code for Isolators, Transformers and Meters

LETTER	ITEM TYPE	NUMBERS	COMMENTS
Q	Circuit Breakers	00	Q00, Q10, Q20
	Disconnectors (Isolators)	01-04	Q01-04, Q11-14
	Earthing Switches	05-08	Q05-08, Q15-18
	Other Switches (e.g HV Links)	09	Q09, Q19
T	Power Transformers	01-02	Includes earthing transformers and auxiliary supplies T01-02, T11-12
T	Current Transformers	03-06	Includes sum and interposing T03-06, T13-16
T	Voltage Transformers	07-08	Includes sum and interposing T07-08, T17-18
T	Other Transformers	09	Such as lighting transformers T09, T19
P	SCADA Metering	03	Panel meters or used for AVR / VVR - P03
P	Plant Monitoring	90	CVT monitors – P90
P	Statistical / Check Metering	02	P02
P	Power Quality	60	P60
P	HV Revenue Metering (including REG)	01	P01
P	Multifunction	11	Multifunction uses one or more of the above functions – P11

Naming of earthing transformers shall be relative to the bay the earthing transformer is situated in e.g. =TX01-TE01. In the situation where an earthing transformer is situated remotely to the associated power transformer it shall be issued with its own bay number as well e.g. =TX03-TE01.

For a breaker and a half arrangement, the isolators and transformers shall be numbered as per Figure 8. The first digit shall match the Function Code (i.e. 1 for bus 1 breaker, 2 for bus 2 breaker and 3 for the middle breaker) with the second digit as per Table 9 for Q and T Item Codes.

For Frame Leakage Protection Schemes the approved method is:

- A Frame Leakage Relay or Current Transformer associated to Bus Bar Section 1 shall use codes =RFB01-J50N, =RFB01-TC03.
- A Frame Leakage Relay or Current Transformer associated to Bus Bar Section 2 shall use codes =RFB02-J50N, =RFB02-TC03.
- A Frame Leakage Relay or Current Transformer associated to Bus Bar Section 3 shall use codes =RFB03-J50N, =RFB03-TC03

- A Frame Leakage Relay or Current Transformer associated to both Bus Bar Section 1 and 2 shall use codes =RFB12-J50N, =RFB12-TC03
- A Frame Leakage Relay or Current Transformer associated to both Bus Bar Section 2 and 3 shall use codes =RFB23-J50N, =RFB23-TC03

When Substation Standards arrange new period contracts they shall request manufacturers to apply this standard STNW3001 for coding. However, when this is not possible or in brownfield sites, when manufactures apply their own codes to equipment mounted or housed in Transformers and Switchgear, these codes should be used instead of this standard, primarily to ensure that safety and asset data capture are not compromised.

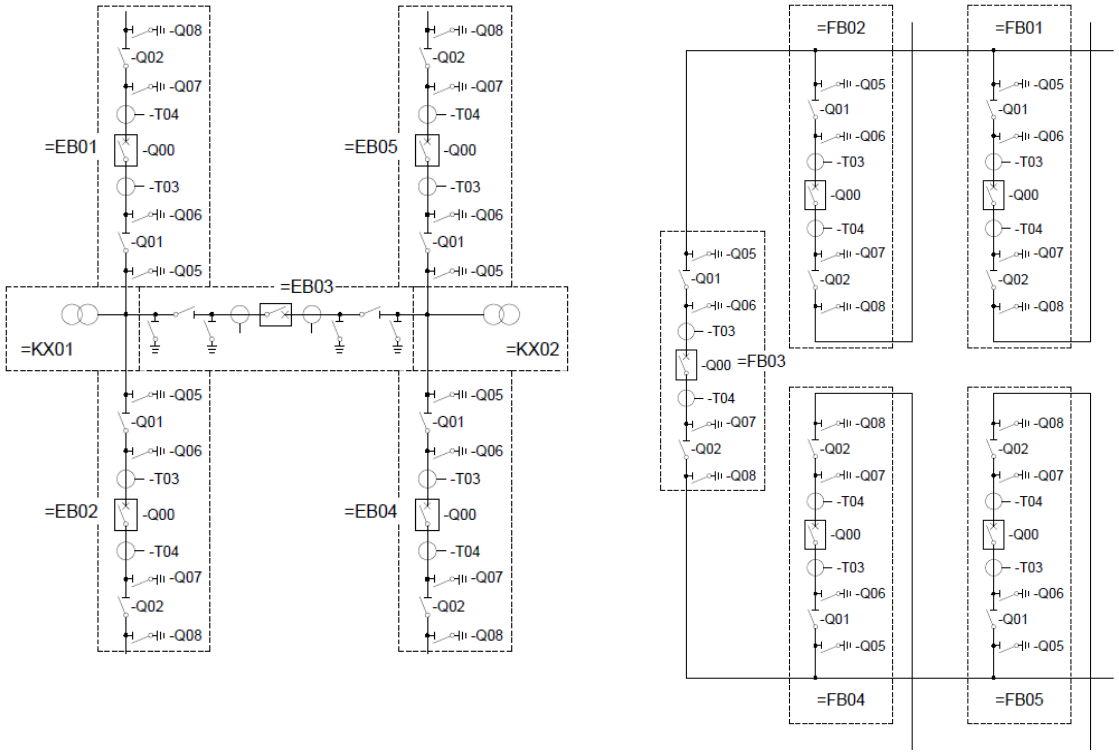


Figure 7: Item Coding for a 'H' Configuration Substation & for a Folded Bus Substation

