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## 0.2 Amendment Record

| Rev No. | Date (YYYY-MM-DD) | Description of Change | Prepared by (Name & Signature) | Approved by (Name & Signature) |
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| 0 | 2011-09-20 | New Issue | Eng. Simon Kimitei | George Owuor |
| 0 | 2016-02-19 | Issue No. 2, cancels and replaces Issue No. 1 | Michael Apudo | Dr. Eng. Peter Kimemia |
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## FOREWORD

This specification has been prepared by the Standards Department in collaboration with Common Services Section both of The Kenya Power and Lighting Company Limited (Kenya Power) and it lays down requirements for Single Phase Modular Cable Fault Locating Equipment Mounted In A Special General Purpose Van – 100kV Surging Type. It is intended for use by Kenya Power in purchasing the equipment.

The manufacturer shall submit information which confirms satisfactory service experience with products which fall within the scope of this specification for purposes of tender evaluation.

## 1. SCOPE

1.1. This specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, supply, delivery, installation and commissioning of a Single Phase Modular Cable Fault Locating Equipment Mounted In A Special General Purpose Van, suitable for locating fault on Low /Medium / High Voltage Power Cables up to 66 kV (Um =72.5kV) complete with all materials and accessories for efficient and trouble free operation.

1.2. It is not the intent to specify completely herein all details of the design and construction of equipment. However, the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation up to the Bidder's guarantee in a manner acceptable to the KPLC, who will interpret the meanings of drawings and specifications and shall have the power to reject any work or material which in his judgment is not in accordance therewith. The offered equipment shall be complete with all components necessary for its effective and trouble free operation along with associated equipment, interlocks, protection schemes etc. Such components shall be deemed to be within the scope of supply, irrespective of whether those are specifically brought out in this specification and/or the commercial order or not.

1.3. The scope covers complete design, engineering and supply of the Comprehensive Van Mounted Multifunctional Cable Fault Locator system that shall be used for Cable Fault conditioning (burn-down), Pre-Location, Route Location, Pin-pointing & Testing of HV & LV cables of different types and sizes. The set shall be suitable to carrying out the above mentioned multifunction on power cables of various voltage levels mainly 66kV, 33kV, 11kV, 415V and control cables with 1.1 kV grade. The set shall be used for cable types namely XLPE, PVC, PILC with Al / Cu conductor. The cables are laid underground (under plain earth, trenches, or RCC surface), above ground or partly under and partly above ground with maximum cable length around 25 Km.

1.4. The several runs of cables of different voltage levels are laid on common racks / underground trench and during the cable fault identification process, nearby cables shall be

in charged condition; hence the accuracy of the set being offered shall not suffer due to the above. The set shall be capable to identify and locate faults for all types of cable faults including high resistance, low resistance or intermittent / flashing faults using a single or combination of units in the set. The manufacturer shall specifically mention the use of individual unit being offered for the particular type of fault with range. The various units being offered by the manufacturer as a comprehensive multifunctional set shall be fully compatible with each other, wherever required.

1.5. The technical specification required of the various units attached to the comprehensive multifunctional set for Cable Fault Conditioning (burn-down), Pre-Location, Route Location, Pin-pointing and Testing are given below. Point-wise conformity to the specifications shall be submitted along with the offer (fully filled GTP) without which the offer shall be liable for rejection. The comprehensive cable fault locator set shall be suitable for fault locating and pinpointing the following types of cable faults viz.

(i) High impedance
(ii) Low impedance
(iii) Intermittent type or flashing faults.
(iv) Sheath Fault location

The type of faults may be 3-phase short circuit, ground fault, phase fault and open circuit. The cable fault locator set shall be suitable to locate cable fault and trace cables in areas with multiple energized / de-energized cables in the same route without affecting the accuracy.

## 2. REFERENCES

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|---|---|
| IEC 61238-1: | Compression and mechanical connectors for power cables for rated voltages up to 36 kV (Um = 42 kV)—Part 1: Test methods and requirements |
| IEC 61230: | Standard Specification Live working –Portable equipment for earthing or earthing and short circuiting. |
| IEC 60309-2: | Plugs, socket-outlets and couplers for industrial purposes. Dimensional interchangeability requirements for pin and contact-tube accessories |
| IEC 60664-1: | Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests |
| IEC 601010-1: | Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements |
| IEC 61557 (all parts): | Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. —Equipment for testing, measuring or monitoring of protective measures |

| | |
|---|---|
| IEC 60529: | Degrees of protection provided by enclosures (IP code) |
| IEEE Std 400.1: | IEEE Guide for Field Testing of Laminated Dielectric, Shielded Power Cable Systems Rated 5 kV and Above with High Direct Current Voltage. |
| BS EN 50191: | Erection and operation of electrical test equipment: General requirements |
| VDE 0104: | Erection and Operation of Electrical Test Equipment: General requirements |
| EOS 09-0001: | High Voltage Insulation Testing Standard |
| ECP 11-0505: | Polymeric Cable Sheath Test Procedure |
| ASTM B33: | Standard Specification for Tinned Soft or Annealed Copper for Electrical Purposes |
| NEMA WC 74 | 5-46kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy. |
| OIML D 11: | General requirements for measuring instruments - Environmental conditions |

## 3. TERMS AND DEFINITIONS

For the purpose of this specification the terms and definitions given in the reference standard shall apply.

## 4. REQUIREMENTS

### 4.1. SERVICE CONDITIONS

#### 4.1.1. Physical conditions

The equipment and the accessories to be supplied against this technical specification shall be suitable for satisfactory continuous operation under the following tropical conditions.

a) Max. ambient temperature: $+40^0$ C
b) Min. ambient temperature: $-1^0$ C
c) Max. daily average ambient temperature: $30^0$ C
d) Max. relative Humidity (%): <5%
e) Max. altitude above M.S.L (meters) : 2,200 m
f) Average Annual Rainfall (mm): 1000 mm
g) Max wind pressure (kg. /$mm^2$) : 130
h) Isokeraunic level (days/yr.): 180 thunderstorm days per year

i) Average no. of rainy days / annum: 120
j) Induced electromagnetic disturbance: 1.6 kV
k) Pollution class / Creepage distance: "Very Heavy"; Level IV/ 31mm/kV, as per IEC 60815
l) Seismic Zone: Zone V, as per IEEE 693
m) Acceleration due to gravity, g: 0.5 g

### 4.1.2. Safety and environmental requirements

4.1.2.1. The Cable Fault Location and Test Van - 100kV Surging Type shall be designed and manufactured in accordance with IEC 601010-1 and OIML D 11 safety and environmental standard requirements such that:

a) Their errors do not exceed the maximum permissible errors under rated operating conditions.
b) When they are exposed to disturbances, either:
   (i) Significant faults shall not occur, or
   (ii) Significant faults shall be detected and corrected by means of inbuilt checking facility.

4.1.2.2. Software controlled equipment that are complex in their functionality shall require that the user is guided for the correct use and for achieving correct measurement results.

4.1.2.3. The manufacturer shall specify the limiting conditions; storage and transport conditions for each specified influence quantity - quantity which is not the subject of the measurement and whose change affects the relationship between the indication and the result of the measurement.

4.1.2.4. Measuring equipment shall have a valid calibration status prior to being confirmed, within a specified metrological requirement.

4.1.2.5. The Cable Fault Location and Test Van - 100kV Surging Type shall also be designed manufactured and tested in conformity with the following safety and environmental design requirements and standards as per Table 1;

