



BLOEMSMOND GRID (PTY) LTD

Utility Substation and Overhead Line Design
Preliminary Technical Report

INDEX

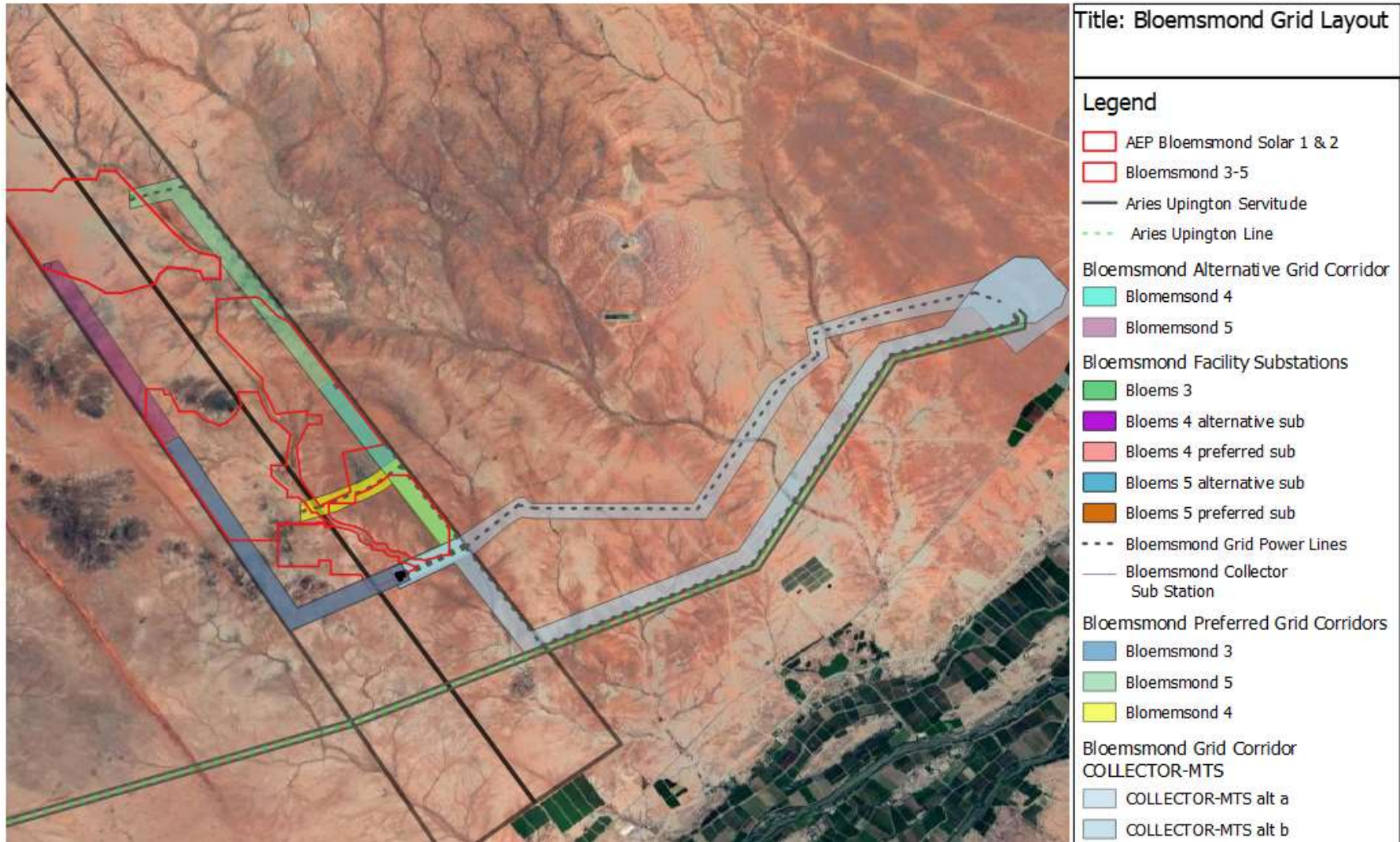
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LIST OF ACRONYMS

