



GEEL KOP GRID (PTY) LTD

Utility Substation and Overhead Line Design
Preliminary Technical Report

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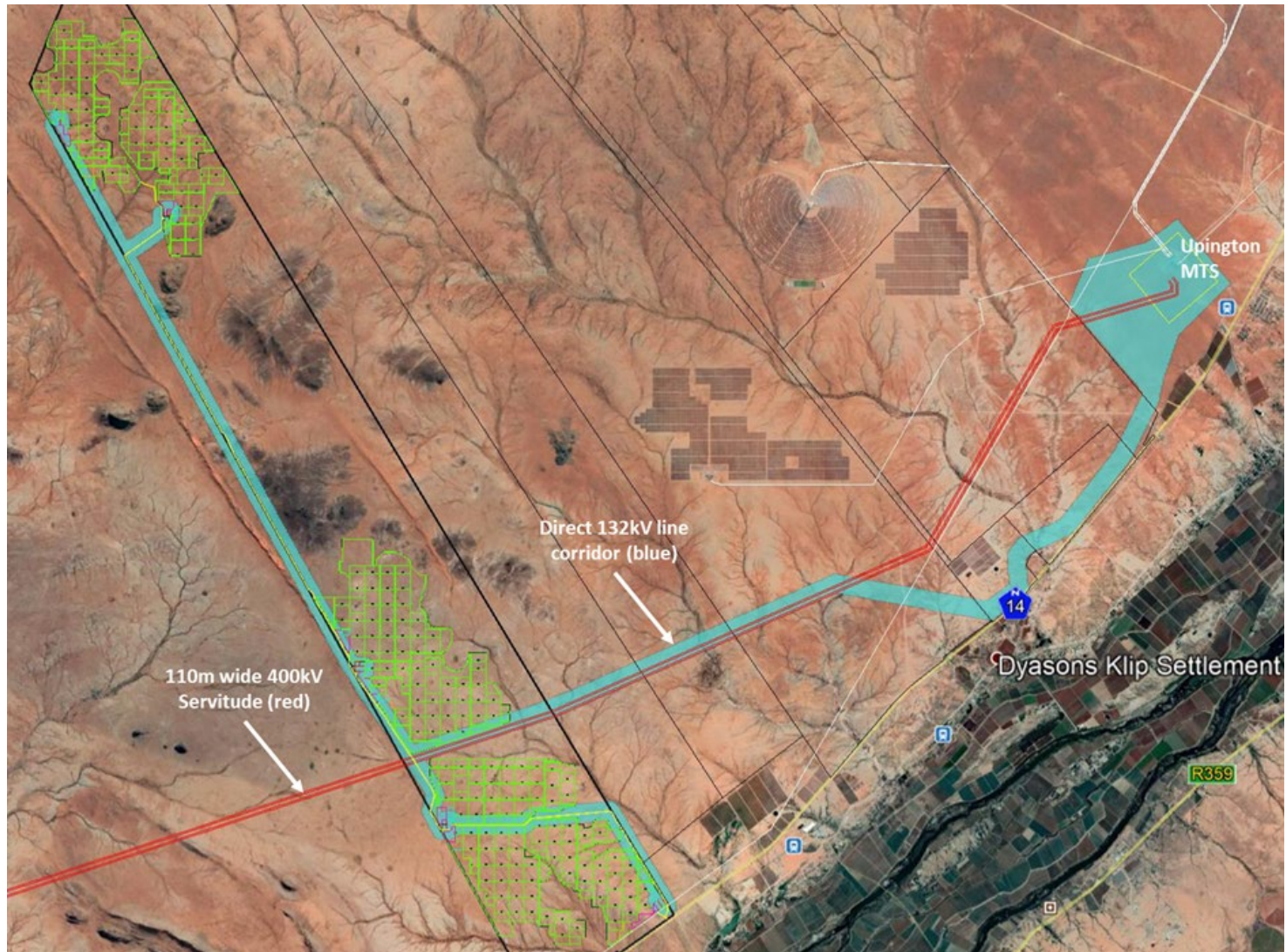
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LIST OF ACRONYMS

