

	Report	Transmission Eskom Telecommunications NPAE
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Title: **Application Design for:
Naboomspruit SS - Tweekoppies
RS MSAP and Radio Project**

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Alternative Reference PRJ 11231
Number:

Area of Applicability: **Eskom Holdings SOC Ltd**

Functional Area: **Northern Region: Limpopo
Application Engineering**

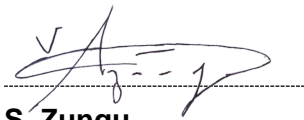
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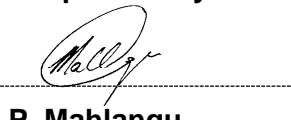
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1. Introduction

Eskom Distribution Northern Region requires a supervisory 19.2 kbps RTU data circuit (RS232) and an IP telephone in Naboomspruit SS. Eskom Distribution Northern Region will erect a 25 m tower in Naboomspruit SS. The PDH level radio will be used to connect a multiplexing MSAP device to the existing network.

2. Supporting Clauses

2.1 Scope

2.1.1 Purpose

This document outlines the detailed design of supplying, installing and commissioning of a radio and MSAP device in Naboomspruit SS for telecommunications purposes.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.1.3 Effective date

This document is effective upon Eskom Telecommunications Design Review Team (TDRT) committee approval date.

2.2 Normative/Informative References

2.2.1 Normative

- [1] **240-56362336** Standard for the Installation of a Telecoms Equipment Cabinet.
- [2] **240-56576361** Telecommunication Transport Network Equipment Installation and Commissioning Standard.
- [3] **240-77092389** Installation of Telecommunication Cable.
- [4] **240-170000055** Installation and Commissioning of Power Electronics Equipment.
- [5] **240-132190480** Telecommunications Equipment Installation Standard.
- [6] **240-56872313** Radio Station Earthing and Bonding Standard.
- [7] **240-70044602** Occupational Health & Safety (OHS) Baseline risk assessment.
- [8] **240-56576361** Telecommunication Transport Network Equipment Commissioning Standard.
- [9] **240-170000055** Installation and Commissioning of Power Electronics Equipment.
- [10] **240-110412152** Generic QA Tick Sheet for Project.
- [11] **240-130311123** Router Installation Acceptance Test Procedure.
- [12] Naboomspruit SS **240-139189078** Project and Turnkey Supporting Templates Rev 4.

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[13] Naboomspruit SS 240-73198174 SHE Specification.

2.2.2 Informative

- [1] 240-170000675 Ceragon Split Unit Microwave Access Radio Design Guide.
- [2] 240-70732272 MSAP Design Guideline.
- [3] 240-132513474 Telecommunications Network Interface Converters Design Guide.
- [4] 240-94136376 IP Voice and Data Network Design Guide.
- [5] 240-170000419 OT VOICE DESIGN GUIDE.
- [6] LES1135 Scope of Work for 25 m ET Tower at Naboomspruit SS.
- [7] ISO 9001 Quality Management Systems.
- [8] Act No. 85 Occupational Health and Safety Act, 1993

2.3 Abbreviations

Table 1: Abbreviations and acronyms.

Abbreviation	Explanation
A	Ampere
AC	Alternating Current
ADM	Add-Drop Multiplexer
Ah	Ampere per hour
ATP	Acceptance Test procedure
dB	Decibel
dB/km	Decibel per kilometre
dBm	Decibel per milliwatt
DC	Direct Current
DCN	Data Communications Network
EAS	Environmental Alarm System
ET	Eskom Telecommunications
FOX	Fibre Optic Multiplexer
IDU	Indoor Unit
IP	Internet Protocol
km	kilometre
LES	Line Engineering Service
LOU	Limpopo Operating Unit

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Abbreviation	Explanation
MSAP	Multiple-Service Access Platform
MUX	Multiplexer
NMC	Network Management Centre
NPAE	National Planning and Application Engineering
O & FS	Operations and Field Services
ODU	Outdoor Unit
OHS	Occupational Health and Safety
PAX	Private Automatic Exchange
PDH	Plesosynchronous Digital Hierarchy
PMO	Project Management Office
PoE	Power Over Ethernet
PS	Power Station
PTM & C	Protection, Tele-protection, Maintenance and Control
QA	Quality Assurance
REH	Regional Engineering Head
RTU	Remote Terminal Unit
RX	Receive
SCADA	Supervisory Control and Data Acquisition
SHEQ	Safety, Health, Environment and Quality
SDH	Synchronous Digital Hierarchy
SOW	Scope of Work
SS	Substation
TCM	Telecoms Contracts Manager
TDRT	Telecommunications Design Review Team
TX	Transmit
UHF	Ultra High Frequency

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2.4 Roles and Responsibilities

Table 2: Roles and Responsibilities.

Responsibility / Department	Responsible Person	Contact numbers	E-mail address
Project Planner	Siboniso Zungu	076 661 2698 015 230 1420	ZunguSV@eskom.co.za
ET Project Manager	Fako Pitsi	079 490 6326 013 693 2731	PitsiFS@eskom.co.za
Senior Supervisor (O & FS Bela Bela)	Eric Tshivhotshwa	072 081 6477 014 762 8119	TshivhE@eskom.co.za
TDRT Workgroup Chairperson (Limpopo)	Blessing Buthelezi	072 430 9939 013 693 4519	ButhelBI@eskom.co.za
Senior Supervisor (Project Implementation Limpopo)	Obed Aphane	082 773 1489 013 693 4447	AphaneSO@eskom.co.za
Dx Project Coordinator	Levy Masenya	073 560 6666 012 421 3026	MasenyL@eskom.co.za
LOU TCM	Lesiba Buthane	073 293 2026 012 421 3329	ButhanL@eskom.co.za
SHEQ Limpopo	Solly Maswanganyi	076 681 7125 017 779 8778	MaswanSH@eskom.co.za

2.5 Process for Monitoring

Project Management to monitor all implementations and processes of the project as per scope of work (SOW). Bela Bela O & FS under the Limpopo Region to maintain all sites involved upon official handover.

2.6 Related/Supporting Documents

ETFM 1846 ET Project Planning Book Rev 1

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3. Naboomspruit SS – Tweekoppies RS MSAP and Radio Project

- **Project Objectives**

The project objective is to supply, install and commission a PDH radio and MSAP device in Naboomspruit SS for telecommunication purposes.

- **Project Deliverables**

Telephone and data (RTU) circuits.

- **Limits and Exclusions**

All work to be carried out by the Limpopo O & FS, Project Implementation and PMO shall be executed as per Application Design for: Naboomspruit SS - Tweekoppies RS MSAP and Radio Project, specifications, standards, equipment manual and shall adhere to ET procedures.

Eskom Distribution Limpopo Operating Unit to provide control room layout with allocated cabinet space all required information as stated in service application request.

Eskom Distribution Limpopo Operating Unit to ensure that DC supply feed is provided in the ET cabinet.

Project Manager is delegated with authority to appoint human resource to complete the project.

- **Miscellaneous Items**

Limpopo Project Implementation and Limpopo O & FS to provide all miscellaneous items to carry out their duties successfully.

- **Resources**

Labour: Limpopo Project Implementation, Limpopo O & FS (Bela Bela), PMO, NMC and SHEQ.

Tools: Calibrated test equipments and all required tools to be used as per approved documents and manuals.

Work: Refer to scope of work and, related documents and manuals.

3.1 Financials

Table 3: Overall Project Cost Estimate.

A: OVERALL PROJECT COSTS ESTIMITATES

PLCM Stage	
all figures in rand	amount (R)
cra: Pre-Feasibility	
dra: Feasibility	R 126 443
Bankable Project: Business Plan	
era: Execution	R 914 803
FRA	
total	R 1 041 246

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3.2 Detailed Design

Naboomspruit SS

Tweekoppies RS

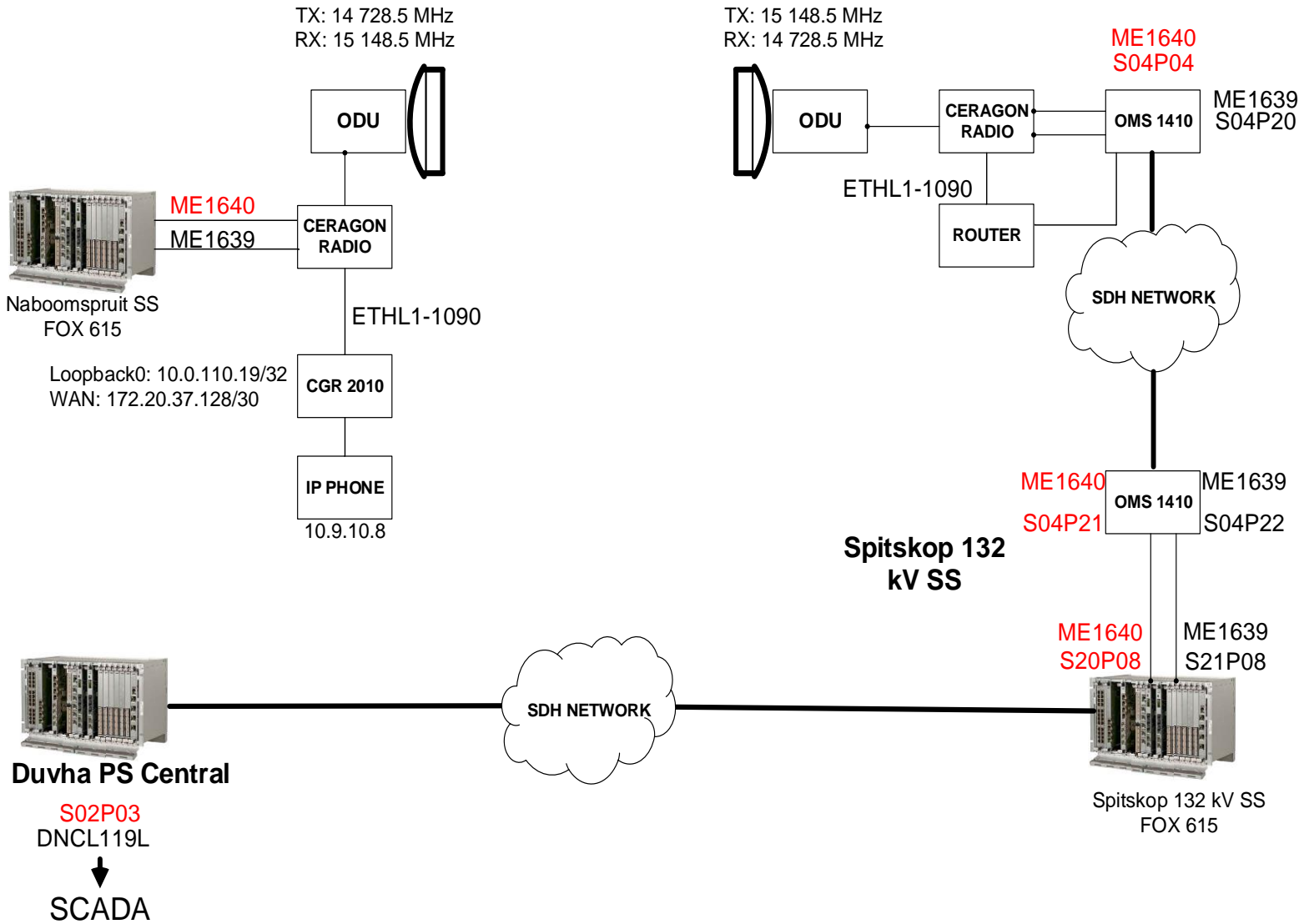


Figure 1: An overview of proposed system integration design.

Load Calculation		
Total Current drawn by Equipment (incl Growth factor)	57,77	A
ampère-hour Load per Day	1386,4	Ah

Figure 2: Tweekoppies RS Estimated Load Calculations.

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Table 4: Current site DC parameters.