**Table 1: Safety and Environmental Design Requirements**

| Performance tests | Test category | | Test method | Severity level | Test Severity |
|---|---|---|---|---|---|
| Climatic | Static temperatures | Dry Heat | IEC 60068-2-2, IEC 60068-3-1 – Dry Heat (non- condensing) | 2 | 40$^0$C for 2 hours |
| | | Cold | IEC 60068-2-1, IEC 60068-3-1 – Cold | 1 | +5$^0$C for 2 hours |
| | Damp Heat | Steady state | IEC 60068-2-78, IEC 60068-3-4 – Damp heat, steady state | 1 | 30$^0$C, 85% RH for 2 days |
| | | Cyclic | IEC 60068-2-30, IEC 60068-3-4 – Damp heat, cyclic | 1 | 40$^0$C for 2 cycles |

| Performance tests | Test category | | Test method | Severity level | Test Severity |
|---|---|---|---|---|---|
| | Water | | IEC 60068-2-18, IEC 60512-14-7, IEC 60529 – Water falling drops and impacting water | 2 | Flow rate of 0.07 L/min for 10mins at $\pm 180^0$ |
| | Atmospheric pressure | Static | OIML 11 Annex B | 1 | -2.5kPa (± 0.15) -+2.5kPa (± 0.15) |
| | | Variable | OIML 11 Annex B | 2 | 10kPa ± 1 |
| | Sand and Dust | | IEC 60512-11-8, IEC 60529, IEC 60721-2-5 – Sand and Dust | 1 | 1 No. of cycles |
| | Salt mist | | IEC 60068-2-11, IEC 60721-2-5 – Salt mist | 2 | 24 hours |
| Mechanical | Vibration | Random | IEC 60068-2-47, IEC 60068-2-64, IEC 60068-3-8 | 1 | 10-150 Hz<br>RMS level – 1.6ms$^{-2}$<br>ASD level 10-20Hz – 0.05ms$^{-2}$<br>ASD level 10-150Hz – 3dB/octave |
| | | Sinusoidal | IEC 60068-2-6, IEC 60068-2-47, , IEC 60068-3-8 | 1 | 10-150Hz<br>2 ms$^{-2}$<br>20 cycles |
| | Shock | | IEC 60068-2-31 – Dropping on to a face | 1 | Height of fall – 25mm for 1 fall |
| Electrical, general | RF immunity, EMF | Origin | IEC 61000-4-3 – Annex F – Radiated electromagnetic fields | E2 - 3 | 26-800 MHz – 10V/m<br>960-1400 MHz – 10V/m |
| | | Digital radio telephones | IEC 61000-4-3 – Annex F – Radiated electromagnetic fields | E2 - 3 | 960-1400MHz-10V/m<br>1400-2000MHz-10V/m |
| | Conducted Radio Frequency Fields | | IEC 61000-4-6 – Conducted electromagnetic fields | 3 | RF amplitude (50Ω) – 10V<br>Frequency range – 0.15-80 MHz<br>Modulation – 80% AM, 1 kHz sine wave |
| | Electrostatic discharge | | IEC 61000-4-6 - ESD | 3 | Contact discharge – 6kV<br>Air discharge – 8kV |
| | Power frequency magnetic field | | IEC 61000-4-8 – PFMF (50Hz) | 4 | Magnetic Field Strength:<br>Continuous – 30A/m<br>Short duration (1s to 3s) – 300A/m |
| | Bursts (transients) on signal, data and control lines | | IEC 61000-4-1, IEC 61000-4-4 – Electrical bursts | 3 | Peak value – 1kV<br>Repetitive rate – 5kHz |
| | Surges on signal, data and control lines | | IEC 61000-4-5 – Electrical surges | 3 | Unbalanced lines:<br>-Line to line – 1 kV<br>-Line to earth – 2 kV<br>Balanced lines:<br>-Line to line – N/A<br>-Line to earth – 2.0 kV |
| Electrical – mains power | DC mains voltage variation | | IEC 60654-2 – Variation in DC mains power voltage | N/A | Specified max/min permissible levels by manufacturer. |
| | AC mains voltage variation | | IEC/TR 61000-2-1, IEC 61000-4-1 – Variation in AC mains power voltage (single phase) | 1 | Mains voltage:<br>Upper limit – $U_{nom}$+10%<br>Lower limit - $U_{nom}$-15% |
| | AC mains frequency variation | | IEC/TR 61000-2-1, IEC 61000-2-2, IEC 61000-4-1 | 1 | Mains frequency:<br>Upper limit – $f_{nom}$+2%<br>Lower limit - $f_{nom}$-2% |
| | AC mains voltage dips, short interruptions and voltage variations | | IEC 61000-4-11, IEC 61000-6-1, IEC 61000-6-2 – Short time reductions in mains voltage | 3 | As specified in Table 13.4 of OIML D 11 |
| | Voltage dips, short | | IEC 61000-4-29 | 1 | As specified in Table 13.6 of |

| Performance tests | Test category | Test method | Severity level | Test Severity |
|---|---|---|---|---|
| | interruptions and voltage variations on DC mains power | | | OIML D 11 |
| | Bursts (transients) on AC and DC mains | IEC 61000-4-1, IEC 61000-4-4 – Electrical bursts | 3 | Peak value – 2kV<br>Repetition rate – 5 kHz |
| | Ripple on DC mains power | IEC 61000-4-17 | 1 | % of nominal DC voltage – 2% |
| | Surges on AC and DC mains power lines | IEC 61000-4-5 – Electrical surges | 3 | Line to line – 1.0kV<br>Line to earth – 2.0kV |
| Electrical (battery power) | Low voltage of internal battery (not connected to mains power | Variation in supply voltage | 1 | Lower limit of the voltage – Lowest voltage specified<br>No. of cycles - 1 |
| | Power from external 12V and 24V road vehicle batteries | ISO 16750-2 - Variation in supply voltage | 12V – C<br>24V - F | 12V – 9V to 16V<br>24V – 16V to 32V |
| | Electrical transient conduction along supply lines | ISO 7637-2 | IV | As specified in Table 14.2.2 of OIML D 11 |
| | Electrical transient conduction via lines other than supply lines | ISO 7637-3 | IV | As specified in Table 14.2.3 of OIML D 11 |
| Safety | Rated Impulse Voltage for equipment -1.2/50µs | IEC 60664-1, table 1 | N/A | 6000 V |
| | Overvoltage category | IEC 61010-1 | N/A | At least Class IV 600 V |
| | Pollution category | IEC 60664-1 clause 2.5.1 | N/A | At least Degree 2 |
| | Insulation material group | IEC 60112 and IEC 60664-1 clause 2.7.1 | N/A | At least Group II - 400≤CTI<600 (PLC=1) |
| | Minimum clearances for equipment to withstand steady state voltages, temporary over-voltages and to avoid partial discharge | IEC 60664-1 section 3, clause 3.1 and Table 1 | N/A | At least 5.5mm |
| | Partial discharge requirements | IEC 60664-1 Annex C | N/A | At least 10pC |
| | Solid insulation design | IEC 60664-1 clause 3.3 | N/A | Shall withstand short term and long term stresses |

## 4.2. DESIGN AND CONSTRUCTION

4.2.1. The Cable Fault Location and Test Van - 100kV Surging Type shall have a modular design in accordance with BS EN 50191 and shall be capable of testing cables in accordance with IEEE Std 400.1, EOS 09-0001 and ECP 11-0505 standards.

4.2.2. The test equipment shall be mounted on a van and shall consist of the following major component parts:

a) Control Unit System
b) Cable Fault Location System
c) Cable Fault Pre-location System
d) High Voltage Test Set
e) Tracing and Pin-pointing System
f) Cable Identification System
g) Cable Drums and cables
h) Accessories

i) Mounting Vehicle
j) Cable Test Van Furnishing
k) Power Supply Generator

## 4.3. CONTROL SYSTEM

4.3.1. The Control Unit shall be an integrated central operator inter-face for all operational modes that provide the monitoring of the system and the integrated safety facilities.

4.3.2. It shall provide an easy and quick operation of the system, prevent operational errors and reduce the fault location time considerably. All necessary selection of equipment, switching and operations such as pre-locations, high voltage test, and pin-pointing shall be carried out from here.

4.3.3. The control unit shall be manually operated using local control screen (LCD) with control keys and shall be responsible for all the control operation of various functions such as Mode Selection Surge Test, Burn and Arc Reflection, Range Selection, Voltage and current limit adjustment, Surge sequence selection, auto discharge, earth monitoring, etc., from a single button and no access to the high voltage side shall be available to the operator as well as Operator guidance with on-screen help texts.

4.3.4. The control unit shall provide a visual indication of failure of safety circuits/incorrect selection etc. with possible corrective methods. Constant monitoring of all safety circuits such as earth monitoring circuit etc. should be inbuilt into the control unit, safety interlock monitoring etc. Safety function should be incorporated in the van suitably.

4.3.5. The control system shall be 110 kV Control System S, 1-phase consisting of:

**(A) Selection Unit**

The selection unit shall be suitable for control and monitoring of all test functions with an integrated high voltage instrument selection switch with the following characteristics:

(i) The HV selection switch: Two (2)-pole
Maximum operating voltage - 32 kV DC
Maximum operating current - 100 A
(ii) Operating voltage: 220 V +/- 10%, 12 V DC

**(B) Phase selection switch**

This shall consist of a manual instrument and phase selection switch in air insulated design with the following characteristics:

(i) Nominal operating voltage: 110 kV DC
(ii) Rated current of contacts: 200 A
(iii) Shall have a single (1) phase design

**(C) Discharge Unit**

The discharge and grounding system shall be electro-magnetically controlled-type, and shall have the following characteristics:
(i) Nominal operating voltage: 110 kV DC
(ii) Maximum discharge energy:
- 18,000 W with recovery time of 10min.
- 30,000 W with recovery time of 20min.

