



**Kenya Power**

**PROTECTIVE RELAYS, CONTROLS DEVICES AND  
INSTRUMENTS - SPECIFICATION**

A Document of the Kenya Power & Lighting Co. Ltd

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Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

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Page 2 of 72

TABLE OF CONTENTS

0.1 Circulation List ..... 4

0.2 Amendment Record ..... 5

FOREWORD ..... 6

1. SCOPE ..... 7

2. NORMATIVE REFERENCES ..... 7

3. DEFINITIONS AND ABBREVIATIONS ..... 8

    3.1. ABBREVIATIONS ..... 8

4. REQUIREMENTS ..... 8

    4.1. SERVICE CONDITIONS ..... 8

    4.2. GENERAL REQUIREMENTS ..... 8

    4.3. SPECIFIC REQUIREMENTS ..... 9

        4.3.1. Materials ..... 9

        4.3.2. Instruments ..... 10

        4.3.3. Protective Relays ..... 10

4.4.DETAILED SPECIFICATIONS - RELAYS, INSTRUMENTS AND CONTROL DEVICES ..... 11

    4.4.1. Ratings for Protection Relays and Control Devices: ..... 11

    4.4.2. Distance Protection Relay Type I: ..... 11

    4.4.3. Distance Protection Relay Type II: ..... 17

    4.4.4. Biased Differential Protection Relay for a Two or Three Winding Power Transformer:22

    4.4.5. Restricted Earth Fault Relay: ..... 24

    4.4.6. Feeder Protection Relay: ..... 26

    4.4.7. Electrical Reset – Trip Relay ..... 29

    4.4.8. Self-Reset Trip Relay ..... 30

    4.4.9. Trip Circuit Supervision Relay Type I: ..... 31

    4.4.10. Auxiliary relays For Transformer Mechanical Protection Trip Function Type I: ..... 32

    4.4.11. Annunciator Relay Type I ..... 32

    4.4.12. Annunciator Relay Type II: ..... 34

    4.4.13. Discrepancy Switch for Circuit Breaker Control: ..... 35

    4.4.14. Semaphores for Isolator and Earth Switch Position Indication ..... 36

    4.4.15. LED Indicating Lamps:- ..... 37

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**TITLE:**  
**PROTECTIVE RELAYS, CONTROL  
 DEVICES AND INSTRUMENTS-  
 SPECIFICATION**

<b>Doc. No.</b>	KP1/3CB/TSP/02/004
<b>Issue No.</b>	1
<b>Revision No.</b>	3
<b>Date of Issue</b>	2019-06-07
Page 3 of 72	

4.4.16. Multi-Functional Power Meter ..... 38

4.4.17. Additional Specifications for Relays ..... 40

4.4.18. Relay Programming Software and Connection Cables ..... 40

APPENDIX A: TESTING.....41

APPENDIX B: WARRANTY .....41

APPENDIX C: QUALITY MANAGEMENT SYSTEM (NORMATIVE) .....41

APPENDIX D: TECHNICAL DOCUMENTATION (NORMATIVE).....42

APPENDIX E: TECHNICAL MANUALS/GUIDE & OPERATION AND MAINTENANCE MANUALS  
43

APPENDIX F: FACTORY ACCEPTANCE TESTS, INSPECTION AND TRAINING.....44

APPENDIX G: LOCAL TRAINING IN NAIROBI.....44

APPENDIX H: REQUIREMENT FOR TENDER EVALUATION .....45

APPENDIX I: SOFTWARE.....46

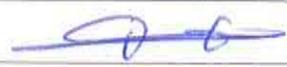
APPENDIX J: PC TO DEVICE CONNECTION CABLE .....46

APPENDIX K: PACKING AND DELIVERY .....46

APPENDIX L: DELIVERY .....47

APPENDIX M: TENDER AWARD .....47

APPENDIX N: TECHNICAL SCHEDULES FOR RELAYS: .....49

<b>Issued by: Head of Section, Standards Development</b>	<b>Authorized by: Head of Department, Standards</b>
<b>Signed:</b> 	<b>Signed:</b> 
<b>Date: 2019-06-07</b>	<b>Date: 2019-06-07</b>



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DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 4 of 72	

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### 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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DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 5 of 72

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Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 1 Rev 1	2018-06-28	Replaces Issue 1 rev 0 of 2013-08-29	S. Nguli	Dr. Eng. P. Kimemia
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TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 6 of 72	

## FOREWORD

This specification has been prepared by Network Maintenance (Protection section) of the Network Management Division in collaboration with Standards Department both of both of The Kenya Power and Lighting Company Limited (KPLC) and lays down specification for Design, Manufacture and Testing of Protective Relays, Control devices and Accessories, Measuring and Indicating Instruments.

This specification is intended for procurement of materials and does not include provision of contract.

This specification stipulates the minimum requirements for protective relays, control devices and measuring and indicating instruments acceptable for use in the company and it shall be the responsibility of the suppliers and manufacturer to ensure that the offered design is of the highest quality and guarantees excellent service to KPLC, and good workmanship and good engineering practice in the manufacture.

There are no other specifications in this series.

Users of these Kenya Power specifications are responsible for their correct interpretation and application.

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

Name	Department
Eng. Paul Mwangi	Network Maintenance
Eng. Stephen Nguli	Standards
Mr Bernard Rotich	Standards
Mrs. Nancy Wairimu	Standards

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Date: 2019-06-07



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<b>Doc. No.</b>	KP1/3CB/TSP/02/004
<b>Issue No.</b>	1
<b>Revision No.</b>	3
<b>Date of Issue</b>	2019-06-07
Page 7 of 72	

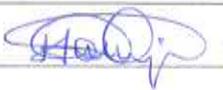
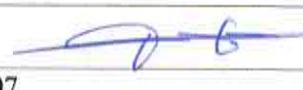
**1. SCOPE**

This specification is for Protective Relays, Controls devices and Instruments.

**2. NORMATIVE REFERENCES**

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

- IEC 60255: Measuring relays and protection equipment –. Part 1: Common requirements  
(All relevant parts)
- IEC 60688: Electrical measuring transducers for converting a.c. and D.C. electrical quantities to analogue or digital signal.
- IEC 61000-4-13: Part 4-13: Electromagnetic compatibility (EMC) - Testing and measurement techniques. Harmonics and inter harmonics including mains signalling.
- IEC 61850-8-1:2011: Communication networks and systems for power utility automation
- IEC 60932 Additional requirements for enclosed switchgear and controlgear from 1 kV to 72.5 kV to be used in severe climatic conditions
- IEC 60051 Direct acting indicating analogue electrical measuring instruments and their accessories. (Relevant parts)
- IEC 60870-5- 103 Telecontrol equipment and systems - Part 5-103: Transmission protocols - Companion standard for the informative interface of protection equipment
- IEC 61010-1 Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements
- BS142 Electrical protection relays. Requirements for single input energizing quantity relays. Specification for single input energizing quantity measuring relays with dependent specified time
- ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories
- ISO 9001:2015 Quality management systems -- Requirements

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**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 8 of 72	

### 3. DEFINITIONS AND ABBREVIATIONS

For the purpose of this specification the definitions and abbreviations given in the reference standards shall apply together with the following:

#### 3.1. ABBREVIATIONS

**KPLC**- Kenya Power and Lighting Company Limited

**IEC** – International Electro Technical Commission

**ISO** – International Organization for Standardization

### 4. REQUIREMENTS

#### 4.1. SERVICE CONDITIONS

The equipment shall be tropicalized, designed and constructed for continuous indoor operation in areas with the following atmospheric conditions: -

- (i) Altitude: From sea level up to 2200m above mean sea level.
- (ii) Humidity: High at the Coast, up to 95% and lower inland, up to 50%.
- (iii) Temperatures: Average ambient temperature of +35°C with a minimum of -1°C and a maximum of +40°C.
- (iv) Maximum Indoor temperature inside the Relay Panels is +50 ° C.
- (v) 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.

Heavy saline with severe corrosive effects in coastal lands and generally clean air inland.

#### 4.2. GENERAL REQUIREMENTS

- 4.2.1. All Relays shall be designed for operations in the severe tropic climate conditions and fully comply with climatic aging tests as per IEC 60932-Class 2.
- 4.2.2. In choosing materials and their finishes, due regard shall be given to the humid tropical conditions under which the Relay will work.
- 4.2.3. Iron and Steel are generally to be painted or galvanized as appropriate. Indoor parts may alternatively have chromium or copper-nickel plated or other approved protective finish.

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Date: 2019-06-07



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DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 9 of 72	

- 4.2.4. Small iron and steel parts (other than stainless steel) of all Relays and instruments, the cores of electromagnets and the metal parts of relays and mechanisms shall be treated in an appropriate manner to prevent rusting.
- 4.2.5. The use of Iron and steels shall be avoided in instruments and electrical relays wherever possible. Steel screws shall be zinc, cadmium or chromium plated or where plating is not possible owing to tolerance limitations; it shall be of corrosion resisting steel.
- 4.2.6. Instrument screws (except those forming part of a magnetic circuit) shall be of brass or bronze.
- 4.2.7. Springs shall be of non-rusting material, e.g., phosphor-bronze or nickel silver, as far as possible.
- 4.2.8. Neoprene and similar synthetic compounds, not subject to deterioration due to the climatic conditions, shall be used for gaskets.
- 4.2.9. Power supply modules for Relays and Measuring instruments:
- (i) All equipment and apparatus including protective relays and control and measuring devices shall be capable of satisfactory operation at 80% to 125% of the rated supply voltage.
  - (ii) The Rated DC supply voltage shall be inscribed on the device.

### 4.3. SPECIFIC REQUIREMENTS

#### 4.3.1. Materials

- 4.3.1.1. All materials shall be new and of the best quality and of the class most suitable for working under the conditions specified.
- 4.3.1.2. The devices shall withstand the variations of temperature and atmospheric conditions arising under working conditions without distortion, deterioration or undue stresses in any parts or heating.
- 4.3.1.3. All the devices shall be suitable for installation in relay panels inside control rooms without air conditioning.
- 4.3.1.4. The heat generated by the relays and other measuring devices shall therefore be minimal to ensure that the temperature inside the panels does not rise beyond the rating of the relays and other devices.

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DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 10 of 72	

#### 4.3.2. Instruments

- 4.3.2.1. All measuring instruments, including the energy meters, shall be of flush-mounted, back-connected, dust-proof and heavy-duty switchboard type and in accordance with the requirement of IEC 60051.
- 4.3.2.2. For analogue type instruments, scale plates shall be of a permanent white circular or rectangular finish with black pointer and markings. The scale range shall be provided as given in the detailed specifications.
- 4.3.2.3. All measuring instruments of analog type shall be approximately 96 X 96 mm enclosures and shall be provided with clearly readable long scale, approximately 240 degrees. The maximum error shall not be more than one and a half (1.5%) percent of full-scale range.

#### 4.3.3. Protective Relays

- 4.3.3.1. All Measurement relays shall be flush mounted and of Numeric Design, with event recording, disturbance recording, power measurement, and shall be in accordance to IEC 60255.
- 4.3.3.2. Besides the communication port, the relays shall have a human-machine interface facility (HMI) comprising a keypad and an LCD screen, where one can easily access relay information and manually program the parameter settings.
- 4.3.3.3. Relay contacts shall be suitable for making and breaking the maximum currents, which they are required to control in normal service.
- 4.3.3.4. In particular, the Relay Trip contacts shall be capable of interrupting without damage the Circuit Breaker Trip Coil Current should the Circuit Breaker Auxiliary Contacts fail to open. Relay trip contacts shall be rated for 130V DC and switching capacity of 1000W/VA make, and 30W/VA break. Permissible current shall be 5A continuous and 15A for 3 seconds.
- 4.3.3.5. Where contacts of the protective relays are not sufficient for Circuit Breaker Tripping and interrupting the Trip Current, this shall be clearly stated by the manufacturer.
- 4.3.3.6. Relay contacts shall make firmly without bounce and the relay mechanism shall not be affected by Panel vibration or external magnetic fields.
- 4.3.3.7. Relays shall be suitable for operation on the rated D.C. auxiliary supply without use of dropping resistors or diodes.
- 4.3.3.8. The relay Thermal rating shall be such that the fault clearance times on any combination of current and time multiplier settings shall not exceed the thermal withstand capability of the relay. (Max. fault current = 31.5kA).

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DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 11 of 72	

4.3.3.9. The relays, control devices and instruments shall be supplied complete with all screws, bolts, brackets and all other accessories necessary for mounting/installation in panels and terminating all external wiring connections.

4.3.3.10. Plug –in auxiliary relays for DIN rail mounting shall be supplied complete with the bases.

#### 4.4. DETAILED SPECIFICATIONS - RELAYS, INSTRUMENTS AND CONTROL DEVICES

##### 4.4.1. Ratings for Protection Relays and Control Devices:

Unless otherwise stated, all protection relays and control devices shall have the following rated values:

- (i) The power system where the relays are to be installed has nominal frequency of 50HZ
- (ii) The rated CT secondary current is 1A
- (iii) The rated VT secondary voltage is 110V AC, phase to phase (63.5V AC phase to ground)
- (iv) DC auxiliary rating is 110V DC.
- (v) Relay trip operation shall be indicated by a red LED, for measurement relays. Red mechanical flags are acceptable for transformer mechanical protection – auxiliary

##### 4.4.2. Distance Protection Relay Type I:

4.4.2.1. The Distance relay is for use on Transmission Lines, to provide fast and highly dependable selective fault clearance on both overhead and underground feeders.

4.4.2.2. The Relay shall be for application in a substation with 1½ circuit breaker configuration, hence shall be suitable for tripping of two circuit breakers, monitoring the status of two circuit breakers and automatic recloser of two circuit breakers. The relay shall be used for retrofit to replace existing old static & electromechanical relays.

##### Manufacturer's Experience and Product Qualification

4.4.2.3. The Distance Protection Relay Type 1 manufacturer shall have a minimum experience of 25 years in the manufacture of Distance protection relays, 15years of which shall be in the manufacture of Numerical Distance Protection relays.

4.4.2.4. The Relay type offered must have been in Service and given reliable service for a minimum period of 8 years, in at least two utilities, in at least three of the following regions/continents:

- a. Europe
- b. North America
- c. Africa and
- d. Asia

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DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 12 of 72	

Note: *The manufacturer shall provide references to support this requirement, including Export records with copy of contract letters, relay details and date of export. Letters of satisfaction from the utilities should also be provided with the bid. Email address contacts for Senior Technical personnel in the utilities where the relay is already in service shall be provided with the bid.*

- 4.4.2.5. Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.
- 4.4.2.6. The Warranty for the offered relay shall be Five (5) years from the date of relay delivery to KPLC Store.

**Functions and Features:**

- 4.4.2.7. The Distance Protection Relay shall have Four (4) analogue current input channels and Five (5) voltage input channels for connection of CTs & VTs secondary analogue signals as a minimum.
- 4.4.2.8. The relay shall be of Numeric/Digital Design and employ complete digital signal processing of measured values.
- 4.4.2.9. The relay shall be suitable for Flush mounting on the protection panel.
- 4.4.2.10. The relay shall have Full Scheme distance protection, with parallel calculation and monitoring of all the fault loops.
- 4.4.2.11. The relay shall have selective single phase and/or three phase tripping Logic
- 4.4.2.12. Under Impedance Starting criteria. Other starting criteria in addition to the under impedance starting are acceptable.
- 4.4.2.13. Five zones of phase distance protection (for Phase-phase faults) with selectable Mho and quadrilateral characteristics. Parameters (resistive reach, reactive reach and time delay) for each zone to be independently set.
- 4.4.2.14. As a minimum five zones of ground distance protection, (for Phase- Ground/Phase-Earth Faults) with selectable Mho and Quadrilateral characteristics with residual current compensation. Parameters (resistive reach, reactive reach and time delay) for each Zone to be independently set.
- 4.4.2.15. The Distance Protection Zones direction shall be independently set as forward or reverse or non-direction.
- 4.4.2.16. Operating time for Distance Zone 1 set at 0 seconds delay shall not exceed 30ms
- 4.4.2.17. The Distance protection relay shall have Communication Channel Aided Scheme logic for phase and ground distance protection with at least the following schemes: -
  - (a) Permissive Undereach Transfer Trip scheme (PUTT)
  - (b) Permissive Overreach Transfer Trip scheme (POTT) and

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 SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 13 of 72	

- (c) Blocking Schemes.
- (d) Direct Transfer Tripping Scheme

**Note:** *The Tele-protection scheme shall be suitable for hardwiring connection between the relay and the telecommunication multiplexer cabinet.*

- 4.4.2.18. Load encroachment Discrimination Feature, to guarantee reliable discrimination between load operation and short circuits faults for long heavily loaded lines, to prevent inadvertent trips.
- 4.4.2.19. Parallel line compensation feature to cancel the effect of mutual inductance.
- 4.4.2.20. Measuring voltage monitoring/ Fuse failure supervision Logic.
- 4.4.2.21. The distance relay shall be blocked from operating in the event of failure of the measuring voltage or when the auxiliary switch of the Voltage transformer secondary MCB trips.
- 4.4.2.22. Weak end in-feed Protection: Echo and/or Trip, to allow effective operation of permissive schemes when there is little or no in-feed on one end of the line.
- 4.4.2.23. Current Reversal Guard Feature – for use on parallel lines, to prevent mal-operation of relays on the healthy line, due to current reversal during sequential fault clearance.
- 4.4.2.24. Power Swing detection feature for blocking Distance operation for moderate power swings. The Power swing shall be selected to block or not block each distance protection zone.
- 4.4.2.25. Out of step protection to allow tripping and network separation for generator out of step condition.
- 4.4.2.26. Voltage Memory Feature for use by the distance comparators
- 4.4.2.27. Automatic Switch on to Fault Feature(SOTF), enabled when the line is de-energised and only active for a set time delay after the line circuit breaker is closed
- 4.4.2.28. Directional Earth Fault Protection, with communication channel aided scheme with at least the following schemes: -

- (a) Directional Comparison Scheme(POTT)
- (b) Blocking Scheme
- (c) Selectable final time tripping for use when the communication channel is not in use, or for use on radial feeder. It shall be possible enable/disable the final time trip feature.

