

DOCUMENT NO.: KP1/13D/4/1/TSP/09/030 - 2



Kenya Power

**CABLE FAULT LOCATING EQUIPMENT
— SPECIFICATION**

A Document of the Kenya Power & Lighting Company Plc.

November 2023

**TITLE:****CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION****Doc. No.****KP1/13D/4/1/TSP/09/030 - 2****Issue No.****2****Revision No.****0****Date of Issue****Date: 2023-11-22****Page 1 of 36****Table of Contents**

0.1	CIRCULATION LIST.....	2
0.2	AMENDMENT RECORD.....	3
	FOREWORD.....	4
1.	SCOPE.....	5
2.	NORMATIVE REFERENCES.....	6
3.	DEFINITIONS AND ABBREVIATIONS.....	6
4.	REQUIREMENTS.....	6
4.1.	SERVICE CONDITIONS.....	6
4.2.	SPECIFIC REQUIREMENTS.....	7
4.2.1.	Portable Cable Fault Location Equipment with Prelocation and DC Pressure Test 32kV.....	7
4.2.2.	Cable Identifying Sets & Route Locator.....	8
4.2.2.1.	Cable Identifying Set.....	8
4.2.2.2.	Cable Route Locators.....	9
4.2.3.	Cable Sheath Testing Equipment.....	10
4.2.4.	Cable Sheath Fault Receiver.....	11
4.2.5.	Low Voltage Fault Location Sets.....	11
4.2.6.	Portable DC Pressure Test Sets.....	12
4.2.7.	VLF Pressure Testing with Tan Delta of At Least 24 kVrms but not exceeding 28 kVrms.....	13
4.2.8.	Portable Partial Discharge (PD) System.....	15
4.2.9.	VLF pressure testing with Tan delta of at least 33 kVrms but not exceeding 60 kVrms.....	16
4.2.10.	VLF High Voltage Generator 80 KVRms.....	19
4.2.10.12.	Pulse Reflection Test (PRT) System integrated in VLF Diagnostic system.....	21
4.2.11.	Full Monitor Withstand Test (MWT).....	22
5.	TESTS AND INSPECTION (Normative).....	23
6.	MARKING AND PACKING.....	23
6.1.	MARKING.....	23
6.2.	PACKING.....	23
	APPENDICES.....	24
	APPENDIX A: TESTS AND INSPECTION (NORMATIVE).....	24
	APPENDIX B: QUALITY MANAGEMENT SYSTEM (Normative).....	24
	APPENDIX C: DOCUMENTATION AND DEMONSTRATION (Normative).....	25
	APPENDIX D: TRAINING.....	26
	APPENDIX E: GUARANTEED TECHNICAL PARTICULARS.....	28

Issued by: Head of Section, Standards Development**Authorized by: Head of Department, Standards****Signed:****Signed:****Date: 2023-11-22****Date: 2023-11-22**



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.	KP1/13D/4/1/TSP/09/030 - 2
Issue No.	2
Revision No.	0
Date of Issue	Date: 2023-11-22
Page 2 of 36	

0.1 CIRCULATION LIST

COPY NO.	COPY HOLDER
1	Manager, Standards
2	Electronic copy (pdf) on Kenya Power server (http://172.16.1.40/dms/browse.php?ffFolderId=23)

REVISION OF KPLC STANDARDS

To keep abreast of progress in the industry, KPLC Standards shall be regularly reviewed. Suggestions for improvements to approved Standards, addressed to the Manager, Standards department, are welcome.

© Kenya Power & Lighting Co. Ltd.

Users are reminded that by Section 25 of the Copyright Act, 2001 (Revised 2014) Cap 130 of the Laws of Kenya, copyright subsists in all KPLC Standards and except as provided under Section 26 of this Act, no KPLC Standard produced by KPLC may be reproduced, stored in a retrieval system by any means without prior permission from the Managing Director & CEO, KPLC.

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 3 of 36

0.2 AMENDMENT RECORD

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 1 Rev 0	2016-04-22	New Issue	Eng. S. K. Nguli	Dr. Eng. P. Kimemia
Issue 1 Rev 1	2020-03-06	Additional requirement of Tan delta and PD on all VLF pressure testing and rating up to 120KV	Eng. S. K. Nguli	Dr. Eng. P. Kimemia
Issue 2 Rev 0	2023-11-22	Replaces all previous versions of KP1-6C.1-TSP-09-030-2	Eng. F. Gicugu	Dr. Eng. P. Kimemia

Issued by: Head of Section, Standards Development

Signed:

Date: 2023-11-22

Authorized by: Head of Department, Standards

Signed:

Date: 2023-11-22



TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 4 of 36

FOREWORD

This Specification has been prepared by the Standards Department in collaboration with Common Services Section, both of The Kenya Power and Lighting Company Plc. It lays down requirements for specification for Cable Fault Locating Equipment. It is intended for use in purchasing the equipment.

The specification stipulates the minimum requirements for the Cable Fault Locating Equipment that is acceptable for use in the company. It shall be the responsibility of the supplier and manufacturer to ensure adequacy of the design, good workmanship, good engineering practice and adherence to standards, specifications and applicable regulations, and that the offered design is of the highest quality and guarantees excellent service to Kenya Power.

The following are the members of the team that developed this specification:

Name	Division
Eng. Raphael Ndolo	Network Management
Eng. Lydia Mugure	Network Management
Eng. Faith Gicugu	Standards
Eng. Benson Dianga	Standards
Rotich Benard	Standards

Issued by: Head of Section, Standards Development

Signed:

Date: 2023-11-22

Authorized by: Head of Department, Standards

Signed:

Date: 2023-11-22



TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 5 of 36

1. SCOPE

- 1.2. This Specification covers the design, manufacture, assembly, testing at manufacturer's works, supply, delivery, installation & commissioning of Cable Fault Locating equipment for low, medium and high voltage power cables up to 220 kV, complete with all accessories for efficient and trouble free operation.
- 1.3. The Cable Fault Locating Equipment for use on power lines operating at voltages of up to 220 kV (245 kV) 50Hz covered by this specification are:
- (i) Portable Cable Fault Location equipment with pre-location and DC pressure test 32 kV
 - (ii) Cable Identifying Sets & Route Locator
 - (iii) Cable Sheath Testing Equipment
 - (iv) Cable sheath Fault receiver
 - (v) Low Voltage Fault Location Sets
 - (vi) Portable DC Pressure Test Sets
 - (vii) VLF pressure testing with tan delta of at least 24 kVrms but not exceeding 28 kVrms
 - (viii) Partial Discharge (PD) System
 - (ix) VLF pressure testing with Tan delta of at least 33 kVrms but not exceeding 60 kVrms
 - (x) VLF High Voltage Generator 80 kVrms
 - (xi) Full Monitor Withstand Test (MWT)
- 1.4. The equipment shall be suitable for the two ranges of cable types below and their accessories in all voltage ranges from 415 V to 36 kV and from 66 kV to 220 kV.
- 1.5. For commissioning tests on 12 kV, 36 kV, 66 kV, 132 kV and 220 kV cables. Provision shall be given to perform VLF test up to $3U_0$ with parallel PD measurement.
- 1.6. For maintenance test on 12 kV, 36 kV, 66 kV, 132 kV and 220 kV cables. Provision shall be given to perform cable diagnostic up to $1.5U_0$ with Tan Delta and Partial Discharge measurement.
- 1.7. The specification does not purport to include all the necessary provisions of a contract.

