 Eskom	Standard	Technology
--	-----------------	-------------------

Title: **DRAWING STANDARD FOR
SUBSTATIONS: POWER PLANT**

Unique Identifier: **240-83563472**

Alternative Reference Number: **<n/a>**

Area of Applicability: **Engineering**

Documentation Type: **Standard**

Revision: **01**

Total Pages: **61**

Next Review Date: **January 2023**

Disclosure Classification: **Controlled
Disclosure**

Compiled by

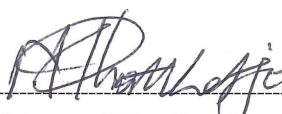


Derrick Delly

**Chief Engineer: Substation
Engineering**

Date: 21/06/2018

Approved by



Phineas Tlhatlhetji

**COE Manager: Substation
Engineering**

Date: 21/06/2018

Authorized by



Prince Moyo

**Power Delivery Engineering
GM**

Date: 2/07/2018

Supported by SCOT/SC



Phineas Tlhatlhetji

SCOT/SC Chairperson

Date: 21/06/2018

Content

	Page
1. Introduction	5
2. Supporting clauses	5
2.1 Scope	5
2.1.1 Purpose	5
2.1.2 Applicability	5
2.2 Normative/informative references	5
2.2.1 Normative	5
2.2.2 Informative	6
2.3 Definitions	6
2.3.1 General	6
2.3.2 Disclosure classification	7
2.4 Abbreviations	7
2.5 Roles and responsibilities	7
2.6 Process for monitoring	7
2.7 Related/supporting documents	7
3. Substation Design Drawings (Power Plant Technologies)	8
3.1 Title Block and Stamps	8
3.1.1 Title block	8
3.1.2 Drawing Stamps	11
3.2 Drawing Sheet Format	13
3.3 Drawing Sheet Electronic Format	15
3.4 Drawing Numbering Format	15
3.4.1 Transmission Drawing Numbering Format	15
3.4.2 Distribution Drawing Numbering Format	18
3.5 Text Font, Line Types and Dimensioning	22
3.5.1 Text Font	22
3.5.2 Types of Lines	25
3.5.3 Thickness of Lines	25
3.5.4 Spacing of Lines	27
3.5.5 Termination of Leader Lines	27
3.5.6 Dimensioning	28
3.6 Presentation of Views and Projections	29
3.6.1 Drawing Layout	29
3.7 Scales, Co-Ordinates and Grid	29
3.7.1 Scales	29
3.7.2 File design to views	30
3.7.3 Drawing sheets	30
3.8 Mark-Ups, Red-lining and Checking	32
3.8.1 Marking-Up of Drawings	32
3.8.2 Colour Codes for Mark-Ups	32
3.8.3 Check List	32
3.8.4 Guide to Acceptable Drawing Practice	33
3.9 Reference Files and Levels	33
3.9.1 Technology Group: Substation Engineering	33
3.9.2 Distribution	35

ESKOM COPYRIGHT PROTECTED

3.10	Revisions, General Notes and References	39
3.11	Information for the Production of Substation Layout Project Drawings	39
3.11.1	Station Electric Diagram	40
3.11.2	Keyplan	42
3.11.3	Bay Layout and Equipment Schedule.....	43
3.11.4	Foundation and Trench.....	47
3.11.5	Steelwork Marking Plan	48
3.11.6	Overhead Earth-Wire Layout	49
3.11.7	Transformer and Reactor Plinths	49
3.11.8	Safety and Security Fencing	50
3.11.9	Security Fence Lighting	50
3.11.10	Floodlighting.....	51
3.11.11	Special Application Drawings.....	51
3.11.12	Site and Contour Plan	52
3.11.13	Terrace, Road & Drainage Layouts	52
3.11.14	Earth-mat Layout	52
3.11.15	Buildings.....	52
3.11.16	Access Road Layout	53
3.11.17	Tubular Busbar Layout.....	53
3.11.18	Operating Diagrams.....	53
3.12	Microstation relevant files.....	55
3.12.1	Seed Files	55
3.12.2	Library Files.....	55
3.12.3	Cells	55
3.13	Municipal Approval of Drawings : Group Technology and Distribution Divisions	55
3.14	Technology Group: Storage of Drawings: Megawatt Park.....	56
4.	Authorization.....	56
5.	Revisions	57
6.	Development team	57
7.	Acknowledgements	57

Figures

Figure 1: - Eskom Logo	8
Figure 2: Group Technology: Standard Title Blocks.....	10
Figure 3: Distribution Operating Units: Standard Title Block	10
Figure 4: Kwa Zulu Natal OU: Standard Title Block	11
Figure 5: Western Cape OU: Standard Title Block.....	11
Figure 6: Standard Sizes for Drawing Sheets	14
Figure 7: KZN: Set and Sheet Numbers – Power Plant	21
Figure 8: Font 80 – Text Font	22
Figure 9: Bay Layout Drawing Guideline	45
Figure 10: Bay Layout Earthing Drawing Guideline	46
Figure 11: Operating Diagram Guideline.....	54

Tables

Table 1: Transmission: Title Block: Text Height and Width.....	23
Table 2: Distribution: Title Block:Text Height and Width	24
Table 3: Types of Line Styles	26
Table 4: Scales for different types of drawings	29
Table 5: Drawing Checklist.....	32
Table 6: Transmission: Electrical Drawing Levels.....	33
Table 7: Transmission: Electrical Drawing Levels.....	35
Table 8: Drawing Levels: Free State OU.....	36
Table 9: Set 11 Sheet Numbers: Western Cape OU.....	37

1. Introduction

This document sets out 2D CAD drawing requirements for all Substation Design Drawings for Power Plant staff and appointed consultants within the Group Technology, Transmission and Distribution Divisions.

2. Supporting clauses

2.1 Scope

This document defines general rules and codes of practices to be followed by all designers and draftspersons to produce design drawings of consistent and professional quality. The accuracy and adequacy of the design remain the responsibility of the designer or draftsman. Nothing contained in this standard shall be construed as relieving the designer or draftsman of the individual responsibility for producing quality drawings. The following document serves as a reference document to ensure that all 2D CAD Substation Power Plant drawing work within Eskom's Group Technology, Transmission and Distribution Divisions conforms to the same standard.

2.1.1 Purpose

To present a guideline and introduce a system of keeping all Group Technology, Transmission and Distribution 2D CAD Drawings Standard and identify the responsibilities of all personnel preparing and producing work to the highest standard possible. This document determines the standard requirements that must be followed for all internal Eskom as well as all the drawings compiled by parties external to Eskom for Eskom purposes.

2.1.2 Applicability

This standard shall be applicable to all Power Plant: Substation Design drawings for Eskom's Transmission Major Transmission Substations, Power Station Substations and Distribution Substations.

This document supersedes the following standard documents for Power Plant Substation Drawings:

Standard Drawing Practice For CAD Users in the Power Plant and Control Plant Technologies Environments and For Electrification Networks: DST 34-195, Rev. 1

Part 7: Substations, Section 3.2: Distribution Group's Specific Requirements For Standard Drawing Practice For Substation Design Layout, SCSASAAV0, Rev 1

All existing Distribution Operating Units Standards related to Substation: Power Plant drawings

All Group Technology: PDE: Substation Engineering and Transmission Division Design Draughting Standards

This document shall apply throughout Eskom Holdings SOC Limited Divisions, except the Generation Division.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs. The following documents must be read in conjunction with this specification. However, in cases of conflict, the provisions of this specification will take precedence.

2.2.1 Normative

- [1] ISO 9001 Quality Management Systems.
- [2] NRS 002:2000 Second Edition: Graphical symbols for electrical diagrams (www.nrs.eskom.co.za)
- [3] DISASAAN0: Standard for the labelling of high voltage equipment.

- [4] SCSASACM0 (DST_34-1171), Specific representation of operating diagrams in the field, station electric diagrams.
- [5] DISSCABR6 (DSP_34-1612), Specific requirements for symbols to be used on all schematic representations of diagrams for HV and MV voltage levels.
- [6] DSP_34-963 Specification for network operations and operating diagrams.
- [7] DSP_34-254 Specification for equipment labels.
- [8] DST_34-436 Standard for feeder operating diagrams.
- [9] DST_34-437 Standard for station operating diagrams.
- [10] SANS 10111 Engineering Drawing Part 2
- [11] SANS 10400 National Building Regulations
- [12] SANS 10143 Building Drawing practice
- [13] 240 -83904158 CADD Office Workflow Guideline
- [14] 240 – 85194150 EPSS CADD Office Work Request Form
- [15] 32-6 Eskom Document Management Procedure
- [16] 36-1 Standard For Management Systems Document, Correspondence & Records
- [17] 36-2 Writing & Controlling, Management Documentation
- [18] 240-77297024 Standard For Operating Diagrams For Eskom Transmission Substations
- [19] 240-120804300 Standard For The Labelling Of Electrical Equipment Within Eskom Wires Networks
- [20] 240-68972746 Standard Information Required For the Production of Substation Drawings
- [21] 240-8697350 Engineering Drawing Standard Common Requirements
- [22] TST41 -634 Drawing Office Standard
- [23] 240-55922824 Substation Layout Design Guideline , Part 24 , Sections 49-1 to 49-3
- [24] 240-55921217 Substation Engineering Product Realisation

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

Definition	Description
Computer Aided Design	Using a preferred Bentley Micro station application to compile detailed design drawings on computer and create and save them on the DMS.
Designer	The designer is the Engineer/Technician or Consultant responsible for the design of the Substation project.
DGN File	A DGN file is a Micro station file which contains the models, level structure and line style library of the project.
Documentation Management System	An agreed Eskom system (Directa or Bentley Project Wise) to manage all drawings of the Group Technology: Engineering, Transmission and Distribution business, like revision control, workflow, redlining, and Internet accessibility, respectively.

ESKOM COPYRIGHT PROTECTED

Definition	Description
Microfilm	(Not used in Dx and no longer used in Transmission) An original drawing reproduced on a 35mm Silver Halide negative and mounted in an aperture card, will conform to SANS code of Practice No. 10111.)
Paper Print	Clear legible reproduction of a CAD print on PPC 80g bond.

2.3.2 Disclosure classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.4 Abbreviations

Abbreviation	Description
CAD	Computer-aided design
CO	Colour
dgn	Bentley Microstation Drawing File Extension
dxf or dwg	AutoCAD Drawing File Extension
EDMS	Electronic Document Management System
OU	Operating Unit
PLCM	Product Life Cycle Management
SLDG	Substation Layout Design Guide
tiff or cit lrasb	Drawings (Tagged Image File Format)
TL	Terrace Level
TOC	Top of Concrete
SACAP	South African Council for the Architectural Profession
COE	Centre of Excellence
DTF	Document Transmittal Form
EDO	Engineering Drawing Office
EDMS	Electronic Data Management System

2.5 Roles and responsibilities

Substation Designers and Draughting Personnel shall ensure that all new and revised Substation Drawings conform to the requirements set out in this standard.

2.6 Process for monitoring

Not applicable.

2.7 Related/supporting documents

Not applicable.

3. Substation Design Drawings (Power Plant Technologies)

Diagram and data accuracy are the responsibility of every user, wherever inconsistencies and inaccuracies are identified, the valid information must be captured and forwarded to the responsible person for updating the applicable drawings as required.

3.1 Title Block and Stamps


3.1.1 Title block

All Transmission and Distribution Substation drawings, be it a revised drawing or a new drawing, when complete will bear the Eskom logo (Figure.1), Eskom Holdings Limited registration number, substation name, description of drawing, Eskom drawing number, revision number and signatures of draughtsperson's, checked and approved by, as well as the date the drawing was approved. The Eskom corporate standard for the logo shall be adhered to.





Figure 1: - Eskom Logo

The Group Technology title blocks are shown in Figure 2 whereas the title block to be used for all Distribution Operating Unit drawings is shown in Figure 3. Distribution's Kwa Zulu Natal and Western Cape OU title blocks are displayed in Figure 4 and Figure 5 respectively. For the title block level location refer to section 3.9 of this document.


0	FIRST ISSUE							12345	KEY PLAN
REV	REVISION DESCRIPTION	DRAWN	CHKD	AUTH (SUBS)	AUTH (NAT 'C)	DATE	X.XX/- REFERENCE DRAWINGS		
SUBSTATION DESIGN DESIGN CHECKED		SUBSTATION DESIGN DESIGN APPROVED					Eskom Holdings SOC Ltd Reg No 2002/015527/30		
AB CDEFGHJ		AB CDEFGHJ							
DATE DD/MM/20XX		DATE DD/MM/20XX		<div>STATION NAME</div> <div>STATION ELECTRIC DIAGRAM</div>					
SECONDARY PLANT DESIGN CHECKED		DRAWN BY							
AB CDEFGHJ		AB CDEFGHJ		<div>©</div>					
DATE DD/MM/20XX		DATE DD/MM/20XX							
SCALE: ~		0.--/-----					SHEET NUMBER	REVISION	
							0	0	

TITLE BLOCK FOR STATION ELECTRIC DIAGRAM

ESKOM COPYRIGHT PROTECTED


0	FIRST ISSUE						12345	KEY PLAN
		/ /	/ /	/ /	/ /	/ /	12345	STATION ELECTRIC
REV	REVISION DESCRIPTION	DRAWN	CHECKED	AUTH (SUBS)	AUTH (NCC)	AUTH (HV PLANT)	X.XX/-	REFERENCE DRAWINGS
NATIONAL CONTROL MANAGER: AB CDEFGHJ	SUBSTATION ENG APPROVED BY: AB CDEFGHJ					Eskom Holdings SOC Ltd Reg No 2002/015527/30		
DATE DD/MM/20XX	DATE DD/MM/20XX							
HIGH VOLTAGE PLANT MANAGER: AB CDEFGHJ	SUBSTATION ENG CHECKED BY: AB CDEFGHJ	STATION NAME OPERATING DIAGRAM						
DATE DD/MM/20XX	DATE DD/MM/20XX							
SCALE: 	SUBSTATION ENG DRAWN BY: AB CDEFGHJ	© 0.--/-----					SHEET NUMBER	REVISION
	DATE DD/MM/20XX						0	0

TITLE BLOCK FOR OPERATING DIAGRAM

0	FIRST ISSUE					12345	KEY PLAN
						12345	STATION ELECTRIC
REV	REVISION DESCRIPTION	DRAWN	CHKD	AUTH	DATE	X.XX/-	REFERENCE DRAWINGS
APPROVED BY AB CDEFGHJ					Eskom Holdings SOC Ltd Reg No 2002/015527/30		
DATE DD/MM/20XX							
CHECKED BY AB CDEFGHJ	STATION NAME XXXXXX PLAN XXXXXXXXXX						
DATE DD/MM/20XX							
DRAWN BY AB CDEFGHJ	© 0.--/-----					SHEET NUMBER	REVISION
DATE DD/MM/20XX						0	0
SCALE 1:XXXX							

TITLE BLOCK FOR KEY PLAN, STEELWORK, FENCE, FOUNDATION,
EARTHMAT AND EARTHWIRE LAYOUT.