CT	Current Transformer
DCt	Double Circuit
kV	Kilovolts
MTS	Main Transmission Substation
MVA	Mega Volt Ampere
OPGW	Optical Ground Wire
SCt	Single Circuit
S/S	Switching Station
VT	Voltage Transformer

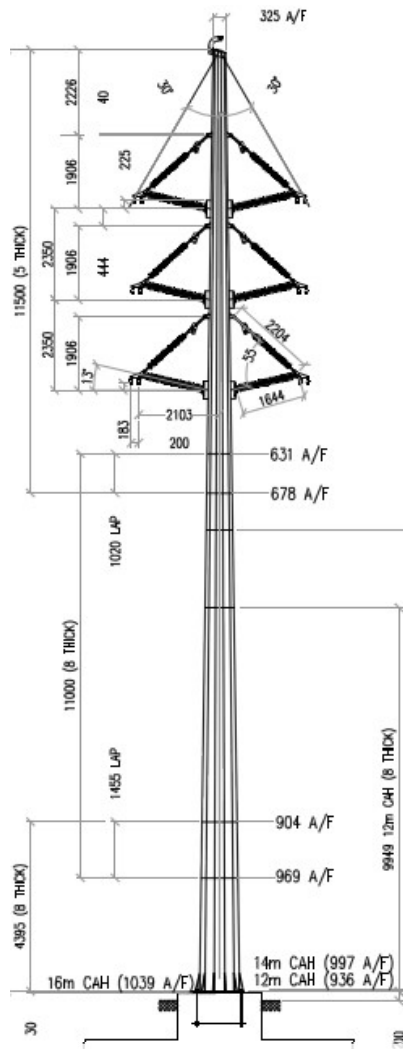
LINE ROUTE OPTIONS



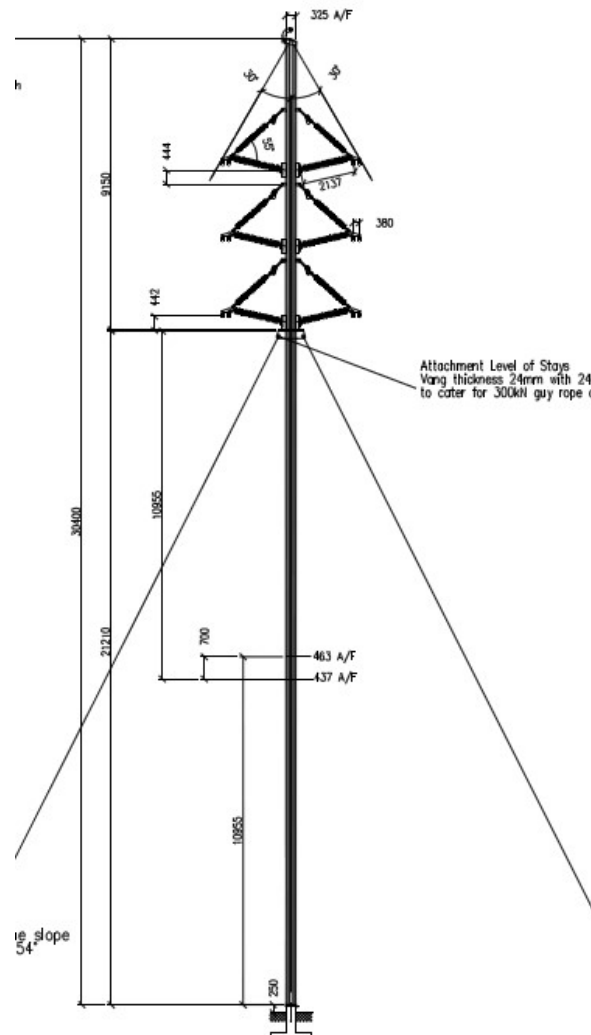
LINE CONDUCTOR RATINGS

Conductor Type	Current Rating (Amps)	MVA Rating 132kV
Kingbird	563	128.7
Twin Kingbird	1126 (2 x 563)	257.4
Tern	830	189.7
Twin Tern	1660 (2 x 830)	379.4

