DOCUMENT NO: KP1/6C/4/1/TSP/09/013

Kenya Power

A PORTABLE SINGLE-PHASE SECONDARY INJECTION RELAY TEST SET — SPECIFICATION

A Document of the Kenya Power & Lighting Co. Ltd

March 2018

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0.1 Circulation List

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

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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)
Issue 1 Rev 0	2018-03-19	New	Rotich Benard	Dr. Eng. P. Kimemia

FOREWORD

This specification has been prepared by the Standards Department in collaboration with Technical Services Department, both of the Kenya Power and Lighting Company Limited, here known as Kenya Power. It lays down requirements for a Portable Single-Phase Secondary Injection Relay Test Set herein called 'equipment'.

This test unit shall be used for secondary testing of protective relay equipment. These include all types of single-phase protection, three-phase protection that can be tested one phase at a time, protective relay systems that require phase shifting and automatic reclosing devices.

Secondary injection tests are performed to verify the correct operation of the protection system with regard to everything that is connected to the secondary of the transformers. The secondary protection system may include protective relays, auxiliary relays, protection circuits, communications and control systems, metering devices, low-voltage devices, alarms, etc. Accordingly, the secondary injection test covers not only the testing of protective relays and their tripping settings, but also the checking of all associated circuitry and devices involved in the proper performance of the secondary protection system.

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

Name	Department
Rotich Benard	Standards
Faith Gicugu	Technical Services

1. SCOPE

1.1. The specification is for a Portable Single-Phase Secondary Injection Relay Test Set, a high accuracy, intelligent and fully automated (Digital/Numerical) relays testing equipment, to be used for field testing of medium and high voltage protection relays on lines, transformers and feeders.

1.2. The relays to be tested by the Single-phase Secondary Injection Relay Test Set shall include but not limited the following:

a) Synchronizing
b) Over/Under voltage
c) Power
d) Over/Under current
e) Reverse phase current
f) Power factor
g) Directional
h) Reclosure
i) Frequency and frequency rate of change
j) Motor protection
k) Differential
l) Directional voltage

2. REFERENCES (NORMATIVE)

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

EN 55011:2016+A1:2017: Industrial, scientific and medical equipment — Radio-frequency disturbance characteristics — Limits and methods of measurement

EN 61326-1:2013: Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements

IEC 60068-2-6: Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)

IEC 60068-2-27: Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock

IEC 60529: Degrees of protection provided by enclosures (IP Code)

IEC 60664-1:2007: Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests

IEC 60664-3:2016: Insulation coordination for equipment within low-voltage systems - Part 3: Use of coating, potting or moulding for protection against pollution

IEC 60950: Information technology equipment –Safety – Part 1: General requirements

IEC 61000-3-2:2014: Electromagnetic compatibility (EMC). Limits. Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)

IEC 61000-3-3:2013: Electromagnetic compatibility (EMC). Limits. Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤ 16 A per phase and not subject to conditional connection.

IEC 61000-4-2:2009: Electromagnetic compatibility (EMC). Testing and measurement techniques. Electrostatic discharge immunity test.

IEC 61000-4-3:2006+A2:2010: Electromagnetic compatibility (EMC). Testing and measurement techniques. Radiated, radio-frequency, electromagnetic field immunity test.

IEC 61000-4-3:2006+AMD1:2007+AMD2:2010 CSV: Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.

IEC 61000-4-4:2012: Electromagnetic compatibility (EMC). Testing and measurement techniques. Electrical fast transient/burst immunity test

IEC 61000-4-5:2014: Electromagnetic compatibility (EMC). Testing and measurement techniques. Surge immunity test

IEC 61000-4-6:2014: Electromagnetic compatibility (EMC). Testing and measurement techniques. Immunity to conducted disturbances, induced by radio-frequency fields

IEC 61000-4-8:2010: Electromagnetic compatibility (EMC). Testing and measurement techniques. Power frequency magnetic field immunity test

IEC 61000-4-11:2004: Electromagnetic compatibility (EMC). Testing and measurement techniques. Voltage dips, short interruptions and voltage variations immunity tests

IEC 61010-1: Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements

IEC 61010-2-033: Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 2-033: Particular Requirements for hand-held multimeters and other meters, for domestic and professional use, capable of measuring mains voltage

3. DEFINITIONS AND ABREVIATION

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

4. REQUIREMENTS

4.1. Service conditions

The equipment shall be suitable for continuous operation outdoors in tropical areas and harsh climatic conditions including areas exposed to:

a) Altitudes of up to 2200m above sea level

b) Humidity of up to 95%

c) Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C, in direct sunlight,

d) Pollution: Design pollution level to be taken as "Heavy" (Pollution level III) for inland and "Very Heavy" (Pollution level IV) for coastal applications in accordance with IEC 60815.

e) *Isokeraunic* levels of up to 180 thunderstorm days per year.

4.2. Design and Construction

4.2.1. The Portable Single-Phase Secondary Injection Relay Test Set shall conform to IEC 61010-1, IEC 60950 and IEC 60664-1 & 3 standards and the requirements of this specification.

