Eskom	Standard	Technology

Title: **MAINTENANCE AND/OR REPAIRS OF MV CABLE FAULT LOCATOR AND TESTING EQUIPMENT**

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Content

Page

1. Introduction 3
2. Supporting clauses 3
   - 2.1 Scope 3
     - 2.1.1 Purpose 3
     - 2.1.2 Applicability 3
   - 2.2 Normative/informative references 3
     - 2.2.1 Normative 3
     - 2.2.2 Informative 3
   - 2.3 Definitions 3
     - 2.3.1 General 3
     - 2.3.2 Disclosure classification 4
   - 2.4 Abbreviations 4
   - 2.5 Roles and responsibilities 4
   - 2.6 Process for monitoring 4
   - 2.7 Related/supporting documents 4
3. Requirements 4
   - 3.1 General requirements 4
   - 3.2 Operating environmental conditions 5
   - 3.3 Cable fault locator test set 5
     - 3.3.1 Cable Fault finding (Scope) 5
4. Trailer 5
5. Additional information to be submitted by tenderer 5
6. Evaluation criteria 6
7. Authorization 6
8. Revisions 6
9. Development team 6
10. Acknowledgements 6
11. Annexure A 7
    - 11.1 32kV Surge Generator (SPG32) 7
    - 11.2 Time Domain Reflectometer (Teleflex SX) 7
    - 11.3 Ground Microphone 8
    - 11.4 Sputnik 10 Trailer 10
    - 11.5 Inverter System 11
    - 11.6 25m HT Rack 12
    - 11.7 Complete Installation 12
    - 11.8 IRG 2000 and IRG 3000 13
    - 11.9 SA 32 13
    - 11.10 SSG 2100 13
    - 11.11 SSG 1500 14
    - 11.12 Protrac 14

1. Introduction

This technical evaluation criteria document has been prepared for the Eskom Distribution Gauteng Cluster (Gauteng Cluster Dx). It will be used by the Gauteng Cluster when conducting technical evaluations on the maintenance and/or repair of the MV cable fault locator and testing equipment, for cables (PILC and XLPE-insulated) with nominal voltages from 1kV up to and including 33 kV.

2. Supporting clauses

2.1 Scope

This technical evaluation criteria document covers the Gauteng Cluster Dx minimum requirements for the maintenance and/or repair of the trailer-mounted cable fault locator test equipment, that comprises a 32kV Surge Generator (SPG 32), Time Domain Reflectometer (Teleflex SX), Ground Microphone, Syscompact 2000/4000 cable fault location system including IRG 2000 Microprocesser scope, Surge voltage generator, Pin pointing system protrac, Univesal receiver UL 30 and Ground microphone BM 30, and a trailer, that will be used on PILC and XLPE-insulated cables with nominal voltages from 1kV up to and including 33 kV.

The spare parts and functionality of the full MV cable fault locating and test equipment can be found on annexure A of this document.

2.1.1 Purpose

This document has been compiled to provide technical requirements for maintenance and/or repairs of cable fault locator test equipment, which includes a cable fault locator test set mounted on a trailer for testing MV cables with nominal voltages from 1kV up to and including 33 kV.

2.1.2 Applicability

This document shall apply for Eskom Holdings Limited (Distribution).

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] ISO 9001, Quality Management Systems

[2] SANS 60060-3, High-voltage test techniques Part 3: Definitions and requirements for on-site testing

2.2.2 Informative

[3] 32-9: Definition of Eskom documents.

[4] 32-644: Eskom documentation management standard.

[5] 474-65: Operating manual of the Steering Committee of Technologies (SCOT).

2.3 Definitions

2.3.1 General

Definition	Description
Service provider/OEM	Maintenance service provider or original equipment manufacturer

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
Dx	Distribution
MV	Medium voltage
OEM	Original equipment manufacturer
Std.	Standard
SI	Standards Implementation
PD	Partial discharge
PILC	Paper-insulated lead cables
PPE	Personal protective equipment
PPM	Power Plant Maintenance
XLPE	Cross-linked polyethylene

2.5 Roles and responsibilities

All Eskom employees and/or appointed bodies involved in the technical evaluation on the maintenance and/or repairs of the MV cable fault locator test equipment and/or the associated accessories shall ensure that the service provided meets the requirements of this standard. Any deviation from these requirements shall constitute non-conformance unless it was in advance agreed to by a delegated specialist and is based on sound engineering judgement.

