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## 0.1 Circulation List

| COPY NO. | COPY HOLDER |
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| 1 | Research & Development Manager |
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| 3 | Stores & Transport Manager |
| 4 | Technical Services Manager |
| 5 | Operations & Maintenance Manager |
| 6 | Design & Construction Manager |
| 7 | 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) |
|---|---|---|---|---|
| 2 | 2010-01-13 | 1. Internal arc resistance rating clause 4.6.4<br>2. 25KA in 3sec ratings on clause 4.7<br>3. Supply of 2 sets of cable terminations clause 4.4.1 | S. Kimtai | G. K. Gathige |

## FOREWORD

This specification has been prepared by the Research and Development Department in collaboration with Technical Services, D&C and O&M Departments all of The Kenya Power and Lighting Company Limited (KPLC) and it lays down requirements for SF6 Gas Insulated Ring Main Unit. It is intended for use by KPLC in procurement of the equipment.

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

## 1. SCOPE

1.1 This specification is for newly manufactured factory-assembled gas insulated Ring Main Unit (RMU) for KPLC 11kV 50Hz system.

1.2 The ring main unit shall be extensible type (both sides) and shall have two cable feeder switch disconnectors (SF6) and one transformer feeder with vacuum circuit breaker. The units shall be automation ready fully wired to allow remote control/full automation.

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

The specification stipulates the minimum requirements for Ring Main Unit 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 Ring Main Unit for KPLC.

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 this text constitute provisions of this specification. Unless otherwise stated, the latest editions (including amendments) apply.

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

IEC 62271-103: High-voltage switchgear and control gear - Part 102: Switches for rated voltages above 1kV and less than 52kV

IEC 62271-200: High-voltage switchgear and control gear - Part 200: A.C. metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.

IEC 60044-1: Instrument transformers - Part 1: Current transformers.

IEC 60376 Specification for SF6 gas

IEC 60255: Electrical Relays.

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

BS 381C: Specification for colours for identification, coding and special purposes.

## 3. TERMS AND DEFINITIONS

The definitions given in the reference standards shall apply.

## 4. REQUIREMENTS

### 4.1 Service Conditions

The equipment shall be suitable for continuous operation outdoors in tropical areas 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 +40°C, heavy saline conditions along the coast and isokeraunic levels of up to 180 thunderstorm days per year.

### 4.2 Design and Construction

4.2.1 The Ring Main Unit shall be free standing metal-enclosed designed and constructed in accordance with IEC 62271 200 and the requirements of this specification. Switches and circuit breakers shall comply with IEC 62271-103 and IEC 62271-100 respectively.

4.2.2 The Ring Main Unit shall be floor mounting type suitable for outdoor and indoor use. The floor fixing shall allow for mounting on a simple plinth with a flat surface

4.2.3 The unit shall incorporate two SF6 ring main switches (three phase) and either switch shall be capable of being operated independently of the other. Each switch shall have integral earthing facility and three operating positions – "ON", "OFF" and "EARTH" and capable of being operated remotely.

4.2.4 The Earth Switch shall be able to carry the rated short circuit current. The RMU switches shall be capable of making and breaking the rated load current.

4.2.5 The Ring Main Unit shall be complete with Auxiliary switches for remote control and supervisory status indication of the switches. 240V AC 50Hz supply, Remote Terminal Unit and the Communication System shall be procured separately.

4.2.6 The unit shall also have a tee-off circuit (three phase) controlled by means of vacuum circuit breaker with trip-all phase mechanism complete with integral earthing facilities. The design of the tee-off chamber shall be such that it can be electrically isolated from the two ring main switches to facilitate maintenance and or testing of the transformer without opening the Ring Main. The tee-off shall have integral earthing facility for the cable.

4.2.7 The ring circuits shall have Earth Fault indicators to indicate whether earth fault current has passed through the switch. The indicator shall have an electrically-reset flag. The RMU shall have accessories for indicating voltage presence.

4.2.8 The tee-off shall have overcurrent and earth fault protection with standard IEC IDMT Time-Current characteristic curves as per IEC 60255. The protection relay shall be connected to a current transformer of ratio 400-200-100-50/5A, to allow effective protection of transformers rated at 315kVA, 630kVA and 1000kVA and Loads of 2 MVA, 3 MVA and 4MVA and powered from within the RMU (No external DC source) to operate a trip coil). Detailed information shall be submitted to facilitate technical evaluation of the protection scheme.
If the protection relays are software driven, the software shall be supplied to KPLC together with the connection cables (PC – relay).

4.2.9 The tee-off shall have three operating positions "ON", "OFF" and "EARTH"

4.2.10 Access to handles for operation and access for viewing of indicator and instruction labels shall be on one side only.