ESKOM COPYRIGHT PROTECTED

0	FIRST ISSUE.				
REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE
 Eskom Transmission		Eskom Holdings SOC Ltd Reg No 2002/015527/30			
<h1>ASTERIA</h1> <h2>400kV TRANSFORMER 11 – FEEDER 1 BAY</h2> <h3>DIAMETER GA</h3> <h3>ELECTRICAL LAYOUT</h3>					
© WHoU12P01-SE-D16			SHEET NUMBER <div>1</div>	REVISION <div>0</div>	

TITLE BLOCK FOR BAY LAYOUT SCHEDULES ONLY

Figure 2: Group Technology: Standard Title Blocks

[illegible]

Figure 3: Distribution Operating Units: Standard Title Block

ESKOM COPYRIGHT PROTECTED

When downloaded from the WEB, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorized version on the WEB.

							CHECKED <i>[Signature]</i>	AUTHN ZED		ER _____
							DRAWN	<i>[Signature]</i>		SET SHEET REV SIGN
							<i>[Signature]</i>			
DO	REV	DRAWN	CNGD	APPROVED	DATE	FIRST ISSUE	SCALE	1:400		
						REV 3 ON DESIG PTION				

CHECKED	AUTHORIZED	MANDAWE SUBSTATION 88/11-kV EARTHMAT AND SECURITY FENCE PLAN	ER00184		
M A Cant 24/6/1988	F J Dalling 24/6/1988		SET	SHEET	REVISION
DRAWN					
J K Rodda 2/6/1988			17	04	00
SCALE	1:200				

Figure 4: Kwa Zulu Natal OU: Standard Title Block

[illegible]

Figure 5: Western Cape OU: Standard Title Block

Copyright © is to be placed in the title block of all Group Technology, Transmission and Distribution drawings. The current drawing sheet has the copyright logo in the title block. When a drawing is revised and the title block is of the old type, it shall be revised as well and this shall be noted in the revision description of the title block, that the drawing is copyright protected.

3.1.2 Drawing Stamps

Various stamps have been developed within Group Technology and are to be used and applied to all Substation Electrical and Civil drawings, created within Group Technology, for each of the PLCM stages that define the project, viz. Concept Design Phase, Detail Design Phase, Execution/Construction Design Phase and As Built Drawings.

For the Concept Design Phase, the following stamp must be applied to all associated drawings:

ESKOM COPYRIGHT PROTECTED

**CONCEPT DESIGN
NOT FOR CONSTRUCTION**

ORIGINAL DWG #: X.XX/XXXXXX REV XX

For the Detail Design Phase, the following stamp must be applied to all associated drawings:

**DETAIL DESIGN
NOT FOR CONSTRUCTION**

**ORIGINAL DWG #: X.XX/XXXXXX REV XX
CONCEPT DWG #: X.XX/XXXXXX REV XX**

For the Execution/Construction Design Phase, the following stamp must be applied to all associated drawings:

**FINAL DESIGN
FOR CONSTRUCTION**

**ORIGINAL DWG #: X.XX/XXXXXX REV XX
CONCEPT DWG #: X.XX/XXXXXX REV XX
DETAIL DWG #: X.XX/XXXXXX REV XX**

After the substation power plant infrastructure associated with a particular project is commissioned, all the drawings associated with that particular project shall be marked as As Built and uploaded onto the EDMS. Where the drawings issued for construction do not reflect the As Built status of the asset constructed, they shall first be marked up and corrected to reflect the As Built status of the constructed asset before being marked as As Built. The following stamp must be applied to all associated drawings:

ESKOM COPYRIGHT PROTECTED

AS-BUILT DRAWING

3.2 Drawing Sheet Format

Approved drawing paper, sizes from A0 – A4 as per ISO 216 and indicated in Figure 6 are to be used for prints produced for Group Technology, Transmission and Distribution divisions. A1 – A3 are the sizes normally used. The following standard drawing sheet sizes must be used:

- A0 1189mm x 841mm
- A1 841mm x 594mm
- A2 594mm x 420mm
- A3 420mm x 297mm
- A4 297mm x 210mm

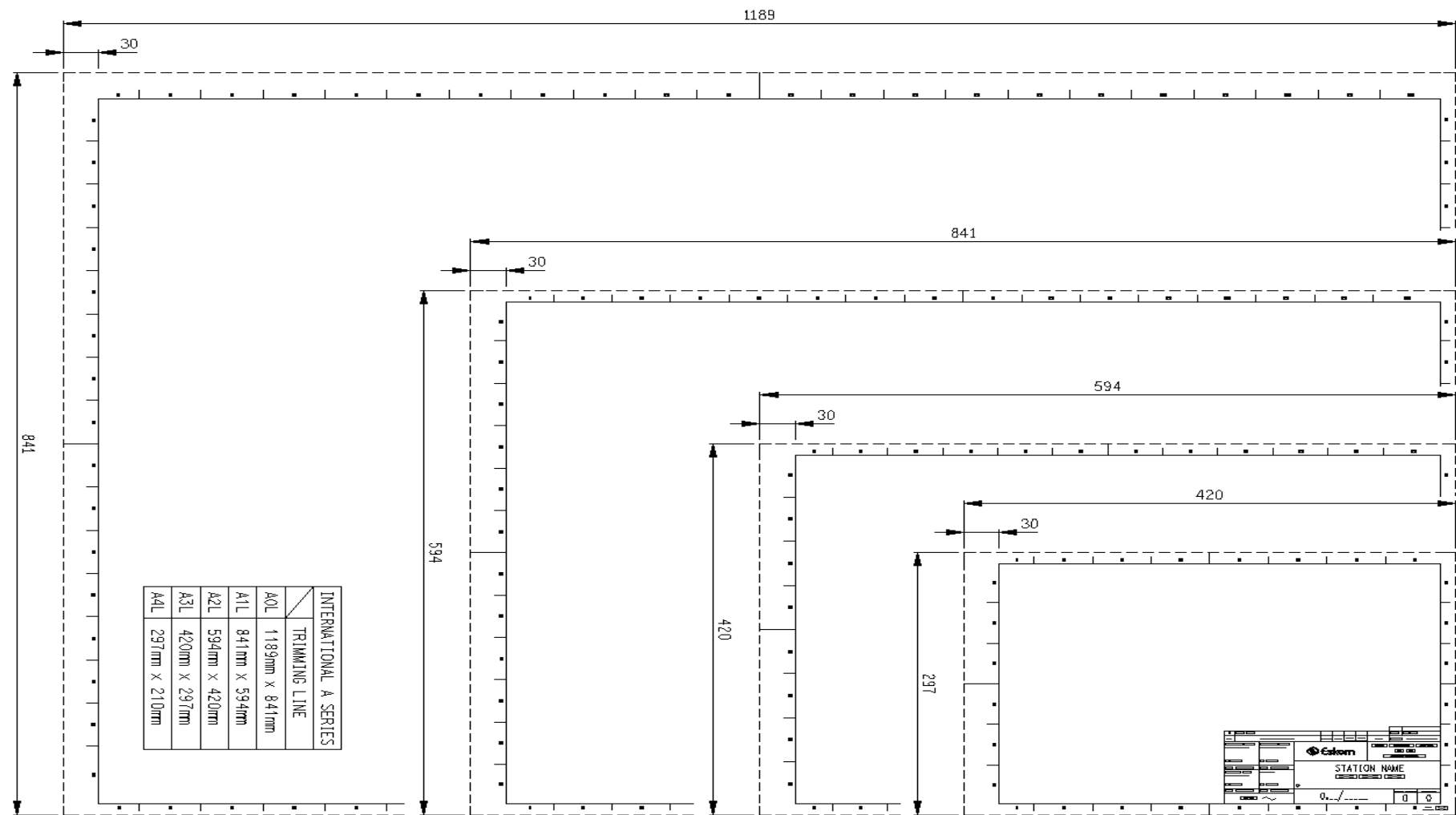


Figure 6: Standard Sizes for Drawing Sheets

ESKOM COPYRIGHT PROTECTED

3.3 Drawing Sheet Electronic Format

A Group Technology, Transmission and Distribution division approved software package must be used for all drawings produced on a CAD workstation. The preferred drawing software to be used is Microstation version V8 or later.

All drawings submitted to Eskom shall comply with the Eskom standard drawing application version at that specific time. For drawing sheet location see cell "EskomSheet_2014_REV_09".

- All vector drawings must be saved with a **.dgn** extension format.
- All raster drawings must be saved with a **.tif** extension format.
- All scanned drawings must be saved with a **.pdf** extension format

3.4 Drawing Numbering Format

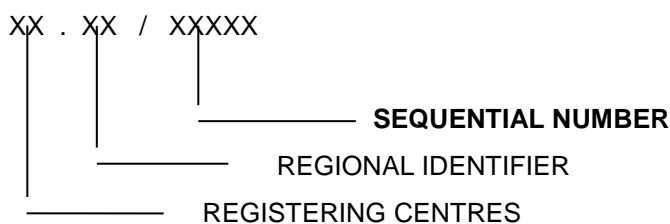
- All drawings must be registered by Eskom on the Electronic Document Management System (EDMS)
- Contractors shall maintain a Drawing Register which records at least the following information:
 - Eskom Drawing Number.
 - Drawing Title.
 - Eskom Revision.
- The Contractor's drawing register must be made available to Eskom for audit on request.

3.4.1 Transmission Drawing Numbering Format

Drawings that have more than one sheet must have the same drawing number, this should be indicated as such on the drawing, in numerical order starting from sheet 1 (one). The cover sheet of such Drawings should be indicated as sheet 0 (zero). The cover sheet, should indicate the sheet number, title, design and project revision and date pertaining to that scheme. Also indicated are the levels used and the description of that particular level.

Drawing numbers shall be requested in writing from the designated Eskom Document Controller.

Drawing numbers shall have the following format:



The following is a list of the registering centres and regional identifiers.

3.4.1.1 Registering Centres

- | | | |
|---|--------------------------|----|
| • | Megawatt Park | 0 |
| • | Simmerpan (Distribution) | 10 |
| • | Rosherville | 13 |
| • | Peaking | 18 |
| • | Witbank | 19 |
| • | Matimba | 20 |

ESKOM COPYRIGHT PROTECTED

•	Tutuka	21
•	Lethabo	23
•	Duvha	24
•	Hendrina	25
•	Arnot	26
•	Kriel	28
•	Matla	29

3.4.1.2 Regional Identifiers

•	00	Head Office
•	03	West Cape Region
•	07	Natal Region
•	08	East Transvaal Region
•	09	Umgeni Power Station
•	10	Hex River Power Station
•	13	Wilge Power Station
•	7.14	Klip Power Station
•	15	Hendrina Power Station
•	17	Border Region
•	18	Rand and Orange Free State Region
•	19	Grootvlei Power Station
•	21	Vaal Power Station
•	22	Vierfontein Power Station
•	24	Simmerpan
•	25	Rosherville
•	26	Taaibos Power Station
•	31	Highveld Power Station
•	33	Komati Power Station
•	35	Ingagane Power Station
•	36	Camden Power Station
•	37	Orange River Region
•	38	Hendrik Verwoerd Power Station and Dam
•	39	Vanderkloof Power Station and P.K. Le Roux Dam
•	41	Arnot Power Station
•	42	Ruacana Power Station
•	44	Swawek Distribution Region
•	45	Kriel Power Station

- 46 Koeberg Nuclear Power Station
- 47 Matla Power Station
- 48 Pumped Storage Stations
- 49 Gas Turbine Power Stations
- 50 Megawatt Park Complex
- 51 Transmission Line Towers (all Regions)
- 52 Control and Protection Equipment (all Regions)
- 53 Communication (all Regions)
- 54 HV Yard Standards (CB's, CT's, Isol, SA's and Similar Equipment (all Regions)
- 57 Duvha Power Station
- 58 Matimba Power Station
- 60 Eskom College
- 61 Tutuka Power Station
- 63 Lethabo Power Station
- 64 Kendal Power Station
- 65 Strategic Spares (under Operations Dept. Control)
- 66 Majuba Power Station
- 68 765 kV Projects
- 69 Eskom (Copyright) Line Towers
- 70 Megawatt Park Tenants Properties
- 70 Megawatt park Special Projects
- 71 Epupa Project
- 72 Modular Applications
- 73 Measurement Standards
- 78 Hydro
- 82 Klipheuwel Windfarm
- 83 Braamhoek
- 84 Medupi Power Station
- 85 Mosel Bay/ Gourikwa
- 86 Atlantis/Ankerlig
- 87 Gourikwa Gas 1
- 88 Ankerlig Gas 1
- 89 Coega CCGT
- 90 Kusile
- 91 Golf
- 92 Coega Gas 1

-
- 93 Ngula
 - 94 Combined Cycle Gas Turbine
 - 95 Wing Energy Facility No. 1
 - 96 Nuclear Site 1
 - 97 Coal 3
 - 98 Underground Coal Gasification

The naming convention on a CAD workstation is in the following format:

XX . XX - XXXXX / XX - XX - . dgn/tif
X - ab- XXXXX - XX - XX - . dgn/tif

FILE NAME

FILENAME EXTENSION

The naming convention on the document management system is in the following format:

Metadata:

XX . XX / XXXXX - XX
XX - ab - XXXXX - XX

Filename:

XX . XX / XXXXX - XX - XX - . dgn/tif
XX - ab - XXXXX - XX - XX - . dgn/tif

FILENAME EXTENSION

FILE NAME

File names use the drawing number of the drawing e.g.

0.12/12345 Sheet 5 Revision 2, thus 0.12-12345-05-02-.dgn

On the drawing sheet, where the sheet number is indicated as a single character, the filename within the document management system and the CAD workstation are to be denoted as two characters. Also, the drawing number will have 5 characters on the drawing as well as the document management system.