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22



TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 6 of 36

2. NORMATIVE REFERENCES

The following standard and guidelines contain provision, which, through reference in this text, constitute provisions of this specification. For dated editions, the cited edition will apply; for undated editions, the latest edition of the referenced document shall apply:

- IEC 60502-2018: Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1.2$ kV) up to 30 kV ($U_m = 36$ kV) - all parts
- IEC 62067: Power cables with extruded insulation and their accessories for rated voltages above 150 kV ($U_m = 170$ kV) up to 500 kV ($U_m = 550$ kV) - all parts
- IEC 60840: Power cables with extruded insulation and their accessories for rated voltages above 30 kV ($U_m = 36$ kV) up to 150 kV ($U_m = 170$ kV) - all parts
- IEEE 400.2-2013: IEEE Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF) (Less than 1 HZ)
- IEC 60060-3: High-voltage test techniques – Part 3: Definitions and requirements for on-site testing
- IEC 60520: Degrees of Protection (IP-Code System)
- 2006/95/EC: CE-compliant in accordance with Low Voltage Directive
- IEC 60229: Tests on Extruded Oversheaths with a Special Protective Function

2. DEFINITIONS AND ABBREVIATIONS

For the purpose of this specification, the definitions and abbreviations given in the reference standards shall apply

3. REQUIREMENTS**3.1. SERVICE CONDITIONS**

The cable fault locating equipment shall be suitable for continuous use outdoors in the following tropical operating conditions: -

- (i) Altitude: up to 2,200m above sea level;
- (ii) Temperature: average of +30°C with a minimum of -1°C and max +40 °C;
- (iii) Humidity: up to 95%;
- (iv) Pollution: Design pollution level to be taken as "Very Heavy" (Pollution level IV) for all areas of applications in accordance with IEC 60815.

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.	KP1/13D/4/1/TSP/09/030 - 2
Issue No.	2
Revision No.	0
Date of Issue	Date: 2023-11-22
Page 7 of 36	

3.2. SPECIFIC REQUIREMENTS

3.2.1. Portable Cable Fault Location Equipment with Prelocation and DC Pressure Test 32kV

3.2.1.1. The equipment shall be portable and capable of locating all types of cable faults including open circuits, high resistance, low resistance, intermittent faults in XLPE and Paper insulated cables and testing of surge arrestors.

3.2.1.2. The complete set functionality shall comprise of testing, converting faults, pre-location and pinpointing cable faults in low and medium voltage networks. The highest degree of safety to users shall be guaranteed. It shall be suitable for outdoor use.

3.2.1.3. The equipment shall have the following features:

- (v) Easily transportable in a van and net weight of complete equipment set should not exceed 500 kg.
- (vi) Test range of at least 20 km
- (vii) Menu driven large screen color TDR (Time Domain Reflectometer)
- (viii) User-friendly system software for simple, intuitive and safe operation
- (ix) High surge energy of at least 2,000 J in every range for acoustic pinpointing
- (x) Impulse voltage levels for medium-voltage cable of at least 016 kV in ranges
- (xi) Impulse voltage levels for lower voltages 0 ... 4 kV or 0 ... 8 kV
- (xii) Sheath fault locating
- (xiii) Modes of operation:
 - (a) Insulation proof testing
 - (b) Test up to at least 20 kV with measurement of leakage current and automatic deactivation in case of breakdown
 - (c) Breakdown detection with ramp function, automatic switch-off (self-discharging and earthing) in case of breakdown and display of breakdown voltage
 - (d) Acoustic pinpointing

3.2.1.4. Pre-location procedure shall include all system components offering the pre-location functions integrated into one package with one control panel with display for controlling the system with single button operation. TDR shall be separate and removable from the main unit to enable use independently OR with the integrated cable fault locating system. Pre-location functions include:

- (i) Arc Reflection Method
- (ii) Impulse current coupling

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22

- (iii) Decay voltage coupling
- (iv) Pulse reflection method
- (v) Secondary Impulse Method (SIM)
- (vi) Impulse Current Method

4.2.1.5. The equipment shall operate from 240 V, 50 Hz AC. and shall be supplied with backup power generator 5 kVA with 230 VAC and a 415 V outlet.

4.2.1.6. The equipment shall be complete with the following Accessories:

- (i) Surge Generator
- (ii) TDR screen and 15m copper connecting leads to the cable under test
- (iii) Pinpointing Receiver complete with ground microphone, earphones and cables.
- (iv) Mounting frame on wheels for ease of moving of the equipment
- (v) Operating manual
- (vi) Set of connecting cables
- (vii) Earth Spike

4.2.1.7. The equipment shall be complete with the following Connecting Cables (detachable):

- (i) High Voltage flexible with connection clamps and strain relief coaxial test cable: minimum 50 m of 72 kV, single phase
- (ii) Input power Supply: minimum of 50 m, 2.5 mm² single phase supply
- (iii) Earthing: minimum 50 m, 10 mm² complete with clamps
- (iv) High Voltage flexible coaxial test cable should be tight at the point of plug-in and clamping to prevent arcing during operation

4.2.1.8. The equipment shall be supplied as complete stand-alone ready to use unit with all its accessories and Operating manual in English language

4.2.2. Cable Identifying Sets & Route Locator

4.2.2.1. Cable Identifying Set

4.2.2.1.1. The cable identifying set shall be capable of clearly carrying out identification of a cable before cutting as an important safety measure. It shall incorporate a mains supply unit and an inbuilt battery with a charging unit at 230 V, 50Hz. The battery voltage shall be 12 V rechargeable with operating time of at least 4 hours

4.2.2.1.2. The equipment shall be complete with the following Features:

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22

- (i) A current pulse generator/transmitter and receiver and a signal clamp to enable identification of both dead and live cables of up to 150 mm cable diameter.
- (ii) Adjustable signal strength of deflection in the display.
- (iii) Necessary connection cables for signal coupling, mains lead and clamps.
- (iv) Precise cable identification even when many cables are buried together.
- (v) Carrying cases for both transmitter and receiver.

4.2.2.1.3. Technical Parameters

- (i) Pulse current of up to 180 A
- (ii) Pulse voltage up to 300 V
- (iii) 15 Impulses / min
- (iv) Fully automatic calibration of receiver
- (v) Digital display with clear indication of signal strength / current value / direction and depth of cable
- (vi) Signal verification with Amplitude / Time / Phase identification

4.2.2.2. Cable Route Locators

4.2.2.2.1. The cable route locator comprising of a transmitter and receiver shall be suitable for use in quickly locating routes of cables, measure how deep they are and find cable faults.

4.2.2.2.2. The transmitter shall be inductively and directly coupled.

4.2.2.2.3. The equipment shall have the following Features:

- (i) Precise direction guidance with right/left arrows to keep it directly above the line.
- (ii) Route sensor weighing less than 2 kg for ease of carrying.
- (iii) Multi-frequency operation- transmits at least two frequencies simultaneously.
- (iv) Combines the conventional Maximum and Minimum methods.
- (v) Detection of ground leakage fault
- (vi) Power Supply for transmitter: Mains 230 V, 50 Hz and battery operated.
- (vii) Output power of minimum 5 W
- (viii) Output frequencies of 815 Hz, 8 kHz, 33 kHz, 82 kHz
- (ix) Integrated frame antenna
- (x) Inductive signal coupling coil, 82 kHz, 100 mm D
- (xi) Transmitter weight: maximum 5 kg

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 10 of 36

- (xii) Power Supply for receiver: To use rechargeable batteries or alkaline batteries.
- (xiii) Operating time for batteries shall not be less than 6 hours.
- (xiv) Digital display of cable depth and detect cable depth of at least 5 m.
- (xv) Current measurement for identification of target cable.
- (xvi) Automatic gain control by pushing a button.
- (xvii) Carrying case or soft protection bag

4.2.2.2.4. The equipment shall be supplied as complete stand-alone ready to use unit with all its accessories and Operating manual in English language.