4.2.2. The Portable Single-Phase Relays Test Unit shall perform complete testing of directional current or voltage, synchronization, differential, over-current & earth fault, reclosing, voltage and frequency relays together with the calibration of instruments such as ammeters, voltmeters, energy meters and transducers, testing of MCBs with two or more poles, knee-point (saturation) analysis on current transformers, etc.

4.2.3. The Injection Set shall be a light weight portable unit (not more than 18 kgs) designed for both laboratory and field use.

4.2.4. The Injection Set shall be both manually operated and PC/laptop-controlled (Clause 4.8.1). Its Operating System shall run on Windows 7 Professional and its higher/latest versions or equivalent and be capable of being integrated with other analytical and data management software in MS office suite.

4.2.5. It shall be fully automated, intelligent and of high accuracy with no additional external calibration kit/tool and shall be equipped with most recent software for ease of operation, data analysis and test plan scheduling.

4.2.6. The set shall provide basic functional testing of electro-mechanical, solid state and microprocessor-based, IEC 61850 IEDs, generation, transmission and distribution relays.

4.2.7. It shall be capable of being upgraded in hardware instrumentation-features/options and software, which provides for customization to meet various field and laboratory applications.

4.2.8. The system shall be formed to provide full testing capability; voltage & current sources, timer/sensing, breaker simulation, logic outputs and logic inputs for single phase relaying.

4.2.9. In order to achieve maximum power to test relays, the test system shall be provided with multiple current and voltage ranges. Control of the parametric values shall come from individual controls.

4.2.10. **Test results**

4.2.10.1. Test preparations and analysis of results and parameters shall be prepared off-line and tests executed automatically.

4.2.10.2. The equipment shall generate the test reports automatically, and a facility for exporting them to MS Word or Excel for detailed analysis shall be available.

4.2.10.3. The equipment shall be equipped with a standard data communication interface for connection to remote data processing such as computer, or control equipment.

4.2.10.4. The equipment shall be capable of data uploading and downloading to laptop through 2.0 or higher USB port and/or Ethernet.

4.3. Set Functionality

The unit shall have the following functions to enable usage in Protection testing works: -

4.3.1. Measurement

Shall measure and display the following: -

a) Test voltage

b) Test current

c) Test time,

d) Other test parameters such as Z, R, X, S, P, Q, phase angle and cos φ.

4.3.2. **Display**

All test values shall be presented on a single easy-to-read display.

4.3.3. **Variable voltage source**

Test set shall have a built-in variable voltage source, both DC and AC with a continuous phase shift function and adjustable frequency.

4.3.4. **Variable current source**

Test set shall have a built-in variable Current source, both DC and AC.

4.4. Required features

4.4.1. Current source

4.4.1.1. The Single-Phase Secondary Injection Test Set shall provide current sources of varied outputs as required in Table 1.

4.4.1.2. Selection and settings shall be made using an appropriate knob provided and through a software.

4.4.1.3. The readings of current shall also appear on the display. An appropriate switch shall be provided to turn the current source ON and OFF.

4.4.2. Voltage source

4.4.2.1. Test set shall provide various voltage sources as outlined in Table 1.

4.4.2.2. It shall also provide an auxiliary DC voltage source in two appropriate ranges as outlined in Table 1. These shall be equipped with overload protection and separated from the other outputs.

4.4.3. Ammeter and voltmeter

4.4.3.1. The test set shall have an in-built ammeter and voltmeter for measuring currents and voltages generated by the test set.

4.4.3.2. Test set shall also measure other outputs such as resistance, impedance, phase angle, power and power factor as required.

4.4.3.3. Readings shall appear on the display.

4.4.3.4. These instruments shall also be used to take measurements in external circuits.

4.4.3.5. The voltmeter shall have flexibility to be used as a second ammeter e.g. when testing differential relays.

4.4.3.6. Current and voltage shall be displayed either as amperes and volts or as percentages of a given current or voltage.

4.4.4. **Set of resistors**

Built-in set of resistors shall be provided to facilitate fine regulation of current and voltage.

4.4.5. **Display**

The display shall be used to present time, current, voltage and other entities. The graphical display has the following main features:

a) Graphical Display: >= 240x64 pixels
b) View area: >= 135x40 pixels
c) Backlight colour: white or equivalent for clarity
d) LCD type: FSTN or equivalent

4.4.6. **Start switch**

Used to control the turning ON and OFF of the current source and timer with not less than four states as follows: -

a) ON+TIME: To start generation and timing simultaneously.
b) OFF: To turn OFF the current source, where upon generation is interrupted.
c) ON: To turn ON the current source in the generating state.
d) OFF+TIME: To Interrupt generation and start the timer simultaneously.

4.4.7. **Freeze function (HOLD)**

The test set shall enable freezing of voltage and current readings when the timer stops or if the timer does not stop, the reading present when the current was interrupted shall be frozen on the display. This function makes it possible to measure voltages and current as short as a quarter of a mains voltage period by immobilizing the reading on the display.

4.4.8. **Make/break contact**

Test set shall have a make/break contact that changes state automatically when a test is started, usable e.g. to synchronize two or more test sets, other external equipment or to switch the voltage applied to the protective relay equipment back and forth between non-faulty and faulty.