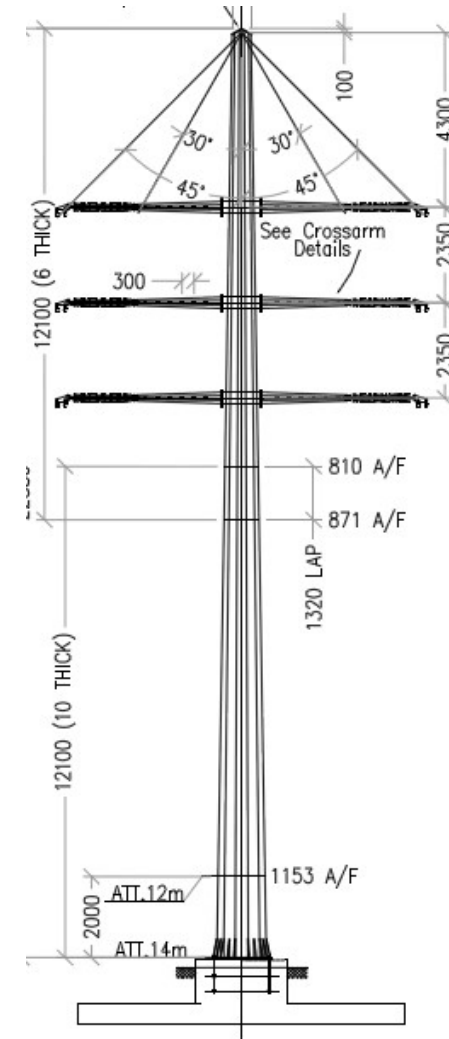
STRUCTURE OPTIONS: Double Circuit (DCt) Structures - 277 Monopoles