4.2.3. Cable Sheath Testing Equipment

4.2.3.1. The standalone equipment shall be used for cable and cable sheath fault pre-location as well as for pinpointing, cable testing of low voltage cables as well as cable sheath testing in power cables up to 10 kV DC combined with the accurate pre-location of faults and pinpointing over the full.

4.2.3.2. Integrated high precision measuring bridge allows pre-location of cable faults and cable sheath faults in power cables according to Murray and Glaser. The measuring principle also enables fault pre-location in control and lighting cables. For highest accuracy, also different cable sections with different conductor material and diameter can be defined and are considered in the result.

4.2.3.3. The full analysis shall be done automatically and results in digitally displayed distance to the fault. At the pinpointing mode, a DC pulse pattern with a voltage up to 10 kV is released for cable and cable sheath fault pinpointing based on the step voltage measurement, with the pickup device in combination with two earth probes.

4.2.3.4. The Equipment shall have the following mains features:

- (i) Cable - and Cable Sheath Testing up to 10 kV
- (ii) Resistance measurement
- (iii) Cable - and cable sheath fault pre-location with high precision measuring bridge according to Murray and Glaser up to 10 kV, current limitation
- (iv) Cable Sheath Fault Pinpointing
- (v) Build in discharge unit
- (vi) Step less voltage adjustment 0 - 10 kV, 10 mA
- (vii) Max. Output Current for sheath fault pinpointing 700 mA
- (viii) Battery operation and mains operation

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22

- (ix) Battery operation more than 1.5 hours
- (x) Fully menu guided and easy to use
- (xi) Definable cable sections
- (xii) Portable standalone unit
- (xiii) Weight less than 20 kg

4.2.4. Cable Sheath Fault Receiver

4.2.4.1. The cable sheath fault receiver shall be applied according to the step voltage method.

4.2.4.2. With two earth probes (dismountable for transportation), the cable route shall be followed.

4.2.4.3. Additionally, the battery-powered instrument shall be suitable for location of several successive sheath faults.

4.2.4.4. Equipped with an adjustable carrying strap, the sturdy instrument shall fulfil all requirements for a successful application in the field.

4.2.4.5. Accessories set for Sheath fault location:

- (i) Earth probe red
- (ii) Earth probe blue
- (iii) Measuring line 2 m, blue
- (iv) Measuring line 2 m, red
- (v) Auxiliary line 25 m on hand reel

4.2.5. Low Voltage Fault Location Sets

4.2.5.1. The equipment shall be suitable for the location of low resistance faults and interruptions in low and medium voltage cables.

4.2.5.2. The equipment shall be complete with an integrated battery power supply ideally suited for field use.

4.2.5.3. It should be conveniently button-operated and automatically shows the far end of the cable and fault distance. Even inexperienced users should easily be able to locate faults.

4.2.5.4. The equipment shall have the following features: -

- (i) Display color Screen.
- (ii) Systematic interactive menu guided control.
- (iii) Automatic far end indication and fault recognition with distance indication.

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22

- (iv) To employ Impulse current and voltage decay mode, Arc Reflection, Time Domain Reflection (TDR) etc.
- (v) To have Direct L1, Direct L2, and comparison mode L1 / L2, waveforms this can be displayed at the same time.
- (vi) High resolution in the short range with great accuracy using special pulse forms
- (vii) Minimum measuring range of 10 km.
- (viii) Zooming facility.
- (ix) Memory locations of at least 10 traces.
- (x) Power Supply: Mains 230 V, 50 Hz and battery operated.
- (xi) Rechargeable batteries with operation time of not less than 8 hours
- (xii) Lightweight.
- (xiii) Carrying case.

4.2.5.5. The equipment shall be supplied as complete stand-alone ready to use unit with all its accessories and Operating manual in English language.

4.2.6. Portable DC Pressure Test Sets

4.2.6.1. The equipment shall be a portable DC Voltage testing set suitable for testing newly installed cables and splices and electrical installations before connecting to energized system.

4.2.6.2. The equipment shall have the following features:

- (i) The Test System capable of producing 0-25 kV DC test voltage.
- (ii) With Control and power modules.
- (iii) With breakdown recognition and shutdown capability.
- (iv) With two (2) voltage ranges, 0-5 kV, 0-25 kV
- (v) Capable of DC leakage current measurement.
- (vi) Current measuring ranges: 50 nA to 1 μ A / 10 μ A / 100 μ A / 1 mA / 10 mA
- (vii) With integrated discharge facilities for safety of users.
- (viii) High voltage and ground connecting cables not less than 2,5 m long
- (ix) Mains power supply at 240 V, 50 Hz and built-in rechargeable battery making the test set independent of an external power supply.
- (x) Minimum rechargeable battery operating time of 30 min - 2 hours
- (xi) Maximum weight: 17 kg


Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:



Signed:



Date: Date: 2023-11-22

Date: Date: 2023-11-22



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.	KP1/13D/4/1/TSP/09/030 - 2
Issue No.	2
Revision No.	0
Date of Issue	Date: 2023-11-22
Page 13 of 36	

4.2.6.3. The equipment shall be supplied as complete stand-alone ready to use unit with all its accessories and Operating manual in English language.

4.2.7. VLF Pressure Testing with Tan Delta of At Least 24 kVrms but not exceeding 28 kVrms

4.2.7.1. The equipment shall be a portable not exceeding 30 kgs in weight, Very Low Frequency Voltage (VLF) testing set suitable for testing XLPE cables with test voltage between (34 kV to 40 V) peak, sinusoidal waveform.

4.2.7.2. The mobile testing and diagnostic device shall be used for testing medium voltage cables and electrical equipment, for cable sheath testing and cable diagnostics including:

- (i) Fully integrated tan delta (TD) measurement.
- (ii) Pre-set program for testing and evaluation according to IEEE400.2-2013
- (iii) Monitored withstand test (MWT) with TD function integrated.
- (iv) Pre-set program according to IEEE400.2-2013
- (v) Partial discharge (PD) measurement
- (vi) Simultaneously TD and PD measurement for diagnostic test

4.2.7.3. The equipment shall have the following Features:

- (i) Cable sheath testing according to IEC 60502/IEC 60229
- (ii) Insulation tests on electrical equipment according to IEEE 433
- (iii) Tan delta diagnostics for electrical equipment and medium voltage cables up to 24 kV
- (iv) Precise tan delta measurement with accuracy not less than 1×10^{-3} and resolution not less than 1×10^{-4} .
- (v) Fully automated and individually programmable diagnostic sequences including evaluation
- (vi) No additional external hardware required for tan delta measurements, function integrated into VLF generator
- (vii) Integrated measurement data storage
- (viii) Data export via USB interface
- (ix) Measurement data shall be viewed in computer with Microsoft excel, no additional software required.
- (x) Automatic discharging device
- (xi) Integrated cable compartment with HV connection cable

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22

4.2.7.4. Technical Data shall be as per table 1

Table 1: Technical Data for VLF Testing Set

s/n	Parameter description	Units	Value
A.	General		
1)	Frequency range	Hz	0.01-0.1
2)	Input voltage	V, Hz	100-260, 50/60 Hz
3)	Max. power consumption	VA	300
4)	Data interface	USB	2.0
5)	Protection class	IP	54
6)	EMC compatibility	compliance with EN 61010-1, EN 50191) and EMC guideline (EN 55011, EN61000-4)	
B.	Output voltage		
1)	VLF true sine Wave	kV rms	1...24.0 (34.0 kV peak)
2)	VLF rectangular wave voltage	kV	34
3)	DC voltage	kV	±0..34
4)	Resolution	kV	0.1
5)	Accuracy	%	1
6)	Load range	nF	1 nF...8 µF
C.	Output current		
	Max. load	uF at Hz, kVrms	0.5 µF at 0.1 Hz, 24 kVrms 8 µF at 0.01 Hz, 18 kVrms
D.	Tan delta measurement		
1)	VLF true Sine Wave	kV rms	1 ... 24
2)	Load range	nF- µF	10 nF ... 8 µF
3)	Accuracy		Not less than 1x10 ⁻³
4)	Resolution		Not less than 1x10 ⁻⁴
5)	Measurement range		1x10 ⁻⁴ ... 21,000x10 ⁻³
6)	TD measurement frequency	Hz	0.1
7)	Leakage current		Leakage current compensation of HV test lead