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

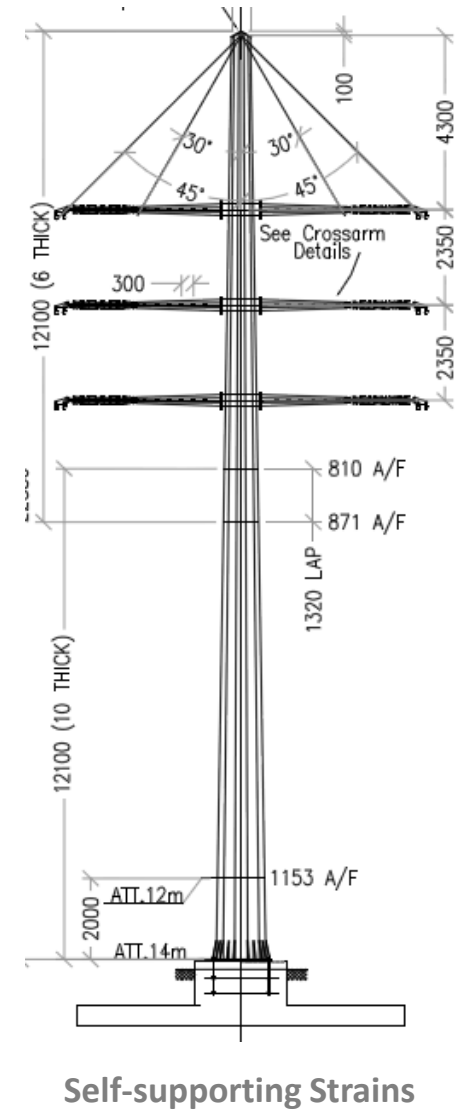
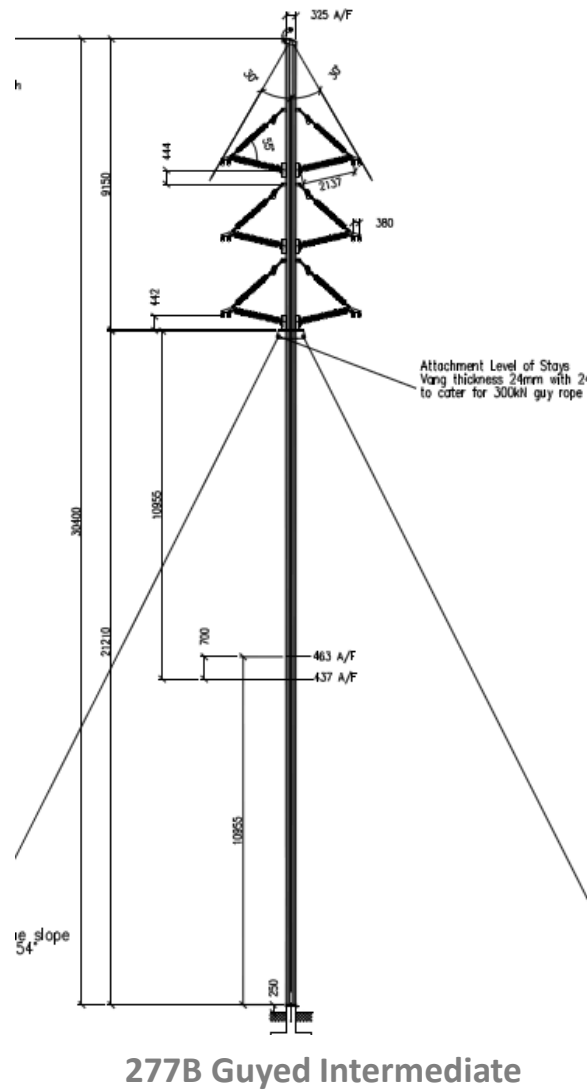
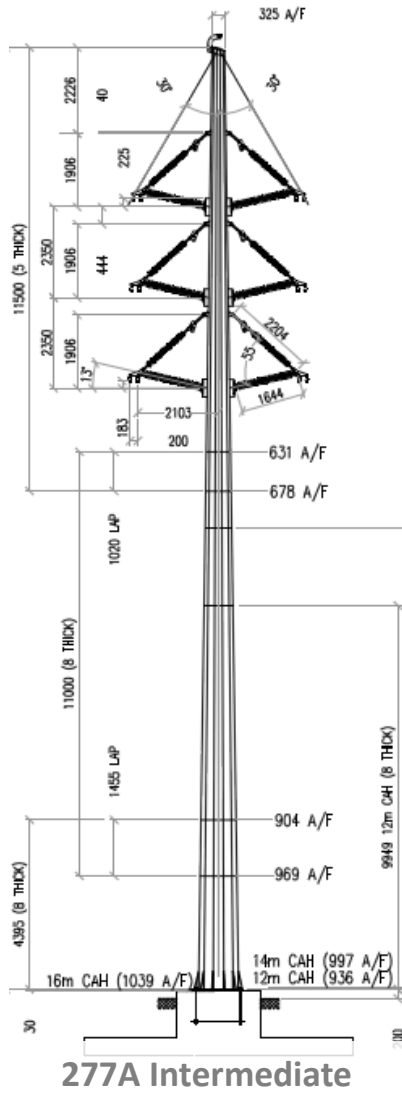
PREFERRED LINE ROUTE



