
TABLE OF CONTENTS

Page

1.FOREWORD

This standard was compiled by the following Work Group members:

Ntsako Mdaka	Technical Support

The Work Group was appointed by the NIS Group Head (GH), which, at the time of approval,

Marc Paravano	Secondary Plant
Emmanuel Hlatshwayo	Plant Test
Reckson Mabasa	Plant Test
Johannes Letsholo	Secondary Plant
Zamokuhle Magagula	Secondary Plant
Sixolele Toko	Secondary Plant
Mbuyiselo Mphuta	Secondary Plant
Willie Du Plessis	Engineering Workshops
Story Napo	Transmission
Archibald Masondo	Public Lighting
Siphiwe Maphumulo	Public Lighting
Nkele Simelane	Public Lighting

Recommendations for corrections, additions or deletions should be addressed to the:

Chief Engineer

NIS: Technical Support

City Power Johannesburg (SOC) Ltd

P O Box 38766

Booysens

2016

INTRODUCTION

The cable fault locating equipment is used for testing, pre-locating, and pin-pointing conductor and insulation faults of low and high resistance, intermittent or flashing nature in PVC, PILC and XLPE High Voltage underground power cables.

2.NORMATIVE REFERENCES

The following documents contain provisions that, through reference in the text, constitute requirements of this specification. At the time of publication, the editions indicated were valid. All standards and specifications are subject to revision, and parties to agreements based on this specification are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

DIN VDE 0104 (EN50191): *Erection and operation of electrical test equipment*

DIN VDE 0105 (EN 50110): *Operational of electrical installations-Part 100: General requirements*

SANS 20055: *Uniform provisions concerning the approval of mechanical coupling components of combinations of vehicles*

VC 8026: *Category o1 and o2 vehicles (caravans and light trailers)*

3.DEFINITIONS AND ABBREVIATIONS

The definitions and abbreviations in the documents listed above shall apply to this specification. In addition, any reference to City Power shall mean City Power Johannesburg (Pty) Ltd.

SHERQ – Safety Health Environmental Risk and Quality

OEM – Original Equipment Manufacturer

PPE – Personal Protective Equipment

GH – Group Head

TDR – Time Domain Reflectometry

LCD – Liquid Crystal Display

VGA – Video Graphics Array

J – Joules

DFL - Digital Fault Locator

HT – High Tension

ICE – Impulse Current Mode

SIM/MIM – secondary/multiple impulse

IFL – Intermittent Fault Location

4.SCOPE

The scope of this specification includes the design, manufacturing, testing, supply, installation, and training of cable fault locating equipment.

5.REQUIREMENTS

Nothing in this specification shall lessen the obligation of the Service Provider. The Service Provider shall be fully responsible for the cable fault location machine, installations and satisfactory performance in service.

6.DESIGN

The system shall operate on 230V (+/- 5% tolerance), 50Hzand single-phase supply with integrated back up supply with minimum of 4 hours in use. The system shall be accompanied by compatible software, which visualizes the recorded data in an understandable way on a PC.

The fault location system shall be capable to perform pre-location, pinpointing of high-resistive, low-resistive and intermittent faults on low, medium and high-voltage cables. the machine shall have the following capabilities: Location of low-resistive, high-resistive and intermittent cable faults

- Efficient cable fault pre-location methods
- Pinpointing according to the noise location method and acoustic propagation time measurement with a Universal Locator and ground microphone
- Sheath fault location according to the step voltage method (with Universal Locator and two measurement probes)

6.1 Digital Time Domain Reflectometer (TDR) Set (Pre-Location Unit)

Pre location unit shall consist of the following features:

1. Time Domain Reflection Measurement
2. SIM/MIM: secondary/multiple impulse method with surge voltage or in DC mode,
3. Impulse Current Mode (ICE),
4. Decay Travelling Wave Method,
5. Intermittent Fault Location (IFL),
6. The minimum operating parameters for TDR shall be as follows:
   - Pulse voltage of 20 – 200V
   - Pulse width of 20ns – 1.3 ms
   - Voltage-proof up to 400V, 50Hz
   - Output impedance of 8 – 2000 ohm
   - Input signal gain of Dynamic range 107 dB (-63 to +44 dB)
   - View range from 10m upwards (at v/2 = 80 m/µs)
   - Accuracy of 1% relating to the measurement result
   - Data rate of 400 MHz
   - Resolution of 0.1 m (at v/2 = 80 m/µs)
   - velocity of propagation (v/2) of 20 -150 m/µs, adjustable

6.2 Surge Voltage Generator

The surge generator shall be capable of providing repetitive surges at voltage variable from zero to the required voltage indicated below with an output of surge energy of 2100 Joules in each range. It shall be

possible to obtain a single shot surge for breaking down the fault for analysis in conjunction with Time Domain Reflection (TDR). It shall be possible to apply repetitive surge for pin-pointing the faults with the help of pin pointing set.