Tweekoppies DC	
Battery	3597 Ah
Charger	600 A

Eskom Distribution is required to at least have capacity that will meet these DC minimum requirements as shown in **Figure 3** below.

Load Calculation		
Total Current drawn by Equipment (incl Growth factor)	6,93	A
ampère-hour Load per Day	166,3	Ah

Figure 3: Naboomspruit SS Estimate Load Calculations.

NMC allocations

TX: 14 728.5 MHz

RX: 15 148.5 MHz

MSAP link number: ME1640 (DCN)

MSAP link number: ME1639 (Traffic)

MSAP IP address: 10.20.11.127

Router IP address: 10.10.110.19

IP phone: 10.9.10.8

Supervisory circuit and group: DNCL119L and DNCL119

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NMC New Services Configuration Work Order

(Only fill in the yellow blocks. Some blocks have pull down lists to make selection easier)

Template: D00946/4

General Information			
Task Number:	Tsv51805	Required Completion Date:	
Project Description:	Naboomspruit SS - Tweekoppies RS MSAP and Radio Project		Project Number: PRJ11231

NEW Circuit Configuration Data										
Circuit Number	SLA	Crt Speed	Site A Name	WorkPlace PlantID	Port	Interface	Site B Name	WorkPlace PlantID	Port	Interface
DNCL119L	Silver	19.2 kb/s	Naboomspruit SS	Naboo-SS01	S01P01	LEDS	Duvha PS Central	Duvha-PS04	S02P03	LEDS
ETHL1-1090	Bronze	2 Mbps	Naboomspruit SS	Naboom-SS01	GE0/0	CGR2010	Tweekoppies RS	Tweek-RS01	FE0/7	GRWIC-D

NEW Node Configuration Data								
MSAP Hangs off Site Name	WorkPlace PlantID	New Node Site Name	WorkPlace PlantID	NodeType	Short Code	Node Number	Domain	
Spitskop 132 kV SS	Spits-SS01	Naboomspruit SS	Naboo-SS01			10.20.11.127	11	

NEW Link Configuration Data								
Region	Site A Name	WorkPlace PlantID	Site B Name	WorkPlace PlantID	Link Type	Ownership	End Point	
PGA - Pietersburg Ad	Naboomspruit SS	Naboo-SS01	Spitskop 132 kV SS	Spits-SS01	PDH	Distribution	Spitskop 132 kV SS	
(Region is as per Morning Report categories)					Billable	Link No	Capacity	SDH End Point
					No	ME1639	2Mb/s (E1)	Spitskop 132 kV SS
					No	ME1640	2Mb/s (E1)	Spitskop 132 kV SS
					External SDH Payload Positions			
(if more than one link do each link on a separate form)								

Scope of Work		Time
Commission Naboomspruit SS DCN and Traffic links.		
Commission router (IP 10.0.110.19/32), IP phone (IP 10.9.10.8) port and RTU circuits.		
Update and label virtual network accordingly.		

Figure 4: NMC configuration work order.

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3.3 Scope of Work

Naboomspruit SS:

Site co-ordinates: Latitude 24° 31' 11.51" S

Longitude 28° 42' 03.16" E

Project Management

1. Procure all materials as per bill of quantities in **Naboomspruit SS 240-139189078 Project and Turnkey Supporting Templates Rev 4** and make certain all most recent revision documents (**normative references**) stated in **2.2.1 Normative** above and resources are available. Arrange outage with O & FS as per installation requirement. Obtain all relevant telecommunications tower documents from LES. Attached below is Ceragon_FibeAir_IP20G_Installation_Guide_Rev_E.11.



Project Implementation (Limpopo)

1. Decommission and collect old cabinet and its content (non-functional UHF repeater and DC power supply), all work shall adhere to **240-132190480 Telecommunications Equipment Installation Standard**, **240-56576361 Telecommunication Transport Network Equipment Installation and Commissioning Standard** and **240-17000055 Installation and Commissioning of Power Electronics Equipment**.
2. Install a swing frame cabinet by referring to **240-56362336 Standard for the Installation of a Telecoms Equipment Cabinet**. Cabinet shall be labelled as “**Comms Cabinet**” and positioned as illustrated in **A.12 Naboomspruit SS Control Room Layout**. Please Note: Customer requested to change Comms Canopy to Comms Cabinet.
3. The following should be done in the cabinet as per cabinet layout while adhering to **240-56362336 Standard for the Installation of a Telecoms Equipment Cabinet**, all work shall include but not limited to:
 - Install and commission 110 V to 48 V DC to DC converter with DC rails as per **240-17000055 Installation and Commissioning of Power Electronics Equipment** requirement and it must place as illustrated in **A.4 Naboomspruit SS Comms Cabinet Layout**. All wiring must be as stated in **240-77092389 Installation of Telecommunication Cable**. All connections shall be as shown in **A.5 Naboomspruit SS Comms Cabinet DC Wiring Layout**.
 - Install and commission Ceragon IP 20G Indoor Unit 1+0 (7 MHz Channel, Adaptive Modulation with Ethernet Interfaces between Naboomspruit SS and Tweekoppies RS shown in **A.4 Naboomspruit SS Comms Cabinet Layout** then rig and install ODU and

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parabolic antennae as shown in **A.8 Naboomspruit SS Tower Layout** by referring to **240-132190480 Telecommunications Equipment Installation Standard**, **240-56576361 Telecommunication Transport Network Equipment Installation and Commissioning Standard** and then **240-77092389 Installation of Telecommunication Cable** for electrical wiring and harnessing as shown in **A.5 Naboomspruit SS Comms Cabinet DC Wiring Layout**. The radio shall be configured but not limited to **A.1 Tweekoppies RS MUX diagram** illustration (4 x E1 + Ethernet (Electrical)) and **Table 5** below:

Table 5: Simulated Parameters (Naboomspruit SS).

Parameters	
Transmit Frequency	14 728.5 MHz
Receive Frequency	15 148.5 MHz
Channel Spacing	7 MHz
Modulation	128 QAM
Bandwidth	36 – 44 Mbps
Transmit Power	22 dBm
Receiver Threshold	-79 dBm
Receiver Signal	-36.84 dBm

- Install and commission MSAP and all integrating equipments shown **A.4 Naboomspruit SS Comms Cabinet Layout** as per **240-132190480 Telecommunications Equipment Installation Standard**, **240-56576361 Telecommunication Transport Network Equipment Installation and Commissioning Standard** and then **240-77092389 Installation of Telecommunication Cable** for electrical wiring and harnessing as shown in **A.5 Naboomspruit SS Comms Cabinet DC Wiring Layout**. All slots shall be as illustrated in **A.13 Naboomspruit SS FOX 615 Slots Allocation Layout**, all modules interfaces shall be terminated as illustrated in **A.4 Naboomspruit SS Comms Cabinet Layout** and circuit **ME1639**, **ME1640** and **DNCL119L** shall be configured and connected to **Slot 21 Port 01**, **Slot 21 Port 02** and **Slot 01 Port 01** respectively.
 - a. **ME1640** and **ME1639** connects to **Slot 20 Port 08** and **Slot 21 Port 08** in Spitskop 132 kV SS MSAP respectively.
 - b. **DNCL119L** connects (point to merger) to an existing group **DNCL119** in Duvha PS Central **Slot 02 Port 03**.
- Patch link **ME1639** and **ME1640** from **MSAP Slot 21 Port 01** and **MSAP Slot 21 Port 02** to Tweekoppies RS via **Tweekoppies RS Tributary 01** and **Tributary 02** respectively as per **240-132190480 Telecommunications Equipment Installation Standard**. The circuit shall be connected as illustrated in **A.1 Tweekoppies RS MUX diagram** and **Figure 1** above.

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- Install, configure and commission CGR 2010 Router and connect IP phone in PoE port shown **A.4 Naboomspruit SS Comms Cabinet Layout** as per **240-132190480 Telecommunications Equipment Installation Standard**, **240-56576361 Telecommunication Transport Network Equipment Installation and Commissioning Standard** and then **240-77092389 Installation of Telecommunication Cable** for electrical wiring and harnessing as shown in **A.5 Naboomspruit SS Comms Cabinet DC Wiring Layout**.
- Once all installations are done and commissioned ensure the completion of **240-110412152 Generic QA Tick Sheet for Project**, **240-130311123 Router Installation Acceptance Test Procedure** and **240-70732272 MSAP Design Guideline (MSAP ATP)**. All earth on equipments shall be applied as per equipment as per **240-132190480 Telecommunication Installation Standard** and **240-56872313 Radio Station Earthing and Bonding Standard**.
- Label accordingly as shown in **A.4 Naboomspruit SS Comms Cabinet Layout**, **A.4 Naboomspruit SS Comms Cabinet DC Wiring Layout** and **Figure 1**.

Tweekoppies RS:

Site co-ordinates: Latitude 24° 36' 35" S

Longitude 28° 49' 38" E

- Install and commission Ceragon IP 20G Indoor Unit 1+0 (7 MHz Channel, Adaptive Modulation with Ethernet Interfaces between Tweekoppies RS and Naboomspruit SS shown in **A.5 Tweekoppies RS Cabinet Layout** then rig and install ODU and parabolic antennae as shown in **A.9 Tweekoppies RS Tower Layout** by referring to **240-132190480 Telecommunications Equipment Installation Standard**, **240-56576361 Telecommunication Transport Network Equipment Installation and Commissioning Standard** and then **240-77092389 Installation of Telecommunication Cable** for electrical wiring and harnessing as shown in **A.7 Tweekoppies RS Bearer Comms 2 Cabinet DC Wiring Layout**. The radio shall be configured but not limited to **A.1 Tweekoppies RS MUX diagram** illustration (4 x E1 + Ethernet (Electrical)) and **Table 5** below:

Table 6: Simulated Parameters (Tweekoppies RS).

Parameters	
Transmit Frequency	15 148.5 MHz
Receive Frequency	14 728.5 MHz
Channel Spacing	7 MHz
Modulation	128 QAM
Bandwidth	36 – 44 Mbps
Transmit Power	22 dBm

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Receiver Threshold	-79 dBm
Receiver Signal	-36.84 dBm

- Patch link **ME1639** and **ME1640** from **Naboomspruit SS** radio **Tributary 01** and **Tributary 02** to Tweekoppies RS 1410 ADM **Slot 04 Port 20** and **Slot 04 Port 04** respectively as per **240-132190480 Telecommunications Equipment Installation Standard**. All connections shall be connected as illustrated in **A.1 Tweekoppies RS MUX diagram** and **Figure 1** above.
- Connect Naboomspruit SS router from radio Ethernet port (electrical) to Tweekoppies RS router **Slot 01 FE0/7** (ETHL-1090) as stated in **240-132190480 Telecommunications Equipment Installation Standard** and **240-56576361 Telecommunication Transport Network Equipment Installation and Commissioning Standard**. All connections shall be connected as illustrated in **A.1 Tweekoppies RS MUX diagram** and **Figure 1** above.
- Label circuit connection accordingly.

Spitskop 132 kV SS:

Site co-ordinates: Latitude 24° 57' 57" S

Longitude 24° 13' 40" E

- Patch links **ME1639** and **ME1640** from Spitskop 132 kV SS **1410 ADM Slot 04 Port 22** and **Slot 04 Port 21** in the **Bearer Comms Cabinet 1** to Spitskop 132 kV SS **FOX Slot 21 Port 08** and **Slot 20 Port 08** in the **FOX Cabinet** respectively as per **240-132190480 Telecommunications Equipment Installation Standard**, next available tributaries between ties shall be used where required. The circuit shall be connected as illustrated in **A.2 Spitskop SS MUX diagram** and **Figure 1** above.

NMC:

- Virtually connect and configure for **ME1639** and **ME1640**, circuits **DNCL119L**, CGR 2010 Router and IP phone (also issue telephone number) as per **240-132190480 Telecommunications Equipment Installation Standard**. Updated virtual network layout accordingly.