- 4.4.2.29. Back up three phase overcurrent & Earth fault protection, with the following protection functions:
  - a. High set element for Phase and Earth fault overcurrent with selectable definite time delay

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Date: 2019-06-07	Date: 2019-06-07



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 DEVICES AND INSTRUMENTS-  
 SPECIFICATION**

Doc. No.	KP1/3CB/TS/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 14 of 72	

b. Low set element for Phase and Earth fault overcurrent with inverse current-time characteristics as per IEC 60255.

4.4.2.30. Stub Bus overcurrent protection enabled via binary input when the bay disconnector is open

4.4.2.31. Under frequency and rate of change of frequency Protection

4.4.2.32. Overvoltage protection

4.4.2.33. Circuit Breaker Failure Protection

4.4.2.34. Circuit Breaker Contact wear feature

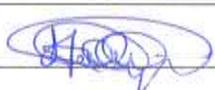
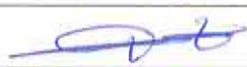
4.4.2.35. Broken Conductor detection for Alarm purposes.

4.4.2.36. Auto-reclose function for One Phase and/or three phases, suitable for use with the following selections made via external switch:

- (i) **Auto reclose Block:** No Auto-reclose: Trip to Lockout for all faults
- (ii) **Single Pole Autoreclose:** (Single pole Trip and Auto-reclose for Distance Zone 1- phase to ground faults only). Other fault types shall lead to three phase trip and lock out.
- (iii) **Single Pole + Three Phase Auto-reclose (SPAR + DAR):** Single pole trip and auto-reclose for Distance Zone 1 phase to ground faults only, followed by three pole trip and auto-reclose for the next phase to ground fault or phase to phase fault within the reclaim time). If the first fault is phase to phase, then the scheme will perform one shot of three phase trip and auto-reclose only and lock out if a second fault of any type occurs during the reclaim time. Three phase faults shall lead to three phase trip and Lockout.
- (iv) **Three Phase Auto-reclose (DAR):** three phase Trip and auto-reclose only for phase to ground faults or Phase to Phase faults. Three phase trip and Lock out for three phase faults.
- (v) It shall be possible to initiate auto-reclose in the distance relay from the line current differential relay in the neighbouring panel protecting the same transmission line.

4.4.2.37. Synchro-check Function for use with three phase auto-reclose

4.4.2.38. Fault Locator; with automatic display on the Relay LCD Screen of the distance to fault in terms of Line percentage or distance in km. This information is for use by the maintenance/repair teams. The last distance to fault will always be displayed on the screen, for ease on access by the maintenance personnel.

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Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 15 of 72	

**Note 1:** *In the bid submission the bidder shall demonstrate that the requirement of this clause is fully met. Requirement to use the keypad or PC as the only way to access this information is not acceptable*

**Note 2:** *Distance Relays which do not meet this requirement shall not be accepted*

4.4.2.39. The accuracy of Distance to fault location shall be  $\pm 2\%$  as a minimum.

4.4.2.40. The following information shall be provided with fault location:

- (i) The short-circuit loop which was used to determine the fault reactance
- (ii) The reactance X per phase in Ohms Primary and secondary
- (iii) The reactance R per phase in Ohms Primary and secondary
- (iv) The distance to fault in percentage and kilometers of line length

4.4.2.41. The relay shall be able to display Fault details on the LCD such as Fault- Loop or Faulty phases, the Zone that has operated and the Relay operate time.

4.4.2.42. The Distance relay shall have a Disturbance recorder with capacity to record ten analogues and twelve digital signals. The relay shall have capacity to store the latest, twenty (20), disturbance records. The pre-fault, fault and post fault duration of the fault record shall be freely set.

4.4.2.43. Storage of at least one hundred (100) event records

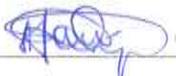
4.4.2.44. Storage of at least Twenty (20) Trip records. The following fault data will be available:

- (i) Magnitude and phase angle of phase currents and voltages before the fault
- (ii) Magnitude and phase angle of phase currents and voltages during the fault
- (iii) The sequence of events of digital signals, start and operate (Trip) signals involved in fault detection and clearance. The events shall be time-tagged to 10ms level.

4.4.2.45. Events and fault records shall not be erased even when the auxiliary DC supply is switched off.

4.4.2.46. Metering and display on the LCD screen of the following Power system instantaneous parameters including;

- (i) Voltage
- (ii) Load current
- (iii) Active Power (import (+) or Export (-))
- (iv) Reactive Power ( import (+) or Export (-))

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
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Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 16 of 72	

- (v) Apparent Power
- (vi) Power Factor and
- (vii) Frequency

*Note: Simultaneous Maximum demand values of Active Power, Reactive Power and Apparent Power shall be available in the relay.*

4.4.2.47. At least Twenty-Four (24) Binary inputs.

4.4.2.48. At least Thirty-two (32) Binary outputs

*Note: Two pairs of the binary output relays shall be rated to directly energise the circuit breaker trip coil. These output relays shall provide phase segregated outputs for each phase. This is to allow single phase tripping and auto-reclose. This trip output relays shall have fast operating times of less than 5ms. Adequate output contacts shall be provided for tripping of two circuit breakers.*

4.4.2.49. Stability against switching inrush currents and reverse faults.

4.4.2.50. Clear faulted phase indication.

4.4.2.51. Clear fault identification even for boundary conditions.

4.4.2.52. At Least twelve (12) LEDs for indication of the following; - Relay trip, Phase L1, Phase L2, Phase L3, Zone 1, Zone 2, Zone 3, DEF, Channel aided trip, SOTF, Back up O/C, Relay healthy LED (Relay self-supervision, with LED for healthy status indication(green) and Error indication (red) and watchdog contact)

4.4.2.53. Protocol applicable: Full IEC 61850-8-1 compliant & IEC 60870-5- 103. Appropriate communication ports to be provided for local and remote communication.

4.4.2.54. Relay Terminals-shall be screw type terminals large enough to accommodate at least 2 x 2.5 mm<sup>2</sup> cable and shall be located at the back of the relay

4.4.2.55. Front Serial RS232 or USB or Optical or Ethernet Port shall be provided for relay configuration and parameter setting and download of Data using a Laptop Computer.

4.4.2.56. Software for Programming the configuration and Relay Settings and also downloading and analysing the Relay Data shall be provided.

4.4.2.57. Relay to Laptop connection cable shall be provided.

4.4.2.58. Relay configuration: The Manufacturer shall carry out relay configuration at the Factory to suit installation in existing transmission substations in KPLC Network. Existing Protection and control drawings for the substations shall be handed over to the manufacturer/supplier for relay configuration. The FATs shall be carried out once the relays have been configured.

Issued by: Head of Section, Standards Development

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Date: 2019-06-07

Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
 DEVICES AND INSTRUMENTS-  
 SPECIFICATION**

Doc. No.	KP1/3C B/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 17 of 72	

Correct functionality of all relay Protection and Control Functions shall checked during the FATs, including correct operation of the single pole auto reclose scheme where applicable.

**4.4.3. Distance Protection Relay Type II:**

**Distance Protection Relay Type II Manufacturer's Experience and Product Qualification: -**

- 4.4.3.1. The Relay manufacturer shall have a minimum experience of 25 years in the manufacture of Distance Protection relays, 15 years of which shall be in the manufacture of Numerical Distance Protection relays.
- 4.4.3.2. The Relay Type Offered must have been in Service and given reliable service for a minimum period of 8 years, in at least two utilities, in each of the following regions: -
  - a. Europe
  - b. North America
  - c. Africa and
  - d. Asia

*Note: The manufacturer shall provide references to support this requirement, including Export records with copy of contract letters, relay details, including numbers and date of export. Letters of satisfaction from utilities should be provided with the bid. Email contacts for senior Technical personnel in the utilities shall be provided with the bid.*

- 4.4.3.3. Relays that have failed in service or mal-operated on the Kenyan Power system shall not be accepted.
- 4.4.3.4. Warranty for the offered relay shall be Five (5) years from the date of relay delivery to KPLC store.

**The Distance Protection Relay Type II shall have the following Functions and Features:**

- 4.4.3.5. The Distance relay shall be used for protection of Sub transmission and Distribution Lines, both overhead lines and underground cables of different characteristic impedances and lengths. The relay shall be used for fault location on the protected feeders.
- 4.4.3.6. To achieve this, the relay shall automatically display the distance to fault in km on the LCD screen upon fault interruption. This requirement is critical and the offered relays that are not able to meet this requirement will not be considered.
- 4.4.3.7. The ability to Access the distance to fault details using the Keypad or a laptop is of secondary value and shall not be considered as a solution for the above requirement.
- 4.4.3.8. The relay shall have four analogue current input channels and four voltage input channels for connection of CT & VT secondary analogue signals

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 18 of 72	

- 4.4.3.9. Shall be suitable for Flush mounting on the protection panel
- 4.4.3.10. The relay shall be of Numeric/Digital Design and employ complete digital processing of measured values
- 4.4.3.11. Full distance Protection Scheme, i.e., non-switched
- 4.4.3.12. Under Impedance Starting criteria. Other starting criteria in addition to the under impedance starting are acceptable.
- 4.4.3.13. The relay shall employ three phase tripping Criteria, since it shall be used on sub-transmission and distribution lines
- 4.4.3.14. Four zones of Phase distance protection (for Phase-phase faults) with selectable Mho and Quadrilateral characteristics. Parameters (resistive reach, reactive reach and time delay) for each Zone independently set.
- 4.4.3.15. Four zones of Ground distance protection, (for phase- Ground/Phase-Earth Faults) with selectable Mho and Quadrilateral characteristics with residual current compensation. Parameters (resistive reach, reactive reach and time delay) for each zone shall be independently set.
- 4.4.3.16. The Distance Protection Zones direction shall be independently set as forward or reverse or non-direction.
- 4.4.3.17. Minimum operating time shall not exceed 40ms.
- 4.4.3.18. The distance Relay shall have Communication channel Aided Scheme logic for the distance protection with at least the following schemes:
  - (i) Permissive Under-reach Transfer scheme
  - (ii) Permissive Overreach Transfer scheme and
  - (iii) Direct Transfer Tripping Scheme

**Note:** *The tele-protection shall be achieved by hard wiring between the relay and the telecommunication equipment*

- 4.4.3.19. Load encroachment Discrimination Feature, to increase the possibility to detect high resistive faults on heavily loaded lines.
- 4.4.3.20. Fuse failure supervision Logic
- 4.4.3.21. Voltage Memory Feature for use by the distance comparators
- 4.4.3.22. Automatic Switch on to Fault Feature(SOTF), enabled when the line is de-energised and only active for a set time delay after the line circuit breaker is closed
- 4.4.3.23. Directional Earth Fault Protection, with communication channel aided scheme as follows: -
  - (i) Directional Comparison Scheme
  - (ii) Blocking Scheme

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 19 of 72	

*Note: Selectable final time tripping for use when the communication channel is not in use, or for use on radial feeder.*

- 4.4.3.24. Back up three phase overcurrent & Earth fault protection, with the following protection functions:
- (i) High set element for Phase and Earth fault overcurrent with selectable definite time delay
  - (ii) Low set element for Phase and Earth fault overcurrent with inverse current-time characteristics as per IEC 60255.

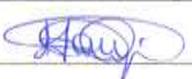
***Other Functions, include:***

- 4.4.3.25. Sensitive Earth Fault Protection
- 4.4.3.26. Stub Bus overcurrent protection
- 4.4.3.27. Circuit Breaker Failure Protection
- 4.4.3.28. Under-frequency and rate of change of frequency protection
- 4.4.3.29. Overvoltage protection
- 4.4.3.30. Broken conductor detection for Alarm purposes.
- 4.4.3.31. Auto-reclose function for three phases, suitable for high speed and delayed auto-reclose. Fault types and Zones that initiate auto-reclose to be selectively enabled.
- 4.4.3.32. The Auto-reclose scheme will be selectable as enabled or disabled preferably on the relay LCD screen:
- 4.4.3.33. Only the selected functions in the distance relay shall initiate auto-reclose
- 4.4.3.34. The auto-reclose function shall be capable of two auto-reclose shots, with separately set dead times.

*Note: It shall be possible to initiate auto-reclose in the distance relay from an external backup overcurrent and earth fault relay on the same Panel.*

- 4.4.3.35. Fault Locator; with automatic display on the Relay LCD Screen of the distance to fault in terms of Line percentage or distance in km. This information is for use by other operational staff to guide the maintenance teams. The last distance to fault shall always be displayed on the screen.

*Note: In the bid submission the bidder shall demonstrate that the requirement of this clause is fully met. Requirement to use the keypad or laptop to access this information is OK, as a secondary option, but will not be considered on its own to fulfil the requirements above.*

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



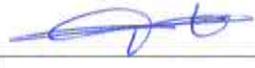
TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 20 of 72	

***Distance Relays Offered which do not meet the above requirement shall not be accepted***

- 4.4.3.36. The accuracy of Distance to fault location shall be  $\pm 2\%$  as a minimum.
- 4.4.3.37. The following additional information shall be provided with fault location:
- (i) The short-circuit loop which was used to determine the fault reactance
  - (ii) The reactance X per phase in Ohms Primary and secondary
  - (iii) The reactance R per phase in Ohms Primary and secondary
  - (iv) The distance to fault in percentage and km of line length:
- 4.4.3.38. The relay shall be able to display Fault details on the LCD Screen such as Fault- Loop or Faulty phases, the Zone, and the Relay Operate time.
- 4.4.3.39. Internal Disturbance recorder with capacity to record eight analogue and twelve digital signals. The relay shall have capacity to store the latest, twenty (20), disturbance records.
- 4.4.3.40. Storage of at least Fifty (50) event records
- 4.4.3.41. Storage of at least twenty (20) trip records. The following fault data will be available:
- (i) Magnitude and phase angle of phase currents and voltages before the fault
  - (ii) Magnitude and phase angle of phase currents and voltages during the fault
  - (iii) The sequence of events of digital signals, start and operate (Trip) signals involved in fault detection and clearance. The events shall me time tagged to 10ms level.
- 4.4.3.42. Events and fault records shall not be erased even when the auxiliary DC supply is switched off.
- 4.4.3.43. Metering and display on the LCD screen of the following Power system instantaneous parameters including;
- (i) Voltage
  - (ii) Load current
  - (iii) Active Power ( Import(+) or Export (-)
  - (iv) Reactive Power( Import (+) or Export (-)
  - (v) Apparent Power
  - (vi) Power Factor and
  - (vii) Frequency

**Note:** *Simultaneous Maximum demand values of Active Power, Reactive Power and Apparent Power shall be available in the relay.*

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
 DEVICES AND INSTRUMENTS-  
 SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 21 of 72	

- 4.4.3.44. As a minimum the relay shall have ten (10) Binary inputs.
- 4.4.3.45. As a minimum the relay shall have twelve (12) Binary outputs.