3.4.2 Distribution Drawing Numbering Format

Distribution Region Identifiers

The following regional identifiers exist and are to be used within the Eskom Distribution division:

- O-WC West Cape Region
- O-SC South Cape Region
- O-NC North Cape Region
- O-EC East Cape Region
- O-FS Orange Free State Region
- O-CT Central Transvaal Region
- O-ST South Transvaal Region

ESKOM COPYRIGHT PROTECTED

- O-WT West Transvaal Region
- O-NT North Transvaal Region
- O-ET East Transvaal Region
- O-WN West Natal Region
- O-EN East Natal Region

3.4.2.1 Limpopo

No indication of the naming convention was provided at the time of publishing this standard

3.4.2.2 Mpumalanga

The naming convention of CAD drawings is to be in the following format: X.XX/XXX.**DGN**

Existing Drawing number prefixes are as follows:

- 7.18/
- 0.00/
- 0.08/
- 2.08/
- D-ET/
- 2-WT/
- 2-NT/

All new drawings will have the following format: 2-ET/XXXX

Set numbers are only used for Primary Plant Drawings, e.g. The set normally consist of 8 sheets:

- Sht 1 – STATION ELECTRIC DIAGRAM
- Sht 2 – SITE PLAN
- Sht 3 - LEVEL AND DRAINAGE LAYOUT
- Sht 4 - FOUNDATION AND EARTHMAT LAYOUT
- Sht 5 - GENERAL ARRANGEMENT
- Sht 6 - SECTIONS AND CLAMP LAYOUT
- Sht 7 - A) CONTROL ROOM
 - B) ELECTRIC LAYOUT
 - C) DOOR SCHEDULE
- Sht 8 - TRANSFORMER PLINTH LAYOUT
- Sht 9 - OTHER INFORMATION AS NEEDED

3.4.2.3 Northwest

No indication of the naming convention was provided at the time of publishing this standard

3.4.2.4 Gauteng

No indication of the naming convention was provided at the time of publishing this standard

3.4.2.5 Free State

No indication of the naming convention was provided at the time of publishing this standard

3.4.2.6 Kwa Zulu Natal

- The naming convention of CAD drawings is to be in the following format: ER00001-16-01-00.DGN
- ER00001 the unique ER number that remains with the asset for life
- 16 the set number that differentiates between different types of drawings
- 01 the sheet number, when one or more sheets are needed for that set
- 00 the revision number of the drawing
- DGN the file extension
- Set numbers for drawings have been pre-allocated to the different sections within Asset Creation and are defined as follows -
 - **Sets 01 to 15** - Land Development drawings.
 - **Sets 16 to 50** - NED Power Plant drawings.
 - **Sets 51 to 100** - NED Control Plant drawings
- See Figure 7 for Kwa Zulu Natal OU's Set and Sheet Numbers to be used for Power Plant

SET No	SHT No	TITLE	REVISIONS								
			1	2	3	4	5	6	7	8	9
16		DRAWING INDEX									
20		SINGLE LINE DIAGRAM									
01		CIVIL/STRUCTURAL DRAWINGS COVER SHEET									
17		***-kV YARD									
01		SITE, LEVEL AND DRAINAGE PLAN									
02		STEELWORK MARKING AND ARRANGEMENT PLAN									
03		FOUNDATIONS AND CABLE ROUTES PLAN									
04		EARTHMAT AND SECURITY FENCE PLAN									
05		TRFR PLINTHS, BUNDS AND MANHOLES LAYOUT AND SECTION									
18		BAY ELEVATIONS/SECTIONS									
01		***-kV FEEDER 1 BAY ELEVATION									
02		***-kV FEEDER 2 BAY ELEVATION									
03		***-kV BUSBARS, BUS-SECTION AND VT'S BAY SECTION									
04		***-kV TRANSFORMER 1 HV BAY ELEVATION									
05		***-kV TRANSFORMER 1 MV BAY ELEVATION									
06		***-kV TRANSFORMER 2 HV BAY ELEVATION									
07		***-kV TRANSFORMER 2 MV BAY ELEVATION									
08		***-kV FEEDER 1 BAY ELEVATION (AF1)									
09		***-kV FEEDER 2 BAY ELEVATION (AF2)									
10		***-kV FEEDER 3 BAY ELEVATION (AF3)									
11		***-kV FEEDER 4 BAY ELEVATION (AF4)									
12		***-kV FEEDER 5 BAY ELEVATION (AF5)									
13		***-kV FEEDER 6 BAY ELEVATION (AF6)									
14		***-kV FEEDER 7 BAY ELEVATION (AF7)									
15		***-kV FEEDER 8 BAY ELEVATION (AF8)									
16		***-kV BUSBAR AND VT'S SUPPORT BAY ELEVATION (AF9)									
17		***-kV BUSBAR BAY SECTION									
19		CONTROL ROOM									
01		SITE PLAN									
02		FLOOR PLAN									
03		SECTIONS AND DETAIL									
04		ELEVATIONS									
05		PANEL LAYOUT									
06		ELECTRICAL LAYOUT									
07		WATER TANK DETAILS									
08		PAINTING SCHEDULE									
20		CIVILS									
01		***-kV TRANSFORMER 1 (***MVA) PLINTH AND OIL BUND DETAILS									
02		***-kV TRANSFORMER 2 (***MVA) PLINTH AND OIL BUND DETAILS									
03		OIL DAM SECTION AND DETAILS									
04		STAINLESS STEEL FIRE BARRIER DETAILS									
05		STONE PITCHED HEADWALL SECTION AND DETAILS									
06		BRICK HEADWALL AND STILLING BASIN SECTION AND DETAILS									
07		TERRACE SECTIONS A-A AND B-B CHAINAGE									
08		ACCESS ROAD CROSS SECTIONS									
21		***-kV 'A' FRAMES									
01		BUSBAR STRUCTURE ASSEMBLY DETAILS (AF1)									
02		END STRUCTURE ASSEMBLY DETAILS (AF2)									
03		INTERMEDIATE STRUCTURE ASSEMBLY DETAILS (AF3)									
04		INTERMEDIATE STRUCTURE ASSEMBLY DETAILS (AF4)									
05		INTERMEDIATE STRUCTURE ASSEMBLY DETAILS (AF5)									
06		INTERMEDIATE STRUCTURE ASSEMBLY DETAILS (AF6)									
07		END STRUCTURE ASSEMBLY DETAILS (AF7)									
08		BUSBAR STRUCTURE ASSEMBLY DETAILS (AF8)									
09		BUSBAR/VT SUPPORT STRUCTURE ASSEMBLY DETAILS (AF9)									
10		ITEMS 1-29 MANUFACTURING DETAILS									
11		SOIL TYPES 1-3 FOUNDATION DETAILS									
22		2.4m STEEL PALISADE FENCE									
01		COVER SHEET									
02		POSTS & PARTS MANUFACTURING DETAILS									
03		CLG2, G5 & G6 ASSEMBLY AND DETAILS									
04		CPJCP, PFP, TP & AP ASSEMBLY AND DETAILS									
05		PLP2 & P3 ASSEMBLY AND DETAILS									
06		RPS & RPS ASSEMBLY AND DETAILS									
07		SG5 & SGG ASSEMBLY AND DETAILS									
23		HC-CUBE CONTAINER (12m)									
01		STEELWORK MANUFACTURING DETAILS									
02		CONTROL ROOM ELEVATION									
03		SETTING OUT SECTIONS AND PLAN									
04		FOUNDATION AND SETTING OUT PLAN									
05		SETTING OUT SECTIONS AND PLAN									
06		'SUPAVENT' MOUNTING AND DUCTING MANUFACTURING DETAILS									

REV	DATE	BY	CHKD	AUTH	DESCRIPTION
01					FIRST ISSUE

CHECKED	AUTHORIZED
H/S/D	SCALE
DRAWN	NTS

STANDARD SUBSTATION

***-kV

CIVIL/STRUCTURAL DRAWINGS

COVER SHEET

ER00000

SET	SHEET	REVISION
16	01	00

Figure 7: KZN: Set and Sheet Numbers – Power Plant

ESKOM COPYRIGHT PROTECTED

3.4.2.7 Eastern Cape

No indication of the naming convention was provided at the time of publishing this standard

3.4.2.8 Northern Cape

No indication of the naming convention was provided at the time of publishing this standard

3.4.2.9 Western Cape

No indication of the naming convention was provided at the time of publishing this standard

3.5 Text Font, Line Types and Dimensioning**3.5.1 Text Font**

Text font used in Group Technology, Transmission and Distribution divisions is Font 80 as indicated in Figure 8. The text justification should be done in such a way that later editing does not require the text to be moved. Distribution's Mpumalanga OU uses Font 1 and 3.

- a) The standard font used for all text is ESKOMFT80

FONT 80					
LETTERS AND DIGITS			SPECIAL CHARACTERS		
FONT 80			FONT 80	KEYBOARD	
A	a	0	~	<	~
B	b	1	Ω	>	!
C	c	2	@	θ	@
D	d	3	#	,	#
E	e	4	Σ	.	\$
F	f	5	%	/	%
G	g	6	^	,	^
H	h	7	&		&
I	i	8	*		*
J	j	9	((
K	k))
L	l		+		+
M	m		+		+
N	n		=		=
O	o		φ		{
P	p		Ø		}
Q	q		≡		
R	r		∴		[
S	s		∴]
T	t		≡		\
U	u		∴		:
V	v		∴		"
W	w		∴		;
X	x		∴		
Y	y		∴		
Z	z		,		

Figure 8: Font 80 – Text Font

ESKOM COPYRIGHT PROTECTED

- b) Standard layers and colours have been defined for the text styles. The draughtsperson must ensure that the correct layer is selected when placing text.
- c) The text size must be adjusted in the text style once the draughtsperson has selected the final drawing size and scale.
- d) The text style settings specified in Table 1 must be used in accordance with the drawing scales specified:

Table 1: Transmission: Title Block: Text Height and Width

	Drg. No Sheet Revision	Station Title	Drg. Title	Scale Notes Dimensions	Rev./Ref. Notes Signature
Scale: 1:1					
Text Height	7	7	3.5	3	1.8
Text Width	5	5	2.5	2.5	1.5
Weight	4	4	2	2	1
Scale: 1:2					
Text Height	14	14	7	6	3.6
Text Width	10	10	5	5	3
Weight	4	4	2	2	1
Scale: 1:5					
Text Height	35	35	17.5	15	9
Text Width	25	20	12.5	12.5	7.5
Weight	4	4	2	2	1
Scale: 1:10					
Text Height	70	70	35	30	18
Text Width	50	50	25	25	15
Weight	4	4	2	2	1
Scale: 1:20					
Text Height	140	140	70	60	36
Text Width	100	100	50	50	30
Weight	4	4	2	2	1
Scale: 1:50					
Text Height	350	350	175	150	90
Text Width	250	250	125	125	75
Weight	4	4	2	2	1
Scale: 1:100					
Text Height	700	700	350	300	180
Text Width	500	500	250	250	150
Weight	4	4	2	2	1

	Drg. No Sheet Revision	Station Title	Drg. Title	Scale Notes Dimensions	Rev./Ref. Notes Signature
Scale: 1:150					
Text Height	1050	1050	525	450	270
Text Width	750	750	375	375	225
Weight	4	4	2	2	1
Scale: 1:250					
Text Height	2500	1500	1000	750	500
Text Width	1500	1000	750	625	375
Weight	4	4	2	2	1
Scale: 1:750					
Text Height	7500	4500	3000	2250	1500
Text Width	4500	3000	2250	1875	1125
Weight	4	4	2	2	1

Group Technology and Transmission: Text

The texts used for a 1:1 scale shall be as follows:

- Notes and dimensioning, the text height (TH) shall be 3mm and the text width (TW) 2.5mm.
- Subheadings, like the drawing scale, notes and dimensions, the text height shall be 3,5mm and the text width 3,0mm.
- Headings /SOL, the text height shall be 4.5mm and the text width 3,75mm.
- Master font used shall be Font 80 with a line spacing (LS) of 0.5mm for Scale: 1. All text attributes to be multiplied by the active scale, for example, for scale 1:100: TH=300, TW=250, LS=50
- The indicated text heights, widths, weight are only to be used when a new drawing is created. For all existing drawings the text must remain as it is and must not be changed. Only if the revision is for the text to be revised or added, then the indicated sizes and levels shall be used.
- The text heights specific to the following Group Technology drawings: Operating Diagram, Bay Layout and Bay Layout Earthing, should be in accordance with figures

Distribution:Text

The text used shall be in accordance with the information displayed in Table 2.

Table 2: Distribution: Title Block:Text Height and Width

	Name	TH	TW	WT
Text sizes (All sheets in scheme) * application only	Title	7	5,5	2
	Sub titles	4,5	3,5	2
	Drawing no.	7	5,5	2
	Revision notes *	3	2,5	0
	Revision number *	7	5,5	3
	Project signature *	3	2,5	0
	Authorised signature *	3	2,5	0

ESKOM COPYRIGHT PROTECTED

	Name	TH	TW	WT
	Checked Signature *	3	2,5	0
	Drawn signature *	3	2,5	0
Other text	CAD reference number	3	2,5	0

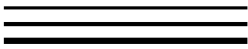
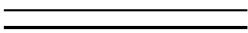


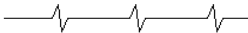






3.5.2 Types of Lines

Only the types and thickness of lines shown in Table 3 will be used. In cases where other types of lines are used for special fields, or if lines specified in Table 3 are used for application other than those detailed in the second last column of the table, the conventions adopted must be indicated or explained by notes on the drawings concerned.

3.5.3 Thickness of Lines

In general, no more than two thicknesses of lines should be used on any one drawing. However, for lines that do not represent a real feature, it is preferable to use a line that is "thin", (i.e. the thinner line for centre lines and dimension lines, and the thicker line for certain physical features, e.g. hidden detail, outlines of revolved sections, bus bars, etc.). Where it is possible to restrict the drawing to two-line thickness, the ratio of the thick line to the thin line shall not be less than 2:1.