3.4 Contractual

2.4.1 The following contracts are part of the agreement Eskom have with supplier:

- Contract Number **4600064029** (ABB MSAP FOX 615)
- Contract Number **4600069784** (Mustek)
- Contract Number **4600062265** (DC-to-DC Convecton) (**Out of funds**)
- Contract Number **4600062264** (DC Distribution Rail) (**Out of funds**)
- Contract Number **4600061645** (Cabinet) (**Out of funds**)

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Name		Naboomspruit SS Radio and MSAP Project										Number	PRJ11231					
Equipment Delivery Address		Sakhile Zulu, Block A Basement, Eskom Park, Cnr Jelico and										Number of Sites		3				
Item No.	Bill of Materials for Telecommunications (Standard Design, Contract Items)	SAP Line Number	Material Number	Asset Class	Unit	Unit Price	Naboomspruit SS	Tweekoppies RS	Spitskop 132 kV SS								Total Qty	Total Price
Description (enter contract number first, then enter descriptions)																		
1	ABB FOX 615 4600064029																	
2	4600064029, SHELF ASSY,ELCTR:ABBMSAP-6U;FOX;FFT	110	253458	3	ea	R 67 079	1										1	R 67 079
3	4600064029, MODULE,COMMS:ABB-MSAP-E18;FOX	160	253469	3	ea	R 24 467	1										1	R 24 467
4	4600064029, MODULE,COMMS:ABB-MSAP-UNIDA;FOX	140	253463	3	ea	R 39 417	1										1	R 39 417
5	4600064029, SOFTWARE:ABB-MSAP-LIC;FOX	70	253454	3	ea	R 28 506	1										1	R 28 506
6	Mustek 4600069784 (US\$ 1 = R20)																	
7	4600069784, UNIT:INDOOR;1+0 16E1/ETH	250	699079	9	ea	R 17 876	1	1									2	R 35 751
8	4600069784, UNIT:OUTDOOR;ODU SP;15GHZ;STANDARD POWER	190	699072	9	ea	R 12 360	1	1									2	R 24 720
9	4600069784, ANTENNA:SINGLE POLARIZED;15 GHZ;STEEL	780	701577	9	ea	R 13 238	1	1									2	R 26 476
10	4600069784, CABLE COAX:FLEX;50 OHM;COPPER;AL;1 MM2	1270	701390	9	ea	R 1 329	1	1									2	R 2 657
11	4600069784, KIT INSTLTN:CABLE;MW RADIO	1290	701393	9	ea	R 26	1	1									2	R 51
12	4600069784, KIT INSTLTN:EARTHING PER LG 25M;MW RADIO	1330	703078	9	ea	R 716	1	1									2	R 1 432
13	4600069784, KIT INSTLTN:CLAMPING;MW RADIO;1	1340	703079	9	ea	R 1 124	3	2									5	R 5 622
14	4600069784, UNIT:SOFTWARE NMS;MW RADIO	1400	701395	9	ea	R 1 385	1	1									2	R 2 769
13	OT Voice 4600068823																	
14	4600068823, DIAL TEL:CP-3905;IP;CISCO UNIFIED SIP	910	629810	20	ea	R 479	1										1	R 479
15	Wircorn 4600071130																	
16	4600071130, CABINET:COMPLETE A-48U;WD 600 MM;600	180	579563	3	ea	R 7 980	1										1	R 7 980
Item No.	Bill of Materials Telecommunications (Non-Standard Design, Non-Contract Items)	Equipment Reference Number	Material Number	Asset Class	Unit	Unit Price	Naboomspruit SS	Tweekoppies RS	Spitskop 132 kV SS								Total Qty	Total Price
Description (enter supplier name, then enter descriptions)																		
1	ICASA																	
2	Radio License Application Fee (Link)					R 830	1										1	R 830
3	Radio License Application Fee (Area Radio)					R 1 100												
4	DC COM 10 (40% escalation)																	
5	4600062265, CONVERTER:110D04820/C001 ;DC TO DC	300	636758	5	ea	R 31 538	1										1	R 31 538
6	Com 10 Charger (40% escalation)																	
7	4600062264, MODULE:M; DISTRIBUTION;I/P 50 VDC	2080	661451	5	ea	R 7 290	1										1	R 7 290
8	Tower Bracket																	
9	Universal Large Tower Bracket - 0.3 - 0.9 Antenna	BRK_TWR-UNIV-010	242330	9	ea	R 18 000		1									1	R 18 000
10	ROUTER																	
11	Cisco CGR2010 security bundle w/SEC license PAK	CGR-2010-SEC/K9	603218		ea	R55 998,00	1										1	R 55 998
12	P Base License (Paper) for Cisco CGR2010	SL-20-DATA-K9	552919		ea	R9 031,00	1										1	R 9 031
13	MODULE:GRWIC-D-ES-2S-8PC;ROUTER	GRWIC-D-ES-2S-8PC	603343		ea	R 14 704,13	1										1	R 14 704

Figure 5: Bill of Quantities.

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3.5 Safety

- 240-70044602 Occupational Health & Safety (OHS) Baseline risk assessment.
- Naboomspruit SS 240-73198174 SHE Specification.

3.6 Procurement

Refer to Naboomspruit SS 240-139189078 Project and Turnkey Supporting Templates Rev 4.

3.7 Completion

Project Manager, Project Engineer, O & FS, and all relevant stakeholders to conduct quality assurance (QA) once the project is completed all document and results to be handed over to the Project Manager.

4. Acceptance

This document has been seen and accepted by TDRT workgroup participants:

Name	Designation / Department
B. Buthelezi	REH - Limpopo
E. Rakgwahla	NPAE - Limpopo
E. Tshivhotshwa	Senior Supervisor (Bela Bela)
F. Pitsi	Project Manager (Limpopo)
J. Buys	Senior Supervisor (Plant - Limpopo)
L. Lamola	NPAE - Limpopo
L. Serei	Technician (Plant – Limpopo)
O. Aphane	Senior Supervisor (Project Implementation - Limpopo)
P. Nthabalala	Senior Supervisor (Polokwane)
S. Maswanganyi	SHEQ - Limpopo
S. Steenkamp	NPAE – North / Workgroup Secretary
S. Zulu	Project Co-Ordinator (Limpopo)
T. Morule	NPAE North Manager
T. Ringani	Limpopo O & FS Manager

5. Revisions

Date	Rev.	Compiler	Remarks
April 2022	0	SV Zungu.	Naboomspruit SS detailed design document.
June 2022	2	SV Zungu	Updated as per TRDT comments. Added missing items and corrected diagrams.

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6. Development Team

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

- Siboniso Zungu

7. Acknowledgements

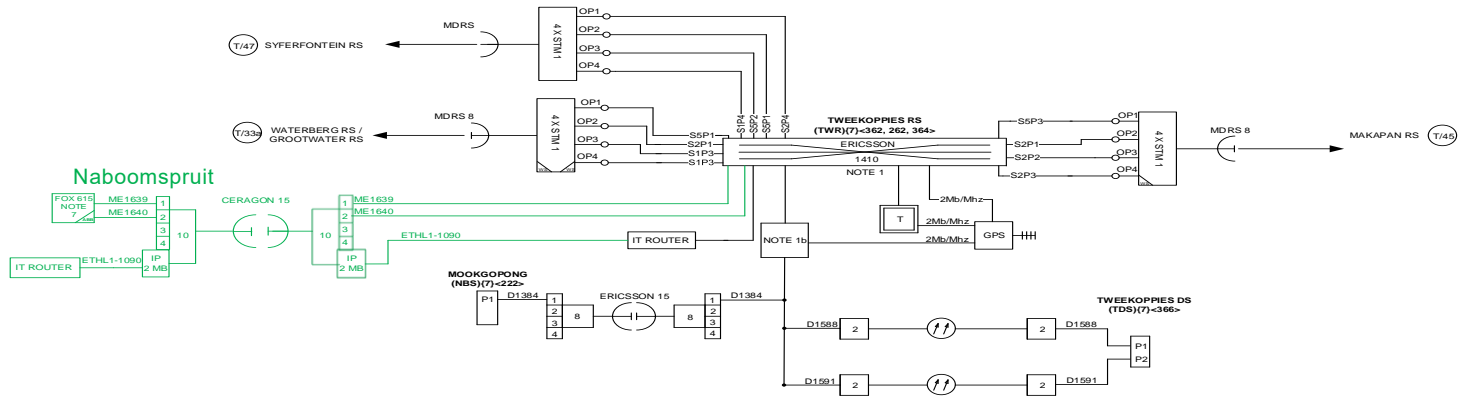
- Blessing Buthelezi
- Edward Rakgwahla
- Lesibana Lamola
- Solly Maswanganyi

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A.1 Tweekoppies RS MUX diagram.



NOTE 1 (TWEKKOPIES ERICSSON 1410)

ADM	LNK	CODE	DESTINATION
4-1	R0662	TWEKKOPIES	MAKAPANSTAD (S4P2) EAS
4-2			
4-3	D1294	TWEKKOPIES	BAKENKOP (S18P2)
4-4	ME1640	TWEKKOPIES	SPT SCOP 1.32 KV BS (S4P2)
4-5	D1296	TWEKKOPIES	S/PAN 4" FLR (S18P3) TMSE
4-6	X0382	TWEKKOPIES	BAKENKOP (S18P1)
4-7	X0108	TWEKKOPIES	WITBANK R/ROOM (S3P2)
4-8	D1171	TWEKKOPIES	MA TIMBA (P2) S/ROUTE
4-9	D1172	TWEKKOPIES	MA TIMBA (P3) L/ROUTE
4-10	D1173	TWEKKOPIES	MA TIMBA (P4) L/ROUTE
4-11	X0300	TWEKKOPIES	MA TIMBA (P5)
4-12	D1090	TWEKKOPIES	MAKAPANSTAD (S4P14)
4-13	D1090	TWEKKOPIES	MAKAPANSTAD (S4P15)
4-14	D1090	TWEKKOPIES	MAKAPANSTAD (S4P22)
4-15	D5618	TWEKKOPIES	BEACON 7(S4P8)
4-16	D1560	TWEKKOPIES	BEACON 7(S4P18)
4-17	D1570	TWEKKOPIES	BEACON 7(S4P19)
4-18	D1571	TWEKKOPIES	BEACON 7(S4P20)
4-19	D1572	TWEKKOPIES	BEACON 7(S4P21)
4-20	ME1639	TWEKKOPIES	SPT SCOP 1.32 KV BS (S4P3)
4-21	X0102	TWEKKOPIES	HVR 30 (S4P20)
4-22	D2092	TWEKKOPIES	MAKAPANSTAD (S4P7)
4-23	D3360	TWEKKOPIES	MAKAPANSTAD (S4P8)
4-24			
4-25	D1090	TWEKKOPIES	MAKAPANSTAD (S4P10)
4-26	D1101	TWEKKOPIES	WITKOP (S3P5)
4-27	D0228	TWEKKOPIES	MAKAPANSTAD (S4P12)
4-28	D2090	TWEKKOPIES	MAKAPANSTAD (S4P13)
4-29	X0431	TWEKKOPIES	MAKAPANSTAD (S4P14)
4-30	X0100	TWEKKOPIES	WITKOP (S3P6)
4-31	X0100	TWEKKOPIES	S/PAN 2" FLOOR (S18P14)
4-32	D1182	TWEKKOPIES	SUNNYRIDGE (S4P57)
4-33	D1184	TWEKKOPIES	SUNNYRIDGE (S4P58)
4-34	D1185	TWEKKOPIES	SUNNYRIDGE (S4P59)
4-35	D1186	TWEKKOPIES	SUNNYRIDGE (S4P60)
4-36	D1183	TWEKKOPIES	SUNNYRIDGE (S4P62)
4-37	D1588	TWEKKOPIES	MAKAPANSTAD (S4P18)
4-38			
4-39	X0042	TWEKKOPIES	PELLY (S4P77)
4-40			
4-41	D1216	TWEKKOPIES	PELLY (S4P14)
4-42	D1217	TWEKKOPIES	PELLY (S4P16)
4-43	X0435	TWEKKOPIES	PELLY (S4P18)
4-44	D1880	TWEKKOPIES	SYFERFONTEIN (S4P7)
4-45	D2250	TWEKKOPIES	SYFERFONTEIN (S4P9)
4-46	D1176	TWEKKOPIES	SYFERFONTEIN (S4P11)
4-47	D1166	TWEKKOPIES	SYFERFONTEIN (S4P14)
4-48	X0439	TWEKKOPIES	SYFERFONTEIN (S4P18)
4-49	X0438	TWEKKOPIES	SYFERFONTEIN (S4P12)
4-50	D1150	TWEKKOPIES	HEKPOORT (S4P24)
4-51	D1156	TWEKKOPIES	HEKPOORT (S4P25)
4-52	D1157	TWEKKOPIES	HEKPOORT (S4P26)
4-53	X0348	TWEKKOPIES	HEKPOORT (S4P27)
4-54	D0800	TWEKKOPIES	PRETORIA (S4P1)
4-55	D1587	TWEKKOPIES	WATERBERG (S4P4)
4-56	X0418	TWEKKOPIES	MENLYN (S4P8)
4-57	D5408	TWEKKOPIES	WATERBERG (S4P5)
4-58	D5407	TWEKKOPIES	WATERBERG (S4P6)
4-59	D1295	TWEKKOPIES	BAKENKOP (S14P34)
4-60			
4-61			
4-62			
4-63			

NOTE 1b (TWEKKOPIES/ADDITIONAL BME/X CONN.)