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.	KP1/13D/4/1/TSP/09/030 - 2
Issue No.	2
Revision No.	0
Date of Issue	Date: 2023-11-22
Page 15 of 36	

4.2.7.5. The VLF Testing and Diagnostic System shall also have ;

- (i) Tan Delta (TD) measurement device integrated in VLF source. No external TD measurement device accepted.
- (ii) Leakage current compensation of connection leads by integrated TD measurement device.
- (iii) Automatic testing programs integrated in VLF generator menu.
- (iv) Automatic testing sequence for MWT (Monitored Withstand Test) TD according to IEEE400.2-2013 with 1×10^{-4} accuracy and 1×10^{-6} resolution.
- (v) TD Raw data files to be imported and exported to different computer.
- (vi) TD Raw data files to be opened, viewed and edited with Microsoft Excel, no additional software required.
- (vii) TD Reports to be automatically generated in different formats such as PDF and Microsoft Excel. No additional software shall be required,
- (viii) Pre-programed test sequences according to the international standards CENELEC HD 620, IEC 60502 / IEC 60229, IEEE 400.2, VDE 0276-620, VDE 0276-621
- (ix) Tan Delta and MWT measurements with table and diagram during the measurements as well as after the test performed.

4.2.8. Portable Partial Discharge (PD) System

4.2.8.1. The portable PD and $\tan \delta$ diagnostics system shall be used for carrying out:

- (i) Partial discharge measurement and location
- (ii) Dissipation factor measurement (simultaneously with the PD test)

4.2.8.2. This shall provide a one-step 360° cable analysis with early detection and localization of weak points through the PD test, detection of moist points in joints,

4.2.8.3. The portable PD and $\tan \delta$ diagnostics system shall be software operated. The software shall be windows-based installed in a laptop for each equipment. The laptop specifications shall be as per Table 2.

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22

Table 2: Laptop specifications

Description	Mandatory Minimum Requirements
a) Processor	Intel Core i7-5500 (2.60GHz 1600MHz 3MB, 2 Cores)
b) RAM	8GB 1600 MHz DDR3L
c) Operating System	Windows 10 pro 64 bit
d) Optical Drive	Super-Multi DVD burner
e) Hard Disk	750GB 7200 rpm Hard Drive
f) Display Panel	15.6" FHD LED Glossy (1920x1080) with integrated Webcam 720p camera
g) Graphics	Intel HD Graphics 5500
h) Internal Audio	Integrated HD audio internal speaker(standard), 1 x Mic / headphone combo
i) Communications	56K Modem, Integrated Intel Gigabit Network Connection (10/100/1000 NIC),
j) Wireless	Intel 802.11ac WLAN and Bluetooth
k) Security	Security Lock Slot plus steel cable with a combination lock
l) Interfaces	Memory Stick (MS), Memory Stick Pro (MS-Pro), Multi-Media Card (MMC) compatible.1 USB 2.0 port, 2 USB 3.0 ports, 1 Ethernet port, 1 HDMI port, Bluetooth, Wi-Fi enabled.
m) Pointing Devices	Touchpad with scroll zone, two pick buttons or Point stick, two pick buttons
n) Keyboard	Standard Keyboard
o) Mouse	External USB Mouse
p) Warranty	1 Year or More Warranty
q) Power	4-cell 41WHr Lithium-ion Battery; External AC adapter
r) Power Supply	240V AC, 50 Hz, British plugs
s) Carrying Case	Genuine Leather Carrying Case

4.2.9. VLF pressure testing with Tan delta of at least 33 kVrms but not exceeding 60 kVrms

4.2.9.1. The equipment shall be a portable Very Low Frequency Voltage (VLF) testing set suitable for testing XLPE cables with test voltage between (46 kV and 85 kV) peak.

4.2.9.2. The mobile testing and diagnostic device shall be used for testing medium voltage cables and electrical equipment, for cable sheath testing and cable diagnostics including:

- (i) Fully integrated tan delta (TD) measurement.

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22

- (ii) Pre-set program for testing and evaluation according to IEEE400.2-2013
- (iii) Monitored withstand test (MWT) with TD function integrated.
- (iv) Pre-set program according to IEEE400.2-2013
- (v) Partial discharge (PD) measurement
- (vi) Simultaneously TD and PD measurement for diagnostic test

4.2.9.3. The equipment shall have the following Features:

- (i) Cable sheath testing according to IEC 60502/IEC 60229
- (ii) Insulation tests on electrical equipment according to IEEE 433
- (iii) Tan delta diagnostics for electrical equipment and medium voltage cables up to 66 kV
- (iv) Precise tan delta measurement with accuracy and resolution of 1×10^{-4} and 1×10^{-6} respectively
- (v) Fully automated and individually programmable diagnostic sequences including evaluation
- (vi) No additional external hardware required for tan delta measurements, function integrated into VLF generator
- (vii) Integrated measurement data storage
- (viii) Data export via USB interface
- (ix) Measurement data shall be viewed in computer with Microsoft excel, no additional software required.
- (x) Automatic discharging device.
- (xi) The equipment shall be supplied in mounting frame on wheels for ease of moving of the equipment

4.2.9.4. Technical Data shall be as per table 2

Table 3: Technical Data for VLF Testing Set

S/n	Parameter description	Units	Value
	General		
1	Frequency range	Hz	0.01-0.1
2	Input voltage	V/Hz	100-260/50
3	Max. power consumption	VA	300
4	Data interface	USB	2.0
5	Protection class	IP	54
6	EMC compatibility	compliance with EN 61010-1, EN 50191) and EMC guideline (EN 55011, EN61000-4)	
	Output voltage		

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.	KP1/13D/4/1/TSP/09/030 - 2
Issue No.	2
Revision No.	0
Date of Issue	Date: 2023-11-22
Page 18 of 36	

1	VLF true sine Wave	kV rms	0...60 (85 kVpeak)
2	VLF rectangular wave voltage	kV	85
3	DC voltage	kV	±0..85
4	Resolution	kV	0.1
5	Accuracy	%	1
6	Load range	nF	1...8
Output current			
1	Maximum load	μF at Hz, kVrms	1 μF at 0.1 Hz, 42.5 kVrms 3 μF at 0.03 Hz, 42.5 kVrms 10 μF at 0.01 Hz, 10 kVrms
Tan delta measurement			
1	VLF true Sine Wave	kV rms	1 ... 44
2	Load range	nF- μF	10 ... 10
3	Accuracy		1x10 ⁻⁴
4	Resolution		1x10 ⁻⁶
5	Measurement range		1x10 ⁻⁴ ... 21,000x10 ⁻³
6	TD measurement frequency	Hz	0.1
7	Leakage current		Leakage current compensation of HV test lead

4.2.9.5. The VLF Testing and Diagnostic System shall also have the features;

- (i) Tan Delta (TD) measurement device integrated in VLF source. No external TD measurement device accepted.
- (ii) Leakage current compensation of connection leads by integrated TD measurement device.
- (iii) Automatic testing programs integrated in VLF generator menu.
- (iv) Automatic testing sequence for MWT (Monitored Withstand Test) TD according to IEEE400.2-2013 with 1x10⁻⁴ accuracy and 1x10⁻⁶ resolution.
- (v) Import and Export of TD Raw data files different computers.
- (vi) It shall be possible to open, view and edit TD Raw data files using Microsoft Excel with no additional software requirements.
- (vii) It shall be possible to automatically generate TD Reports in different formats such as PDF and Microsoft Excel with no additional software requirement.
- (viii) Pre-programed test sequences according to the international standards CENELEC HD 620, IEC 60502 / IEC 60229, IEEE 400.2, VDE 0276-620, VDE 0276-621

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22

(ix) Tan Delta and MWT measurements shall be with table and diagram during the measurements as well as after the test performed.