*Note: Two pairs of the binary output relays shall be rated to directly energise the circuit breaker trip coil. These contacts shall be able to safely interrupt the Circuit Breaker trip Coil current.*

- 4.4.3.46. Stability against switching inrush currents and reverse faults.
- 4.4.3.47. Clear faulted phase indication.
- 4.4.3.48. Clear fault identification even for boundary conditions.
- 4.4.3.49. At least twelve (12) LEDs for indication of the following; - Relay trip, Phase L1, Phase L2, Phase L3, Zone 1, Zone 2, Zone 3, DEF, Channel aided trip, SOTF, etc.
- 4.4.3.50. Relay healthy LED
- 4.4.3.51. Relay self-supervision, with LED for healthy status indication(green) and Error indication (red) and watchdog contact
- 4.4.3.52. Protocol applicable: IEC 61850-8-1. Appropriate communication ports to be provided on the relay.
- 4.4.3.53. Relay Terminals-shall be screw type terminals large enough to accommodate at least 2 x2.5mm<sup>2</sup> cable and shall be located at the back of the relay.
- 4.4.3.54. Front Serial RS232 or USB or Optical or Ethernet Port shall be provided for relay configuration and parameter setting and download of Data using a Laptop Computer.
- 4.4.3.55. Software for Programming the configuration and Relay Settings and also downloading and analysing the Relay Data shall be provided.
- 4.4.3.56. Relay to Laptop connection cable
- 4.4.3.57. **Relay configuration:** The Manufacturer shall carry out relay configuration at the Factory to suit installation in existing transmission substations in KPLC Network. Existing Protection and control drawings for the substations shall be handed over to the manufacturer/supplier for relay configuration. The FATs shall be carried out once the relays have been configured. Correct functionality of all relay Protection and Control Functions shall checked during the FATs.

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 22 of 72	

**4.4.4. Biased Differential Protection Relay for a Two or Three Winding Power Transformer:**

**Biased Differential Protection Relay Manufacturer's Experience and Product Qualification:-**

4.4.4.1. The Relay manufacturer shall have a minimum experience of 25 years in the manufacture of Biased Differential Protection relays, 15 years of which shall be in the manufacture of Numerical Distance Protection relays.

4.4.4.2. The Relay type offered must have been in Service and given reliable service for a minimum period of 8 years, in at least two utilities, in each of the following regions:-

- a. Europe
- b. North America
- c. Africa and
- d. Asia

*Note: The manufacturer shall provide references to support this requirement, including Export records with copy of contract letters, relay details, including numbers and date of export. Letters of satisfaction from utilities should be provided with the bid. Email contacts for senior Technical personnel in the utilities shall be provided with the bid.*

4.4.4.3. Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.

4.4.4.4. Warranty for Offered relay shall be Five (5) years from the date of relay delivery to the KPLC store.

**The Biased Differential Protection Relay shall have the following Functions and Features: -**

4.4.4.5. Suitable for protection of a two or three winding power transformer, with a power rating of up to 90 MVA, with HV winding rated up to 245kV. Specific requirements will be stated in the Scope of supply or Price schedules.

4.4.4.6. Relay must be of Numerical design

4.4.4.7. Flush mounting design

4.4.4.8. Pick up setting range, for IDIFF > 0.1 to 1.0 x rated current, as a minimum

4.4.4.9. Pickup on switch-on (factor of IDIFF>) 1.0 to 2.0

4.4.4.10. High-set Element (IDIFF>>) with a setting range of 1.0 to 20.0 x rated current

4.4.4.11. Independent definite time delay setting for IDIFF> and for IDIFF>> of 0.00 to 30.00 seconds as a minimum

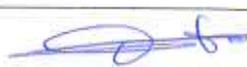
Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
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Date: 2019-06-07	Date: 2019-06-07



**TITLE:**  
**PROTECTIVE RELAYS, CONTROL  
 DEVICES AND INSTRUMENTS-  
 SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 23 of 72	

- 4.4.4.12. Magnetizing current inrush restraint feature, using 2nd harmonic restraint and /or zero crossing on the sine wave
- 4.4.4.13. Setting range of  $I_{2fn}/I_{fn}$  of 10 to 50% as a minimum
- 4.4.4.14. Compensation for zero sequence currents that may appear on only one winding of the power transformer
- 4.4.4.15. Measurement and indication on the LCD screen, of phase – HV&LV currents and relay differential and bias currents
- 4.4.4.16. Storage of at least Five (5) Fault records and Ten (10) Event records
- 4.4.4.17. Events and fault records shall not be erased even when the auxiliary DC supply is switched off
- 4.4.4.18. The Fault flags should be visible on the LCD screen, and provide details of the phases that have operated and the fault current values.
- 4.4.4.19. Over-fluxing protection function with at least two stages of alarm and trip functions
- 4.4.4.20. 5th harmonic restraint feature on the differential Element to prevent unnecessary tripping due to CT saturation or transformer over-excitation.
- 4.4.4.21. Over-excitation Protection with both alarm and trip elements
- 4.4.4.22. Stabilized against transient and steady-state fault currents caused e.g. by over-excitation of transformers, using fifth harmonic.
- 4.4.4.23. Insensitive against DC offset currents and current transformer saturation.
- 4.4.4.24. High stability also for different current transformer saturation
- 4.4.4.25. High-speed instantaneous trip on high-current transformer faults.
- 4.4.4.26. Independent of the conditioning of the star point(s) of the power transformer.
- 4.4.4.27. High earth-fault sensitivity by detection of the star point current of an earthed transformer winding
- 4.4.4.28. Integrated matching of the transformer connection group
- 4.4.4.29. Integrated matching of the transformation ratio including different rated currents of the transformer windings
- 4.4.4.30. Dual Bias characteristics with two slopes to ensure relay stability for heavy through faults. The start and end of the two slopes shall be settable, in terms of the rated current.
- 4.4.4.31. Unbalanced Load Protection
- 4.4.4.32. Thermal Overload Protection
- 4.4.4.33. Back up Overcurrent and Earth Fault protection for HV and/or LV winding
- 4.4.4.34. The following measurements shall be available in the relay:
  - i. Magnitudes and phase angles of the phase currents for the three phases on the HV side of Transformer
  - ii. Magnitudes and phase angles of the phase currents for the three phases on the LV side of Transformer

<b>Issued by: Head of Section, Standards Development</b>	<b>Authorized by: Head of Department, Standards</b>
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<b>Date: 2019-06-07</b>	<b>Date: 2019-06-07</b>



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
 DEVICES AND INSTRUMENTS-  
 SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 24 of 72	

iii. Magnitude of differential current and restraining current for the three phases

- 4.4.4.35. The disturbance recorder function shall have a capacity for eight (8) analogue and twelve (12) digital signals. The last four disturbance records will be available in the relay.
- 4.4.4.36. Red L.E.D to indicate that the relay has operated/issued trip command
- 4.4.4.37. Relay Self diagnostic, with LED to indicate Relay failure and a contact for remote indication of relay failure status
- 4.4.4.38. The relay shall have at least eight (8) LEDs for trip and alarms and at least four (4) binary inputs.
- 4.4.4.39. The relay shall have at least four (4) outputs relays with normally open contacts for circuit breaker tripping and alarm annunciation. Two pairs of contacts shall be rated to directly energise the circuit breaker tripping coil.
- 4.4.4.40. The relay shall have the ability to select output contacts to latched or non-latched status and the LCD screen where the settings and measurands can be read.
- 4.4.4.41. The relay shall have keypad for manual programming of settings and data access.
- 4.4.4.42. The relay shall have front serial RS232 or USB or Ethernet Port for Relay communication with a laptop computer for relay configuration and parameter settings and download of fault records, events records and disturbance record.
- 4.4.4.43. Relay terminals shall be screw type terminals large enough to accommodate at least 2x2mm<sup>2</sup> cable and shall be located at the back of the relay.
- 4.4.4.44. Four (4) sets of installation, commissioning, operation and maintenance manuals shall be provided.
- 4.4.4.45. Relay to Laptop connection cable shall be provided.
- 4.4.4.46. Software for relay configuration and settings programming using Laptop computer shall be provided.

4.4.5. **Restricted Earth Fault Relay:**

**Restricted Earth Fault Protection Relay Manufacturer's Experience and Product Qualification: -**

- 4.4.5.1. The relay manufacturer shall have a minimum of 25 years in the manufacture of Restricted Earth Fault Relays, 10 years of which shall be in the manufacture of numerical Restricted Earth Fault relays.
- 4.4.5.2. The relay type offered must have been in service and given reliable service for a minimum period of 8 years, in at Least two utilities, in each of the following regions:-
  - a. Europe
  - b. North America
  - c. Africa and
  - d. Asia

*Note: The manufacturer shall provide references to support this requirement, including Export records with copy of contract letters, relay details, including numbers and*

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

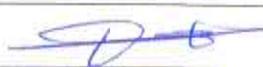
Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 25 of 72	

*date of export. Letters of satisfaction from utilities should be provided with the bid. Email contacts for Senior Technical personnel in the utilities shall be provided with the bid.*

- 4.4.5.3. Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.
- 4.4.5.4. Warranty for offered relay shall be five (5) years from the date of relay delivery to KPLC store.

**The Restricted Earth Fault Protection Relay shall have the following Functions and Features: -**

- 4.4.5.5. This relay shall be used for protection of one winding of a power transformer.
- 4.4.5.6. This relay shall have the following functions and features:
- Relay shall be of Numerical, static type or Electro-Mechanical type.
  - The Relay shall operate on high impedance principle.
  - The relay shall be of numeric design.
  - The relay shall be suitable for flush mounting on panel front.
- 4.4.5.7. The relay shall be of an independent relay and not a function in the differential relay.
- 4.4.5.8. Relay shall reject harmonics produced by the system particularly third harmonics.
- 4.4.5.9. Stabilising resistor and voltage dependent resistor (metrosil) of suitable rating shall be offered with the Relay based on maximum through Fault of 31kA.
- 4.4.5.10. The relay current setting range shall be 0.05- 0.8 x rated current (In) as a minimum and an operating time < 25ms at 5 times the setting.
- 4.4.5.11. The relay shall have four (4) LEDs for relay status indication and for trip and alarms annunciation as a minimum and two (2) binary inputs as a minimum
- 4.4.5.12. The relay shall have four (4) Binary Outputs as a minimum with LCD screen where the settings and measurands can be read
- 4.4.5.13. The relay's REF operate current shall be displayed on the LCD screen and keypad for manual programming of settings and data access
- 4.4.5.14. The relay shall have serial RS232, USB or Ethernet Port for relay configuration and programming of parameter settings and data download using a laptop computer.
- 4.4.5.15. The relay shall have an event recorder with capacity to store the last fifty (50) events
- 4.4.5.16. The relay shall have fault recorder with capacity to store the last ten (10) fault records
- 4.4.5.17. The relay shall have a disturbance record with capacity to store the last four (4) disturbance records
- 4.4.5.18. The relay terminals shall be screw type terminals large enough to accommodate at least 4 mm<sup>2</sup> cable and shall be located at the back of the relay

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Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 26 of 72

**4.4.5.19. Stabilizing Resistor**

Each REF relay shall be supplied with an adjustable stabilizing resistor. For dimensioning of the stabilizing resistor consider maximum through fault phase –earth current of 31.5kA.

**4.4.5.20. Voltage Dependent Resistor (Metrosil)**

Each REF relay shall be supplied with a voltage dependent resistor (VDR) or metrosil to limit voltage across the REF high impedance circuit. The basis for the rated voltage of the VDR is the maximum phase-earth through fault of 31.5kA.

*Note: The Stabilising resistor and the Voltage dependent resistor shall preferably be housed in a box with terminals that allow connection of the REF relay to the resistor and VDR in the box. Several terminals will be provided to allow selection of required stabilizing resistor. The single box will be suitable for panel mounting.*

**4.4.6. Feeder Protection Relay:**

**Feeder Protection Relay Manufacturer’s Experience and Product Qualification:-**

4.4.6.1. The relay manufacturer shall have a minimum of 25 years in the manufacture of Feeders Protection relay, 15 years of which shall be in the manufacture of numerical Distance Protection relays.

4.4.6.2. The relay type offered must have been in service and given reliable service for a minimum period of 8 years, in at Least two utilities, in each of the following regions:-

- a. Europe
- b. North America
- c. Africa and
- d. Asia

*Note: The manufacturer shall provide references to support this requirement, including export records with copy of contract letters, relay details, including numbers and date of export. Letters of satisfaction from the utilities should be provided with the bid. Email contacts for senior Technical personnel in the utilities shall be provided with the bid.*

4.4.6.3. Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.

4.4.6.4. Warranty for offered relays shall be five (5) years from the date of relay delivery to the KPLC store.

Issued by: Head of Section, Standards Development

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Date: 2019-06-07

Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 27 of 72	

**The Feeder Protection Relay shall have the following Functions and Features:-**

4.4.6.5. The Relay shall have the following protection functions and features in a single casing as a minimum: -

- i. Three phase overcurrent
- ii. Earth fault
- iii. Sensitive Earth Fault
- iv. Broken Conductor detection
- v. Auto-reclose function for three phase auto-reclose.
- vi. Under and Over Frequency Protection, including rate of change frequency protection

**Note 1:** *Earth Fault and Sensitive Earth Fault Protection elements shall be separate to allow independent settings to be applied. These functions will have separate CT inputs*

**Note 2:** *Earth Fault and Sensitive earth fault elements shall have separate CT Inputs.*

**Note 3:** *Detailed specifications for three phase overcurrent, earth fault and sensitive earth fault functions are included elsewhere in this specification. All requirements must be met.*

4.4.6.6. There shall be independent CT input for Earth Fault and for Sensitive Earth Fault Protection to allow independent connection of the Sensitive Earth Fault Protection Function to a separate Core type CT

4.4.6.7. Relay must be of Numerical design.

4.4.6.8. Relays that have failed in service or mal-operated shall not be acceptable

4.4.6.9. The relays shall be suitable for flush mounting on the front of the panel

4.4.6.10. Current setting range for overcurrent function shall be  $0.5I_n$ - $2.0I_n$  as a minimum

4.4.6.11. Current setting range for earth fault function shall be  $0.05I_n$ - $0.8I_n$  as a minimum

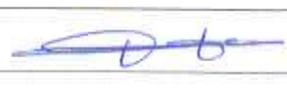
4.4.6.12. Two stages of High Set Element for both overcurrent and earth fault protection function, with a setting range of  $1-20I_n$  as a minimum and a definite time delay setting of 0 – 60 seconds as a minimum.

4.4.6.13. I.D.M.T characteristics for overcurrent and Earth fault protection function according to BS142 or IEC60255 i.e. Standard Inverse (SI), Very Inverse (VI), Extremely Inverse (EI), Long Time Inverse (LTI), including definite time for the high-set Elements.

4.4.6.14. Time setting multiplier 0.05 – 1.0 as a minimum

4.4.6.15. Current setting range for sensitive earth fault function  $0.01I_n$  -  $0.8I_n$  as a minimum

4.4.6.16. Definite time delay characteristic for Sensitive earth fault function; setting range, 0- 30 seconds as a minimum.

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 28 of 72	

- 4.4.6.17. Requirements for the auto reclose function:
- Three phases auto reclose
  - Selectable 1 – 3 auto-reclose shots
  - Independently set dead time for each shot
  - Auto-reclose inhibit after manual close
  - Each auto-reclose shot shall be initiated by the selected Protection Function(s). Operation of Protection Function not selected to initiate a particular shot of Auto-reclose shall lead to Lock-out.
  - Auto-reclose inhibition for over current high set element

- 4.4.6.18. Data Storage:
- Storage of at least five (5) fault/trip records
  - Ten (10) event records
  - Five (5) disturbance records

**Note:** *Events and fault records shall not be erased even when the auxiliary DC supply is switched off*

- 4.4.6.19. Configurable output relays for protection element pick up (start) and Trip outputs which can be used to back-trip upstream circuit breakers and for implementing blocking schemes for busbar protection.
- 4.4.6.20. Red L.E.D to indicate that the protection functions have operated and issued a trip output to Trip the circuit breaker.
- 4.4.6.21. Relay self-diagnostic, with LED to indicate relay healthy status (green colour) and relay failed status (red colour) and a watch dog contact for remote alarm
- 4.4.6.22. LEDs: The relay shall have a minimum eight (8) LEDs for alarms annunciation.
- 4.4.6.23. Binary Outputs: The relay shall have as a minimum twelve (12) Binary inputs.
- 4.4.6.24. Binary Outputs: The relay shall have a minimum four (4) outputs Relays. One (1) of the output relays shall be adequately rated to directly operate the circuit breaker trip coil.
- 4.4.6.25. LCD screen where the settings and measurands can be read
- 4.4.6.26. Keypad for manual programming of settings and data access
- 4.4.6.27. Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm<sup>2</sup> cable and shall be located at the back of the relay
- 4.4.6.28. The relay applicable protocol shall be IEC 61850-8-1

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Date: 2019-06-07

Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KPI/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 29 of 72	

- 4.4.6.29. Front Serial RS232 or USB or Ethernet Port for relay communication with a laptop computer for relay configuration and parameter settings and download of fault records, events records and disturbance records for analysis.
- 4.4.6.30. Software for configuration and relay parameter settings and also downloading and analysing the relay fault data shall be provided.
- 4.4.6.31. Relay to Laptop connection cable shall be provided
- 4.4.6.32. Auto reclose relay Function in the feeder protection relay. This auto reclose function shall be housed within the feeder protection relay: -
- Selectable 1 – 3 auto reclose shots
  - Independently set dead time for each shot
  - Auto-reclose inhibit after manual close
  - Each auto-reclose shot shall be initiated by the selected protection function(s). Operation of protection function not selected to initiate a particular shot of auto-reclose shall lead to lock-out of the relay.
  - Auto-reclose inhibition for over current high set element.