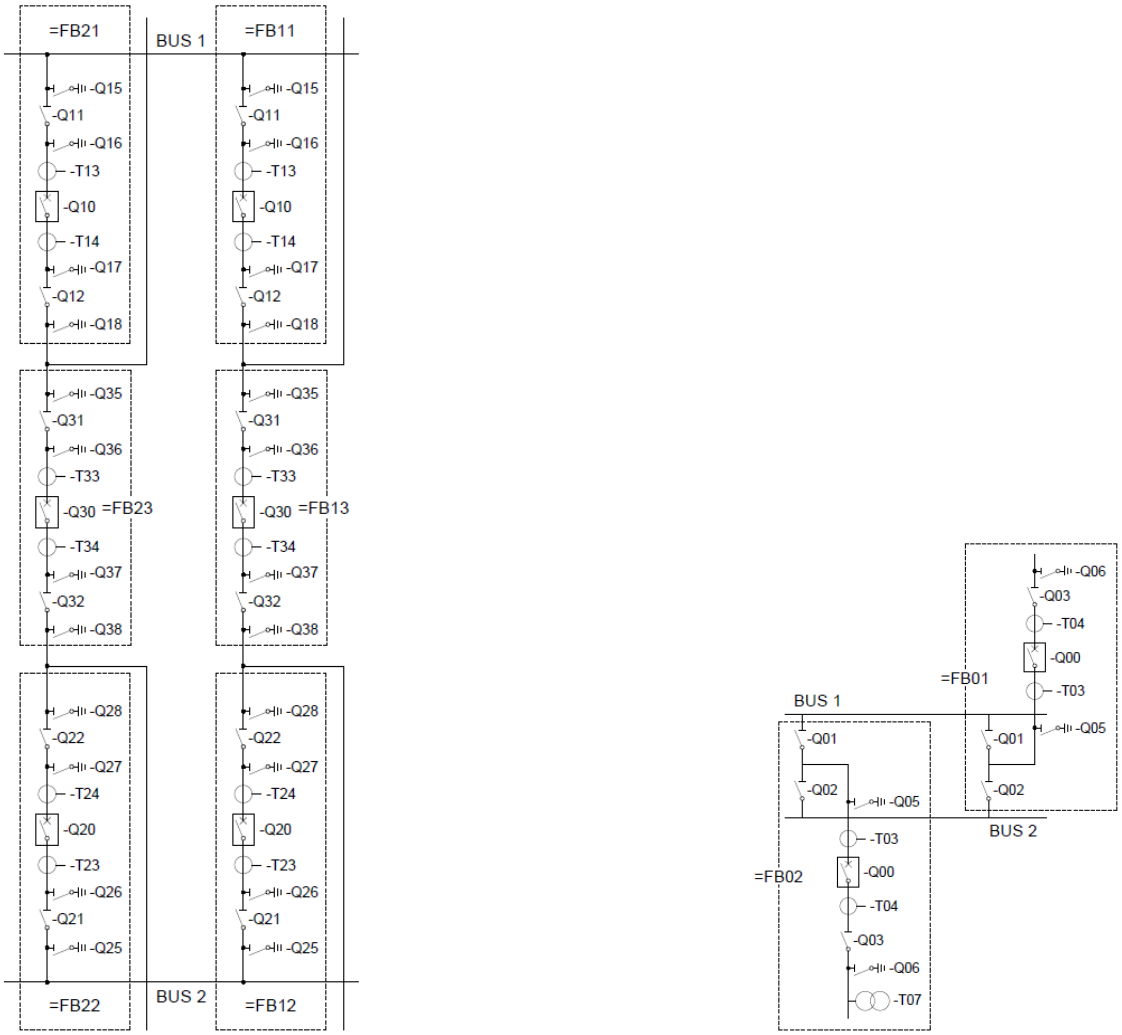


Figure 8: Item Coding for a Breaker and a Half Arrangement & for a Double Bus Substation

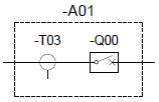


Figure 9: Item Coding for an Assembly

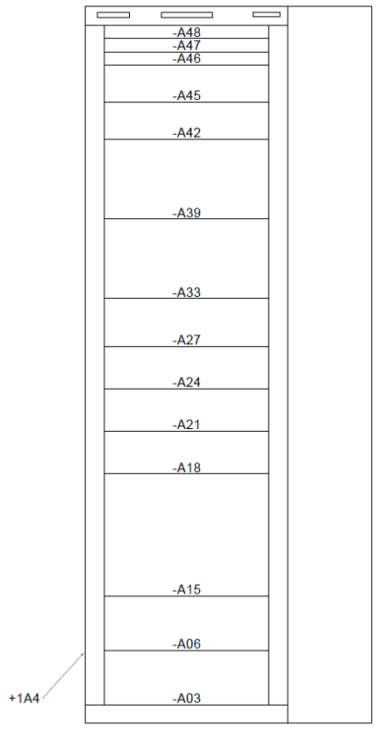


Figure 10: Item Coding for an Assembly within a Cubicle

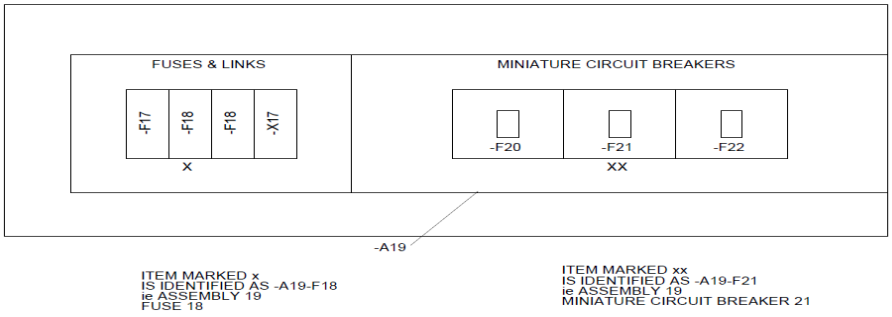
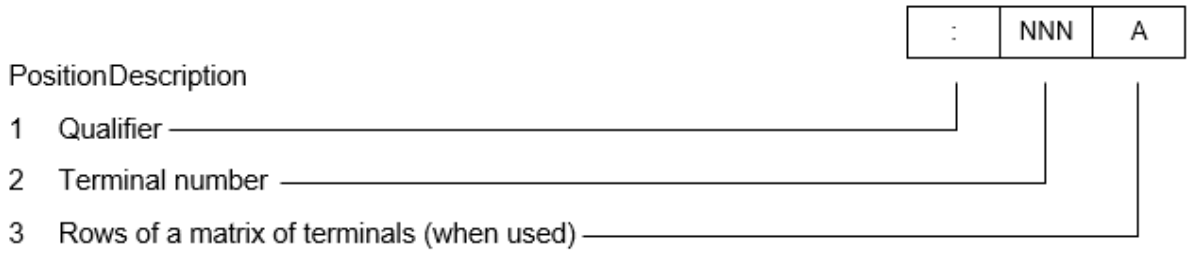


Figure 11: Item Coding within a Panel Assembly

5.5 Terminal Code: (:)

The TERMINAL CODE shall be used as shown below.



Below are examples of Terminal Coding with Figure 12 and Figure 13 showing graphic examples of terminal code allocation.

Examples:

:58 Terminal 58

:3C Terminal 3 Row C

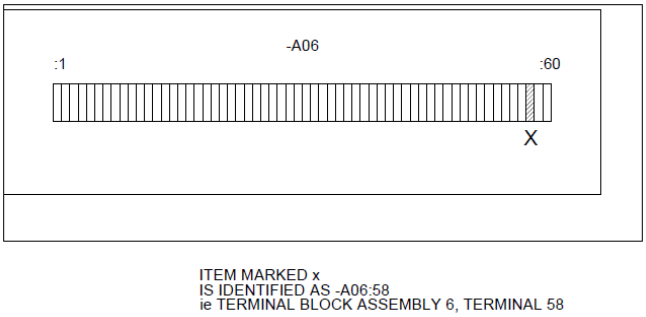


Figure 12: Coding for a Terminal Block Assembly

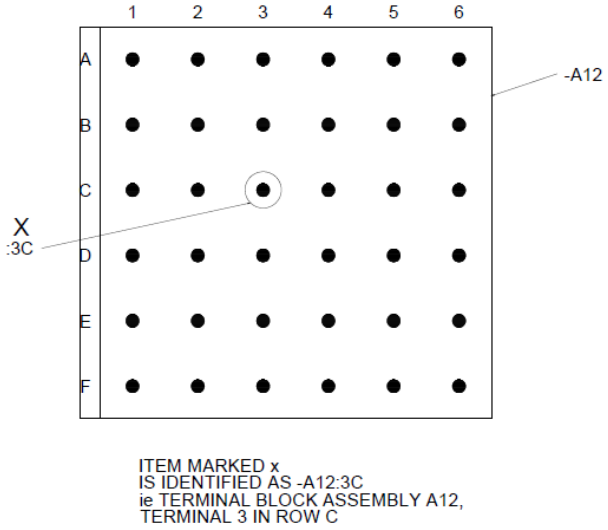


Figure 13: Coding within a Matrix Terminal Block

5.6 Bay Numbering

Each bay shall be given a function letter code in accordance with Table 2 and a number that is unique to that function letter in the substation.

Bay numbers shall be allocated as follows:

1) Obtain the ultimate development and preliminary layout drawings for the switchyard in question.
2) Determine any factor that would limit additional extension of the busbars in any direction; e.g. Transformers installed at the end of the busbars.
3) Allocate bay numbers such that the lowest number is adjacent to the determined limiting factor.

If there is no natural limiting factor to busbar extension in either direction, then the lowest number is allocated to the first bay on the left-hand side of the ultimate line diagram, where the line diagram is drawn with the highest voltage circuits to the top of the page. The commencing bay number may be greater than one to allow for future extensions using the lower numbers.

5.7 Busbar Identification

Where there is provision for two or more busbar sections, they shall be numbered such that the lowest numbered bays are connected to or between the lowest numbered busbars. For example, if there are two busbar sections containing switching functions =EA01 and =EA02 on one and =EA03 and =EA04 on the other, they shall be numbered bus 1 and bus 2 respectively.

In double busbar arrangements, the lowest numbered busbar shall be at the top of the ultimate line diagram where the line diagram is drawn with the highest voltage circuits to the top of the page.