4.4.9. **Status indicators**

These shall be provided for the timer's start and stop inputs which, when lighted, indicate a closed circuit (useful for detecting contact closings/openings) or the presence of voltage.

4.4.10. **Tripping indicator**

This shall be provided to light up when a stop condition is fulfilled to indicate operation of the protective relay equipment. This indicator shall also be used when the test being conducted incorporates timing and shall indicate relay operation through blinking of an appropriate mode of indication.

4.4.11. **Timer inputs**

4.4.11.1. The timer shall be an electronic digital timer with fully automatic start and stop functions, both for make and break of the input, which can be either a clean contact or a contact under voltage.

4.4.11.2. All selections shall be menu-driven via an appropriate function knob or equivalent.

4.4.11.3. The measured time shall appear on the display.

4.4.12. **Computer communication interface USB**

The test set shall be provided with a 2.0 or higher USB port and Ethernet communication port for purposes of communication with personal computers and the PC software provided.

4.4.13. **PC software**

4.4.13.1. Test set shall be provided with a window-based software that enables the user to record the currents and voltages as well as the trip time while the test set is connected to the PC.

4.4.13.2. The Windows software shall provide easy access to connection instructions, test instructions and advance preparation using standard word processing packages.

4.4.13.3. The settings made by a user during a test shall be saved in a file, and shall be retrievable for future use.

4.4.13.4. It shall also provide test results that are reportable directly with table and graph as well as being exported to an external program, such as Microsoft® EXCEL.

4.4.13.5. The PC software shall run on Windows® 7 / 8 / 10 or higher platforms.

4.4.14. **Transportation casing**

Transportable box, provided with cover and handles for ease of transportation, and sized appropriately, shall allow carrying of the test set with no concern about shocks up to a fall of 1 meter.

4.5. Characteristic Values/ Ratings

The specification requirement ratings for the various parameters are as per Table 1:

Table 1: Single-Phase Secondary Injection Test Set Requirements

No	Item	Requirements
1.	Power supply	230 V AC, 50 Hz single phase
2.	Generators	Main generator: For AC current, AC voltage; DC voltage; Load consumption VA; Auxiliary AC voltage generator: For phase, adjustable AC voltage; Auxiliary DC voltage generator: For adjustable DC voltage supply.
3.	Burdens	Main AC Current generator: >300VA max power, >60VA for reduced power; Main AC Voltage generator: >500VA for max power, >60VA for reduced power; Main DC generator:>300VA max power, >60VA reduced power; Auxiliary AC voltage generator: >30VA continuous, >40VA for 1 min; Auxiliary DC voltage generator: >90W full range
4.	Current outputs – AC	0 – 10 A, >=75V, max current of 10A, max full load time of not less than 2 minutes; 0 – 40 A, >=20V, Max current of 40A, max full load time of not less than 1 minute; 0 – 100 A, >=8V, max current of 100A, max full load time of not less than 1 minute; 0 – 100 A, >=10V, max current of 250A, max full load time of not less than 1 second.
5.	Voltage outputs – AC / DC	0 – 250 V AC, >=3A, max Voltage of 290V, max load time of not less than 10 minutes;

No	Item	Requirements
		0 – 300 V DC, >=2A, max Voltage of 290V, max load tome of not less than 10 minutes
6.	Auxiliary DC output	Voltage Range: 20 – 130 V DC Max. current: 20 V DC (300 mA), 130 V DC (375 mA) Voltage Range: 130 – 220 DC Max. current: 130 V DC (325 mA), 220 V DC (400 mA)
7.	Power factor and phase angle measurements	Range Resolution Power factor cos φ -0.99 (cap) to +0.99 (ind) Accuracy 0.01 ± 0.04 Phase angle φ (°) 000 – 359° Accuracy 1° ±2°
8.	Impedance and power measurements	AC Z (Ω and °), Z (Ω), R and X (Ω and Ω), P (W), S (VA), Q (VAR) DC R (Ω), P (W) Range Up to 999 kX, where X= unit
9.	Ammeter	Internal Ranges: 0.00 – 250.0 A AC Resolution Internal range 10 mA (range <100 A) 100 mA (range >100 A) External range 1 mA
10.	Ammeter Measurement method	AC - true RMS; DC - mean value
11.	Ammeter Accuracy	0 – 10A: AC ± (1% + 20 mA) 0 – 40A: AC ± (1% + 40 mA) 0 – 100A: AC ± (1% + 200 mA)
12.	Voltmeter Measurement method	AC - true RMS; DC - mean value