#### 4.4.7. Electrical Reset – Trip Relay

##### Electrical Reset – Trip Relay Manufacturer’s Experience and Product Qualification:-

- 4.4.7.1. The manufacturer shall have experience of a minimum of 15 years in the manufacture of Trip relays
- 4.4.7.2. The offered relays must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.
- 4.4.7.3. Relays that failed in Service or Mal-operated on the Kenyan Power System shall not be accepted.
- 4.4.7.4. Warranty for offered relays shall be Five (5) years from the date of relay delivery to the KPLC store.

##### The Electrical Reset Trip Relay shall have the following Functions and Features: -

- 4.4.7.5. High burden tripping relay, immune to capacitance discharge currents and leakage currents
- 4.4.7.6. At least Four (4) pairs of normally open (NO) and two (2) pairs of normally closed (NC) or 4NO/NC output contacts.
- 4.4.7.7. Instantaneous operation; time <15ms

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2019-06-07

Date: 2019-06-07

- 4.4.7.8. The Relay shall be suitable for flush mounting
- 4.4.7.9. Flag or target shall be a red; L.E.D, or durable bulb or Red Mechanical flag
- 4.4.7.10. The Relay shall be electrically reset, and the reset button shall be inbuilt on the relay and accessible without opening the relay cover or shall be supplied separately for panel flush mounting, in which case the reset button shall be illuminated with red colour.
- 4.4.7.11. Contact rating – capable of carrying 30Amps for 3 seconds and 10A, continuously
- 4.4.7.12. Relay terminals-shall be screw type large enough to accommodate at least 4mm<sup>2</sup> cable and shall be located at the back of the relay
- 4.4.7.13. Relay terminals shall be clearly marked
- 4.4.7.14. Relay contacts configuration shall preferably be drawn on the relay casing.
- 4.4.7.15. Alternatively, a connection drawing shall be supplied with the relay.
- 4.4.7.16. Size not greater than 24x19x6 cm

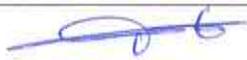
**4.4.8. Self-Reset Trip Relay**

**Self- Reset – Trip Relay Manufacturer’s Experience and Product Qualification:-**

- 4.4.8.1. The manufacturer shall have experience of a minimum of 15 years in the manufacture of trip relays
- 4.4.8.2. The offered relays must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.
- 4.4.8.3. Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.
- 4.4.8.4. Warranty for offered relays shall be five (5) years from the date of relay delivery to KPLC store.

**The Self-Reset Trip Relay shall have the following Functions and Features:-**

- 4.4.8.5. High burden tripping relay, immune to capacitance discharge currents and leakage currents
- 4.4.8.6. At least Four (4) pairs of normally open (NO) and two (2) pairs of normally closed (NC) or 4NO/NC output contacts.
- 4.4.8.7. Instantaneous operation; time <15ms
- 4.4.8.8. The Relay shall be suitable for flush mounting or for mounting on 35mm DIN rail, in which case the relay shall be supplied complete with the base
- 4.4.8.9. Flag or target shall be a red; L.E.D, or durable bulb or Red Mechanical flag
- 4.4.8.10. The Relay shall be self-reset, once the relay initiating the trip resets.
- 4.4.8.11. Contact rating – capable of carrying 30Amps for 3 seconds and 10A, continuously and the Relay terminals shall be clearly marked
- 4.4.8.12. Relay Terminals-shall be screw type terminals large enough to accommodate at least
- 4.4.8.13. 2 x 2.5 mm<sup>2</sup> cable and shall be located at the back of the relay

<b>Issued by: Head of Section, Standards Development</b>	<b>Authorized by: Head of Department, Standards</b>
<b>Signed:</b> 	<b>Signed:</b> 
<b>Date: 2019-06-07</b>	<b>Date: 2019-06-07</b>



**TITLE:**  
**PROTECTIVE RELAYS, CONTROL  
 DEVICES AND INSTRUMENTS-  
 SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 31 of 72	

- 4.4.8.14. Drawing for relay connection shall be provided with the relay
- 4.4.8.15. Relay contacts configuration shall preferably be drawn on the relay casing.
- 4.4.8.16. Alternatively, a connection drawing shall be supplied with the relay.
- 4.4.8.17. Size not greater than 24x19x6 cm

**4.4.9. Trip Circuit Supervision Relay Type I:**

**Trip Circuit Supervision Relay Type I- Manufacturer's Experience and Product Qualification:-**

- 4.4.9.1. The manufacturer shall have experience of a minimum of 15 years in the manufacture of Trip Circuit Supervision relays
- 4.4.9.2. The offered relays must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.
- 4.4.9.3. Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.
- 4.4.9.4. Warranty for Offered relays shall be five (5) years from the date of delivery to KPLC store.

**The Trip Circuit Supervisory Relay shall have the following Functions and Features:-**

The relay shall have the following features:-

- 4.4.9.5. Continuous supervision of trip circuit for circuit breaker in both OPEN & CLOSED positions
- 4.4.9.6. Trip Circuit Healthy – Red/Green L.E.D ON
- 4.4.9.7. Trip circuit fail –Green/Red L.E.D OFF
- 4.4.9.8. Two (2) normally closed (NC) and two (2) normally open(NO) or 2 C/O (change-over) output contacts
- 4.4.9.9. The relay shall have a time delay of at least 150mS to avoid transient operations
- 4.4.9.10. Contact ratings – 30 Amps for 3 seconds and 5 Amps continuously.
- 4.4.9.11. Suitable for Flush mounting on the relay panel
- 4.4.9.12. Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm<sup>2</sup> cables and shall be located at the back of the relay and relay terminals shall be clearly marked.
- 4.4.9.13. Relay shall be supplied complete with the base.
- 4.4.9.14. Relay contacts configuration shall preferably be drawn on the relay casing.
- 4.4.9.15. Alternatively, a connection drawing shall be supplied with the relay.
- 4.4.9.16. Size not greater than 16x9x9 cm

<b>Issued by: Head of Section, Standards Development</b>	<b>Authorized by: Head of Department, Standards</b>
<b>Signed:</b> 	<b>Signed:</b> 
<b>Date: 2019-06-07</b>	<b>Date: 2019-06-07</b>



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 32 of 72	

**4.4.10. Auxiliary relays For Transformer Mechanical Protection Trip Function Type I:**

**Auxiliary relays for Transformer Mechanical Protection Trip Function I - Manufacturer's Experience and Product Qualification:-**

- 4.4.10.1. The manufacturer shall have experience of a minimum of 15 years in the manufacture of auxiliary relays for Power Transformer Mechanical Protection.
- 4.4.10.2. The offered relays must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.
- 4.4.10.3. Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.
- 4.4.10.4. Warranty for Offered relays shall be five (5) years from the date of delivery to KPLC store.

**Annunciator Type I Relay, Functions and Features:-**

- 4.4.10.5. The relays shall be used as repeat relays for power transformer mechanical protection functions.
- 4.4.10.6. The Relay shall have the following features: -
  - i. High speed operation; < 20 ms for tripping
  - ii. One (1) element in one casing/relay
  - iii. Hand reset contacts
  - iv. Manually reset Operation indication/mechanical flag (Red in colour)
  - v. Shall be suitable for 35mm DIN rail mounting inside the panel
  - vi. At Least Three (3) pairs of normally open (NO) output contacts
- 4.4.10.7. Relay Terminals-shall be screw type terminals large enough to accommodate at least 2.5 mm<sup>2</sup> cables and located at the back of the relay.
- 4.4.10.8. Contact ratings – 30 Amps for 3 seconds and 10 Amps continuously.
- 4.4.10.9. Relay terminals shall be clearly marked, with indelible numbers
- 4.4.10.10. Relay shall be supplied complete with base.
- 4.4.10.11. Relay contacts configuration shall preferably be drawn on the relay casing.
- 4.4.10.12. Alternatively, a connection drawing shall be supplied with the relay.
- 4.4.10.13. Size not greater than 24x18x10 cm

**4.4.11. Annunciator Relay Type I**

**Annunciator Relay Type I – Manufacturer's Experience and Qualification:-**

- 4.4.11.1. The manufacturer shall have a minimum experience of 15 years in the manufacture of the annunciator relay.
- 4.4.11.2. The offered relays must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07

- 4.4.11.3. Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.
- 4.4.11.4. Warranty for Offered relays shall be five (5) years from the date of delivery to KPLC store.

**Annunciator Relay type I - Functions and Features:-**

The Annunciator relays shall have compact design. The Relay shall have the following features:

- 4.4.11.5. The Annunciator shall be designed to receive station equipment status information through hardwired contacts, hence provide a common point through which alarms can be monitored.
- 4.4.11.6. The relay shall be compact and integrated into one common device. Relays with individual alarm covers are not acceptable.
- 4.4.11.7. The relay shall be suitable to read and acknowledge alarms locally or remotely
- 4.4.11.8. The relay shall be fully programmable via keypad and/or Laptop.
- 4.4.11.9. The status of the alarms shall be retained even with loss of auxiliary dc power supply. On power, up the last alarm status will be displayed.
- 4.4.11.10. Shall have Silence, Accept, Reset and Test push buttons, to control the Alarms
- 4.4.11.11. The single relay shall be equipped with at least thirty-six (36) separate alarm elements in a single casing. Each alarm to be independently programmable
- 4.4.11.12. The relay shall be of digital design
- 4.4.11.13. The relay shall be suitable for flush panel mounting
- 4.4.11.14. Each of the elements shall be freely assigned to one of two common output alarms; Urgent, and Non-urgent alarm.
- 4.4.11.15. Each Alarm Element shall have a red L.E.D. to indicate alarm ON status. It shall also have provision for fixing of Identification Label changeable at site. A flashing alarm element shall be clearly visible.
- 4.4.11.16. The Urgent and Non-Urgent common alarms shall be freely configurable to the output relays.
- 4.4.11.17. It shall have high immunity against electrical interference.

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 34 of 72	

- 4.4.11.18. Relay Terminals-shall be of screw type, large enough to accommodate at least
- 4.4.11.19. 2x2.5 mm<sup>2</sup> cable and shall be located at the back of the relay
- 4.4.11.20. Relay terminals shall be clearly marked with indelible writing
- 4.4.11.21. Relay contacts configuration shall preferably be drawn on the relay casing
- 4.4.11.22. At least two output relays one for urgent and the other for non-urgent alarm
- 4.4.11.23. The relay shall be supplied with field configurable labels.
- 4.4.11.24. At least two (2) pairs of Normally Open (NO) out-put contacts for each out-put relay

**4.4.12. Annunciator Relay Type II:**

**Annunciator Relay Type II – Manufacturer’s Experience and Product Qualification:-**

- 4.4.12.1. The manufacturer shall have a minimum experience of 15 years in the manufacture of the annunciator relay.
- 4.4.12.2. The offered relays must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.
- 4.4.12.3. Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.
- 4.4.12.4. Warranty for Offered relays shall be five (5) years from the date of delivery to KPLC store.

**Annunciator Relay type II – Functions and Features:**

The relay shall have the following functions and features: -

- 4.4.12.5. The Annunciator shall be designed to receive station equipment status information through hardwired contacts, hence provide a common point through which alarms can be monitored.
- 4.4.12.6. The relay shall be compact and integrated into one common device. Relays with individual alarm covers are not acceptable.
- 4.4.12.7. The relay shall be suitable to read and acknowledge alarms locally or remotely
- 4.4.12.8. The relay shall be fully programmable via keypad and/or Laptop.
- 4.4.12.9. The status of the alarms shall be retained even with loss of auxiliary dc power supply, on power up the last alarm status will be displayed.
- 4.4.12.10. The relay shall be of digital design
- 4.4.12.11. The relay shall be suitable for flush panel mounting. The Relay shall have the following features: -
- 4.4.12.12. Shall have Silence, Accept, Reset and Test push buttons, to control the Alarms

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
 DEVICES AND INSTRUMENTS-  
 SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 35 of 72	

- 4.4.12.13. The single relay shall be equipped with sixteen (16) separate alarm Elements in a single casing.
- 4.4.12.14. The Relay Offered must have been in Service in Kenya Power System and operated successfully for the last 4 years. Improved designs of previous relays are acceptable.
- 4.4.12.15. Relays offers from Manufacturers who have not supplied relays before are not acceptable for this tender.
- 4.4.12.16. Relays that have failed in service or mal-operated shall not be acceptable
- 4.4.12.17. Each of the elements shall be freely assigned to one of two common output Alarms; Urgent and NON-urgent Alarm.
- 4.4.12.18. Each Alarm Element shall have a Red L.E.D. to indicate ON status. It shall also have provision for fixing of Identification Label changeable on site. A flashing Alarm element shall be clearly visible.
- 4.4.12.19. The Urgent and Non-Urgent common alarms shall be freely configurable to the output Relays.
- 4.4.12.20. It shall have high immunity against electrical interference
- 4.4.12.21. Relay Terminals-shall be of screw type, large enough to accommodate at least 2x2.5 mm2 cable and shall be located at the back of the relay
- 4.4.12.22. Relay terminals shall be clearly marked, with indelible writing
- 4.4.12.23. Relay contacts configuration shall preferably be drawn on the relay casing
- 4.4.12.24. At least two out-put relays one for urgent and the other for non-urgent alarm
- 4.4.12.25. Drawings for wiring of the relay shall be supplied with the relay.

**4.4.13. Discrepancy Switch for Circuit Breaker Control:**

**Discrepancy Switch for Circuit Breaker Control- Manufacturer's Experience and Product Qualification:-**

- 4.4.13.1. The manufacturer shall have minimum experience of 15 years in the manufacture of the switch.
- 4.4.13.2. The offered Discrepancy switch must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.
- 4.4.13.3. Discrepancy switches that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.
- 4.4.13.4. Warranty for offered Discrepancy Switches shall be five (5) years from the date of delivery to KPLC store.

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 36 of 72	

**The Discrepancy Switch for Circuit Breaker Control switch – Functions and Features: -**

- 4.4.13.5. Suitable flush mounting
- 4.4.13.6. Press and Turn operation for Circuit Breaker close and open operation.
- 4.4.13.7. As a minimum three (3) pairs of Normally Open(NO) contacts for circuit breaker close operation and two (2) pairs of Normally Open(NO) contacts for circuit breaker open operation.
- 4.4.13.8. White colour continuous illumination for discrepancy in circuit breaker status. The illumination shall be by white LED bulb.
- 4.4.13.9. The discrepancy switch shall be sturdy and durable.
- 4.4.13.10. The position for circuit breaker close and the position for circuit breaker open Operations shall be clearly marked on the escutcheon plate supplied with the switch.
- 4.4.13.11. The top of the switch having the escutcheon plate shall have a rectangular outer shape.
- 4.4.13.12. The switch shall have screw type terminals large enough to accommodate 2x2.5mm<sup>2</sup> cable
- 4.4.13.13. Switch terminals shall be indelibly marked, white numbers on black background
- 4.4.13.14. The switch contacts configuration shall preferably be drawn on the switch
- 4.4.13.15. Switch to be supplied with white illumination LED bulb
- 4.4.13.16. The lamp shall be rated at below 4 W power consumption
- 4.4.13.17. The switch shall be supplied with a drawing showing how the switch operates and contact configuration.
- 4.4.13.18. Switch Offered shall be type DK10 or equivalent in terms of size, quality and durability.

**4.4.14. Semaphores for Isolator and Earth Switch Position Indication**

**Semaphores for Isolator and Earth switch Position Indication – Manufacturer’s experience and Product Qualification:-**

- 4.4.14.1. The manufacturer shall have at least 15 years’ experience in the manufacture of the semaphores.
- 4.4.14.2. This device shall be used to remotely mimic on the control panel, the position (open or closed) of disconnectors/Isolators, which are located in the switchyard.

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
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Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 37 of 72	

- 4.4.14.3. The offered Semaphores must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.
- 4.4.14.4. Semaphores that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.
- 4.4.14.5. Warranty for Offered semaphores shall be Five (5) years from the date of delivery to KPLC store.

**Semaphores for Isolator and Earth switch Position Indication – Functions and Features:-**

- 4.4.14.6. Shall be suitable for flush mounting
- 4.4.14.7. With Red L.E.D for closed (ON) status indication and Green L.E.D for open (OFF) status Indication.
- 4.4.14.8. Shall be of circular or rectangular front appearance
- 4.4.14.9. The Unit shall have screw type terminals large enough to accommodate 2x2.5mm<sup>2</sup> cable
- 4.4.14.10. The Terminals shall be indelibly marked

**4.4.15. LED Indicating Lamps:-**

**LED Indicating Lamps – Manufacturer’s Experience and Product Qualification:-**

- 4.4.15.1. The manufacturer shall have at least 15 years’ experience in the manufacture of LED indicating lamps. The lamps are primarily for indicating the status of switchgear in the substation.
- 4.4.15.2. The offered LED Indicating Lamps must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.
- 4.4.15.3. LED Indicating Lamps that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.
- 4.4.15.4. Warranty for offered LED Indicating Lamps shall be five (5) years from the date of delivery to KPLC store.