4.2.11 Test facilities for applied high voltage (15kV) shall be provided for the ring cables (connected to earth switch) by means of a one piece three-phase test probe or by a three-phase integral device with connections external to the switch equipment. The

probe shall be applied only when the switch is in "Earth" position. In addition there shall be capacitive voltage indicators on each circuit.

4.2.12 Each equipment shall be provided with a main earth bar of not less than 25 x 3 mm. H. D. D. C. copper strip or equivalent cross-section. The earth bar shall be bolted to the main frame and located so as to provide convenient facilities for earthing cable sheaths and earthing devices. Earth connections to cable glands shall be provided.

4.2.13 Each equipment shall be provided with lifting facilities and shall be marked to indicate its weight. The ring main unit shall be complete with all necessary components and accessories.

4.2.14 Padlocking facilities shall be provided to prevent unauthorized access and operation. The facilities shall be suitable for padlocks with shanks of 6mm diameter.

4.2.15 The switchgear enclosure shall be dry painted to Dark Admiralty Grey Colour No. 632 as per BS 381C.

4.2.16 For the first twenty five (25) years of service, RMU offered shall be virtually maintenance free.

4.2.17 The Ring Main Unit shall have provision for remote operation. Auxiliary switches for remote and supervisory status indication of the ring switches shall be provided. It shall have terminals brought out to a terminal block that will facilitate wiring of REMOTE CLOSE and REMOTE TRIP by KPLC. Detailed information on this shall be submitted with the tender. KPLC shall provide the Remote Terminal Unit and Communication Network. Compatibility requirements/limitations of the RMU offered shall be stated in the bid. The RMU shall be equipped with appropriate AC or DC auxiliary power supply required to operate the switches. In addition 240V AC auxiliary supply for SCADA shall be provided.

### 4.3 Operating Mechanism

4.3.1 The operating mechanisms of the switches shall be spring-operated-manual devices designed so that energy stored in the initial part of each operation shall be used to complete the making, circuit earthing or opening from circuit earth operations as the case may be, independently of the operator. Slow making or breaking shall not be possible. For remote operation, each of the two switches shall be equipped with a motorized switch actuator with option for manual operation shall be provided. The motor shall be rated 30V DC.

4.3.2 It shall not be possible for the operating mechanism(s) to be left in such a condition that any energy stored in the initial part of an incomplete operation remains in the spring when the switch is in the "ON", "OFF" or "EARTH" positions.

4.3.3 For the tee-off, the operation of the protective device shall cause the opening of all three phases.

4.3.4 Means shall be provided for manual tripping from "ON" to "OFF".

4.3.5 It shall be possible to lock the operating mechanism(s) in any operating position and independently to lock off the "EARTH" and "ON" position by use of padlock.

4.3.6 It shall be necessary before it is possible to operate from "OFF" to "EARTH", to move a captive device which can be padlocked and which shall be labeled "REMOVE to EARTH".

4.3.7 Mechanical indication of the operating positions of the switch shall be provided with indicators in both directions so as to show whether the switch contacts are in the "ON", "OFF" or "EARTH" positions. The positions shall be clearly indicated and the indicators shall be inscribed "ON" in white letters on a red background, "OFF" in white letters on a green background and "EARTH" in black letters on a yellow background.

4.3.8 Operating handles shall be arranged to operate in a vertical plane and downward movement shall complete the making and earthing operations.

4.3.9 Interlocks shall be provided to prevent any operation that threatens safety. In addition interlocks shall prevent the following operations:

a) Inadvertent operation of any Ring Main Switch and Tee-off Switch direct from the "ON" position to "EARTH" position or vice versa.
b) Operation of any switch to "ON" position from any position with the access cover opened.
c) Test facility (probes or plugs) being inserted or withdrawn unless the relevant switch is at the "EARTH" position
d) Operation of any switch from "EARTH" to "OFF" position unless the associated access cover is closed or test plugs inserted.

4.3.10 Operating procedures and interlocks shall be clearly inscribed on the operations side of the unit.

### 4.4 Cable Termination

4.4.1 The unit shall be complete with cable boxes and terminals suitable for three core XLPE copper and aluminium cables of up to 300sq mm. The unit supplied with two complete sets of cable terminations (one for immediate connection and the other for spare).

4.4.2 The cable boxes shall be air insulated suitable for dry type cable terminations, bottom entry. Compound filled cable boxes are not accepted

4.4.3 The cable boxes shall be equipped with glands to facilitate cable terminations.

### 4.5 Vacuum Circuit Breaker

4.5.1 The bidder shall state period of experience of the manufacturer of vacuum interrupters used in the switchgear. Such experience shall be not less than seven (7) years and shall be supported by list of customers for similar units in at least three (3) utilities. Additional supportive evidence of the suitability of the vacuum bottle shall be provided in the form of type test reports and certificates from the relevant International or National Testing/Standards Authority or ISO/IEC 17025 accredited independent laboratory.

