

Title: **POWER LINE CARRIER LINE  
TRAPS AND ASSOCIATED POST  
SUPPORT INSULATORS  
STANDARD**

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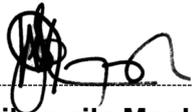
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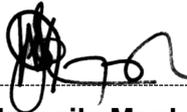
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## 1. Introduction

This standard stipulates Eskom's requirements for designing, manufacturing, and testing of Line Traps used in Eskom Transmission substations. The requirements stipulated in this document are based on international practices combined with Eskom's experiences. The requirements are specified to ensure the integrity of the product thereby minimising the risk of failure of equipment.

## 2. Supporting clauses

### 2.1 Scope

The standard provides the technical requirements of Line Traps and post support insulators.

#### 2.1.1 Purpose

The document is written to capture and standardise Eskom requirements for line traps and their associated post insulators.

#### 2.1.2 Applicability

This document shall apply throughout Eskom Transmission.

## 2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

### 2.2.1 Normative

- [1] IEC 60518: Dimensional standardization of terminals for high-voltage switchgear and control gear.
- [2] IEC 60358: Coupling capacitors and capacitor dividers.
- [3] IEC 60353: Line traps for a.c. power systems.
- [4] IEC 60353: 2002-04, Line traps for a.c. power systems – Amendment 1.
- [5] IEC 60273: Characteristics of indoor and outdoor post insulators.
- [6] IEC 60270: Partial discharge measurements.
- [7] IEC 60168: Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000 V.
- [8] SANS (IEC) 62271-102: Alternating current disconnectors and earthing switches.
- [9] IEC 60099-4: Surge arresters — Part 4: Metal-oxide surge arresters without gaps for a.c. systems.
- [10] IEC 60085: Thermal evaluation and classification of electrical insulation.
- [11] IEC 60076: Power Transformers.
- [12] IEC 60076-2: Power Transformers — Part 2: Temperature rise.
- [13] IEC 60060: High voltage test techniques.
- [14] IEC 60060-1: High voltage test techniques — Part 1: General definitions and test requirements.
- [15] IEC 60050: International Electrotechnical Vocabulary.
- [16] IEC 60050-441: Switchgear, control gear and fuses.
- [17] IEC 60815: Guide for the selection of insulators in respect of polluted conditions
- [18] BS1872: Specification for electroplated coatings of tin

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- [19] BS 381: Specification for colours for identification, coding and special purposes.
  - [20] SABS CISPR 16 - Part 1:1993, Radio disturbance and immunity measuring apparatus Gr 18.
  - [21] QM-58, Eskom Standard: Supplier Contract Quality Requirements specification.
  - [22] 240-9543610: Management of Manufacturers / Supplier Equipment Drawings
  - [23] 240-7565504: Eskom Specification: Corrosion protection standard for new indoor and outdoor Eskom equipment, components, materials and structures manufactured from steel standard.
  - [24] 240-56178825: Requirements for Transportation and Movement of Large Electrical Equipment Standard.

### **2.2.2 Informative**

None

## **2.3 Definitions**

### **2.3.1 General**

None

### **2.3.2 Disclosure classification**

**Controlled disclosure:** controlled disclosure to external parties (either enforced by law, or discretionary).

## **2.4 Abbreviations**

| <b>Abbreviation</b> | <b>Description</b>                      |
|---------------------|---|
| <b>CVT</b>          | Capacitor Voltage Transformer           |
| <b>KHz</b>          | Kilo-hertz                              |
| <b>LT</b>           | Line Trap                               |
| <b>PLC</b>          | Power Line Carrier                      |
| <b>SHEQ</b>         | Safety, Health, Environment and Quality |

## **2.5 Roles and responsibilities**

All Eskom employees and/or appointed bodies involved in the procurement of line traps shall ensure that the products meet the requirements of this standard. Any deviation from these requirements shall constitute a non-conformance, unless if approved in advance by a delegated Eskom instrument transformers specialist in writing and is based on sound engineering judgement.

All the Contractors supplying line traps and associated post support insulators to Eskom must be conversant with the requirements of this standard and shall comply with the requirements. All the deviations shall be clearly listed in the deviation schedule as part of the tender deliverables. No deviations will be accepted unless approved by Eskom in writing.

The Eskom Instrument Transformer Care Group is responsible for ensuring that this document is valid at all times.

## **2.6 Process for monitoring**

This document and its relevance will be evaluated by the instrument transformers Care Group.

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## 2.7 Related/supporting documents

Not applicable.

## 3. Power Line Carrier Line Traps and associated Post Support Insulators

### 3.1 General

The schedule A of the relevant A/B schedules shall form part of this specification and they shall take precedence over this specification in case the two documents are conflicting.

#### 3.1.1 Life expectancy

- a) The life expectancy of line traps under normal service conditions shall be 25 years.

#### 3.1.2 Warranty

- a) Eskom only accepts capacitor voltage transformers with a minimum warranty of 5 years

#### 3.1.3 Erection

If erection is called for, the contractor shall be responsible for the supply of all necessary tools and equipment to complete erection, and for removing these items from site when the work is completed. The contractor shall be responsible for complying with all Eskom's SHEQ requirements.

#### 3.1.4 Environmental conditions

The equipment will be operated under the following conditions:

##### 3.1.4.1 Outdoors.

##### 3.1.4.2 At an altitude above sea level up to 1800 metres.

##### 3.1.4.3 At the following ambient air temperatures:

- Maximum 40 °C.
- Daily average 30 °C.
- Yearly average 20 °C.
- Minimum –10 °C.
- Maximum diurnal variation 35 °C.
- Altitude: up to 1800 m
- Solar Radiation: 2500 kWh/m<sup>2</sup>
- Relative humidity: Not exceeding 95% (measured for a period of 24 hours)
- Wind pressure: 700 Pa (corresponding to 34 m/s wind speed)
- Atmospheric pollution: Very heavy
- Seismic shock: 0.3g
- Power frequency: 50Hz

##### 3.1.4.4 Incidence of lightning extremely severe.

### 3.1.5 Construction

#### 3.1.5.1 Finish

Where painting is required, it shall be done in accordance with 240-75655504.

#### 3.1.5.2 Mounting arrangements

#### 3.1.5.3 Holding down bolts

- a) Each support insulator shall be supplied complete with holding-down bolts, hot-dip galvanized in accordance with 240-75655504 as a minimum requirement. The holding down bolts shall be:
- 1) suitable for a thickness of supporting structure top plate of 15 mm, in the case of steel;
  - 2) suitable for grouting, in the case of concrete;
  - 3) either M16 or M20; and
  - 4) fitted with taper washers.

