

DOCUMENT NO.: KP1/6C/4/1/TSP/11/035



Kenya Power

220KV SURGE ARRESTERS - SPECIFICATION

A Document of the Kenya Power & Lighting Co. Ltd

June 2018



**220KV SURGE
ARRESTERS -
SPECIFICATION**

Doc. No.	KP1/6C/4/1/TSP/05/035
Issue No.	3
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0.1 CIRCULATION LIST



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

REVISION OF KPLC STANDARDS

In order 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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Users are reminded that by virtue of Section 25 of the Copyright Act, 2001 (Revised 2009) Cap 130 of the Laws of Kenya copyright subsists in all KPLC Standards and except as provided under Section 26 of this Act, no KPLC Standard produced by KPLC may be reproduced, stored in retrieval system by any means without prior permission from the Managing Director & CEO, KPLC.

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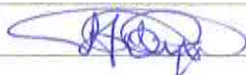
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0.2 AMENDMENT RECORD

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
0	2012-03-22	Cancels and replaces all previous issues	S. Kimitei	G. K. Gathige
0	2018-05-28	(i) Updated table 1 and 2 (ii) Added clause 4.2.2 on surge arrester housing.	Nancy Wairimu	Dr. Eng. Peter Kimemia 

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FOREWORD

This specification has been prepared by the Standards Department and Technical services department both of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for 220kV Surge Arrestors.

The surge arresters are intended for use in the power system to protect electrical equipment from overvoltage and transients caused externally by lightning and internally by switching.

Specifications in this series are:



- (i) TSP/11/033 -Specification for 66kV Surge Arresters
- (ii) TSP/11/034- 132kV Surge Arresters - Specification
- (iii) TSP/11/036- Specification for 11kv and 33kv surge arrestors for distribution systems
- (iv) TSP/11/037- Integrated Drop-out surge arrestors & Fuse (11kv and 33kv) Unit Specification

This specification stipulates the minimum requirements for Surge Arrestors 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 exhibits good workmanship and good engineering practice in the manufacture.

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

Technical Team

Name	Designation	Department
Rose Murage	3 rd Assistant Engineer	Network Management
Nancy Wairimu	4 th Assistant Engineer	Standards

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1. SCOPE

- 1.1. This specification, 220kV Surge Arresters, covers non-linear metal-oxide resistor type surge arresters without spark gaps designed to limit voltage surges on a.c. power circuits operated at 220kV nominal voltages at 50Hz.
- 1.2. The specification covers requirements, design, inspection and tests and schedule of Guaranteed Technical Particulars of surge arresters.

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 60099:	Surge arresters - Part 4: Metal-oxide surge arresters without gaps for a.c. systems - Part 5: Selection and application recommendations.
IEC 60270:	High-voltage test techniques — partial discharge measurements.
IEC 60071-2:	Insulation co-ordination - Part 2: Application Guide.
IEC 60507:	Artificial pollution tests on high voltage insulators to be used on ac systems.
IEC 60587	Electrical insulating materials used under severe ambient conditions - Test methods for evaluating resistance to tracking and erosion.
ISO 1461	Metallic Coatings – Hot dip galvanized coatings on fabricated ferrous products – Requirements.
ISO 48:	Rubber, vulcanized or thermoplastic -- Determination of hardness (hardness between 10 IRHD and 100 IRHD),
IEC/TS 60815:	Selection and dimensioning of high voltage insulators intended for use in polluted conditions.
ISO 9001:	Quality Management System.

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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 Electrotechnical Commission

ISO - International Organization for Standardization.

4. REQUIREMENTS

4.1. SERVICE CONDITIONS

4.1.1 The 220kV Surge Arrestors shall be suitable for continuous use outdoors in tropical areas and harsh climatic conditions including areas exposed to:

- a) Altitudes of up to 2200m above sea level;
- b) Humidity of up to 95%;
- c) Average ambient temperature of +30°C with a minimum of -1°C and a maximum of +40°C
- d) Pollution: Design pollution level to be taken as "Heavy" (Pollution level III) for inland and "Very Heavy" (Pollution level IV) for coastal applications in accordance with IEC 60815.
- e) Isokeraunic level: 180 thunderstorm days per year

4.1.2 The Surge Arrestors shall be connected between phase and earth to a system that is generally solidly earthed and with the following system characteristics shown in Table 1.