**(D) Mains supply unit**

The mains supply unit shall consist of an automatic circuit breaker and residual current relay; thyristor controlled battery charging set and shall have the following characteristics:
(i) Operating voltage: 220 V +/- 10%
(ii) Rated current: 32 A
(iii) Trip current: 30 mA
(iv) Charging unit: 14 V DC, 10 A
(v) Overload protection, constant voltage

**(E) Low Voltage selection unit**

**(F) Safety equipment**

The Cable Fault Location and Test Van - 100kV Surging Type shall fully comply to clause 4.1.2 and Table 1 of this specification and shall give high priority to safety of operating personnel. The van system shall be divided in two sections:

(i) Operator section - Operator section shall have an Emergency ON/OFF control panel and External emergency off switch at the entrance door to switch off entire system in case of any emergency.

(ii) HV section - HV section is equipped with proper safeguards such as door interlocks, inbuilt auto discharge.

The van system shall be designed in accordance with VDE 0104 and BS EN 50191 and shall consist of:
(i) Automatic earth loop control system to make sure that the screen of the high voltage cable and the protection earth cable are connected to the same earth.
(ii) Automatic auxiliary earth monitoring system to make sure that no differences between station earth and vehicle surrounding earth occur.

## 4.4. CABLE FAULT LOCATION SYSTEM

The cable fault location system shall consist of the following components:

### 4.4.1. Surge Voltage Generator

4.4.1.1. The Surge Voltage Generator (SVG) shall be designed for pre-locating as well as for pin-pointing of high and low resistance faults in power cables. It shall enable the stored energy of the high voltage capacitors to be fed into the faulty cable and cause a flash over at the fault position which can be detected with a ground microphone.

4.4.1.2. The maximum surge energy released shall be available in minimum three stages - 8, 16, 32 kV, each regulated from 0 to 100 % at 2000 Joule.

4.4.1.3. The SVG shall have a Selectable mode of output with the following features:
(i) Single pulse for cable fault pre-location;
(ii) Cyclical pulse repetition for precise pin-pointing according to the acoustic Method;
(iii) DC-Voltage output for cable testing and cable fault pre-location.

4.4.1.4. The SVG shall have the following technical characteristics:
(i) Adjustable output voltage from 0 to 100 %;
(ii) Single pulse or repetitive pulse release in two ranges (10 and 20 impulses/min);
(iii) Two (2) automatic discharging devices;
(iv) Reliable solenoid operated surge switch;
(v) Separate system and protection grounding device;
(vi) Safety control circuit according to VDE 0104:2011;
(vii)Maximum DC output current:
- 8kV range - 850 mA
- 16kV range - 425 mA
- 32kV range - 210 mA

### 4.4.2. Pulse Reflection Test (PRT) System

4.4.2.1. 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.

4.4.2.2. The design shall incorporate an integrated 200 MHz transient recorder for the highest measuring accuracy. It shall be able to offer unique features for intelligent manual and automatic cable fault location.

4.4.2.3. 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.

4.4.2.4. The PRT system shall have upto three cable fault location methods to be displayed at the same time on a 15" 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.

4.4.2.5. 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) Time Domain Reflectometer (TDR) output pulse from 20 to 160 V;
(vi) 200 MHz real time transient recorder with high resolution;
(vii)Measuring ranges of over 1000 km;
(viii) Automatic reporting function;
(ix) Emergency Power Supply unit.

4.4.2.6. The PRT measuring methods shall be as follows:

(i) Time Domain Reflection Method - single or multicore;
(ii) Secondary Impulse Method, SIM;
(iii) Multiple Impulse Method MIM, advanced SIM;
(iv) Differential Secondary Impulse Method;
(v) Impulse Current Method;
(vi) Decay Method.

4.4.3. **Uninterrupted Power Supply UPS 500VA**

4.4.3.1. The Uninterrupted Power Supply shall form part of the PRT and it shall be suitable for monitoring the mains power supply of the IRG 3000 reps. Industrial Computer IPC and overtakes the mains supply in case of mains cut-off.

4.4.3.2. The technical characteristics of the UPS shall be as follows:

a) Nominal Input Voltage: 196 - 280V
b) Input Frequency: 50/60 Hz +/- 3 Hz (auto sensing)
c) Output Power Capacity: 300 Watts / 500 VA
d) Max Configurable Power: 300 Watts / 500 VA
e) Nominal Output Voltage: 220 – 240 V
f) Interface Port(s): USB
g) Control panel LED status display

| | | |
|---|---|---|
| | with Audible Alarm: | On Line, On Battery, Replace Battery and Overload indicators when on battery;<br>Distinctive low battery alarm;<br>Overload continuous tone alarm |
| h) | Mounting: | Holder and mounting facility included |
| i) | Battery Type: | Maintenance free sealed Lead-Acid battery with suspended electrolyte-leak-proof |
| j) | Runtime | Approx. 3 hours |

## 4.5. CABLE FAULT PRE-LOCATION SYSTEM

The cable fault pre-location system shall consist of impulse reflection measurement with integrated TDR (Time Domain Reflectometer) - Integrated with Central Control Unit. The above fault locator will be used to pre-locate the faults in power cables with following features/parameters.

a) Modes of operation:
   (i) Pulse Reflection Method
   (ii) Impulse Current Method
   (iii) Arc Reflection Method and ARM Plus method.
   (iv) Decay, Decay Plus Method

b) Measuring Range of 80mtrs to 100Km in suitable steps with minimum sampling rate of 350 MHZ.
c) **Accuracy:** 0.2% of the range.
d) **Number of memories:** automatic storage of all data with a special history function and the seven days old data should automatically be stored into daily files. The curve in memory shall be stored with complete information of operation mode, date, time, length of cable and other relevant parameter. Automatic Storage of all measurements Protocol Printout, also as PDF file or for Transfer to a Software.
e) **Measuring variants:** Normal / core, comparison, difference.
f) Power supply; 230V ±10%, 50Hz, 1 phase
g) The equipment shall be suitable for using in conjunction with a surge generator specified above without the need for any accessory in between generator and digital fault locator.
h) The bidder shall supply along with the quotation complete details of all types of curves obtained on the screen under different conditions of fault break-down with drawings and explanations.

## 4.6. HIGH VOLTAGE TEST SET

### 4.6.1. General design

4.6.1.1. The high voltage test set shall be a two-part design needed to offer the ability to be operated with DC output voltage. The two-parts are as described in clauses 4.6.2 and 4.6.3.

4.6.1.2. The control unit shall include all operating and indication elements. The high voltage unit shall be equipped with a high voltage transformer conforming to IEC 60076 (relevant parts) and a rectifier rod for DC operation.

4.6.1.3. The features and technical specification shall be as follows:

(i) Oil insulated/resin impregnated dry type, maintenance-free high voltage transformer to IEC 60076 (all relevant parts),
(ii) Continuous adjustable output voltage,
(iii) Nominal output voltage DC: 110 kV
(iv) Maximum output current cont. DC: 22 mA
(v) Short circuit current DC: 104 mA
(vi) Rugged two-part design
(vii)Automatic short-circuit current limitation

### 4.6.2. Burn down Transformer

4.6.2.1. The burn down transformer shall enable the user to change a high impedance fault into a low impedance fault. Thus shall allow an Impulse Reflection Test Set to be used for low impedance fault pre-location.

4.6.2.2. The burn down transformer shall be enclosed in a sturdy steel housing. The well proven power electronics shall allow individual control of output voltage and current.

4.6.2.3. The burn down transformer shall have the following features:

a) Output voltage of up to 10 kV DC
b) Maximum output current of 32 A
c) Optimized power matching by 6 output voltage ranges, switchable even at full load (2.5kVA)
d) Individual electronic voltage and current control
e) Integrated terminal for connection of external ohmmeter
f) AC output for use in low voltage system
g) Safety control circuit according to VDE 0104.

4.6.3. **Cable and cable sheath fault system**

4.6.3.1. This shall be an instrument for cable - and cable sheath fault pre-location and pinpointing and shall be suitable for Cable testing at low voltages as well as cable sheath testing in power cables up to 10 kV DC combined with the accurate pre-location of faults and pinpointing to cover the full request for field application.

4.6.3.2. The instrument shall be designed and equipped with an integrated high precision measuring bridge to allow pre-location of cable faults and cable sheath faults in power cables according to Murray and Glaser methods.

