



The Kenya Power & Lighting  
Co. Ltd.

TITLE:

**SPECIFICATION FOR 11kV  
VACUUM AUTOMATIC  
RECLOSERS (Pole Mounted)**

Doc. No.	KPLC1/3CB/TSP/11/005
Issue No.	5
Revision No.	0
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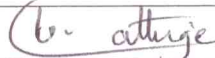
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### 0.1 Circulation List

COPY NO.	COPY HOLDER
1	Research & Development Manager
2	Procurement Manager
3	Stores & Stock Control Manager
4	Technical Services Manager
5	Operations & Maintenance Manager
6	Deputy Manager, Technical Audit

### 0.2 Amendment Record

Rev No.	Date (YYYY-MM-DD)	Description of Change	Prepared by (Name & Signature)	Approved by (Name & Signature)
Issue 5 Rev 0	2010-04-09	Cancel and replaces 4 <sup>th</sup> Issue Rev 4 dated 2004- 10-18	R&D/Technical Services <i>[Signature]</i>	Head of Department R&D <i>[Signature]</i>

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## FOREWORD

This specification has been prepared by the Research & Development and Technical Services Departments both of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for 11kV vacuum automatic reclosers. It is intended for use by KPLC in purchasing the equipment.

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

### 1. SCOPE

This specification is for 11kV vacuum automatic reclosers (pole mounted) together with controls and auxiliary equipment for use on distribution lines to provide switching and protection of the overhead power distribution lines.

The equipment shall be complete with control unit and all components/accessories necessary to realize the intended application.

The specification stipulates the minimum requirements for equipment acceptable for use in the company and it shall be the responsibility of the manufacturer to ensure adequacy of the design, good workmanship and good engineering practice in the manufacture of the equipment for KPLC.

The specification also covers inspection and test of the equipment as well as schedule of Guaranteed Technical Particulars to be filled, signed by the manufacturer and submitted for tender evaluation.

The specification does not purport to include all the necessary provisions of a contract.

### 2. REFERENCES

The following standards contain provisions which, through reference in the text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

IEC 60529: Degree of protection offered by enclosures (IP code)

IEC 62271-100: High-voltage switchgear and control gear. Part 100:  
High-voltage alternating-current circuit-breakers

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IEEE/ANSI C37.60: IEEE Standard Requirements for Overhead, Pad Mounted, Dry Vault, and Submersible Automatic Circuit Reclosers and Fault Interrupters for AC Systems.

ISO 1461: Hot dip galvanized coatings on fabricated iron and steel articles.

### 3. TERMS AND DEFINITIONS

For the purpose of this specification the definitions given in the reference standards shall apply.

### 4. REQUIREMENTS

#### 4.1 SERVICE CONDITIONS

The 11kV automatic reclosers shall be suitable for continuous operation outdoors in tropical areas at altitudes of up to 2200m above sea level, humidity of up to 90%, average ambient temperature of +30°C with a minimum of -1°C and a maximum of +45°C, heavy saline conditions along the coast and high isokeraunic levels of up to 180 thunderstorm days per year. The level of galvanizing and painting for all ferrous parts and materials used for the recloser tank, control box and all components shall be suitable for these conditions.

The auto recloser shall be connected to protect 11kV 50Hz, 3-phase overhead line with a maximum system voltage of 12kV and is generally unearthed (without aerial earth wire).

#### 4.2. CONSTRUCTION

4.2.1 The auto recloser shall be out-door type, designed for three phase operation and suitable for H-pole mounting. Single pole mounting will also be considered.

4.2.2 The auto recloser shall have Oil or Air/Solid for electrical insulation and employ Vacuum interrupters.

4.2.3 The auto recloser should preferably be complete with suitable and sufficiently sized brackets fitted on both sides of the auto recloser tank for fixing of surge diverters. Drawings and technical details shall be submitted with tender.

4.2.4 The auto reclosers shall be supplied complete with supporting/mounting brackets, operating mechanism and control box.

4.2.5 The recloser tank shall have a mechanical status indicator for both the Open and the Closed position. The status indication shall be visible from the ground.