Table 3: Types of Line Styles

LINE	DESCRIPTION	GENERAL APPLICATIONS	LINE WEIGHT	LINE CODE
A 	CONTINUOUS	A1 VISIBLE OUTLINE	2, 3 OR 5	0
A 	CONTINUOUS	A2 VISIBLE OUTLINE	1 OR 2	0
B 	CONTINUOUS THIN (STRAIGHT OR CURVED)	B1 IMAGINARY LINES OF INTERSECTION	0	0
		B2 DIMENSION LINES	0	0
		B3 PROJECTION LINES	0	0
		B4 LEADER LINES	0	0
		B5 HATCHING	0	0
		B6 OUTLINES OF RESOLVED SECTIONS IN PLACE	0	0
C 	CONTINUOUS (CURVED)	C1 LIMITS OF PARTIAL OR INTERRUPTED VIEWS AND SECTIONS, THE LIMIT IS NOT A CHAIN THIN LINE	0	0
C 	BREAK	C2 LIMITS OF PARTIAL OR INTERRUPTED VIEWS AND SECTIONS, THE LIMIT IS NOT A CHAIN THIN LINE	0	0
D 	CLOUD	D1 REVISION	2	0
E 	DASHED	E1 EMPHASISED APPLICATIONS	5	3
E 	DASHED	E2 HIDDEN OUTLINES AND FUTURE EXTENTION	0	2 OR 5
E 	DASHED	E3 LINKING LINES	1	2
F 	PLANE	F1 CUTTING PLANES	0 (CHAIN)	6
			3 (END)	0
G 	CHAIN)	G1 INDICATION OF LINES WHICH SPECIAL REQUIREMENTS APPLIES (eg: X-Y SETTING OUTLINE)	3	6
LINE WEIGHT AND CODE IS DEPENDENT ON DISCIPLINE AND APPLICATION				

ESKOM COPYRIGHT PROTECTED

3.5.4 Spacing of Lines

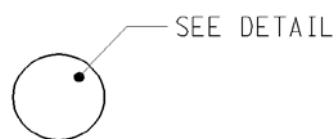
To allow for the present limitations of printing and viewing of microfilm copies, the adjacent parallel lines should be spaced at least 1mm apart (it is accepted that in some cases the scale of the drawing will thus be violated).

3.5.5 Termination of Leader Lines

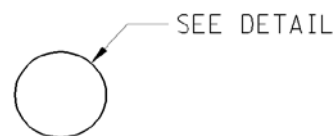
(Use **Place Note** from MicroStation menu, where possible)

Leader lines should terminate: -

- With a dot, if line ends within the outlines of an object, at an angle of 135° where possible to the leader line.



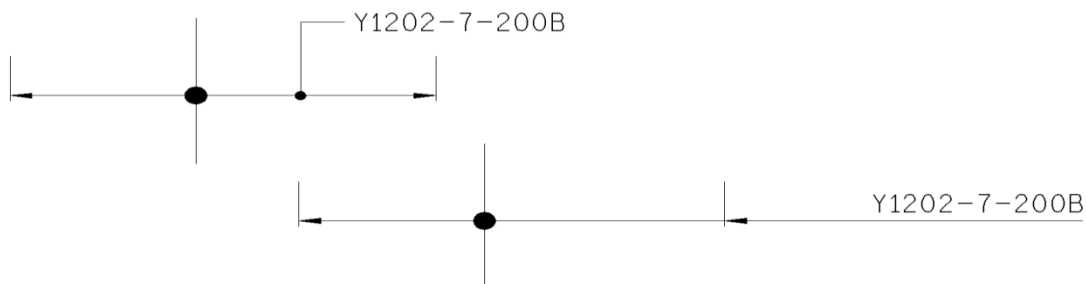
- With an arrowhead, if line ends on an outline of an object, at an angle of 135°.



- Without a dot or arrowhead, if a line ends on a dimension line.



- Without a dot or arrowhead, without any dimension line, e.g. reinforcement details.



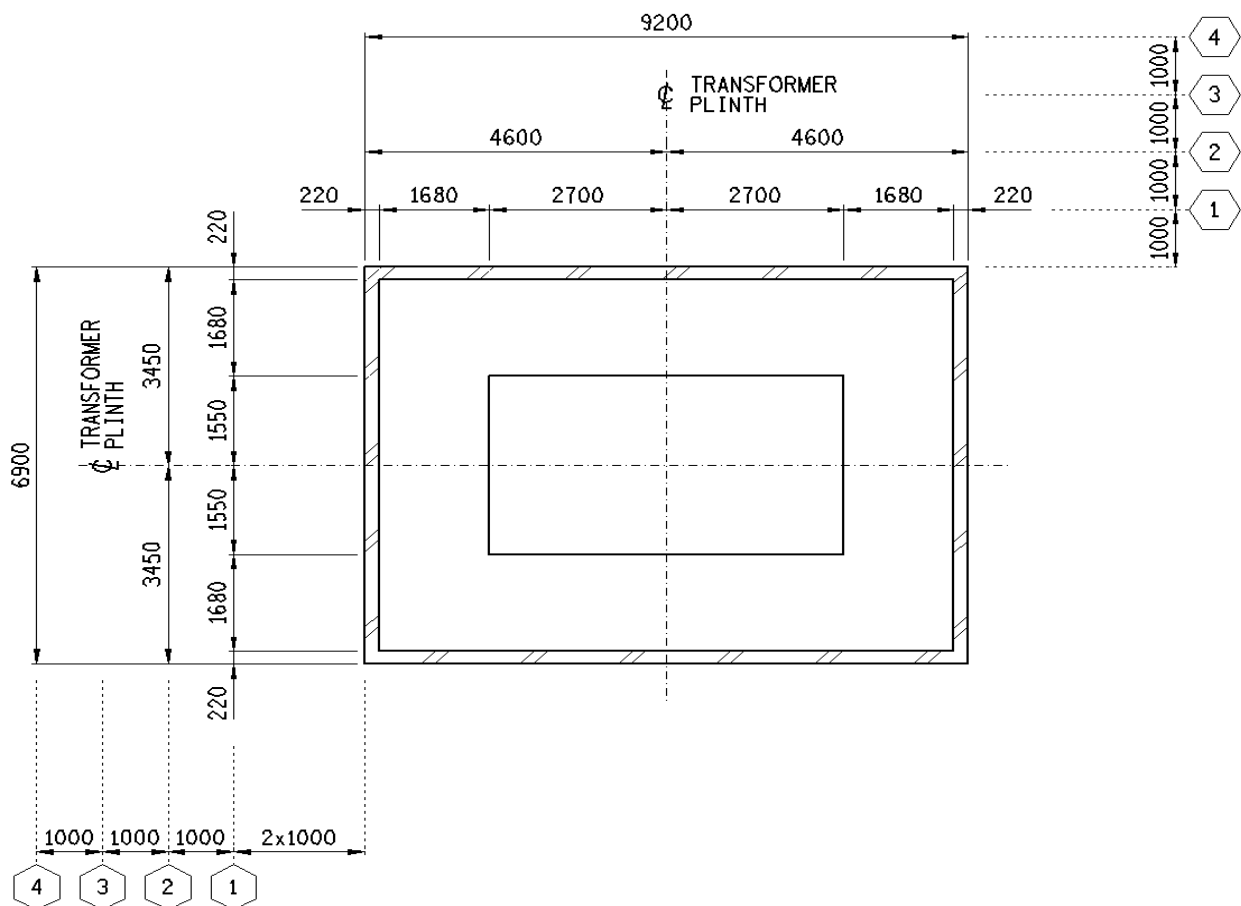
- Arrowhead must be filled.



3.5.6 Dimensioning

(Use Linear Dimensioning from Microstation menu)

- Arrow heads are to be closed and filled in.
- Auto dimensioning can be used with the annotation scale on.
- The length of the Arrow is 1 x (Text Width) and Height is 0.5 x (Text Height).
- Where the space is too small for an arrowhead, a dot (1.5mm) may be used, as shown below.
- Auto dimensioning is to be used, but must conform as per Standard, as set out in this manual.
- Do not drop dimensions, nor double dimensioning; it is to ensure your overall accuracy.
- Try to avoid dimension line crossings.
- Give overall dimensions.
- Write smaller dimensions first, (1) then (2) then (3).



- Draw witness lines 10mm apart (hint: use AcuDraw), starting at the same distance away from the drawing.
- Dimension lines cutting-drawing lines should be deleted at points of interference, as the drawing line takes preference.
- When a dimension line sits over a centre line, delete the part of centre line.
- Always use the Station Setting Out Lines and Centre Lines as the base for dimensioning. When a number is greater than 1m, write 2340 and not 2 340, i.e. do not leave a space.

ESKOM COPYRIGHT PROTECTED

3.6 Presentation of Views and Projections

3.6.1 Drawing Layout

- Where practical, place the Plan in the top left-hand corner of the sheet. Start from the top Left-hand corner on big layouts. Sections and Elevations are to be placed to the right or below the Plan.
- Long sections of roads should be placed below the plan, preferably with the 0 change in line.
- Only 1000m of road should be shown on the sheet at a scale of 1:1000. The long section should be exaggerated 2.5 or 10 times, depending on the topography of the ground.
- Do not cram the drawings - rather use another sheet if there is too much detail.
- Do not place boxes around separate details - drawings should be laid out so that details are clearly separated.
- Line up descriptive notes to details and draw leader lines to the detail as close as possible.

3.7 Scales, Co-Ordinates and Grid

3.7.1 Scales

The number of scales on each drawing shall be kept to a minimum. The final drawing is to indicate the following scales as specified in Table 4. Where possible, all drawings are created on CAD at 1:1 (full size) to an accuracy of 1mm. This complies with the Group Technology, Transmission and Distribution CAD System requirements.

Table 4: Scales for different types of drawings

TYPE OF DRAWING	SCALE
Locality Plan	1:50 000
	1: 25000
	1:10000
Key Plan	1:1000
	1: 750
	1:500
	1:400
	1:250
	1:200
Contour Plan	1:750
	1:500
	1:200
Layout Drawing (Plans, Sections, Elevations)	1:500
	1:400
	1:250
	1:200
	1:150
	1:100
Component Drawing (Details)	1:50
	1:25
	1:20
	1:10
	1:5
	1:2
	1:1

ESKOM COPYRIGHT PROTECTED

When work is completed for a drawing (at scale 1:1), the Scale of certain Details and Sections will be adjusted to prepare the final drawing for plotting. Likewise the Text Height and Width shall be altered to suit the final Scale of the Border Sheet, as shown in **Table 1: Transmission: Title Block: Text Height and Width** for scaled Drawings.

3.7.2 File design to views

The final drawing must be saved with “Rotating view angles = 0°”

Set the views on the screens as follows:

Window 1: The drawing to be fitted in this view.

Window 8: Title block

3.7.3 Drawing sheets

3.7.3.1 Sheet 00 — Master sheet

This sheet shall be the Master sheet (named as ***. **/****-00**) with all the information required for the substation.

Draughts persons can use either modules or levels which-ever is preferred.

Dimensioning should be done on the master.

A Master files must always be created for all new greenfield substations.

Where time and project cost permit and all the existing drawings exist in dgn format (Microstation files), a Master file must be created for all existing substations where it does not exist.

3.7.3.2 Sheet 01 — Station Electric Diagram / Operating Diagram

This sheet is a legally binding document (named ***. **/****-01**). For national standard see 240-89556857(SCSASACM0), Distribution Group’s specific representation of operating diagrams in the field, station electric diagrams.

3.7.3.3 Sheet 02 — Site Plan

This sheet shall show the location of the substation and its co-ordinates or the north arrow” (named ***. **/****-02**).

Additional information specific to the Site Plan sheet will be drawn on the Master sheet.

3.7.3.4 Sheet 03 — Terrace Level and Drainage Plan

This sheet shall show all levels of the terrace, the positions and schedules of the drainage (named ***. **/****-03**).

Any additional information specific to the Terrace Level and Drainage Plan sheet will be drawn on the Master sheet.

3.7.3.5 Sheet 04 — Earth Grid Layout/Earthmat Layout

This sheet shall indicate the position of the copper rods, straps in relation to the equipment, the earthing of the main steelwork foundations and the fence earthing.

(named ***. **/****-04**).

Any additional information specific to the Earth Grid Layout sheet will be drawn on the Master sheet at the.

3.7.3.6 Sheet 05 — Foundation Layout

This sheet shall show all the positions of the Main Column foundations, trenches, pug boxes, FEK busbar foundations including numbering and Transformer plinths of the substation (named *.*/*-05).

Any additional information specific to the Foundation Layout sheet will be drawn on the Master sheet.

3.7.3.7 Sheet 06 — Steelwork Layout/Steelwork Marking Plan

This sheet shall show all the steelwork including the main columns, beams, bay arrows, busbar foundation and numbering, u-bolts, beams mounting heights (named *.*/*-06).

Any additional information specific to the Steelwork Layout sheet will be added to the Master sheet.

3.7.3.8 Sheet 07 — General Arrangement Layout

This sheet shall indicate the main steelwork, floodlight, tubular and busbar support (named *.*/*-07).

Any additional information specific to the General Arrangement Layout sheet will be added to the Master sheet.

3.7.3.9 Sheet 08 — Sections Layout

This sheet shall indicate various sections and clamps to be used for the substation (named *.*/*-08).

Any additional information specific to the Section Layout sheet will be drawn on the Master sheet.

3.7.3.10 Sheet 09 – Earthwire Layout

This sheet shall indicate earth wire, columns, earthwire peaks, tubular, floodlight, U-bolts to be used to attach the earthwires (name *.*/*-09).

3.7.3.11 Sheet 10 – Tubular Busbar Layout

This sheet shall indicate the busbar support, tubular layout and the clamps, tubular conductor and damping conductor details to be used for the substation (name *.*/*-10).

3.7.3.12 Sheet 11 – Bay Layout

This sheet shall indicate the busbar support, tubular layout, equipment, equipment foundation, columns, beams and Transformer plinth and earthing details to be used for the substation (name *.*/*-11).

3.7.3.13 Sheet 12 – Transformer Plinth

3.7.3.14 Sheet 13 – Safety and Security Fencing

3.7.3.15 Sheet 14 – Security Lighting Layout

3.7.3.16 Sheet 15 – Operational Floodlight Layout

3.7.3.17 Sheet 16 – Access Road Layout

3.7.3.18 Sheet 17 – Site and Contour Plan

3.7.3.19 Sheets that will follow

Any additional sheets for the same project shall continue with the same numbering system, adding the sheet number to the same drawing number (named *.*/*-**).

3.8 Mark-Ups, Red-lining and Checking

3.8.1 Marking-Up of Drawings

All drawing sheets will be marked up with the following listed colours, which represent what function needs to be performed by the draughtsperson. No other markings of any sort, e.g. pencil or pen, will be added to the drawing.

3.8.2 Colour Codes for Mark-Ups

Corrections or Add Information	- Red
Delete	- Yellow
Correct work	- Green
Comments(will not be drafted)	- Blue

3.8.3 Check List

The table provides a systematic, non-exhaustive, suggested approach to aid checkers in checking work and training new people.