4.6.3.3. The measuring principle shall enable fault pre-location of control- and lighting cables with the highest accuracy; there shall be a provision for defining different cable sections of different conductor materials and diameter in the final result.

4.6.3.4. The system shall allow full analysis to be done automatically and results displayed digitally at a distance to the fault. At the pinpointing mode, the system shall allow a DC pulse pattern with a voltage of up to 10 kV to be released to the cable - and cable sheath fault based on the step voltage measurement. The system shall have a pick-up receiver in combination with two earth probes to complete the set design.

4.6.3.5. The main features and technical specifications for the system shall include:

a) Cable and Cable Sheath Testing up to 10 kV
b) Resistance measurement equipment
c) Cable and cable sheath fault pre-location with high precession measuring bridge according to Murray and Glaser up to 10 kV, with a current limitation
d) Cable Sheath Fault Pinpointing
e) Built-in discharge unit
f) Stepless voltage adjustment 0 - 10 kV, 10mA
g) Battery operation and mains operation
h) Fully menu guided and easy to use
i) Definable cable sections
j) Portable stand-alone unit

4.7. **TRACING AND PIN-POINTING SYSTEM**

The tracing and pinpointing system shall consist of the following;

4.7.1. **Locator Set Audio Frequency System stored in a transport case.**

4.7.1.1. The Locator Set shall be used for tracing and depth evaluation of cables.

4.7.1.2. The system shall be enabled to apply the following methods for pin pointing of faults:

a) Acoustic location and acoustic proportionate time measurement
b) Step voltage method
c) Twist method

4.7.1.3. The standard set shall consist of following components:
a) Audio frequency transmitter
b) Audio frequency receiver
c) Search coil
d) Headphone
e) 2 earth spikes
f) 2 auxiliary lines
g) Transport case

4.7.2. **Audio Frequency Transmitter**

4.7.2.1. The audio frequency transmitter shall be a portable, mains or battery powered Audio Frequency Generator with integrated charging unit. The transmitter shall be capable of sending audio frequency signals into the cables so as to trace the cable route and evaluate depth. Metallic pipes shall also be traced in a similar manner.

4.7.2.2. The audio frequency transmitter features shall be as follows:
a) Output power up to 50 VA;
b) Automatic or manual impedance matching;
c) Charging unit and battery shall be incorporated;
d) Continuous or pulse mode selectable;
e) Two (2) output frequencies – selectable

4.7.3. **Audio Frequency Receiver**

4.7.3.1. The audio frequency receiver shall be designed to use a ground microphone and surge generator for pin-pointing of cable faults. It shall have an integrated acoustic propagation time measurement to display the distance to the fault in metres and indicates the exact position.

4.7.3.2. The frequency receiver shall also have the ability to measure the fault distances in cable arrangements accessible via manholes. In combination with audio frequency transmitter and detecting rod, the receiver shall be suitable for route tracing and depth evaluation of electric lines and cables.

4.7.3.3. It shall have a sheath fault location feature using two earth spikes - according to the step voltage method.

4.7.3.4. The Audio Frequency Receiver features and technical specification shall include:

a) Acoustic method including manhole distance location;
b) Accurate route tracing;
c) Digital indication of fault distance in meters;
d) Cable depth measurement in combination with the surge coil;
e) Location of cable sheath faults;
f) Water-resistant design with IP68 in accordance with IEC 60529;
g) Integrated loudspeaker;
h) Large illuminated LCD display;
i) Digital filters for suppression of traffic noise;
j) Easy menu operation;
k) Lightweight

4.7.4. **Ground microphone**

The microphone shall be capable of precise location (pin pointing) of cable faults with the audio frequency receiver.

4.7.5. **Search coil**

The search coil shall be suitable for cable route tracing and determination of the cable depth with the audio frequency receiver.

4.7.6. **Accessories**

A set for Sheath fault location with the Audio Frequency Receiver shall also be declared at the time of tender and included in the bid.

## 4.8. CABLE IDENTIFICATION SYSTEM

4.8.1. The Cable Identification System shall be suitable for selection of single and multi-core cables from a cable bundle. The system shall apply the concept of amplitude, time and phase control analysis and shall give the user the utmost security of cable identification method.

4.8.2. The cable identification system shall offer a fully automatic gain control, user friendly menu guidance, and a voltage-proof transmitter output.

4.8.3. The features and technical characteristics of the cable identification shall be as follows:
a) Cable identification of single and multi-core cables;
b) Reliable signal acquisition;
c) Identification of pulse direction, even with higher loop resistance;
d) High pulse current up to 180 A;

e) Small, flexible receiver with integrated graphics display;
f) Flexible coupler of 150 mm.

## 4.9. CABLE DRUMS AND CABLES

### 4.9.1. Rotating Cable drum rack

The rotating cable drums shall be hand-operated with lockable brakes for accommodation of:

a) 50 m high voltage (HV) cable;
b) 50 m mains cable of 3 x 4.0 mm² cross-sectional area;
c) 50 m ground cable of 16 mm² cross-sectional area
d) 50 m RF cable (TDR)
e) 25 m auxiliary ground cable 2.5 mm² cross-sectional area

The rotating cable drums shall be strong and suitable for use in the life of the cables.

### 4.9.2. Cables

The cables shall include at least:
a) High voltage cable rated 110kV, 30mm$^2$ (minimum) of about 50 m of flexible HV coaxial cable with connection clamps and strain relief ;
b) Mains cable - 50 m, 3x4 mm², with mains plug type CEE 32A conforming to IEC 60309-2;
c) Ground line cable – 50m of 16 mm² cable with tapping ferrules every 3m, including clamps, Type YF 16mm$^2$ transparent ;
d) RF cable – 5mm$^2$ (minimum) x 50m for connecting the TDR to the fault cable. This shall be separate as the combination of HV and TDR cable shall not be suitable as the HV cable generally gets faulty in operation.
e) Auxiliary ground cable - 25 m, 2.5 mm² highly flexible, with tapping clamp; hand operated drum (slip ring)

**NOTE:**
1. *All cables shall be manufactured and tested to ASTM B33 and NEMA WC 74 standards or equivalent;*
2. *Earth clamps and connectors manufactured and tested to IEC 61230 and IEC 61238-1 respectively.*

## 4.10. ACCESSORIES

The accessories for the cable fault location and test van shall include:

a) Cable route length meter including fixing device – This shall have:

- Sturdy design
- Measuring range 9,999.99m
- Zero-reset lever
- Overvoltage category of at least CAT IV 600V in accordance with IEC 61010-1

b) Tools – These shall include;
- Discharging Rods – 110kV;
- Measuring wheel;
- Operate or Cabin Fan;
- Earth Spikes;
- Set of spanners, screwdrivers etc.;
- Digital multimeter conforming to IEC 61557 (relevant parts) and OIML D 11 with overvoltage category of at least CAT IV 600V in accordance with IEC 61010-1;
- Earth resistance tester (0-10kV) conforming to IEC 61557 (relevant parts) and OIML D 11 with overvoltage category of at least CAT IV 600V in accordance with IEC 61010-1;
- Any other tool not mentioned above but otherwise required shall also be supplied.

## 4.11. CABLE TEST VAN – VEHICLE

### 4.11.1. Van Requirements

i) A standard production, van of latest design in class, in current production and marketed in Kenya.
ii) Supplied new.
iii) Capable of operating in tropical road conditions.
iv) Van to be fitted with electronic speed governor.
v) Governor to limit maximum speed to 80km/hr.
vi) Governor to be tamper proof.
vii) Anti-theft alarm fitted.
viii) Metallic Hazard Triangles, standard First Aid and 1Kg capacity fire extinguisher.