4.2.10. VLF High Voltage Generator 80 KVrms

4.2.10.1. The system shall support cable fault location and all type of cable testing and diagnostic for installation, commissioning and maintenance testing in accordance with the valid IEC 60060-3, IEC 60502 and IEEE 400.2-2013 standards and regulations. It should be suitable for the complete range of cable types and their accessories in all voltage ranges from 415 V to 66 kV.

4.2.10.2. For commissioning test on 11 kV and 33 kV cables provision shall be given to perform VLF test up to 3 U₀ with parallel PD measurement according to IEC 60502. For maintenance test on 11 kV, 33 kV and 66 kV cables provision shall be given to perform cable diagnostic up to 1.5 U₀ (or maximum 57 kVrms) with Tan Delta and Partial Discharge measurement according to IEEE 400.2-2013

4.2.10.3. The VLF high voltage generator (HVG) shall be true sinusoidal- digital) with a power rating of 3 kW adjustable output voltage. The HVG shall have manual or automatic test sequences, selectable with or without burn down mode in case of breakdown.

4.2.10.4. The VLF diagnostic system shall allow Tan Delta and Partial Discharge Diagnostic with the same connection setup with 0.1 Hz sinusoidal voltage.

4.2.10.5. The HVG shall have the following features:

- (i) Programmable test voltage: sine wave, square wave, DC
- (ii) Fully symmetrical output voltage
- (iii) Programmable test frequency 0.01 Hz to 1 Hz

4.2.10.6. Programmable output voltage:

- (i) 0 to -80 kV DC
- (ii) 0 to + 80 kV DC
- (iii) 0 to 57 kVrms 0.1 Hz sine wave
- (iv) 0 to 80 kV 0.1 Hz square wave
- (v) Max. capacitive load: 1.2 μ F @ 0.1 Hz, 57 kVrms
- (vi) 3 μ F @ 0.1 Hz, 38 kVrms
- (vii) 8 μ F @ 0.1 Hz, 18 kVrms
- (viii) 20- μ F max. load @ reduced frequencies

4.2.10.7. Output currents:

- (i) 1.8 mA @ 80 kV

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 20 of 36

- (ii) 10 mA @ 70 kV
- (iii) 60 mA @ 50 kV
- (iv) 90 mA @ 20 kV
- (v) Maximum current: 120 mA
- (vi) Accuracy: 1%
- (vii) Resolution: 10 μ A

4.2.10.8. Tan Delta (Dissipation factor measurement):

- (i) Load range ≥ 10 nF
- (ii) Measurement range 0.1×10^{-3} to $1,000 \times 10^{-3}$
- (iii) Resolution: 1×10^{-6}
- (iv) Display of individual Tan delta values 1×10^{-5}
- (v) Accuracy 1×10^{-4}

4.2.10.9. The equipment shall have the following features:

- (i) Guard Ring application for compensation of termination surface leakage current.
- (ii) Compensation of test lead leakage current.
- (iii) Partial Discharge free VLF generator
- (iv) Tan Delta measurement device shall be integrated inside the VLF source.
- (v) Automatic evaluation of Tan Delta diagnostic results according to IEEE evaluation criteria as well as freely definable evaluation criteria.

4.2.10.10. Partial Discharge Measurement:

- (i) Voltage range: up to 57 kV rms
- (ii) Measurement range 10 – 12,800 m (at 80 m/ μ s)
- (iii) Sampling rate 100 M Samples/s (10 ns)
- (iv) PD measurement range 5 pC – 100 nC
- (v) Accuracy 1% of cable length
- (vi) Resolution 0.1 pC / 0.1 m
- (vii) Velocity of propagation (v/2) 50 – 120 m/ μ s
- (viii) Weight of coupling capacitor including filter: maximum 21 kg

4.2.10.11. The equipment shall have the following features:

- (i) PD recording and display over different voltage levels
- (ii) PD localization evaluation based on cable length
- (iii) Automatic PD evaluation
- (iv) Filtering functions

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22



TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 21 of 36

- (v) Gain and trigger setting possibility
- (vi) Calibration and measurement according to IEC 60270
- (vii) PD phase resolved pattern recognition
- (viii) PD measurement throughout the 360degree of the sinusoidal VLF waveform over definable time
- (ix) PD measurement during VLF withstand test up to 57 kVrms
- (x) The Equipment shall be supplied in mounting frame on wheels for ease of movement

4.2.10.12. Pulse Reflection Test (PRT) System integrated in VLF Diagnostic system

4.2.10.12.1. For the localization of joints with water ingress, a specialized TDR device shall be integrated in the diagnostic system. This shall be a computer aided test system designed as a pulse reflection-measuring instrument for fault location on single and three-phase cable systems.

4.2.10.12.2. The design shall incorporate an integrated 400 MHz transient recorder for the highest measuring accuracy. It shall be able to offer unique features for intelligent manual and automatic cable fault location.

4.2.10.12.3. The Software of the Pulse Reflection System shall be based on latest windows OP system to allow every user an easy and fast operation of the system.

4.2.10.12.4. The PRT system shall have up to three cable fault location methods to be displayed at the same time on a 17" TFT-LCD display unit. The high resolution and zoom function shall be included to enable accurate pre-location of cable faults. There shall be a provision for easy transfer to any computer data files and the automatic reporting functions.

4.2.10.12.5. The following features and technical specification shall form part of the PRT test system:

- (i) Fully automatic measuring sequences
- (ii) Fully automatic cursor settings
- (iii) Three (3) phase measurement and display
- (iv) Memory for more than 100,000 waveforms (hard disk limit)
- (v) TDR pulse width: 20 ns – 1.3 ms
- (vi) Time Domain Reflectometer (TDR) output pulse from 20 to 200 V
- (vii) Output impedance: 12 – 2,000 Ohm
- (viii) Sampling rate: 400 MHz
- (ix) Input signal gain: -10 to +60 dB
- (x) SIM/MIM: 20 TDR multi-shot measurements
- (xi) Resolution (@ $v/2 = 80 \text{ m}/\mu\text{s}$): 0.1 m
- (xii) Measuring ranges of over 10 m - 1000 km
- (xiii) Accuracy: 0.1% of measuring result

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.	KP1/13D/4/1/TSP/09/030 - 2
Issue No.	2
Revision No.	0
Date of Issue	Date: 2023-11-22
Page 22 of 36	

- (xiv) Propagation velocity factor $v/2$ range: 20 – 150 m/ μ s
- (xv) Power supply: 100 – 260 V, 50/60 Hz
- (xvi) Power consumption: Max. 280 VA
- (xvii) Automatic reporting function;
- (xviii) Emergency Power Supply unit.

4.2.10.13. IR tests shall meet the following parameters;

- (i) Test voltage: up to 1.000 V
- (ii) Measuring range: up to 5 G-Ohm
- (iii) Simultaneous for: L1/N, L2/N, L3/N, L1/L2, L2/L3, L1/L3

4.2.11. Full Monitor Withstand Test (MWT)

4.2.11.1. This shall enable measurement of dielectric losses and test the cable route for partial discharges during the VLF cable test providing condition-based test duration.