All the service providers/OEM for the maintenance and/or repairs of the MV cable fault locator test equipment to Eskom must be conversant with the requirements of this standard and shall comply with the requirements. No deviations will be accepted, and service providers shall ensure that they obtain clarity where required and obtain all supporting information or documents necessary to comply with this document.

2.6 Process for monitoring

The technical evaluation criteria in clause 6 will be used for process monitoring as per Eskom requirements.

2.7 Related/supporting documents

Refer to clause 2.2.

3. Requirements

3.1 General requirements

The tenderer that will provide the maintenance and repair service for the MV cable fault locator test equipment shall be responsible for the full maintenance and/or repairs, when necessary, of the individual components as well as testing the correct operation of the full system thereafter. Appropriate PPE shall be worn during the maintenance and repair process.

The technical evaluation criteria on clause 6 will be used to evaluate all submitted documentation. Each tenderer must obtain a minimum score of 85% to qualify; any score below 85% will lead to immediate disqualification.

3.2 Operating environmental conditions

The trailer mounted cable fault locator test equipment shall be able to function in the following operating environmental conditions:

Temperature	5 - 40°C
Humidity	20% to 80%
Altitude	up to 1500 meters
Terrain	Rough, off-road conditions
Rainfall	summer - severe thunderstorms

3.3 Cable fault locator test set

The cable Fault locator test set shall be used during commissioning and maintenance of the underground cables to perform the tests stipulated in the subsections below, at 220 -230V at 50Hz.

3.3.1 Cable Fault finding (Scope)

The test set should be able to:

- Have 5kW invertor system with 4x100AH deep cycle batteries
- Inject voltages up to 32kV
- Pre-locate and provide the fault distance from the source.
- Pinpoint the fault. (eg. Ground microphones, Headphones, audio transmitter etc.)
- Pressure-test the cable after repairs.

4. Trailer

The trailer shall be:

- Easily and securely attachable to any Eskom vehicle used during maintenance and/or commissioning
- Suitable for on-road and off-road conditions, due to cable routes that might deviate from normal roadways.
- Compliant with the South African Road Ordinance Act and shall be fitted with the latest approved Eskom Distribution Logos
- Supplied fully fitted with the cable fault locator test set

5. Additional information to be submitted by tenderer

- Guarantees offered to Eskom with regards to the safe operation after maintenance and/or repairs of the cable fault locator test equipment
- Time it will take the service provider/OEM to maintain and/or repairs the equipment
- Warranty information of MV cable fault locator test equipment after maintenance and/or repairs

6. Evaluation criteria

Technical evaluation criteria for maintenance and/or repair of a trailer-mounted cable fault locator and test equipment		
TASK / MEASURE		
Criteria	**Weighting**	**Score**
Maintain and/or repair a 32kV Surge Generator (SPG 32)	15	
Time Domain Reflectometer (Teleflex SX)	15	
Maintain and/or repair a ground Microphone	10	
Maintain and/or repair a Syscompact 2000/4000 cable fault location system including IRG 2000 Microprocesser scope	15	
Maintain and/or repair a Surge voltage generator	10	
Maintain and/or repair a Pin pointing system protrac	15	
Univesal receiver UL 30 and Ground microphone BM 30	10	
Maintain and/or repair a trailer	10	
TOTAL	/100	

7. Authorization

This document has been seen and accepted by:

Name and surname	**Designation**
Stephen Nkwane	Manager: Standards Implementation (GOU)
Jabu Cele	Manager: Power Plant Maintenance (GOU)

8. Revisions

Date	**Rev**	**Compiler**	**Remarks**
July 2022	0	P Bopape	New Document

9. Development team

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

- Phenny Bopape: Principal Engineering Assistant PPM
- Sandisiwe Mtshaulana: Engineer SI

10. Acknowledgements

The following PPM cables senior supervisors accepted the document.