6.2.1 Surge voltage ranges of 0 – 8 KV, 0 – 16 KV and 0 – 32 KV

6.2.2 Surge sequence of 10 or 20 pulses/min, single surge

6.2.3 DC testing of 0 – 32 kVdc,

6.2.4 Max. output current of 560 mA at 0 – 8 KV range

6.3 Acoustic and Magnetic pin-pointing set

The portable pin pointing instrument shall consist of a receiver and combined sensor which shall measure electromagnetic and acoustic signals associated with flashovers in cables. The instrument shall pinpoint the fault with direction when used in conjunction with surge generator by combination of acoustic and magnetic signal. The set shall be portable, and battery operated. Fault location by the magnetic field and sound signal fluke method with the following capabilities:

6.3.1 Consisting of a receiver and ground sensor with accessories, headphones, connection cables and transport box or mountings,

6.3.2 High acoustic and magnetic field sensitivity,

6.3.3 High performance electronic suppression of external noise and interference,

6.3.4 Excellent acoustic characteristics (frequency range 1 Hz to 2 kHz),

6.3.5 Active ear protection by a 85 dB limiter,

6.3.6 Resolution of 21 µs (approx. 0.1 m @ v = 500 m/s),

6.3.7 Acoustic gain of 0 – 34 dB,

6.3.8 Electromagnetic gain of 0 – 50 dB,

6.3.9 Propagation time measurement range of 0 – 100 ms

6.4 Power Supply

A power supply system shall be provided to ensure uninterrupted supply to the equipment during testing with the following requirements:

6.4.1 5kW system,

6.4.2 Integrated inverter,

6.4.3 Integrated charger,

6.4.4 Lithium-ion batteries

6.4.5 Strong durable metal enclosure to ensure batteries are kept in safe and stationary position

6.5 Installation frame

The installation shall include a frame/rack with the following requirements:

6.5.1 Silicone HV lead of 50m with rated voltage of above 50kV,

6.5.2 Earth and Mains leads shall be 50m in length,

6.5.3 Cable rack must have 3 reels and an earth interlock for safety,

6.5.4 A frame shall an integrated central earth point connected to surge unit to ensure proper earthing

6.6 Assembling of equipment

All equipment and accessories shall be installed in the trailer to ensure a safe and comfortable working experience, meeting the following requirements:

6.6.1 An installation shall include all wiring with DB Board, Separation Transformer, central earth points and a minimum of two additional 3 plug outlets,

6.6.2 Mounted but removable rotating office chair,

6.6.3 An installation shall have external orange warning lights system indicating the presence of high voltage or when the system is earthed.

6.6.4 Installation shall include mounting brackets for the ground microphone.

6.6.5 Installation shall include a discharge rod with a resister to ensure soft discharge with a minimum voltage rating of 50kV and

6.6.6 An earthing spike and hammer shall be provided

6.7 Mobile trailer

The trailer construction shall comprise of the following:

6.7.1 Outside and inside lighting,

6.7.2 Reflectors and reflective tape,

6.7.3 Light emitting diode (LED) rear lights,

6.7.4 License, registration and number plate,

6.7.5 All steel work internally shall be non-slippery material

6.7.6 The trailer shall have gross vehicle mass not exceeding 1,5 ton and have a coupling devices that comply with relevant requirements given in SANS 20055:2003,

6.7.7 One jockey wheel,

6.7.8 Spare wheel,

6.7.9 Stabilisers (Two front and two rear)

6.7.10 Single axel suspension fitted with brake.

6.8 Test

All routine tests as required in terms of this specification [i.e.DIN VDE 0104 (EN50191) or equivalent] and any additional recommended original equipment manufacturer shall be performed.

6.9 Marking, Labelling AND Packaging

All required marking and labelling and packaging shall be provided the Service Provider in conjunction with approval from the responsible City Power official.

7.TRAINING

The following approved training courses, for City Power's staff, shall be provided at no cost

7.1 Operating, and

7.2 Maintenance.

The suppliers shall provide technical support on system and equipment queries for the duration of the warranty.

8.DOCUMENTATION

8.1 Documentation as detailed in this specification shall be submitted with the original tender submission.

8.2 Full and complete documentation is required. The following documents shall be provided:

8.2.1 Technical product catalogue

8.2.2 Operating manual and

8.2.3 Maintenance manuals

8.2.4 The service provider shall make available documentation in both hard and soft copy

9.QUALITY MANAGEMENT

A quality management plan/system shall be set up to assure the proper quality management of the test set during design, development, production, installation and servicing phases. Guidance on the requirements for a quality management certificate may be found in the ISO 9001:2015. The details shall be subject to agreement between City Power and the Service Provider.