LINE CONDUCTOR RATINGS

Conductor Type	Current Rating (Amps)	MVA Rating 132 kV
Kingbird	771	176.3
Twin Kingbird	1542 (2 x 771)	352.5
Tern	894	204.4
Twin Tern	1788 (2 x 894)	408.8

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



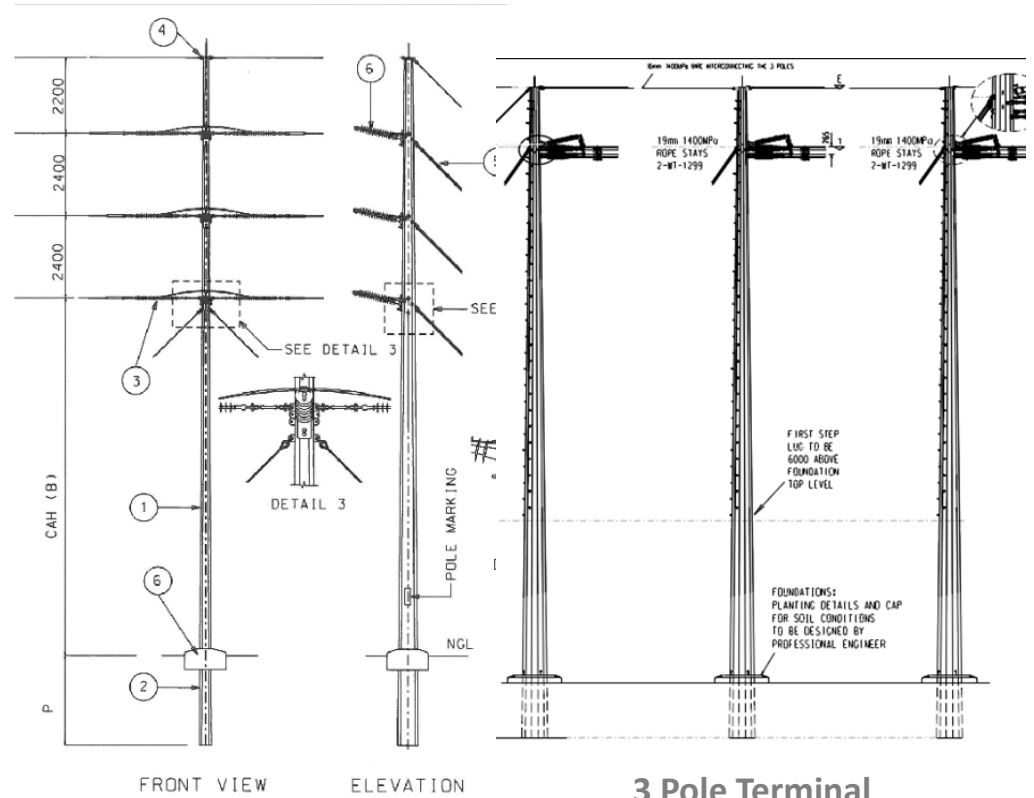
STRUCTURE OPTIONS: Single Circuit (SCt) Guyed Structures