- Jabu Cele Manager PPM
- Stephen Nkwane Manager SI

11. Annexure A

Complete 32kV Test System Trailer

No.	Item	Quantity
1	32kV Surge Generator	1
2	Time Domain Reflectometer	1
3	Ground Microphone	1
4	Trailer	1
5	Inverter System	1
6	HT Rack 25m	1
7	Full Installation	1

11.1 32kV Surge Generator (SPG32)

Complete 32kV surge unit for fault location on low and medium voltage cable. The unit has built in Arc reflection, DC Testing and Sheath Fault Location. The unit has 1750 Joules energy.

Requirements	**Comply Yes**	**Comply No**	
DC Testing: 0 to 32kV DC			
Test Current: 0 to 2 mA 1000Ws			
Surge: 0 to 8kV 1750 J 0 to 16kV 1750 J 0 to 32kV 1750 J			
Surge Rate: 3 to 10 seconds, Single Pulse			
Burning: 0 to 32kV, 160mA			
MFO - Sheath Fault Locating: 0 to 5kV power regulated			
MFO – 0 to 160mA			
Pulsed Output: 2 to 6 sec			
Weight: 135kg			
Protection Type: IP21			
Capacitor: Metal Casing with Porcelain Insulators			
HV Transformer must have temperature cut-out with thermal fuse.			

11.2 Time Domain Reflectometer (Teleflex SX)

Requirements	**Comply Yes**	**Comply No**	**Variation**
Operation: Touch Screen & Control Knob			

Range: 20 m to 160 km @ v/2 = 80 m/µs			
Resolution: 0.1 m @ v/2 80 m/µs, 1.0 cm @ v/2 < 40 m/µs			
Sample Rate: Up to 400 MHz			
Gain: - 37 … + 37 dB			
De-Attenuation: 0 … + 22 dB for Pro Range (Adjustable 0 … 100 %)			
Propagation Velocity: V/2 10 … 149.9 m/µs, ft/µs or nvp			
Dynamic Range: > 80 dB			
Compensation: 8 Ω ... 500 Ω, adjustable			
Arm slide: 15 measurements in one ARM shot			
Voltage Proof Input: > 400 V			
Display: 10.4“color TFT XGA 1024x768, 600 cd/m2, CCFL-Backlight			
Data Storage: 4 GB mSATA for program and data			
Connectors: Ethernet, USB, BNC, CAN (LON optional)			
Protection: Class IP 65 closed, IP 54 open lid			
Supply: 110 … 240 V, 50/60 Hz, 30 VA, 12 V ext.			
Dimensions (w x h x d): 362 x 195 x 306 mm (Option 19“, 6 HU)			
Weight: 10 kg			
Prelocating Modes: Reflection Measurement (TDR) ARM Measurements up to 32kV Decay up to 32kV ICE Impulse Current Method up to 32kV			
Operation: Touch Screen & Control Knob			
Range: 20 m to 160 km @ v/2 = 80 m/µs			
Resolution: 0.1 m @ v/2 80 m/µs, 1.0 cm @ v/2 < 40 m/µs			

11.3 Ground Microphone

Surge wave receiver for acoustic and electromagnetic cable fault pinpointing.

Requirements	Comply Yes	Comply No	Variation
Carrying bag with Foam Inserts for unit plus accessories			
Bluetooth Interphase for pairing with headphones			
Receiver			
Display: TFT Colour Display, 320x240 pixels			
Safety: Volume limitation to 84dB			
Gain: >120dB Automatic			
Supply: 6 x R6 Alkaline Batteries			
Operating Time: >10 hours			
Protection Rating: IP 54			
Dimensions (H x W x D): 65 x 225 x 100mm			
Weight: 900g (Incl Batteries)			
Fully automatic trigger level adjustment for acoustic as well as for magnetic channel			
Intelligent noise suppression (Background Noise Reduction)			
Distance measurement in milliseconds or meter/feet			
Easy tracing with left-right indicator			
“Compass” for fault direction indication			
Sensor			
Height: 140mm			
Outer Rim Diameter: 230mm			
Handle Length: 450 – 750mm Adjustable			
Weight: 2.2kG (incl batteries and handle)			
Dynamic Range: Magnetic Chanel > 110dB Acoustic Chanel > 110dB			
Frequency Range: 100 – 1500Hz			
Filter Stages: Off – 100 to 1500Hz Low Pass – 100 to 400Hz Band Pass – 150 to 600Hz High Pass – 200 to 1500Hz			