5.8 Phase Identification and layout

Phase identification (not to be confused with colour abbreviations) shall be A B C on drawings.

The layout of the phase shall be dictated by the labelling of the power transformer phasing, where included, as detailed in the Australian Standard for Power Transformers (AS/NZS 60076.1, 2014) and the following clauses.

a) The order of the phase labels when viewed from the high voltage side of the power transformer shall be A B C from left to right.
b) For connections from the transformer the labelling shall match the transformer phase layout.
c) For lines perpendicular to the power transformer bay, the phase labels with respect to the high voltage side of the transformer shall be A B C respectively from the line closest to the transformer to the line furthest from the transformer as per Figure 14. This may not apply in exceptional circumstances, for example, where the orientation of an additional transformer is such that Clause (a) disallows the labelling of Clause (c).
d) Where a power transformer is not shown on a diagram, the labelling shall be as per Clauses (a) and (c) when facing into the substation along the incoming feeder in accordance with the Figure 14.
e) The phase layout shall be consistent for the entire drawing.
f) Where there is a folded bus arrangement, the phase layout shall be as for Clauses (a), (b), (c), (d) and (e) as per Figure 15.

For the placement of the phase identifiers, refer to the standard drawings Figure 14 and Figure 15.

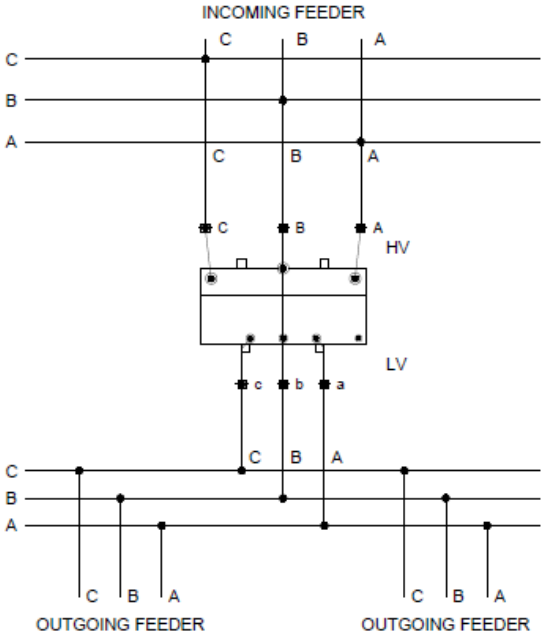


Figure 14: Phase Layout

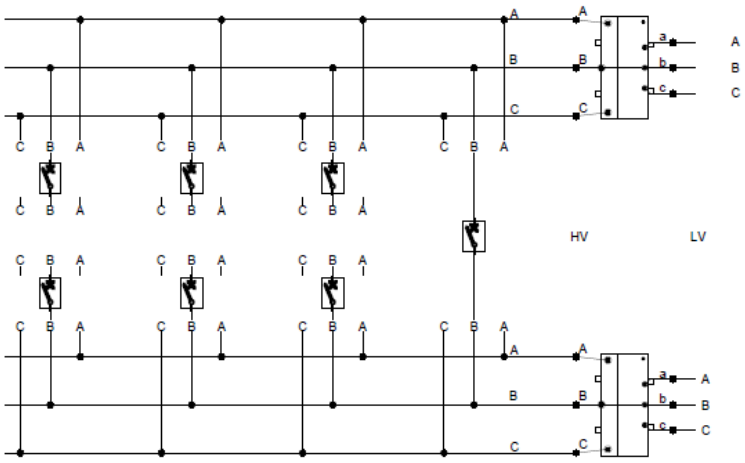


Figure 15: Phase Layout for a Folded Bus arrangement

5.9 DC Voltage Identification

For DC identification, when required, the identification shall be the voltage level of the supply followed by a capital V and the polarity sign, + or – (e.g. 110V+, 110V–).

5.10 Ground and Neutral Identification

The identifier N (neutral) shall be used when a device is connected in the residual of a polyphase circuit, across a broken delta, or is internally derived from the polyphase current or voltage quantities. The identifier G (ground) shall be used where the measured quantity is in the path to ground, or in the case of ground fault detectors, is the current flowing to ground.

5.11 Cable Numbering

Cables shall be numbered using item code Wxxx where W is the Item Designation code and xxx is a unique number within a particular substation. The Item code shall be prefixed with a Function Code (e.g. =FB02-W10). The numbering of secondary cabling shall start at 10 (to prevent confusion with HV cables) and numbered in ascending order.

The HV cables shall be given the Function Code associated with a host switching device or plant device such as a Transformer or Generator. Where the host is not clear the following rules are to be applied for function code selection:

- The host closest to the incoming supply
- The host with the lowest number

Figure **16** and Figure 17 show graphic examples of cable numbering.

Examples:

=TX01-W01	Transformer 1 HV Cable to MV Switchboard
=TX01-W02	Transformer 1 HV Cable to Earthing Transformer
=FB02-W01	11 kV Feeder 2 HV Cable
–W10	CT Secondary LV secondary cable (Figure 16)
–W62	DC Supply LV secondary cable (Figure 17)

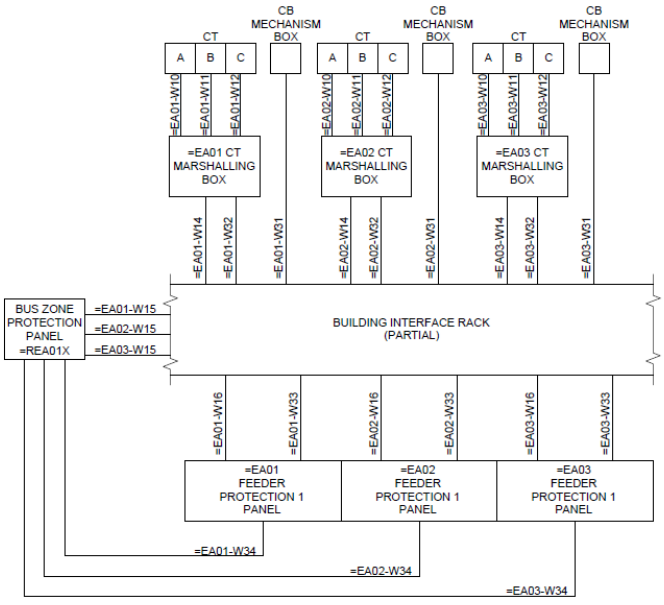


Figure 16: Multicore Cable Numbering

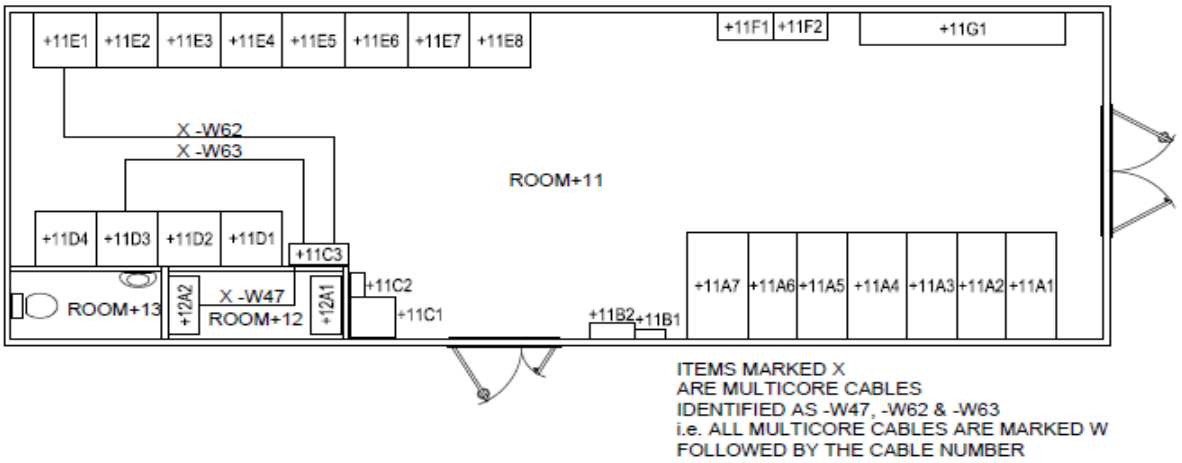


Figure 17: Multicore Cable Numbering within a Building

5.12 Wire Numbering

To assist the preparation of diagrams, checking circuits, fault finding and modifications; the ends of each wire shall be identified by suitable marking to show its function. The Energy Queensland wire numbering method is based on withdrawn British Standard (BS 158, 1961) and AS 2067 : 2016, Appendix E; with variations as set out in this document. Wire marking and installation shall be in accordance with the Energy Queensland Panel Wiring Standard (STNW3021). Each circuit function should be defined by a code consisting of letters and numbers as per Table 10.