No	Item	Requirements
		Range 0.00 – 600.0 V
13.	Voltmeter Accuracy	AC, ± (1% + 200 mV) Max. value DC, ± (0.5% + 200 mV) Max. value
14.	Timer	Display: in seconds Range: 000-9.999 s, Resolution: 1 ms, Accuracy: ± (1 ms + 0.01%) Range: 10.00-99.99 s, Resolution: 10 ms, Accuracy: ± (10 ms + 0.01 %) Range: 100.0-999.9 s, Resolution: 100 ms, Accuracy: ± (100 ms + 0.01 %) Display: mains-frequency cycles. Range: 0.0-999.9 cycles, Resolution: 0.1 cycles, Accuracy: ± (0.1 cycles + 0.01%) Range: 1000-49999, Resolution: 1 cycle at 50 Hz, Accuracy: ± (1 cycle + 0.01 %)
15.	Sets of resistors and a capacitor	Resistors 0.5 Ω to 2.5 kΩ Capacitor: 10 µF, max voltage 450 V AC
16.	Mains voltage	230 V AC, 50 Hz
17.	Power consumption	< 1400 W
18.	Protection	Thermal cut-outs, automatic overload protection
19.	Dimensions	Instrument Not exceeding 350 x 270 x 220 mm (13.8" x 10.6" x 8.7")
20.	Weight	< 30kg with accessories and transport case <18kg without accessories and transport case
21.	Test lead sets	Provide as follows: With 4 mm stackable safety plugs or equivalent: 2 x 0.25 m (0.8 ft), 2.5 mm^2 2 x 0.5 m (1.6 ft), 2.5 mm^2

No	Item	Requirements
		8 x 2.0 m (6.6 ft), 2.5 mm^2 With spade tongue connectors or equivalent 2 x 3.0 m (9.8 ft), 10 mm^2
22.	Display	LCD
23.	CE marking	LVD Low Voltage Directive 2006/95/EC EMC Directive 2004/108/EC
24.	Regulations and standards	Interference emission – immunity: Electrical safety: IEC 61010-2 Contamination degree: 2 Circuit insulation Voltage: 600V
25.	Make / Break contact	Max. Current 1 A, Max. voltage 250 V AC or 120 V DC Reclosing test Items measured: Tripping and reclosing times Display after test is finished Breaker state feedback functionality
26.	Sets of resistors	Range: 0.5 Ω to 2.5 kΩ
27.	Capacitor	10 µF, max voltage 450 V AC
28.	Operation environment	Application field: high-voltage substations and industrial environments. Vibration: IEC 60068-2-6 (20 m/s^2 at 10 – 150 Hz) Shock: IEC 60068-2-27 (15 g; 11 ms; half-sine)
29.	Electromagnetic Compatibility:	Applicable Standard: EN 61326-1 + A1 + A2.
30.	Emission	IEC 61000-3-2: Harmonic content of power supply basic acceptable limits IEC 61000-3-3: Limitation of voltage fluctuations and flicker basic acceptable limits

No	Item	Requirements
		EN 55011 class A: Limits and measurement methods of radio-electric disturbances for industrial, medical and scientific instruments at radio-electric frequencies
31.	Immunity	IEC 61000-4-2 – ESD IEC 61000-4-3 – Radio frequency interference IEC 61000-4-4 – high speed transients IEC 61000-4-5 – surge IEC 61000-4-6 - low-voltage sinusoidal waveform IEC 61000-4-8 - low frequency magnetic fields IEC 61000-4-11 - power supply drops
32.	Inputs/outputs protection:	IP 2X – IEC 60529.

4.6. Test control

4.6.1. Manual control:

4.6.1.1. Test control: by two push-buttons.

a) OFF: main outputs are not generated; V AC aux is generated, and it can be either the pre-fault value or the fault value, according to selections; V DC aux is generated.

b) ON: main outputs are generated; Vac aux has the fault value. In this situation, it is possible to verify and memorize the relay threshold, both trip and reset.

c) ON + time: main outputs are generated and the timer starts, as STOP is sensed, main outputs are removed and the elapsed time displayed and test result can be memorized.

d) OFF + time: main outputs are removed the timer starts according to selections; as STOP is sensed, the elapsed time is displayed and test result can be memorized.

4.6.1.2. Other test control selections:

a) Momentary: in ON mode, main outputs are generated until the push-button is pressed;

b) Timed: main outputs are generated for the programmed maximum time;

c) Reclose test. It shall be possible to select via menu the test of a reclosing scheme. Two selections are available, according to the type of the recloser under test.

4.6.2. **Software control**

Provide advance preparation using standard word processing packages.

4.7. Derived measurements

Starting from the above measurements, the test set shall compute derived measurements; the selection shall be performed through an approved method. These shall include the following: -

a) Active power, P
b) Reactive power, Q
c) Apparent power, S
d) Power Factor, p.f
e) Active impedance Component, R
f) Reactive impedance component, X

4.8. Accessories (To be supplied with the equipment)

4.8.1. Laptop (optional unless specified in the tender)

The laptop shall be designed and manufactured as per the requirements of IEC 60950 with minimum requirements as per Table 2. The supplier shall be required to declare in Annex D the offered values for the laptop.