#### 3.1.5.4 Mounting of equipment

- a) 132kV line trips are mounted either on coupling capacitors, capacitor voltage transformers or post insulators. These line traps' base plates must be constructed such that they have 4 x 18mm diameter holes at 127mm PCD and 225mm PCD respectively (i.e., have holes at both PCDs).
- b) Where line traps are mounted on structures, they shall be mounted on the following structures and support caps (see drawings in Annex H):
- |                |                     |                                      |
|----------------|---------------------|--------------------------------------|
| 132kV:         | 0.54/302 (support)  | 0.54/306 (support cap)               |
| 275kV & 400kV: | 0.54/302 (support)  | 0.54/306 or 0.54/6008 (support caps) |
| 765kV:         | 0.54/6492 (support) | 0.54/6092 (support cap)              |

#### 3.1.5.5 Transport

The transport of all equipment shall comply with the requirements of Eskom's specification, 240-56178825.

## 3.2 Line Traps

### 3.2.1 General

**3.2.1.1** Line traps are required for insertion into the high voltage transmission lines to provide a known blocking impedance to the carrier signals, for all power system conditions, to prevent undue attenuation of carrier signals.

**3.2.1.2** Line traps shall be mounted in the manner specified in schedule A of an enquiry document. The requirements of each individual installation will determine whether a line trap shall be mounted on top of its associated coupling capacitor or separately on post insulators provided by the manufacturer.

**3.2.1.3** Line traps operating at 220 kV and higher voltages shall be mounted vertically on separate line post insulator(s). The post insulators shall be supplied as part of the line traps. At 132 kV and lower voltages the line trap shall be mounted vertically on the associated coupling capacitor or CVT. In exceptional cases at 132 kV and lower voltages, where line traps are required for insertion at line T points, the line traps may be mounted on separate line post insulators or suspended. The cost of the line trap post insulators for these exceptional cases shall be included in the price schedule of an enquiry document as an additional item.

**3.2.1.4** When the line traps are mounted on post insulators, unless otherwise specified, the support structures and plinths required for supporting the post insulators will be provided by Eskom. The manufacturer shall provide all mounting hardware.

**3.2.1.5** With either mounting arrangement, the high voltage terminals on the line traps shall comply with the details given in 3.3 and schedule A of an enquiry document. For line traps mounted on post insulators, the line side terminals shall be located at the top of the trap and bus-bar terminals shall be located at the bottom of the trap. For line traps mounted on CCs and CVTs, the line terminal shall be located at the bottom of the trap and the bus-bar side shall be mounted at the top.

## **3.2.2 Main coil**

### **3.2.2.1 Rated inductance ( $L_{IN}$ )**

The rated inductance of the line traps, as stated by the supplier in schedule B of an enquiry document, shall be the inductance of the main coil measured at 100 kHz. The inductance value specified by Eskom in schedule A will be the nominal inductance. In general the rated main coil inductance required will not vary by more than  $\pm 20\%$  of the nominal inductance quoted.

### **3.2.2.2 Co-ordination of rated r.m.s. continuous current ( $I_N$ ) and rated short-time r.m.s. current ( $I_{kN}$ ).**

The specified co-ordination between rated continuous current and rated short-time current is given in annex C. The co-ordination requirements of the line traps called for will be specified in the schedule A of an enquiry document.

### **3.2.2.3 Asymmetrical peak current ( $I_{km}$ )**

The asymmetrical peak value of the first half wave of the rated short-time current shall be assumed to be 2.55 times the r.m.s. value of the rated short-time current.

### **3.2.2.4 Voltage across the line trap (U)**

The voltage 'U' developed across the line trap at rated power frequency ( $f_{pN}$ ) by the rated short-time current ( $I_{kN}$ ), and for which insulation of the main coil and tuning device shall be adequately rated, is:

$$U = 2\pi \cdot f_{pN} \cdot L_p \cdot I_{kN}$$

Where  $f_{pN} = 50$  Hz

$L_p$  = Inductance at power frequency

$I_{kN}$  = Rated short - time current

### **3.2.2.5 Limits of temperature rise**

- a) The temperature rise of any part of the line trap under rated continuous current shall not exceed the limits specified in annex D with the ambient air temperature values stated in 3.1.2. For certain insulating materials outside the classification, temperature rises in excess of 150 °C may be adopted by agreement between Eskom and the manufacturer.
- b) For bare metallic parts or windings, the temperature rise shall not exceed the limits given for adjacent insulating materials.

- c) The temperature rise of the line trap terminals shall conform with requirements specified in SANS (IEC) 62271-102, taking into account that, in general, the terminals of line traps operate at a higher temperature than do those of isolators because of the heat generated in the main coil. The maximum temperature rise of the line trap terminals shall not, in any case, exceed that of the line trap hot-spot.

#### 3.2.2.6 Short-circuit capabilities

- a) The line trap shall be constructed to withstand, without damage, under service conditions, the effects of external short circuits. It shall be capable of withstanding the electromagnetic forces and thermal effects of the rated short-time current, for the rated short-time current specified in schedule A of an enquiry document, after previous operation at rated continuous current at the maximum ambient temperature specified in 3.1.2.
- b) The final permissible temperature after short-circuit testing shall not exceed the temperature specified in IEC 60076.

**3.2.2.7** Manufacturing tolerances of the main coil shall be such that the specified blocking bandwidths shall be obtained without adjustment when tuning units of identically rated line traps are interchanged.

**3.2.2.8** If the Line Traps provided by the supplier utilises bird barriers, Eskom needs to check if these bird barriers are acceptable or not. If the bird barriers are not acceptable, then the supplier shall have an option to remove these bird barriers.

#### 3.2.3 Blocking requirements

**3.2.3.1** The rated blocking bandwidth requirements of the line traps for this specification are given in annex E.

**3.2.3.2** The rated blocking bandwidth shall be determined by the rated blocking impedance or the rated tapping loss. The values of the blocking impedance or rated tapping loss are specified in annex E.

**3.2.3.3** The rated blocking impedance or rated tapping loss within the rated blocking bandwidth of the line trap shall not be less than the values specified for determining the rated blocking bandwidth.

**3.2.3.4** Manufacturers are at liberty to vary the nominal inductance values in annex E to obtain the rated bandwidths specified in annex E.

**3.2.3.5** The manufacturer shall submit a set of graphs for each trap inductance and tuning band showing the blocking impedance and rated blocking impedance (resistive component) or tapping loss and rated tapping loss (reactive portion compensated) versus frequency. These graphs can be derived from actual line trap tests or calculated from the component values.

#### 3.2.4 Line Trap tuning units

- a) Each tuning unit shall provide a single specified rated blocking bandwidth when used in conjunction with the appropriately rated main coil inductance. Adjustable or multiband tuning units are not acceptable. Preference will be given to sealed tuning units.
- b) Manufacturers shall ensure that in the design of individual tuning unit components, including the surge arresters, and the positioning of the tuning units, due consideration is given to the magnetic and thermal effects of the main coil.

##### 3.2.4.1 Insulation co-ordination of tuning units

- c) The co-ordination of the short-time voltage, the rated voltage of the surge arrester and the test voltage of the tuning unit is extremely important. Manufacturers shall provide detailed information of the line trap ratings offered, as required in schedule B of an enquiry document.