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- 4.2.6 The unit shall be equipped with inbuilt current transformers of appropriate ratio, which will be connected to the control so that faults on the load side can be detected and circuit opened. The current transformer shall be appropriately rated taking into consideration the maximum load current of 400A and rated short circuit current of 12kA.
- 4.2.7 All current carrying parts shall be made of electrolytic high conductivity copper with the contacts silver-plated.
- 4.2.8 Manually operated levers to enable manual trip and close of source-side interrupter switches during power outages shall be provided.
- 4.2.9 A single bushing providing the required creepage shall be mounted on the tank for each phase. Use of an additional boot or cable tails to be connected between the bushing and the overhead line to achieve the required creepage shall not be accepted. The bushings shall be either porcelain or silicon rubber material.
- 4.2.10 The auto recloser shall be complete with suitable terminals and connecting clamps for conductors of up to 18.2 mm diameter (both copper and aluminium conductors).

### 4.3. OPERATING MECHANISM

- 4.3.1 The auto recloser shall be provided with a multi-shot auto-reclosing mechanism able to undertake up to 4 trip and autoreclose operations in one cycle.
- 4.3.2 Recloser lockout link and operations counter shall be provided on the Recloser Tank. Provision of Operation counters in the Recloser Control, as has been specified under the Control Box, shall also be supplied.
- 4.3.3 The control mechanism shall be suitable for mounting at the auto recloser supporting structure, and below the auto recloser in a weatherproof, dust-proof, vermin-proof housing. The necessary brackets and fittings for this purpose shall be provided. Mounting drawings shall be provided with the tender.

The degree of protection shall at least be class IP 54 as per IEC 60529.

- 4.3.4 The bidder shall indicate the number of recloser operations to the first maintenance as well as the number of operations between successive maintenance, i.e. the Recloser Duty Cycle.
- 4.3.5 Detailed catalogues and mechanical drawings shall be submitted with the tender for the purpose of tender evaluation.

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#### 4.4 RATINGS

Description	Requirement
System Nominal Voltage & Frequency	11kV, 50Hz
System highest operating voltage	12kV
Rated continuous current, minimum	400A
Minimum Power Frequency Withstand Voltage, rms (50Hz, 60s)	38kV
Minimum Lightning Impulse Withstand Voltage, 1.2/50 $\mu$ s, +ve, dry, KVp	95kVp
Rated short time withstand current, 3 seconds	12kA
Minimum creepage distance of insulator	350mm
Minimum clearance between phase to phase and phase to earth	300mm
Minimum number of Mechanical & Full Load Operations	10,000

**NB1: The highest voltage of the equipment offered shall be adequate to satisfy the specified basic insulation levels.**

#### 4.5 CONTROL UNIT (BOX)

The control box shall be a fully programmable microprocessor (numerical) based unit. The control box shall have the following features on its front face.

- a) LCD Screen to facilitate manual programming of the control unit and for viewing data such as events, fault records and measurands. The LCD shall switch off when not in use and be activated by pressing the appropriate key such as panel ON/OFF switch.
- b) KEY PAD: This shall be used for programming and viewing the protection settings, measurands, constants and control logic for the unit. All data stored in the unit such as events, fault records and measurands shall be accessible through the keypad.
- c) CONTROL KEYS: Control keys shall be provided for the following functions.
  - (i) Enable/block earth fault protection
  - (ii) Enable/block sensitive earth fault protection
  - (iii) Enable/block cold load (load inrush) protection
  - (iv) Select Remote/local control of the unit.

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- (v) Enable/block auto reclose.
- (vi) Close Push-button with RED LED indication to manually close the recloser and show recloser closed status via a Red LED.
- (vii) Trip Push-button with GREEN LED indication to manually open the recloser and show recloser open status via a Green LED.
- d) RECLOSER CONTROL HEALTHY STATUS: This shall be indicated by a Green LED, on the control or on the LCD Screen.
- e) RECLOSER CONTROL FAILURE: This shall similarly be indicated by Red LED or on the LCD Screen. If the control fails, then all protection functions shall be blocked from operating.
- f) RECLOSER CONTROL SAFETY: The recloser control shall have a door on the front, which is lockable with a padlock to prevent unauthorized access to the control unit.
- g) COMUNICATION PORT/SOFTWARE: The Recloser Control shall be provided with an RS232 or similar port, for ease of programming of settings and down loading of data from the unit via a laptop computer. Seven cables for connecting a laptop to the control unit shall be supplied with the units.