277A Intermediate



277B Guyed Intermediate

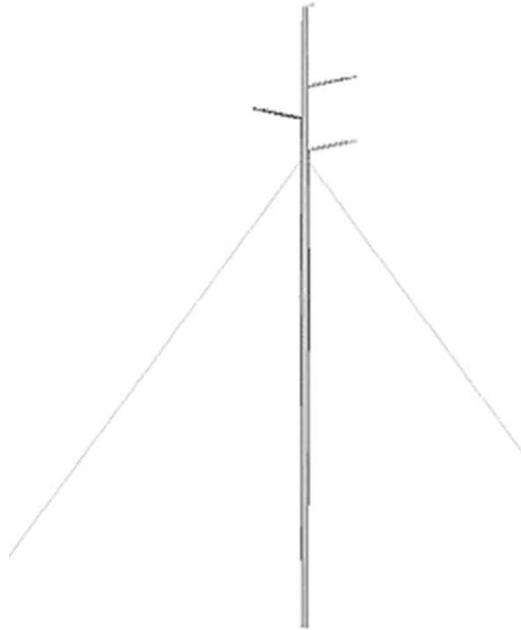


Self-supporting Strains

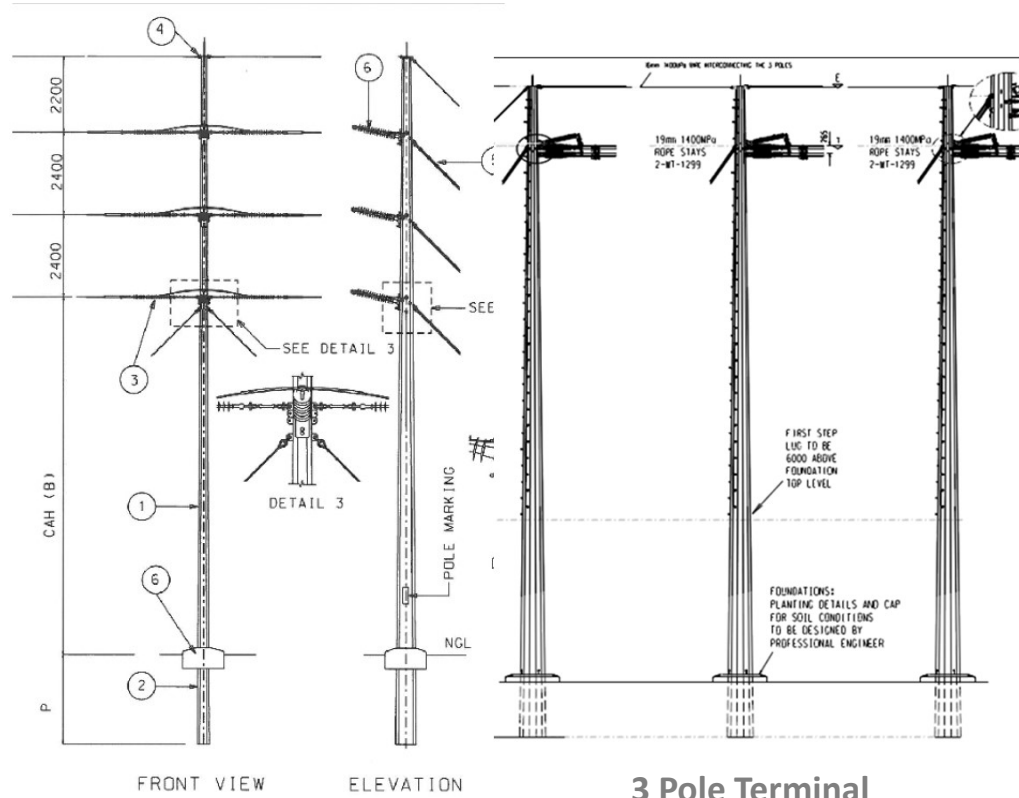
STRUCTURE OPTIONS: Single Circuit (SCt) Guyed Structures