Table 1: System requirements

Particulars	Requirements
System highest voltage, kV	245
Frequency, Hz	50
Maximum duration of earth fault, Seconds	3
Earth fault factor as per IEC 60099-4	1.4
Maximum short circuit current, kA	10

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Particulars		Requirements
Discharge class as per IEC 60099-4		3
Power frequency withstand voltage, wet, kVrms		395
Lightning impulse withstand voltage, kV peak		950
Pollution level as per IEC TS 60815	Inland	III (Heavy)
	Coastal	(IV) Very Heavy
Minimum specific creepage distance as per IEC TS 60815	Inland	25mm/kV
	Coastal	31mm/kV

4.2. DESIGN AND CONSTRUCTION

4.2.1. GENERAL

- 4.2.1.1. The 220kV Surge Arrestors shall be designed and constructed in accordance with IEC 60099-4 and the requirements of this specification.
- 4.2.1.2. The Surge Arrestors shall be suitable for atmospheric and switching overvoltage protection of switchgear, transformers, cables and other high voltage equipment.
- 4.2.1.3. The Surge Arrestors shall have one non-linear metal-oxide resistor with highly non-linear voltage-current characteristics, connected in series, but having no integrated series or parallel spark gaps
- 4.2.1.4. The metal-oxide used shall be of quality to ensure thermal stability under service duty of the surge arrester.
- 4.2.1.5. The Surge Arrestors shall be single column with no stack, self-supported and shall be installed between phase and earth.
- 4.2.1.6. Surge Arrester shall be provided with a pressure relief device, a means for relieving internal pressure in an arrester and preventing explosive shattering of the housing following prolonged passage of flow current or internal flashover of the arrester.
- 4.2.1.7. Each Surge Arrester shall be supplied complete with a surge counter and a leakage current indicator. The interpretation of condition indication shall be given on the unit.
- 4.2.1.8. The Surge Arrestors shall be hermetically sealed to ensure no moisture absorption or deterioration of the metal-oxide element of the surge arrester.

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- 4.2.1.9. Each Surge Arrestor shall be complete with a disconnecter/fault indicator device for disconnecting the arrester from the system in the event of arrester failure, to prevent a persistent fault on the system and to give visible indication of the failed arrester. Technical details (including interpretation of the condition indication) of the device shall be submitted with the bid.
- 4.2.1.10. Each Surge Arrestor shall be supplied complete with fixing accessories, line terminal and earth terminal. It shall be fitted with conductor connector (suitable for conductor sizes of up to 400mm², either copper or aluminium).
- 4.2.1.11. The steel plates or straps and all ferrous parts shall be hot dip galvanized in accordance with ISO 1461.
- 4.2.1.12. Each Surge Arrestor shall be complete with an insulating base. The mounting shall be on a pitch circle diameter (p.c.d.) of 127mm.
- 4.2.1.13. The guaranteed protection characteristics of the surge arrester based on IEC 60099-4 selection formulas shall be required to comply during tests, with all the withstand capabilities stated in Table 2 below.

Table 2: Technical protective data for Arrester

Guaranteed protective data for Arrester calculated as per IEC 60099-4 & 5		
Description		Requirement
Rated voltage, Ur, kV		220kV
Maximum system voltage, Um, kV		245
Continuous operating voltage, kVrms	As per IEC 60099-4, Uc	156
Temporary overvoltage capability (TOV), kVrms	1 s	≥ 255kV
	10 s	≥ 244kV
Maximum residual voltage with current wave	5 kA 8/20 μs	≤ 451 kV
	10 kA 8/20 μs	≤ 475 kV
	20 kA 8/20 μs	≤ 513 kV
	40 kA 8/20 μs	≤ 570 kV
	500 A 30/60 μs	≤ 390kV
	1 kA 30/60 μs	≤ 404 kV
	2 kA 30/60 μs	≤ 419 kV
Lightning impulse protective level, max, kV as per IEC 60099-5		475
Steep current impulse protective level, max, kV as per IEC 60099-5		499

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Guaranteed protective data for Arrester calculated as per IEC 60099-4 & 5

Description		Requirement
Energy discharge capability, kJ/kVrms at Ur		≥7.50
Metal oxide (MO) diameter, nominal, mm		60
Height of the MO resistor column, nominal, mm		36
Long duration discharge class (current compliance)	Current, A	910
	Duration, μs	2000
Accelerated ageing performance	Temperature, °C	20
	Time, hrs	1000
Operating duty characteristics (Discharge current withstand)	Two 4/10μs current wave (Ur), kA	100
	Low current at 2000μs, kApk	910
Partial discharge performance, pC as per IEC 60270.		≥ 10pC
Pressure relief withstand capability (Short circuit)	High symmetrical RMS (A), duration (s)	6500 / 0.2
	Low symmetrical RMS (A), duration (s)	600 / 1