7611 Intermediate



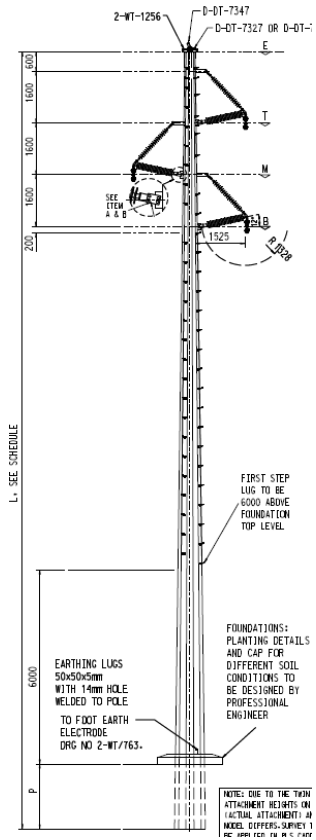
7622 Guyed Intermediate



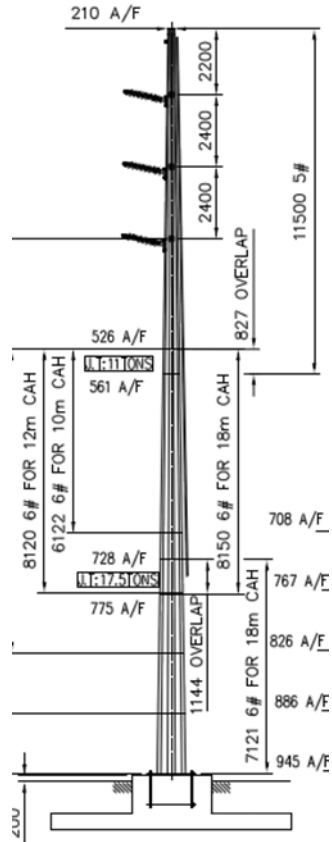
Guyed Strains

3 Pole Terminal Structure/ Strain

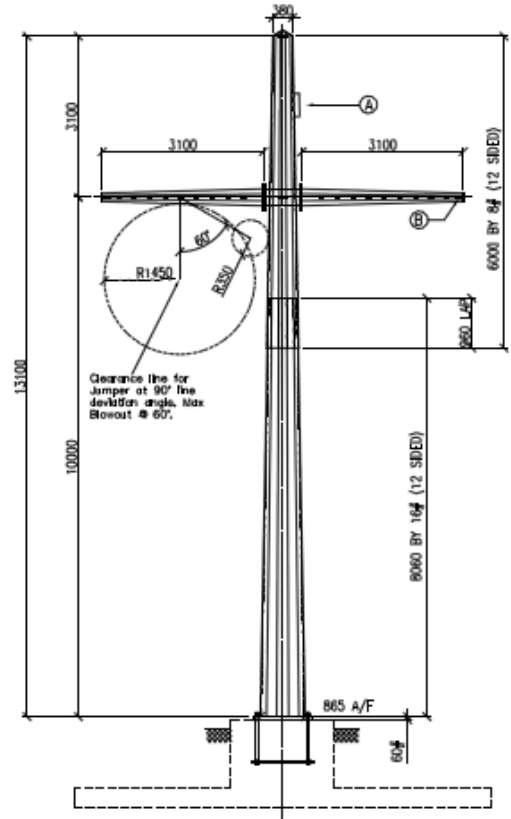
STRUCTURE OPTIONS: SCT Self Supporting Structures



Self-Supporting Intermediate



T2002



STRUCTURE OPTIONS (cont'd)

Conductor Type	Line Route Section	Line Configuration	Structure Option
Kingbird	<ul style="list-style-type: none"> GK Solar PV S/S → Shrubland PV S/S Bushmanland PV Substation → Geel Kop Collector S/S Shrubland PV S/S → Karroid PV S/S /Hari PV Substation 	<p>SCT</p> <p>DCt or 2 x SCT</p>	<p>SCT: 7622 Guyed Suspension 7611/7615 Self Supporting Monopole</p> <p>DCt: 277 DCt Monopoles</p>
Twin Kingbird	<ul style="list-style-type: none"> Shrubland PV S/S → Karroid PV S/S /Hari PV Substation Karroid PV S/S /Hari PV Substation → Geel Kop Collector S/S 	<p>SCT</p> <p>DCt or 2 x SCT</p>	<p>SCT: Eskom SCT 132kV Self-supporting suspension and guyed strain monopoles (designed for 2 x Bersfort/ 2 x Kingbird)</p> <p>DCt: 277 DCt Monopole</p>
Tern	<ul style="list-style-type: none"> GK Solar PV S/S → Shrubland PV S/S Bushmanland PV Substation → Geel Kop Collector S/S 	<p>SCT</p>	<p>SCT: 7622 Guyed Suspension 7611/7615 Self Supporting Monopole (DCt shafts to be used for Tern)</p> <p>DCt: 277 DCt Monopoles</p>
Twin Tern	<ul style="list-style-type: none"> Karroid PV S/S /Hari PV Substation → Geel Kop Collector S/S Geel Kop Collector S/S → Upington MTS 	<p>DCt or 2 x SCT</p>	<p>SCT: Eskom SCT 132kV Self-supporting suspension and guyed strain monopoles (designed for 2 x Bersfort / 2 x Kingbird)</p> <p>DCt: 276 Monopoles</p>