The necessary Software for installation into a Laptop computer to facilitate communication with the Recloser Control Unit for Programming Protection, Configuration and Control Settings and for Viewing, Downloading and Analyzing Data from the Recloser Control shall be provided. Seven CDs loaded with the operating software shall be supplied with the units.

Four Laptop computers (NEW) with the auto recloser software program already loaded shall be prepared for use during acceptance testing and shall be handed over to KPLC for use in the field.

Each auto recloser unit shall have a full set of installation, commissioning and maintenance as well as software manuals describing the software installation, and application for programming the settings and configuration of the control as well as downloading and analysis of Data. The documents shall all be of Hard Cover.

Additional Four (4) copies of the Software manual in soft copy shall be supplied with the Reclosers.

- h) Minimum requirements of the Laptop computers:
  - Pentium 4, 2.6GHz
  - 80GB Hard Disk with 3.5 inch external Floppy disk drive
  - 4GB RAM
  - DVD Drive
  - WINDOWS XP
  - USB Ports (at least two)

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RS232 or suitable port  
At least 14 inch display

- i) DEFAULT DISPLAY ON LCD: This shall be selectable.
- j) An LED shall be provided to indicate recloser lockout. Alternatively this shall be displayed on the LCD Screen.
- k) EXTERNAL TRIP ACCESSORY; This feature shall be included in the Control Box, to enable the Recloser to be tripped via an external Signal/Command and shall be wired to the Terminal Block of the Control Box for external connection.
- l) REMOTE CLOSE ACCESSORY; This feature shall be included in the Control Box, to enable the Recloser to be closed from a Remote Position and shall be wired to the terminal block of the control Box for external connection.
- m) RECLOSER AUXILIARY CONTACTS: One set each of NO and NC auxiliary contacts of the recloser shall be wired to the terminal board of the control box for external connection to monitor the status of the recloser.
- n) SCADA FACILITY: This feature is required to monitor the status of the recloser and also to transmit data such as measurands, fault details, events list, etc., to the control center. The bidder shall indicate the features for SCADA application up to the modem interface requirements, the protocol used and the communication links that can be used with this accessory to transfer data if SCADA application is implemented in the future. The protocol used shall be as per IEC requirements or equivalent.

#### PROTECTION FUNCTIONS:

The following Protection features shall be provided in the Control Unit.

- ◆ 3-phase over-current and earth fault protection. The above shall be equipped with Inverse time-current tripping characteristics to BS 142, IEC 60255 and ANSI (IEEE) Standards. Also provision shall be made for programming of custom made curves to enhance co-ordination of the unit with existing relays and auto reclosers. The over-current and earth fault protection shall also be equipped with 2-stage high set (instantaneous) elements.
- ◆ Sensitive earth fault shall be provided with definite time characteristic.
- ◆ Auto reclose of up to four shots to be provided and shall be initiated by any of the above protection functions which is selected to do so. The tripping curves for each stage of the auto reclose sequence shall be programmed separately for over-current and earth fault protection.
- ◆ The dead time for each auto reclose shot shall be separately programmable.

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The following functions/features shall be provided on the control unit:

- The battery for the control box shall be rechargeable. The charger circuit shall be capable of accepting input from a single-phase distribution transformer (240V AC, 50Hz).

The Following Functions/Features shall be included in the Software:

- Number of trips to lock out selectable from menu.
- Operations counters for each Phase and for Earth Fault and Sensitive Earth Fault.
- Fault Records logging: date, time, faulted phase, fault current and fault duration

*Any control box shall work with any Recloser Tank, without any limitation and achieve the declared functionality. Cases where a given control box is calibrated and programmed to work with a specific Recloser Tank to achieve the declared performance shall not be accepted.*

### **Energy and Power Measurements.**

Bidders shall indicate if the Auto Reclosers offered are complete with Energy and Power Measurement capability.