4.2.2. HOUSING

- 4.2.2.1. The housing of the Surge Arrestor shall be made of high quality reinforced high temperature vulcanized (HTV) silicone rubber based on dimethyl siloxane, which exhibit hydrophobicity with the capability to transfer hydrophobicity to the layer of pollution.
- 4.2.2.2. The reinforced HTV silicone rubber shall have a Shore 'A' hardness of not less than 60 as per ISO 48 and the track resistance of the sheath and shed materials shall meet the requirements of IEC 60587 Method 1 Class 1A4.5 or 1B4.5 or Method 2 Class 2A4.5.
- 4.2.2.3. The housings shall meet the requirements of IEEE Std. 592 by demonstrating shield resistance of less than 5000Ω and capability of initiating two consecutive fault-current arcs to ground.
- 4.2.2.4. The complete Surge Arrestor shall be housed in a silicon rubber housing which shall be dimensioned to provide a leak free interface with the end caps.

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- 4.2.2.5. Insulator sheds shall be open type, designed to minimize trapping of contamination. It shall be made of polymer having glazed grey color.
- 4.2.2.6. The silicon rubber housing shall be made by direct molding method.
- 4.2.2.7. The entire insulator housing shall have the rated withstand voltage given in Table 3 based on IEC 60099-4 clause 6.1.

Table 3: Withstand capabilities of surge arrester housing as per IEC 60099-4

Description		Units	Requirement
Maximum system voltage, Um,		kV	245
Lightning impulse withstand voltage,		kV pk	933
Power frequency withstand voltage for 1 min, wet		kVrms	490
Creepage distance	25mm/kV	mm	6125
	31mm/kV	mm	7595
Permissible head load static (SLL),		N	2000 SLL
Permissible head load dynamic (SLL),		N	2500 SSL
Short circuit withstand capability current (Is)		kA	65
Permissible length of the active part		mm	> 2700mm
Housing shield resistance		Ω	>5000
Number of units			2

5. TESTS REQUIREMENTS

The Surge Arresters shall be inspected and tested in accordance with the requirements of IEC 60099-4, IEC 60099-5, IEC 60507, IEC 60071-2, IEC 60587, ISO 48, ISO 1461 and provision of this specification.

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6. MARKING AND PACKAGING

6.1. MARKING



The following information shall be marked indelibly and legibly on a nameplate permanently attached to each surge arrester in English language:

- a) Continuous operating voltage;
- b) Rated voltage;
- c) Rated frequency;
- d) Nominal discharge current;
- e) Rated short-circuit withstand current in kilo amperes (kA);
- f) The manufacturer's name and trade mark;
- g) Type and identification of the complete arrester;
- h) The year of manufacture;
- i) Line discharge class
- j) Standard of manufacture
- k) The letters, "**Property of the The Kenya Power & Lighting Co. Ltd.**"

6.2. PACKAGING

- 6.2.1. The Surge Arrestors shall be supplied packed in wooden crates which are reinforced and held closed by external steel wire bindings. Each crate shall be internally braced to permit stacking and the steel wire bindings shall be designed to keep the crate firmly closed and permit easy and rapid opening at time of installation.
- 6.2.2. The crates shall then be stacked on sturdy wood pallet. The assembly shall be held tightly in place with steel bands and protected against moisture by a complete covering of heat-shrinkable polyethylene film.
- 6.2.3. A set of three (3) original installation and technical manuals for the surge arresters shall be supplied with the equipment. Details on the surge counter and disconnect/fault indicator device shall also be submitted during deliver (as well as for tender evaluation).

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APPENDICIES

A: TESTS AND INSPECTION (Normative)

A.1 It shall be the responsibility of the supplier to test or to have all the relevant tests performed.

A.2 Copies of Type Test Certificates and Type Test Reports issued by a third party testing laboratory that is accredited to ISO/IEC 17025 shall be submitted with the tender for the purpose of technical evaluation. A copy of the accreditation certificate for the testing laboratory shall also be submitted with the tender (all in English Language).