Table 2: Technical data for a Laptop

Item	Minimum Specification
Brand	Specify
Model	Specify
Year of manufacture	Specify
Processor	Intel® Core™ i7-920 Processor
Clock speed	2.2 GHz or higher
Chipset	Compatible – (specify)
Motherboard	Compatible – (specify)
Memory	2GB DDR3, 1333MHz (Upgradable up to 6 GB)
Cache memory	3MB L2 or higher
Graphics	256MB Dedicated DDR3 Memory
Hard disk controller	Serial ATA
Hard disk	250 GB or higher 5400RPM SATA Hard Drive
Shock resistant	Anti-shock mounting design to protect screen and hard disk drive from damage and data loss
Keyboard	Spill resistant keyboard

Item	Minimum Specification
Mouse	2- or 3-button with scroll wheel optical PC Mouse with pad – USB 3.0
Touch pad	Intelligent Touch with configurable vertical and horizontal scroll functions
Power supply	Input – 220V – 250V Auto-sensing, 50 Hz
Battery life	4 hours or higher
Optical drive	Dual Layer DVD +/-RW
Card slots	Secured Digital Card Reader
Display	14" or smaller WXGA with 1280 x 800 or higher resolution
Integrated Web Camera	2 Mega Pixels or higher
Network/Wireless Interfaces	Integrated 10/100/1000Mbps Ethernet LAN, Integrated 802.11 a/b/g/n WLAN, Bluetooth
Security	Booting/HDD User Password Protection and Fingerprint Recognition
I/O Inputs	Minimum 3 x USB 3.0 Hi-Speed, 1 x RJ45, 1 VGA
Operating system	MS Windows 7 Professional OEM Version with original Media kit, & manuals (firewall enabled and all security updates and patches and fixes up-to-date) or equivalent higher version.
Productivity software	Latest versions of Open Office AND Genuine Microsoft Office 2010 Standard or better, OEM, Full or Suitable licensing scheme * *The supplier shall quote the unit price of the Microsoft Office 2010 application software*
	Adobe Acrobat reader - the latest version
Anti-virus	Anti-Virus software should be installed with licenses (Specify) * The supplier shall quote the unit price of the Anti-Virus software
Carrying bag	Include with the same brand of the computer.
Manufacturer Authorization and warranty	Attach Authorization letter and 3 years comprehensive on-site manufacturer authorized warranty (labour & parts).

4.8.2. **Cable Accessories**

The cable accessories requirements shall be as per Table 3. The bidder shall be required to declare in Annex D the additional cable accessories accompanying the equipment.

Table 3:Cable accessories

No	Particulars	Accessories
1	Generator Combination cable	To carry at least 3 x V and 3 x Currents
2	Flexible Test Leads (2.5mm^2, 3m long)	At least 12 banana ended leads
3	Insulated Crocodile clips (4mm^2)	At least 8 pieces
4	Flexible jumpers (2.5mm^2, 50mm long)	at least 4 banana ended leads
5	PC to Test Set Communication cable	Parallel port or Ethernet and USB, or Optical Ethernet, Optical, IEC 61850
6	Network communication cable	Parallel port or Ethernet or USB, or Optical Ethernet, Optical, IEC 61850
7	Carrying Bag for accessories	Shall be able to carry all the accessories, shall be water proof
8	Others if any	Specify

4.9. Warranty and Training

4.9.1. The portable single-phase secondary injection relays test set shall be backed by a minimum 36-months factory warranty.

4.9.2. Technical support and software upgrades, where applicable, shall be provided free of charge to Kenya Power for a period of not less than 36 months.

4.9.3. If the test set brand is new to Kenya Power (manufacturer has never supplied Kenya Power), and following the delivery of the equipment, the manufacturer shall conduct complete training on the equipment to Kenya Power engineers/Technicians, in Nairobi Kenya. The supplier shall meet the cost of the trainer and any materials required for the training.

4.9.4. The Training shall include theory on how the equipment works followed by practical demonstrations on operation, protection and control configuration and parameter settings. All the operational and control features of the equipment shall be exhaustively explained and demonstrated, including the operation of the software.

4.9.5. The Training shall be considered to have been successful once the Engineers/Technicians are able to: -

a) Competently carry out all the operations on the equipment;

b) Establish communication from a computer to the equipment and carry out complete configuration, parameter settings and download and analyse data from the equipment;

c) Trouble shoot and analyse and rectify any minor breakdowns that may occur.

5. TEST REQUIREMENTS

The portable single-phase relay injection set shall be inspected and tested in accordance with the requirements of IEC 61010-1/2, EN 61326; IEC 61000-3-2/3-3/4-2/4-3/4-4/4-5/4-6/4-8/4-11; IEC 61068-2-6, 2-27 standards and this specification.

6. MARKING AND PACKING

6.1. Marking

6.1.1. The Portable Single-Phase Relay Secondary Set shall be marked in a permanent manner with the following information (in English Language):

a) Standard to which the Portable Single-phase Relay Secondary Injection Set complies

b) Name of manufacturer & Trademark/Logo

c) Type of Portable Injection Set (description of type, number and overall size of sections)

d) Year and month of manufacture and serial number

e) Maximum permissible measurement limits

f) The words "**Property of The Kenya Power & Lighting Co. Ltd**" shall be engraved permanently on each portable single-phase relay test unit (secondary injection set – numerical) while the other parameters shall be marked on a permanent label.

g) The overvoltage protection category and duty rating e.g. category IV-field

h) The portable single-phase relays test unit (secondary injection set – numerical) shall be provided with a separate permanent label displaying advice to the user.

i) In addition, the portable single-phase relay secondary injection set shall be marked with the necessary labels that conform to IEC 61010-1, clause 5.1.2 to 5.