**LED Indicating Lamps – Functions and Features:-**

They shall have the following features: -

- 4.4.15.5. The LED indicating lamps shall be complete with lamp and mounting base
- 4.4.15.6. These shall be suitable for mounting on the front of the control panel (Flush mounting).
- 4.4.15.7. The Indicators Lamps shall be of LED type

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 38 of 72	

- 4.4.15.8. The Lamp Indicators should be rated for 4W power consumption or less.  
4.4.15.9. The lamp indicators should be designed for continuous operation and to give a long operating life of at least 10 years.  
4.4.15.10. Red LED indicators shall be of the high brightness type

*Note 1: The colour and quantities of the LED Indicating lamps will be specified in the Bill of materials and price schedules*

*Note 2: The manufacturer of Miniature Circuit Breakers (MCBs) shall experience of at least 15 years in the manufacture of the MCBs*

**4.4.16. Multi-Functional Power Meter**

**Multi-Functional Power Meter – Manufacturer’s Experience and Product Qualification:-**

- 4.4.16.1. The manufacturer shall have at least 15 years’ experience in the manufacture of the Multi-functional Power Meter.  
4.4.16.2. The offered power meters must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.  
4.4.16.3. Power meters that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.  
4.4.16.4. Warranty for Offered Multi-functional Power Meters shall be five (5) years from the date of delivery to KPLC store.

**Multi-Functional Power Meter – Functions and Features:-**

- 4.4.16.5. This is a power measurement meter for panel mounting  
4.4.16.6. The unit shall be of numerical design  
4.4.16.7. The unit shall have a large LCD display for displaying four (4) or more lines of measurands simultaneously.  
4.4.16.8. The keypad shall be simple to allow scrolling between the various measurands  
4.4.16.9. The unit shall measure instantaneous values of; rms voltage, both phase – phase and phase to ground, phase currents, active power, reactive power, apparent power, energy, frequency, power factor and phase angle per phase

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2019-06-07

Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 39 of 72	

- 4.4.16.10. The Unit shall measure time stamped maximum and minimum demand for current and power (MW & MVA)
- 4.4.16.11. The unit shall also measure unbalance voltage and current
- 4.4.16.12. The unit shall measure Total harmonic distortion(THD) and Total Demand Distortion(TDD) for current and voltage
- 4.4.16.13. The unit shall have the following input ratings, 1Amps and 110V AC phase to phase.
- 4.4.16.14. The unit should be able to continuously withstand 2Amps and 260 V AC
- 4.4.16.15. The unit shall be for flush mounting on the front of the panel
- 4.4.16.16. The unit shall be for 3 phases, 4 –wire connection on the secondary of current and voltage transformers
- 4.4.16.17. The unit shall be equipped with an RS232 port for programming the unit to ensure correct measurement and display of the parameters. The CT and VT ratios shall be programmable. Alternatively, programming can be achieved through the keypad.
- Note:** *Programming will be conducted at site during installation.*
- 4.4.16.18. RS 485 port shall be provided for remote communication.
- 4.4.16.19. Communication protocol shall be IEC 61850 and IEC 60870-5-104
- 4.4.16.20. The accuracy of measurement shall be at least class 1.0
- 4.4.16.21. Shall have inbuilt real-time clock and calendar
- 4.4.16.22. It shall be possible to display all the measured parameters on the screen through the pre-programmed display screen. The screen to be displayed shall be selectable using the keys on the front of the unit
- 4.4.16.23. The software and the PC to power meter unit connection cable shall be supplied with the units. At least eight communication cables devices shall be required
- 4.4.16.24. All the terminals shall be clearly marked
- 4.4.16.25. The measurement range for power shall at least be up to 90 MVA.
- 4.4.16.26. The meter shall be powered with 110V DC; or 110V DC /110V AC

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 40 of 72	

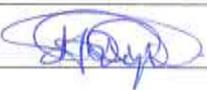
**4.4.17. Additional Specifications for Relays**

- 4.4.17.1. All measurement relays must be of Numeric design.
- 4.4.17.2. Relays of Electromechanical design are acceptable only for use as auxiliary relays and contactors, not for measuring relays.

**4.4.18. Relay Programming Software and Connection Cables**

- 4.4.18.1. Software must be provided for programming and downloading data for all numerical relays supplied and also for any numerical instruments such as transducers provided.
- 4.4.18.2. It shall be possible to install the Software to twenty different computers without any additional License Cost. Two (2) CDs shall be supplied for each different type of Software.
- 4.4.18.3. Four (4) copies the software Users Guide shall also be supplied. The numerical relays will be equipped with an RS232 communication port or other suitable port to facilitate connection to a Laptop.
- 4.4.18.4. The relevant communication cable, between the relay and the laptop shall also be provided. Four (4) cables shall be provided for each set of Relays using the same cable. Four (4) communication cables shall be provided for each set of transducers and also for the power measurement unit.
- 4.4.18.5. Communication facilities shall be provided on each numerical relay for remote interrogation and programming of the numerical relays.
- 4.4.18.6. The relays will also have an MMI consisting of a keypad and an LCD screen to facilitate manual relay programming and data access.
- 4.4.18.7. Relay operation due to system fault, shall be indicated by a red L.E.D. and the fault details (flags) shall be displayed on the LCD screen. Both the relay fault flags and red L.E.D will be reset without opening the relay cover, except where the relay contacts are latched.

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Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



**TITLE:**  
**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 41 of 72	

**APPENDIX A: TESTING**

- A.1. The manufacturers shall carry out all the routine tests of the protective relays, control devices and accessories and measuring instruments at the factory.
- A.2. Copies of test reports shall be packaged together with the respective relays and measuring instruments before delivery to KPLC.
- A.3. The tests shall be in accordance with the requirements of IEC 60255 & IEC 60051.

**APPENDIX B: WARRANTY**

- B.1. The supplier/manufacturer warrants the purchaser that all goods supplied under this tender shall have no defect arising from design, materials or workmanship.
- B.2. A warranty of 60 months from the date of delivery of the measuring protection relays to KPLC store shall be offered by the manufacturer for the protection measurement relays, including annunciator relays.
- B.4. The Warranty for other auxiliary relays and control devices shall be 60 months from the date of delivery of the devices to Kenya Power store. Any protection relays and control and measurement devices found to have failed at commissioning or while the device is in service or store during the stated warranty periods shall be replaced free of charge by the manufacturer/Supplier.

**APPENDIX C: QUALITY MANAGEMENT SYSTEM (NORMATIVE)**

- C.1. The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the PQA 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 9001:2015
- C.2. The Manufacturer's Declaration of Conformity to applicable standards and copies of quality management certifications, including copy of valid and relevant ISO 9001:2015 certificate, shall be submitted with the tender for evaluation.

<b>Issued by: Head of Section, Standards Development</b>	<b>Authorized by: Head of Department, Standards</b>
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 42 of 72	

C.3. The manufacturer shall indicate the delivery time of the equipment; manufacturer's monthly and annual production capacity and experience in the production of the type and size of items being offered. A detailed list and contact addresses (including e-mail) of the manufacturer's previous customers for similar type of PQA 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 D: TECHNICAL DOCUMENTATION (NORMATIVE)**

D.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).

D.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**);

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 43 of 72	

- 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.

D.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.

D.4. Each equipment package shall be supplied with detailed user's manual printed in English language that includes the following among other information written in English language to Kenya Power stores. 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 E: TECHNICAL MANUALS/GUIDE & OPERATION AND MAINTENANCE  
MANUALS**

Technical manuals and operation and maintenance manuals shall be supplied with the goods as follows: -

- E.1. Eleven (11) copies of hard copy technical manual/guides shall be furnished to KPLC for each type of relay, transducer, and instrument and control device. Soft copy of the manuals shall also be supplied with the goods.

The technical manual shall describe in detail the handling, installation, application, technical data and operating curves, test and commissioning, servicing/maintenance and calibration of the protection relays, measuring devices, transducers and control accessories,

- E.2 These shall also include user/operator guide for protection relays, transducers, instruments and measuring devices for programming of the settings and configuration, and accessing the settings and data. Application drawings for the relay/device shall be included

The technical manuals shall be delivered to the office of the General Manager, Network Management, KPLC, at Stima Plaza, Nairobi.

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 44 of 72	

**APPENDIX F: FACTORY ACCEPTANCE TESTS, INSPECTION AND TRAINING**

- F.1. The protective relays shall be subjected to factory acceptance testing and inspection by at least two KPLC engineers at place of manufacture where all routine tests as per IEC 60255 shall be carried out on a minimum of two relays of each type for each specific (unique) configuration.
- F.2. All the Relays, Instruments and Control devices shall be inspected to ensure they fully comply with the specifications.
- F.3. In addition, training shall be conducted in the factory for the two KPLC engineers attending FATs, for the durations indicated below. Approval for shipment of goods by KPLC shall dependent on a satisfactory FAT report by the Engineers.
- F.4. The full cost of the visit, including air tickets and accommodation shall be borne by KPLC.
- F.5. Factory Training shall be carried out for the following relays: -
  - (i) Distance Protection Relay - 3 days
  - (ii) Biased Differential Protection Relay - 2 days
  - (iii) Feeder Protection & Control Relay – 2 days
  - (iv) Power Measurement Unit – 1 day
- F.6. The purpose of the training is to ensure that the KPLC engineers have adequate knowledge so that the relays are correctly installed, configured and parameters correctly set and finally the relays are successfully tested and put into service on the Kenyan Power system. The manufacturer/supplier shall conduct an assessment to ensure that the KPLC Engineers have acquired the necessary knowledge and skills to be able to successfully apply the relays on the power system.
- F.7. Where the number of days required for training on any of the above relays is more than what is indicated above, the manufacturer/bidder shall indicate the required number of days in their bid. The number of days indicated above is however the minimum requirement.
- F.8. Each supplier/manufacturer shall conduct training for the protection relays they shall be offered to supply.

**APPENDIX G: LOCAL TRAINING IN NAIROBI**

- G.1. Local Training shall be conducted for KPLC Engineers and Technicians in Nairobi. This training shall cover the following relays: -
  - (a) Distance Protection Relay - 2 days

<b>Issued by: Head of Section, Standards Development</b>	<b>Authorized by: Head of Department, Standards</b>
Signed:	Signed:
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3C B/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 45 of 72	

- (b) Transformer Differential Protection Relay - 3 days
- (c) Feeder Protection & Control Relay – 2 days
- (d) Power Measurement Unit – 1 day

- G.2. The Training shall be for a maximum of 10 working days and will involve training of not less than 15 Engineers/ Technicians.
- G.3. The manufacturer shall meet the total cost of the factory training as well as Local Training in Nairobi Kenya.
- G.4. The supplier shall also meet all the other costs for conducting the local training, including local accommodation and transport for the training staff. The supplier shall provide all the training materials including notes. However the costs do not include the transport and accommodation for KPLC engineers
- G.5. The purpose of the training is to ensure that the KPLC Engineers/Technicians have adequate knowledge so that the relays are correctly installed, configured and parameters correctly set and finally the relays are successfully tested and put into service on the Kenyan power system. The manufacturer/supplier shall conduct an assessment to ensure that the KPLC Engineers have acquired the necessary knowledge and skills to be able to successfully apply the relays on the power system.

#### **APPENDIX H: REQUIREMENT FOR TENDER EVALUATION**

- H.1. Two copies each of product catalogue and technical publications for the specific protection relays, transducers, instruments and control devices offered shall accompany the bid.  

The product catalogue and technical publications provided shall provide all the technical details of the offered relays/devices, including all the technical data and protection and control functions included in the device.

The product catalogue and technical publication shall be used to verify information entered in the technical schedules completed by the bidder.
- H.2. Application drawings for the relay/device shall also be submitted with the bid.
- H.3. Failure to submit the product catalogue and the technical publication for each relay/device included in the bid may lead to rejection of the bid.

<b>Issued by: Head of Section, Standards Development</b>	<b>Authorized by: Head of Department, Standards</b>
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 46 of 72	

**APPENDIX I: SOFTWARE**

- I.1. The software for each relay, transducer and measurement device shall be supplied for: -
- (i) Configuration of the protection, measurement and transducer device.
  - (ii) Setting and programming of all parameters for the relay, measurement and transducer device/
  - (iii) Download and analysis of relay disturbance and fault record data.
- I.2. Four CDs and four memory sticks for each type of software shall be supplied.
- I.3. It shall be possible to install each software in twenty (20) desktop/laptop computers without requirement for additional licenses. Where additional licenses are required, the cost shall be considered to have been included in the bid.
- I.4 The latest version of each software at the time of shipment of the goods shall be supplied.

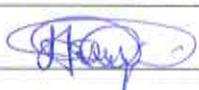
**APPENDIX J: PC TO DEVICE CONNECTION CABLE**

Twelve (12) sets of each different type of PC to relay/measurement/transducer device connection cable and all other integral accessories/tools to ensure successful communication between the Laptop and the relay/device shall be supplied.

**APPENDIX K: PACKING AND DELIVERY**

**K.1. PACKING**

- (i) Each item shall be packed properly or protected for shipment from the place of manufacture to the KPLC store.
- (ii) (ii) Each crate of package shall contain a packing list in a waterproof envelope and a copy in triplicate shall be forwarded to KPLC prior to dispatch. All items of material shall be clearly marked for easy identification against the packing list.
- (iii) All cases, packages, etc., shall be clearly marked on the outside to indicate the total weight, to show where the weight is bearing and the correct position of the slings and shall bear an identification mark relating them to the appropriate shipping documents.
- (iv) All Accessories necessary for mounting the Relays, Instruments and Control Devices on to the panels, for terminations of cables or for labelling of LED indications shall be provided with the Relays, Instruments and Control Devices.

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



**TITLE:**  
**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 47 of 72	

**K.2. MARKING**

The packaging shall be marked as detailed below.

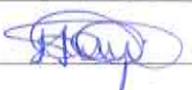
- (a) Consignee: THE KENYA POWER & LIGHTING CO. LTD.
- (b) Name of Project: PROTECTIVE RELAYS AND CONTROL DEVICES AND INSTRUMENTS FOR PROJECTS
- (c) Contract No.: .....
- (d) Port of destination: .....
- e) Item Number, Package number and quantity per package: .....
- f) Description of Contents: .....
- Net and gross weight, cubic measure: .....

**APPENDIX L: DELIVERY**

- L.1. The Supplier shall deliver all the Protection and Control items to KPLC bulk Stores at Isiolo Road, Nairobi.
- L.2. Before acceptance of the devices, all the relays, Instruments and Control accessories shall be checked for any physical damage, for completeness and correctness.
- L.3. The Supplier shall notify KPLC at least one week in advance on his/her date of delivery of the goods to the store.
- L.4. Together with KPLC's representative the supplier will remove the seals on the packages and together inspect the goods for adherence to specifications, for completeness and to ensure that the goods have no physical damage.
- L.5. Incorrect, damaged or incomplete Relays, Instruments and Control Accessories as per the Technical Specifications and the accepted offer and the delivery shall not be accepted and the supplier will take away such goods.
- L.6 All goods must be supplied within the stipulated time as per the contract.

**APPENDIX M: TENDER AWARD**

The tender shall be awarded on the basis of the lowest evaluated bidder for each item; i.e., the Relays, Control devices, Transducers and Measurement Instruments and Measurement Unit.

<b>Issued by: Head of Section, Standards Development</b>	<b>Authorized by: Head of Department, Standards</b>
<b>Signed:</b> 	<b>Signed:</b> 
<b>Date: 2019-06-07</b>	<b>Date: 2019-06-07</b>



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 48 of 72	

Protection relays and control devices offered and which has shown poor performance service in the system shall be rejected.

For purposes of reliability of the Power System Protection Systems, Distance Relays Type I and Line Current Differential Relay Type I may be awarded to two different manufacturers each. The same case applies to Distance Protection type II and Line Current Differential Type II. This is however subject to the relays meeting all the requirements of the specifications.

Warranty for all protection relay devices shall be 5 years from the date of delivery to the stores.