Copies of type test reports to be submitted with the tender for evaluation shall be as stated below:

- a) Insulation withstand test on arrester housing;
- b) Residual voltage tests;
- c) Long duration current impulse withstand test;
- d) Short circuit
- e) Operating duty tests;
- f) Test of disconnector/ fault indicator (when fitted);
- g) Internal Partial discharge test;
- h) Bending moment test;
- i) Weather ageing tests;
- j) Seal leak rate test
- k) Radio interference voltage

In addition, the following test report shall be availed for the silicone insulating material used.

- a) UV test
- b) Thermal endurance test
- c) Flammability test
- d) Long term water immersion test
- e) Dielectric Testing
- f) Tracking and Erosion test

NOTE: Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Authority.

A.3 Routine and sample test reports for the Surge Arrestors to be supplied shall be submitted to KPLC Engineers during Factory acceptance Testing. KPLC Engineers will witness tests at the factory before shipment. Tests to be witnessed by KPLC Engineers at the factory before

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shipment/delivery shall be in accordance with IEC 60099-4, IEC 60270, IEC 60507, ISO 1461 and this specification and shall include the following:

- a) Measurement of reference voltage;
- b) Residual voltage test;
- c) Measurement of power frequency voltage on the complete arrester;
- d) Lightning impulse residual voltage on the complete arrester;
- e) Internal Partial discharge test;
- f) Galvanization test

A.4 On receipt of the Surge Arrestors, KPLC will inspect them and may perform any of the relevant tests in order to verify compliance with the specification. The supplier shall replace without charge to KPLC, any surge arresters which upon examination, test or use fail to meet any or all of the requirements in the specification.

B: QUALITY MANAGEMENT SYSTEM (Normative)

B.1 The supplier shall submit a quality assurance plan (QAP) that will be used to ensure that the surge arresters physical properties, tests and documentation, will fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001.

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

C: DOCUMENTATION (Normative)

C.1 The bidder shall submit its tender complete with technical documents 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 (GTP) signed and stamped by the manufacturer;
- b) Copies of the Manufacturer's catalogues, brochures, drawings giving all relevant dimensions and technical data;
- c) Sales records for the last five years and at least four customer reference letters;
- d) Details of manufacturing capacity and the manufacturer's experience;

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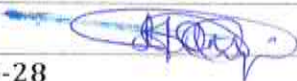

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- e) Copies of required type test reports by a third party testing laboratory accredited to ISO/IEC 17025. The test reports shall not be more than five years old;
- f) Copy of accreditation certificate to ISO/IEC 17025 for the third party testing laboratory;
- g) Contacts and address of third party testing laboratory;
- h) Manufacturers letter of authorization, ISO 9001 certificate and other technical documents required in the tender.
- C.2 The successful bidder (supplier) shall submit the following documents/details to The Kenya Power & Lighting Company for approval before manufacture:
- a) Fully filled clause by clause guaranteed technical particulars (GTP) stamped and signed by the manufacturer **(these are not the ones submitted with the tender)** ;
- b) Design Drawings with details of the surge arrester 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 fulfill the requirements stated in the contract documents, standards, specifications and regulations. The QAP shall be based on and include relevant parts to fulfill the requirements of ISO 9001;
- d) Marking details and method to be used in marking the surge arresters;
- e) Packaging details (including packaging materials).

NOTE: *The drawings to be submitted by the supplier to KPLC for approval before manufacture shall be in standard format clearly indicating the drawing number, parts list with material details and quantities, standard of manufacture, ratings, approval details and identity of the manufacturer (as per manufacturer's authorization submitted during tendering).*

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D: GUARANTEED TECHNICAL PARTICULARS (Normative)

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.

Bidder's name and Address.....

Clause number	KPLC Requirements		Bidder's offer
	Manufacturer's Name and address		Specify
	Country of Manufacture		Specify
	Name and model Number		Specify
1.	Scope		State
2.	Normative References		State
3.	Definitions and Abbreviations		
3.1.	Abbreviations		State
4.	Requirements		
4.1.1	Service conditions		State
4.1.2	System Requirements	System highest voltage, kV	State
		Frequency, Hz	State
		Maximum duration of earth fault, Seconds	State
		Earth fault factor as per IEC 60099-4	State
		Maximum short circuit current, kA	State
		Earth fault factor as per IEC 60099-4	State
		Maximum short circuit current, kA	State
		Discharge class as per IEC 60099-4	State
		Power frequency withstand voltage, wet, kVrms	State
		Lightning impulse withstand voltage, kV peak	State
Pollution level as per IEC TS 60815	Inland	State	
	Coastal	State	
Minimum specific creepage distance as per IEC TS 60815	Inland	State	
	Coastal	State	
4.2	Design and construction		
4.2.1	General		
4.2.1.1	Standard of manufacture		State
4.2.1.2	Application		State