10.ENVIRONMENTAL MANAGEMENT

An environmental management plan/system shall be set up in order to assure the proper environmental management during design, development, production, installation, operation and maintenance, decommissioning and disposal phases). Guidance on the requirements for an environmental management system may be found in ISO 14001:2015 standards. The details shall be subject to agreement between City Power and the Service Provider. This is to ensure that the asset created conforms to environmental standards and City Power SHERQ Policy

11. HEALTH AND SAFETY

A health and safety plan/system shall be set up to ensure proper management and compliance during installation operation, maintenance, and decommissioning phases. Guidance on the requirements of a health and safety certificate may be found in ISO 45001:2018 standards. This is to ensure that the asset conforms to standard operating procedures and City Power SHERQ Policy. The details shall be subject to agreement between City Power and the Service Provider.

ANNEXURE A - BIBLIOGRAPHY

None

ANNEXURE B - REVISION INFORMATION

DATE	REV. NO.	NOTES
August 2014	0	First issue
March 2019	1	Second Issue Removed Trailer
February 2025	2	Added new work group committee General Editing

ANNEXURE C - Item No. 1 – Cable fault location machine

Schedule A: Purchaser's specific requirements
Schedule B: Guarantees and technical particulars of equipment offered

Item	Sub clause of CP_TSSPEC_221	Description		Schedule A	Schedule B
1		Manufacturer		XXXX	
2		Location		XXXX	
3		**Description**			
		110 to 230 V, 50/60 Hz±5%, single phase supply.	Yes/No	Yes	
4		**Digital Time Domain Reflectometer**	Yes/No	Yes	
		1.Time Domain Reflection Measurement	Yes/No	Yes	
		2.SIM/MIM: Secondary / multiple impulse method	Yes/No	Yes	
		3.Impulse Current Mode.	Yes/No	Yes	
		4.Decay Travelling Wave Method.	Yes/No	Yes	
		5.Intermittent Fault Location (IFL)	Yes/No	Yes	
		6.Pulse voltage of 20 – 200 V	Yes/No	Yes	
		7.Pulse width of 20ns – 1.3 ms	Yes/No	Yes	
		8. Voltage-proof up to 400V, 50Hz	Yes/No	Yes	
		9. Output impedance of 8 – 2000 ohm	Yes/No	Yes	
		10.Input signal gain of Dynamic range 107 dB (-63 to +44 dB)	Yes/No	Yes	
		11.View range of 10 m – 1 000 km (at v/2 = 80 m/µs)	Yes/No	Yes	
		12.Accuracy of 1% relating to the measurement result	Yes/No	Yes	
		13.Data rate of 400 MHz	Yes/No	Yes	

Note: Ticks, Cross [√, X], Astrick [*], Word [Noted] or TBA ["To Be Advice"] will not be accepted.

Tender Number: _____

Tenderer's Authorised Signatory: _____

Name in block letters Signature

Full name of company: _____

Item	Sub clause of CP_TSSPEC_221	Description		Schedule A	Schedule B
5		14.Resolution of 0.1 m (at v/2 = 80m/µs)	Yes/No	Yes	
		15.Velocity of propagation (v/2) of 20 -150 m/µs, adjustable	Yes/No	Yes	
		Surge Voltage generator:			
		1. Surge energy of 2 100 Joules	Yes/No	Yes	
		2.Surge voltage of 0 – 8 KV, 0 – 16 KV and 0 – 32 KV	Yes/No	Yes	
		3.Surge sequence of 10 or 20 pulses/min, single surge	Yes/No	Yes	
		4.DC Testing of 0 – 32 KVdc	Yes/No	Yes	
		5.Max. output current of 560 mA at 0 – 8 KV range	Yes/No	Yes	

Note: Ticks, Cross [√, X], Astrick [*], Word [Noted] or TBA ["To Be Advice"] will not be accepted.