- d) The tuning unit shall be capable of withstanding an impulse test voltage which is given by the  $8/20 \mu\text{s}$  10 kA residual voltage produced by the related protective device, multiplied by the safety factor specified in schedule A of an enquiry document. The test impulse shall have a wave-front slope of not less than 200 kV/ $\mu\text{s}$ . This capability shall be proved by application of five positive and five negative test impulses as specified in 4.4.3.7 b).

#### **3.2.4.2 Tuning unit protective device**

- a) The protective device fitted across the tuning unit shall have an impulse discharge current capability of not less than 10 kA r.m.s.
- b) The protective device shall not be operated or remain in operation following transient actuation, as a result of the power-frequency voltage developed across the line trap by the rated short-time current. The tuning unit protective device shall comply with IEC 60099-4.
- c) The complete tuning unit and protective device shall be so designed that they can be easily disconnected (electrically) from the main coil for testing purposes. Eskom shall evaluate if the method of disconnection and reconnection of the tuning units is suitable for testing and maintenance for Eskom.

#### **3.2.5 Carrier frequency power rating**

The complete line trap shall be capable of withstanding the peak current and voltages, produced by the continuous application of carrier frequency signals at any frequencies, within the line trap tuning bandwidth, of 500 W peak envelope power (PEP) across the complete line trap.

#### **3.2.6 System voltage insulation**

The line trap, when mounted on post insulators, shall be capable of withstanding the appropriate insulation test voltages specified in annex A and schedule A of an enquiry document.

#### **3.2.7 Creepage distances**

- a) The post insulators shall comply with the pollution creepage distances specified in annex A and schedule A of an enquiry document.
- b) Equipment required to operate in coastal areas shall comply with the Very Heavy Pollution creepage distances specified in annex A and schedule A of an enquiry document. This equipment shall be identical in all other aspects to the Heavy Pollution creepage equipment.

#### **3.2.8 Radio influence voltage**

The maximum radio influence voltage of the complete line trap, when mounted on its associated line post insulators, shall not exceed the limits specified in annex B and schedule A of an enquiry document when measured in accordance with the procedure specified under line trap type tests.

#### **3.2.9 Mechanical stress**

- a) All line traps, when mounted on their associated post insulators, shall be designed to have a factor of safety of 2.5 when subjected to a wind loading of 1.2 kPa (1200 Newtons per square metre) on the projected area and a simultaneous force of 500 N for 132 kV and lower voltage equipment and 1500 N for 220 kV and higher voltage equipment, in the same direction as the wind pressure, at the top of the equipment. This latter force being due to the pull of the conductor attached to the equipment at this point.
- b) The effective area of cylindrical surfaces is 0.6 of the projected area. This factor may be used when calculating the wind loading of line traps.
- c) The line trap must be capable of managing the mechanical forces caused by electrical fault currents.

### 3.2.10 Marking

3.2.10.1 Rating plates shall be engraved, stamped or embossed on brass or stainless steel, with the following information:

- a) Main coil
  - Eskom Order No. ....
  - Manufacturer
  - Type number.
  - Serial number.
  - Rated inductance, in mH.
  - Rated continuous current, in A.
  - Rated frequency, in Hz.
  - Rated short-time current, in kA, and duration in s
  - Total mass in kg.
- b) Tuning device
  - Eskom Order No. ....
  - Manufacturer
  - Type number.
  - Serial number.
  - Rated tuning band, in kHz.
  - Rated impulse protective level of tuning device, in kV.
  - Belonging to main coil with rated inductance ..... mH and Type No. ...
- c) Protective device
  - Manufacturer
  - Type number.
  - Serial number.
  - Rated impulse discharge current, in kA.
  - Rated voltage, in kV.

3.2.10.2 In addition to the requirements of 3.2.10.1 b), each tuning unit shall be colour coded, as detailed below, in a suitable position, so that the trap rating and tuning band can be easily identified from ground level.

| Band 1 | Inductance rating | Colour |
|--------|-------------------|--------|
|        | 0,2 mH            | Red    |
|        | 0,5 mH            | Green  |
|        | 1,2 mH            | Blue   |
| Band 2 | Current rating    | Colour |
|        | 800 A/20 kA       | Red    |
|        | 1250 A/31,5 kA    | Green  |
|        | 1600 A/40 kA      | Blue   |
|        | 2500 A/40 kA      | Yellow |
|        | 2500 A/50 kA      | White  |

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|               |                    |                          |
|---------------|--------------------|--------------------------|
|               | 3150 A/40 kA       | Black                    |
|               | 3150 A/50 kA       | Brown                    |
|               | 3150 A/63 kA       | Violet                   |
|               | 4000 A/50 kA       | Black and White stripes  |
|               | 4000 A/63 kA       | Yellow and Green stripes |
|               | 5000 A/50 kA       | Orange                   |
| <b>Band 3</b> | <b>Tuning band</b> | <b>Colour</b>            |
|               | 1                  | Red                      |
|               | 2                  | Green                    |
|               | 3                  | Blue                     |
|               | 4                  | Yellow                   |

A suggested format for a suitable coding plate is given in figure 1. The recommended dimensions are 150 mm wide by 200 mm long, with the 'top' (colour band 1 end) semi-circular in order to positively identify the colour sequence.