LNK	DIRECTION	DESTINATION	BME/X
D1588	TWEKKOPIES_DS	TWEKKOPIES_DS	2B3-2
D1384	MOOKGOPONG	MOOKGOPONG	2A4-2
D1587		WATERBERG	2A3-2
D5408		WATERBERG	2B8-1

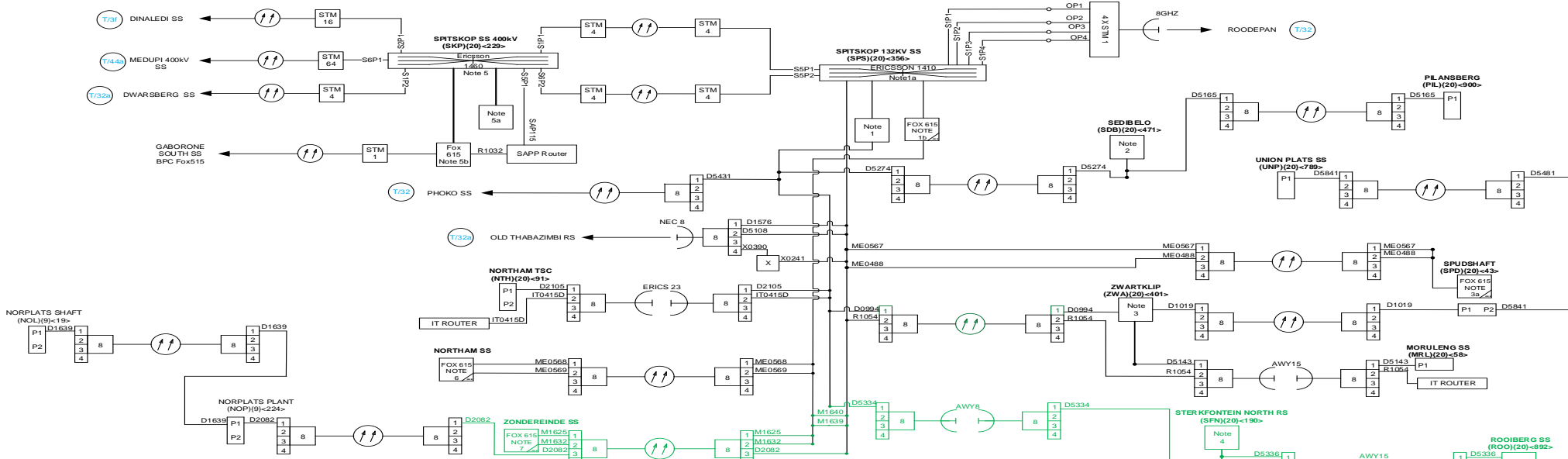
NOTE: (SHORT CODE)/DOMAIN-NODE-
GREEN = PROPOSED/FUTURE

31	Changed ET logo and added Naboomspruit SS.	S. Z	B. B	T. M	06.04.22
30	*Drawing split Waterberg, Grootwater & sites moved to new sheet 327 T/33a. Tables re-done & drawing reflects as build network.	J.Ras	HS	J.Ras	31.07.19
REV	REVISION DESCRPTION	BY	CHKD	AUTH	DATE
PROJECT APPROVED		DATE		TWEKKOPIES	
J.Ras		31.07.2019		MULTIPLEX	
DRAWN		DATE		Eskom	
Hilton Seume		06.08.2019			
SCALE : N/A		DRAWING NUMBER : 10.T/33.14011.73		73	31

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A.2 Spitskop 132 kV SS MUX diagram.



NOTE 5 SPITSKOP 400kV SS ADM1460 E1 CONNECTIONS

ADM PORT	LINK CODE	DESTINATION	BME/X PORT
3-1	D5038	SPITSKOP 132kV	
3-2	D6148	MAMBA SS	
3-3	D5341	PHOKO SS	
3-4	D6317	DINALEDI-HEKPOORT	
3-5	ME0153	SIMMERPAN 4 TH FLR	
3-6	ME0192	NGWEDI SS	
3-7	ME0194	SIMMERPAN GROUND FLOOR	
...
5-1	ETHL1XXX	BOTSWANA PC	

NOTE 1a SPITSKOP 132kV SS ADM1410 E1 CONNECTIONS

ADM PORT	LINK CODE	DESTINATION	BME/X PORT
4-1	D0377	SPS 132kV-THABAZIMBI (SAP2)	
4-2	ME0714	SPS 132kV-HEKPOORT (SAP1)	
4-3	ME0713	SPS 132kV-SPITSKOP (SAP1)	
4-4	ME0714	SPS 132kV-SPITSKOP (SAP1)	
4-5	IT0415D	SPS 132kV-HVI (SAP1) NORTHAM SS	
4-6	ME0714	SPS 132kV-SPITSKOP (SAP1)	
4-7	IT051D	SPS 132kV-DEG-IT (SAP1)	
4-8	D0308	SPS 132kV-SPITSKOP (SAP1)	
4-9	D6148	SPS 132kV-SPITSKOP (SAP1) MAMBA SS	
4-10	D5451	SPS 132kV-SPITSKOP (SAP1) PHOKO SS	
4-11	D1574	SPS 132kV-ROODEPAN SS(SAP2)	
4-12	ME0714	SPS 132kV-ROODEPAN SS(SAP2) DCN	
4-13	ME0716	SPS 132kV-MINERVA (SAP1)	
4-14	R1032	SPS 132kV-DINALEDI (SAP1) MAMBA SS	
4-15	D0488	SPS 132kV-HEKPOORT (SAP1)	
4-16	M1160	SPS 132kV-HEKPOORT (SAP1)	
4-17	M1163	SPS 132kV-HEKPOORT (SAP1)	
4-18	M1163	SPS 132kV-HEKPOORT (SAP1)	

NOTE 1b: SPITSKOP 132kV SS FOX 615

E1 port	LINK CODE	DESTINATION	FOX PORT
20-1	ME0712	DCN Spitskop 400kV SS	20-1
21-1	ME0715	DCN Minerva SS (21-1)	20-2
20-2	ME0713	Spitskop 400kV SS	20-3
21-2	ME0716	Minerva SS (21-2)	20-3
20-3	ME0714	Spitskop 400kV SS	20-3
21-3	ME0567	Fox DCN Spudshaft SS	21-1
20-4	ME0568	Fox DCN Northam SS	21-2
21-4	ME0488	Fox Spudshaft SS	21-2
20-5	ME0569	Fox Northam SS	21-2
20-6	M1163	Zonderende SS DCN	20-4
20-7	ME1632	Zonderende SS Traffic	20-4
20-8	M1160	Naboomspruit SS DCN	20-5
21-8	ME1639	Naboomspruit SS Traffic	21-5

NOTE 5a (SPITSKOP 400kV SS BME/X CONN)

LINK CODE	DIRECTION	DESTINATION	BME/X PORT
D5038	SPITSKOP SS	SPITSKOP SS	1A1-1
D5039	SPITSKOP SS	ROODEPAN RS	1A1-2
D5341	SPITSKOP SS	PHOKO SS	1A2-1
D5334	SPITSKOP SS	STERKFORTEIN RS	1A2-2

NOTE 1 (SPITSKOP 132kV SS BME/X CONN)

LINK CODE	DIRECTION	DESTINATION	BME/X PORT
D0377	ROODEPAN RS	ROODEPAN RS	1A1-1
D1575	ROODEPAN RS	ROODEPAN RS	1A2-1
D1576	OLD THABAZIMBI RS	OLD THABAZIMBI RS	1A1-2
D0377	ROODEPAN RS	ROODEPAN RS	1A2-2
D2105	NORTHAM TSC	NORTHAM TSC	1A3-1
D0994	ZWARTKLIP	ZWARTKLIP	1A3-2
D5165	PILANSBERG SS	PILANSBERG SS	1A8-1
D5168	OLD THABAZIMBI RS	OLD THABAZIMBI RS	1A8-2
X0241	ROODEPAN RS	ROODEPAN RS	1A1-1
X0390	OLD THABAZIMBI RS	TWEEKOPPIES RS	1A1-2

NOTE 5b (SPITSKOP 400kV SS FOX 615)

LINK CODE	DIRECTION	DESTINATION	FOX PORT
ME0712	1460 ADM	SPITSKOP 400kV DCN	20-1
ME0713	1460 ADM	SPITSKOP 400kV SS	20-2
ME0714	1460 ADM	SPITSKOP 400kV	20-3
ME0192	1460 ADM	NGWEDI SS	21-1
ME0193	1460 ADM	SIMMERPAN 4 TH FLR	21-2
R1032	SAPP ROUTER	SAPP ROUTER	Eth 11-1
ME0961	DUVHA S. ADM.	DUVHA S. Fox615	20-4
ME0962	DUVHA S. ADM.	DUVHA S. FOX615	20-4
ME0963	DUVHA S. ADM.	DUVHA S. FOX615	21-4
ME0964	SIMMERPAN 4 TH FLR	SIMMERPAN 4 TH Fox615	19-5
ME0965	SIMMERPAN 4 TH FLR	GND S/PAN Fox615	20-5
ME0966	SIMMERPAN 4 TH FLR	GND S/PAN Fox615	21-5

NOTE 3 (ZWARTKLIP BME/X CONN)

LINK CODE	DIRECTION	DESTINATION	BME/X PORT
D0994	SPUDSHAFT	SPUDSHAFT	1A1-1
D1019	SPUDSHAFT	SPUDSHAFT	1A1-2
D5143	MORULENG SS	MORULENG SS	1A2-1

NOTE 4 (STERKFORTEIN NORTH BME/X CONN)

LINK CODE	DIRECTION	DESTINATION	BME/X PORT
D5334	NEW SPITSKOP	NEW SPITSKOP	1A1-1
D5335	KOEDOESKOP SS	KOEDOESKOP SS	1A1-2
D5335	KOEDOESKOP SS	KOEDOESKOP SS	1A2-1

NOTE 2 (SEDBELO BME/X CONN)