Table 5: Drawing Checklist

Step	Description of activity	Check
1	Good checking = good screening. Problem approach should be systematic and methodical, going through the job step by step, gradually covering the whole subject.	
2	Obtain all information pertaining to the drawing, e.g. design file, tif file, and relevant reference drawings.	
3	The latest revision should be used related to all sources of Information.	
4	Obtain a clear conception of design prior to checking.	
5	All reference drawings are listed in the list of reference drawings. Protection reference drawings are on sheet 0.	
6	Check correct spelling.	
7	Check quantities are correct and in the correct units.	
8	Check all abbreviations. If possible all words should be spelled out in full. Use only standard abbreviations. Be consistent throughout the drawing. <ul style="list-style-type: none"> in accordance with the standard indicated showing clear intent do not overlap with other drawing elements 	
9	Check all dimensions and locations of all items on the drawing.	
10	Check for interference from equipment of other disciplines.	
11	All applicable notes are indicated in the notes drawing section and are clear and concise.	
12	Lines, Text, Symbol, Scales, Levels, Layers etc., as prescribed.	
13	On scanned drawings (i.e. raster files) replace the old symbology with the new drawing sheet and title block.	
14	A cancelled or superseded or dismantled substation drawing must be revised. Place " CANCELLED " or " SUPERSEDED " or " DISMANTLED " and the DATE	

ESKOM COPYRIGHT PROTECTED

Step	Description of activity	Check
	including the draughtperson's name in large bold text at an angle of 30° across the drawing. The comments column in drawing management system must be updated to reflect the status of the drawing as well as the new Superseded Drawing Number.	
15	Drawing items and notes to be well spaced and clear, concise and readable.	
16	The Revision Block must contain a clear description of the changes for the particular Revision. "As built" and "Mark-up as per print on site" are not acceptable.	
17	Check work thoroughly. Problem approach should be systematic and methodical. Strive for CORRECT FIRST TIME .	
18	Check that all electrical clearances conform to SLDG	

3.8.4 Guide to Acceptable Drawing Practice

Take a logical approach towards creating the drawing: -

- Understand what you must draw.
- Think about how to draw it.
- Ensure what you draw is feasible, practical and economical.
- Pay attention to spelling.
- Avoid the use of trade names e.g. Rocia, Bidim, etc.
- Indicate pipe diameters as $\phi 900$ or 900DIA and not DIA900 or 9000.
- When writing a word, dimension etc., ensure that you do not write over something else. Partial delete the least important elements.
- Write the scale under every Layout, Plan, Elevation, Detail, etc. and only "AS SHOWN" in the title block.
- Section Arrows should point to the top of the sheet and from right to left.

3.9 Reference Files and Levels

3.9.1 Technology Group: Substation Engineering

The standard **Transmission_Civil.dgnlib** must be attached to all Tx drawings, and worked hereto.

The Electrical model layout drawing levels are displayed in Table 6 below.

Table 6: Transmission: Electrical Drawing Levels

Level	Level Name
1	Tx_1 Border; Title; Text
2	Tx_2 North Arrow
3	Tx_3 SOL
4	Tx_4 Text and Dimension
5	Tx_5 Station Electric Diagrams Symbols (omit symbols that are not applicable on the drawing)
6	Tx_6 Station Electric Diagrams_Text_Legend_block

ESKOM COPYRIGHT PROTECTED

Level	Level Name
7	Tx_7 Operating Station Electric Diagrams
8	Tx_8 Earth Mat Crimpet
9	Tx_9 Earth Mat Clamp
10	Tx_10 Earth Mat Rod Tx_10A 2x 10mm Cu rod for earthtail
11	Tx_11 Bus Bar Conductor Assemblies
12	Tx_12 Stringer Conductor Assemblies
13	Tx_13 Droppers Interconnectors and Stringers
14	Tx_14 Terrace Line
15	Tx_15 Fences
16	Tx_16 Road Substation
17	Tx_17 Road Outside
18	Tx_18 Yard Trench
19	Tx_19 Control Buildings and Microwave Tower
20	Tx_20 Plinth and Bund Wall
21	Tx_21 Floodlight Mast
22	Tx_22 Floodlight Foundation
23	Tx_23 Main Steelwork and Firewall
24	Tx_24 Main Steelwork Foundation
25	Tx_25 Main Equipment Outline
26	Tx_26 Earth Wire Tx_26A Earth Wire Peak
27	Tx_27 Earth Wire Steelwork Column
28	Tx_28 Earth Wire Steelwork Foundation
29	Tx_29 Equipment Support
30	Tx_30 Equipment Foundation
31	Tx_31 Equipment Outline
32	Tx_32 Equipment Clamps
33	Tx_33 HV Cables
34	Tx_34 Revision
35	Tx_35 Other Buildings
36	Tx_36 PI Support and Foundation
37	Tx_37 Tubular
38	Tx_38 Centre Lines
39	Tx_39 Terminal Towers
40	Tx_40 Miscellaneous Items
41	Tx_41 U-Bolt Steelwork
41A	Tx_41A U-Bolt Earthwire

Level	Level Name
42	Tx_042 Column_Steelwork_Layout_Drawing
43	Tx_043 Beam_Steelwork_Layout_Drawing
44	Tx_044 Firewall
45	Tx_045 Fire Equipment Kiosk
46	Tx_046 Position of Floodlights
47	Tx_047 Plug Box
48	Tx_048 Optical Fibre
49	Tx_049 Pi Support
50	Tx_050 Future Bay and Spare For OD
51	Tx_51 Sleeves

The Civil model layout drawing levels are displayed in Table 7 below.

Table 7: Transmission: Electrical Drawing Levels

Level	Level Name
51	Civil_51 Ownership And Or Farm Boundaries
52	Civil_52 Fire Protections
53	Civil_53 Terrace Slopes
54	Civil_54 Terrace Sections
55	Civil_55 Terrace Drainage Details
56	Civil_56 Terrace Text
57	Civil_57 Road Text
58	Civil_58 Road Drainage Plan Details
59	Civil_59 Roads - Horizontal and Vertical Alignment; Edge of Road
60	Civil_60 Long Section Box
61	Civil_61 Borehole Notations
62	Civil_62 Co-Ordinate Line and Tables

3.9.2 Distribution

At the time of finalising this document only the Free State OU and Western Cape OU provided an indication of the levels used within that specific OU. These levels can be found in Table 8 and Table 9 below. In the case of the Western Cape OU, levels 1 to 14 are used in each sheet with functions differing per sheet number and power plant only uses set 11 for all equipment and set 12 for 11kV Station Electric Diagrams.

Table 8: Drawing Levels: Free State OU

NO	DESCRIPTION	E/M	GA	FDN	STEEL	L & D	SEC
1							
2							
3							
4							
5	Centre lines		ON	ON	ON	ON	
6	Sewerage pipes, manholes and descriptions			ON			
7							
8							
9	Drainage pipes, descriptions and dimensions					ON	
10	Contours					ON	
11	Road terrace, description and dimensions					ON	
12	Foundation levels					ON	
13							
14							
15							
16							
17							
18							
19							
20	Transformer plinth, runway and fire wall	ON	ON	ON	ON	ON	
21	Cable trench		ON	ON			
22							
23	Buildings	ON	ON	ON		ON	
24	Foundation descriptions, dimensions notes and cut outs			ON			
25							
26							
27							
28	Fence and kerbing	ON	ON	ON	ON	ON	
29							
30							
31							
32							
33	Future equipment		ON				
34							
35	Main dimension and description		ON	ON	ON		
36							
37							
38							
39							
40	Foundations	ON		ON		ON	
41	Ga foundations		ON		ON		
42	Ga equipment		ON		ON		
43	Light/Lightning poles		ON				
44	Lights		ON				
45							
46	Steel column and beam configuration		ON		ON		
47	Equipment stringing		ON				
48							
49							
50							
51							
52							
53							
54							
55							
56	Sections and descriptions						ON
57							
58							
59							
60	Existing earth mat	ON					
61	New earth mat	ON					
62							
63							
80	Subbom						

Table 9: Set 11 Sheet Numbers: Western Cape OU

	Function	Building; transformer plinth, bund wall & slipway; fencing and Eskom boundary; gates; gate apron; kerbing; substation road; centre lines; setting out lines.	Contours	Manholes; drainage; culverts & ducts ; cable trenches	Future equipment/extensions	Conductor top view	Earthing	Cable routes	Steelwork (including caps)	Equipment	Foundation	Grid	Dimensions	General information to personal needs	General information to personal needs
	Level No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sheet No.	Function														
00	Master Drawing	-	-	-	-	-	-	-	-	-	-	-	-	-	-
01	Station Electric Diagram/ Operating Diagram	-	-	-	-	-	-	-	-	-	-	-	-	-	-
02	Site Plan	ON	ON	OFF	ON	ON	OFF	ON	ON	ON	OFF	ON	ON	ON	ON
03	Level & Drainage Plan														
04	Earth Grid layout	ON	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF	ON	ON	ON
05	Foundation and trench layout	ON	OFF	ON	ON	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON	ON/OFF	ON/OFF
06	Steelwork Marking plan layout	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	ON/OFF	ON/OFF
07	Electrical equipment	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	OFF	ON/OFF	ON/OFF

ESKOM COPYRIGHT PROTECTED

	layout														
08	Sections and Clamps (HV Feeders, HV Busbars and Transformers)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
09	Section and Clamps (MV Feeders and MV Busbars)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Yard Lighting layout	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	OFF	ON/OFF	ON/OFF
11	Lightning Protection Layout	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	OFF	ON/OFF	ON/OFF
-	Indicates that levels do not apply														

ESKOM COPYRIGHT PROTECTED

When downloaded from the WEB, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorized version on the WEB.

3.10 Revisions, General Notes and References

To show changes/modifications, use a triangle and a cloud. For new clamps, use a square and for existing clamps/items use a circle.

When adding Revision Notes, be explicit. Do not add "As built" or "Mark-up as per print on site".

Adhere to Text Sizes and Weights as noted in this document. The following symbol is to be added to the drawing in the immediate area of the present revision if the Revision Note is not explicit enough, with the current revision number in it and 'cloud' around the revised area on the drawing.



The symbol from all past revisions **must** be deleted. All general notes on a drawing are to be positioned in such a way that they are legible. All notes are to be included under the heading "**Notes**". Any drawing that has information taken from another drawing must have that drawing number stated in the reference column above the title block. The words "**ON HOLD**", are to be denoted within a cloud, if the information specific to a particular item is not available at the time of issuing of the drawing.

In the case of Distribution, Kwa Zulu Natal, North West, Western Cape and Gauteng Operating Units, all revisions are shown in red.

The Eastern Cape Operating Unit makes use of revision notes in the Title block and legends to explain new works

Mpumalanga makes use of clouds and colour.

3.11 Information for the Production of Substation Layout Project Drawings

Group Technology: Power Delivery Engineering: Substation Engineering is responsible for creating the following drawings:

- Station Electric Diagram
- Key Plan
- Bay Layout and Equipment Schedule
- Foundation and Trench
- Steelwork Marking Plan
- Overhead Earth Wire Layout
- Transformer and Reactor Plinths
- Safety and Security Fencing
- Security Fence Lighting
- Floodlight Layout
- Special Application Drawings
- Site and Contour Plan
- Terrace, Road and Drainage Layout
- Earthmat Layout
- Buildings
- Access Road Layout
- Tubular Busbar layout
- Operating diagram

ESKOM COPYRIGHT PROTECTED

For a list of drawings that Distribution : Network Engineering Design is responsible for compiling , see list under item 3.7.3 Drawing Sheets

While all the above drawings are important for any project, the Key Plan and Station Electric Diagram are by far the most significant, as they include information that impacts virtually every other drawing. These are also the drawings that are used for any discussions regarding the project without going to detail drawings (which may or may not be prepared at that time) The Station Electric diagram is classified as a legal and binding drawing.

3.11.1 Station Electric Diagram

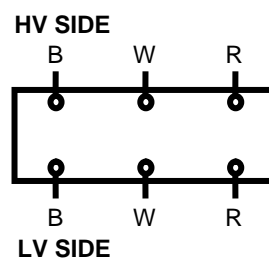
Cell Library = StationElectricD_2010_REV_.cel & Stamp_2015 & 1 EskSheet_2014_REV_09

This is indicated in Single Line form for the complete project including Future Bays shown dotted (Line Code = 2 and weight to be remain), plus Future Extensions also dotted (Future Busbar

Line Code = 3 and weight to be remain). It shows all the equipment with its appropriate electrical symbol in its relative physical position. Obviously the bay positions will follow the layout as dictated by the Key Plan.

The following information is to be shown.

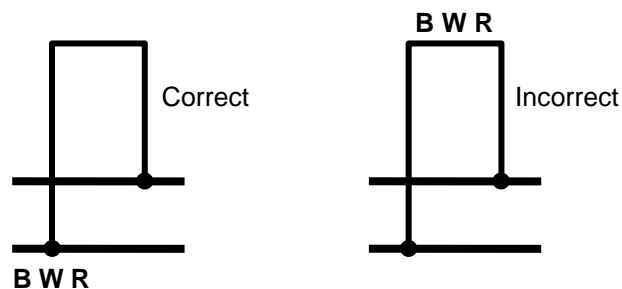
- 1) Busbar designations, phasing and zone numbers for every voltage:
"BUSBAR1", "BUSBAR2", "B/B 1", "B/B 2", "ZONE".
- 2) Numbering and Phasing for Transformer Bays (note: Transformer Phasing is dictated by the transformer reading R W B as looking at the HV terminals on the HV side).



- 3) Numbering and phasing for Feeder Bays:-

Note 1: Phasing must correspond with the station at the other end of the line, with the exception of some long 400kV lines which introduce phase transpositions.

- 4) Transformer bays to indicate MVA, kV and vector group of Transformer,
e.g. TRFR 1 125MVA 400/132/22kV YNa0d1
and also Auxiliary Transformers, Dyn11
e.g. AUX TRFR 315kVA 22 kV/380V
- 5) Bus Coupler bays to indicate lettering.
e.g. B/C "A", B/C "B" etc., and phasing that cannot be confused.



Note: Some existing projects indicate bus coupler bays as “EAST” and “WEST”, or “NORTH” and “SOUTH”. These are to be revised to “A” and “B” (in line with STANDARD FOR THE LABELLING OF ELECTRICAL EQUIPMENT WITHIN ESKOM WIRES NETWORKS5) whenever an existing substation is being modified to accommodate any major new works.