*Note 1: The cost for hard cover Technical Manuals, Guide and Operation and Maintenance manuals shall be deemed to be included in the unit cost of the respective Protection relay, Transducer, Measurement device and control device. Twelve (12) hard copy original manuals for each relay/device type shall be supplied together with the relay/device.*

*Note 2: Each supplier/manufacturer shall supply Twelve (12) Laptops for the lot that the supplier/manufacturer is offered to supply. The cost of the serial communication cables shall be deemed to be included in the bid price.*

*Note 3: Software for the Protection relays, Transducers and Power measurement units shall be supplied as indicated elsewhere in these specifications. This software shall be supplied by the supplier/manufacturer for the items they are offered to supply. The cost of the software shall be deemed to be included in the bid price.*

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Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



**TITLE:**  
**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 49 of 72	

**APPENDIX N: TECHNICAL SCHEDULES FOR RELAYS:**

*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 for previous five years, four customer reference letters, details of suppliers' capacity and experience; and copies of complete type test certificates and test reports for tender evaluation, all in English Language)*

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

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
1	<b>Scope</b>	State
3	Applicable standard	State
	<b>Requirements</b>	
4.1	Service conditions	State
4.2	General requirements	
4.2.1	Compliance to climatic aging conditions as per IEC 60932 class 2	State
4.2.2	Withstand of materials and finishes to humid tropical conditions	State compliance
4.2.3	Protective finish used for indoor parts	State
4.2.4	Protection of iron and steel against rusting	State
4.2.5	Material steel screws	State
4.2.6	Material used for instrument screws	State
4.2.7	Material used for springs	State
4.2.8	Material used for gaskets	State
4.2.9	Operation voltage range	State
	The Rated DC supply voltage shall be inscribed on the device	State compliance
4.3.1	<b>Materials</b>	
4.3.1.1	Shall be new and of the best quality and of the class most suitable for working under the conditions specified	State compliance
4.3.1.2	Ability to withstand the variations of temperature and atmospheric conditions	State
4.3.1.3.	Shall be suitable for installation in relay panels inside control rooms without air conditioning.	State
4.3.1.4	Minimal heat generation by the relays and other measuring devices	State
4.3.2	<b>Instruments</b>	
4.3.2.1	Instruments to be flush mounted, back connected and dust roof as per IEC 60051	State
4.3.2.2	Scale plates provided	State
4.3.2.3	Dimension of Analogue type enclosures	State
	Type of scale provided	State
	Maximum error	State

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TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 50 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.3.3.	<b>Protective Relays</b>	
4.3.3.1	Relays to be flush mounted and Numeric design as per IEC 60255	State
4.3.3.2	Communication port type, HMI facility	State
4.3.3.3	Relay making and breaking contacts rating	State
4.3.3.4	Relay Trip contacts shall be capable of interrupting without damage the Circuit Breaker Trip Coil Current should the Circuit Breaker Auxiliary Contacts fail to open	State compliance
4.3.3.5	Relay DC voltage rating	State
4.3.3.6	Switching capacity	State
4.3.3.5	Are contacts of the protective relays sufficient for Circuit Breaker Tripping and interrupting the Trip Current?	State
4.3.3.6	Relay contacts shall make firmly without bounce and the relay mechanism shall not be affected by Panel vibration or external magnetic fields	State compliance
4.3.3.7	Suitable for operation on the rated D.C. Auxiliary supply without use of dropping resistors or diodes	State compliance
4.4.3.8	Relay thermal ratings and multiplier Settings	State
4.4.3.9	Supplied with all accessories necessary for mounting/installation in panels and terminating all external wiring connections.	State compliance
4.4.3.10	Plug -in auxiliary relays for DIN rail mounting shall be supplied complete with the bases	State
4.4.1	<b>Ratings for Protection Relays and Control Devices:</b>	
(i)	Secondary rating of relay CTs	State
(ii)	Secondary Voltage Rating of VT	State
(iii)	DC auxiliary rating	State
(iv)	Relay trip indication	State
4.4.2	<b>Distance Protection Relay Type I</b>	
4.4.2.1	Shall provide fast and highly dependable selective fault clearance on both overhead and underground feeders	State compliance
4.4.2.2	Shall be suitable for application in a substation with 1&1/2 circuit breaker configuration	State compliance
Manufacturer's Name		State
Type or Designation name of Relay		State
Complete order number for offered Relay		State
4.4.2.3	Experience in manufacture of Distance Protection Relay	State
	Experience in Manufacture of Digital Distance Relay	State
4.4.2.4	Utilities and Regions/continents where the relay is already in service	State
4.4.2.5	Has relay failed in service or mal-operated on the Kenyan Power System?	State
4.4.2.6	Relay Warranty Period in years	State
4.4.2.7	Number of analogue current input channels	State

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Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 51 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
	Number of voltage input channels	State
4.4.2.8	Numerical Design and employ complete digital signal processing	State compliance
4.4.2.9	Shall be suitable for Flush mounting on the protection panel.	State compliance
4.4.2.10	Have Full Scheme distance protection, with parallel calculation and monitoring of all the fault loops	State compliance
4.4.2.11	Have selective single phase and/or three phase tripping Logic	State compliance
4.4.2.12	Starting criteria	State
4.4.2.13	Number of phase distance protection zones	State
4.4.2.14	Number of ground distance protection zones	State
4.4.2.15	Distance protection zone protection	State
4.4.2.16	Operating time for Distance Zone 1	State
4.4.2.17	Communication Aided Schemes for Distance Protection	State
4.4.2.18	Provision of Load Encroachment Discrimination Feature	State
4.4.2.19	Provision of Parallel line compensation feature	State
4.4.2.20	Measuring voltage monitoring/ Fuse failure supervision Logic	State
4.4.2.21	Shall be blocked from operating in the event of failure of the measuring voltage or when the auxiliary switch of the Voltage transformer secondary MCB trips	State compliance
4.4.2.22	Weak end in-feed Protection/ Echo and/or trip feature	State
4.4.2.23	Current Reversal Guard Feature	State
4.4.2.24	Power Swing detection feature	State
4.4.2.25	Out of step protection	State
4.4.2.26	Voltage Memory Feature	State
4.4.2.27	Automatic Switch on to Fault Feature(SOTF)	State
4.4.2.28	Communication Aided schemes for Directional Earth Fault(DEF) Protection	State
4.4.2.29	Back-up Overcurrent and Earth fault protection function	State
4.4.2.30	Stub Bus overcurrent protection function	State
4.4.2.31	Under frequency and rate of change of frequency Protection function	State
4.4.2.32	Overvoltage protection	State
4.4.2.33	Circuit Breaker Failure Protection	State
4.4.2.34	Circuit Breaker Contact wear feature	State
4.4.2.35	Broken Conductor detection for Alarm purposes	State
4.4.2.36	Auto-reclose function	State
4.4.2.37	Synchro-check Function	State
4.4.2.38	Fault Locator with automatic Distance to Fault indication on the LCD screen in km.	State
4.4.2.39	Accuracy of Distance to fault location	State
4.4.2.40	Information provided with fault location	State

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DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 52 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.2.41	Fault details to display on the LCD	State
4.4.2.42	Capacity of disturbance recorder	State
4.4.2.43	Capacity of storage of event records	State
4.4.2.44	Capacity of storage of trip records	State
4.4.2.45	Relay configuration & parameter settings, Event & Fault records and LED status are retained upon loss of relay DC power supply	State
4.4.2.46	Power system instantaneous parameters displayed on the LCD	State
4.4.2.47	Number of binary inputs	State
4.4.2.48	Number of binary outputs	State
4.4.2.49	Stability against switching inrush currents and reverse faults	State
4.4.2.50	Clear faulted phase indication	State
4.4.2.51	Clear fault identification even for boundary conditions	State
4.4.2.52	Number of LEDs	State
4.4.2.53	Communication protocols	State
4.4.2.54	Relay terminals type and size	State
4.4.2.55	Communication ports provided	State
4.4.2.56	Software for relay configuration and parameter setting and fault data Analysis offered for use with the relay. Software to be offered in CD form	State
4.4.2.57	Relay to Laptop connection cables offered	State
4.4.2.58	Relay configuration during FAT	State compliance
<b>4.4.3</b>	<b>Distant Protection Relay Type II</b>	
	Manufacturer's Name	State
	Type or Designation name of Relay	State
	Complete order number for offered Relay	State
4.4.3.1	Experience in manufacture of Distance Protection Relay	State
	Experience in Manufacture of Digital Distance Relay	State
4.4.3.2	Utilities and Regions/continents where the relay is already in service	State
4.4.3.3	Has relay failed in service or mal-operated on the Kenyan Power System?	State
4.4.3.4	Relay Warranty Period in years	State
4.4.3.5	Application of the relay	State
4.4.3.6	shall automatically display the distance to fault in km on the LCD screen upon fault interruption	State
4.4.3.7	Ability to Access the distance to fault details using the Keypad or a laptop	State
4.4.3.8	Number of analogue current input channels	State
	Number of analogue Voltage input channels	State
4.4.3.9	Suitability for flush mounting on the protection panel	State
4.4.3.10	Numeric/Digital Design with complete digital processing of measured values	State
4.4.3.11	Full distance Protection Scheme, i.e., non-switched	State

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TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.

KPI/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 53 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.3.12	Under Impedance Starting criteria. Other starting criteria in addition to the under impedance starting are acceptable	State
4.4.3.13	Three phase tripping Criteria, since it shall be used on sub-transmission and distribution lines	State
4.4.3.14	Four zones of Phase distance protection (for Phase-phase faults) with selectable Mho and Quadrilateral characteristics. Parameters (resistive reach, reactive reach and time delay) for each Zone independently set	State
4.4.3.15	Four zones of Ground distance protection, (for phase- Ground/Phase-Earth Faults) with selectable Mho and Quadrilateral characteristics with residual current compensation. Parameters (resistive reach, reactive reach and time delay) for each zone shall be independently set	State
4.4.3.16	Distance Protection Zones direction shall be independently set as forward or reverse or non-direction	State
4.4.3.17	Minimum operating time shall not exceed 40ms	State
4.4.3.18	The distance Relay shall have Communication channel Aided Scheme logic for the distance protection with at least the following schemes	State
	(i) Permissive Under-reach Transfer scheme	State
	(ii) Permissive Overreach Transfer scheme and	State
	(iii) Direct Transfer Tripping Scheme	State
4.4.3.19	Load encroachment Discrimination Feature	State
4.4.3.20	Fuse failure supervision Logic	State
4.4.3.21	Voltage Memory Feature	State
4.4.3.22	Automatic Switch on to Fault Feature(SOTF), enabled when the line is de-energised and only active for a set time delay after the line circuit breaker is closed	State
4.4.3.23	Directional Earth Fault Protection, with communication channel aided scheme as follows	State
	(i) Directional Comparison Scheme	State
	(ii) Blocking Scheme	State
4.4.3.24	Back up three phase overcurrent & Earth fault protection, with the following protection functions	State
	(i) High set element for Phase and Earth fault overcurrent with selectable definite time delay	State
	(ii) Low set element for Phase and Earth fault overcurrent with inverse current-time characteristics as per IEC 60255	State
4.4.3.25	Sensitive Earth Fault Protection	State
4.4.3.26	Stub Bus overcurrent protection	State
4.4.3.27	Circuit Breaker Failure Protection	State

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Date: 2019-06-07



Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.

KPI/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 54 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.3.28	Under-frequency and rate of change of frequency protection	State
4.4.3.29	Overvoltage protection	State
4.4.3.30	Broken conductor detection for Alarm purposes	State
4.4.3.31	Auto-reclose function for three phases, suitable for high speed and delayed auto-reclose. Fault types and Zones that initiate auto-reclose to be selectively enabled	State
4.4.3.32	The Auto-reclose scheme will be selectable as enabled or disabled preferably on the relay LCD screen	State
4.4.3.33	Only the selected functions in the distance relay shall initiate auto-reclose	State
4.4.3.34	The auto-reclose function shall be capable of two auto-reclose shots, with separately set dead times	State
4.4.3.35	Fault Locator; with automatic display on the Relay LCD Screen of the distance to fault in terms of Line percentage or distance in km. The last distance to fault shall always be displayed on the screen	State
4.4.3.36	The accuracy of Distance to fault location shall be $\pm 2\%$ as a minimum	State
4.4.3.37	The following additional information shall be provided with fault location	State
	(i) The short-circuit loop which was used to determine the fault reactance	State
	(ii) The reactance X per phase in Ohms Primary and secondary	State
	(iii) The reactance R per phase in Ohms Primary and secondary	State
	(iv) The distance to fault in percentage and km of line length	State
4.4.3.38	Ability to display Fault details on the LCD Screen such as Fault- Loop or Faulty phases, the Zone, and the Relay Operate time	State
4.4.3.39	Internal Disturbance recorder with capacity to record eight analogue and twelve digital signals. The relay shall have capacity to store the latest, twenty (20), disturbance records	State
4.4.3.40	Storage of at least Fifty (50) event records	State
4.4.3.41	Storage of at least twenty (20) trip records. The following fault data will be available	State
	(i) Magnitude and phase angle of phase currents and voltages before the fault	State
	(ii) Magnitude and phase angle of phase currents and voltages during the fault	State
	(iii) The sequence of events of digital signals, start and operate (Trip) signals involved in fault detection and clearance. The events shall be time tagged to 10ms level	State
4.4.3.42	Events and fault records shall not be erased even when the auxiliary DC supply is switched off	State

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Date: 2019-06-07



Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 55 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.3.43	Metering and display on the LCD screen of the following Power system instantaneous parameters including	State
	(i) Voltage	State
	(ii) Load current	State
	(iii) Active Power ( Import(+) or Export (-)	State
	(iv) Reactive Power( Import (+) or Export (-)	State
	(v) Apparent Power	State
	(vi) Power Factor and	State
	(vii) Frequency	State
4.4.3.44	Minimum ten (10) Binary inputs	State
4.4.3.45	Minimum twelve (12) Binary outputs	State
4.4.3.46	Stability against switching inrush currents and reverse faults	State
4.4.3.47	Clear faulted phase indication	State
4.4.3.48	Clear fault identification even for boundary conditions	State
4.4.3.49	At least twelve (12) LEDs for indication of the following; - Relay trip, Phase L1, Phase L2, Phase L3, Zone 1, Zone 2, Zone 3, DEF, Channel aided trip, SOTF, etc.	State
4.4.3.50	Relay healthy LED	State
4.4.3.51	Relay self-supervision, with LED for healthy status indication(green) and Error indication (red) and watchdog contact	State
4.4.3.52	Protocol applicable: IEC 61850-8-1. Appropriate communication ports to be provided on the relay	State
4.4.3.53	Relay Terminals-shall be screw type terminals large enough to accommodate at least 2 x2.5mm <sup>2</sup> cable and shall be located at the back of the relay	State
4.4.3.54	Front Serial RS232 or USB or Optical or Ethernet Port shall be provided for relay configuration and parameter setting and download of Data using a Laptop Computer	State
4.4.3.55	Software for Programming the configuration and Relay Settings and also downloading and analysing the Relay Data	shall be provided
4.4.3.56	Relay to Laptop connection cable	State
4.4.3.57	Relay configuration to be carried out by the manufacturer shall at the Factory to suit installation in existing transmission substations in KPLC Network. Existing Protection and control drawings for the substations shall be handed over to the manufacturer/supplier for relay configuration. The FATs shall be carried out once the relays have been configured. Correct functionality of all relay Protection and Control Functions shall be checked during the FATS	State

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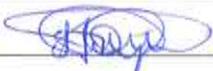


Kenya Power

TITLE:  
**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 56 of 72	

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.4	<b>Biased Differential Protection Relay for a Two or Three Winding Power Transformer</b>	State
	Manufacturer's Name	State
	Type or Designation name of Auxiliary Relay	State
	Complete order number for offered Auxiliary Relay	State
	<b>Manufacturer's Experience and Product Qualification</b>	State
4.4.4.1	The Relay manufacturer shall have a minimum experience of 25 years in the manufacture of Biased Differential Protection relays, 15 years of which shall be in the manufacture of Numerical Distance Protection relays	State
4.4.4.2	The Relay type offered must have been in Service and given reliable service for a minimum period of 8 years, in at least two utilities, in each of the following regions	State
	a. Europe	State
	b. North America	State
	c. Africa and	State
	d. Asia	State
4.4.4.3	Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted	State
4.4.4.4	Warranty for Offered relay shall be Five (5) years from the date of relay delivery to the KPLC store	State
	<b>Functions and Features</b>	State
4.4.4.5	Suitable for protection of a two or three winding power transformer, with a power rating of up to 90 MVA, with HV winding rated up to 245kV. Specific requirements will be stated in the Scope of supply or Price schedules	State
4.4.4.6	Relay must be of Numerical design	State
4.4.4.7	Flush mounting design	State
4.4.4.8	Pick up setting range, for IDIFF > 0.1 to 1.0 x rated current, as a minimum	State
4.4.4.9	Pickup on switch-on (factor of IDIFF>) 1.0 to 2.0	State
4.4.4.10	High-set Element (IDIFF>>) with a setting range of 1.0 to 20.0 x rated current	State
4.4.4.11	Independent definite time delay setting for IDIFF> and for IDIFF>> of 0.00 to 30.00 seconds as a minimum	State
4.4.4.12	Magnetizing current inrush restraint feature, using 2 <sup>nd</sup> harmonic restraint and /or zero crossing on the sine wave	State
4.4.4.13	Setting range of I <sub>2fn</sub> /I <sub>fn</sub> of 10 to 50% as a minimum	State
4.4.4.14	Compensation for zero sequence currents that may appear on only one winding of the power transformer	State