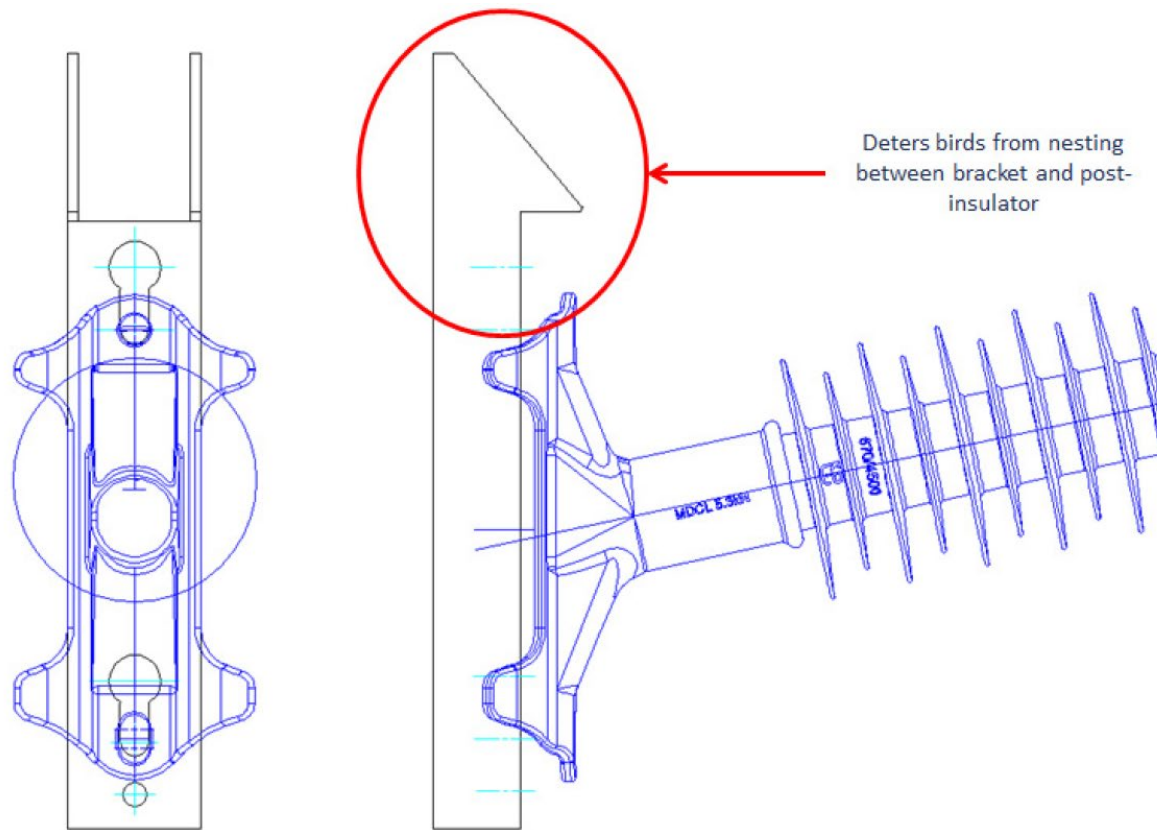
KEY CONSIDERATIONS

- 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 and therefore a wider disturbance area and increased visual and avifaunal impacts.
- 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 transplanting of protected plant species should they be identified within the line corridors.
- There is a potential for conductor collision and electrocution of birds. 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 132 kV line requires a 31 m wide servitude – 15.5 m either side of centre (see extract from Eskom Distribution Guide 34-600, below).
- Eskom's preferred separation distance for 2 x 132 kV lines in parallel, is 21m (see extract from Eskom Distribution Guide 34-600, below). 2 x 132kV lines in parallel will therefore require a 52 m 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