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4.2.1.3	Type of Surge Arrestor	State
4.2.1.4	Metal oxide quality	State
4.2.1.5	Shall be single column with no stack, self-supported and shall be installed between phase and earth.	State
4.2.1.6	Pressure relief present?	State
4.2.1.7	Surge counter and a leakage current indicator present	State
	interpretation of condition indication	State
4.2.1.8	Surge Arrestor shall be hermetically sealed	State
4.2.1.9	Disconnecter/ fault indicator present?	State
	Interpretation of the condition indication	State
4.2.1.10	Accessories	List
4.2.1.11	Galvanization of ferrous parts	State
4.2.1.12	Mounting pitch circle diameter	State
4.2.1.13	Technical protective data for arrester	
	Maximum System voltage, Um	State
	Rated Voltage, Ur	State
	Continuous operating voltage, KVrms	State
	Temporary overvoltage capability (TOV), KVrms	1 s
		10 s
	Maximum residual voltage with current wave	5 kA 8/20 μ s
		10 kA 8/20 μ s
		20 kA 8/20 μ s
		40 kA 8/20 μ s
		500 A 30/60 μ s
		1 kA 30/60 μ s
	2 kA 30/60 μ s	State
	Lightning impulse protective level, max, kV as per IEC 60099-5	State
	Steep current impulse protective level, max, kV as per IEC 60099-5	State
	Energy discharge capability, kJ/kVrms at Ur	State
	Metal oxide (MO) diameter, mm	State
	Height of the MO resistor column, mm	State
	Long duration discharge class (current compliance)	Current, A
		Duration, μ s
	Accelerated ageing performance	Temperature, $^{\circ}$ C
		Time, hrs

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Kenya Power

**220KV SURGE
ARRESTERS -
SPECIFICATION**

Doc. No. KP1/6C/4/1/TSP/05/035

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Clause number	KPLC Requirements	Bidder's offer
	Operating duty characteristics (Discharge current withstand)	Two 4/10 μ s current wave (Ur), kA Low current at 2000 μ s, kA _{pk}
	Partial discharge performance, pC as per IEC 60270.	State
	Pressure relief withstand capability (Short circuit)	High symmetrical RMS (A), duration (s) Low symmetrical RMS (A), duration (s)
4.2.2	Housing	
4.2.2.1	Material of housing of the surge arresters	State
4.2.2.2	Reinforced HTV silicone rubber hardness	State
	Track resistance	State
4.2.2.3	Shield resistance	State
	Capability of initiating two consecutive fault-current arcs to ground.	State
4.2.2.4	Dimensioned to provide a leak free interface with the end caps	State
4.2.2.5	Type of shed	State
	Colour	State
4.2.2.6	Method of molding	State
4.2.2.7	Withstand capabilities of surge arrester housing	
	Lightning impulse withstand voltage,	State
	Power frequency withstand voltage for 1 min, wet	State
	Creepage distance	25mm/kV 31mm/kV
	Permissible head load static (SLL),	State
	Permissible head load dynamic (SLL),	State
	Short circuit withstand capability current (Is)	State
	Permissible length of the active part	State
	Housing shield resistance	State
	Number of units	State
5	Test requirements	State
6	Marking and Packing	
6.1	Marking	State
6.2	Packaging	State
A	Test and inspection	
A.1	Responsibility of carrying out tests	State
A.2	Copies of Type Test Reports submitted with tender	Provide

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Clause number	KPLC Requirements	Bidder's offer
A3	Test certificates to be submitted by supplier to KPLC for approval before supply/delivery	Provide
	Tests to be witnessed by KPLC Engineers at the factory	List
A.4	Inspection at the stores and replacement of rejected items	State compliance
B	Quality Management System	
B.1	Quality Assurance Plan	Provide
B.2	Copy of ISO 9001:2008 Certificate	Provide
C	Documentation	
C.1	Documents submitted with tender	Provide
C.2	Documents to be submitted by supplier to KPLC for approval before manufacture	Provide
	Statement of compliance to specification (indicate deviations if any & supporting documents)	State compliance

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Manufacturer's Name, Signature, Stamp and Date

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