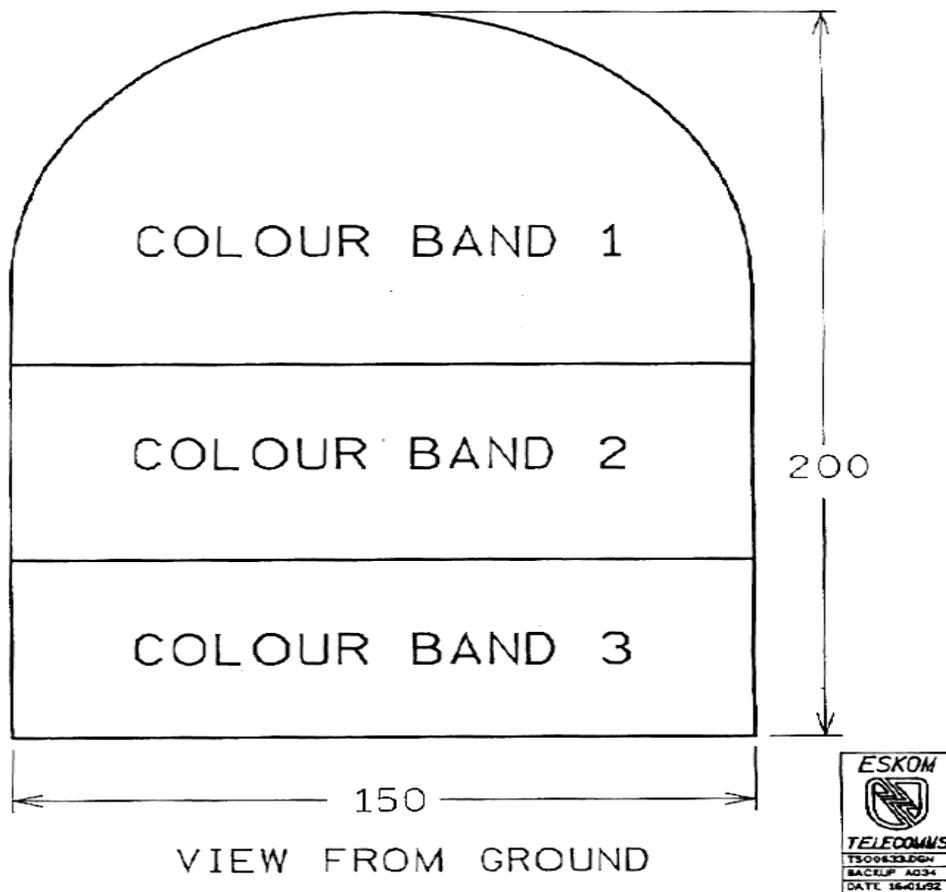


Figure 1: Suggested line trap colour coding plate

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### **3.3 Main Terminals**

#### **3.3.1 Arrangement**

- a) The number, spacing, dimensions and arrangement of the HV terminals of the various items of equipment are as detailed in schedule A of an enquiry document.
- b) The line trap line terminals shall be located at the top of the line trap and the bus-bar terminals shall be located at the bottom of the line trap for units mounted on post insulators. For line traps mounted on CCs or CVTs the line terminals shall be located at the bottom of the line trap and the bus-bar terminals shall be mounted at the top.

#### **3.3.2 Construction**

- a) Equipment line and bus-bar connection terminals shall be made of either solid copper or aluminium, to the dimensions specified in schedule A of an enquiry document. Copper terminals shall be electro-tinned to classification Sn 12c of BS 1872. Fabricated terminal arrangements will be acceptable only subject to Eskom's approval, but fabrication which may cause annealing of any yellow metals used will not be acceptable. The manufacturer shall ensure that cast terminals are free from internal voids.
- b) The line trap coil windings shall be connected directly to the terminals. The spider support arms shall preferably not be used as current conductors.

### **3.4 Drawings and Instruction Manuals**

Drawings and instruction manuals form an essential part of the Contract Works. No payment will be made for any equipment supplied as part of the Contract Works until all drawings and instruction manuals have been supplied in accordance with the requirements specified in the contract.

All drawings and manuals shall be delivered or electronically sent to an Eskom representative as stipulated in the Eskom National Contract.

#### **3.4.1 Drawings**

**3.4.1.1** The language used on drawings shall be English and units used on the outline drawing must be as per the International System of Units (SI units).

**3.4.1.2** Duplicate copies of the schedule listing all drawings and circuit diagrams applicable to all the equipment included in the contract, shall be supplied with or before the notification of readiness for acceptance testing.

**3.4.1.3** The following drawings shall be submitted in for approval, for all the equipment included in the contract, before establishment of the Eskom National Contract.

- a) A drawing giving outline dimensions, mounting details and main terminal configuration.
- b) A drawing showing the assembly details of the complete unit, in cross section.
- c) A drawing showing details of the interconnection between the pedestal and the spider arms, specifically detailing the steps taken to prevent corrosion at the joints between the two components at the mounting bolts.
- d) Details of terminals.

**3.4.1.4** After the drawings have been approved, the supplier shall provide the drawings in an electronic format, that is a pdf format and a dwg or dxf format.

**3.4.1.5** Detailed drawings of all equipment shall be supplied not later than the notification of the first item of equipment readiness for acceptance testing. The drawings shall be incorporated in the instruction manuals.

**3.4.1.6** Before the establishment of the Eskom National Contract, one copy of each drawing called for in 3.4.1.3 above will be returned by Eskom to the supplier, marked up with the drawing number allocated by

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Eskom. The supplier shall then supply Eskom with a set of electronic copies within 30 days of Eskom's notification of the drawing numbers.

**3.4.1.7** When changes to the equipment are envisaged, either by the manufacturer or Eskom within the negotiated period, the manufacturer shall submit details of these changes in writing together with the modification drawings for Eskom's approval, before proceeding with the implementation of these changes. An electronic copy shall be supplied as stated in 3.4.1.4 for each new drawing approved.

### **3.4.2 Instruction manuals**

**3.4.2.1** The copies of the instruction manuals and descriptive information specified in the enquiry document, covering all equipment shall be supplied in an electronic - pdf format before the Eskom National Contract is established.

**3.4.2.2** The manuals shall include technical details of the equipment, and complete details concerning installation, commissioning and adjustment for the equipment actually supplied, in addition to the drawings as specified in 3.4.1.3 of this specification.

**3.4.2.3** The manuals shall, where appropriate, give details of the testing procedure used to verify the basic parameters of the equipment. Manuals for line traps shall give curves of blocking impedance for the equipment supplied.

**3.4.2.4** The manuals shall contain full details of component values or the manufacturer's type numbers, for all components within the units, as well as the rating of the components used.

## **3.5 Delivery and Installation**

- a) The equipment shall be delivered to the destinations stated in the enquiry document.
- b) The ex-works delivery dates, and delivery dates to site, for the equipment shall be indicated in the relevant schedule of an enquiry document.
- c) The equipment shall be protectively packed in such a way that it can be safely transported, handled and stored at site, as it will not necessarily be possible for erection to commence immediately upon delivery.
- d) Attention is drawn to the fact that Eskom will accept delivery at the specified destination only, and that the supplier shall make all necessary arrangements for acceptance, off-loading and transshipping at all intermediate points, as well as the ultimate off-loading at the specified destination.
- e) Where called for, the equipment shall be erected, including grouting where necessary and all tools, staging, lifting tackle, etc, for off-loading, handling and installation of the equipment shall be supplied and these items shall be removed from site when erection is completed.

## **3.6 Quality Assurance**

Eskom's Quality Assurance requirements specified in QM-58 shall be applicable.

## **4. Test and Test Certificates**

### **4.1 Test certificates**

- a) The routine test certificates, in English, shall be submitted as soon as possible but not later than the delivery date of the specific equipment type or rating.
- b) Where a specimen set of routine test certificates is called for, the set shall comprise copies of all certificates covering the routine tests performed on one particular equipment.
- c) The manufacturer shall, on completion of the contract, submit a statement confirming that all units have been routine tested and proved to comply with the routine test requirements of this specification. The statement shall list the serial numbers of the units.

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- d) The manufacturer shall retain a complete set of routine test certificates for Eskom's reference for a period of 10 years.
- e) The type test certificates, in English, shall be submitted before the establishment of the Eskom National Contract either in a physical or electronic copy.
- f) The manufacturer shall, on completion of the contract, submit a statement confirming that one unit of each particular type of rating ordered has been type tested and proved to comply with the requirements of this specification.
- g) The manufacturer shall retain a complete set of type test certificates, for Eskom's references for a period of five years.
- h) All routine test certificates and type test certificates shall give all relevant details of the test, in addition to the test results, and where appropriate, shall include oscillograms or graphs of the equipment performance with the amplitude and time or frequency graduations clearly indicated.