Every branch of any connection should bear the same identification mark. Where, however, it is necessary to identify branches that are connected to a common point, e.g. current-transformer leads, different numbers for the branches may be employed only if they are connected through links, or are connected to separate terminals which are then joined by removable connections.

A system of providing functional identification is described below and summarised in Table 10.

a) Each wire should have a letter to denote its function, e.g. control of circuit breaker, current transformer for primary protection, voltage for instruments, metering and protection.

b) Each wire should have a suffix number identifying the individual wire and its function. This may consist of one or more digits as required. For functions A-G, H, J and M, the suffix numbers should be in accordance with Table 10.

c) Wire numbers shall increment sequentially on passing through a link or device, but not a terminal.

d) Where a number of similar leads from separate units are taken to a common panel, e.g. bus-zone protection, summation metering, the function code prefix, e.g. =FB09, should be used to distinguish them.

e) Where common apparatus covers more than one function, the first of the appropriate function letters in the table should be used. This applies only to parallel circuits, and where these circuits split at a separate contact, e.g. fuse-link, switch or relay contact, the function letter should change if necessary from the splitting point onwards.

f) Where relays are employed, the wiring to the coil and the contact circuits do not necessarily bear the same function letter, which should be determined by the function of the individual circuit containing them. For example, the coil circuit of an interposing relay

should be ‘W’ but the contact circuits may bear letters such as ‘K’, ‘L’, or ‘N’, as appropriate.

g) Current and voltage transformer function letters should follow through any interposing and auxiliary current and voltage transformers.

h) Telephone-type or electronic signalling equipment may require numbering schemes differing from the above for complete identification. In such cases, where connections from such equipment are associated with power equipment wired in accordance with this section, the numbering of such connections should include the appropriate prefix letter (J, W, X, or Y) to distinguish them.

i) Earth wiring for CT and VT secondaries, Relays, RTUs and cases of other devices shall use a wire marker code of the circuit they are from or the code of the device they are connected to.

Table 10: Circuit and Wire Identification Code

Letter	Circuit Function	Wire Numbers
A	Current transformers for prot 1 & prot 2 schemes excluding overcurrent & bus bar protection	10-29 A Phase 30-49 B Phase 50-69 C Phase 70-89 Residual circuits and neutral current transformers 90 Earth wires directly connected to the earth bar 91-99 Test windings, normally inoperative
B	Current transformer for busbar protection	
C	Current transformers for overcurrent protection (including combined earth-fault protection and instruments)	
D	Current transformers for instruments, metering and voltage control	
E	Reference voltage of instruments, metering and Protection	
F	Reference voltage for voltage control	
G	Reference voltage for synchronising	
H	a.c. supplies	Any number from 1 upwards
J	d.c. supplies	Any number from 1 upwards
K	Closing and tripping control circuits (Red K’s signified by #K on the drawings denote hot positive trip wires where a positive will directly lead to a trip)	Any number from 1 upwards
L	Alarms and indications initiated by auxiliary switches and relay contacts, excluding those for remote selective control and for general indication equipment	Any number from 1 upwards

Letter	Circuit Function	Wire Numbers
M	Auxiliary and control motor devices, e.g. governor motor, rheostat motor, generator automatic voltage regulator control, spring-charging motors, transformer cooler-motor control, motors for isolator operation	Any number from 1 upwards
N	Tap-change control including automatic voltage control, tap position & progress indications	Any number from 1 upwards
O	An indication that the ferruling is not in accordance with the general scheme and that if it is not altered double ferruling will be required for coordination with the remaining equipment in the station (see paragraph (h))	Any number from 1 upwards For modifying legacy drawings only Not to be used on new designs
P	d.c. tripping circuits used solely for busbar protection (Red P's signified by #P on the drawings denote hot positive trip wires where a positive will directly lead to a trip)	Any number from 1 upwards For modifying legacy drawings only. Not to be used on new designs
R	Interlock circuits not covered above	Any number from 1 upwards
S	d.c. instruments and relays, exciter and field circuits for generators	Any number from 1 upwards
T	Pilot conductors (including directly associated connections) between panels, independent of the distance between them, for pilot-wire protection, for inter- tripping or for both	Any number from 1 upwards
U	Spare cores and connections to spare contacts where terminated	Spare cores should be numbered from 1 upwards in each cable and should be so arranged that they can be readily identified on site with the cable containing them. Alternatively the cable number should precede the core number.
W	Connections to SCADA auxiliary control equipment	Any number from 1 upwards
X	Alarms and indications to SCADA	Any number from 1 upwards
Y	Telephones	Any number from 1 upwards
Z	Special Purposes. e.g. Test circuitry	Any number from 1 upwards

NOTES:

1. If, for functions A-G and for functions H, J and M, more numbers are required, add multiples of one hundred, e.g., 10-29 may be extended to 110-129, 210-229.

2. The term ‘remote selective control’ denotes ‘control at a point distant from the switchgear by the transmission of electrical signals through common communications channels using selective means to operate one of a number of switching devices.

5.13 Wire Colours

Wiring colours shall be selected in accordance with the Energy Queensland Panel Wiring Standard (STNW3021) Colour abbreviations shall be as per Table 11.

Table 11: Colour Abbreviations

Colour	Abbreviation
Black	BK
Brown	BN
Red	RD
Orange	OG
Yellow	YE
Green	GN
Blue	BU
Violet	VT
Purple	PP
Grey (slate)	GY
White	WH
Pink	PK
Magenta	MG
Turquoise	TQ

Where separate cores are coloured differently, the codes for different colours are separated by the sign “plus” (+) e.g. a five-core cable with two black, a brown, a blue and green-and-yellow core is given by BK+BK+BN+BU+GN/YE.

Colour combinations shall be designated by adding the codes for the different colours, in sequence from the top of Table 11, with a back slash ‘/’ between each colour abbreviation used e.g. a green core with a yellow stripe is given as GN/YE.

Where a colour is being associated with another colour, brackets ‘( )’ shall be used e.g. white associated with blue WH(BU).

5.14 Voltage Colours for HMI’s

Where colours are used to indicate the different voltage levels the definitions given in Table 12, as taken from (IEC 60073, 2002), shall be applied. Table 12 contains the colours as described by their Hue, Saturation and Luminous values and their Red, Green and Blue combination.

Table 12: Voltage Level Colours

Voltage Level	Colour	Hue	Saturation	Luminous	Red	Green	Blue
330 kV and Above	Pink	231	240	171	255	108	140
275/220 kV	Magenta	200	240	120	255	0	255
132/110 kV	Red	0	240	120	255	0	0
66 kV	Orange	20	240	120	255	130	0
33 kV	Yellow	40	240	120	255	255	0
19.1 kV SWER	Light Yellow	40	240	210	255	255	191
22/19 kV	Blue	160	240	120	0	0	255
12.7 kV SWER	Light Blue	149	219	154	81	126	247
11 kV	Cyan	120	240	120	0	255	255
6.6/3.3 kV	Violet	160	240	210	191	191	255
415 V	Purple	200	240	62	132	0	132
Earth	Green	80	240	120	0	255	0

(Normative)

Device Function Numbers 95-102

The table below defines the preferred allocation of the installation specific codes 95 to 102, which IEEE Std C37.2,2022, allows to be used for specific applications. These codes may be assigned on an installation basis if none of the functions assigned to codes 1 to 94 are suitable.