4.11.2. **Body Structure**: The vehicle shall be a box body van with high roof with the following features:

i) ABS Anti Blocking System
ii) Stabilizer at rear axle
iii) Stabilizer at front axle
iv) Air condition for driver cabin
v) No partition wall behind driver seat
vi) Sliding door in working compartment with window on right side
vii) Sliding window opposite sliding door
viii) Rear door with window

ix) Footboard at rear door
x) Rear end is to be provided with red reflectors
xi) Mud guards are to be provided
xii) Stairs shall be aluminium checkered plate

4.11.3. **Cable Test Van Furnishing**

- Insulation - Walls and roof shall be insulated for noise, thermal and electrostatic protection
- Wall covering
- Roof covering
- Special floor - Laid over whole area
- Floor - In control room antistatic layer
- Air conditioner
  - Coleman Rotary Mach 3 for roof mounting;
  - Powered by mains supply or generator;
  - Operating voltage of 220-240 V
  - Maximum rated current of 7 A
  - Cooling capacity - 3000 kcal
  - Heating capacity - 1400 kcal
  - Air capacity - 210-470 $m^3/h$
- Partition wall to Eurodesk - Partition wall between control room and high voltage room shall be made of Plexiglas.
- Cable outlet, spring version in rear door
- Rotary flashing light
  - Fix roof mounted
  - Colour: yellow
  - Operating voltage: 12 V
  - Halogen lamp with reflector
- Internal lighting 230 V AC and 12 V DC
- Warning lamp LED - Visual indication of operating condition, in plastic housing mounted must be behind rear door window with a red/green colour.
- Operating desk - Operating desk for installation of 19"rack mounted units, with epoxy coated steel frame;
- 19" drawers for storage of accessories;
- Swivel chair - Safety swivel chair according with 5 radial rollers, including bayonet quick catch for securing during driving.
- Electric door contacts –For rear doors of vehicle. Positive contact.

4.11.4. **Dimensions and weights**

Table 2: Dimensions and weights

| Item | Requirement |
|---|---|
| Overall length, mm, min. | 6,500 |
| Overall width, mm, min. | 2,400 |
| Overall height (high roof) , mm, min. | 2,600 |
| Wheelbase, mm, min. | 4,300 |
| Max. G.V.W. approx., Kg | 3,500 |
| Ground clearance, mm, min. | 200 |
| Minimum turning radius, m, approx. | 15.0 |

4.11.5. **Engine**

Table 3: Engine

| Item | Requirement |
|---|---|
| Engine type | Diesel, 4 stroke, water cooled |
| Piston displacement, within the range, cc | 2100-2800cc |
| Maximum power output (hp/rpm), min. | 120kw/3800rpm |
| Maximum torque developed (Nm/rpm), min. | 360Nm/2400rpm |
| Engine aspiration | Natural or turbocharger |

4.11.6. **Steering Control & Power Transmission**

Table 4: Steering and Transmission

| Item | Requirement |
|---|---|
| Steering | Right hand drive |
| Steering type | Power assisted |
| Gear box, synchromesh | Gear box, synchromesh |
| Drive configuration | 4x2 |
| Number of speeds, min | 6F, 1R |
| Gear box | Manual or automatic or semi-automatic |

4.11.7. **Manuals**

i) All literature in the English language
ii) Repair manuals to be supplied
iii) Parts catalogue/microfiche/CD to be supplied

4.11.8. **Warranty & Free Service**

i) Specimen of vehicle warranty to be submitted when tendering
ii) Each vehicle supplied should carry a statement of warranty
iii) Free service shall be provided on labour and parts (bidder to state kilometres for each)

Table 5: Warranty

| Item | Requirement |
|---|---|
| Vehicle warranty (months or kilometers, whichever comes first): | |
| Months, min. | 12 |
| Kilometers, min. | 40,000 |

4.11.9. **Other Requirements**

i) Van to be registered in Kenya by Registrar of Motor Vehicles prior delivery
ii) Van to be spray painted in current KPLC colours as per the user and be inspected by the KPLC Engineer prior to delivery
iii) Franchise Holders and dealers who own fully fledged workshops with adequate equipment and facilities in Kenya
iv) Body construction and all fitments to conform to Kenya Traffic Act CAP 403
v) Chevrons and reflectors fitted on rear to conform to Kenya Traffic Act

4.11.10. **Isolation Transformer 5 kVA**

- Primary voltage: 230 V (110/110)
- Secondary voltage: 230 V
- Rated power: 5 kVA
- Mains frequency: 50Hz
- Single screen winding

4.12. **POWER SUPPLY GENERATOR**

4.12.1. Standby generator 6 kVA

This shall be a petrol engine generator with electro start and incorporated with 12V battery and shall be placed at specially created housing in the van body / side body of the van. The generator is equipped with:

| | | |
|---|---|---|
| (i) | Rated voltage: | 220 - 240 V |
| (ii) | Rated power: | 5.4 kVA continuous and 6.0 kVA maximum; |
| (iii) | Speed: | 3000 rpm |
| (iv) | Frequency: | 50 Hz |
| (v) | Fuel; | Petrol/ 3 litres per hour |
| (vi) | Starting: | Self Start by key |
| (vii) | Oil Alert: | Provided |
| (viii) | AVR: | Automatic Voltage Regulation |
| (ix) | Frame: | Pipe Full Frame |
| (x) | Approximate weight: | Manufacturer to state |
| (xi) | Approximate dimensions: | Manufacturer to state |
| (xii) | Noise level: | 72 dB as per NEMA requirements |

4.12.2. Heavy load drawer for standby generator

This shall include;

(i) Structural steel frame
(ii) Guide bars with retaining device for transportation
(iii) Carrying capacity: 100 kg
(iv) Length approx. 900 mm

## 5. TESTS AND INSPECTION

### 5.1. Type Tests

5.1.1. The supplier shall be responsible for performing or for having performed all the required tests in this specification. Tenderers shall confirm the supplier's/manufacturer's capabilities in this regard when submitting tenders. Any limitations shall be clearly specified.

5.1.2. The performance of the components of the cable fault location and test van shall be substantiated by the test data relevant to the particular designs offered. The type test reports shall not be older than five (5) years and shall be valid up to expiry of validity of the offer.

5.1.3. Evidence of valid type tests shall be submitted with the tender and shall include but not be limited to dielectric tests, temperature rise tests, short time current tests, EMC tests, environmental and mechanical endurance tests together with the evidence of tests to verify the making and breaking capacity of the included switching devices and other primary components. All other test certificates as per relevant standards shall also be included.

5.1.4. Copies of previous Type Tests 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 same third party testing laboratory used shall also be submitted with the tender (all in English Language).

5.1.5. KPLC authorized Engineers shall have access at all reasonable time to all places of work and when work is being carried out and shall be provided (by the manufacturer) with all necessary facilities for inspection and testing during and after design and fabrication.

5.1.6. Copies of type test reports to be submitted with the tender (by bidder) for evaluation shall be as stated.

### 5.2. Routine tests

5.2.1. Routine tests on the Cable Fault Location and Test Van and accessories shall be carried out as per the latest edition of relevant standards. The complete routine test report for all the components stated in clause 4.2.2 arranged section wise for each shall be submitted to KPLC for approval 3 months before inspection.

5.2.2. Also two (2) sets of inspection packages (which shall include approved set of drawings, test procedures, copies of relevant standards, day wise test programme etc.) shall be submitted at least one (1) month before each inspection.

5.2.3. All Cable Fault Location and Test Van components and accessories shall be offered for routine witness tests and inspection in the presence of KPLC engineers.

5.2.4. During inspection by KPLC engineers, at the manufacturer's works, the quantities of Cable Fault Location and Test Van which will be ready and offered for inspection and tests shall be considered already tested. The remaining components shall be subject to future tests whenever they will be ready.

5.2.5. On receipt of the goods KPLC may perform or cause to be performed any of the tests specified in order to verify compliance with this specification. The supplier shall replace without charge to KPLC Cable Fault Location and Test Van component parts which upon examination, test or use fail to meet any of the requirements in the specification.

5.2.6. The routine tests to be witnessed by KPLC engineers at the factory before shipment shall be in accordance with all relevant manufacturing standards and this specification.

## 6. MARKING AND PACKING

### 6.1. Markings

6.1.1. The following types of nameplate shall be furnished in a convenient central location to provide information for operation and maintenance.

6.1.1.1. A Single Line Diagram showing all HV devices in a single line diagram. Also shown shall be the Cable Fault Location and Test Van nomenclature, a legend, Manufacturer's type and serial number and year of manufacture.

6.1.1.2. Cable Fault Location and Test Van Rating / Name plate shall consists of:

(i) Manufacturer's name & address;
(ii) Cable Fault Location and Test Van type & designation;
(iii) Serial Number;
(iv) Maximum ambient temperature;
(v) System frequency, Maximum continuous voltage;
(vi) Maximum continuous current at 40°C ambient temperature;
(vii) Basic Impulse Level;
(viii) Power Frequency one minute voltage;
(ix) Short circuit current, rms.;
(x) Symmetrical Short time (rms) current & duration;
(xi) Symmetrical Momentary current, peak;
(xii) Auxiliary voltages;
(xiii) Contract/Purchase Order numbers;
(xiv) Total weight of the equipment.
(xv) The letters, "**Property of KPLC**".

6.1.2. Equipment nameplate containing nameplate rating information for all HV modules as required in relevant standards,

.