Protection Rating: IP 65			
High ground stability of the sensor up to 45°			
Automatic headset mute function during the handling of the sensor (Automatic Proximity Mute)			
Optional Accessories			
Vehicle Installation Kit			
Bluetooth Headset			

11.4 Sputnik 10 Trailer

This trailer is designed as a fully closed unit with a large door to facilitate easy loading and unloading. The "Rigidised Steel" panel design creates an extremely sturdy and light container box and has a "Wind deflecting" nosecone that reduces wind drag and lowers fuel consumption of the towing vehicle. The Container trailer can accommodate a low, high bulk load configuration.

Requirements	Comply Yes	Comply No	Variation
2500kg Braked Axle			
Gas Lift Supported Side and Rear Door			
205 x 14" Tyres 4 X 4			
5 Hole x 114.3 14" Rims			
1100 – 2000kg Braked Coupler			
Jockey Wheel: Heavy Duty			
Chassis: Rectangular Tube and Chanel Sections			
Length Overall: 3683mm			
Length Body: 3090mm			
Width Inside: 1525mm			
Width Overall: 2000mm			
Ground Clearance: 500mm			
Height Inside: 1637mm			
Height Overall: 2190mm			
Tare Mass: 560kg			
GVM: 1525kg			
Pay Load: 965kg			
Brakes: Yes			
Axle Length: 1830mm			
Axle Capacity: 2500kg			
Customized Suspension for Equipment Weight Rubber Axle			

11.5 Inverter System

3000W Self-contained inverter system for power supply to test equipment.

Requirements	Comply Yes	Comply No	Variation
Inverter			
Output AC Voltage: 220 / 230 / 240 VAC			
Output Rated Power: 3000W			
Output Surge Power: 6000W			
Output Waveform: True sine wave (THD < 3%)			
Output Frequency: 50 / 60 Hz selectable by DIP switch			
Output AC Regulation: +-3%			
Output Power Factor Allowed: COS_-90O~ COS_+90O			
Input No Load Current Draw: 2.80A			
Input Stand-By Current Draw: 0.50A			
Input DC Voltage: 12VDC			
Input Voltage Range:			
Input Efficiency: 90.0%			
Input Fuse: 40A x 10			
Protection Bat. Low Alarm: 11VDC			
Protection Bat. Low Shutdown: 10.5VDC			
Protection Over Voltage: 15.3VDC			
Dimensions L x W x H: 452x208x166mm			
Cooling: Loading Controlled Fan			
Charger			
Output Boost Charge Voltage: 14.4V			
Output Float Charge Voltage: 13.8V			
Output Recommended Battery Capacity (AMP Hours):135 – 400AH			
Output Current: 40A			
Input Voltage Range: 90 ~ 264VAC 127 ~ 370VDC			
Input Frequency Range: 47 – 63Hz			
Input Power factor: 0.95/230VAC 0.98/115VAC at full load			
Efficiency: 86%			
Input AC Current: 6.8A/115VAC 3.4A/230VAC			
Inrush Current: 25A/115VAC 50A/230VAC			
Leakage Current: <3.5mA / 240VAC			
Protection Over Voltage: 16-18V			

Over Temperature: Protection type: Shut down o/p voltage, recovers automatically after temperature goes down			
Fast Charge: 2 / 3 / 8 stage selectable			
Charger OK: Relay contact (RY15)			
Output OK: Relay contact (RY13)			
Safety Standards: UL1012, TUV EN60335-1, EN60335-2-29 (except for 48V), EN60950-1(48V only) approved			
Dimensions: 230*158*67mm(L*W*H)			
Batteries & Housing			
Number of Batteries: 4			
Batteries must be mounted in steel housing			
Batteries: 102Ah or 105Ah			
Cable from Batteries to Inverter: 1000V 70mm² (SABS 1507)			
Cable from Charger to Batteries: 1000V 16mm² (SANS 1574)			
Battery level indicator			

11.6 25m HT Rack

25m HT Rack for extending the High voltage extension cable for installed equipment.