LINK CODE	DIRECTION	DESTINATION	BME/X PORT
D5274	SPITSKOP SS	SPITSKOP SS	1A1-1
D5165	PILANSBERG	PILANSBERG	1A1-2

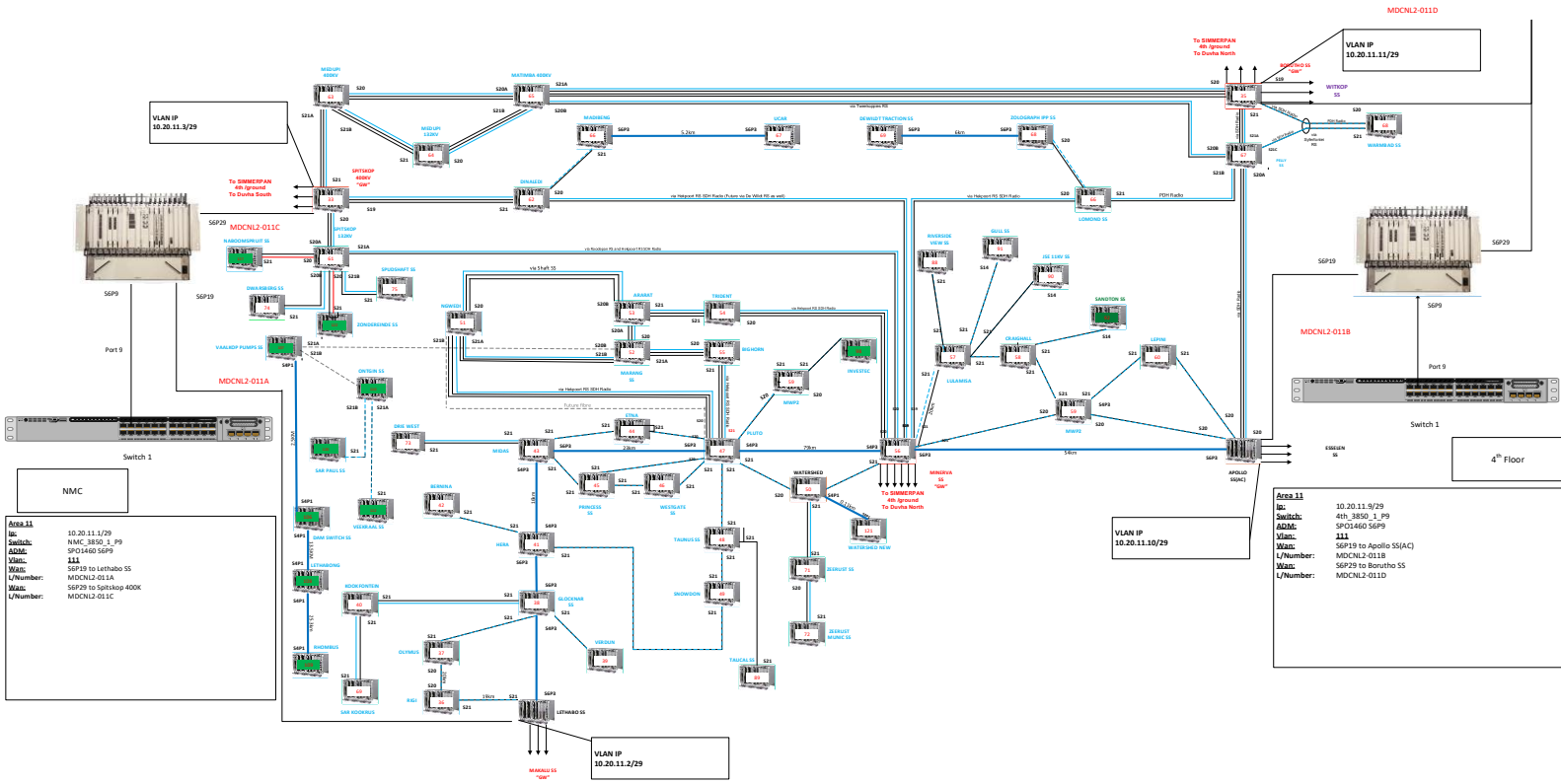
NOTE: (SHORT CODE)/DOMAIN<NODE>
GREEN = PROPOSED/FUTURE

21	Added proposed Naboomspruit SS links ME 1640 (DCN) and ME 1639 (Traffic)	S.Zungu	B.B	B.Botha	24.04.2022
20	Added proposed Zonderende SS links and new Norplats SS BME link route then changed ET logo. Updated NOTE 1b: SPITSKOP 132kV FOX 615	S.Zungu	B.B	B.Botha	24.02.2022
19	S.G-Added Spud Shaft new OLTE link with Fox 615 and New Northam SS OLTE with Fox 615. <i>Dinaledi STM 16, Drawsborg STM4 commissioned, Tables updated. Hyperlinks active</i>	S.Gwala	H.S	H.Craff	10.10.2019
18	New Mux Tag applied to drawing. Added MSAP/Fox 615 links from Spitskop 400kV to Span 4 TH FLR & Duvha PS	I.Thipi	H.S	H.Craff	25.07.2018
REV	REVISION DESCRIPTION	BY	CHKD	AUTH	DATE
PROJECT	APPROVED	DATE			
Hendrik Crafford	10.10.2019				
DRAWN	DATE				
Hilton Sehome	21.10.2019				
SCALE : N/A	DRAWING NUMBER : 10.T/32a.1401.1.155		DATE	REV	

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A.3 MSAP OSPF AREA 11 diagram.



NMC

Area 11 ID:	10.20.11.1/29
Switch:	NMC_3850_1_P9
ADM:	SPO1460 S6P9
Man:	S6P19 to Lethabo SS
L/Number:	MDCNL2-011A
U/Number:	S6P29 to SpStokop 400K

Area 11 ID:	10.20.11.9/29
Switch:	400_3850_1_P9
ADM:	SPO1460 S6P9
Man:	S6P19 to Apollo SS(AC)
L/Number:	MDCNL2-011B
U/Number:	S6P29 to Barotlo SS

REVISIONS

REV	DATE	DESCRIPTION	BY	CHKD	APPD
11	2020/01/29	Initial Design			

Legend:
 - Solid red line: 240-135101235-0001-0001-0001
 - Solid blue line: 240-135101235-0001-0001-0001
 - Dashed red line: 240-135101235-0001-0001-0001
 - Dashed blue line: 240-135101235-0001-0001-0001

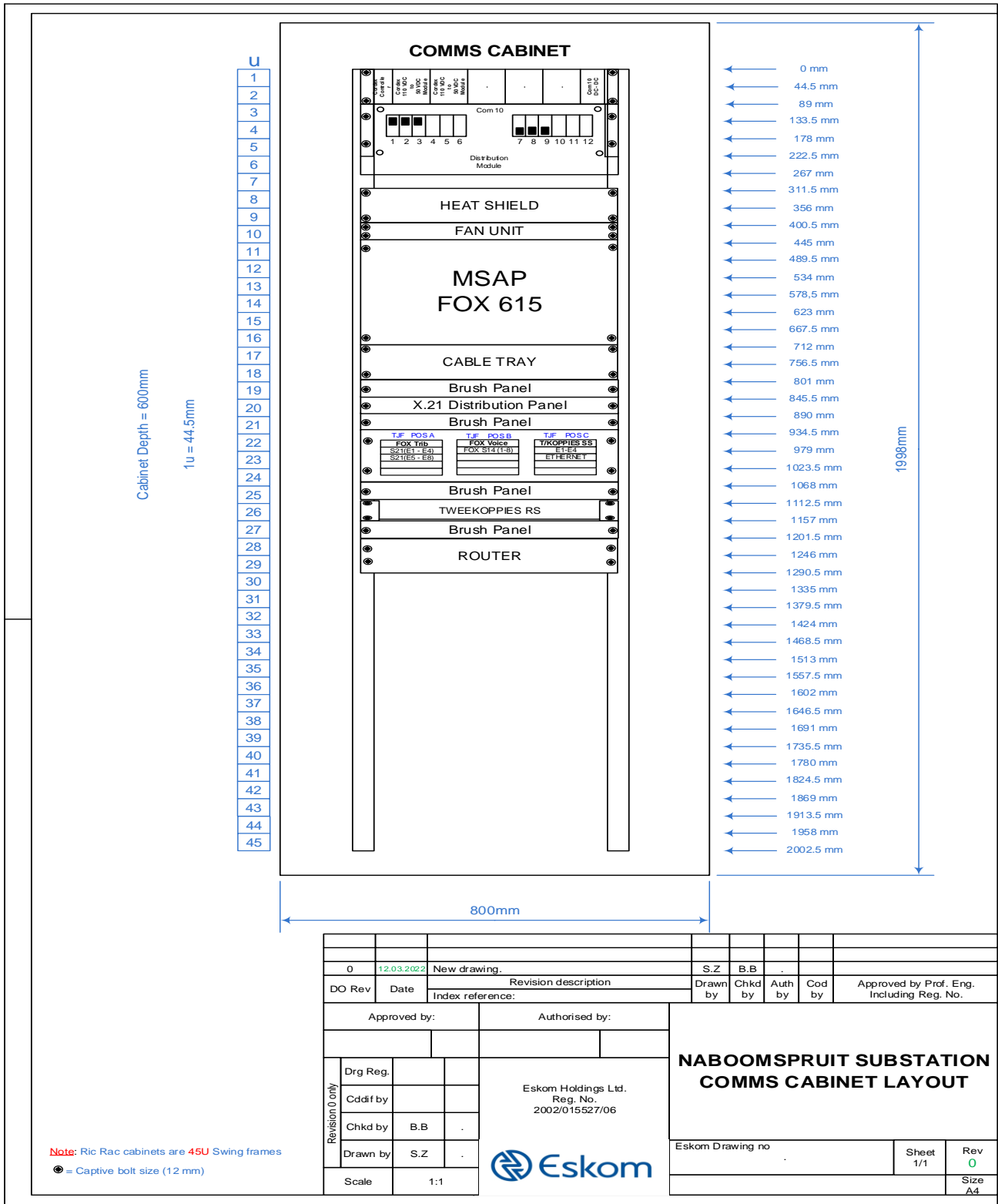
Project Name	Project No	Project Manager	Project Status
Client Name	Client No	Client Manager	Client Status
Design Name	Design No	Design Manager	Design Status
Drawn By	Drawn Date	Drawn Date	Drawn Date
Checked By	Checked Date	Checked Date	Checked Date

Drawing Number: 10-10000-11
 Scale: 1:1
 Date: 2020/01/29

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A.4 Naboomspruit SS Comms Cabinet Layout.