The meaning of each code used shall be designated on the drawing in which it is used or on a key index drawing to the set.

Table 13: Device Function Numbers 95-102

Device No	Description
95	
96	Transformer Gas Relay
97	Fire Protection
98	Security Systems
99	Trip Circuit Supervision
100	Auto Reclose Enable/Inhibit Relay
101	Sensitive Earth Fault Enable/Inhibit Relay
102	Work Clearance Set/Reset Relay

(Normative)

Application Guide

This application guide is to be used to determine what codes should be applied. As these situations arise, this section will be added to for future users of this standard.

The assignment of item designation codes for relays and protection devices shall be to the definitions given below:

- An electrical relay is a device designed to produce sudden, predetermined changes in one or more electrical output circuits, when certain conditions are fulfilled in the electrical input circuits controlling the device. Electrical relays shall be designated the letter K.
- A protective relay is a device designed to initiate disconnection of a part of an electrical installation, and / or to operate a warning signal due to a fault or other abnormal condition with the minimum interruption to service. Protective relays shall be designated the letter J.
- Other protective devices that don't comply with the definitions above, such as fuses and miniature circuit breakers, shall be designated the letter F.
- Spark and surge suppression devices shall be designated the letter Z.

Table 14: Item Designation Coding Examples

Situation	Code
CB Fail Relay	–J03
Trip Circuit Supervision Relay	–J99
Transformer Oil Temperature Relay	–J26
Transformer Winding Temperature Relay	–J49
Earth Fault Relay – Sensitive	–J51NS
Transformer Over Pressure Relay	–J63
Neutral Voltage Shift Relay	–J64
Transformer OLTC Surge Relay	–J80
Latching Trip Relay	–K86
CB Trip Coil	–K4T
CB Close Coil	–K4C
Fuse or Miniature Circuit Breaker	–Fnn (nn=number identifier)
Protection Signalling Equipment	–K85
High Impedance Earth Fault Detection	–J51NZ
Circuit Breaker Close Inhibit Relay	-K69

Situation	Code
Automatic Voltage Regulating Relay (AVR) or (VRR)	-K90

A.1 Equipment mounted in Transformers and Switchgear

When Substation Standards arrange new period contracts, they request manufacturers to apply this standard's STNW3001 codes. However, this is not always successful, and Energy Queensland has existing brownfield sites that were purchased prior to this standard being developed.

When this is the case, Substation Standards agreed with Design and Asset Managers to use manufacturer's codes instead of STNW3001 codes for equipment mounted or housed in Transformers and Switchgear. This was primarily to ensure that safety and asset data capture is not compromised.

In rare special circumstance that manufacturer codes are not able to be used in Ellipse, both the manufacturer codes and the STNW3001 codes should both be applied on all drawings and then the STNW3001 codes may be used in Ellipse. This method is not preferred and should be avoided whenever possible.

A.2 Frame Leakage Protection Schemes

Network Data adopted =EX02 to designate Frame Leakage protection and associated relays for asset data capture. Standards did not support this as =EX01 is designated for the substation earth grid and using =EX02 implied Frame Leakage schemes were part of the earthing system.

Frame Leakage protection has been implemented in various methods across the legacy energy board regions including:

- 2 Frame Leakage Bus Zones for 2 bus sections
- 3 Frame Leakage Bus Zones for 2 bus sections
- 5 Frame Leakage Bus Zones for 3 bus sections. (Stuart Substation)

Some use individual relays for each zone, some use one relay with 3 internal elements and have various arrangements of tripping relays. Standards engaged with Substation Design and Protection.

The approved method is:

- A Frame Leakage Relay or Current Transformer associated to Bus Bar Section 1 shall use codes =RFB01-J50N, =RFB01-T03.
- A Frame Leakage Relay or Current Transformer associated to Bus Bar Section 2 shall use codes =RFB02-J50N, =RFB02-T03.
- A Frame Leakage Relay or Current Transformer associated to Bus Bar Section 3 shall use codes =RFB03-J50N, =RFB03-T03
- A Frame Leakage Relay or Current Transformer associated to both Bus Bar Section 1 and 2 shall use codes =RFB12-J50N, =RFB12-T03
- A Frame Leakage Relay or Current Transformer associated to both Bus Bar Section 2 and 3 shall use codes =RFB23-J50N, =RFB23-T03

A.3 Substation Wide Control and Protection Bay codes

If a substation has a Load Control Bay this will be designated =LX01. If the same substation also has a Substation Wide Control and Protection Bay, this will be designated =LX02. If a substation has no Load Control Bay but does have a Substation Wide Control and Protection Bay, this will be designated =LX01.

A.4 Summated Backup Neutral Earth Fault Relays

Summated Backup Neutral Earth Fault protection relays typically have (1) BU NEF relay for two (2) Transformers. This aligns with a Substation Wide Control and Protection Scheme and these should use the =LXnn bay code.

These old, summated schemes typically join Current Transformers from both transformer neutrals, usually in the same circuits as Frame Leakage and Sensitive Earth Fault Check schemes. They backup LV protection for feeders, busbars, and transformers; tripping all transformer CBs and clearing all supply to the LV feeders. This aligns with a Substation Wide Control and Protection Scheme.

New Backup Neutral Earth Fault protection relays that align with the latest protection schemes from the Protection Standard STNW1002, having one (1) BU NEF relay for each one (1) Transformer. These should use the =TXnn bay code for the transformer they are associated with.

A.5 Weather Station coding

23 is for temperature controlling devices like thermostats.

26 is for transformer oil temperature devices.

49 is for transformer winding temperature devices.

77 is for Telemetering devices – transmitting device used to generate and transmit to a remote location an electrical signal representing a measured quantity; or a receiver used to receive the electrical signal from a remote transmitter and convert the signal to represent the original measured quantity.

-B is for transducing non-electrical to electrical quantities.

-U is for transducing electrical to electrical quantities.

To avoid using protection device codes we should use:

- -B77.1 Soil Temperature Sensor (non-electrical input to electrical output)
- -U77.1 Soil Temperature transducer (electrical input to electrical output)

- -B77.2 Soil Moisture Sensor (non-electrical input to electrical output)
- -U77.2 Soil Moisture transducer (electrical input to electrical output)

- -B77.3 Rain Gauge Sensor (non-electrical input to electrical output)
- -U77.3 Rain Gauge transducer (electrical input to electrical output)

- -B77.4 Air Temperature Sensor (non-electrical input to electrical output)
- -U77.4 Air Temperature transducer (electrical input to electrical output)

- -B77.5 Solar Radiation Sensor (non-electrical input to electrical output)
- -U77.5 Solar Radiation transducer (electrical input to electrical output)

- -B77.6 Wind speed Sensor (non-electrical input to electrical output)
- -U77.6 Wind speed transducer (electrical input to electrical output)

(Normative)

Alphabetical List of Items and their Letter Codes

Table 15 is as taken from (IEC 81346-2, 2009) with modifications to comply with this standard.