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Kenya Power

TITLE:

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Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 57 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.4.15	Measurement and indication on the LCD screen, of phase – HV&LV currents and relay differential and bias currents	State
4.4.4.16	Storage of at least Five (5) Fault records and Ten (10) Event records	state
4.4.4.17	Events and fault records shall not be erased even when the auxiliary DC supply is switched off	confirm
4.4.4.18	The Fault flags should be visible on the LCD screen, and provide details of the phases that have operated and the fault current values.	State
4.4.4.19	Over-fluxing protection function with at least two stages of alarm and trip functions	State
4.4.4.20	5 <sup>th</sup> harmonic restraint feature on the differential Element to prevent unnecessary tripping due to CT saturation or transformer over-excitation.	State
4.4.4.21	Over-excitation Protection with both alarm and trip elements	State
4.4.4.22	Stabilized against transient and steady-state fault currents caused e.g. by over-excitation of transformers, using fifth harmonic.	State
4.4.4.23	Insensitive against DC offset currents and current transformer saturation.	State
4.4.4.24	High stability also for different current transformer saturation	State
4.4.4.25	High-speed instantaneous trip on high-current transformer faults.	State
4.4.4.26	Independent of the conditioning of the star point(s) of the power transformer.	State
4.4.4.27	High earth-fault sensitivity by detection of the star point current of an earthed transformer winding	State
4.4.4.28	Integrated matching of the transformer connection group	State
4.4.4.29	Integrated matching of the transformation ratio including different rated currents of the transformer windings	State
4.4.4.30	Dual Bias characteristics with two slopes to ensure relay stability for heavy through faults. The start and end of the two slopes shall be settable, in terms of the rated current.	State
4.4.4.31	Unbalanced Load Protection	State
4.4.4.32	Thermal Overload Protection	State
4.4.4.33	Back up Overcurrent and Earth Fault protection for HV and/or LV winding	State
4.4.4.34	The following measurements shall be available in the relay:	State
	Magnitudes and phase angles of the phase currents for the three phases on the HV side of Transformer	State
	Magnitudes and phase angles of the phase currents for the three phases on the LV side of Transformer	State
	Magnitude of differential current and restraining current for the three phases	State

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**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 58 of 72	

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.4.35	The disturbance recorder function shall have a capacity for eight (8) analogue and twelve (12) digital signals. The last four disturbance records will be available in the relay.	State
4.4.4.36	Red L.E.D to indicate that the relay has operated/issued trip command	state
4.4.4.37	Relay Self diagnostic, with LED to indicate Relay failure and a contact for remote indication of relay failure status	State
4.4.4.38	The relay shall have at least eight (8) LEDs for trip and alarms and at least four (4) binary inputs.	State
4.4.4.39	The relay shall have at least our (4) outputs relays with normally open contacts for circuit breaker tripping and alarm annunciation. Two pairs of contacts shall be rated to directly energise the circuit breaker tripping coil.	State
4.4.4.40	The relay shall have the ability to select output contacts to latched or non-latched status and the LCD screen where the settings and measurands can be read.	State
4.4.4.41	The relay shall have keypad for manual programming of settings and data access.	State
4.4.4.42	The relay shall have front serial RS232 or USB or Ethernet Port for Relay communication with a laptop computer for relay configuration and parameter settings and download of fault records, events records and disturbance record.	State
4.4.4.43	Relay terminals-shall be screw type terminals large enough to accommodate at least 2x2mm <sup>2</sup> cable and shall be located at the back of the relay.	State
4.4.4.44	Four (4) sets of installation, commissioning, operation and maintenance manuals shall be provided.	State
4.4.4.45	Relay to Laptop connection cable shall be provided.	State
4.4.4.46	Software for relay configuration and settings programming using Laptop computer shall be provided.	State
4.4.5.	<b>Restricted Earth Fault Relay</b>	State
	Manufacturer's Name	State
	Type or Designation name of Auxiliary Relay	State
	Complete order number for offered Auxiliary Relay	State
	<b>Manufacturer's Experience and Product Qualification</b>	
4.4.5.1	Minimum of 25 years in the manufacture of Restricted Earth Fault Relays, 10 years of which shall be in the manufacture of numerical Restricted Earth Fault relays	State
4.4.5.2	The relay type offered must have been in service and given reliable service for a minimum period of 8 years, in at Least two utilities, in each of the following regions	State

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Kenya Power

TITLE:

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Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 59 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
	a. Europe	State
	b. North America	State
	c. Africa and	State
	d. Asia	State
4.4.5.3	Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.	State
4.4.5.4	Warranty for offered relay shall be five (5) years from the date of relay delivery to KPLC store	State
	<b>Functions and Features</b>	State
4.4.5.5	Shall be used for protection of one winding of a power transformer	State
4.4.5.6	Shall have the following functions and features: Relay shall be of Numerical, static type or Electro-Mechanical type.	State
	(i) The Relay shall operate on high impedance principle.	State
	(ii) The relay shall be of numeric design.	State
	(iii) The relay shall be suitable for flush mounting on panel front.	State
4.4.5.7	Relay shall be of an independent relay and not a function in the differential relay	State
4.4.5.8	Relay shall reject harmonics produced by the system particularly third harmonics	State
4.4.5.9	Stabilising resistor and voltage dependent resistor (metrosil) of suitable rating shall be offered with the Relay based on maximum through Fault of 31kA.	State
4.4.5.10	The relay current setting range shall be 0.05- 0.8 x rated current (In) as a minimum and an operating time < 25ms at 5 times the setting.	State
4.4.5.11	The relay shall have four (4) LEDs for relay status indication and for trip and alarms annunciation as a minimum and two (2) binary inputs as a minimum	State
4.4.5.12	The relay shall have four (4) Binary Outputs as a minimum with LCD screen where the settings and measurands can be read	State
4.4.5.13	The relay's REF operate current shall be displayed on the LCD screen and keypad for manual programming of settings and data access	State
4.4.5.14	The relay shall have serial RS232, USB or Ethernet Port for relay configuration and programming of parameter settings and data download using a laptop computer.	State
4.4.5.15	The relay shall have an event recorder with capacity to store the last fifty (50) events	State
4.4.5.16	The relay shall have fault recorder with capacity to store the last ten (10) fault records	State

Issued by: Head of Section, Standards Development

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Date: 2019-06-07

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TITLE:  
**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.	KPI/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 60 of 72	

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.5.17	The relay shall have a disturbance record with capacity to store the last four (4) disturbance records	State
4.4.5.18	The relay terminals shall be screw type terminals large enough to accommodate at least 4 mm <sup>2</sup> cable and shall be located at the back of the relay	State
4.4.5.19	<b>Stabilizing Resistor</b> Each REF relay shall be supplied with an adjustable stabilizing resistor. For dimensioning of the stabilizing resistor consider maximum through fault phase –earth current of 31.5kA	State
4.4.5.20	<b>Voltage Dependent Resistor (Metrosil)</b> Each REF relay shall be supplied with a voltage dependent resistor (VDR) or metrosil to limit voltage across the REF high impedance circuit. The basis for the rated voltage of the VDR is the maximum phase-earth through fault of 31.5kA	State
4.4.6	<b>Feeder Protection Relay</b>	State
	Manufacturer's Name	State
	Type or Designation name of Auxiliary Relay	State
	Complete order number for offered Auxiliary Relay	State
	<b>Manufacturer's Experience and Product Qualification</b>	State
4.4.6.1	The relay manufacturer shall have a minimum of 25 years in the manufacture of Feeders Protection relay, 15 years of which shall be in the manufacture of numerical Distance Protection relays	State
4.4.6.2	The relay type offered must have been in service and given reliable service for a minimum period of 8 years, in at Least two utilities, in each of the following regions:	State
	a. Europe	State
	b. North America	State
	c. Africa and	State
	d. Asia	State
4.4.6.3	Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted	State
4.4.6.4	Warranty for offered relays shall be five (5) years from the date of relay delivery to the KPLC store	State
4.4.6.5	The Relay shall have the following protection functions and features in a single casing as a minimum:	State
	i. Three phase overcurrent	State
	ii. Earth fault	State
	iii. Sensitive Earth Fault	State
	iv. Broken Conductor detection	State

Issued by: Head of Section, Standards Development	Authorized by: Head of Department, Standards
Signed:	Signed:
Date: 2019-06-07	Date: 2019-06-07



Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 61 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
	v. Auto-reclose function for three phase auto-reclose.	State
	vi. Under and Over Frequency Protection, including rate of change frequency protection	State
4.4.6.6	There shall be independent CT input for Earth Fault and for Sensitive Earth Fault Protection to allow independent connection of the Sensitive Earth Fault Protection Function to a separate Core type CT	State
4.4.6.7	Relay must be of Numerical design	State
4.4.6.8	Relays that have failed in service or mal-operated shall not be acceptable	State
4.4.6.9	The relays shall be suitable for flush mounting on the front of the panel	State
4.4.6.10	Current setting range for overcurrent function shall be 0.5In-2.0In as a minimum	State
4.4.6.11	Current setting range for earth fault function shall be 0.05In-0.8In as a minimum	State
4.4.6.12	Two stages of High Set Element for both overcurrent and earth fault protection function, with a setting range of 1-20In as a minimum and a definite time delay setting of 0 – 60 seconds as a minimum	State
4.4.6.13	I.D.M.T characteristics for overcurrent and Earth fault protection function according to BS142 or IEC60255 i.e. Standard Inverse (SI), Very Inverse (VI), Extremely Inverse (EI), Long Time Inverse (LTI), including definite time for the high-set Elements	State
4.4.6.14	Time setting multiplier 0.05 – 1.0 as a minimum	State
4.4.6.15	Current setting range for sensitive earth fault function 0.01In - 0.8In as a minimum	State
4.4.6.16	Definite time delay characteristic for Sensitive earth fault function; setting range, 0- 30 seconds as a minimum	State
4.4.6.17	Requirements for the auto reclose function:	State
	i. Three phases auto reclose	State
	ii. Selectable 1 – 3 auto-reclose shots	State
	iii. Independently set dead time for each shot	State
	iv. Auto-reclose inhibit after manual close	State
	v. Each auto-reclose shot shall be initiated by the selected Protection Function(s). Operation of Protection Function not selected to initiate a particular shot of Auto-reclose shall lead to Lock-out	State
	vi. Auto-reclose inhibition for over current high set element	State
4.4.6.18	Data Storage	State
	(i) Storage of at least five (5) fault/trip records	State
	(ii) Ten (10) event records	State
	(iii) Five (5) disturbance records	State

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Date: 2019-06-07

Date: 2019-06-07



**TITLE:**  
**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.	KPI/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 62 of 72	

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.6.19	Configurable output relays for protection element pick up (start) and Trip outputs which can be used to back-trip upstream circuit breakers and for implementing blocking schemes for busbar protection	State
4.4.6.20	Red L.E.D to indicate that the protection functions have operated and issued a trip output to Trip the circuit breaker	State
4.4.6.21	Relay self-diagnostic, with LED to indicate relay healthy status (green colour) and relay failed status (red colour) and a watch dog contact for remote alarm	State
4.4.6.22	LEDs: The relay shall have a minimum eight (8) LEDs for alarms annunciation.	State
4.4.6.23	Binary Outputs: The relay shall have as a minimum twelve (12) Binary inputs.	State
4.4.6.24	Binary Outputs: The relay shall have a minimum four (4) outputs Relays. One (1) of the output relays shall be adequately rated to directly operate the circuit breaker trip coil.	State
4.4.6.25	LCD screen where the settings and measurands can be read	State
4.4.6.26	Keypad for manual programming of settings and data access	State
4.4.6.27	Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm <sup>2</sup> cable and shall be located at the back of the relay	State
4.4.6.28	The relay applicable protocol shall be IEC 61850-8-1	State
4.4.6.29	Front Serial RS232 or USB or Ethernet Port for relay communication with a laptop computer for relay configuration and parameter settings and download of fault records, events records and disturbance records for analysis.	State
4.4.6.30	Software for configuration and relay parameter settings and also downloading and analysing the relay fault data shall be provided.	State
4.4.6.31	Relay to Laptop connection cable shall be provided	State
4.4.6.32	Auto reclose relay Function in the feeder protection relay. This auto reclose function shall be housed within the feeder protection relay;	State
	i. Selectable 1 – 3 auto reclose shots	State
	ii. Independently set dead time for each shot	State
	iii. Auto-reclose inhibit after manual close	State
	iv. Each auto-reclose shot shall be initiated by the selected protection function(s). Operation of protection function not selected to initiate a particular shot of auto-reclose shall lead to lock-out of the relay.	State
v. Auto-reclose inhibition for over current high set element.	State	

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<b>Signed:</b>	<b>Signed:</b>
<b>Date: 2019-06-07</b>	<b>Date: 2019-06-07</b>



Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 63 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.7	<b>Electrical Reset – Trip Relay</b>	State
	Manufacturer's Name	State
	Type or Designation name of Auxiliary Relay	State
	Complete order number for offered Auxiliary Relay	State
	<b>Manufacturer's Experience and Product Qualification</b>	State
4.4.7.1	Minimum of 15 years in the manufacture of Trip relays	State
4.4.7.2	The offered relays must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement	State
4.4.7.3	Relays that failed in Service or Mal-operated on the Kenyan Power System shall not be accepted	State
4.4.7.4	Warranty for offered relays shall be Five (5) years from the date of relay delivery to the KPLC store	State
	<b>Functions and Features</b>	State
4.4.7.5	High burden tripping relay, immune to capacitance discharge currents and leakage currents	State
4.4.7.6	At least Four (4) pairs of normally open (NO) and two (2) pairs of normally closed (NC) or 4NO/NC output contacts.	State
4.4.7.7	Instantaneous operation; time <15ms	State
4.4.7.8	The Relay shall be suitable for flush mounting	State
4.4.7.9	Flag or target shall be a red; L.E.D, or durable bulb or Red Mechanical flag	State
4.4.7.10	The Relay shall be electrically reset, and the reset button shall be inbuilt on the relay and accessible without opening the relay cover or shall be supplied separately for panel flush mounting, in which case the reset button shall be illuminated with red colour.	State
4.4.7.11	Contact rating – capable of carrying 30Amps for 3 seconds and 10A, continuously	State
4.4.7.12	Relay terminals-shall be screw type large enough to accommodate at least 4mm <sup>2</sup> cable and shall be located at the back of the relay	State
4.4.7.13	Relay terminals shall be clearly marked	State
4.4.7.14	Relay contacts configuration shall preferably be drawn on the relay casing.	State
4.4.7.15	Alternatively, a connection drawing shall be supplied with the relay.	State
4.4.7.16	Size not greater than 24x19x6 cm	State
4.4.8	<b>Self-Reset Trip Relay</b>	State
	Manufacturer's Name	
	Type or Designation name of Auxiliary Relay	State

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Signed: 	Signed: 
Date: 2019-06-07	Date: 2019-06-07



Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 64 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
	Complete order number for offered Auxiliary Relay	State
	<b>Manufacturer's Experience and Product Qualification</b>	State
4.4.8.1	Minimum of 15 years in the manufacture of trip relays	State
4.4.8.2	The offered relays must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.	State
4.4.8.3	Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.	State
4.4.8.4	Warranty for offered relays shall be five (5) years from the date of relay delivery to KPLC store.	State
4.4.8.5	High burden tripping relay, immune to capacitance discharge currents and leakage currents	State
4.4.8.6	At least Four (4) pairs of normally open (NO) and two (2) pairs of normally closed (NC) or 4NO/NC output contacts.	State
4.4.8.7	Instantaneous operation; time <15ms	State
4.4.8.8	The Relay shall be suitable for flush mounting or for mounting on 35mm DIN rail, in which case the relay shall be supplied complete with the base	State
4.4.8.9	Flag or target shall be a red; L.E.D, or durable bulb or Red Mechanical flag	State
4.4.8.10	The Relay shall be self-reset, once the relay initiating the trip resets.	State
4.4.8.11	Contact rating – capable of carrying 30Amps for 3 seconds and 10A, continuously and the Relay terminals shall be clearly marked	State
4.4.8.12	Relay Terminals-shall be screw type terminals large enough to accommodate at least	State
4.4.8.13	2 x 2.5 mm <sup>2</sup> cable and shall be located at the back of the relay	State
4.4.8.14	Drawing for relay connection shall be provided with the relay	State
4.4.8.15	Relay contacts configuration shall preferably be drawn on the relay casing.	State
4.4.8.16	Alternatively, a connection drawing shall be supplied with the relay.	State
4.4.8.17	Size not greater than 24x19x6 cm	State
4.4.9	<b>Trip Circuit Supervision Relay Type I</b>	State
	Manufacturer's Name	State
	Type or Designation name of Auxiliary Relay	State
	Complete order number for offered Auxiliary Relay	State
	<b>Manufacturer's Experience and Product Qualification</b>	State
4.4.9.1	Minimum of 15 years in the manufacture of Trip Circuit Supervision relays	State
4.4.9.2	The offered relays must have been sold to at least two utilities outside the country of manufacture, and operated reliably for at least 8 years. Copy of Export sales contract shall be provided with the bid to support this requirement.	State