7611 Intermediate



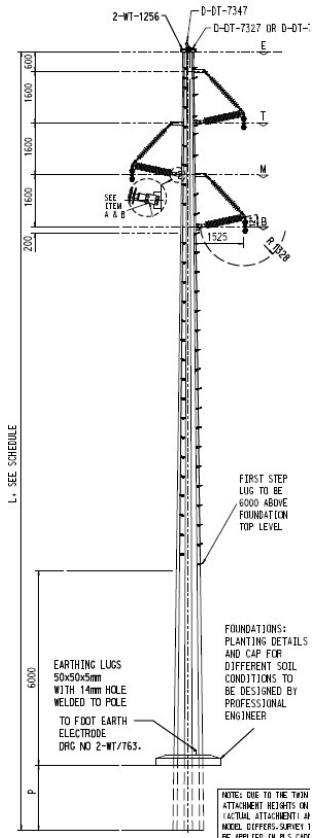
7622 Guyed Intermediate



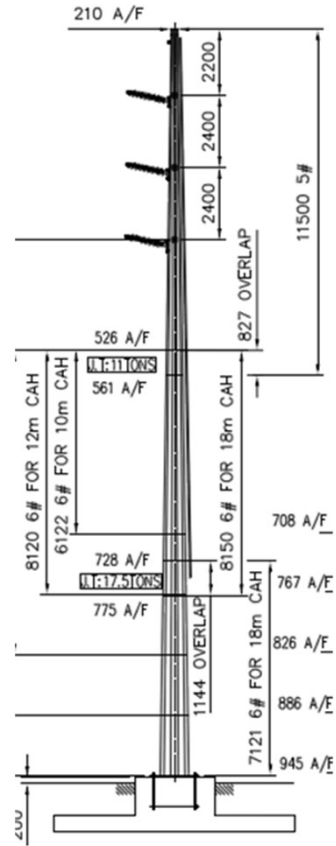
Guyed Strains

3 Pole Terminal Structure/ Strain

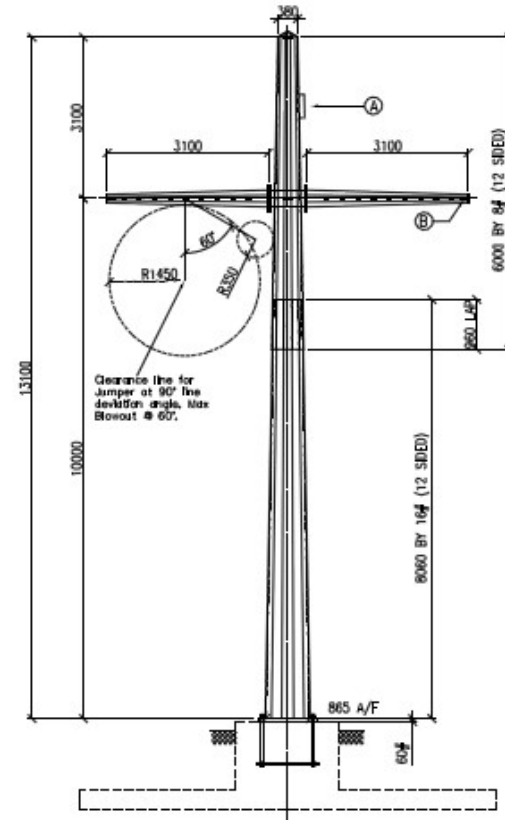
STRUCTURE OPTIONS: Sct Self Supporting Structures



Self-Supporting Intermediate



T2002



STRUCTURE OPTIONS (cont'd)

Conductor Type	Line Route Section	Line Configuration	Structure Option
Kingbird	Bloemsmond 5 S/S → Bloemsmond 3 S/S Bloemsmond 4 S/S → Bloemsmond Collector S/S	SCT	SCT: 7622 Guyed Suspension 7611/7615 Self Supporting Monopole
	Bloemsmond 3 S/S → Bloemsmond Collector S/S	DCt or 2 x SCT	DCt: 277 DCt Monopoles
Twin Kingbird	Bloemsmond 3 S/S → Bloemsmond Collector S/S	SCT	SCT: Eskom SCT 132kV Self-supporting suspension and guyed strain monopoles (designed for 2 x Bersfort/ 2 x Kingbird)
	Bloemsmond Collector S/S → Upington MTS	DCt or 2 x SCT	DCt: 277 DCt Monopole
Tern	Bloemsmond 5 S/S → Bloemsmond 3 S/S Bloemsmond 4 S/S → Bloemsmond Collector S/S	SCT	SCT: 7622 Guyed Suspension 7611/7615 Self Supporting Monopole (DCt shafts to be used for Tern)
	Bloemsmond 3 S/S → Bloemsmond Collector S/S	DCt or 2 x SCTs	DCt: 277 DCt Monopoles
Twin Tern	Bloemsmond Collector S/S → Upington MTS	DCt or 2 x SCT	SCT: Eskom SCT 132kV Self-supporting suspension and guyed strain monopoles (designed for 2 x Bersfort / 2 x Kingbird) DCt: 276 Monopoles