Table 15: Alphabetical List of Items and their Letter Codes

Item	Letter Code	Item	Letter Code
Access point	A	Core storage	D
Accumulator	G	Corrector, distortion	Z
Aerial	W	Counter	P
Acoustic indicator	H	Coupler, wavelength	W
Alternator	G	Crystal filter	Z
Amplifier	A	Crystal oscillator	G
Amplifier magnetic	A	Crystal transducer	B
Amplifier operational	N	Current transformer	T
Ammeter	P	Delay devices	D
Ampere-hour meter	P	Delay line	D
Analogue elements	N	Delay network	D
Analogue integrated circuit	N	Demodulator	U
Antenna	W	Detector	B
Appliance, heating/lighting	E	Detector, radiation	P
Arrester	F	Dial, contact	S
Artificial line	Z	Dial, telephone	S
Assembly	A	Digital integrated circuits	D
Attenuator	Z	Dimmer	S
Battery	G	Diode	V
Beacon	H	Dipole	W
Bell	H	Disc drive	D
Binary element	D	Discharge lamp	E
Brake	Y	Disconnecting plug	X
Breaking or isolating jack	X	Discriminator	U
Busbar	W	Distortion corrector	Z

Item	Letter Code	Item	Letter Code
Butt-connector	X	Dynamometer	B
Buzzer	H	Earphone	B
Cable	W	Earth bar	X
Cable sealing ends	X	Earthing electrode	X
Cable sealing joints	X	Earthing switch	Q
Cable balancing network	Z	Electrical appliances	E
Capacitor	C	Equaliser	Z
Capacitor-synchronous	C	Expander	Z
Capacitor-resistor unit	C	Fader	Z
Cell, dry or wet	G	Fan	E
Changer	U	Fault thrower	Q
Choke	L	Ferrite bead (inductor assembly)	L
Circuit breaker	Q	Filament lamp	E
Clamper	Z	Filter	Z
Clip	X	Fluorescent lamp	E
Clipper	Z	Frequency changer	U
Clock	P	Fuse	F
Clutch	Y	Fuse switch	F
Coder	U	Galvanometer	P
Co-efficient scaler	N	Gas discharge tube	V
Coil	L	Generator, non-rotating	P
Compandor (compressor/expander)	Z	Generator, rotating	G
Compressor	Z	Generator, signal	P
Conductor	W	Gyrator, ideal/current/voltage	G
Connecting stage	S	Hall generator	P
Connector	X	Head-phones	B
Contactor	K	Heater	E
Control gear assembly	A	Horn	H
Control switch	S	HV Link	Q
Controller, amplitude	Z	Hybrid transformer	T

Item	Letter Code	Item	Letter Code
Converter, general	G	Hydraulic valve	Y
Converter—digital to analogue (I.C.)	N	Indicator, acoustic	H
Converter—analogue to digital	N	Indicator, measuring	P
Cooling device	E	Indicator, optical	H
Inductor coil	L	Power supply	G
Inductor	L	Printed board assembly	A
Instrument, measuring	P	Programmable logic controller	A
Integrated circuit, analogue	N	Protective device	F
Integrated circuit, digital	D	Pulse meter	P
Inverter	G	Pulse modulator	U
Isolating jack	X	Push button switch	S
Isolator	Q	Pyrometer	P
Jack (telephone)	X	Radiation detector	P
Jack, test	X	Radiation detector tube	V
Jack, isolating	X	Radio receiver	U
Joint	X	Reactor	L
Jumper (connection)	X	Receiver translator (changer)	U
Key (see switch)	S	Recloser	Q
Key-operated switch	S	Recorder, magnetic	D
Lamp, discharge	E	Recorder, measuring	P
Lamp, signal	H	Recorder (reproducer)	D
Lamps, luminaries	E	Rectifier	U
Laser	A	Rectifier tube	V
Light-emitting diode	V	Reed relay	K
Light-operated devices	V	Register	D
Lighting device	E	Regulator, induction	L
Lightning arrester	F	Regulator, transformer	T

Item	Letter Code	Item	Letter Code
Limit switch	S	Regulator, voltage (I.C.)	N
Limiter	Z	Regulator, voltage-power	T
Line trap	L	Relay, other than protection	K
Link	X	Relay, protection	J
Loudspeaker	B	Resistor	R
Luminaries	B	Resolver	B
Machine	Y	Rheostat	R
Magnetic tape recorder	D	Rotating frequency converter	G
Maser	A	Rotating generator	G
Measuring equipment	P	Salinity meter	P
Mechanical device, electrically operated	Y	Selector switch	S
Mechanical switching device for power circuits	Q	Semiconductor	V
Mercury arc rectifier	V	Sensor, thermoelectric	B
Meter	P	Shunt resistor	R
Microphone	B	Signal generator	P
Microwave tube	V	Signal lamp	H
Miscellaneous device	E	Signal path	W
Modem	U	Signal translator	U
Modulator	U	Signalling device	H
Motor	M	Siren	H
Motor generator	G	Socket (jack)	X
Network	Z	Socket-outlet	X
Network, cable balancing	Z	Solar cell	G
Network, terminating	Z	Solenoid	Y
Ohmmeter	P	Solid state relay	K
Operational amplifier	N	Solion diode	V
Optical fibre	W	Spark gap	F
Optical indicator	H	Starter (motor)	A

Item	Letter Code	Item	Letter Code
Opto-isolator	V	Static capacitor	C
Oscillator	G	Storage device	D
Oscilloscope	P	Subassembly	A
Overvoltage discharge device	F	Supply device	G
Pad	Z	Surge diverter	F
Phase changer	U	Switch	S
Phase meter	P	Switchboard	A
Phase modulator	U	Switchgear assembly	A
Photoelectric cell	B	Switching devices for control	S
Photocoupler	B	Switching devices, power	Q
Pickup	B/U	Synchro	B
Plug	X	Synchronous capacitor	C
Pneumatic valve	Y	Synchroscope	P
Potentiometer	R	Tachometer	P
Power factor meter	P	Tape recorder	D
Telegraph translator	U	Translator telegraph	U
Telemetering instrument	P	Transistor	V
Telephone jack, socket	X	Translator (transmitter)	U
Television camera tube	V	Transmission path	W
Television picture tube	V	Transmitter	U
Television receiver	U	Tube	V
Terminal	X	U point (connector)	X
Terminal board or strip	A	Valve, electrically-operated	Y
Termination, resistive	R	Variable resistor	R
Terminating set or network	Z	Var-hour meter	P
Test jack	X	Varistor	V
Test point	X	Varmeter	P
Testing equipment	P	Voltage divider, inductive	L

Item	Letter Code	Item	Letter Code
Thermocouple	B	Voltage divider, resistive	R
Thermoelectric sensor	B	Voltage regulator	T
Thermionic tube	V	Voltage regulator-integrated circuit	N
Thermistor	R	Voltage regulator, analogue	N
Thermostat	S	Voltage regulator, power	T
Threshold device	Z	Voltage transformer	T
Thyristor	V	Voltmeter	P
Time switch	S	Watt-hour meter	P
Transducer, electrical	U	Wattmeter	P
Transductor	L	Waveguide	W
Transformer	T	Wavemeter	P
Transformer, current	T	Winding (inductor)	L
Transformer, hybrid	T	Winding (transformer)	T
Transformer, power	T	X-ray tube	V
Transformer, voltage	T	Zener diode	V

(Informative)

Device Function Number System

Table 16 summarises the (IEEE Std C37.2, 2022) standard used in **Error! Reference source not found.** and **Error! Reference source not found.Error! Reference source not found.**of this standard for the designation of relay item designation codes –J and –K. Table 17 gives a list of common possible suffix letters for the relay codes.

This annex should be used as a reference guide only with full details given in this standard and the IEEE standard.