- **Eskom Switching Station**

28°31'29.54"S 20°57'13.90"E

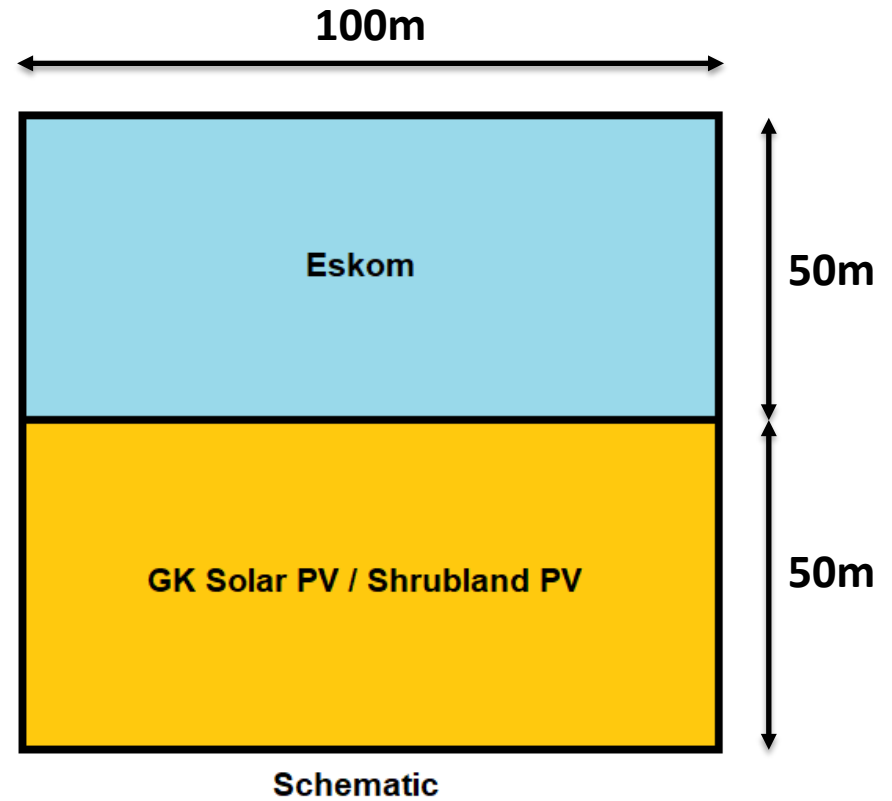
28°32'16.86"S 20°58'19.29"E

- **GK Solar PV Substation**

28°31'29.46"S 20°57'15.63"E

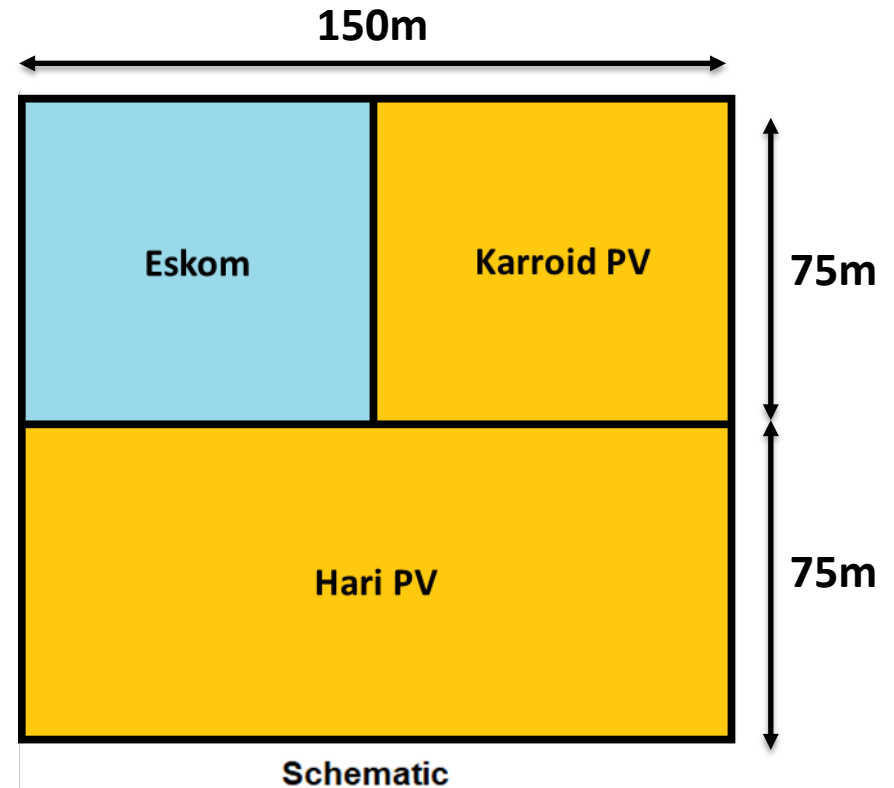
- **Shrubland PV Substation**

28°32'16.81"S 20°58'21.10"E