6.2. Packaging

6.2.1. The portable single-phase relay injection set shall be packed in a Standard-size case with wheels for heavy transport stress with at least IP20 according to EN 60529 Class protections. The case shall be suitable for storage and long-term use.

6.2.2. The equipment shall be portable, rugged and light weight. Its carrying case shall be shockproof, and impact resistant.

APPENDICES

APPENDIX A: TESTS AND INSPECTION (NORMATIVE)

A.1. It shall be the responsibility of the manufacturer to perform or to have performed the tests specified in Clause 5, and other tests normally performed at works. Copies of previous test certificates and test reports by the relevant International or National Testing/Standards Authority of the country of manufacture (or ISO/IEC 17025 accredited independent laboratory) shall be submitted.

A.2. Copies of type test reports to be submitted with the tender (by bidder) for evaluation shall be as stated below:

a) Type Tests for Equipment Performance

i. Electromagnetic compatibility (EMC); (EN 61326; IEC 61000-6-4; IEC 61000-3-2/3)
ii. Switching tests on the equipment.
iii. Impulse overvoltage tests on the equipment -Clearances
iv. Dielectric voltage withstand tests on the equipment - Controlled overvoltage
v. Functional tests of the equipment.

b) Type Tests for Printed Circuit Board Coating Performance

i. Environmental, humidity and thermal conditioning tests
ii. Dielectric voltage withstand tests
iii. Comparative tracking index (CTI)
iv. Resistance to soldering heat
v. Flammability
vi. Coating adhesion
vii. Insulation resistance between conductors

A.3. Kenya Power may send two engineers to witness factory acceptance tests (FAT), inspection and certification of the equipment before shipment. Tests to be witnessed at the factory before shipment shall be in accordance with IEC 61010-1, IEC 60664- 1 & 3, IEC 61326, IEC 60112 and IEC 60529 standards and this specification, and shall include the following:

i. Insulation Resistance of the equipment
ii. Leakage Current
iii. Ground Continuity

iv. Ground Bond

v. Polarization Test

vi. Recurring Peak Voltage Determination

vii. Dielectric Voltage Withstand Tests - Measuring clearances

viii. Functional tests of the equipment.

A.4. During delivery of the equipment, Kenya Power shall inspect them and may perform or have performed any of the relevant tests to verify compliance with the specification. The supplier shall replace/rectify without charge to Kenya Power, equipment which upon examination, test or use fail to meet any or all the requirements in the specification

APPENDIX B: QUALITY MANAGEMENT SYSTEM (NORMATIVE)

B.1. The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the portable single phase secondary injection set properties, tests 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 9001:2008

B.2. The Manufacturer's Declaration of Conformity to applicable standards and copies of quality management certifications, including copy of valid and relevant ISO 9001: 2008 or 2015 certificate, shall be submitted with the tender for evaluation.

B.3. The manufacturer shall indicate the delivery time of the equipment; manufacturer's monthly & annual production capacity and experience in the production of the type and size of items being offered. A detailed list & contact addresses (including e-mail) of the manufacturer's previous customers for similar type of the portable single phase secondary injection set sold in the last five years as well as reference letters from at least four of the customers shall be submitted with the tender for evaluation.

APPENDIX C: TECHNICAL DOCUMENTATION (NORMATIVE)

C.1. The bidder shall submit its tender complete with technical documents required for tender evaluation. The technical documents to be submitted (all in English language) for tender evaluation shall include the following:

a) Fully-filled clause by clause Guaranteed Technical Particulars (GTPs)- Appendix D - stamped and signed by the manufacturer.

b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data for the equipment;

c) Details of the manufacturer's experience; Sales records for the last five years and at least four customer reference letters.

d) Copies of previous test certificates and test reports (As given in Clause A.2) by the relevant International or National Testing/Standards Authority of the country of manufacture (or ISO/IEC 17025 accredited independent laboratory) shall be submitted with the offer for evaluation. A copy of accreditation certificate for the laboratory shall also be submitted (all in English Language);

e) Marking & Packaging details (including packaging materials).

C.2. The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:

a) Fully filled clause by clause Guaranteed Technical Particulars (GTPs) stamped and signed by the manufacturer **(these are not the ones submitted with the tender)**;

b) Technical details and drawings with details of portable single phase secondary injection set to be manufactured for KPLC.

c) Quality assurance plan (QAP) that will be used to ensure that the design, material; workmanship, tests, service capability, maintenance and documentation will fulfil the requirements stated in the contract documents, standards, specifications and regulations.

C.3. Routine and sample test reports for the equipment to be supplied shall be submitted to Kenya Power for approval before shipment/delivery of the goods.

C.4. Each equipment package shall be supplied with detailed user's manual printed in English language. All information shall be unambiguous. All documentation necessary for safety of the equipment as specified in IEC 61010-1 clause 5.4 shall be provided with the equipment.

APPENDIX D: GUARANTEED TECHNICAL PARTICULARS (GTPS) — NORMATIVE

(to be filled, stamped and signed by the Supplier and submitted together with relevant copies of the Manufacturer's catalogues, brochures, drawings, technical data, sales records for previous five years, four customer reference letters, details of suppliers' capacity and experience; and copies of complete test certificates and test reports for tender evaluation or approval, all in English Language, as per clauses C.1 and C.2)

Tender No. .....