## **4.2 Inspection and witnessing of tests**

- a) Eskom reserves the right to appoint a representative to inspect the equipment at any stage of manufacture or to be present at any of the specified tests. Such inspection shall not relieve the manufacturer of his responsibility for meeting all the requirements of the specification, and it shall not prevent subsequent rejection, if such material or equipment is later found to be defective.
- b) The manufacturer shall ascertain in writing from Eskom whether inspection or witnessed tests, or both, are required. Eskom will provide notice as agreed to between the Eskom representative and the supplier.
- c) Where Eskom has called for a type testing of equipment, which Eskom intends to witness, the manufacturer shall prepare a detailed programme for Eskom's approval. Eskom will, at its own discretion, select a number of people from Eskom's various departments and offices to witness these tests. All costs incurred by these people, for travelling, accommodation, etc. will be borne by Eskom. In the event of the approved testing programme not being satisfactorily completed in the period agreed upon, which would require Eskom to undertake a return visit(s), all costs incurred by Eskom shall be for the manufacturer's account.

## **4.3 Numbering of test certificates**

Each routine test and type test certificate shall clearly state the type of test being performed and cross refer to the appropriate test section number as listed below.

## **4.4 Tests**

### **4.4.1 Standard ambient temperature**

The standard ambient temperature range for testing is 10 °C to 40 °C. The ambient temperature during testing shall be recorded in the test report.

### **4.4.2 Routine test**

All equipment supplied in compliance with this specification shall be subjected to the routine tests listed below.

#### **4.4.2.1 Measurement of blocking impedance or tapping loss**

The blocking bandwidth of the line trap shall be measured either by:

- a) Bridge measurement from which the resistive and reactive components may be read off. The rated bandwidth is determined by the frequency limits at which the rated impedance (resistive component) is not less than the minimum value specified.

Or

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- b) Measuring the rated tapping loss, with the reactive component compensated. The rated bandwidth is determined by the frequency limits at which the rated tapping loss (resistive component) is not greater than the maximum value specified.

#### **4.4.3 Type tests**

**4.4.3.1** Type tests shall be carried out on one complete line trap of each type and rating.

**4.4.3.2** If evidence of type tests on identical equipment is available, this may be accepted in place of these tests, and the relevant documents shall be submitted with the tender. If type tests in accordance with this specification are not available, indication shall be given of the date on which such tests will be made.

**4.4.3.3** Every line trap to which it is intended to apply type tests, shall first have withstood satisfactorily the application of all routine tests. All type tests shall be carried out on the same line trap, unless otherwise approved.

**4.4.3.4** Measurement of rated inductance of the main coil

- a) The inductance of the main coil shall be measured at 100 kHz.  
b) The self-resonant frequency of the main coil shall also be measured.

**4.4.3.5** Temperature rise test

The measurement of temperature rise at rated current shall be measured as specified in IEC 60353. This test must be done on a complete trap, including the tuning unit and protective arrester. The maximum temperature of the arrester must be measured and proved to be lower than that specified by the arrester manufacturer to ensure that the integrity of the seals are not compromised, leading to a shortened service life. The relevant documentation from the arrester manufacturer must accompany the type test results.

**4.4.3.6** Short-time current tests

A short-time current test, at the rated short-time current and asymmetrical peak value of the first half wave as specified in schedule A of an enquiry document, shall be applied for 1 s to the complete line trap as specified in IEC 60353. On completion of this test the line trap shall be inspected visually for damage as well as having its blocking bandwidth rechecked as specified in 4.4.2.1.

**4.4.3.7** Tuning unit insulation tests

a) Power frequency test

A high-voltage power frequency withstand voltage ( $U_i$ ) of  $1.3U \times TOV_{1\text{ sec}}$  (Transient Overvoltage Level) shall be applied to the tuning device for 5 s. The formula for voltage  $U$  is in 3.2.2.4. This test must be performed with the protective device removed from service. On completion of the test the line trap blocking bandwidth is to be re-checked as specified in 4.4.2.1.

b) Impulse test

The tuning unit, without its protective arrester, shall be subjected to five test impulses of positive voltage polarity and five of negative voltage polarity with a front of wave rise time of  $200\text{kV}/\mu\text{s}$ . These impulses shall be applied to each terminal with the other terminal earthed as specified in IEC 60353. The amplitude of these impulses shall be as defined in Schedule B of the contract – the 10kA, 8/20 $\mu\text{s}$  residual voltage of the matching arrester multiplied by the specified margin of safety. On completion of the test the line trap blocking bandwidth is to be re-checked as specified in 4.4.2.1.

**4.4.3.8** Protective arrester test

This test shall be carried out in accordance with IEC 60099-4 Part 4.

**4.4.3.9** System voltage insulation

1) High-voltage 1 min dry power frequency test

Each post insulator shall be subjected to the appropriate a.c. test voltage specified in annex A and schedule A of an enquiry document in accordance with IEC 60358.

2) High-voltage 1 min wet power frequency test

The test shall be conducted as specified in IEC 60358. The test voltage shall be the appropriate voltage specified in Annex A and schedule A of an enquiry document. This test shall be carried out on a complete post insulator. No flashover shall occur. The artificial rain conditions shall be in accordance with the European practice in IEC 60060.

3) Impulse test

This test shall be conducted in accordance with IEC 60358. The test voltage is specified in Annex A and schedule A of an enquiry document.

4) Switching impulse test (wet)

This test is applicable to equipment rated at 275 kV and higher voltages. The test shall be performed on a completely assembled line trap under wet conditions. The unit shall be subjected to 15 impulses of positive polarity followed by 15 impulses of negative polarity of the standard waveform 250/2500  $\mu$ s. The test voltage is specified in annex A and schedule A of an enquiry document. It is permissible, after changing polarity, to apply some impulses of minor amplitude before the application of the test impulses. The time intervals between consecutive applications of the voltage shall be sufficient to avoid effects from the previous application of voltage. The line trap shall have passed the test if no failure occurs and if the number of flashovers at either polarity does not exceed two. The artificial rain conditions shall be in accordance with the European practice in IEC 60060.

**4.4.3.10** Radio influence voltage test

This test shall be conducted with the line trap mounted on its appropriate line post insulator. The test shall be conducted as detailed in IEC 60270 and IEC 60353. The test instrument used shall be a quasi-peak voltmeter, as described in SABS CISPR 16 — Part 1, with the following parameters:

- Bandwidth of 9 kHz at 6 dB.
- Charging time constant  $\tau_1$  of 1 ms.
- Discharging time constant  $\tau_2$  of 160 ms
- Mechanical time constant  $\tau_3$  of 160 ms.