6.1.3. Nameplates showing serial numbers and similar data specific to individual components shall be mounted on the components. Each transformer must have its own rating plate mounted adjacent to each terminal box cover, with all terminal and ratio markings. Each bay auxiliary control cubicle must be identified with its designation to which it is assigned.

## 6.2. Packing

6.2.1. All equipment shall be suitably packed and protected during shipment/transportation. Each shipping unit shall be sealed in a clean dry condition with leak-tight shipping covers securely mounted for shipment. All covers to be removed during installation shall be clearly marked.

6.2.2. Each shipping section shall be carefully sealed and filled with dry gas to a slightly positive pressure to prevent the entrance of moisture and contamination. The packing method for the Cable Fault Location and Test Van equipment shall be standard and it shall be guaranteed that each component of the equipment will not be damaged, deformed or lost.

The storage instructions shall be submitted by bidder for long term storage. Components requiring indoor storage shall be so identified.

6.2.3. Cable Fault Location and Test Van and Equipment shall be properly packed to protect them during ocean shipment, inland transport, carriage at site and outdoor storage during transit and at the site. Completely assembled modules (subject to transport limitations) of the Cable Fault Location and Test Van shall be transported as one shipment unit.

6.2.4. Packing materials shall be dust and waterproof. All packages shall be clearly, legibly and durably marked with uniform block letters on at least three sides. Fragile items and fully assembled equipment shall be securely packaged and shipped in containers. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment wherever necessary.

6.2.5. As far as possible, trans-shipment shall be avoided.

6.2.6. Impact recorders (Accelerometers) shall be provided on the packages to confirm that Cable Fault Location and Test Van equipment has not suffered any shocks during shipment, transport, handling, etc. The impact recorders readings are to be noted on receipt of equipment at site and reported to user and manufacturer, in case the readings are exceeding the permissible values. It shall be at discretion of user to accept or reject the same.

## 7. DOCUMENTATION AND TRAINING

### 7.1 Drawings Data & Manuals

7.1.1 Drawings, Data and Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions on contract and/or elsewhere in this specification for approval and subsequent distribution after the issue of Letter of Intent.

7.1.2 To be submitted with the Bid are:

a) Typical general arrangement drawings of the equipment indicating space requirement, room dimensions, capacity etc.
b) Technical Specifications of equipment and special tools explaining construction features, principle of operation, special features etc.
c) Comprehensive QAP, FQP, SLD, schematic diagrams technical brochures, building requirements, earth mat design, list of recommended spares, special tools or fixtures, O&M manuals, environmental guide for handling $SF_6$ gas &

decommissioning (if applicable), and any other documents required for successful commissioning & operation of complete Cable Fault Location and Test Van.

d) Control and protection: block and principle diagram showing proposed scheme, layout & equipment arrangement drawings, catalogues and brochures of offered devices.

7.1.3 Successful bidder shall submit three (3) sets of spiral bound volume of following drawings and data for approval before commencement of supply:

a) A comprehensive Manufacturing Quality Assurance plan with effective quality assurance system.
b) Field Quality plan indicating instruction and procedures sequenced for storage, assembly, maintenance and disassembly.
c) Assembly and maintenance clearance requirements.
d) Dimensional general arrangement drawing showing disposition of various fittings, name plates indicating equipment ratings.
e) Structure Plan with details and loading
f) Control schematic and wiring diagrams.
g) Grounding arrangement and ground bus details including Manufacturer's recommendation on grounding of various component equipment.
h) Calculation of Voltage rise for Cable Fault Location and Test Van enclosure
i) Calculated point to point resistance for each assembly.
j) Calculation for Surge Protection
k) Design Calculations for bus-bar sizing, short circuit forces and vibration on Bus-bar & each equipment, thermal stability and losses.
l) Any other relevant drawing or data necessary for satisfactory operation and maintenance.
m) Operating instruction and manuals for Cable Fault Location and Test Van and its accessories
n) The manual shall clearly indicate method of installation, checkups and tests to be carried out before commissioning of the equipment.
o) The bidder shall note that the approval of drawings & documents by the Owner does not relieve him of his contractual obligation. The bidder may note that the drawings, data and manuals listed herein are minimum required only. The bidder shall ensure that all other necessary write-up, curves, etc. require to fully describe the equipment are to be submitted with the bid.

7.1.4 All drawings shall be prepared by using AutoCAD and documents shall be generated using Electronic version. The paper copy of the drawings & document shall be submitted for approval & reference.

7.1.5 All final drawings and documents shall be submitted in CD in AutoCAD 2007 and MS office format as applicable for Owner's future reference. Also AutoCAD version of main GA drawings is to be submitted for Owner's layout finalization.

### 7.2 Training

7.2.1 Training of Ten (10) persons of KPLC on construction, installation, commissioning and O&M shall be imparted by bidder free of charge.

7.2.2 Duration of the complete training shall be 7 working days, covering minimum below specified curriculum. Any other specific area may be brought to notice and shall include:

1. General explanation for Cable Fault Location and Test Van
2. Layout and architecture of Cable Fault Location and Test Van
3. Construction of Cable Fault Location and Test Van
4. Operating mechanism of Cable Fault Location and Test Van
5. Maintenance of Cable Fault Location and Test Van
6. Overhaul of Bus/ Cable head
7. Overhaul of various transformer connections
8. Operation of Cable Fault Location and Test Van with SCADA
9. Construction & Maintenance of Lightning Arrester
10. Construction & Maintenance of Local control panel
11. Type tests of Cable Fault Location and Test Van
12. Routine tests of Cable Fault Location and Test Van.
13. Faults simulation of Cable Fault Location and Test Van
14. Localization of Cable Fault Location and Test Van fault.

7.2.3 Bidder shall at his cost arrange for the above training facilities and in addition shall bear all living expenses plus inland travel expenses of all the trainees. The Purchaser shall only pay to and fro passage of the trainees.

## 8. WARRANTY AND EXTENDED WARRANTY

### 8.1. Warranty and post installation support

8.1.1. The supply and installation will be made at KPLC stores. All the supplied cable fault locating machines shall have comprehensive onsite warranty (inclusive of parts and labour) for 66 months from the date of supply or 60 months from the date of installation and commissioning. Post installation support shall be as per the given service levels.

Table 6: Warranty conditions

| Item | Service level |
|---|---|
| General Purpose Van Mounted Single Phase Modular Cable Fault Locating Equipment Suitable for Locating Fault on Low /Medium / High Voltage Power Cables up to 66 KV. | 1. To be attended to within 12 hours;<br>2. The fault to be removed within 36 hours;<br>3. In case the problem remains unresolved for more than 72 hours then the Machine will have to be replaced with a standby;<br>4. On repair of the fault the original machine will have to be replaced with the standby machine;<br>5. If the repair is not removed within 1 month, then the manufacturer will have to supply new machine. |

8.1.2. The supplier will have to create a central help desk to register the complaints of the users. The help desk application shall allow the help desk personnel log the user's complaint along with date and time. The helpdesk will operate from 9.00 am to 6.00 pm (GMT+3) on all working days.

8.1.3. The help desk will have facilities management system adequate to attend to the problems as per the given service levels. The help desk will have direct communication facility so as to find out the status of complaint directly from KPLC. This communication facility shall be made available to concerned Engineer in Charge and the operating officer.

8.1.4. Help desk will have a personnel to attend the operators complaints promptly. The complaint will be deemed to be rectified when the faulty equipment is rectified successfully and the facility management personnel takes the written sign off from the concerned officer in charge.

8.2. **Extended Warranty**

8.2.1. The extended warranty period shall be for 5 (Five) years after expiry of the initial warranty period of 5 (Five) years. The obligation of the supplier during extended warranty period shall be same as defined in the initial warrantee period.

8.2.2. KPLC intends to award post warranty annual maintenance and repairs contract for a period of five years. The annual maintenance and repairs rate contract includes cost of labour and materials/ components. A separate performance bank guarantee must be deposited by the successful tenderer at the rate of 5% of charges quoted for five years, before completion of the initial warranty period of five years.

8.2.3. **The extended warranty shall come into force after expiry of initial warranty period, i.e., free service shall be provided in the extended warranty period during which no**

**charges of any sort shall be payable.** This would include minimum one monitoring visit, once in a month, by the supplier's representative. The extended warrantee contract may broadly include the following.

(i) Scheduled monthly inspection and maintenance of the equipment towards preventive maintenance based on specific need of the equipment.

(ii) Unscheduled on call corrective and remedial maintenance services to set right any malfunctioning of the equipment, replacement of unserviceable components, as per the nature of the complaint so that the equipment is placed in to service again. It is expected that such calls shall be attended within a period of 12 hours of receipt of such intimation from the field officers so that there is minimum down time of the equipment.