Bidder's name and Address.....

Clause number	KPLC requirement	Bidder's offer
Manufacturer's Name and address		Specify
Country of Manufacture		Name
Bidder's Name and address		Name
Name of Equipment offered		Name
Make of the Equipment		Name
1.1	Scope	State
1.2	Tests carried out by the equipment	List
2.	Applicable Standards	Specify
3.	Definitions and abbreviation	Specify
4.	**REQUIREMENTS**	
4.1	Service conditions	Specify
4.2.1	Applicable standards to be conformed to	State
4.2.2	Tests performed by the test set	State
4.2.3	Weight of the test set and site use	Specify
4.2.4	Injection set control system	Specify
4.2.5	Injection set is fully automated, intelligent	Specify
4.2.6	Types of relays tested	List
4.2.7	The set's hardware and software are upgradable	Specify
4.2.8	System is formed to provide full testing capability	Specify
4.2.9	Test system is provided with multiple current and voltage ranges	Specify
4.2.10.1	Test preparations and analysis of results and parameters are prepared off-line	Specify

Clause number	KPLC requirement	Bidder's offer
4.2.10.2	The equipment generates test reports automatically, and has facility for exporting them to MS Word or Excel	Specify
4.2.10.3	The equipment is equipped with a standard data communication interface for connection to remote data processors	Specify
4.2.10.4	Data uploading and downloading ports	List
4.3	**Set Functionality**	
4.3.1	Measurement	List
4.3.2	Test values are presented on a single easy-to-read display	Specify
4.3.3	Test set has a built-in variable voltage source, both DC and AC with a continuous phase shift function and adjustable frequency	Specify
4.3.4	Test set has a built-in variable Current source, both DC and AC	Specify
4.4	**Required features**	
4.4.1.1	The Test Set provides current sources of varied outputs	Specify
4.4.1.2	Selection and settings is made using an appropriate knob provided and through a software	Specify
4.4.1.3	Readings of current appear on the display	Specify
4.4.2.1	Various voltage sources provided (as outlined in Table 1)	List
4.4.2.2	Auxiliary DC voltage source in two appropriate ranges is provided (as outlined in Table 1)	Specify
4.4.3.1	Test set shall have an in-built ammeter and voltmeter for measuring currents and voltages generated	Specify
4.4.3.2	Other outputs also measure by test set	List
4.4.3.3	Readings appear on the display	Specify
4.4.3.4	The instruments are also used to take measurements in external circuits	Specify
4.4.3.5	The voltmeter has flexibility to be used as a 2nd ammeter e.g. when testing differential relays	Specify
4.4.3.6	Current and voltage are displayed either as amperes and volts or as percentages of a given current or voltage	Specify
4.4.4	Built-in set of resistors are provided to facilitate fine regulation of current and voltage	State
4.4.5	Main features of the graphical display	State
4.4.6	Four states of the start switch	State
4.4.7	Freeze function enable freezing of voltage and current readings when the timer stops or if the timer does not stop	State
4.4.8	Test set has a make/break contact that changes state automatically when a test is started	Specify

Clause number	KPLC requirement	Bidder's offer
4.4.9	Status indicators are provided for the timer's start and stop inputs	State
4.4.10	Tripping indicator is provided to light up when a stop condition is fulfilled	Specify
4.4.11.1	Timer is an electronic digital timer with fully automatic start and stop functions	Specify
4.4.11.2	All selections of the timer are menu-driven via an appropriate function knob or equivalent	Specify
4.4.11.3	Measured time appear on the display	State
4.4.12	Communication interface for connection to PC	List
4.4.13.1	Test set is provided with a window-based software for carrying out the test when connected to PC	Specify
4.4.13.2	The Windows software provides easy access to connection instructions, test instructions and advance preparation using standard word processing packages	State
4.4.13.3	The settings made by a user during a test are saved in a file are retrievable for future use	State
4.4.13.4	The software provides test results that are reportable directly with table and graph as well as being exported to an external program	Specify
4.4.13.5	The software runs on Windows® 7 / 8 / 10 or higher platforms	Specify
4.4.14	Transportable box allows carrying of the test set with no concern about shocks up to a fall of 1 meter	Specify
4.5	**Characteristic Values/ Ratings**	

No	Item	Requirements
1.	Power supply	Specify
2.	Generators	List
3.	Burdens	List
4.	Current outputs – AC	Ranges
5.	Voltage outputs – AC / DC	Ranges
6.	Auxiliary DC output	Ranges
7.	Power factor and phase angle measurements	Specify
8.	Impedance and power measurements	Ranges
9.	Ammeter	Specify
10.	Ammeter Measurement method	Specify
11.	Ammeter Accuracy	Specify
12.	Voltmeter Measurement method	Specify
13.	Voltmeter Accuracy	Specify
14.	Timer	Specify