Where the above is provided, the unit shall give the following measurands:

Instantaneous values; KW, I, V, KVA, Kvar, p.f.

Maximum Demand values; KW, KVA, I, Kvar with Date and Time stamps, recorded for each month.

Energy measurements; kWh & Kvarh, Cumulative

The accuracy of the instruments shall be stated in the bid documents.

### **OPERATION**

In addition to trip/close push buttons provided on the control unit, the control of the recloser shall be enabled in the software for control through a Laptop computer or through a remote connection.

### **EVENTS & FAULT RECORDS LISTS**

The unit shall also generate a sequence of events (time-tagged) for all operations, Auto & Manual and system status (e.g. supply failure etc.).

When tripping of the unit occurs, the protection function responsible for the trip, phase(s) affected, fault current magnitudes, fault duration, date and time (up to hundredth of a millisecond) of the trip, shall be displayed on the LCD screen and be resettable via a reset button on the control unit. These details shall also be available in the events list and fault records list and accessible by use of a laptop computer.

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**EVENTS LOG:** Each event whether generated by manual or automatic operation of the recloser control, shall have the following details.

- (i) Serial no.
- (ii) Date of occurrence (DD:MM:YY)
- (iii) Time of occurrence, up to millisecond level and
- (iv) The phase affected and the magnitude of current.

**AUXILLIARY POWER SUPPLY**

This shall be 30V DC or any other suitable DC Voltage provided by a charger/battery set. The charger shall be supplied with 240 V AC 50Hz. The normal life of the battery shall be at least 10 years. Upon loss of 240V AC auxiliary supply, the battery shall power the electronics and provide supply for control of the recloser for at least 8 hours. The battery capacity shall be >25AmpHour and this shall be demonstrated during factory acceptance testing in the presence of KPLC Engineers. The supplier shall give to KPLC, a written guarantee for the batteries of at least 5 years.

4.6 Detailed manuals and drawings of the installation and control unit circuits and components shall accompany the tender (all in English Language)

**5. TESTS AND INSPECTION**

- 5.1 The auto recloser shall be tested in accordance with IEC 62271-100, IEC 60529, ANSI C37.60, ISO 1461 and the requirements of this specification. It shall be the responsibility of the manufacturer to perform or to have performed all the relevant tests.
- 5.2 Copies of previous type test reports by the relevant International or National Testing/Standards Authority of the country of manufacture (or ISO/IEC 17025 or ILAC accredited independent laboratory) shall be submitted with the tender for evaluation (all in English Language). A copy of accreditation certificate for the laboratory shall also be submitted.
- 5.3 The auto recloser shall be subject to acceptance tests at the manufacturer's works before dispatch. Acceptance tests shall be witnessed by two Engineers appointed by The Kenya Power and Lighting Company Limited (KPLC). Routine and Sample Test Reports for the auto recloser to be supplied shall be submitted to KPLC for approval before shipment of the goods.
- 5.4 On receipt of the equipment, KPLC will inspect them for acceptance at stores and may perform or have tests performed in order to verify compliance of the equipment with this specification.

The supplier shall replace/rectify without charge to KPLC, any equipment which upon examination, test or use fail to meet any or all of the requirements in this specification.

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## 6. MARKING AND LABELLING

The following information shall be marked indelibly and legibly and in a permanent manner on each item.

- i) Manufacturer's Name or Trademark;
- ii) Manufacturer's Type Reference Number;
- iii) Specified Electrical Characteristics;

## 7. SPARES

The units will be complete with the following spares:

- a) Control units – 8No.
- b) Control Box Battery – 5No.
- c) Control Cable Sets – 2 Sets
- d) Fuses (if any) – 10No.

The above items shall be listed on the price schedule and their cost indicated separately by the bidder.

## 8. TRAINING

### 8.1 TRAINING AT MANUFACTURER'S PREMISES

During the factory acceptance testing (FAT), the manufacturer shall conduct complete training for the complete recloser and the control box for five KPLC Engineers/Technicians.