SUBSTATION SIZE AND POSITION (cont'd)

- **Eskom Switching Station**
28°36'11.97"S 21° 0'11.47"E
- **Karroid PV Substation**
28°36'11.92"S 21° 0'14.19"E
- **Hari PV Substation**
28°36'14.49"S 21° 0'12.63"E

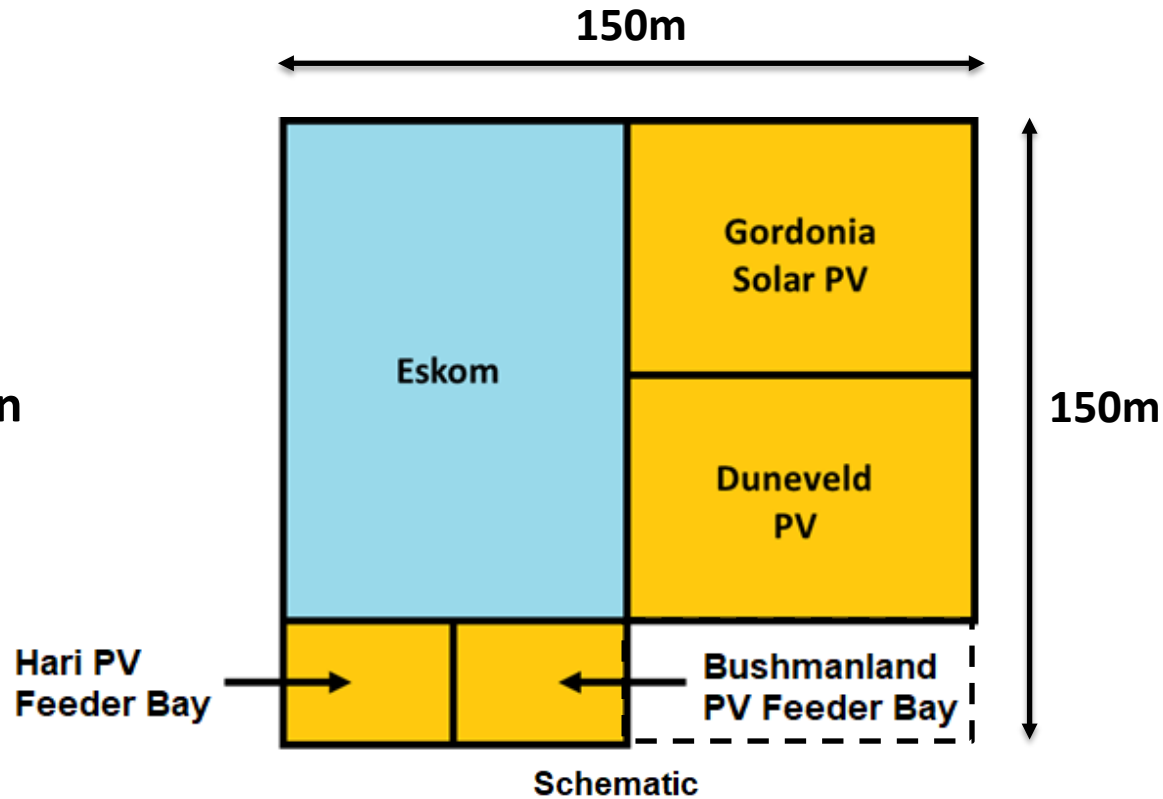


SUBSTATION SIZE AND POSITION (cont'd)