- 6) Each zone of Busbar is to be identified with ‘BUSBAR 1’ and “BUSBAR 2” OR “BUSBAR 1A” and “BUSBAR 1B”, in the case that a busbar is sectionalised.
- 7) Position of Line Traps to be given by reference to the appropriate phase, or phases where they are physically located.

Note: In general, these should correspond to the other end of the line.

- 8) North Point (same direction as KEY PLAN [use Reference File])
- 9) Table for each voltage providing:
 - a) Bay name FEEDER 1 (or FDR 1), BUS COUPLER ‘A’ (or B/C ‘A’), etc.
 - b) Description to provide the name of the line destination and its number
e.g. NEPTUNE 1, NEPTUNE 2, etc.
 - c) Number and date for each stage of the project to be given against each bay.
 - d) Rating of circuit breaker for each bay and voltage
e.g. 3150A
- 10) Place note for “ISOLATOR BLADE OPENING DIRECTION SHOWN GEOGRAPHICALLY CORRECT” (remember this when placing isolator symbol in bays).
- 11) Table for CT Bus Zone turns ratios for each voltage
e.g. 400kV 1/2400.
- 12) Station battery voltage.

General note: If revising an existing Station Electric Diagram where information under notes 4.9.4, 4.11 and 4.12 are missing, add if possible.

- 13) Bay Bus-Zone number prefixes to be shown in a bubble located close to the circuit breaker of each bay - this information to be obtained by passing a print of drawing to the relevant person in the Protection Department.
- 14) One set of CVT’s/VT’s to be indicated for each zone of busbar.
- 15) Remember to indicate the Isolator Earth Switches on the correct sides.
Refer to S.L.D.G. 12 - 1.
- 16) Bus Section Bays to be identified
e.g. 400kV BUSBAR 1, 400kV BUS SECTION 1 etc. and B/S 1 and B/S 2. (See Labelling Standard 240-120804300)
- 17) Ends of each voltage Busbar to be designated ‘EAST’, ‘WEST’ or ‘NORTH’, ‘SOUTH’ depending on North point. (See note 4.8).

-
- 18) Indicate the current ratings of the Busbars - i.e. for twin "BULL" Busbars and triple "BULL" Busbars
- 19) The handing of the Isolator Earth Switches, are determined by viewing the isolator from the front of the isolator mechanism box. The position of the isolator mechanism box will be indicated on the Station Electric Diagram in conjunction with the isolator symbol.

3.11.2 Keyplan

Cell Library = New ENC 2012, Stamp_2015 & 1 EskSheet_2014_REV_09

This drawing indicates the overall picture of the project and its position relative to site boundaries, existing Roads, existing Power Lines etc.

Information that should be shown on the drawing:-

- 1) An Outline of all Main Steelwork (Columns and Beams) for all the Voltages involved.
- 2) Busbars and Stringers to be indicated on the centre phase only.
- 3) Terrace Lines.
- 4) Buildings (Control Room, Workshops, Stores, etc.).
- 5) Microwave Tower reservation
(Allow for the largest Tower available - 75m high - (\pm 17m square over base) unless the size has been specified for the project).
- 6) Oil Holding Dam/Oil Traps.
- 7) Roads. Note that the minimum Radius for the transporters are 35m. The minimum Straight beyond the TRFR's Centre Line are 50m.
- 8) **TERMINAL TOWER:** Maximum spans thus; From C of the Substation Steel to the C of the Terminal Tower.
(Commonly referred to as "Closing or Slack Span")

66/88kV	aprox	35m
132kV	aprox	40m
220/275kV	aprox	50m
330/400kV	aprox	60m
765kV	aprox	70m (30deg maximum angle)

Note: Longer spans than quoted can be attained - confirm this with the Structural Engineer.
- 9) Setting Out Beacons and Station Setting Out Lines X-X1 and Y-Y1 (preferably through a line of columns).
Note: Y-Y1 is North/South and X-X1 is East/West.
- 10) Yard Setting Out Line.
- 11) North point (in top, left hand corner and pointing in an upwards direction if possible).
- 12) Possible Future Extensions to be shown in dashed
(Line Code = 2 or 5, but do not change weight).
- 13) Bay Centre Line and Description.
- 14) Gates and Removable Panels.
- 15) Barrier Fence.
- 16) Safety Fence

ESKOM COPYRIGHT PROTECTED

-
- 17) Dimensions relative to the Setting Out Lines (SOLs) for Columns, Beams, Fence, Terrace Lines, Bay Centre Lines, Terminal Towers, Roads and Beacons.
 - 18) Table for Busbar, Conductor size per Phase (all Voltages).
 - 19) Table for tensions per conductor (all voltages plus earth wire).
 - 20) Each yard portion to be identified with its Voltage.
 - 21) Transformer Fire Equipment Kiosk (FEK) to be indicated.
 - 22) Floodlighting position indicated with correct symbol.
 - 23) Standard notes and Schedules as required. Refer CELL "1 EskomSheet_2014_REV_09 04_a0_KP"
 - 24) Fire Walls (if required).
 - 25) Water Tower (if required).
 - 26) Area for conservancy Tank/Septic Tank to be indicated.
 - 27) Tubular Busbar and PI support foundations

3.11.3 Bay Layout and Equipment Schedule

Cell Library = New ENC 2012, Stamp_2015 & 1 EskSheet_2014_REV_09

This drawing consists of A3 size CAD generated sheets that are copied over from "STBAYS", bay types selected to suit the project. Three sheets covering bay descriptions and sheet numbers, reference drawings and conductor and hardware schedule precede the bay sheets.

- 1) Sheet numbers to be added for:
 - a) Cover Sheet
 - b) Reference Drawing Sheet
 - c) Conductor and Hardware Sheet
 - d) All Bay Sheet plus Bay Earthing Sheet (Do not add North arrow)
 - e) System Fault Level per Voltage to be added. (Refer to Design Engineer).
 - 2) Sheet 1
 - Add drawing numbers and titles for all layout drawings associated with the project
 - i.e. KEY PLAN, STATION ELECTRIC DIAGRAM, CONTOUR SITE PLAN, STEELWORK AND MARKING PLAN, FOUNDATION, TRENCH AND EARTH-MAT LAYOUT, etc.
 - 3) Sheet 2
 - a) Add all the requirements as listed to suit Stage 1 of the project. (Any later Stages 2, 3 etc. to have a new sheet for their particular requirements, and will take sheet numbers 2A, 2B etc.). The stage number and date to follow Station Electric Diagram. (Do not quote dates).
- Note:** Bay requirements can only be finalised when each bay and earthing sheet has been completed; common requirements are to be taken from the KEY PLAN and the FOUNDATION, TRENCH & EARTH-MAT LAYOUT.
- 4) Skeleton Master Bay sheets are to be completed to suit project information.
 - a) Equipment Schedule to be filled in with relevant numbers for Foundations, Supports, Caps, Outline numbers, Order Number and ENC Number, Stem and Pad Details of equipment
 - b) Outline and Foundation of Circuit Breaker is to be shown, and Conductor Connections to adjacent equipment indicated.
 - c) Any missing dimensions are to be filled in (e.g. dimensions for Pantograph Isolators and Post Insulators on 400 kV Bays on both the Elevation and Foundation Plan).

ESKOM COPYRIGHT PROTECTED

- d) Positions of line traps, Pantograph Isolators and Post Insulators are to be indicated on the Foundation Plan using the appropriate Symbol as indicated.

Note: The relative positions should agree with the STATION ELECTRIC DIAGRAM.

- e) Level of the Foundation for the Pantograph Isolators and associated Post Insulators are to be completed. (This is normally the same level as the Main Busbar Steelwork Foundations - refer to the **FOUNDATION LAYOUT**).
- f) Conductor and Hardware Schedule are to have all the blanks completed to suit the equipment as recorded in the Equipment Schedule.

- 5) Station Setting Out Lines X-X1 or Y-Y1.

Note: Number and size of the line conductor is required to complete the "Line Clamp" part of schedule - refer to the Design Engineer.

- 6) Busbar numbers are to be added to the Elevation.

Note: These should line up with the STATION ELECTRIC DIAGRAM.

- 7) The bubble shown at the opposite end to the Bay Arrow is to be completed. (This information is available from the **FOUNDATION LAYOUT** so as to correctly orientate the bay).
- 8) Skeleton Master Bay Earthing sheets are also to be completed to suit the project. Earthing Sheets are selected to match bay type and Fault Levels as shown on Schedule Sheet 1.
- 9) Foundation of the Circuit Breaker is to be indicated. (Refer to Equipment Schedule on the Bay Sheet for drawing number).
- 10) Earth Connections are to be shown for the addition of the Circuit Breaker. The numbers of connections are to match the fault level. (Refer to Transmission Substation Earth Fault Application Guide, 240 - 95773230).

Upto 25kA	:	Two connections
Between 25kA and 40kA	:	Three connections
Above 40kA	:	Four connections

Note: Table of quantities includes clamps, crimpets and copper for Circuit Breaker. (If in doubt regarding Circuit Breaker Earthing refers to Design Engineer).

- 11) Standard Bays Check hyperwave & Sharepoint
- 12) The required text heights, widths together with the information required to create this drawing are shown in Figures 9 and 10 below.

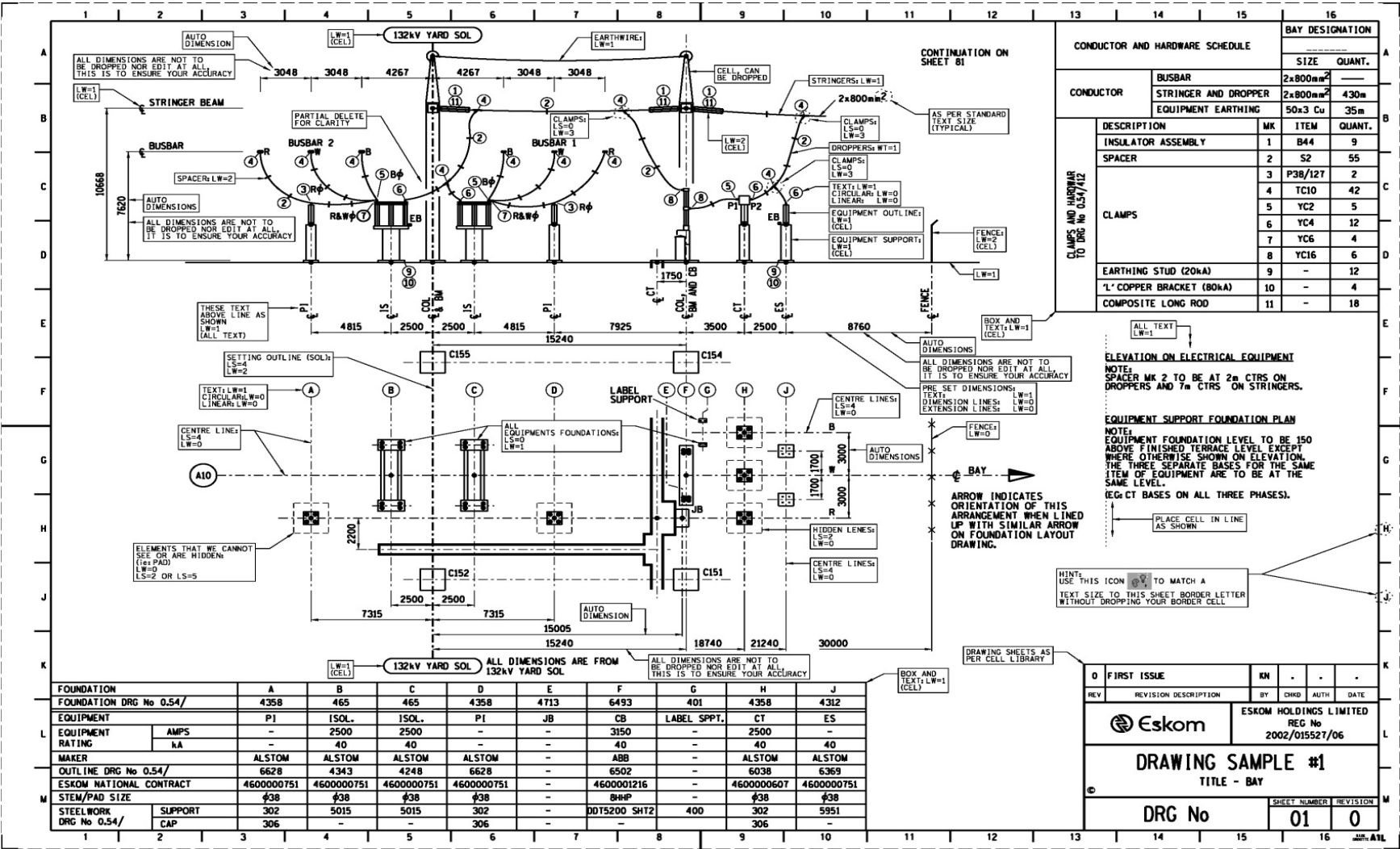
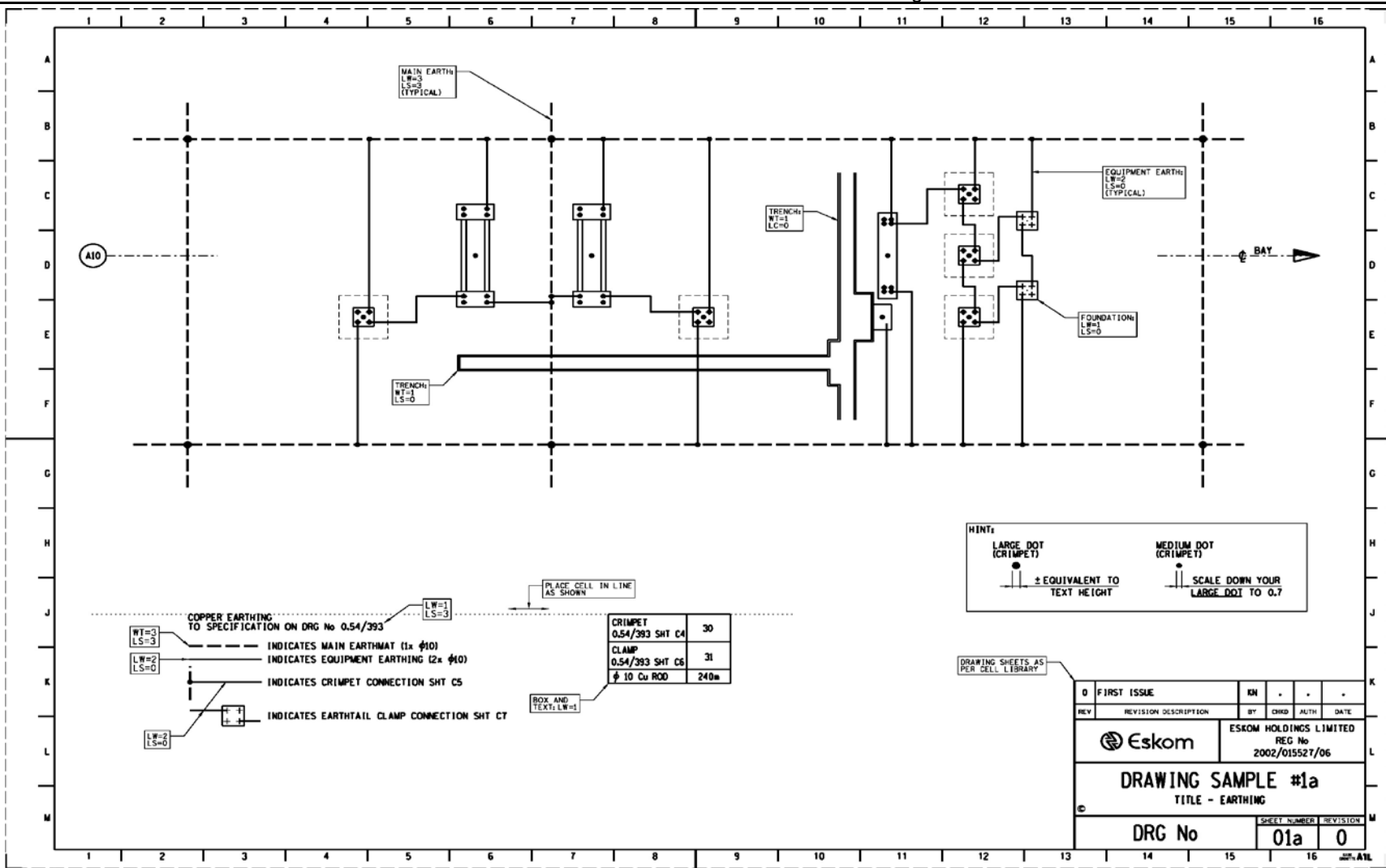