4.5.2 The units shall have a service life of at least twenty five years

4.5.3 Where replacement of the bottles shall be required before the twenty fifth ($25^{th}$) year of service, the supplier shall render a service to recover and replace the bottles at no cost to KPLC (supplier to provide clear and sufficient details in his offer).

4.5.4 The units shall be sealed for life.

### 4.6 SF6 Gas

4.6.1 The Gas insulated Ring Main Unit shall be supplied filled with new SF6 gas complying with IEC 60376. The gas in each chamber shall be independent of the gas in the other chambers.

4.6.2 The switchgear shall be factory sealed so as not to require any routine gas replenishment in normal service. The design, construction and sealing of gas compartments shall be such that the period to replenishment of gas is not less than twenty five (25) years. In addition the manufacturer shall confirm that the maximum leakage rate is lower than 0.1% per year. Each unit shall be sealed for life and proof of the same given.

4.6.3 The unit shall be complete with a device for checking the SF6 gas pressure on each tank in service with indication of minimum permissible pressure level for safe operation.

4.6.4 The gas enclosure and switchgear housing shall be designed such that in the event of an internal arc fault, the operator shall be safe. Internal arc resistance rating required is 20kA for 1sec

4.6.5 The bidder shall state period of experience of the manufacturer of the gas switchgear. Such experience shall be not less than seven (7) years and shall be supported by list of customers for similar units in at least three (3) utilities. Additional supportive evidence of the suitability of the switchgear shall be provided in the form of type test reports and certificates from the relevant International or National Testing/Standards Authority or ISO/IEC 17025 accredited independent laboratory.

## 4.7 Ratings

The Ring Main Unit (RMU) shall be of the following ratings:

| | |
|---|---|
| Nominal System Voltage | 11kV |
| Highest System Voltage | 12kV |
| Equipment Class | => 15kV |
| Frequency | 50Hz |
| Impulse-voltage withstand level, peak (1.2/50μs dry) | 95kV |
| Power Frequency Withstand Voltage, rms (50Hz 60se wet ) | 38kV |
| Ring main switch rated current (temperature rise within IEC) | 630A |
| Ring main, main and earth switches rated short time current (3 sec) | 25kA |
| Circuit Breaker rated short time current (3 sec) | 25kA |
| Tee-off circuit rated current | 200A |

## 4.8 Circuit Labels

The front shall include a clear mimic diagram which indicates the different functions. The position indicators shall give a true reflection of the position of the main contacts and shall be clearly visible to the operator. All labels and diagrams shall be suitable for outdoor service and must have non fading properties.

Physical position of the disconnector contacts shall be visible through a window of weather resistant transparent glass for safety operations.

## 5. TESTS AND INSPECTION

5.1 The Ring Main Unit and its components shall be inspected and tested in accordance with the requirement of IEC 62271- 200 and this specification. It shall be the responsibility of the manufacturer to perform or to have performed all the tests specified

5.2 Circuit breakers shall be inspected and tested in accordance with the requirement of IEC 62271-100 and this specification.

5.3 Switches shall be inspected and tested in accordance with the requirement of IEC 62271-103 and this specification.

5.4 Current transformers shall be inspected and tested in accordance with the requirement of IEC 60044-1 and this specification.

5.5 Relays shall be inspected and tested in accordance with the requirement of IEC 60255 and this specification

5.6 Copies of previous Type Test Certificates and Type Test Reports issued by the relevant International or National Testing/ Standards Authority or ISO/IEC 17025 accredited independent laboratory shall be submitted with the offer for evaluation (all in English Language). A copy of the accreditation certificate for the laboratory shall also be submitted. Any translations of certificates and test reports into English language shall be signed and stamped by the Testing Authority.

5.7 The equipment shall be subject to acceptance tests at the manufactures' works before dispatch. Acceptance tests will be witnessed by two Engineers appointed by Kenya Power and Lighting Company Limited (KPLC).

5.8 Test reports for the Ring Main Unit (including its individual component(s) shall be submitted to Kenya Power and Lighting Company for approval before shipment

5.9 On receipt of the equipment KPLC will inspect it and may perform or have performed any of the relevant tests in order to verify compliance with the specification. The manufacturer shall replace without charge to KPLC, equipment which upon examination, test or use fail to meet any or all of the requirements in the specification.

5.10 The supplier shall include a quality assurance programme (QAP) that will be used to ensure that the Ring Main Unit 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 9001:2008.