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Date: 2019-06-07

Date: 2019-06-07



TITLE:  
**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 65 of 72	

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.9.3	Relays that have failed in service or mal-operated on the Kenyan Power System shall not be accepted.	State
4.4.9.4	Warranty for Offered relays shall be five (5) years from the date of delivery to KPLC store.	State
	<b>Functions and Features</b>	State
4.4.9.5	Continuous supervision of trip circuit for circuit breaker in both OPEN & CLOSED positions	State
4.4.9.6	Trip Circuit Healthy – Red/Green L.E.D ON	State
4.4.9.7	Trip circuit fail –Green/Red L.E.D OFF	State
4.4.9.8	Two (2) normally closed (NC) and two (2) normally open(NO) or 2 C/O (change-over) output contacts	State
4.4.9.9	The relay shall have a time delay of at least 150mS to avoid transient operations	State
4.4.9.10	Contact ratings – 30 Amps for 3 seconds and 5 Amps continuously.	State
4.4.9.11	Suitable for Flush mounting on the relay panel	State
4.4.9.12	Relay Terminals-shall be screw type terminals large enough to accommodate at least 4mm <sup>2</sup> cables and shall be located at the back of the relay and relay terminals shall be clearly marked.	State
4.4.9.13	Relay shall be supplied complete with the base.	State
4.4.9.14	Relay contacts configuration shall preferably be drawn on the relay casing.	State
4.4.9.15	Alternatively, a connection drawing shall be supplied with the relay.	State
4.4.9.16	Size not greater than 16x9x9 cm	State
4.4.10	<b>Auxiliary relays For Transformer Mechanical Protection Trip Function Type I</b>	State
	<b>Manufacturer's Experience and Product Qualification</b>	State
	Manufacturer's Name	State
	Type or Designation name of Auxiliary Relay	State
	Complete order number for offered Auxiliary Relay	State
4.4.10.1	Years of Experience in the manufacture of Annunciator relays	State
4.4.10.2	Utilities outside the manufacturer's country where the relay has been sold	State
	Number of similar Annunciator Relay sold to date to the export market: Minimum; 1000	State
4.4.10.3	Have the offered Annunciator Relay failed in service or mal-operated on the Kenyan Power System?	State
4.4.10.4	Relay Warranty period in years	State
	<b>Functions and Features:</b>	
4.4.10.5	Application	State
4.4.10.6	Relay features:	
	i. Relay operating time	State

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Date: 2019-06-07

Date: 2019-06-07



Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL  
DEVICES AND INSTRUMENTS-  
SPECIFICATION**

Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 66 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
	ii. Number of relay elements per casing	State
	iii. Hand reset contacts and red flag	State
	iv. Suitable for 35mm DIN Rail mounting	State
	v. Number of NO contacts	State
4.4.10.7	Type and size of relay terminals for cable termination	State
4.4.10.8	Contact ratings	State
4.4.10.9	Relay terminals are indelibly marked	State
4.4.10.10	Supplied complete with base	State
4.4.10.11	Relay contacts configuration	State
4.4.10.12	Wiring drawings	State
4.4.10.13	Size : lxhxb	State
<b>4.4.11</b>	<b>Annunciator Relay Type I</b>	State
	Manufacturer's Name	State
	Type or Designation name of Annunciator Relay	State
	Complete order number for offered Annunciator Relay	State
4.4.11.1	Years of Experience in the manufacture of Annunciator relays	State
4.4.11.2	Utilities outside the manufacturer's country where the relay has been sold	State
	Number of similar Annunciator Relay sold to date to the export market: Minimum; 1000	State
4.4.11.3	Have the offered Annunciator Relay failed in service or mal-operated on the Kenyan Power System?	State
4.4.11.4	Relay Warranty period in years	State
4.4.11.5	Relay application	State
4.4.11.6	Design of the Annunciator Relay	State
4.4.11.7	Suitability in reading and acknowledging alarms	State
4.4.11.8	Method of programming the alarms	State
4.4.11.9	Behaviour of alarms upon loss of auxiliary DC supply	State
4.4.11.10	Alarm management buttons	State
4.4.11.11	Number of alarm elements/windows	State
4.4.11.12	Numerical/Digital design	State
4.4.11.13	Suitability for Panel flush mounting design	State
4.4.11.14	Alarm elements freely configurable to URGENT or NON-URGENT alarm bus and to output relays	State
4.4.11.15	LED colour for alarm ON Indication	State
4.4.11.16	Immunity against electrical interference	State
4.4.11.17	Relay terminals type and size	State
4.4.11.18	Marking of relay terminals	State
4.4.11.19	Relay configuration	State
4.4.11.20	Number of contacts for output relays	State

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Date: 2019-06-07

Date: 2019-06-07



Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No. KP1/3CB/TSP/02/004

Issue No. 1

Revision No. 3

Date of Issue 2019-06-07

Page 67 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.11.21	Field configurable labels	State
4.4.11.22.	Number of Normally Open (NO) out-put contacts	State
<b>4.4.12</b>	<b>Annunciator Relay Type II</b>	
	Manufacturer's Name	State
	Type or Designation name of Annunciator Relay	State
	Complete order number for offered Annunciator Relay	State
4.4.12.1	Years of Experience in the manufacture of Annunciator relays	State
4.4.12.2	Utilities outside the manufacturer's country where the relay has been sold	State
	Number of similar Annunciator Relay sold to date to the export market: Minimum; 1000	State
4.4.12.3	Have the offered Annunciator Relay failed in service or mal-operated on the Kenyan Power System?	State
4.4.12.4	Relay Warranty period in years	State
4.4.12.5	Application	State
4.4.12.6	Design of the Annunciator Relay	State
4.4.12.7	Suitability in reading and acknowledging alarms	State
4.4.12.8	Method of programming the alarms	State
4.4.12.9	Behaviour of alarms upon loss of auxiliary DC supply	State
4.4.12.10	Numerical/Digital design	State
4.4.12.11	Suitability for Panel flush mounting design	State
4.4.12.12	Alarm management buttons	State
4.4.12.13	Number of alarm elements/windows	State
4.4.12.14	Has relay operated in Kenya power System successfully for the last 4 years?	State
4.4.12.15	Has the relay offered been supplied before?	State
4.4.12.16	Alarm elements freely configurable to URGENT or NON-URGENT alarm bus and to output relays	State
4.4.12.17	LED colour for alarm ON Indication	State
4.4.12.18	Immunity against electrical interference	State
4.4.12.19	Relay terminals type and size	State
4.4.12.20	Marking of relay terminals	State
4.4.12.21	Relay configuration	State
4.4.12.22	Number of contacts for output relays	State
4.4.12.23	Wiring drawings	Provide
<b>4.4.13</b>	<b>Discrepancy Switch for Circuit Breaker Control</b>	State
	Manufacturer's Name	State
	Type or Designation name of Discrepancy switch	State
	Complete order number for offered Discrepancy switch	State
4.4.13.1	Manufacturer's experience in manufacture of Discrepancy switch	State

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Signed:

Date: 2019-06-07

Date: 2019-06-07



Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.

KPI/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 68 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.13.2	Utilities outside the manufacturer's country where the Discrepancy control switch has been sold	State
	Number of similar Discrepancy switches sold to date to the export market: Requirement; 1000	State
4.4.13.3	Have the offered Discrepancy switches failed in service or mal-operated on the Kenyan Power System?	State
4.4.13.4	Discrepancy Switch Warranty Period in years	State
4.4.13.5	Suitability for flush mounting	State
4.4.13.6	Application	State
4.4.13.7	Number and configuration of contacts for close and open operations	State
4.4.13.8	Indication for discrepancy in circuit breaker status	State
4.4.13.9	Durability and sturdy discrepancy switch	State
4.4.13.10	Indelibly marked rectangular escutcheon plate with closing and opening positions clearly marked	State
4.4.13.11	Shape of Top of the switch	State
4.4.13.12	Type and size of switch contacts for cable termination	State
4.4.13.13	Marking of the switch terminals	State
4.4.13.14	Switch configuration drawing	Provide
4.4.13.15	Rating of discrepancy white illumination bulb	State
4.4.13.16	Type of switch offered	State
<b>4.4.14</b>	<b>Semaphore for Isolator and Earth Switch Position Indication</b>	
	Manufacturer's Name	State
	Type or Designation name of LED Indicating Lamps	State
4.4.14.1	Manufacturer's experience in manufacture of Semaphores	State
4.4.14.2	Application of the semaphores	State
4.4.14.3	Utilities outside the manufacturer's country where the Semaphore has been sold	State
	Number of Semaphores sold to the Export Market – Minimum: 1000	State
4.4.14.4	Have the offered Semaphores failed in service or mal-operated on the Kenyan Power System?	State
4.4.14.5	Warranty period for Semaphores in years	State
4.4.14.6	Suitability for Panel Flush mounting	State
4.4.14.7	Indications for Closed and Open status	State
4.4.14.8	Front appearance	State
4.4.14.9	Type and size on semaphore terminals for cable connection	State
	Marking of the terminals	State
<b>4.4.15</b>	<b>LED Indicating Lamps</b>	
	Manufacturer's Name	State
	Type or Designation name of LED Indicating Lamps	State

Issued by: Head of Section, Standards Development

Authorized by: Head of Department, Standards

Signed:

Signed:

Date: 2019-06-07

Date: 2019-06-07



Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 69 of 72	

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.15.1	Manufacturer's experience in the Manufacture of LED Indicating Lamps.	State
4.4.15.2	Utilities outside the manufacturer's country where the LED indicating lamp has been sold	State
	Number of LED indicating Lamps sold to the Export Market – Minimum: 1000	State
4.4.15.3	Have the offered LED Indicating Lamps failed in service or mal-operated on the Kenyan Power System?	State
4.4.15.4	Warranty in years.	State
4.4.15.5	Supplied complete with lamp and mounting base	State
4.4.15.6	Suitable for flush mounting	State
4.4.15.7	Type of LED Indicating Lamps	State
4.4.15.8	LED lamp rating in watts	State
4.4.15.9	Minimum operating life	State
4.4.15.10	Red LED indicators are of the high brightness type	State
<b>4.4.16</b>	<b>Multi-Functional Power Meter</b>	
	Manufacturer's Name	State
	Type or Designation name of Multi-functional Power meter	State
4.4.16.1	Manufacturer's experience in the Manufacture of Multi-functional Power meter	State
4.4.16.2	Utilities outside the manufacturer's country where the Multi-Functional Power Meter has been sold	State
	Number of Multi-functional Power Meter, sold to the Export Market – Minimum: 1000	State
4.4.16.3	Has the offered Multi-functional Power meter failed in service or mal-operated on the Kenyan Power System?	State
4.4.16.4	Warranty period for Multi-Functional Meter in years	State
4.4.16.5	Suitability for flush mounting	State
4.4.16.6	Design	State
4.4.16.7	Type of display	State
	Number of measurands displayed simultaneously	State
4.4.16.8	Keypad simplicity to allow scrolling between the various measurands	State
4.4.16.9	The instantaneous values measured by the unit	State
4.4.16.10	Ability to measure time stamped maximum and minimum demand for current and power (MW & MVA)	State
4.4.16.11	Shall measure unbalance voltage and current	State
4.4.16.12	Shall measure Total harmonic distortion(THD) and Total Demand Distortion(TDD) for current and voltage	State
4.4.16.13	Rated current and Voltage	State
4.4.16.14	Maximum current and voltage the unit can withstand continuously	State

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Kenya Power

TITLE:

**PROTECTIVE RELAYS, CONTROL DEVICES AND INSTRUMENTS-SPECIFICATION**

Doc. No.

KP1/3CB/TSP/02/004

Issue No.

1

Revision No.

3

Date of Issue

2019-06-07

Page 70 of 72

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
4.4.16.15	Suitability for flush mounting	State
4.4.16.16	3 phase, 4-wire connection	State
4.4.16.17	Port for programming	State
	CT and VT ratio programmable	State
4.4.16.18	Communication ports	State
4.4.16.19	Communication protocols	State
4.4.16.20	Accuracy class	State
4.4.16.21	Inbuilt real-time clock and calendar feature	State
4.4.16.22	Display operation	State
4.4.16.23	Software provided	State
	PC to Measurement Unit connection cable provided	State
4.4.16.24	Terminals clearly marked	State
	Type & size of terminals	State
4.4.16.25	Measurement range for MVA	State
<b>4.4.17</b>	<b>Additional specification for relays</b>	
4.4.17.1	Design of all measurement relays	State
4.4.17.2	Use of electromechanical relays used	State
<b>4.4.18</b>	<b>Relay Programming Software and Connection Cables</b>	
4.4.18.1	Software supplied for all numerical relays and numerical instruments	State
4.4.18.2	Number of computers that can be installed a software without any additional License Cost	State
	Number of CDs for each different type of Software	State
4.4.18.3	Number of software user guides	State
	Type of communication port to facilitate connection to a Laptop	State
4.4.18.4	Number of communication cables for each set of relays	State
	Number of communication cables for each set of transducers	State
	Number of communication cables for power measurement unit	State
4.4.18.5	Communication facility provided for remote interrogation and programming of the numerical relays	State
4.4.18.6	Type MMI provided to facilitate manual relay programming and data access.	State
4.4.18.7	Relay operation during system fault indications	State
<b>A</b>	<b>TESTING</b>	
A1.	Responsibility of carrying out tests	State
A2.	Copies of Type Test Reports submitted with tender	State
A3.	Test requirements	State
<b>B</b>	<b>WARRANTY</b>	
B.1	There shall be no defect arising from design, materials or workmanship	State
B.2	Warranty period for protection measurement relays	State

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Doc. No.	KP1/3CB/TSP/02/004
Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 71 of 72	

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
B.3	Warranty period for auxiliary relays and control devices	State
	Replacement without charge for items within the warranty period	State
<b>C</b>	<b>QUALITY MAMNAGEMENT SYSTEM</b>	
C.1	Quality Assurance Plan	State
C.2	Copy of ISO 9001:2008 Certificate	State
	Manufacturer's experience	State
	Manufacturing Capacity (units per month)	State
	List of previous customers	State
	Customer reference letters	State
<b>D</b>	<b>TECHNICAL DOCUMENTATION</b>	
D.1	Documents to be submitted for tender evaluation	State
D.2	Documents to be submitted for approval before manufacture	State
D.3	Routine test reports submitted for approval before shipment	State
D.4	Documentation included in the equipment package	State
<b>E</b>	<b>TECHNICAL MANUALS/GUIDE AND OPERATION AND MAINTENANCE MANUALS</b>	
E.1	Number of hard copy technical manual and guides	State
	Soft copy manuals provided	State
E.2	Number of user/operator guides	State
<b>F</b>	<b>FACTORY ACCEPTANCE TESTS, INSPECTION AND TRAINING</b>	
F.1	FAT to be conducted by 2 KPLC engineers and training	State
F.2	Inspection	State
F.3	Cost of local transport to be borne by the manufacturer during FAT	State
F.4	Number of days for factory training for Distance protection relays	State
	Number of days for factory training for Biased Differential Protection Relay	State
	Number of days for factory training for Feeder Protection & Control Relay	State
	Number of days for factory training for Power Measurement Unit	State
F.5	Assessment of the training by the manufacturer	State
<b>G</b>	<b>LOCAL TRAINING IN NAIROBI</b>	
G.1.	Number of days for local training for Distance protection relays	State
	Number of days for local training for Biased Differential Protection Relay	State
	Number of days for local training for Feeder Protection & Control Relay	State
	Number of days for local training for Power Measurement Unit	State
G.2	Number of working days for the training	State
	Number of Engineers/Technicians to be trained	State
G.3	The supplier to meet all costs and provide all training materials	State
G.4	Assessment of the training by the manufacturer	State

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Issue No.	1
Revision No.	3
Date of Issue	2019-06-07
Page 72 of 72	

CLAUSE	KPLC REQUIREMENTS	BIDDER'S OFFER
<b>H</b>	<b>PACKING AND MARKING</b>	
H.1	Packing Details	State
H.2	Marking Details	State
<b>I</b>	<b>DELIVERY</b>	
I.1	Delivery to KPLC bulk Stores at Isiolo Road, Nairobi.	State
I.2	Inspection at KPLC stores	State
I.3	One week notification before delivery	State
I.4	Supply within the stipulated time as per the contract	State
	Statement of compliance to specification	State

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

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

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