Figure 9: Bay Layout Drawing Guideline

ESKOM COPYRIGHT PROTECTED

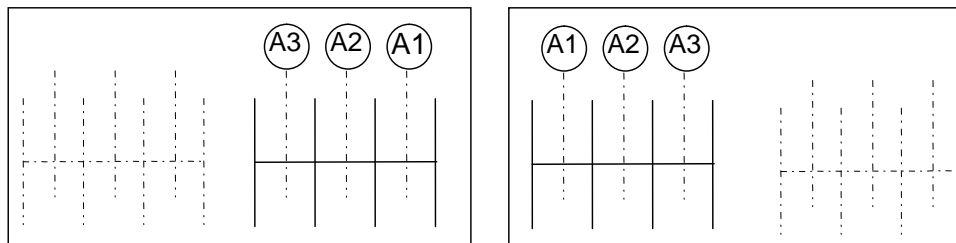


3.11.4 Foundation and Trench

Cell Library = New ENC 2012, Stamp_2015 & 1 EskSheet_2014_REV_09

- 1) The majority of information to be given on this drawing is for the Civil Construction of the project including the total quantities of the Main and Equipment bases. Station Setting Out Lines X-X1 and Y-Y1 and Yard Setting Outlines are to be shown. (As per Key Plan [use Reference File]).
- 2) All Main Column bases are to be shown and fully dimensioned relative to the Station and Yard Setting Out Lines (See Note 6.13), (Same as per Key Plan [use Reference File]) and each Base to be identified by a Mark Number e.g. C1 upwards for the one Yard Voltage and C101, C201 etc. upwards for other Yard Voltages, preferably starting with the highest voltage at C1, others following in voltage order)..
- 3) Centre Lines and description of all bays are to be shown. (As per KEY PLAN [use Reference File]).
- 4) Orientation Arrow for all bays are to be indicated. (Refer to BAY LAYOUT SCHEDULE).

Bay Arrow. (Numbering to have prefix "A" for the highest Voltage, "B" and "C" etc. for the lower Voltages). If the Yard has Future Bays on the left hand side, start with A1 on the furthest right hand bay and number sequentially to the left of this. Reverse this when future bays are on the right hand side as shown below.



- 5) Each Yard portion is to be identified with its Voltage (as per KEY PLAN [use Reference File])
- 6) Cable Trench and Ramp positions are to be shown and dimensioned together with Junction Boxes for each equipped bay. (Reference should be made to the Bay Layout Schedule initially for these details, together with Civil Work standard details 0.54/390 for detail numbers of Trenches and Junctions). Diameter Marshalling Kiosk (DMK) to be shown and dimensioned on larger Voltage designs (400kV and above on Breaker and Half designs) for the size and shape of the Building - refer to Civil Design Engineer. (Detail drawings for the Building will be produced by the Civil Section). No centre lines for Trenches, only on Bay Layouts
- 7) Road is to be shown and its Centre Line dimensioned.
- 8) Ducts under the Road and into the Control Building are to be shown and positioned
- 9) Fence lines are to be shown, but not dimensioned.
- 10) Control Building is to be shown and positioned dimensionally. For the size and shape of the Building - refer to Design Engineer. (Detail drawings for the Building will be produced by the Civil Engineering Section).
- 11) Schedule for Main Bases (One Schedule per Voltage) covering the Main Columns, Transformer Plinths. Microwave Towers, etc. - giving mark numbers, types (if any), number off, Drawing Numbers and Levels. Also indicate the stage number, but not date, for each Schedule - refer to the Station Electric Diagram. Each Schedule is to be identified with a unique letter A, B, C, etc.
- 12) Schedule for Equipment Bases. (One schedule per Voltage covering all Equipment positioned in that Yard) is to include the description, number off, Drawing Number, plus remarks regarding any grouped bases being indicated, and a reference to the Bay Layout Schedule for the location of Bases (or located on Foundation Layout drawing). Quantities for most of the Equipment Bases can be taken from the Bay Layout Schedule. Also indicate the stage number, but no date, for each Schedule - refer to the Station Electric Diagram. Each schedule is to be identified with a unique letter A, B, C, etc.

- 13) Schedule of all Buildings including all Drawing Numbers of Plan, Elevations, Building Details, lighting etc. Also indicate the stage number, but no date, for each Schedule - refer to the Station Electric Diagram. Each Schedule is to be identified with a unique letter A, B, C, etc.
- 14) North point (same direction as per Key Plan).
- 15) All notes. Notes 4 and 8 are to have the relevant Drawing Number filled in.
- 16) Plug Boxes are to be positioned and dimensioned. Try to locate a plug box per transformer or reactor bay to provide power for an oil filtration unit.

Note: One Plug Box (PB) contains 8 circuits and each bay takes one of these circuits - positioning of plug boxes are to accommodate future extensions if possible, treat each side of bus section as a separate area. (Liaise with Protection Department).

- 17) Transformer Fire Equipment Kiosks (FEK) are to be positioned and dimensioned.
(Refer to Key Plan [use Reference File]).
- 18) Transformer Plinths are to be indicated. For detail refer to Civil Section
- 19) Fire Wall are to be indicated. (Detail drawings for the Fire Walls will be produced by the Civil Section).
- 20) Protection Kiosks are to be indicated and dimensioned. Lighting and Lightning Masts to be shown and dimensioned. Note that the Cell for these differ from each other
- 21) Standard notes and Schedules as required. Refer CELL "1 EskomSheet_2014_REV_09 04_a0_KP"

3.11.5 Steelwork Marking Plan

Cell Library = New ENC 2012, Stamp_2015 & 1 EskSheet_2014_REV_09

This drawing shows all the information required by the steelwork contractor for the correct erection of all the Main Yard and Equipment Steelwork used on the project.

- 1) Station Setting Out Lines X-X1 & Y-Y1 and Yard Setting Out Lines are to be shown.
(As per Key Plan [use Reference File]).
- 2) All main Columns, Beams and position of any Earth-Wire peaks (whether part of the Column or a separate part bolted to top of Column) are to be shown. (Refer to Key Plan and Overhead Earth-Wire layout [use Reference File]).
- 3) U-bolts for all Strain and Suspension Insulators, plus Earth-Wire Peaks are to be indicated - remember to provide U-bolts on line side of Beam on all Feeders, whether Equipped or Future.

Note: U-bolts are not to be shown for 400kV pre 1990 steelwork, or 275kV and 400kV post 1990 steelwork, as these are an integral part of the steelwork detail and include all beams U-bolts, and on all four sides of earth-wire peak.

- 4) Bay Centre Lines and descriptions are to be shown. (Refer KEY PLAN [use Reference File]).
- 5) Bay and Busbar Centre Lines are to be dimensioned relative to the Main Columns. Ensure that the Beams with off-set U-bolts are erected the correct way around. (Refer to Key Plan [use Reference File]).
- 6) For new 400kV Stringer Beam type NB2, an indication is to be made regarding which side of the Beam carries U-bolts at 8m centres.
(This will normally be on the side away from the 400kV Busbars).
- 7) Bay Orientation Arrow plus the Bay bubble reference number is to be indicated as per Foundation Layout.
- 8) Each Yard portion is to be identified with its Voltage. (Refer to Key Plan).
- 9) All Columns and Earth-Wire peaks are to have a mark number that will be the same as recorded on Foundation Layout.

ESKOM COPYRIGHT PROTECTED

- 10) All Beams are to have a mark number that is similar to the Columns; they should start with B1 upwards for the one Yard Voltage, and B101, B102 etc. upwards for other Yard Voltages preferably starting with the highest voltage at B1, others following in order of voltage order.
- 11) The Height of every Beam Centre-Line above the Foundation level must be shown
- 12) Indicate the Fence, Control Building, Microwave Tower, Water Tanks etc. but do not dimension.
- 13) North point. (As per Key Plan [use Reference File]).
- 14) Schedule for the Main Steelwork. (One schedule per voltage) covering Columns, Beams, Earth-wire Supports, U-bolts, etc. giving mark numbers, types (if any), number offs and drawing numbers. Also indicate the stage number, but no date, for each Schedule - refer to the Station Electric Diagram. Each Schedule is to be identified with a unique letter A, B, C, etc.
- 15) Schedule of Equipment Steelwork. (One Schedule per Voltage) include description, drawing number, number off, plus remarks for any grouped Steelwork. Refer also to the Bay Layout Schedule for the equipment location. Also indicate the stage number, but no date, for each Schedule - Refer to the Station Electric Diagram. Each Schedule is to be identified with a unique letter - A, B, C, etc.
- 16) Standard notes and Schedules as required. Refer CELL "1 EskomSheet_2014_REV_09 04_a0_KP"

3.11.6 Overhead Earth-Wire Layout

Cell Library = New ENC 2012, Stamp_2015 & 1 EskSheet_2014_REV_09

This drawing indicates the routing of the overhead Earth-Wire Information that should be shown on the drawing:-

- 1) The supporting Columns with Earth-Wire peaks.
- 2) Roads.
- 3) Transformers and Reactors.
- 4) Buildings (Control Room, Workshops, Stores, etc.).
- 5) Fences are to be shown, but do no dimension.
- 6) Station Setting Out Lines X-X1 and Y-Y1.
- 7) North point (top left-hand corner pointing upwards)
- 8) Each Yard to be identified with its Voltage.
- 9) Schedule for Conductor and Hardware.
- 10) Earth-Wire attachment Detail
- 11) U-bolts position
- 12) Standard notes and Schedules as required. Refer CELL "1 EskomSheet_2014_REV_09 04_a0_KP"

3.11.7 Transformer and Reactor Plinths

Cell Library = (TBA)

This drawing is to include all Details and dimensions to cover the Plinth construction by the Civil Contractor. Obviously it must be drawn to suit the particular Transformer/Reactor ordered for the project.

- 1) North point. (As per Key Plan [use Reference File]). Remember to position the Layout Plan relative to the North point.

-
- 2) Plan view to indicate and dimension Runway, Cooler Bank Foundations (if any) Bund Walls, Plinth, Drains plus Auxiliary Transformer Foundation and Tertiary Column Foundation (if any). Also the Fence line and Foundations for Surge Arresters (both sides of Transformer), Label Support, Transformer Distribution Board and Main Columns.
 - 3) To be dimensioned relative to the Road centre line and Main Columns.
 - 4) Bund Wall Areas, Floor Slopes and Drainage are to comply with the standard for Passive Fire Protection for oil filled Equipment in HV yards.
 - 5) Cooler Bank Foundation - to be detailed and to be 15mm below TRFR Plinth level.
 - 6) Transformer Earthing Diagram with all connections to Main Earth-Mat to be shown.
(Refer 0.54/393 SHT 25 for typical)
 - 7) Reference to the following:
 - a) Cable Trench Detail.
 - b) Gutter Detail.
 - c) Bund Wall Detail.
 - 8) Notes to CELL.

3.11.8 Safety and Security Fencing

Cell Library = (TBA)

To enable the Fence contractor to position and erect all the various types of Fencing, Gates, etc.

Note: Confusion often arises with the terms "Security Fence" and "Barrier Fence". Before the introduction of S.L.D.G 20-5 during November 1990, "Security Fence" referred to the fence normally with overhang surrounding the electrical equipment that was to restrict access to unauthorised persons. "Barrier Fence" referred to an additional set of fences positioned off the terrace and closer to the site boundary, plus fence around any transformers, which was basically "Anti-Intrusion". The present fence surrounding the electrical equipment is now known as "Safety Fence" and does not require any overhang. The additional set of fencing, now positioned on the terrace is now the "Security Fence". Before November 1990 the policy was to produce two drawings, one for "Security Fence" and one for the "Barrier Fence", but now these will be combined on one drawing, as for security levels 2 and 3 the "Safety Fence" and parts of the inner "Security Fence" form the surround for the electrical equipment

- 1) North point. (As per Key Plan [use Reference File]).
- 2) Station Setting Out Lines X-X1 and Y-Y1.
- 3) Outline of all Fencing, Gates and Removable Panels. (Most of this information should come from the Key Plan) plus dimensions using Setting Out Lines as basic Datum.
- 4) Identify each yard portion with its Voltage.
- 5) Indicate Road and Control Building.
- 6) Indicate line of Verge and Kerb.
- 7) Notes.
- 8) Show elevation of the Barrier Fence.
- 9) Detail of the Access Gate arrangement for security levels 1 and 2, where applicable.
- 10) Capacitor Bank Fencing
- 11) For fence line style: Refer to Symbol style 2010

3.11.9 Security Fence Lighting

This drawing shows all the information required by the Civil contractor for the correct erection of all the security lighting poles and luminaires on the poles, including the installation of the supply cables to the luminaires. A copy of the security and safety fence drawing is obtained from the civil design engineer.