The measurements shall be made at a frequency of 1 MHz using a terminating impedance of 300  $\Omega$ . Prior to measurement, the instrument shall be calibrated in the specified manner.

The appropriate test voltages and maximum radio influence voltages are specified in annex B and schedule A of an enquiry document.

**4.4.3.11** Mechanical test

a) Cantilever test

The complete line trap, when mounted on its appropriate post insulators, shall be tested to prove its capability to withstand the equivalent cantilever stress as detailed in 3.2.9, when the relative mounting arrangement is fitted with the largest line trap specified, at the corresponding voltage rating. The combined cantilever force shall be applied to the extremity of the main terminal for a period of 3 min.

b) Equipment terminals

The connecting terminals, mounted on the equipment as in service, shall be capable of withstanding for a period of 3 min each of the following forces:

- A pull equivalent to 3000 N without failure.
- A pull equivalent to 1500 N without any significant distortion measured at the extremity of terminals.

In each case the pull shall be applied at right angles to the axis of the terminals in a plane 25 mm beyond the free extremity of the terminal. Strength type tests shall be carried out on each type and rating of equipment.

**4.4.3.12** Post Insulator test

The post insulator shall be tested in accordance with IEC 60168.

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## 5. Authorization

This document has been seen and accepted by:

| Name and surname  | Designation  |
|-------------------|--|
| Sibongile Maphosa | Engineer (TX AME – Substation Equipment & diagnostics)       |
| Tejin Gosai       | Chief Engineer (TX Engineering – PTM&C)                      |
| Bheki Ntshangase  | Senior Manager (TX AME – Substation Equipment & diagnostics) |

## 6. Revisions

| Date      | Rev | Compiler   | Remarks  |
|-----------|-----|------------|--|
| May 2022  | 2.1 | S. Maphosa | Added list of line traps and Tuning Units used in Eskom together with their respective SAP numbers<br>Removed line traps with heavy pollution creepage<br>Changed RIV test voltages to reflect $U_m$ |
| July 2017 | 2   | T Gosai    | The 66kV Line Trap types are no longer required in Eskom and therefore were removed from the specification.  |
| Nov 2013  | 1   | T Gosai    | Document for review created from 41-595 and document number changed to 240-57648739  |

## 7. Development team

The following people were involved in the development of this document:

- S Maphosa
- T Gosai

## 8. Acknowledgements

The development team would like to acknowledge all members of the Instrument Transformers Care Group members who contributed to this standard.

**Annex A – Minimum Internal and External Insulation for Carrier Coupling Equipment**

| Rated system voltage<br><br>(Line-to-line)<br>$U_n$<br><br>kV r.m.s. | Highest system voltage<br><br>(Line-to-line)<br>$U_m$<br><br>kV r.m.s. | Power frequency withstand voltage at sea level<br><br>60 s<br><br>kV r.m.s. | Rated lightning withstand voltage level<br><br><br>kV peak | Rated switching impulse withstand voltage at sea level<br><br><br>kV peak | Minimum nominal creepage distance over external insulation |   |
|--|--|---|--|---|--|---|
|  |  |   |  |   | Heavy pollution<br>mm<br>(25mm/kV)                         | Very Heavy pollution<br>mm<br>(31mm/kV) |
| 132  | 145  | 275   | 650  |   | 3625   | 4495                                    |
| 220  | 245  | 460   | 1050   |   | 6000   | 7500                                    |
| 275  | 300  | 460   | 1050   | 850   | 7500   | 9300                                    |
| 400  | 420  | 630   | 1425   | 1050  | 10500  | 13020                                   |
| 765  | 800  | 975   | 2100   | 1550  | 19125  | 23715                                   |

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**Annex B – Radio Influence Voltage**  
(Normative)

| Rated System Voltage<br>(Line-to-Line) | Radio Influence<br>Test Voltage | Maximum Radio<br>Influence Voltage |
|--|---------------------------------|------------------------------------|
| U <sub>n</sub><br>kV r.m.s.            | U <sub>t</sub><br>kV r.m.s.     | μV<br>Note 1                       |
| 145                                    | 97                              | 250                                |
| 245                                    | 163                             | 250                                |
| 300                                    | 199                             | 250                                |
| 420                                    | 280                             | 250                                |
| 800                                    | 531                             | 250                                |

**Notes:**

- 1) Measured across 300 Ω
- 2) The value of the specified test voltage U<sub>t</sub>, between line terminals and earth, shall be multiplied by the following factor:

$$\left[ \frac{\text{Relative Air Density during test}}{\text{Relative Air Density at 1800 m}} \right]^{\frac{1}{2}}$$

The relative air density at 1800 m is 0,79.

**Annex C – Line Trap co-ordination of Rated Continuous Current and Short-time Current**

| Rated continuous current<br>in<br><br>A | Rated short-time current<br><br>$I_{kN}$ |                |
|---|--|----------------|
|   | Series 1<br>kA                           | Series 2<br>kA |
| 800                                     | 20                                       | 25             |
| 1250                                    | 31,5                                     | 40             |
| 1600                                    | 40                                       | 50             |
| 2500                                    | 40                                       | 50             |
| 3150                                    | 40                                       | 50             |
| 4000                                    | 50                                       | 63             |
| 5000                                    | 50                                       | 63             |

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**Annex D – Limits of Temperature Rise of Line Traps**  
(Normative)

| Class | Temperature rise in 0°<br>measured by           |                           |
|-------|---|---------------------------|
|       | Thermometer<br>(maximum temp rise)<br>-Hot spot | Increase in<br>Resistance |
| A     | 75  | 65                        |
| E     | 100   | 85                        |
| B     | 110   | 90                        |
| F     | 135   | 115                       |
| H     | 155   | 140                       |
| C     | 200   | 160                       |

The line traps are specified for service at an altitude in excess of 1000 m. If the equipment is tested at an altitude below 1000 m, the limits of temperature rise given in this table are reduced by 2,5 % for each 500 m that the altitude specified exceeds 1000 m.

**Annex E – Line Trap Rated Blocking Bandwidth**  
(normative)

| Nominal inductance | Rated Impedance | *Rated tapping loss | Tuning band | Rated blocking bandwidth |
|--------------------|-----------------|---------------------|-------------|--------------------------|
| mH                 | $Z_{bn}$        | $A_{tn}$            |             | $f_{1n}$ Or $f_{2n}$     |
|                    | $\Omega$        | dB                  |             | kHz                      |
| 0,2                | 400             | 3,52                | 1           | 80 to 108                |
|                    |                 |                     | 2           | 104 to 156               |
|                    |                 |                     | 3           | 125 to 204               |
|                    |                 |                     | 4           | 194 to 500               |
| 0,5                | 400             | 3,52                | 1           | 48 to 78                 |
|                    |                 |                     | 2           | 70 to 156                |
|                    |                 |                     | 3           | 101 to 500               |
| 1,2                | 400             | 3,52                | 1           | 40 to 500                |

Blocking bandwidth is defined as the frequencies ( $f_{1n}$  or  $f_{2n}$ ) between which the rated tapping loss ( $A_{tn}$ ) or rated blocking impedance ( $Z_{bn}$ ) does not fall short of the specified values.