This shall include theory on how the equipment works followed by practical demonstrations. All the operational, protection and control features of the Tank and the control Box shall be exhaustively explained and demonstrated, including the operation of the interface software

The manufacturer shall plan adequate time for the training separate from the FATs. The duration of the training shall however not be less than three (3) eight hour working days. The employer may send a separate team from the team witnessing the FATs to attend the training.

The Training shall be considered to have been successful once the engineers are able to:-

- Competently carry out all the operations on the equipment

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- Correctly install all the equipment, including effective earthing of the tank and the control box
- Establish communication from a laptop to the control box and carry out complete parameter settings and download and analyze data
- Trouble shoot and analyze and rectify any minor breakdowns that may occur

The manufacturer shall conduct evaluation tests and give a feedback report on the training to the employer for each of the engineers/technicians.

## 8.2 LOCAL TRAINING (IN KENYA)

Following the delivery of the equipment, the manufacturer shall conduct complete training for the complete recloser and the control box for 30 KPLC Engineers/Technicians, in Nairobi Kenya.

The training shall be conducted in two sessions of 15 engineers/technicians each. Each session shall last at least one day (eight hours).

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

The Training shall be considered to have been successful once the engineers are able to:-

- Competently carry out all the operations on the equipment
- Correctly install all the equipment, including effective earthing of the tank and the control box
- Establish communication from a laptop to the control box and carry out complete parameter settings and download and analyze data
- Trouble shoot and analyze and rectify any minor breakdowns that may occur

All the cost of conducting the training including the venue, refreshments and meals shall be borne by the manufacturer.

## 8.3 INSTALLATION OF TWO RECLOSER UNITS

In order to ensure that the installation and commissioning of the units is carried out correctly, the manufacturer shall supervise the installation of two recloser units on two selected 11kV feeders within Nairobi. This event can be arranged to follow immediately after the local training.

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**ANNEX A: Guaranteed Technical Particulars** (to be filled and signed by the Manufacturer for all clauses and submitted together with catalogues, brochures, drawings, and technical data and test reports for tender evaluation)

**MANDATORY TABLE TO BE FILLED BY MANUFACTURERS/BIDDERS**

	DESCRIPTION	KPLC'S REQUIREMENT	MANUFACTURERS/ BIDDERS' OFFER	Remarks
1	Manufacturers name and address	Bidder to state		
2	Model or Type Reference Number of Auto Recloser offered	Bidder to state		
3	Equipment Highest System Voltage	15KV, 50Hz		
4	Rated Continuous Current carrying capacity	≥400A		
5	Short Time Withstand Current & Time	≥12kA, for 3Secs		
6	Control Box enclosure [IP] class of protection [attach type test certificate]	≥IP54		
7	Rated power frequency withstand voltage, 50Hz 60s, wet [attach routine test report]	38kV		
8	Rated lightning impulse withstand voltage, 1.2/50µs +ve, dry [attach type test report]	95kVp		
9	Relays Operating Characteristics	According to IEC 60255 with at least NI, VI, EI, LTI and DT. Other types of curves like the ANSI curves are acceptable as additional to the IEC curves		
10	Protection Functions Available	Must offer, 3OC+EF+SEF +AR		

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		as a minimum		
11	Setting Ranges for Over current Protection (50/51)	0.....600A, 2 stage		
12	Setting Ranges for Earth Fault Protection (50N/51N)	0.....300A, 2 stage		
13	Setting Ranges for Sensitive Earth Fault Protection (50N-2/51N-2)	0.....50A, 0.....1000Seconds		
14	Setting Ranges for Auto Reclose Function (79)	0.....4 Shots to Lockout Independently selectable for OC & EF		
15	DC Battery System	≥25AmpHour capacity, should be able to sustain a minimum of 8 hrs without charging ac supplies. Battery should have a life of at least 10years		
16	Auxiliary Power Supply to the Control Box	Nominal 240Vac , 50Hz		
17	Live Tank Dimensions [WxHxD ] [attach layout drawing]	provide		
18	Control Box Dimensions [WxHxD ] [attach layout drawing]	provide		
19	LCD screen and MMI for programming and viewing measurands/settings	<ul style="list-style-type: none"> <li>• Should be able to display all the 3 phase and 1 neutral current simultaneousl y.</li> <li>• Most of the setting parameters should be editable from the MMI.</li> <li>• Should</li> </ul>		