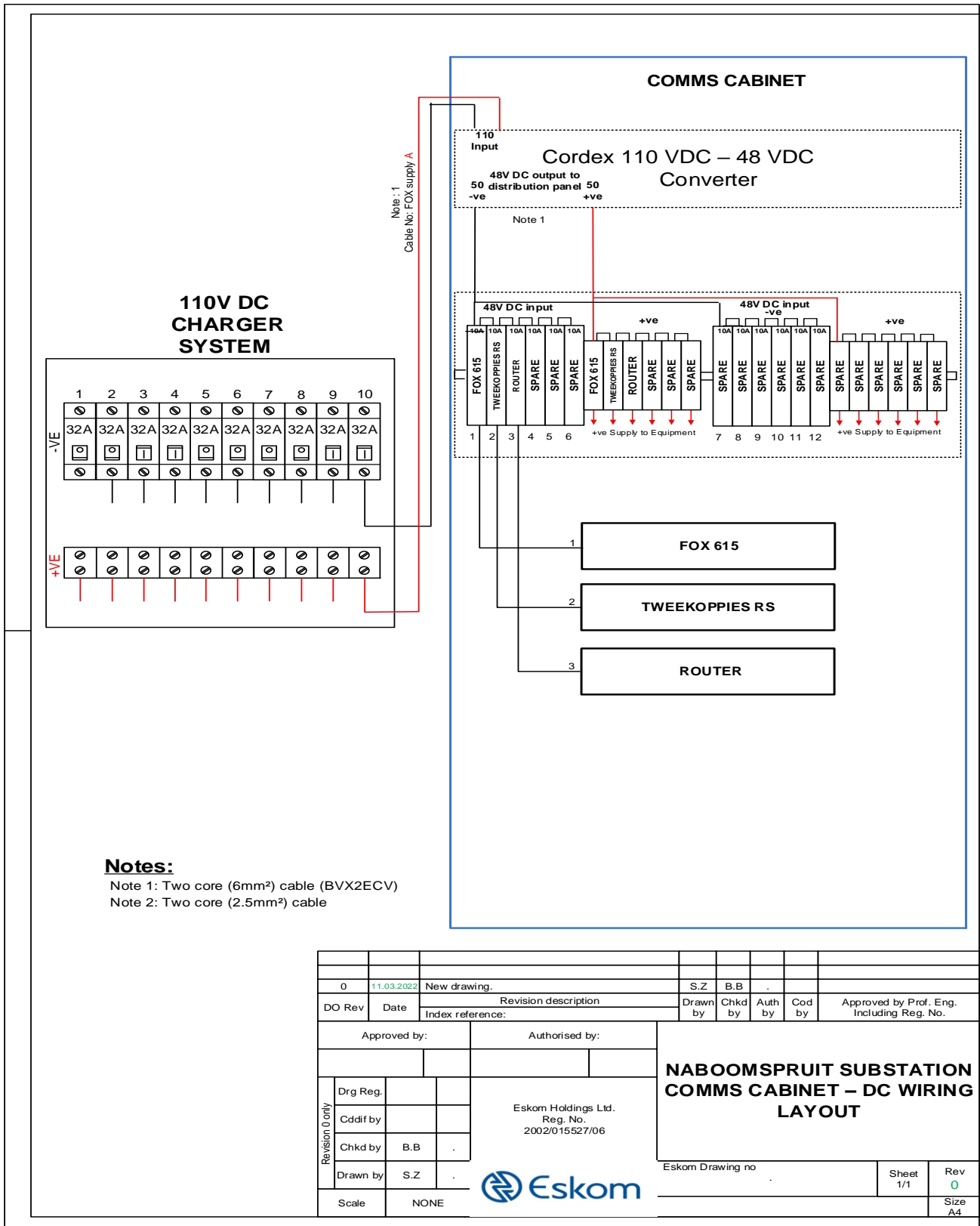


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A.5 Naboomspruit SS Comms Cabinet DC Wiring Layout.

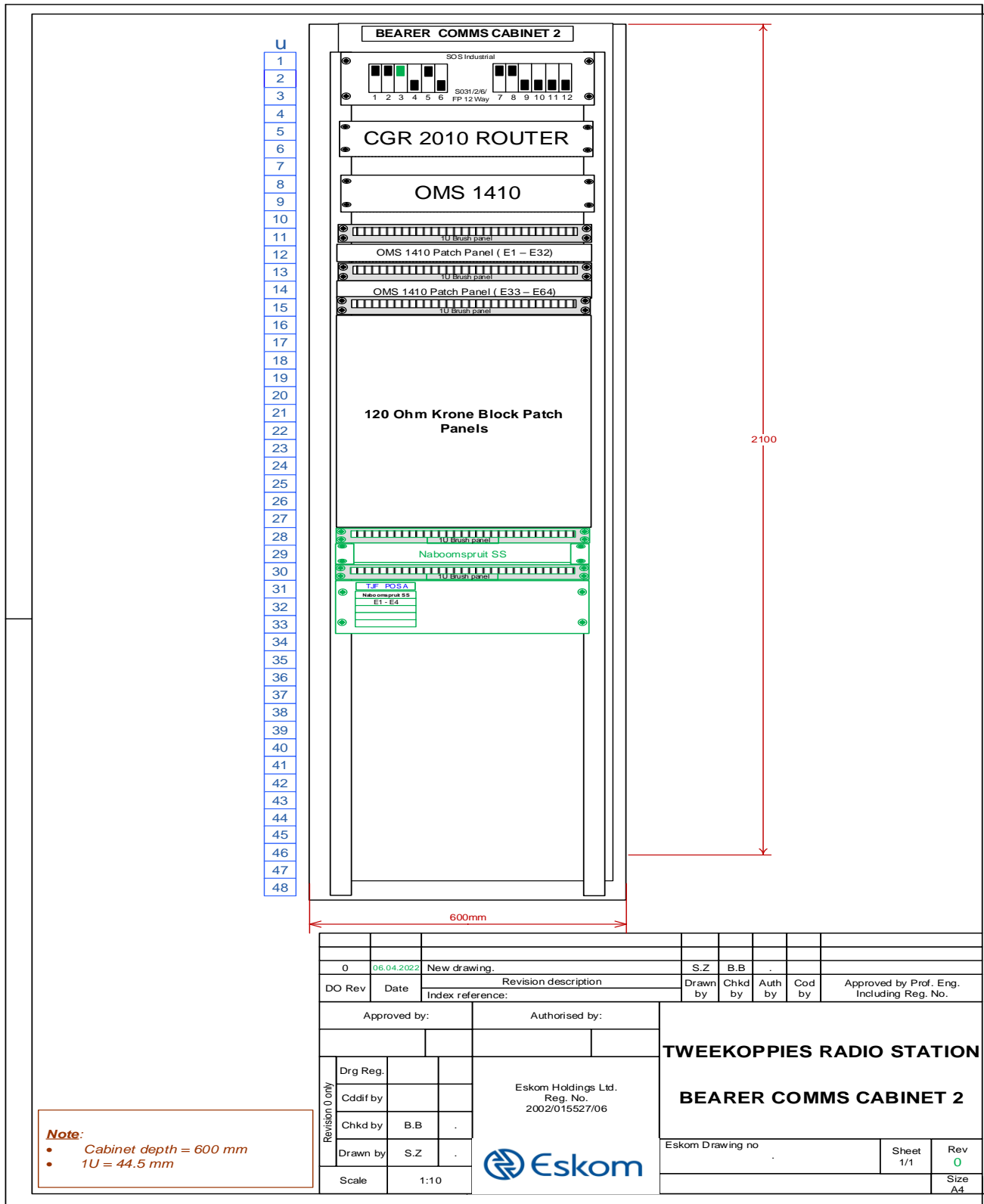


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A.6 Tweekoppies RS Bearer Comms 2 Cabinet Layout.

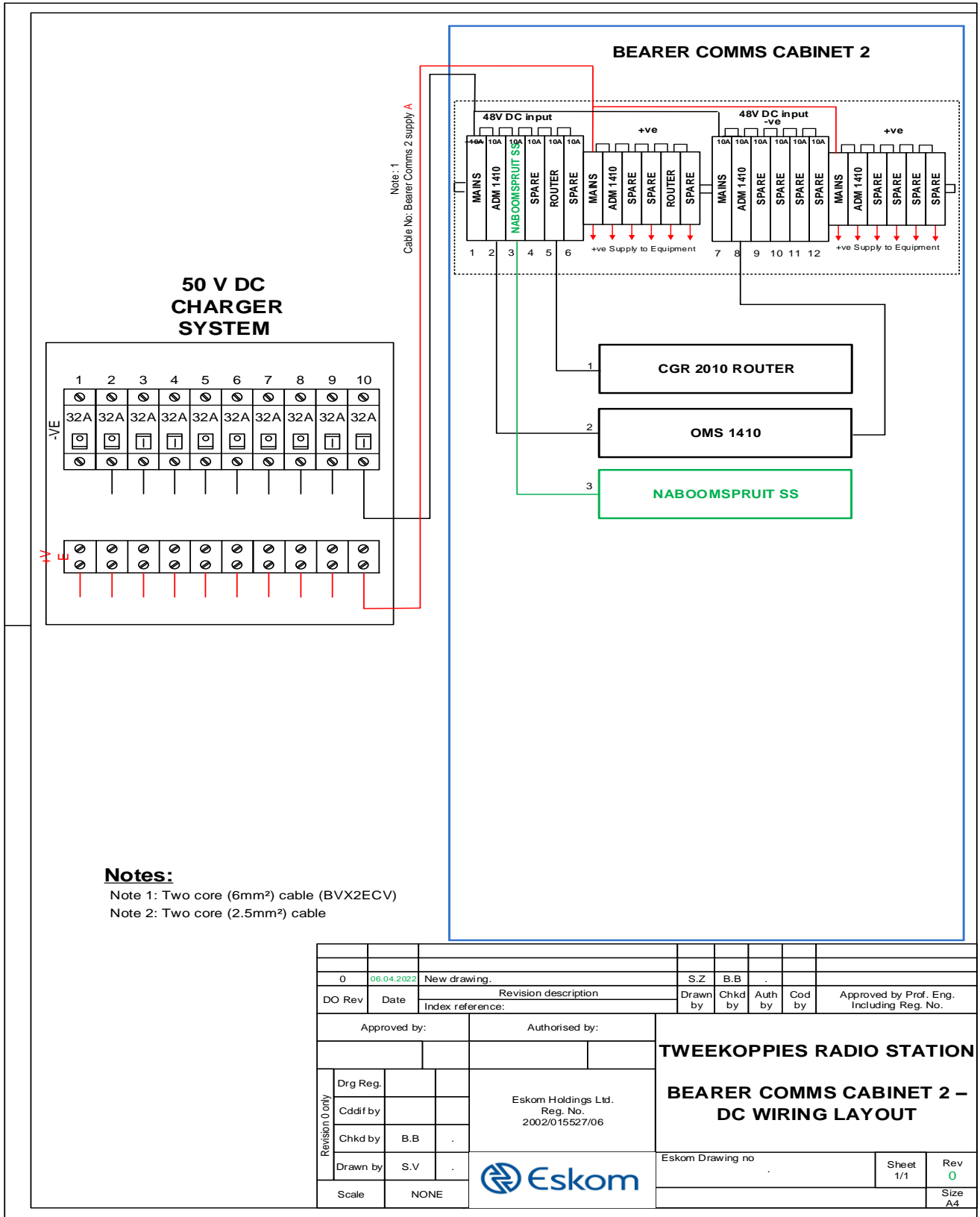


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A.7 Tweekoppies RS Bearer Comms 2 Cabinet DC Wiring Layout.