\*Based on line impedance of 400  $\Omega$ .

### Annex F – Line Traps & Blocking Bandwidths

The line traps and associated post insulators used by Eskom appear in a list below.

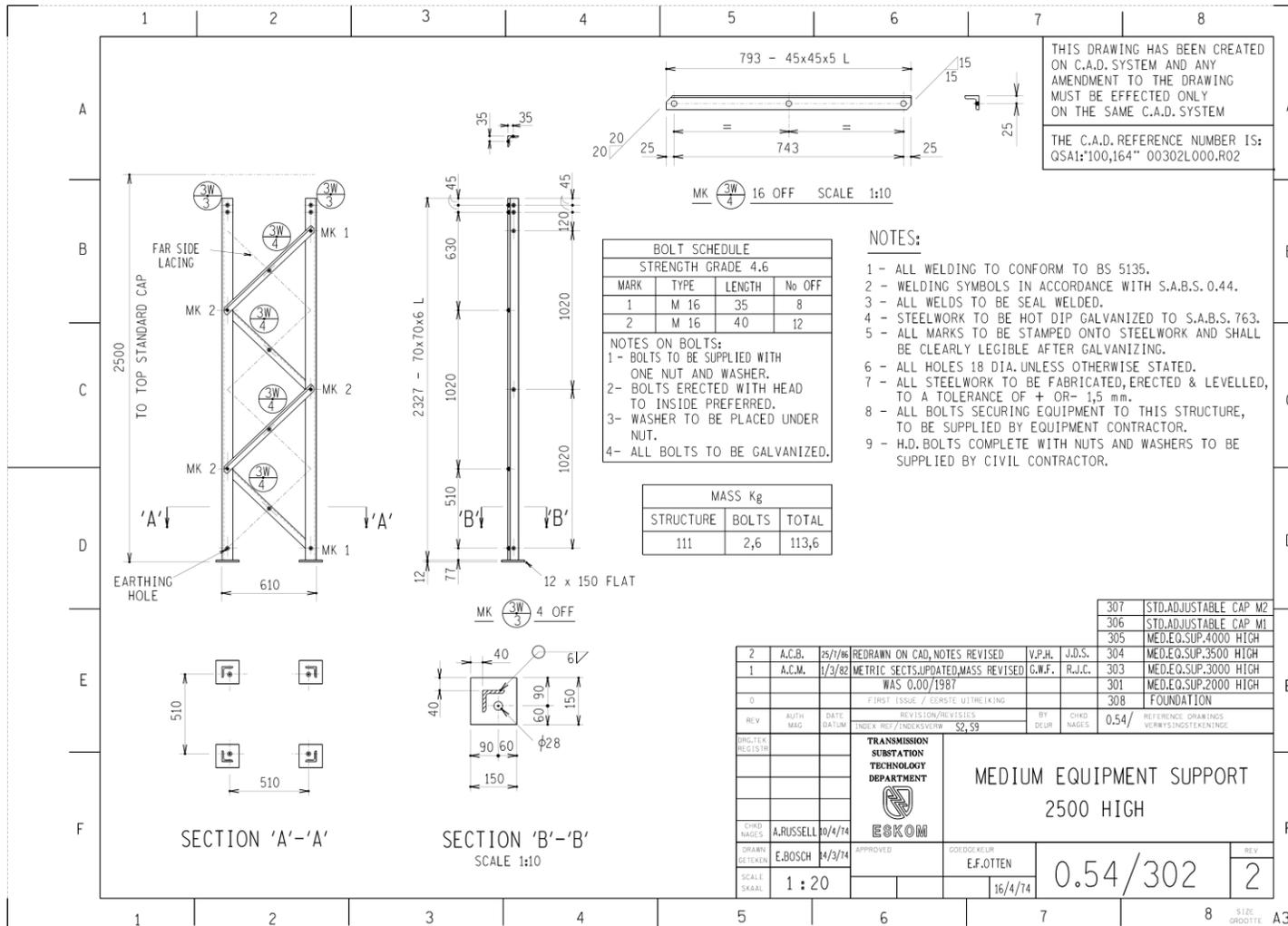
| SAP No | Item  | Short Description                         | TU Band 1   | TU Band 2    | TU Band 3    | TU Band 4    |
|--------|-------|---|-------------|--------------|--------------|--------------|
| 667708 | U2    | 132kV line trap 2500A 40kA 0.2mH          | 80 - 108kHz | 104 - 156kHz | 125 - 204kHz | 194 - 500kHz |
| 4483   | U4    | 132kV line trap 2500A 40kA 0.5mH          | 48 - 78kHz  | 70 - 156kHz  | 101 - 500kHz |              |
| 17528  | U5    | 132kV PI (Station) C4-550 31mm/kV         |             |              |              |              |
| 558642 | S1HH  | 275kV line trap 2500A 50kA 0.2mH 31mm/kV  | 80 - 108kHz | 104 - 156kHz | 125 - 204kHz | 194 - 500kHz |
| 558638 | S3HH  | 275kV line trap 2500A 50kA 0.5mH 31mm/kV  | 48 - 78kHz  | 70 - 156kHz  | 101 - 500kHz |              |
| 558636 | S5HH  | 275kV line trap 2500A 50kA 1.2mH 31mm/kV  | 40 - 500kHz |              |              |              |
| 558632 | S8HH  | 275kV line trap 3150A 50kA 0.5mH 31mm/kV  | 48 - 78kHz  | 70 - 156kHz  | 101 - 500kHz |              |
| 558630 | S9HH  | 275kV line trap 3150A 50kA 1.2mH 31mm/kV  | 40 - 500kHz |              |              |              |
| 558628 | S10HH | 275kV line trap 4000A 50kA 0.5mH 31mm/kV  | 48 - 78kHz  | 70 - 156kHz  | 101 - 500kHz |              |
| 558835 | Q1HH  | 400kV line trap 2500A 50kA 0.5mH 31mm/kV  | 48 - 78kHz  | 70 - 156kHz  | 101 - 500kHz |              |
| 558833 | Q3HH  | 400kV line trap 2500A 50kA 1.2mH 31mm/kV  | 40 - 500kHz |              |              |              |
| 558831 | Q6HH  | 400kV line trap 3150A 50kA 0.5mH 31mm/kV  | 48 - 78kHz  | 70 - 156kHz  | 101 - 500kHz |              |
| 558826 | Q7HH  | 400kV line trap 3150A 63kA 0.5mH 31mm/kV  | 48 - 78kHz  | 70 - 156kHz  | 101 - 500kHz |              |
| 558822 | Q8HH  | 400kV line trap 3150A 50kA 1.2mH 31mm/kV  | 40 - 500kHz |              |              |              |
| 558645 | Q9HH  | 400kV line trap 3150A 63kA 1.2mH 31mm/kV  | 40 - 500kHz |              |              |              |
| 558643 | Q10HH | 400kV line trap 4000A 63kA 0.5mH 31mm/kV  | 48 - 78kHz  | 70 - 156kHz  | 101 - 500kHz |              |
| 558626 | QB2HH | 765kV line trap 5000A 50kA 0.5 mH 31mm/kV | 48 - 78kHz  | 70 - 156kHz  | 101 - 500kHz |              |