- 1) North point. (As per Key Plan [use Reference File]).
- 2) Station Setting Out Lines X-X1 and Y-Y1.
- 3) The double Barrier Fence.
- 4) Indicate Road and Control Building.
- 5) Lighting Poles and luminaire direction.
- 6) All Cables routes.
- 7) Distribution Boards and Junction Boxes.
- 8) Cable and Equipment schedules.
- 9) Standard Notes.

3.11.10 Floodlighting

The Floodlighting consists of three drawings: Operational Floodlighting Cable Route and Mast Location Layout. A copy of the Foundation Trench Earth-mat Drawing is obtained from the electrical design engineer.

Note: All Dimensions and Text level is to be switch off the drawing.

- 1) North point. (As per Key Plan [use Reference File]).
- 2) Station Setting Out Lines X-X1 and Y-Y1.
- 3) The Double Barrier Fence.
- 4) Indicate Road and Control Building.
- 5) Floodlighting Masts locations.
- 6) All Cables Routes and Cable Markers.
- 7) Distribution Boards and Junction Boxes.
- 8) Cable Schedules.
- 9) Standard Notes.
 - Operational Floodlighting Luminaire Orientation Layout.
- 10) Layout of Mast and Luminaire direction.
- 11) Schedule of Luminaires.
- 12) Standard Notes.
- 13) North Arrow and Legend.
 - Operational Floodlighting 400/230V AC Schematic and Cable Block Diagram.
- 14) Schematic Layout of Floodlighting Distribution Board, supply cables, Junction Boxes, and Phasing of Luminaires.
- 15) Standard Notes and Legend.

3.11.11 Special Application Drawings

In addition to the drawings listed under (2) to (9), extra drawings to cover “Specials” are often required: e.g. Internal Bypasses. Special Bay etc.

3.11.12 Site and Contour Plan

This drawing is produced by the civil section and provides information for the project such as:-

- 1) Eskom Site Boundaries.
- 2) Co-Ordinates.
- 3) Contour Lines and Heights across the site.
- 4) Orientation relative to North.
- 5) Positions of any existing Roads, Power Lines, trees, rocky outcrops etc.
- 6) Locality Plan.

3.11.13 Terrace, Road & Drainage Layouts

These drawings are produced by the Civil Section in conjunction with information provided by Electrical Section, namely terrace size and shape, plus Foundation Layout, for Civil Section to determine

Terrace Levels and drainage types and positions.

- 1) Final drawing to be checked.
 - a) Shape and size of Terrace.
 - b) Drainage positions compatible with project requirements.

3.11.14 Earth-mat Layout

- 1) Earth-mat is to be indicated together with the Earth Connection to main columns (Equipment Earthing covered in Bay Schedule) and is to be run basically close to the Main Columns in the same direction as the bay centre lines; also to run around Fence lines to suit Security Level required. (See S.L.D.G 19 – 1, 2 and 3).
- 2) Dimension of the Earthmat rods
- 3) Station Setting Out Lines X-X1 and Y-Y1.
- 4) Standard Notes and Schedules.
- 5) North point. (As per Key Plan [use Reference File]).

3.11.15 Buildings

Building drawings are produced by the Civil Section to accommodate all requirements as specified by the Design Engineers.

The following information must be included on building drawings within the Mpumalanga OU:

For Buildings, civil drawings must be done and specifications must be shown and added as follows:

- Face brick outside, plaster inside.
- Floor details and Finish.
- Add distance for Finished Floor Level above ground level.
- Floor levels relative to Control Room level i.e. foyer to be 80mm lower, ramp also 80mm lower.
- Ceiling details.
- Cable entry details – cable ladder details and cover details.
- Cable rack for top entry into relay & other panels.
- Battery room to spec.

- Water tank to spec.
- Pipes between battery charger abd battery room to run through ceiling.
- Chromadeck roof, gutter and downpipes.
- Whirley birds or similar approved to be shown.
- Paint specs and details for floor, inside walls and ceiling.
- Control and battery rooms have solid wooden double doors as per spec.
- Foyer have galvanised steel double security gate at loading platform, and single galvanised steel security gate at yard side – lock inside.
- Security fence with parking space around control and battery room.
- Communications tower to be placed out of the way, and where it would not hinder future extensions.

3.11.16 Access Road Layout

- No information was provided at the time of finalizing this document

3.11.17 Tubular Busbar Layout

- North point. (As per Key Plan [use Reference File]).
- Standard notes and Schedules as required.
- A planned view layout of the 1 - n busbars showing dimensions between: 1) the centres of the various phases(R,W,B), 2) between the centre phases of the 1 – n busbars, 30 between the centres of the post insulators supporting the tubes that constitute the various busbbars
- An elevation of each of the 1 – n busbars and each of the 1 – n connectors bars (where applicable)) , showing the busbar height, lengths of all the required tubes, with tubes of the same length having the same item number. All fixed and supported points of the busbar are to be shown using “F” and “S” respectively. All tubular clamps required for supporting the tubes on post insulators, end caps, post insulators, label and label support frames, busbar support caps and busbar supports are to be numbered using the same number for similar items.
- A Busbar Clamp Schedule reflecting MK, Description, Item Code and Quantity
- A Busbar Tube Schedule reflecting Item Numbers, Lengths, Remarks and Quantity
- A Damping conductor Schedule reflecting Description, of Conductor/Ferrules and Quantity
- Detail of damping conductor arrangement
- Detail of tube support at the intermediate points and Busbar ends

3.11.18 Operating Diagrams

- Refer to [18]. Standard For Operating Diagrams For Eskom Transmission Substations, 240-77297024
- The required text heights, widths together with the information required to create this drawing are shown in Figure 11 below.

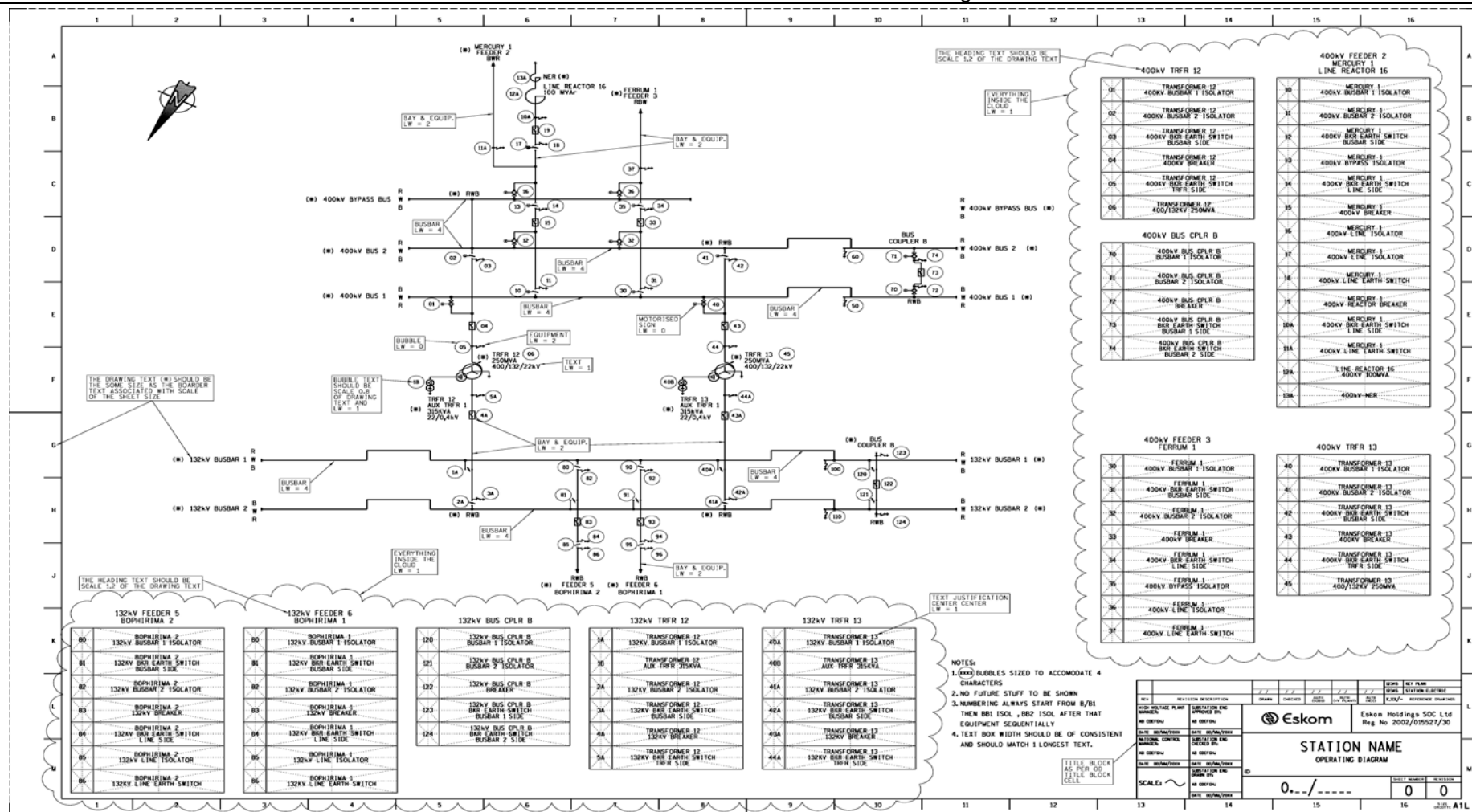


Figure 11: Operating Diagram Guideline

ESKOM COPYRIGHT PROTECTED

When downloaded from the WEB, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorized version on the WEB.

3.12 Microstation relevent files

3.12.1 Seed Files

3D seed file "0_Gen_Seed-3D_2017_Rev_04"

2D seed file "0_Gen_Seed-2D_2017_Rev_09"

3.12.2 Library Files

Dgn library file "Eskom CAD standard rev 1"

3.12.3 Cells

New ENC 2012, Stamp_2015 & 1 EskSheet_2014_REV_09

3.13 Municipal Approval of Drawings : Group Technology and Distribution Divisions

All substation building drawings(new or modifications),where required by the bylaws or the responsible municipality, shall be submitted to the responsible Municipality for approval..

The following documentation are required as part of the application to the responsible municipality for the approval of building plans:

- 1) Building plans prepared according to SANS 10400 Part A.
- 2) Site development plan.
- 3) Copy of title deed of property.
- 4) Local Authority or council building plan application form.
- 5) SANS 10400 National building regulations and building standards act, 1977 Forms 1, 2 and 3. Form 4 after completion of construction.
- 6) Indicate on plan or separate document how building design comply with the:
 - a) SANS 204 - Energy efficiency in buildings.
 - b) SANS 10400-XA – Energy usage in buildings
- 7) South African Council for the Architectural Profession (SACAP) architectural compliance certificate to be completed and signed by registered architect.
- 8) Certificate of due performance for energy efficiency calculations as required by SANS 10400 – XA section A19, clause 9.

The responsible project manager signs the forms mentioned in point 5 above as owner, with his Eskom office as the address.

The package (point 1-8) is prepared by the architect and handed over to the project manager to submit to the local council for approval.

It is important that the Architect/person compiling these drawings is registered with the South African Council for the Architectural Profession. Where there are no Architects within the OU registered with SACAP, the PDE: Substation Engineering COE is to be requested for assistance. Where this mechanism is not viable, external Architects, Fire Engineers and Civil engineers must be appointed to compile and approve the drawings necessary to complete this application.

Under certain circumstances, building plans can be filed under "courtesy submission" to the local authority, accompanied by a letter stating the applicant's name, who the owner is and who is submitting the building plans on behalf of Eskom. It should then also be stated that the application is for exemption and in point form what parts of the building regulation exemption is required from and an indication of who takes responsibility.

The responsible project manager submits the plans on behalf of Eskom to the responsible Municipality and makes any payments that may be due as part of the submission.

Once construction is complete, Form 4 is filled in and an Occupation certificate is issued by the responsible municipality.

3.14 Technology Group: Storage of Drawings: Megawatt Park

Design/Draughting/Administration Staff are to complete a document transmittal form (DTF)(unique Id 240 - 67841635)

Where available, the department administration assistant must take the DTF book together with the applicable drawings to the EDO for storage.

The EDO will sign the form and take the original drawings.

The administration assistant should then return the duplicate copy to the responsible staff member for their own records.

The triplicate copy(yellow copy) will remain in the book.

The administration assistant should then keep the DTF in an official archive.

4. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Phineas Thlatlhetji	Senior Manager : Substation Engineering
Mohammad Nabbie	Senior Engineer: Substation Engineering
Siboniso Ndhlamlenze	Chief Draughtsman: Substation Engineering: Electrical
Julian Venter	Chief Draughtsman: Substation Engineering: Electrical
Daleen Fernandez	Chief Draughtsman: Substation Engineering: Electrical
Trish Van Loggerenberg	HOD: Drawing Office: Dx: Gauteng OU
Johan Le Roux	HOD: Drawing Office: Dx: Mpumalanga OU
Michael Sheela	HOD: Drawing Office: Dx: Limpopo OU OU
Bekezela Nyoni	HOD: Drawing Office:Dx: North West OU
Dickey van Eeden	HOD: Drawing Office: Dx: Free State OU
Sule de Beer	HOD: Drawing Office: Dx: Free State OU
Enver Naaido	HOD: Drawing Office: Dx: Eastern Region OU
Thomas Makhubela	HOD: Drawing Office: Dx: Western OU
Bongani Khosa	HOD: Drawing Office: Dx: Eastern Cape OU
Koos Havenga	HOD: Drawing Office: Dx: Northern Cape OU

5. Revisions

Date	Rev	Compiler	Remarks
June 2018	1	DN Delly	First Issue

6. Development team

The following people were involved in the development of this document:

- Siboniso Ndhlamlenze

7. Acknowledgements

- Anton Naude
- Julian Venter
- Neil Webber