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		indicate recloser status on the MMI <ul style="list-style-type: none"> <li>• Features to Disable /Enable EF, SEF and AR on the MMI</li> <li>• Ability to operate unit from MMI</li> </ul>		
20	Measurands displayable on the LCD screen	I, V, kW, kVAR, f, pf, kWh		
21	Provision for Remote operation of Recloser	Provide facility		
22	Shunt trip accessory	Provide		
23	Insulation Medium	Oil or Air/Solid		
24	Interrupting Medium	Vacuum		
25	Status Indicating facility on the Tank	CLOSED/OPEN		
26	Applicable Standards to which unit complies	IEC62271, IEC60255, IEC60529 or ANSI equivalents		
27	Altitude of operation, humidity and temperature range	<ul style="list-style-type: none"> <li>• Up to 2200m above sea level,</li> <li>• Up to 90% humidity</li> <li>• -1 to +45°C</li> </ul>		
28	Fault Event Records	<ul style="list-style-type: none"> <li>• At Least 50 events with time and date stamps,</li> <li>• Affected phases</li> <li>• Magnitude of current and fault duration</li> </ul>		
29	SCADA Accessory	Provide facility for connection to a SCADA system		
30	RS232 Port for programming	Provide on the front		

Issued by: R&D/Technical Services

Authorized by: Head of Department, R&D

Signed:

Signed: *(Signature)*

Date: 2010-04-09

Date: 2010-04-09



The Kenya Power & Lighting  
Co. Ltd.

TITLE:

**SPECIFICATION FOR 11KV  
VACUUM AUTOMATIC  
RECLOSERS (Pole Mounted)**

Doc. No.

KPLC1/3CB/TSP/11/005

Issue No.

5

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	Settings and downloading data	of the control box		
31	Laptop to control box connection cables	Seven(7) cables to be supplied		
31	Connecting clamps of at least 18.2mm diameter	Provide for all phases		
32	Bushing Creepage distance	350mm for 11kV		
33	Surge arrestors mounting on the auto recloser	for both source side and load side.		
34	Physical Construction	For H-Pole or single pole mounting		
35	Software for parameter setting and downloading and analysis of the data	Provide seven(7) copies of the latest version (indicate name of software) in CD ROMs		
36	Spare Auxiliary contacts	1NO+1NC		
37	Spares together with consignment	<ul style="list-style-type: none"><li>• Recloser Control Unit – 8No.</li><li>• Control Box Battery-5No.</li><li>• Control Cables Sets -2 Sets</li><li>• Fuses (if any) – 10NO.</li></ul>		
38	Laptop Computers	Pentium 4, 2.6Ghz, 40GB, portable Floppy disk drive, 4GB RAM, DVD Drive, WIN XP, RS232, USB Port, Parallel Port – Qty 4		

**NOTE:**

The Bidders should note that the above Guaranteed Technical Particulars schedules must be fully completed and submitted with the bid. Failure to complete the schedules shall lead to rejection of the bid. Each entry in the schedule in compliance with the specifications shall constitute one (1) mark. The maximum possible score shall be 100% and the lowest possible score shall be 0%.

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**Criteria for Passing technical evaluation:** Any Bidder who fails to score a minimum of 70% in the technical schedule shall not be considered further in the evaluation. In addition to a score of 70% the bidder must fully meet the requirements of the specifications.


**Deviation:** Any deviation from these specifications if any shall be clearly stated. The bidder shall demonstrate that the technical specifications are still fully met in spite of such minor deviations. Deviations from the Bill of materials or from the ratings of various equipments listed in the specifications is **NOT** acceptable.

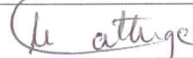
Before Contract signing, any minor deviations shall be discussed and resolved.

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

Issued by: R&D/Technical Services

Authorized by: Head of Department, R&D

Signed: 

Signed: 

Date: 2010-04-09

Date: 2010-04-09