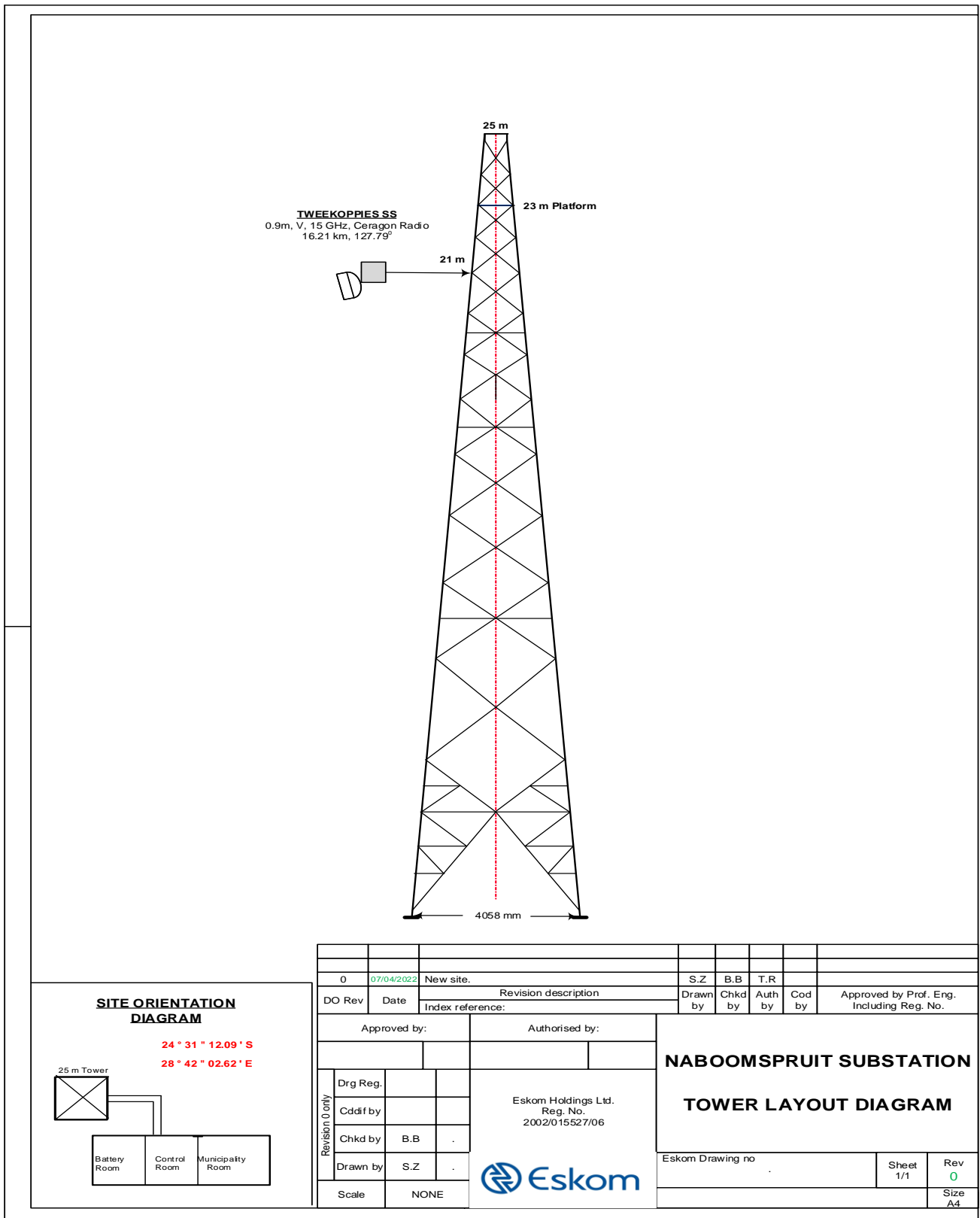


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A.8 Naboomspruit SS Tower Layout.

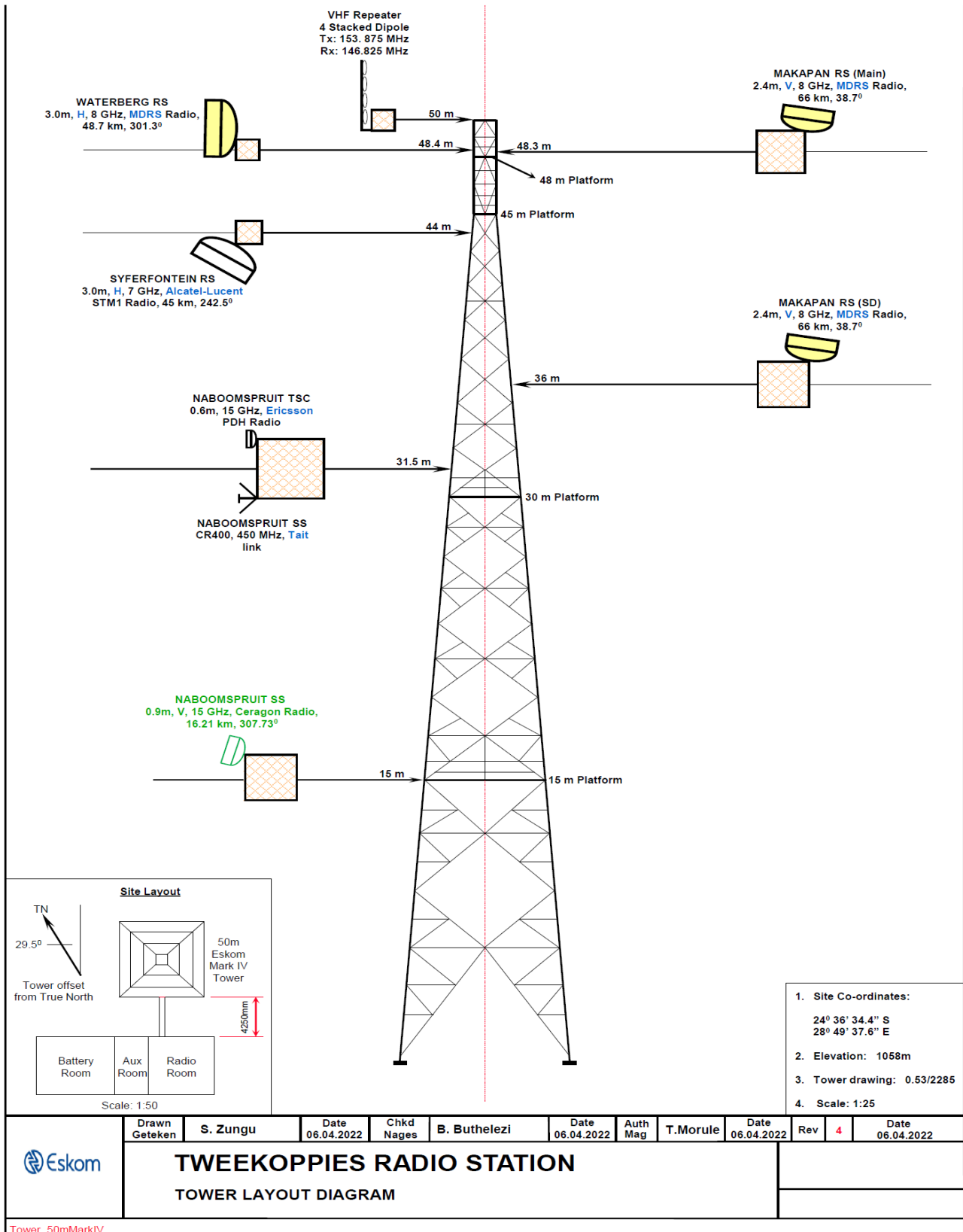


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A.9 Tweekoppies RS Tower Layout.



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A.10 Pathloss Parameters Simulation.

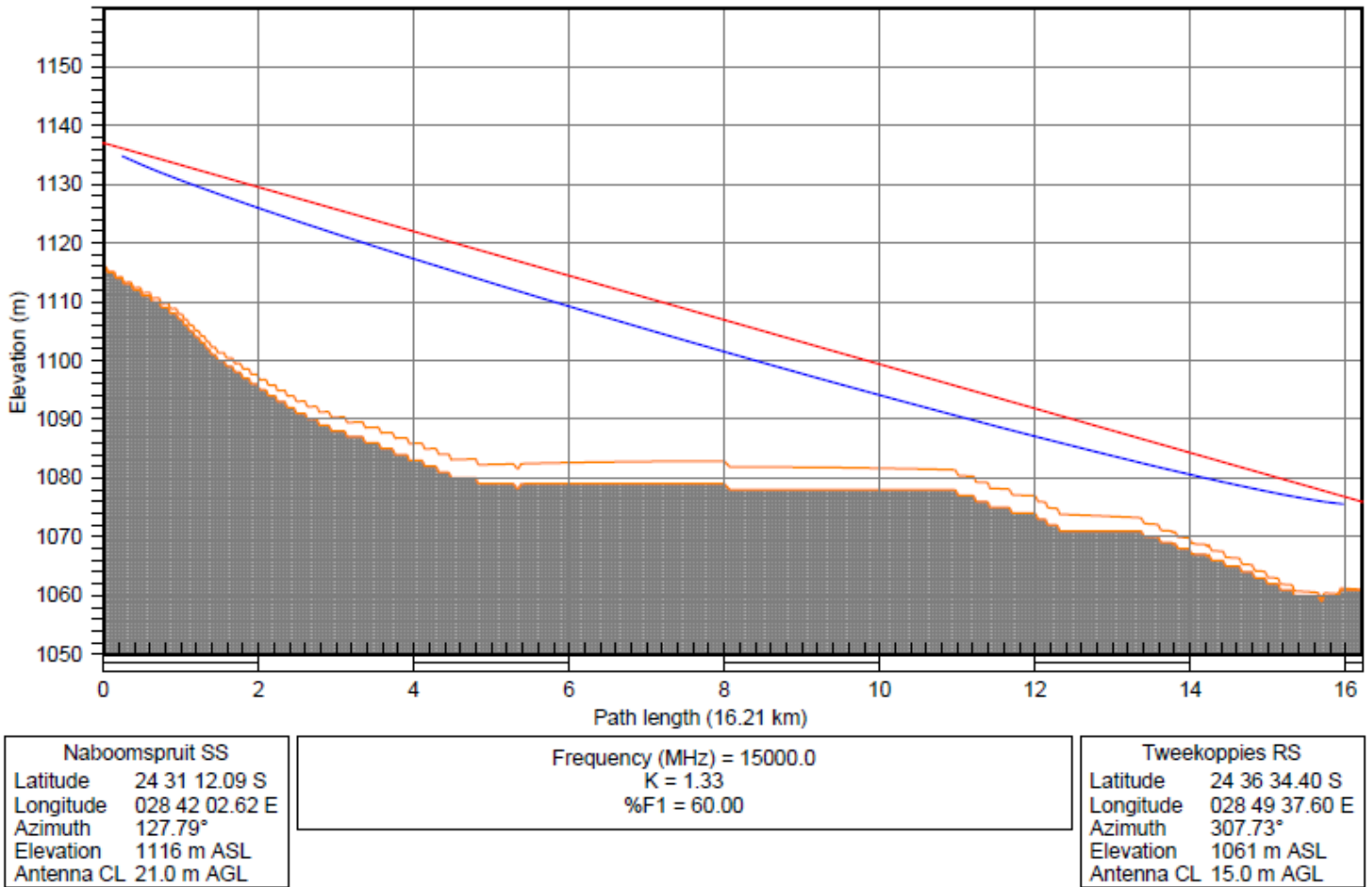
	Naboomspruit SS	Tweekoppies RS
Elevation (m)	1116.00	1060.96
Latitude	24 31 12.09 S	24 36 34.40 S
Longitude	028 42 02.62 E	028 49 37.60 E
True azimuth (°)	127.81	307.76
Vertical angle (°)	-0.27	0.16
Antenna model	ANT2 0.9 15 HP	ANT2 0.9 15 HP
Antenna height (m)	21.00	15.00
Antenna gain (dBi)	40.90	40.90
Frequency (MHz)	15000.00	
Polarization	Vertical	
Path length (km)	16.21	
Free space loss (dB)	140.19	
Atmospheric absorption loss (dB)	0.45	
Net path loss (dB)	58.84	58.84
Radio model	IP20G-15-7X	IP20G-15-7X
TX power (watts)	0.16	0.16
TX power (dBm)	22.00	22.00
EIRP (dBm)	62.90	62.90
Emission designator	7M0D7W	7M0D7W
RX threshold criteria	BER 10-6	BER 10-6
RX threshold level (dBm)	-79.00	-79.00
RX signal (dBm)	-36.84	-36.84
Thermal fade margin (dB)	42.16	42.16
Dispersive fade margin (dB)	70.20	70.20
Dispersive fade occurrence factor	5.00	
Effective fade margin (dB)	42.12	42.12
Geoclimatic factor	1.77E-06	
Path inclination (mr)	3.76	
Fade occurrence factor (Po)	5.02E-04	
Average annual temperature (°C)	21.00	
Worst month - multipath (%)	100.00000	100.00000
(sec)	0.08	0.08
Annual - multipath (%)	100.00000	100.00000
(sec)	0.34	0.34
(% - sec)	100.00000 - 0.68	
Rain region	ITU Region K	
0.01% rain rate (mm/hr)	42.00	
Flat fade margin - rain (dB)	42.16	
Rain rate (mm/hr)	100.11	
Rain attenuation (dB)	42.16	
Annual rain (%-sec)	99.99900 - 314.07	
Annual multipath + rain (%-sec)	99.99900 - 314.75	

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A.11 Pathloss Line of Sight Simulation.