Tender Number: _____

Tenderer's Authorised Signatory: _____

Name in block letters Signature

Full name of company: _____

Item	Sub clause of CP_TSSPEC_221	Description		Schedule A	Schedule B
6		**Acoustic and magnetic Pin-pointing Set**	Yes/No	Yes	
		1. Consisting of a receiver and ground sensor with accessories, headphones, connection cables and transport box or mountings	Yes/No	Yes	
		2. High acoustic and magnetic field sensitivity	Yes/No	Yes	
		3. High performance electronic suppression of external noise and interference	Yes/No	Yes	
		4. Excellent acoustic characteristics (frequency range 1 Hz to 2 kHz)	Yes/No		
		5. Active ear protection by a 85 db limiter	Yes/No	Yes	
		6. Resolution of 21 µs (approx. 0.1 m @ v = 500 m/s)	Yes/No	Yes	
		7. Acoustic gain of 0 – 34 dB	Yes/No	Yes	
		8. Electromagnetic gain of 0 – 50 dB	Yes/No	Yes	
		9. Propagation time measurement range of 0 – 100 ms	Yes/No	Yes	

Note: Ticks, Cross [√, X], Astrick [*], Word [Noted] or TBA ["To Be Advice"] will not be accepted.

Tender Number: _____

Tenderer's Authorised Signatory: _____

Name in block letters Signature

Full name of company: _____

Item	Sub clause of CP_TSSPEC_221	Description		Schedule A	Schedule B
7		**Power Supply for Equipment**:			
		1.5000 W system	Yes/No	Yes	
		2.Integrated inverter	Yes/No	Yes	
		3.Integrated charger	Yes/No	Yes	
		4. Lithium-ion batteries	Yes/No	Yes	
		5.Strong durable metal enclosure to ensure batteries are kept in safe and stationary position	Yes/No	Yes	
8		**Installation frame**			
		1. Silicone HV lead of 50m with rated voltage of above 50 KV	Yes/No	Yes	
		2. Earth and Mains leads shall be 50m in length	Yes/No	Yes	
		3. Cable rack must have 3 reels and an earth interlock for safety	Yes/No	Yes	
		4. A frame shall have an integrated central earth point connected to surge unit to ensure proper earthing	Yes/No	Yes	

Note: Ticks, Cross [√, X], Astrick [*], Word [Noted] or TBA ["To Be Advice"] will not be accepted.

Tender Number: _____

Tenderer's Authorised Signatory: _____

Name in block letters Signature

Full name of company: _____

Item	Sub clause of CP_TSSPEC_221	Description		Schedule A	Schedule B
9		**Assembling of equipment**			
		1. Installation should include all wiring with DB Board, Separation Transformer, central earth points and a minimum of two additional 3-point plugs which is connected to separate breakers.	Yes/No	Yes	
		2. Mounted but removable rotating office chair.	Yes/No	Yes	
		3. Installation should have internal red/green warning lights system indicating the presence of high voltage or when the system is earthed.	Yes/No	Yes	
		4. Installation should include mounting brackets for the ground microphone.	Yes/No	Yes	
		5. Installation should include a discharge rod with a resister to ensure soft discharge with a minimum voltage rating of 50kV	Yes/No	Yes	
		6. An earthing spike and hammer shall be provided	Yes/No	Yes	
10		**Mobile Trailer**			
		1. Outside and inside lighting	Yes/No	Yes	
		2. Reflectors and reflective tape	Yes/No	Yes	
		3. Light emitting diode (LED) rear lights	Yes/No	Yes	
		4. License, registration and number	Yes/No	Yes	
		5. All steel work internally shall be non-slippery material	Yes/No	Yes	
		6. The trailer shall have gross vehicle mass not exceeding 1.5 tones and have a coupling devices that comply with relevant requirements given in SANS 20055:2003	Yes/No	Yes	
		7. One jockey wheel	Yes/No	Yes	
		8. Spare wheel	Yes/No	Yes	
		9. Stabilisers (Two front and Two rear)	Yes/No	Yes	

		10.Single axel suspension fitted with brake	Yes/No	Yes	
11		**Training** 1. Is theoretical and field training on operating the equipment being offered? 2.Is training on maintenance of the equipment being offered?	Yes/No Yes/No	Yes Yes	
12		**Accreditation** 1.ISO 9001:2015 accreditation certificated 2.ISO 14001:2015 accreditation corticated 3.ISO 45001:2015 accreditation corticated	Yes/No Yes/No Yes/No	Yes Yes Yes	

Note: Ticks, Cross [√, X], Astrick [*], Word [Noted] or TBA ["To Be Advice"] will not be accepted.

Tender Number: _____

Tenderer's Authorised Signatory: _____

Name in block letters Signature

Full name of company: _____

Item No. 1 – CABLE FAULT LOCATION MACHINE

Deviation schedule

Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by City Power.		
Item	**Sub clause of CP_TSSPEC_221**	**Proposed deviation**

Tender Number: _____

Tenderer's Authorised Signatory: _____

Name in block letters Signature

Full name of company: _____

ANNEXURE D – Stock Items

It is not intended that City Power should keep stock of these items.