(iii) The format of reporting for said visit shall be mutually finalized after issue of order. The extended warranty contract shall form part of supply contract. **The charges as would be quoted by the tenderer for such extended warranty contract for 5 years shall be loaded in the quoted prices of the main equipment to arrive at computed adjusted prices for comparison purpose and to award contract to most economical proposal, i.e. supply of equipment + extended warranty cost involved for 5 years after expiry of normal warranty period of 60 months from supply.**

(iv) Payment of annual extended warranty contract shall be made annually on prorata basis after expiry of one year period on verification of bills by the Engineer in Charge of the designated for particular station where services are to be rendered by the supplier.

8.3. **Penalty**

In case the supplier fails to adhere to attend the service level as mentioned above and also fails to provide standby machine within 72 Hours, penalty of $ 20 per day subject to maximum of $ 500 will be levied by KPLC.

8.4. **Replacement of defective/damaged materials**

8.4.1. Notwithstanding anything contained in the above liquidated damages clause, when the whole or part of the supplied by the supplier are found to be defective/damaged or are not in conformity with the specification or sample, such defects or damages in the materials / equipment installed shall be rectified within 72 hours from the date of intimation/ information from the system of defect/damage either at the point of destination or at the supplier's works, at the cost of supplier, against proper security and acknowledgement.

8.4.2. If the defects or damages are not rectified or replaced within this period, the supplier shall pay a sum towards liquidated damages as per liquidated damages clause given above, for the delay in rectification/replacement of the defects or damages. Though all substations are manned by KPLC employees/staff, the substation attendant of the utility shall ensure the proper upkeep of the system at field; however, contractor shall monitor the same for operational defects.

**ANNEX A: SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS** *(to be filled and signed by the Manufacturer and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records, four customer reference letters, details of manufacturing capacity, the manufacturer's experience and copies of complete type test certificates and type test reports for tender evaluation, all in English Language)*

**Tender No. .....**

| Clause | KPLC requirements | | | Bidder's offer (indicate full details of the offered equipment for each requirement of the specification) |
|---|---|---|---|---|
| | Bidders Name and Address | | | Provide |
| | Manufacturer and Country of manufacture | | | Provide |
| 1.0 | **SCOPE** | | | |
| . | Design, manufacture, assembly, testing, supply, delivery, installation and commissioning | | | |
| | Scope | Covers design, engineering & supply | | State |
| | | Cable fault conditioning(burn down) | | State |
| | | Pre-location | | State |
| | | Route location | | State |
| | | Pin-pointing | | State |
| | | Testing of HV & LV cables of different types and sizes | XLPE | State |
| | | | PVC | State |
| | | | PILC | State |
| | | Testing 415v, 11KV, 33KV, 66KV and control cables of 1.1KV grade | | State |
| | | Accuracy/Non- interference from nearby charged cables | | State |
| | Fault types | High resistance | State unit used and its range | State whether the various units being offered as a comprehensive multifunction set shall be fully compatible with each other whenever required. |
| | | Low resistance | State unit used and its range | |
| | | Intermittent type or flashing faults. | State unit used and its range | |
| | | Sheath fault location | State unit used and its range | |
| 2.0 | **REFERENCES** | | | |
| | Standards of manufacture | | | Provide a full list of Standards used |
| 4.0 | **REQUIREMENTS** | | | |
| 4.1.1 | **Physical / Operating Conditions** | | | |
| | Max. ambient temperature | | | State |
| | Min. ambient temperature | | | State |
| | Max. daily average ambient temperature | | | State |
| | Max. relative Humidity (%) | | | State |
| | Max. altitude above M.S.L (meters) | | | State |
| | Average Annual Rainfall (mm) | | | State |

| Clause | KPLC requirements | | | Bidder's offer (indicate full details of the offered equipment for each requirement of the specification) |
|---|---|---|---|---|
| | Max wind pressure (kg. /mm2) | | | State |
| | Isokeraunic level (days/yr.) | | | State |
| | Average no. of rainy days / annum | | | State |
| | Induced electromagnetic disturbance | | | State |
| | Pollution class / Creepage distance | | | State |
| | Seismic Zone | | | State |
| | Acceleration due to gravity, g | | | State |
| **4.1.2** | **Safety and Environmental Requirements** | | | |
| | Climatic | | | Attach test reports to justify compliance |
| | Mechanical | | | |
| | Electrical; General | | | |
| | Electrical; Mains power | | | |
| | Electrical; Battery power | | | |
| | Safety | | | |
| **4.2** | **Design and Construction** | | | |
| 4.3 | Control System | Integrated central operator interface system | | Y/N |
| | | Easy and quick operation | | Y/N |
| | | Manual operation | | Y/N |
| | | Visual indication of failure of safety circuits | | Y/N |
| | | Selection unit | | For each, state if available, its use and features/operating conditions. |
| | | Phase selection switch | | |
| | | Discharge Unit | | |
| | | Mains supply unit | | |
| | | Low voltage selection unit | | |
| | | Safety equipment | | |
| 4.4 | Cable fault location system | Surge voltage Generator | Output modes | State output modes and their functions |
| | | | Technical Characteristics | State |
| | | Pulse Reflection test (PRT) system | Computer Aided with latest OS | State, if so |
| | | | Integrated 200MHz transient recorder | State |
| | | | Features and technical specifications | Provide details |
| | | | Measuring methods | State the various methods used |
| | | Uninterrupted Power Supply UPS 500VA | Technical characteristics | State the technical features and characteristics. |
| 4.5 | Cable fault pre-location | Modes of operation | Pulse Reflection Method | State, if available and its |

| Clause | KPLC requirements | | | | Bidder's offer (indicate full details of the offered equipment for each requirement of the specification) |
|---|---|---|---|---|---|
| | system | | | Impulse Current Method | use |
| | | | | Arc Reflection Method and ARM plus Method | |
| | | | | Decay, Decay Plus Method | |
| | | Measuring range | | | |
| | | Accuracy | | | |
| | | Number of measures | | | |
| | | Measuring variants | | | |
| | | Power supply | | | |
| | | Accessories | | | |
| | | Types of curves attached | | | |
| 4.6 | High Voltage Test Set | General design | | | State the features and technical specifications. |
| | | Burn Down Transformer | | | State the features and technical specifications. |
| | | Cable and Cable sheath fault System | | | State the features and technical specifications. |
| 4.7 | Tracing and pin-pointing System | Locater Set Audio Frequency System | | Stored in a transport case | State |
| | | | | Methods for faults pin-pointing | State |
| | | | | Main components | State |
| | | Audio Frequency Transmitter | | Power Unit | State if battery, mains or both |
| | | | | Features | State |
| | | Audio Frequency Receiver | | Features and technical specifications | State |
| | | Ground microphone | | | State its capability |
| | | Search Coil | | State its accessories set for sheath fault location with audio frequency receiver | |
| 4.8 | Cable Identification System | Features and technical characteristics | | | State |
| 4.9 | Cable drums and Cables | Cable drum rack | 50 m HV cable | | State if the cables listed will be accommodated |
| | | | 50 m mains cable 3x4 mm² | | |
| | | | 50 m ground cable 16 mm² | | |
| | | | 50 m RF cable(TDR) | | |
| | | | 25 m auxiliary ground cable 2.5 mm² | | |
| | | Cables | High voltage cable | | State its size, length, rating |

| Clause | KPLC requirements | | | Bidder's offer (indicate full details of the offered equipment for each requirement of the specification) |
|---|---|---|---|---|
| | | | | and make |
| | | | Mains cable | State its size, length and plug type |
| | | | Ground line cable | State size, length and make |
| | | | RF cable | State if available and its sizes |
| | | | Auxiliary ground cable | State its size and length |
| 4.10 | Accessories | Cable route length meter & fixing device | | State its features |
| | | Tools | Discharging rods (110kV) | State if available |
| | | | Measuring wheel | State if available |
| | | | Operate or Cabin fan | State if available |
| | | | Earth Spikes | State if available |
| | | | Set of spanners, screwdrivers etc. | State if available |
| | | | Digital multimeter | State all applicable standards |
| | | | Earth resistance tester(0-10kV) | State all applicable standards |
| | | | Any other required tool not mentioned | State if available |
| 4.11 | Cable Test van- Vehicle | | | |
| | | Body structure | | State its features |
| | | Cable Test Van Furnishing | | State its features |
| | | Isolation transformer 5 KVA | | Provide technical details |
| 4.11.1 | Van Requirements | A standard production, van of latest design in class, in current production and marketed in Kenya. | | State |
| | | Supplied new | | State |
| | | Capable of operating in tropical road conditions. | | State |
| | | Van to be fitted with electronic speed governor. | | State |
| | | Governor to limit maximum speed to 80km/hr. | | State |
| | | Governor to be tamper proof. | | State |
| | | Anti-theft alarm fitted. | | State |
| | | Metallic Hazard Triangles, standard First Aid and 1Kg capacity fire extinguisher | | State |
| 4.11.2 | Body Structure | Box body van with high roof | | State |
| | | ABS Anti Blocking System | | State |
| | | Stabilizer at rear axle | | State |
| | | Stabilizer at front axle | | State |