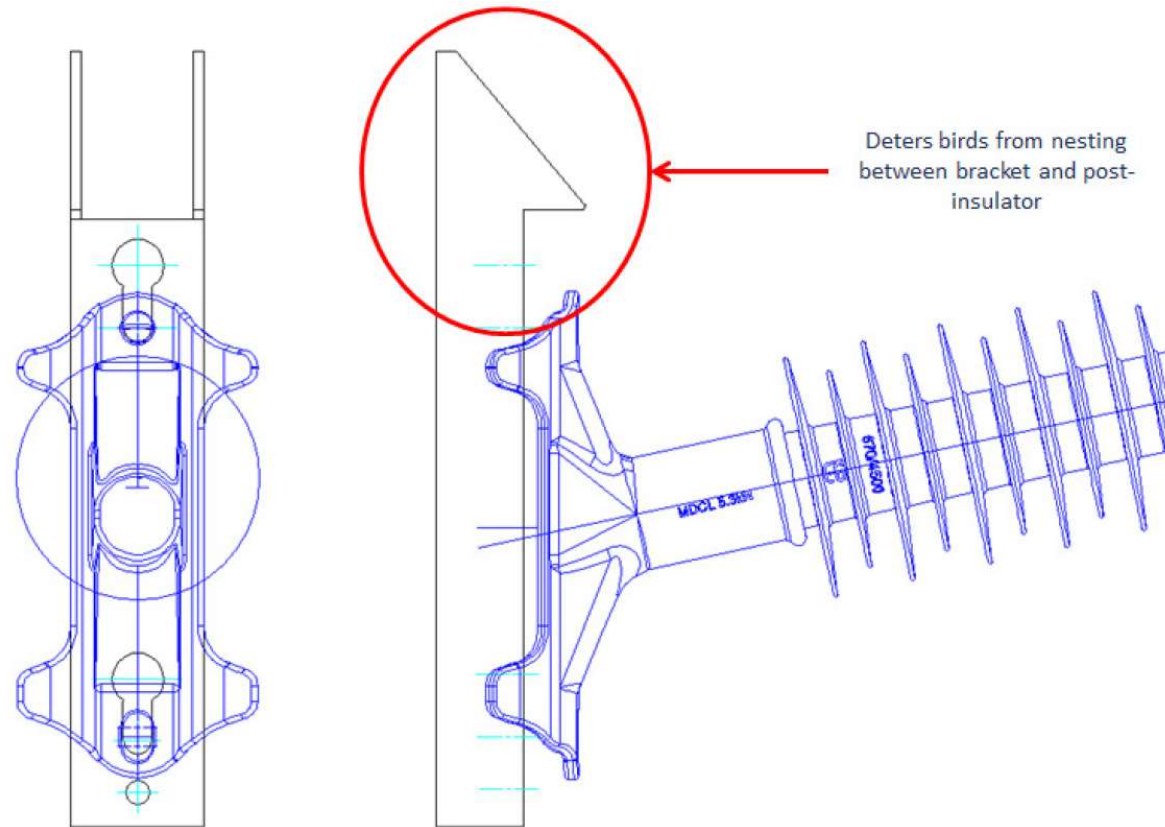
KEY CONSIDERATIONS

- Guyed structures on both SCt and DCt options can significantly reduce line costs (+/- 40% savings on supports).
- Northern Cape Operating Unit have installed guyed structures in the region, but have recently insisted on self-supporting structures.
- Stay corrosion protection will be incorporated.
- 2 x SCt lines will require larger servitudes.
- Tern/Twin Conductor Bundle: Brace Post Insulators required for both DCt and SCt intermediates options.

ENVIRONMENTAL CONSIDERATIONS

- There is a preference for poles to be used as support structures (instead of lattice structures) due to reduced footprints and environmental impacts.
- The main potential environmental constraints are flora and fauna, and main drainage lines and seasonal washes. The required buffer zones on all seasonal washes/streams shall be maintained. The design will also cater for any possible replantation of protected plant species should they be identified within the line corridors.
- There is a potential for conductor collision and electrocution of eagles, vultures and flamingos. To deter nesting, all structures shall be fitted with anti-nesting devices as shown below. In addition, bird perches will be fitted to all structure tops of all intermediate poles to prevent earthwire collisions. OPGW will be fitted with bird flight diverters.

ENVIRONMENTAL CONSIDERATIONS (cont'd)



Anti-bird nesting devices installed above the post insulator

LAND AND RIGHTS

- A DCt or SCt 132kV line requires a 31m wide servitude – 15.5m either side of centre (see extract from Eskom Distribution Guide 34-600, below).
- Eskom's preferred separation distance for 2 x 132kV lines in parallel, is 21m (see extract from Eskom Distribution Guide 34-600, below). 2 x 132kV lines in parallel will therefore require a 52m wide servitude.
- A servitude option agreement will be secured with the affected landowners, in favour of Eskom. Once the projects are awarded Preferred Bidder status, the option agreement is exercised and a formal Deed of Servitude is negotiated and registered against each affected property, in favour of Eskom.