Table 16: Reference Guide to the Device Function Number System

Number	Description	Number	Description
01	Master Element	52	AC Circuit Breaker
02	Time-Delay Starting or Closing Relay	53	Exciter or DC Generator Relay
03	Checking or Interlocking Relay, CB Fail	54	Turning Gear Engaging Device
04	Master Contactor	55	Power Factor Relay
05	Stopping Device	56	Field Application Relay
06	Starting Circuit Breaker	57	Short-Circuiting or Grounding Device
07	Rate-of-Change Relay	58	Rectification Failure Relay
08	Control Power Disconnecting Device	59	Over Voltage Relay
09	Reversing Device	60	Voltage or Current Balance Relay
10	Unit Sequence Switch	61	Density Switch or Sensor
11	Multi-function Device, (e.g. Protection,)	62	Time-Delay Stopping or Operating Relay
12	Over Speed Device	63	Pressure Switch, Transformer Over Pressure
13	Synchronous Speed Device	64	Ground Detector Relay, Neutral Shift Relay

Number	Description	Number	Description
14	Under Speed Device	65	Governor
15	Speed or Frequency Matching Device	66	Notching or Jogging Device
16	Data Communications Device	67	AC Directional Over Current Relay (suffix N, G, NS as needed)
17	Shunting or Discharge Switch	68	Blocking or “Out-of-Step” Relay
18	Accelerating or Decelerating Device	69	Permissive Control Device Circuit Breaker Close Inhibit Relay (-K69)
19	Starting-to-Running Transition Contactor	70	Rheostat
20	Electrically Operated Valve	71	Liquid Level Switch
21	Distance Relay	72	DC Circuit Breaker
22	Equaliser Circuit Breaker	73	Load-Resistor Contactor
23	Temperature Control Device	74	Alarm Relay
24	Volts per Hertz Relay	75	Position Changing Mechanism
25	Synchronising or Synchronism-Check Relay	76	DC Over Current Relay
26	Apparatus Thermal Device, Transformer Oil Temperature	77	Telemetering Device
27	Under Voltage Relay	78	Phase-Angle Measuring Relay
28	Flame Detector	79	AC Reclosing Relay
29	Isolating Contactor or Switch	80	Flow Switch, Transformer OLTC Oil Surge Relay
30	Annunciator Relay	81	Frequency Relay
31	Separate Excitation Device	82	DC Load-Measuring Reclosing Relay
32	Directional Power Relay	83	Automatic Selective Control or Transfer Relay

Number	Description	Number	Description
33	Position Switch	84	Operating Mechanism
34	Master Sequence Device	85	Pilot Communications Carrier or Pilot-Wire Relay
35	Brush-Operated or Slip-Ring Short-Circuiting Device	86	Lockout Relay, Multitrip Relay
36	Polarity or Polarising Voltage Device	87	Differential Protection Relay
37	Under Current or Under Power Relay	88	Auxiliary Motor or Motor Generator
38	Bearing Protective Device	89	Line Switch
39	Mechanical Condition Monitor	90	Regulating Device, AVR (-K90)
40	Field (over / under excitation) Relay	91	Voltage Directional Relay
41	Field Circuit Breaker	92	Voltage and Power Directional Relay
42	Running Circuit Breaker	93	Field-Changing Contactor
43	Manual Transfer or Selector Device	94	Tripping or Trip-Free Relay
44	Unit Sequence Starting Relay	95	
45	Abnormal Atmospheric Condition Monitor	96	Transformer Gas Relay
46	Reverse-Phase or Phase-Balance Current Relay, NPS Current	97	Fire Protection
47	Phase-Sequence or Phase-Balance Voltage Relay	98	Security Systems
48	Incomplete Sequence Relay	99	Trip Circuit Supervision
49	Machine or Transformer Thermal Relay, Transformer Winding Temperature	100	Auto Reclose Enable/Inhibit Relay
50	Instantaneous Over Current Relay (suffix N, G, NS as needed)	101	Sensitive Earth Fault Enable/Inhibit Relay

Number	Description	Number	Description
51	AC Inverse Time Over Current Relay (suffix N, G, NS as needed)	102	Work Clearance Set/Reset Relay

Table 17: Common Suffix Letters for Relay Codes

Suffix	Meaning
A	A leg protection
B	B leg protection
G	In ground lead
N	In residual of polyphase circuit
S	Sensitive relay
1	Protection 1
2	Protection 2
X	X Protection
Y	Y Protection
Z	Impedance
C	Close Function

(Informative)

Superseded Colour Abbreviations

Table 18 details colour abbreviations used in the past. They are included to assist working on existing installations. They shall not be used for any new works.

Table 18 Superseded Colour Abbreviations

Colour	Abbreviation
Black	BK
Brown	BN
Red	R
Orange	O
Yellow	Y
Green	G
Blue	B
Violet	V
Grey	GY
Slate	S
White	W
Turquoise	T

(Informative)

Historical Overview of Standards

The intention of this standard was to provide one complete identification system for all Energy Queensland Substation Equipment based on current Australian and International Standards.

These standards have been revised, redesignated and withdrawn over the years to align with international standards. This Annex has been added to detail these changes.

Australian Standards

AS1103.2 (1973) Diagrams, charts and tables for electrotechnology Definitions and classifications

Revised

AS1103.2 (1982) Diagrams charts and tables for electrotechnology, Part 2: Item designation.

Revised and redesignated

AS 3702 (1989) Item designation in electrotechnology

This Standard is a comprehensive revision of the former Standard (AS 1103.2—1982), which was one part of the AS 1103 series of Standards on diagrams, charts and tables for electrotechnology.

Since the revised system of item designation specified in this Standard is not only used to correlate information in different documents (such as diagrams, parts lists, circuit descriptions and instructions) but may also be displayed on or near the item itself in the equipment, this Standard has been removed from the AS 1103 series and is now a ‘stand-alone’ Standard.

It should be noted that this Standard is technically equivalent to IEC 750 (1983), Item designation in electrotechnology. It follows the same principles including the removal of the publication from IEC 113 series (on which the AS 1103 series is based) to a new IEC number (i.e. IEC 750).

However, a major deviation from IEC 750 is the provision of a comprehensive alphabetical list of items and their letter codes given in Table 2, which has been included as a quick-reference guide.

Withdrawn 2015 and now use IEC 81346 (2009)

International Electrotechnical Commission

IEC 113 (1959)

Revised and redesignated

IEC 750 (1983) Item designation in electrotechnology

Redesignated

IEC 60750 (1983) Item designation in electrotechnology

Revised and redesignated

IEC 61346-1(1996) Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations - Part 1: Basic rules

Revised and redesignated

IEC 81346-1:2009 Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations - Part 1: Basic rules

Revised and redesignated

IEC 81346-1:2022 Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations - Part 1: Basic rules

IEC 81346-2 (2009) Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations - Part 2: Classification of objects and codes for classes

Revised and redesignated

IEC 81346-2 (2019) Current

Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations - Part 2: Classification of objects and codes for classes

A.6 Historical Overview of IEC 81346-1 from Annex A of the standard

IEC 81346-1 is a revision of IEC 61346-1:1996, considering also the content of ISO/TS 16952-1. The number of the publication has been changed in order to facilitate a common ISO/IEC standard series on reference designations.

IEC 61346-1 had two predecessors; IEC 60750:1983 and before that IEC 60113-2:1971. Table I on letter codes in IEC 60750:1983 is in its essential parts taken from IEC 60113-2:1971. The application domain of the standards has increased with time.

Although it can be argued about where exactly the boundaries should be, it is possible to illustrate roughly the ambitions and the scope of the three documents as in Figure A.1. Below.