4.2.11.2. The features of this shall be as follows;

- (i) Parallel dissipation factor and partial discharge measurement
- (ii) Better overview of the cable condition with Full Monitored Withstand Test (VLF cable testing with parallel dissipation factor and partial discharge measurement)
- (iii) Coupling capacitor includes measurement impedance and PD measuring unit in one device
- (iv) PD phase resolving for classification of PD faults
- (v) Integrated filter for suppressing noise signals from the VLF generator
- (vi) Stable data transmission and power supply via a PoE cable (PoE = Power-over-Ethernet)
No battery required!
- (vii) Partial discharge measurement and calibration of the measurement setup according to IEC 60270
- (viii) Detection of PD level, PD inception and extinction voltage as well as PD frequency
- (ix) Exact location of PD activities in cable insulation, joints and terminations
- (x) Excellent noise suppression due to compact structure, and Galvanic isolation between PD measuring unit and laptop
- (xi) Central power supply
- (xii) Reliable $\tan \delta$ measurement results up to 72.5 kV peak using proven technology
- (xiii) Integrated device for detecting leakage currents for dissipation factor measurement
- (xiv) Easy operation software –all-in-one software solution for measurement and auto evaluation
- (xv) Robust design and central power supply developed for mobile use

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22



TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 23 of 36

5. TESTS AND INSPECTION (Normative)

5.1. It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified. Tenderers shall confirm the manufacturer's capabilities in this regard when submitting tenders. Any limitations shall be clearly specified.

5.2. Testing Facility

5.2.1. The bidder shall provide current e-mail address, fax and telephone numbers and contact person at the Testing Laboratory where Type Tests and Special Tests were carried out.

5.2.2. All test and measuring equipment to be used during acceptance testing shall have been calibrated and copies of valid calibration certificates shall be provided to KPLC Engineers. A detailed list of workshop tools, test/measuring equipment and list of tests that can be carried out by the manufacturer shall be submitted with the tender for evaluation.

6. MARKING AND PACKING

6.1. MARKING

The Cable Fault Locating Equipment shall be marked legibly and indelibly in English with the following information:

- (i) Name or trade mark of the manufacturer;
- (ii) Country of origin;
- (iii) Type/model;
- (iv) Serial no;
- (v) Standards of manufacture
- (vi) The inscription "**Property of KPLC**"
- (vii) Year of manufacture.

6.2. PACKING

6.2.1. The Cable Fault Locating Equipment shall be packaged in such a manner as to minimize damage and entry of moisture during transportation and handling.

6.2.2. The Cable Fault Locating Equipment shall have a rugged casing for storage and transportation

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 24 of 36

APPENDICES

APPENDIX A: TESTS AND INSPECTION (NORMATIVE)

- A.1 Copies of Type Test Certificates and Type Test Reports issued by a third-party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. A copy of the accreditation certificate to ISO/IEC 17025 for the testing laboratory shall also be submitted. Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Laboratory that carried out the tests.
- A.2 Each Cable Fault Locating Equipment shall be inspected and tested in accordance with the requirements of relevant international and national standards and provisions of this specification. It shall be the responsibility of the supplier to perform all the tests.
- A.3. After manufacture, KPLC shall nominate three engineers to witness acceptance tests at the factory. Routine and sample test reports for the Cable Fault Locating Equipment to be supplied shall be submitted to KPLC for approval before shipment/delivery of the goods.
- A.4. On receipt of the goods, KPLC will perform any of the tests in order to verify compliance with this specification. The supplier shall replace without charge to KPLC Cable Fault Locating Equipment, which upon examination, test or use fail to meet any of the requirements in the specification.

APPENDIX B: QUALITY MANAGEMENT SYSTEM (Normative)

- B.1 The bidder shall submit a quality assurance plan (QAP) that will be used to ensure that the Cable Fault Locating Equipment design, material, workmanship, tests, service capability, maintenance and documentation, will fulfil the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfil the requirements of ISO 9001:2015 or later.
- B.2 The Manufacturer's Declaration of Conformity to applicable standards, this specification and copies of quality management certifications including copy of valid and relevant ISO 9001 certificate shall be submitted with the tender for evaluation..
- B.3 A detailed list and contact addresses (including e-mail) of the manufacturer's previous customers outside the country of manufacture for exact or similar Cable Fault Locating Equipment sold in the last five years shall be submitted with the tender for evaluation.

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.	KP1/13D/4/1/TSP/09/030 - 2
Issue No.	2
Revision No.	0
Date of Issue	Date: 2023-11-22
Page 25 of 36	

APPENDIX C: DOCUMENTATION AND DEMONSTRATION (Normative)

- C.1. The bidder shall submit its tender complete with technical documents required by Appendix D (Guaranteed Technical Particulars) for tender evaluation. The documents to be submitted (all in English language) for tender evaluation shall include the following:
- Fully filled clause by clause Guaranteed Technical Particulars (GTP) signed by the manufacturer,
 - Copies of the manufacturer's catalogues, brochures, Cable Fault Locating Equipment drawings and wiring diagrams and technical data showing description leaflet, programming details and manuals,
 - Sales records for the last five years and at least four customer reference letters,
 - Details of manufacturing capacity and the manufacturer's experience.
 - Copies of required Type Test certificates and Type Test reports by a third-party testing laboratory accredited to ISO/IEC 17025,
 - Copy of accreditation certificate to ISO/IEC 17025 for the third-party testing laboratory,
 - Manufacturer's warranty and guarantee; subject to 36 months from date of delivery to KPLC laboratory.
 - Manufacturer's letter of authorization, copy of the manufacturer's ISO 9001:2015 certificate.
- C.2. The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:
- Fully filled clause by clause Guaranteed Technical Particulars (GTP) signed by the manufacturer:
 - Design drawings and wiring diagrams of the Cable Fault Locating Equipment.
 - Original software, software manuals and operation manuals shall be submitted,
 - A training schedule of the Cable Fault Locating Equipment and software operation for KPLC staff operators on site,
 - Quality assurance plan (QAP) that will be used to ensure that the design, material, workmanship, tests, service capability, maintenance and documentation will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001:2015.
 - Detailed test program to be used during factory testing,

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.	KP1/13D/4/1/TSP/09/030 - 2
Issue No.	2
Revision No.	0
Date of Issue	Date: 2023-11-22
Page 26 of 36	

- g) Marking details and method to be used in marking the Cable Fault Locating Equipment.
- h) Manufacturer's undertaking to ensure adequacy of the design, good engineering practice, adherence to the specification and applicable standards and regulations as well as ensuring good workmanship in the manufacture of the Cable Fault Locating Equipment for The Kenya Power & Lighting Company,
- i) Packaging details (including packaging materials).

Note: These are new and should not be confused with the ones submitted with the tender.

C.3. The successful bidder and manufacturer shall demonstrate to at least four (4) KPLC staff two of whom must be users at the manufacturer's factory.

APPENDIX D: TRAINING

D.1. Training at the Manufacturer's premises.