LAND AND RIGHTS (cont'd)

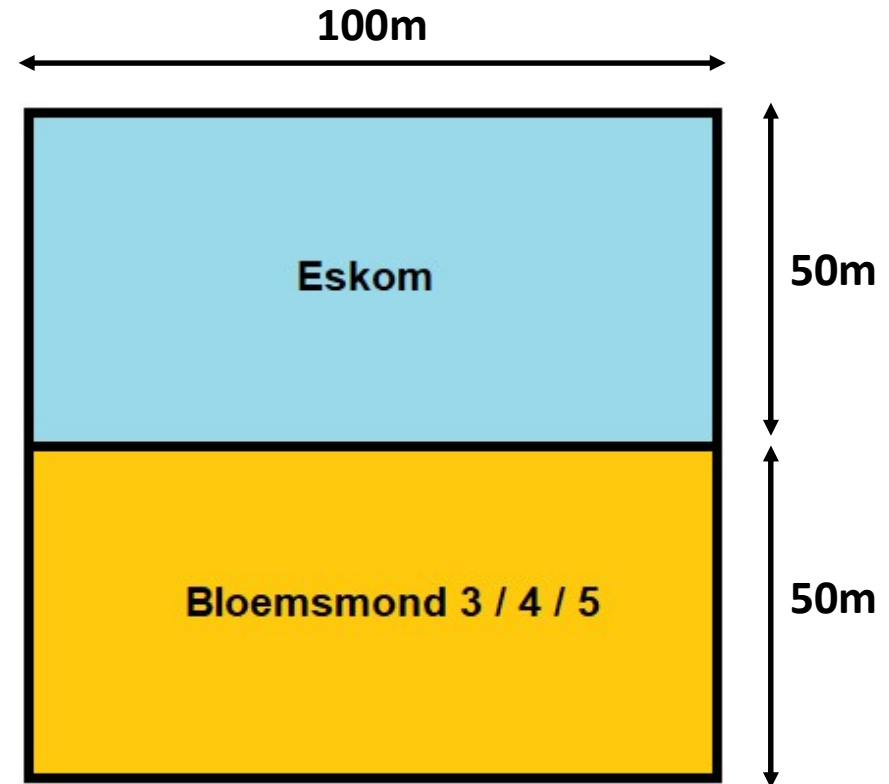
Extract from Eskom Distribution Guide 34-600 "BUILDING LINE RESTRICTIONS, SERVITUDE WIDTHS, LINE SEPARATIONS AND CLEARANCES FROM POWER LINES"

Table 1 – Guidelines for different voltages and requirements

Voltage	Building restriction on each side of centre line	Separation distance between parallel lines
1) All voltages below 22kV	9 metres	12 metres
2) 22kV	9 metres	12 metres
3) 33kV	11 metres	14 metres
4) 44kV	11 metres	14 metres
5) 66kV	11 metres	14 metres
6) 88kV	11 metres	14 to 15 metres
7) 132kV and Delta construction 275kV	18 metres (15.5 - 20)	15 metres (21 - 24)
8) 220kV	23.5 metres (19.5 - 21.0)	32 metres (25m)
9) 275kV (Horizontal)	23.5 metres	32 metres
10) 400kV	27.5 metres (Stayed) (23.5 m Self-supporting)	35 metres
11) 765kV	40 metres	46 metres