Clause number	KPLC requirement		Bidder's offer
	15.	Sets of resistors and a capacitor	Specify
	16.	Mains voltage	Specify
	17.	Power consumption	State value
	18.	Protection	State
	19.	Dimensions	State
	20.	Weight	Value
	21.	Test lead sets	Specify
	22.	Display	Specify
	23.	CE marking	Specify
	24.	Regulations and standards	Specify
	25.	Make / Break contact	Specify
	26.	Sets of resistors	Range
	27.	Capacitor	Specify
	28.	Operation environment	Specify
	29.	Electromagnetic Compatibility:	Specify
	30.	Emission	Specify
	31.	Immunity	Specify
	32.	Inputs/outputs protection:	Specify
4.6	**Test Control**		
4.6.1.1	Manual test control push-buttons settings		State
4.6.1.2	Other Manual test control selections		Specify
4.6.2	The software control provides advance preparation using standard word processing packages		Specify
4.7	Derived measurements		List
4.8	**Accessories**		
4.8.1	**Laptop**		
	Brand		Specify
	Model		Specify
	Year of manufacture		Specify
	Processor		Specify
	Clock speed		Specify
	Chipset		Specify
	Motherboard		Specify
	Memory		Specify
	Cache memory		Specify
	Graphics		Specify
	Hard disk controller		Specify

Clause number	KPLC requirement	Bidder's offer
	Hard disk	Specify
	Shock resistant	Specify
	Keyboard	Specify
	Mouse	Specify
	Touch pad	Specify
	Power supply	Specify
	Battery life	Specify
	Optical drive	Specify
	Card slots	Specify
	Display	Specify
	Integrated Web Camera	Specify
	Network/Wireless Interfaces	Specify
	Security	Specify
	I/O Inputs	Specify
	Operating system	Specify
	Productivity software	Specify
	Anti-virus	Specify
	Carrying bag	Specify
	Manufacturer Authorization and warranty	Specify
4.8.2	**Other Accessories**	
	Generator combination cable	Specify
	Flexible Test Leads ($2.5mm^2$, 3m long)	Specify
	Insulated Crocodile clips ($4mm^2$)	Specify
	Flexible jumpers ($2.5mm^2$, 50mm long)	Specify
	PC to Test Set Communication cable	Specify
	Carrying Bag for accessories	Specify
	Others if any specify	Specify
4.9	**Warranty and Training**	
4.9.1	Single-phase secondary injection relays test set warranty period in months	No of months
4.9.2	Period of free technical support and software upgrades	No. of months
4.9.3	Complete training on the equipment will be conducted to Kenya Power engineers/Technicians, in Nairobi Kenya	Specify
4.9.4	Training includes theory on how the equipment works followed by practical demonstrations on operation, protection and control configuration and parameter settings	Specify
4.9.5	Hallmarks of successful training	List

Clause number	KPLC requirement	Bidder's offer
5	Test and standards for carrying out tests	List
6	**Marking and Packing**	
6.1	**Marking**	
6.1.1	Information to be marked legibly and indelibly:	State
6.2	**Packing**	
6.2.1	Carrying case protections class and standard	State
6.2.2	Carrying case is shockproof, and impact resistant	State
APPENDICES		
A	**TESTS AND INSPECTION (NORMATIVE)**	
A1	Responsibility of performing tests	State
A2	Copies of previous type test reports by the relevant independent /international testing laboratory submitted	State
A3	Tests to be witnessed at the factory	List
A4	The supplier will replace/rectify without charge to Kenya Power, equipment which upon examination, test or use fail to meet any or all the requirements in the specification	Accept
B	**QUALITY MANAGEMENT SYSTEM**	
B1	QAP and ISO 9001:2008	State
B2	Copies of quality management certifications attached	State
B3	Delivery time, Production capacity & experience of the manufacturer	State
C	**TECHNICAL DOCUMENTATION**	
C1	Technical documents to be submitted with tender documents	
	a) Fully-filled clause by clause Guaranteed Technical Particulars (GTPs)- Appendix D - stamped and signed by the manufacturer.	state
	b) Copies of the Manufacturer's catalogues, brochures, drawings and technical data for the equipment;	state
	c) Details of the manufacturer's experience; Sales records for the last five years and at least four customer reference letters.	state
	d) Copies of previous test certificates and test reports (As given in Clause A.2) by the relevant International or National Testing/Standards Authority of the country of manufacture (or ISO/IEC 17025 accredited independent laboratory) shall be submitted with the offer for evaluation. A copy of accreditation certificate for the laboratory shall also be submitted (all in English Language);	state
	e) Marking & Packaging details (including packaging materials).	State

Clause number	KPLC requirement	Bidder's offer
C2	Documents to be submitted Kenya Power for approval before manufacture/supply	
	a) Fully filled clause by clause Guaranteed Technical Particulars (GTPs) stamped and signed by the manufacturer (these are not the ones submitted with the tender);	State
	b) Technical details and drawings with details of portable single phase secondary injection set to be manufactured for KPLC.	State
	c) Quality assurance plan (QAP	State
C3	Routine and sample test reports submitted to Kenya Power for approval before shipment/delivery of the goods	State
C4	Each package is supplied with detailed user manual printed in English language	Specify

** Words like 'agreed', 'confirmed', 'As per KPLC specifications', etc. shall not be accepted and shall be considered non-responsive.*

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Manufacturer's Name, Signature, Stamp and Date