- D.1.1. During the Factory Acceptance Testing (FAT), the manufacturer shall conduct complete training for the cable fault Locating Equipment for at least four (4) KPLC Engineers/Technicians three of whom must be users.
- D.1.2. This shall include theory followed by practical demonstrations. All the operational procedures shall be exhaustively explained and demonstrated.
- D.1.3. The manufacturer shall plan adequate time for the training separate from the FAT, which shall be conducted by the manufacturer's expert. The duration of the training shall however be not be less than three (3) eight-hour working days. The Employer shall send a separate team from the team witnessing the FATs to attend the training. The programme and duration of the training shall be indicated in the bid.
- D.1.4. The training shall be deemed successful once the engineers/technicians are able to completely operate the equipment.
- D.1.5. The manufacturer shall conduct evaluation tests and give a feedback report on the training to the employer for each of the engineers/technicians.
- D.1.6. The manufacturer shall meet the total cost of the factory training for their staff. For KPLC staff, the full cost of the visit, including air tickets and accommodation shall be borne by KPLC

D.2. Local Training

- D.2.1. Following the delivery of the cable fault locating equipment, the manufacturer shall conduct training for the equipment for approximately twenty (20) KPLC engineers/technicians, in Nairobi, Kenya. The training shall be conducted in one session of 20 engineers/technicians. The session

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date: 2023-11-22	Date: 2023-11-22



TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 27 of 36

shall last at least three (3) days for VLF pressure testing equipment and at least two (2) days for cable fault location equipment.

- D.2.2. The training shall include theory on features and how the equipment works followed by practical demonstrations including parameter settings. All steps shall be exhaustively explained and demonstrated.
- D.2.3. The Training shall be considered to have been successful once the engineers/ technicians are able to operate the equipment fully.
- D.2.4. The supplier shall meet all the costs for conducting the local training, including local accommodation and transport for their training staff. The supplier shall provide all the training materials including notes. However, the costs do not include the transport and accommodation for the KPLC engineers/technicians and the venue, which shall be borne by KPLC.

..... THIS SPACE LEFT BLANK ...

Issued by: Head of Section, Standards Development

Signed:

Date: Date: 2023-11-22

Authorized by: Head of Department, Standards

Signed:

Date: Date: 2023-11-22



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.	KP1/13D/4/1/TSP/09/030 - 2
Issue No.	2
Revision No.	0
Date of Issue	Date: 2023-11-22
Page 28 of 36	

APPENDIX E: GUARANTEED TECHNICAL PARTICULARS

(To be filled and signed by the supplier/Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records for previous five years, customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test reports for tender evaluation, all in English Language)

Tender No.

Clause Number	Description	KPLC requirement	Bidder's offer (indicate full details of the offered equipment for each requirement of the specification)
	Name and address of the Manufacturer	State	
	Country of Manufacturer	State	
	Manufacturer's Letter of Authorization	provide	
	Model/Type Reference No. of the offered Equipment	Specify	
	Manufacturer's warranty and guarantee for the offered Equipment	Attach	
2	Scope (2.1 – 2.6)	State/List	
3.1	Applicable standards	List	
3.1	Terms and definitions	Specify	
4.0	Requirements		
4.1	Service Conditions		
4.1.1	Operating Conditions	State	
4.2	Specific requirements		
4.2.1	Portable Cable Fault Location equipment with relocation and DC pressure test 32kV		
4.2.1.1	Portability	State	
	Nature of faults the equipment shall be able to locate	Specify and List	
4.2.1.2	Set functionality	List functions	
	Degree of safety	Specify	
4.2.1.3	Features of the equipment	List/state	

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



Kenya Power

TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 29 of 36

Clause Number	Description	KPLC requirement	Bidder's offer (indicate full details of the offered equipment for each requirement of the specification)
(i)	Max. Weight of complete equipment	Specify	
(ii)	Test range (km)	State	
(iii)	Time Domain Reflectometer (TDR)	Specify	
(iv)	System software usability	Specify	
(v)	Minimum surge energy in every range for acoustic pinpointing	Specify	
(vi)	Impulse voltage levels for medium-voltage cable	Specify	
(vii)	Impulse voltage levels for lower voltages	Specify	
(viii)	Sheath fault locating		
(ix)	Modes of operation	List	
	a) Insulation proof testing	Specify	
	b) Test up to at least 20 kV with measurement of leakage current and automatic deactivation in case of breakdown	Specify	
	c) Breakdown detection with ramp function, automatic switch-off (self-discharging and earthing) in case of breakdown and display of breakdown voltage	Specify	
	d) Acoustic pinpointing	Specify	
4.2.1.4	Pre location procedures	Specify/List	
	Separate and removable TDR to enable use independently OR with the integrated cable fault locating system	Confirm	
4.2.1.5	Operating Voltage	State	
	Backup power generator	Specify	
4.2.1.6	Equipment Accessories	List	
4.2.1.7	Connecting Cables (detachable)	List	
4.2.1.8	Equipment shall be complete stand-alone ready to use unit with all its accessories	Specify	
	Operating manual in English language	State	

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No. KP1/13D/4/1/TSP/09/030 - 2
Issue No. 2
Revision No. 0
Date of Issue Date: 2023-11-22
Page 30 of 36

Clause Number	Description	KPLC requirement	Bidder's offer (indicate full details of the offered equipment for each requirement of the specification)
4.2.2	Cable Identifying Sets & Route Locator		
4.2.2.1	Cable Identifying Set		
4.2.2.1.1	Cable Identification Functionality	State	
	Operating voltage	State	
	Inbuilt battery with a charging unit	State	
	Rechargeable battery voltage	State	
	Battery operating time (Min hours)	State	
4.2.2.1.2	Features & Functions	List	
4.2.2.1.3	Technical Parameters	List	
4.2.2.2	Cable Route Locators		
4.2.2.2.1	Key Functionality and elements	Specify	
4.2.2.2.2	Mode of transmitter coupling	Specify	
4.2.2.2.3	Features of the equipment	List	
4.2.2.3	Complete stand-alone ready to use unit with all its accessories	Specify	
	Operating manual in English language	State	
4.2.3	Cable Sheath Testing Equipment		
4.2.3.1	Functionality of equipment	state	
4.2.3.2	Operating precision	state	
4.2.3.3	Nature of Analysis and display mode	Specify	
4.2.3.4	Mains Features	List and state functionality	
4.2.4	Cable sheath Fault receiver		
4.2.4.1- 4.2.4.4	Mode of operation	state	
4.2.4.5	Accessories	List	
4.2.5	Low Voltage Fault Location Sets		
4.2.5.1	Key Functionality and elements	State	
4.2.5.2	Integrated battery	State	
4.2.5.3	Ease of use	State	
4.2.5.4	Features of the equipment	List	

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



Kenya Power

TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 31 of 36

Clause Number	Description	KPLC requirement	Bidder's offer (indicate full details of the offered equipment for each requirement of the specification)
4.2.5.5	Complete stand-alone ready to use unit with all its accessories	Specify	
	Operating manual in English language	State	
4.2.6	Portable DC Pressure Test Sets		
4.2.6.1	Key Functionality and elements	Specify	
4.2.6.2	Features of the equipment	List	
4.2.6.3	Complete stand-alone ready to use unit with all its accessories	Specify	
	Operating manual in English language	State	
4.2.7	VLF pressure testing with tan delta up to 28KVrms		
4.2.7.1	Functionality of equipment	State	
4.2.7.2	Sheath testing and cable diagnostic Features	List	
4.2.7.3	Equipment features	Specify	
4.2.7.4	Technical data as per table 1		
1	Frequency range (Hz)		
2	Input voltage (V, Hz)		
3	Max. power consumption (VA)		
4	Data interface (USB)		
5	Protection class (IP)		
6	EMC compatibility		
7	Output voltage		
	VLF true sine Wave (kV)		
	VLF rectangular wave voltage (kV)		
	DC voltage (kV)		
	Resolution (kV)		
	Accuracy (%)		
	Load range (nF)		
8	Output current		
	Max. load (uF at Hz, kVrms)		
9	Tan delta measurement		
	VLF true Sine Wave (kV rms)		