Proposed Geel Kop Collector

Switching Station:

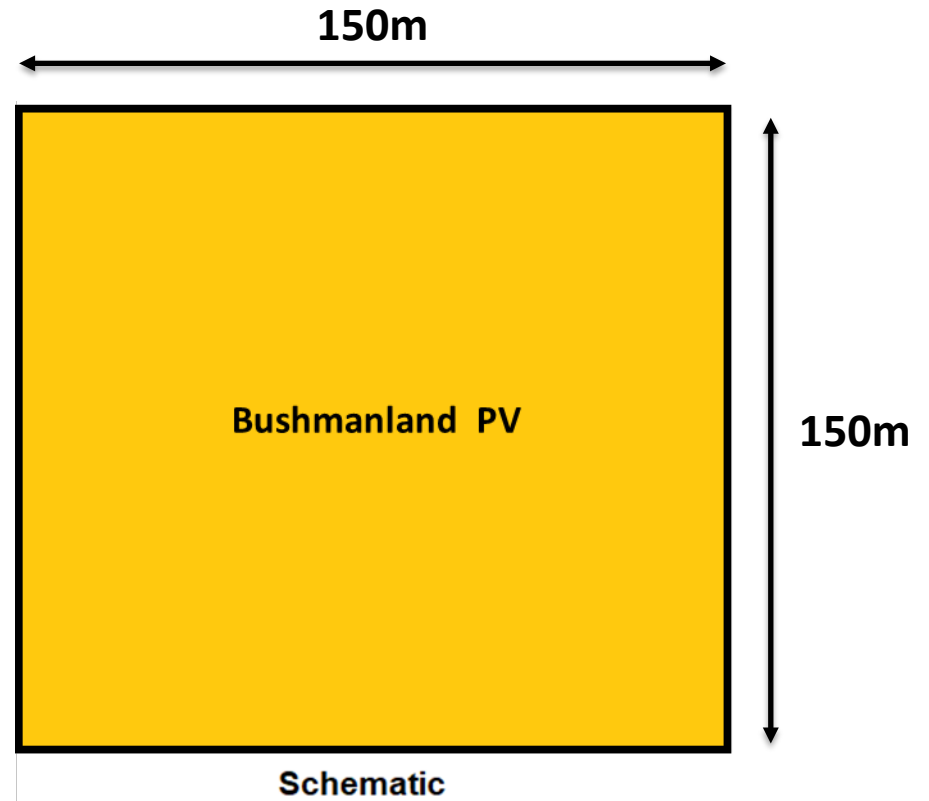
- **Eskom Switching Station**
28°37'34.98"S 21° 1'3.31"E
- **Gordonia Solar PV Substation**
28°37'33.89"S 21° 1'6.05"E
- **Duneveld PV Substation**
28°37'35.87"S 21° 1'6.04"E
- **Hari PV Feeder Bay**
28°37'37.38"S 21° 1'2.63"E
- **Bushmanland PV Feeder Bay**
28°37'37.36"S 21° 1'4.03"E



SUBSTATION SIZE AND POSITION (cont'd)

- **Bushmanland PV Substation**

28°38'16.58"S 21° 3'10.78"E



TYPICAL SUBSTATION COMPONENTS/ SCOPE OF WORK

- Establish new 132 kV feeder bays at the existing 400/132 kV Upington MTS:
 - Install 2 new 132 kV 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 Facility 33 kV or 132 kV Switching Stations and 132 kV Geel Kop Collector Switching Station. For each Switching Station:
 - Platforms with earth mat and civil work complete;
 - New 33 kV or 132 kV (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 19 km 33 kV or 132 kV lines between Facility Switching Stations and the 132 kV Geel Kop Collector Switching Station, inclusive of:
 - Structures;
 - Foundations;
 - Conductor;
 - OPGW;
 - Fibre Layout;
 - Insulation;
 - Assemblies; and
 - Maintenance/ jeep track.

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

- Build approximately 16 km DCt or 2 x SCt 132 kV lines between the 132 kV Geel Kop Collector Switching Station and the Upington MTS, inclusive of:
 - Structures;
 - Foundations;
 - Conductor;
 - OPGW;
 - Fibre Layout;
 - Insulation;
 - Assemblies; and
 - Maintenance/ jeep track.