5.11 The Manufacturer's Declaration of Conformity to reference standards and copies of quality management certifications including copy of valid ISO 9001: 2008 certificate shall be submitted with the tender for evaluation.

## 6. MARKING, LABELLING ANG PACKING

6.1 The Ring Main Unit and associated components shall be packed in a manner as to protect it from any damage in transportation and handling.

6.2 Each assembly and package of items associated with the switchgear shall be suitably marked.

6.3 In addition to markings required elsewhere in the specification, each panel and component shall be marked in accordance with the relevant IEC standard and shall include the following marking:

- Name of manufacturer and country
- Type/Model reference number and Standard of Manufacture
- Ratings: rated normal current and temperature rise, rated short time current and duration, rated voltage, rated frequency, rated lightning impulse withstand voltage, rated power frequency withstand voltage, rated short circuit making current.
- Serial number
- The words "Property of KPLC"

## 7. DOCUMENTATION

7.1 Three sets of operational manuals and drawings detailing dimensions, panel layout, wiring and schematic shall be submitted to KPLC. Industry standard documentation on use of SF6 gas shall be submitted to support the offer.

7.2 All manuals necessary for Maintenance, Commissioning, Installation Testing Configuration and Programming of the relay and all other equipments shall be provided with the equipment

7.3 In addition all necessary software for configuration, setting and programming and for downloading and analysis of relay data shall be provided including all the necessary cables for connecting to a Laptop computer.

7.5 Erecting tools and gauges peculiar to the equipment shall be delivered together with the equipment.

7.6 All documentation shall be in English Language.

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**ANNEX A: Guaranteed Technical Particulars** *(to be filled and signed by the Manufacturer and submitted together with copies of manufacture's catalogues, brochures, drawings, technical data and certified true copies of previous test reports & certificates for tender evaluation)*

**TENDER NO**.....

| | Description | Guaranteed Technical Particulars for Ring Main Unit offered |
|---|---|---|
| 1 | Type & Model Number | |
| 2 | Name of Manufacturer & Country of Origin of equipment being offered | |
| 3 | Service Conditions | |
| 4 | Design standards complied with | |
| 5 | Current breaker and switch arrangement | |
| 6 | Operating Mechanism of the switches | |
| 7a | Available Interlocks | |
| 7b | Physical position of the disconnector contacts shall be visible through a window of weather resistant transparent glass for safety of operations | |
| 8 | Type of Cable box | |
| 9 | Size, type and rating of cable terminals | |
| 10 | Equipment service life | |
| 11 | No of years to first SF6 replenishment | |
| 12 | Manufacturing experience (a)-VCB | |
| | (b) RMU | |
| 13 | Internal Arc fault design safety | |
| 14 | Current Transformer & Ratio provided | |
| 15 | Relay Type provided (Attach relay manual with Technical data and manufacturer's experience & details) | |

| | | |
|---|---|---|
| 16 | **RATINGS:** | |
| 17 | Nominal System Voltage | |
| 18 | Equipment Voltage Class | |
| 19 | Frequency | |
| 20 | Impulse Withstand Voltage, peak (1.2/50µs dry) | |
| 21 | Power Frequency Withstand Voltage, rms (50Hz 60s wet) | |
| 22 | Ring Main Switch Rated Current (temperature rise within IEC requirements) | |
| 23 | Ring Main rated short time current (3 seconds) | |
| | Short time current rating of earth switches | |
| 24 | Tee-off rated current | |
| 25 | Documentation | |
| 26 | Marking, Labeling and Packing | |
| 27 | List test reports submitted (indicate test report numbers, date, Testing Institution and contact addresses). Copy of ISO/IEC 17025 accreditation certificate submitted | |
| 28 | Manufacturer's Guarantee and Warranty | |
| 29 | a) List Copies of manufacturer's catalogues, brochures, technical data, drawings submitted to support the offer (showing model offered) | |
| | b) List of manufacturer'customer sales records submitted to support the offer | |
| 30 | List Acceptance Tests to be witnessed by KPLC Engineers at the factory | |
| 31 | Provision for remote operation (1) Indicate the terminals brought out to the terminal block that will facilitate wiring of REMOTE CLOSE and REMOTE TRIP by KPLC, (2) Indicate detailed information submitted with the offer (3) Indicate compatibility requirements/limitations | |
| 32 | Statement of compliance to tender specifications (indicate deviations if any and supporting documents submitted) | |

.....

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

*Note: This schedule does not in any way substitute for detailed information required elsewhere in the specification.*

| Issued by: Head of Section, Power Systems Research | Authorized by: Head of Department, R&D |
|---|---|
| Signed: | Signed: |
| Date: 2010-02-02 | Date: 2010-01-02 |