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22



Kenya Power

TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 32 of 36

Clause Number	Description	KPLC requirement	Bidder's offer (indicate full details of the offered equipment for each requirement of the specification)
	Load range (nF- μ F)		
	Accuracy		
	Resolution		
	Measurement range		
	TD measurement frequency (Hz)		
	Leakage current		
4.2.7.5	The VLF Testing and Diagnostic System features	Specify	
4.2.8	Portable Partial Discharge (PD) System		
4.2.8.1	Key Elements and Functionality	State	
4.2.8.2	Mode of operation	State	
4.2.8.3	Windows-based software installed in a laptop for each equipment	State	
	Laptop specifications as per table 1	Specify	
4.2.9	VLF pressure testing with Tan delta of at least 33 kVrms but not exceeding 60 kVrms		
4.2.9.1	Key Elements and Functionality	State	
4.2.9.2	Test Functions	State/List	
4.2.9.3	Key Features	State/List	
4.2.9.4	Technical Data as per table 2	Specify	
	General		
1	Frequency range	Specify	
2	Input voltage	Specify	
3	Max. power consumption	Specify	
4	Data interface	Specify	
5	Protection class	Specify	
6	EMC compatibility	Specify	
	Output Voltage	Specify	
1	VLF true sine Wave (kV rms)	Specify	
2	VLF rectangular wave voltage (kV)	Specify	
3	DC voltage (kV)	Specify	

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22



Kenya Power

TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 33 of 36

Clause Number	Description	KPLC requirement	Bidder's offer (indicate full details of the offered equipment for each requirement of the specification)
4	Resolution (kV)	Specify	
5	Accuracy (%)	Specify	
6	Load range (nF)	Specify	
	Output current	Specify	
1	Maximum load (μ F at Hz, kVrms)	Specify	
	Tan delta measurement	Specify	
1	VLF true Sine Wave (kV rms)	Specify	
2	Load range (nF- μ F)	Specify	
3	Accuracy	Specify	
4	Resolution	Specify	
5	Measurement range	Specify	
6	TD measurement frequency (Hz)	Specify	
7	Leakage current	Specify	
4.2.9.5	Features of the VLF Testing and Diagnostic System	List	
4.2.10	VLF High Voltage Generator 80 kVrms		
4.2.10.1	Testing and Diagnostic		
4.2.10.1	Key Elements and Functionality and tests	State	
	Applicable standards	State	
	Cable voltage ranges	State	
4.2.10.2	Provision for commissioning tests	State	
	Provision for maintenance tests	State	
4.2.10.3	Power rating of HVG	State	
	Features	State	
4.2.10.4	Tan delta and PD diagnostic frequency range	State	
4.2.10.5	Features of the HVG	List	
4.2.10.6	Programmable output voltage	State	
4.2.10.7	Output currents	State	
4.2.10.8	Tan Delta Dissipation factor	State	
4.2.10.9	Equipment features	List	
4.2.10.10	Partial Discharge Measurement	List	

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No. KP1/13D/4/1/TSP/09/030 - 2
Issue No. 2
Revision No. 0
Date of Issue Date: 2023-11-22
Page 34 of 36

Clause Number	Description	KPLC requirement	Bidder's offer (indicate full details of the offered equipment for each requirement of the specification)
4.2.10.11	Equipment PD features	List	
4.2.10.12	Pulse Reflection Test (PRT) System integrated in VLF Diagnostic system		
4.2.10.12.1	TDR device integrated in the system	Specify	
4.2.10.12.2	Frequency of transient recorder and aid features	State	
4.2.10.12.3	Software for operating the system	Specify	
4.2.10.12.4	Features of the PRT	List	
4.2.10.12.5	features and technical specification of the PRT test system	Specify	
4.2.10.12.6	IR tests parameters	List	
4.2.11.	Full Monitor Withstand Test (MWT)		
4.2.11.1	Key Functionality	State	
4.2.11.2	Features of the MWT	List	
5	TEST AND INSPECTION		
5.1	Test standards and responsibility of carrying out tests	specify	
5.2	Testing Facility		
5.2.1	Testing Facility address details	Specify	
5.2.2	Valid calibration	Provide	
6	MARKING AND PACKING		
6.1	Marking details	State	
6.2	Packaging details	Provide	
6.2.1	Storage and transportation casing	Provide	
6.2.2	Statement of compliance to Tender Specifications (indicate deviations if any & supporting documents)	State & provide	
	APPENDICES		
A	TESTS AND INSPECTION (NORMATIVE)		
A.1	Copies of Type Test Reports submitted with tender & ISO /IEC17025	provide	

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22



TITLE:

**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No.

KP1/13D/4/1/TSP/09/030 - 2

Issue No.

2

Revision No.

0

Date of Issue

Date: 2023-11-22

Page 35 of 36

Clause Number	Description	KPLC requirement	Bidder's offer (indicate full details of the offered equipment for each requirement of the specification)
A.2	Routine & Acceptance tests to be witnessed by KPLC at factory before shipment	List for each equipment	
A.3	Copies of sample and routine Test Reports submitted with tender	list	
A.4	Replacement of any defective equipment/spare during delivery to KPLC stores without charge	Specify	
	QUALITY MANAGEMENT SYSTEM		
B.1	Quality Assurance Plan	Provide/attach copies	
B.2	Manufacturer's Declaration of Conformity to applicable standards	Provide/attach copies	
	Copy of ISO 9001:2015 Certificate	Provide/attach copies	
B.3	Manufacturer's experience	State	
	Manufacturing Capacity (units per month)	State	
	List of previous customers	Provide	
	Customer reference letters	Provide	
C	DOCUMENTATION AND DEMONSTRATION (Normative)		
C.1	Documents submitted with tender for evaluation	List	
C.2	Documents to be submitted by supplier to KPLC for approval before manufacture	List	
C.3	Demonstration at the factory	State	
D	TRAINING		
D.1	Training at the manufacturers		
D.1.1	Training for four (4) KPLC Engineers/Technicians	Specify	
D.1.2	Theory and practical training with demonstrations	Specify	

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2023-11-22

Date: 2023-11-22



TITLE:
**CABLE FAULT LOCATING
EQUIPMENT —
SPECIFICATION**

Doc. No. KP1/13D/4/1/TSP/09/030 - 2
Issue No. 2
Revision No. 0
Date of Issue Date: 2023-11-22
Page 36 of 36

Clause Number	Description	KPLC requirement	Bidder's offer (indicate full details of the offered equipment for each requirement of the specification)
D.1.3	Program and staff evaluation criteria	Provide	
	Duration not less than three(3) 8-hour working days	State	
D.1.4	Confirmation of successful training	State	
D.1.5	Training evaluation criteria	Provide	
D.1.6	Training cost	State	
D.2	Local Training		
D.2.1	Training for twenty (20) KPLC Engineers/Technicians in Nairobi	State	
	Duration of Training session	State	
D.2.2	Theory and practical training with demonstrations	State	
D.2.3	Confirmation of successful training	State	
D.2.4	Training costs	State	

NOTE:

- 1) Bidders shall give full details of the items on offer as per the specification and applicable standards. The details provided shall conform to the test reports and their certificates, as well as labelled drawings complete with dimensions, catalogues and/or brochures for the purpose of tender evaluation.
- 2) Bidders should note that the above Guaranteed Technical Particulars Schedules must be fully completed and submitted with the bid. Wherever there is conflict between the GTPs and the clauses in the specification, the clauses in the specification take precedence. Failure to complete the schedules shall lead to rejection of the bid.
- 3) Guaranteed values shall be specified. * Words like 'agreed', 'confirmed', 'As per KPLC specifications', etc. shall not be accepted and shall be considered non-responsive.

.....
Manufacturer's Name, Signature, Stamp and Date

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: Date: 2023-11-22

Date: Date: 2023-11-22