| Clause | KPLC requirements | | **Bidder's offer** (indicate full details of the offered equipment for each requirement of the specification) |
|---|---|---|---|
| | | Air condition for driver cabin | State |
| | | No partition wall behind driver seat | State |
| | | Sliding door in working compartment with window on right side | State |
| | | Sliding window opposite sliding door | State |
| | | Rear door with window | State |
| | | Footboard at rear door | State |
| | | Rear end is to be provided with red reflectors | State |
| | | Mud guards are to be provided | State |
| | | Stairs shall be aluminium checkered plate | State |
| 4.11.3 | Cable Test Van Furnishing | Insulation - Walls and roof shall be insulated for noise, thermal and electrostatic protection | State |
| | | Wall covering | State |
| | | Roof covering | State |
| | | Special floor - Laid over whole area | State |
| | | Floor - In control room antistatic layer | State |
| | | Air conditioner | State |
| | | Coleman Rotary Mach 3 for roof mounting; | State |
| | | Powered by mains supply or generator; | State |
| | | Operating voltage of 220-240 V | State |
| | | Maximum rated current of 7 A | State |
| | | Cooling capacity - 3000 kcal | State |
| | | Heating capacity - 1400 kcal | State |
| | | Air capacity - 210-470 $m^3/h$ | State |
| | | Partition wall to Eurodesk - Partition wall between control room and high voltage room shall be made of Plexiglas. | State |
| | | Cable outlet, spring version in rear door | State |
| | | Rotary flashing light | State |
| | | Fix roof mounted | State |
| | | Colour: yellow | State |
| | | Operating voltage: 12 V | State |
| | | Halogen lamp with reflector | State |
| | | Internal lighting 230 V AC and 12 V DC | State |
| | | Warning lamp LED - Visual indication of | State |

| Clause | KPLC requirements | | | Bidder's offer (indicate full details of the offered equipment for each requirement of the specification) |
|---|---|---|---|---|
| | | operating condition, in plastic housing mounted must be behind rear door window with a red/green colour. | | |
| | | Operating desk - Operating desk for installation of 19"rack mounted units, with epoxy coated steel frame; | | State |
| | | 19" drawers for storage of accessories; | | State |
| | | Swivel chair - Safety swivel chair according with 5 radial rollers, including bayonet quick catch for securing during driving. | | State |
| | | Electric door contacts –For rear doors of vehicle. Positive contact. | | State |
| 4.11.4 | Dimensions and weights | **Item** | **Requirement** | |
| | | Overall length, mm, min. | 6,500 | State |
| | | Overall width, mm, min. | 2,400 | State |
| | | Overall height (high roof) , mm, min. | 2,600 | State |
| | | Wheelbase, mm, min. | 4,300 | State |
| | | Max. G.V.W. approx., Kg | 3,500 | State |
| | | Ground clearance, mm, min. | 200 | State |
| | | Minimum turning radius, m, approx. | 15.0 | State |
| 4.11.5 | Engine | Engine type | Diesel, 4 stroke, water cooled | State |
| | | Piston displacement, within the range, cc | 2100-2800cc | State |
| | | Maximum power output (hp/rpm), min. | 120kw/3800rpm | State |
| | | Maximum torque developed (Nm/rpm), min. | 360Nm/2400rpm | State |
| | | Engine aspiration | Natural or turbocharger | State |
| 4.11. | Steering Control & Power Transmission | Steering | Right hand drive | State |
| | | Steering type | Power assisted | State |
| | | Gear box, synchromesh | Gear box, synchromesh | State |

| Clause | KPLC requirements | | | Bidder's offer (indicate full details of the offered equipment for each requirement of the specification) |
|---|---|---|---|---|
| | | Drive configuration | 4x2 | State |
| | | Number of speeds, min | 6F, 1R | State |
| | | Gear box | Manual or automatic or semi-automatic | State |
| 4.11. | Manuals | All literature in the English language | | State |
| | | Repair manuals to be supplied | | State |
| | | Parts catalogue/microfiche/CD to be supplied | | State |
| 4.11. | Warranty & Free Service | Specimen of vehicle warranty to be submitted when tendering | | State |
| | | Each vehicle supplied should carry a statement of warranty | | State |
| | | Free service shall be provided on labour and parts (bidder to state kilometres for each) | | State |
| | | **Item** | **Requirement** | |
| | | Vehicle warranty (months or kilometers, whichever comes first): | | State |
| | | Months, min. | 12 | State |
| | | Kilometers, min. | 40,000 | State |
| 4.11. | Other Requirements | State | | State |
| | | Van to be spray painted in current KPLC colours as per the user and be inspected by the KPLC Engineer prior to delivery | | State |
| | | Franchise Holders and dealers who own fully fledged workshops with adequate equipment and facilities in Kenya | | State |
| | | Body construction and all fitments to conform to Kenya Traffic Act CAP 403 | | State |
| | | Chevrons and reflectors fitted on rear to conform to Kenya Traffic Act | | State |
| | | Van to be registered in Kenya by Registrar of Motor Vehicles prior delivery | | State |
| | | Van to be spray painted in current KPLC colours as per the user and be inspected by the KPLC Engineer prior to delivery | | State |
| | | Franchise Holders and dealers who own fully fledged workshops with adequate equipment and facilities in Kenya | | State |

| Clause | KPLC requirements | | | Bidder's offer (indicate full details of the offered equipment for each requirement of the specification) |
|---|---|---|---|---|
| | | Body construction and all fitments to conform to Kenya Traffic Act CAP 403 | | State |
| 4.11.10 | Isolation Transformer 5 kVA | **Item** | **Requirement** | |
| | | Primary voltage: | 230 V (110/110) | State |
| | | Secondary voltage: | 230 V | State |
| | | Rated power: | 5 kVA | State |
| | | Mains frequency: | 50Hz | State |
| | | Single screen winding | | State |
| 4.12 | Power supply generator | Standby generator 6 KVA | | State |
| | | Heavy load drawer for standby generator | | State |
| **5.1** | **Type Tests** | | | |
| 5.1.1. | Responsibility of carrying out tests, capabilities and limitations | | | Provide |
| 5.1.2. | Data to verify performance of all components and its validity submitted with tender | | | Provide |
| 5.1.3. | Evidence of all valid type tests and all relevant test certificates submitted with tender | | | Provide |
| 5.1.4. | Copies of previous Type Test reports from a third party testing laboratory and its accreditation certificate submitted with tender | | | Provide |
| 5.2.1 | Routine tests on the Cable Fault location and test van and accessories as per relevant standards | | | Provide |
| 5.2.2 | 2 sets of inspection packages viz approved drawings, test procedures, copies of relevant standards, day wise test programme etc. | | | Provide |
| 5.2.3 | Acceptance tests and inspections of all components to be witnessed by KPLC during and after fabrication at factory before shipment | | | Provide |
| 5.2.5 | Replacement of rejected which do not meet the requirements of this specification and applicable standards. | | | Specify |
| 6.1 | Marking | | | Specify |
| 6.2 | Packing | | | Specify |
| 7.1 | Documents submitted with tender | | | Provide |
| 7.2 | Training of users on construction, installation, commissioning and O&M free of charge | | | Provide & Specify |
| 8.1 | Manufactures guarantee and Warranty | | | Provide & Specify |
| 8.2 | Extended Warranty | | | Provide & Specify |
| 8.4 | Replacement of defective/damaged materials | | | Provide & Specify |

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**Supplier's Name, Signature, Stamp and Date**

| Issued by: Head of Section, Standards Development | Authorized by: Head of Department , Standards |
|---|---|
| Signed: | Signed: |
| Date: 2016-02-22 | Date: 2016-02-22 |

**ANNEX B: Past Experience**

The supplier shall provide a schedule of their past experience in successful deliveries as per the table below:

| S/N | Name and type of equipment | Customer | Address, Email, website | Quantity |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

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