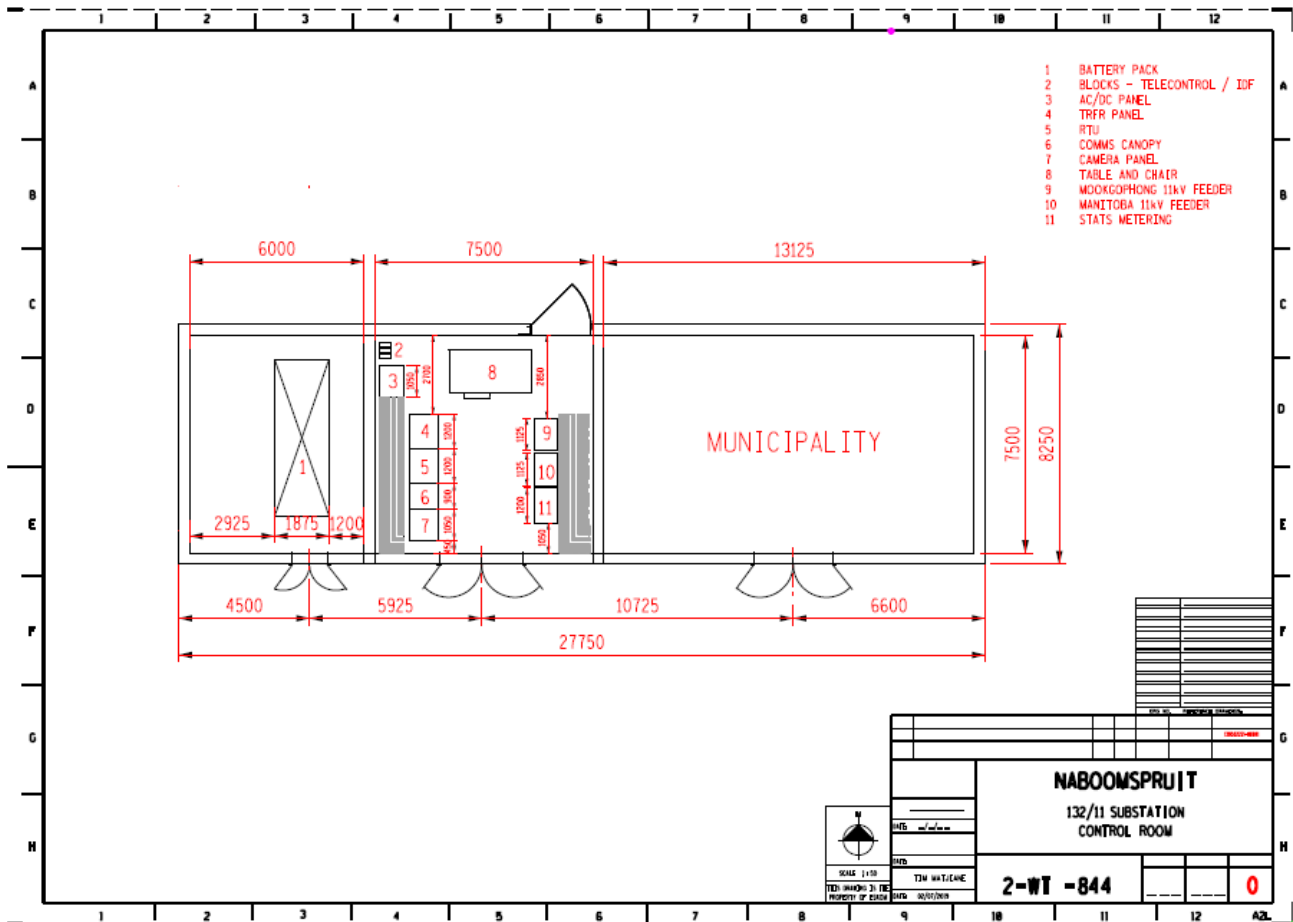


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A.12 Naboomspruit SS Control Room Layout.

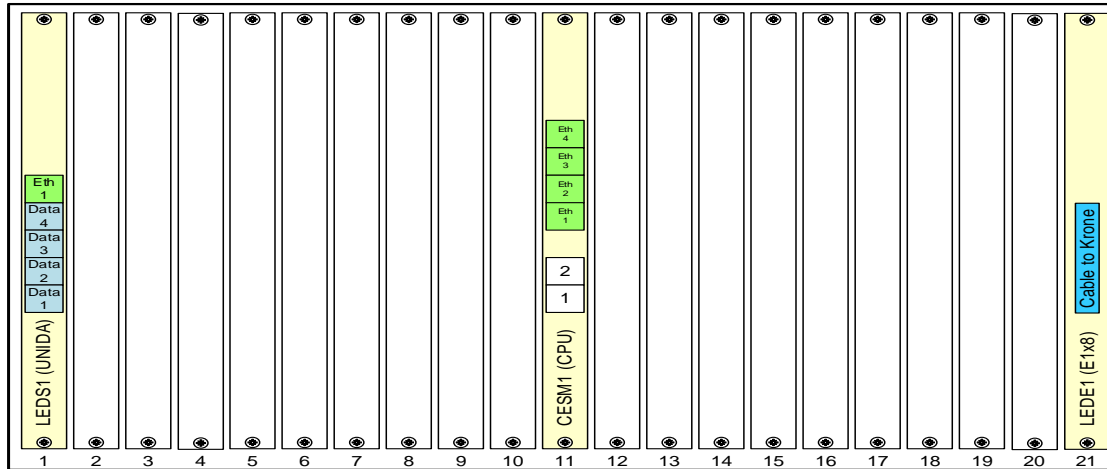


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A.13 Naboomspruit SS FOX 615 Slots Allocation Layout.



MSAP Connection	Connection Type	Destination
Slot 21 Port 1	DCN	Spitskop 132 kV SS (ME1640)
Slot 21 Port 2	Traffic	Spitskop 132 kV SS (ME1639)
Slot 21 Port 3		
Slot 21 Port 4		
Slot 21 Port 5		
Slot 21 Port 6		
Slot 21 Port 7		
Slot 21 Port 8		

MSAP Connection	Connection Type	Destination
Slot 20 Port 1		
Slot 20 Port 2		
Slot 20 Port 3		
Slot 20 Port 4		
Slot 20 Port 5		
Slot 20 Port 6		
Slot 20 Port 7		
Slot 20 Port 8		

IP ADDRESS: 10.20.11.127
Subnet mask : 255.255.255.255
OSFP AREA: 11

Slot Allocations:

Slot 1:	LED S1 - X.21
Slot 2:	Not Used
Slot 3:	Not Used
Slot 4:	Reserved
Slot 5:	Not Used
Slot 6:	Reserved
Slot 7:	Not Used
Slot 8:	Not Used
Slot 9:	Not Used
Slot 10:	Not Used
Slot 11:	CESM1 CPU
Slot 12:	Not Used
Slot 13:	Not Used
Slot 14:	Not Used
Slot 15:	Not Used
Slot 16:	Not Used
Slot 17:	Not Used
Slot 18:	Not Used
Slot 19:	Not Used
Slot 20:	Not Used
Slot 21:	LED E1

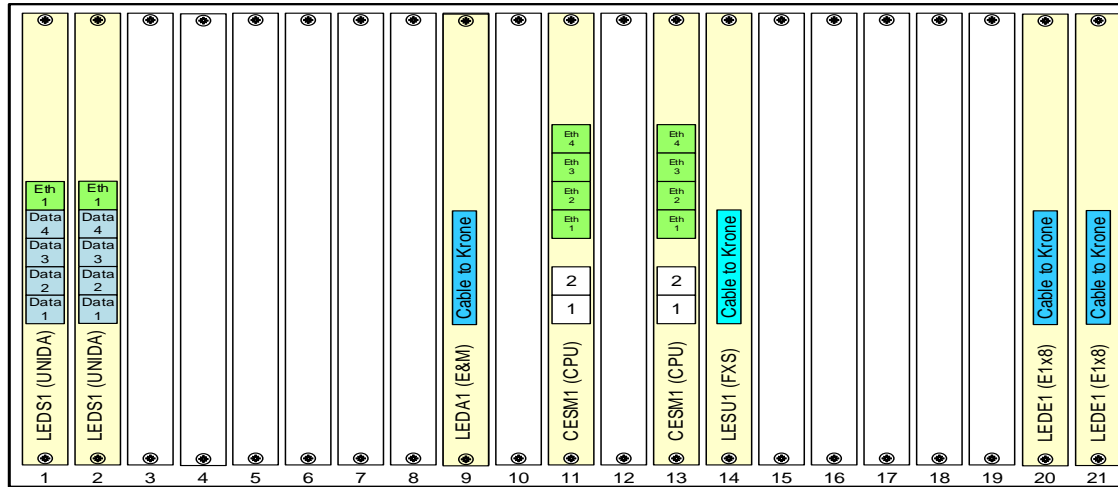
REVISIONS					NABOOMSPRUIT SS				
REV	DESCRIPTION	DATE	REV DONE BY:		MSAP FOX Module Layout				
0	First edition.	11/03/2022	SV Zungu		DRAWN BY: Siboniso Zungu	SIZE	FSCM NO	DWG NO	REV
1						A4	Limpopo	.	0
2				DATE: 11 March 2022	SCALE	1:1	SHEET		
3									
4									

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A.14 Spitskop 132 kV SS FOX 615 Slots Allocation Layout.



ADM Connection	Connection Type	Destination
Slot 21 Port 1	DCN	Minerva SS (ME0715)
Slot 21 Port 2	Traffic	Minerva SS (ME0716)
Slot 21 Port 3	DCN	Spudshaft SS (ME0567)
Slot 21 Port 4	Traffic	Spudshaft SS (ME0488)
Slot 21 Port 5		
Slot 21 Port 6		
Slot 21 Port 7		
Slot 21 Port 8	Traffic	Naboomspruit SS (ME1639)

ADM Connection	Connection Type	Destination
Slot 20 Port 1	DCN	Spitskop 400 kV SS (ME0712)
Slot 20 Port 2	Traffic	Spitskop 400 kV SS (ME0713)
Slot 20 Port 3	Traffic	Spitskop 400 kV SS (ME0714)
Slot 20 Port 4	DCN	Northam SS (ME0568)
Slot 20 Port 5	Traffic	Northam SS (ME0569)
Slot 20 Port 6	DCN	Zondereinde SS (ME1625)
Slot 20 Port 7	Traffic	Zondereinde SS (ME1632)
Slot 20 Port 8	DCN	Naboomspruit SS (ME1640)

IP ADDRESS: 10.20.11.61
Subnet mask : 255.255.255.255
OSFP AREA: 11

Slot allocations:

Slot 1:	LED S1 - X.21
Slot 2:	LED S1 - X.21
Slot 3:	Not Used
Slot 4:	Reserved
Slot 5:	Not Used
Slot 6:	Reserved
Slot 7:	Not Used
Slot 8:	Not Used
Slot 9:	LED S1 - X.21
Slot 10:	Not Used
Slot 11:	CESM1 CPU
Slot 12:	Not Used
Slot 13:	CESM1 CPU
Slot 14:	LES U1 FXS
Slot 15:	Not Used
Slot 16:	Not Used
Slot 17:	Not Used
Slot 18:	Not Used
Slot 19:	Not Used
Slot 20:	LED E1
Slot 21:	LED E1

REVISIONS				Eskom	Spitskop 132 KV SS			
REV	DESCRIPTION	DATE	REV DONE BY:		MSAP FOX Module Layout			
0	First edition	24/02/2022	SV Zungu	DRAWN BY: Siboniso Zungu DATE: 24 February 2022	SIZE	FSCM NO	DWG NO	REV
1	Added Naboomspruit SS.	11/03/2022	SV Zungu		A4	Limpopo	-	1
2					SCALE	1:1	SHEET	11
3								
4								

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