Requirements	**Comply Yes**	**Comply No**	**Variation**
Metal frame with base plate			
3 Reels with internal braking			
25m 16mm Single Core Earth Cable			
25m 2.5mm 3 Core Mains Cable			
25m 6mm Silicon Insulated High Voltage Cable			
Earth Cable must have ferules for central earth point			
Industrial clamp on earth lead			
Swivel handle on reels for hand cranked operation			
Clamp Organizing attachments			

11.7 Complete Installation

Complete Installation of test equipment in vehicle or trailer.

Requirements	Comply Yes	Comply No	Variation
19mm Plywood floor			
Industrial interlocking floor tiles			
Steel Mounting Brackets for test equipment			

DB Board with earth leakage			
Separation transformer			
Change over switch for power supply			
Internal light			
Rotating Low back chair			
300mm Earth Spike			
Hammer			
Measuring Wheel			
Central Earth point with micro switch			

11.8 IRG 2000 and IRG 3000

Spare parts for IRG 2000	**Comply Yes**	**Comply No**	**Variation**
560 400 - Display Board IRG 2000			
560-399 - Acquisition Board IRG 2000			
578-518 - Flat cable IRG 2000			
560-414 -Metal shield acquisition board IRG 2000			
Spare parts for IRG 3000			
460-536 - Board B In- Out IRG 3000			
460-534 - Print C Inpuls generator IRG 3000			
462-603 - Card A DSP IRG 3000			
460-527 - Board D (Powerlo) IRG 3000			

11.9 SA 32

Spare parts for SA 32	**Comply Yes**	**Comply No**	**Variation**
470-889 - mA meter assembly SA 32			
523-753 - Resistor 2.2 kOhm, 200 W			
523-763 - Resistor 15 kOhm, 200 W			
461-704 - Board A for SA 32			
560-268 - Board B for SA 32			
566-923 - Solenoid 180 VDC			

11.10 SSG 2100

Spare Parts for SSG 2100	**Comply Yes**	**Comply No**	**Variation**
472-652 - Set replacement PCB A, PCB B, SSG 32 kV			
461-097 - PCB-CA lifting magnet control SSG 32			
538-043 - HV Capacitor bank 4x16 uF SSG 2100DUAL-USE goods according ECCN 3A201			

650-688 - Temperature indicator 40-71 degrees			
432-756 - Sticker “Danger HV-capacitor” for SSG			
470-489 - HV-Transformer SSG 1500;2100			
561-140 - kV Meter, without scale			
561-149 - kV scale for SSG 1100/ 1500/ 2100			

11.11 SSG 1500

Spare Parts for SSG 1500	**Comply Yes**	**Comply No**	**Variation**
472-652 - Set replacement PCB A, PCB B, SSG 32kV			
461-097 - PCB-CA lifting magnet control SSG 32 DUAL-USE goods according ECCN 3A201			
432-756 - Sticker: Danger HV-capacitor” for SSG			
470-489 - HV-transformer SSG 1500; 2100			
461-140 - kV Meter, without scale			
561-149 - kV scale for SSG 1100/ 1500/ 2100			

11.12 Protrac

Spare Parts for Protrac	**Comply Yes**	**Comply No**	**Variation**
463-270 - PCB-Distribution assembled AGP			
472-665 - PCB-Sensor Mikrofen prog AGP			
472-645 - PCB-User Interface programmed CU			
472-644 - PCB-Proz Colibri VF61 prog CU			