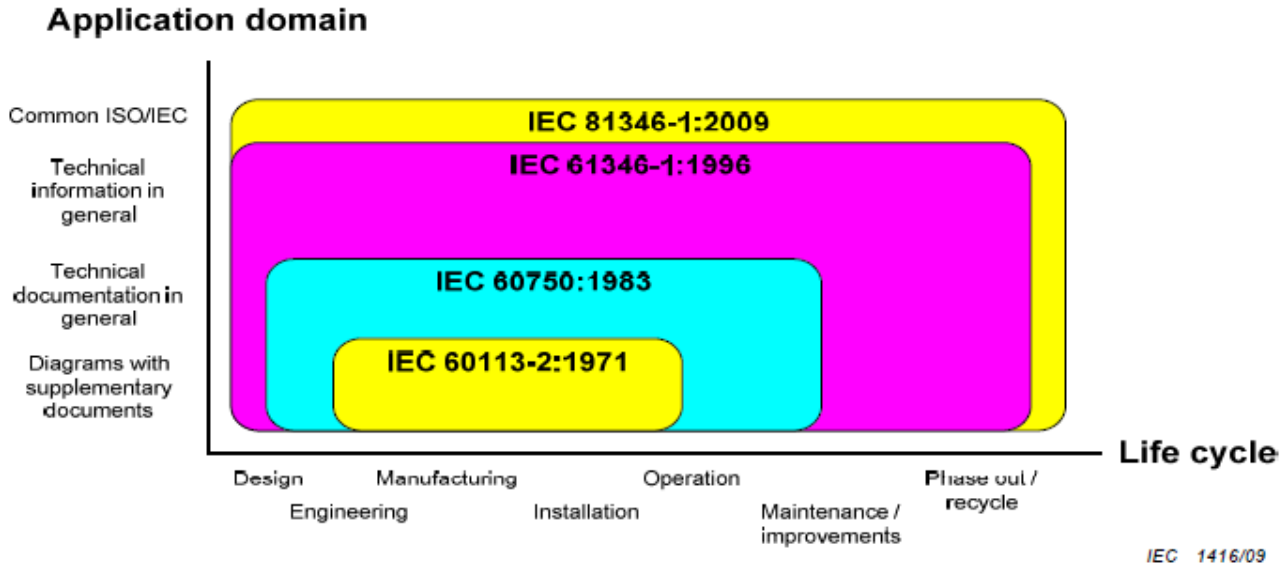


Figure A.1 – Scope of reference designation standards

A.7 IEC 60113-2:1971

Item designations (which is the term used in IEC 60113-2) were, when they first appeared just a classification/coding of discrete components with an added sequential number for separation between components of the same class. Since sequential numbering is impractical for larger designs, IEC 60113-2 included the possibility to put hierarchical designations in front of the component code, and thus to obtain a simple form of structuring.

Information was at that time only contained in documents, and the purpose of the item designation was to make possible cross-referencing inside and among documents, especially from circuit diagram to component lists and connection tables/diagrams.

The life cycle perspective was restricted. The immediate need was to produce the documents for the production of the equipment and for putting it into service.

The possibilities for computer processing at that time were limited. It was necessary to economise with memory space, and the processing was, at least mentally, still related to a "punch card-oriented technology", i.e. fixed data format and "smart" use of available format and memory space was very important.

A.8 IEC 60750:1983

With IEC 60750 it was recognised that hierarchical structuring was not to be seen just as an addition to the letter code for the components, but as a basic tool for the management of the documentation of larger designs. It is probably correct to say that there had been a shift in view so that the structuring became more emphasised than the component coding.

As a consequence, the use of item designations had become more widespread; also used in other documents than in circuit diagrams. Documents were, however, generally still considered to be the most important carrier of the information.

The possibilities for computer processing had been improved; the "punch card-oriented technology" had been left for the "relational oriented technology".

A.9 IEC 61346-1:1996

With the revision of IEC 60750, the use of item/reference designations became further extended. It was recognised that reference designation could be used as a powerful tool for information management. The information was not necessarily contained in ready-made documents, but could be fragmented, put into data bases, from which documents could be put together as needed (including graphical presentations). They could be seen as "windows" into the data base. It was required to use the reference designation system as a "navigation tool" in such an environment.

There was also an urgent need to extend the use to other equipment than electrical, to process equipment, to software, etc.

The possibilities for computer processing had been tremendously improved. It was realised that the "relational oriented technology" could not solve all problems, and the "object-oriented technology" was becoming used.

NOTE The use of the term “object” in "object-oriented system design" and "object oriented programming", is related to but not identical with, the term used in this publication.

Instead of "smart" economising with computing power it had become more essential to describe things logically and straightforward in order to enhance functionality, exchangeability and communication.

Another very important requirement had become emphasised, namely that the reference designations should be possible to use over the entire life cycle of the "objects".

A.10 IEC 81346-1:2022

In IEC 81346-1, the rules established in IEC 61346-1 are maintained, but more emphasis is put on the description of the concepts in order to enhance the understanding and applicability of the standard. The rules and requirements have, based on input from ISO TC10, been adapted to improve the usability of the standard outside the electrotechnical field.

IEC 81346-1 is intended to become a basis for a common reference designation system within IEC and ISO and should be the first part in a series of publications with a common number with split responsibility for the different parts.

A.11 Energex Equipment Identification Standards

Part 2 Section 1 of previous Energex Standard RED364 described the substation item designation system (SIDS) for use in Energex substation drawings. The full description of plant or equipment can be subdivided into the four fundamental groupings based on AS3092:

- Location (+)
- Item (-)
- Terminal (:)
- Function (=)

Function codes were not used on Energex drawings from 2003 onwards.

In addition to this internal Energex codes were added to the drawings. These included:

- Operating numbers based on Energex Operational Designation Scheme (*)

The major differences between this previous Energex standard and this document are:

- Absence of function codes to assign to a bay in Energex drawings
- Increased use of Item codes to group common items for material lists.

(Informative)

Revision History

Revision date	Version number	Author	Description of change/revision
14/11/05	1.0	Substation Standards	Standard approved by the Standards Review Committee and Manager Network Protection and Control
16/12/05	1.1	Substation Standards	Minor corrections to table 8, added M for main and B for backup protection to table 18
24/05/06 15/03/07 06/12/07 24/01/08	1.2	Substation Standards Substation Standards Substation Standards Substation Standards	Minor corrections Changes to align to the Network Operational Identification & Naming Guidelines document and Ellipse: Function & Location Codes padded out to at least 2 letters Function, Location and Device numbers padded out to at least 2 digits Additional Function & Location codes for Power Generation Wire numbers not defined as odd for +ve wires and even for –ve wires Minor changes and additions for protection signalling equipment (table 5 and appendix B) Change to the =K function code to not have the voltage code as a suffix
16/07/08	1.3	Substation Standards	Minor change to Figures 1b and 3b regarding the function coding for the bay and tie isolator. Example for use of Q09 Item code added as “e.g. HV Link”.
18/08/08	2.0	Substation Standards	Changes to the standard approved by the Standards Review Committee and Manager Network Protection and Control
14/05/09 13/01/10	2.1	Substation Standards Substation Standards	Note included to consider other Ergon naming standards Designation for High Impedance Earth Fault Detection added to table 15

Revision date	Version number	Author	Description of change/revision
31/03/15	3.0	Substation Standards	Document name from SS-1-1.2 to STNW3001and format change to latest style. Drawings given EDMS reference and new figure numbers. Appendix's changed to Annex's. 1.2 – Last sentence removed from Scope. 6.1 - Location Code explanation simplified. New Table 1 added so other tables throughout standard re-numbered. 6.2 - Additional Communications codes added to Table 2. 6.3 - Location Codes split over two tables (Internal & External) 6.4 - Naming of Earthing Transformers included. 6.8 - Additional Power Transformer reference & minor change to text for item (f) 6.10 – Table 10 wire numbering modified to align with current practice. 6.11 - Now referred to Annex C 6.12 - Wire Numbers referred to Table 10 6.13 - Wire colours now referred to Ergon Energy Panel Wiring Standard (STNW3021) 6.13 - Superseded colour Table moved to Annex E Annex D - Table 18 showing Device function Numbers from IEEE C37.2 updated to latest revision of IEEE C37.2. References for tables and notes updated.

Revision date	Version number	Author	Description of change/revision
10/06/2020	4.0	Substation Standards	Minor update to Ergon Energy Substation Standard to capture improvements. =LX Code updated details of use. Added more Location Code (+) examples. Added more examples including AVRs (-K90) & CB Close Inhibit (-K69). Annex B – Added applications with Equipment mounted in Transformers and Switchgear, =LXnn bays, Frame Leakage schemes & Summated BUNEF Protection. Added Annex F – Historical Overview of AS IEC & IEEE Standards and changes.
June 2023	5	Substation Standards	Update for ECM Audit to new template. Added identifier Location Code for floor level for buildings Change Protection Identifiers to Prot 1 & 2.from X & Y
June 2025	6	Substation Standards	Combine EQL standard. Refer to protection as Prot 1 and 2. Phasing changed to ABC from RWB. Clarification for BESS units.