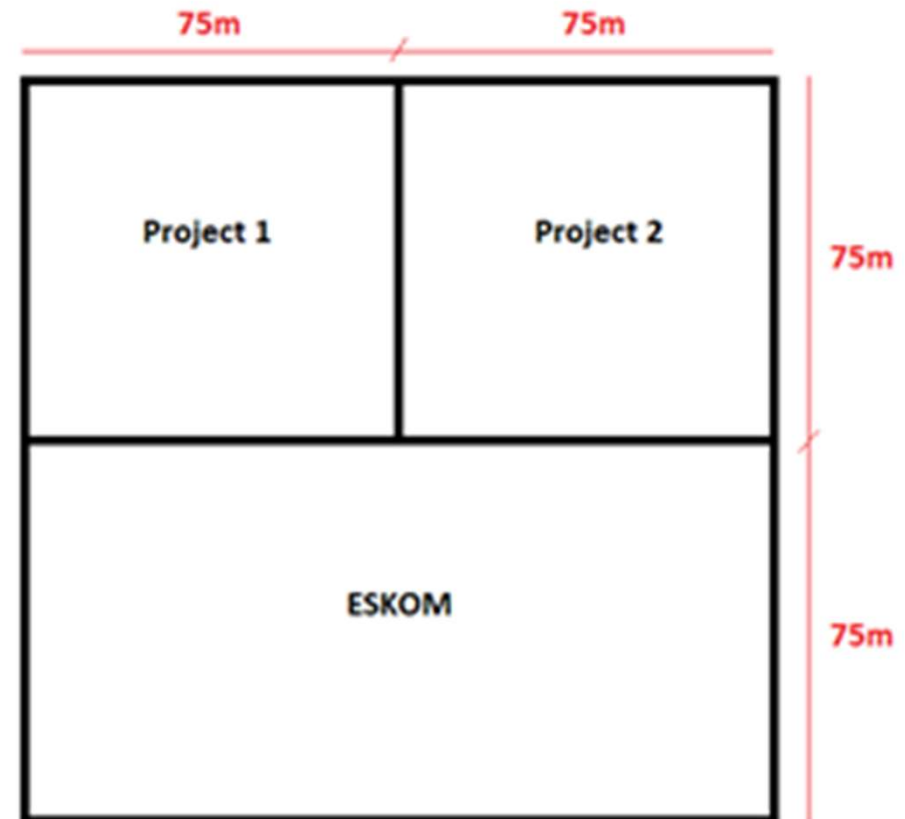
SUBSTATION SIZE AND POSITION

- **Bloemsmond 3 substation**
28°33'32.10"S 21° 1'57.88"E
- **Bloemsmond 4 substation**
28°34'39.80"S 21° 1'40.33"E
- **Bloemsmond 5 substation**
28°31'47.69"S 21° 0'5.52"E



SUBSTATION SIZE AND POSITION (cont'd)

- **Bloemsmond 1 substation**
28°35'16.00"S 21° 2'32.46"E
- **Bloemsmond 2 substation**
28°35'18.03"S 21° 2'33.67"E
- **Bloemsmond Collector Substation**
28°35'16.12"S 21° 2'34.75"E



TYPICAL SUBSTATION COMPONENTS/ SCOPE OF WORK

- Establish new 132kV feeder bays at the existing 400/132kV Upington MTS:
 - Install 2 new 132kV line bays, inclusive of breakers, current transformers (CTs), isolators and surge arrestors;
 - Install a new tubular busbar and bussection for the new line bays, inclusive of isolators, voltage transformers (VTs) and tubular busbar sections; and
 - Access road and fence extensions, additional earthing and lightning protection as may be required, civil works and auxiliary buildings as may be required.

TYPICAL SUBSTATION COMPONENTS/ SCOPE OF WORK (cont'd)

- Establish new Bloemsmond 3, 4 and 5 33 kV or 132kV Switching Stations and 132kV Bloemsmond Collector Substation (inclusive of Bloemsmond 1 and 2 authorized footprints). For each Switching Station/ Substation:
 - Platforms with earth mat and civil work complete;
 - New 33kV or 132kV (incoming/ outgoing) feeder bays as required, inclusive of breakers, CTs, VTs, isolators, surge arrestors and line terminal supports;
 - New tubular busbar and bussection for the new feeder bays, inclusive of isolators, voltage transformers (VTs) and tubular busbar sections;
 - Access roads and fencing, lightning protection as may be required, and auxiliary buildings as may be required.

TYPICAL SUBSTATION COMPONENTS/ SCOPE OF WORK (cont'd)

- Build approximately 17km 33kV or 132kV lines between Bloemsmond 3, 4 and 5 132kV Switching Stations and the 132kV Bloemsmond Collector Substation, inclusive of:
 - Structures;
 - Foundations;
 - Conductor;
 - OPGW;
 - Fibre Layout;
 - Insulation;
 - Assemblies; and
 - Maintenance/ jeep track.

TYPICAL SUBSTATION COMPONENTS/ SCOPE OF WORK (cont'd)

- Build approximately 12.5km DCt or 2 x SCt 132kV lines between the 132kV Bloemsmond Collector Substation and the Upington MTS, inclusive of:
 - Structures;
 - Foundations;
 - Conductor;
 - OPGW;
 - Fibre Layout;
 - Insulation;
 - Assemblies; and
 - Maintenance/ jeep track.