**Annex G – Tuning Units and Compatible Line Traps**

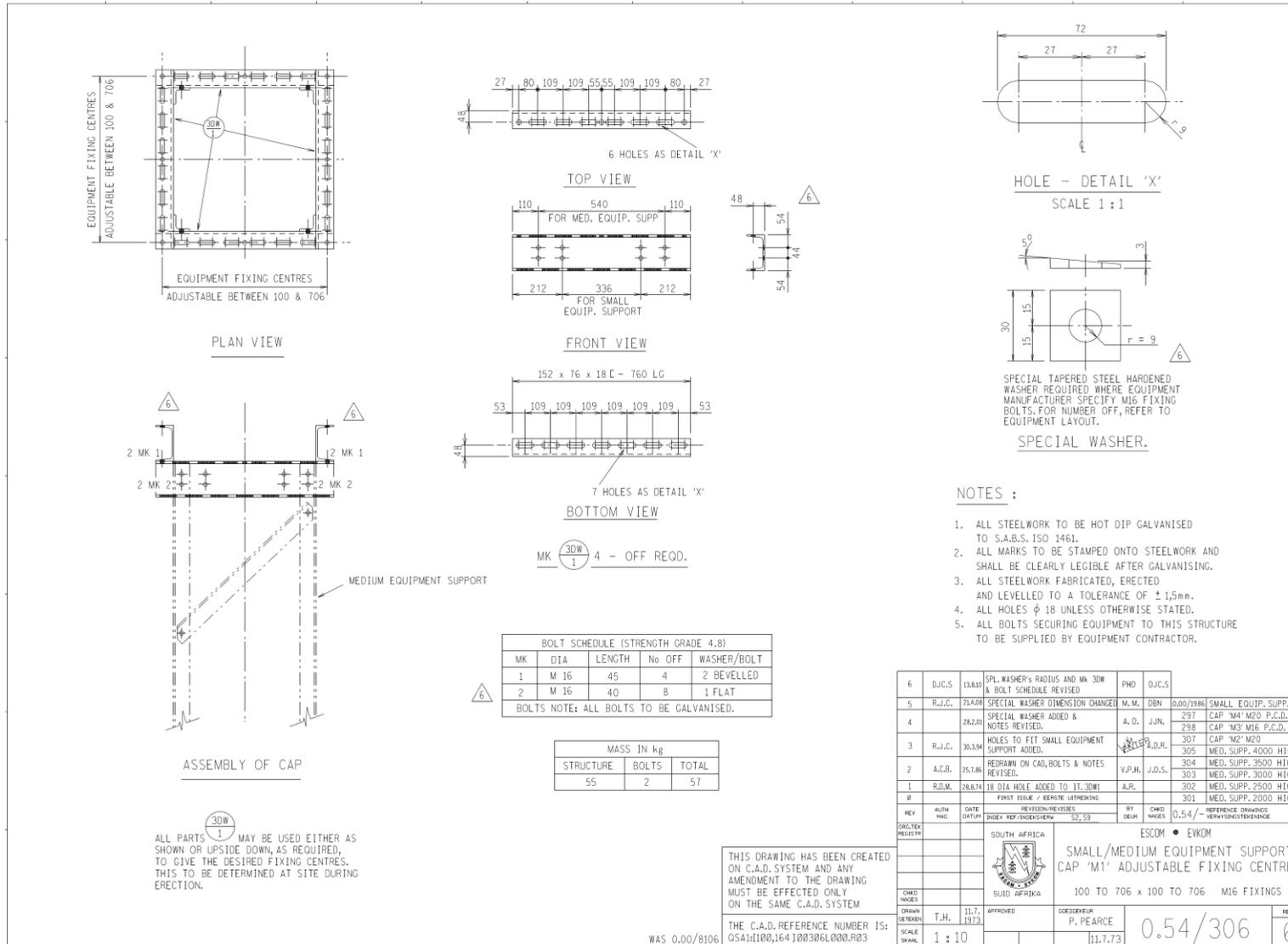
The tuning units and compatible units used by Eskom appear in a list below.

| SAP No | Short Description                             | Compatible Line Trap(s)  |
|--------|---|--|
| 667889 | Line Trap Tuning Unit 40kA 0.2mH 80 - 108kHz  | U2 (667708)  |
| 667891 | Line Trap Tuning Unit 40kA 0.2mH 104 - 156kHz |  |
| 667899 | Line Trap Tuning Unit 40kA 0.2mH 125 - 204kHz |  |
| 667887 | Line Trap Tuning Unit 40kA 0.2mH 194 - 500kHz |  |
| 667890 | Line Trap Tuning Unit 40kA 0.5mH 48 - 78kHz   | U4 (4483)  |
| 667898 | Line Trap Tuning Unit 40kA 0.5mH 70 - 156kHz  |  |
| 667900 | Line Trap Tuning Unit 40kA 0.5mH 101 - 500kHz |  |
| 667904 | Line Trap Tuning Unit 50kA 0.2mH 80 - 108kHz  | S1HH (558642)  |
| 667950 | Line Trap Tuning Unit 50kA 0.2mH 104 - 156kHz |  |
| 667942 | Line Trap Tuning Unit 50kA 0.2mH 125 - 204kHz |  |
| 667944 | Line Trap Tuning Unit 50kA 0.2mH 194 - 500kHz |  |
| 667905 | Line Trap Tuning Unit 50kA 0.5mH 48 - 78kHz   | S3HH (558638), S8HH (558632),<br>S10HH (558628), Q1HH (558835),<br>Q6HH (558831), & QB1HH (558626) |
| 667936 | Line Trap Tuning Unit 50kA 0.5mH 70 - 156kHz  |  |
| 667943 | Line Trap Tuning Unit 50kA 0.5mH 101 - 500kHz |  |
| 667951 | Line Trap Tuning Unit 63kA 0.5mH 48 - 78kHz   | Q7HH (558826) & Q10HH (558643)   |
| 667952 | Line Trap Tuning Unit 63A 0.5mH 70 - 156kHz   |  |
| 667953 | Line Trap Tuning Unit 63kA 0.5mH 101 - 500kHz |  |
| 667945 | Line Trap Tuning Unit 50kA 1.2mH 40 - 500kHz  | S5HH (558636), S9HH (558630),<br>Q3HH (558833), & Q8HH (558822)                                    |
| 667954 | Line Trap Tuning Unit 63kA 1.2mH 40 - 500kHz  | Q9HH (558645)  |

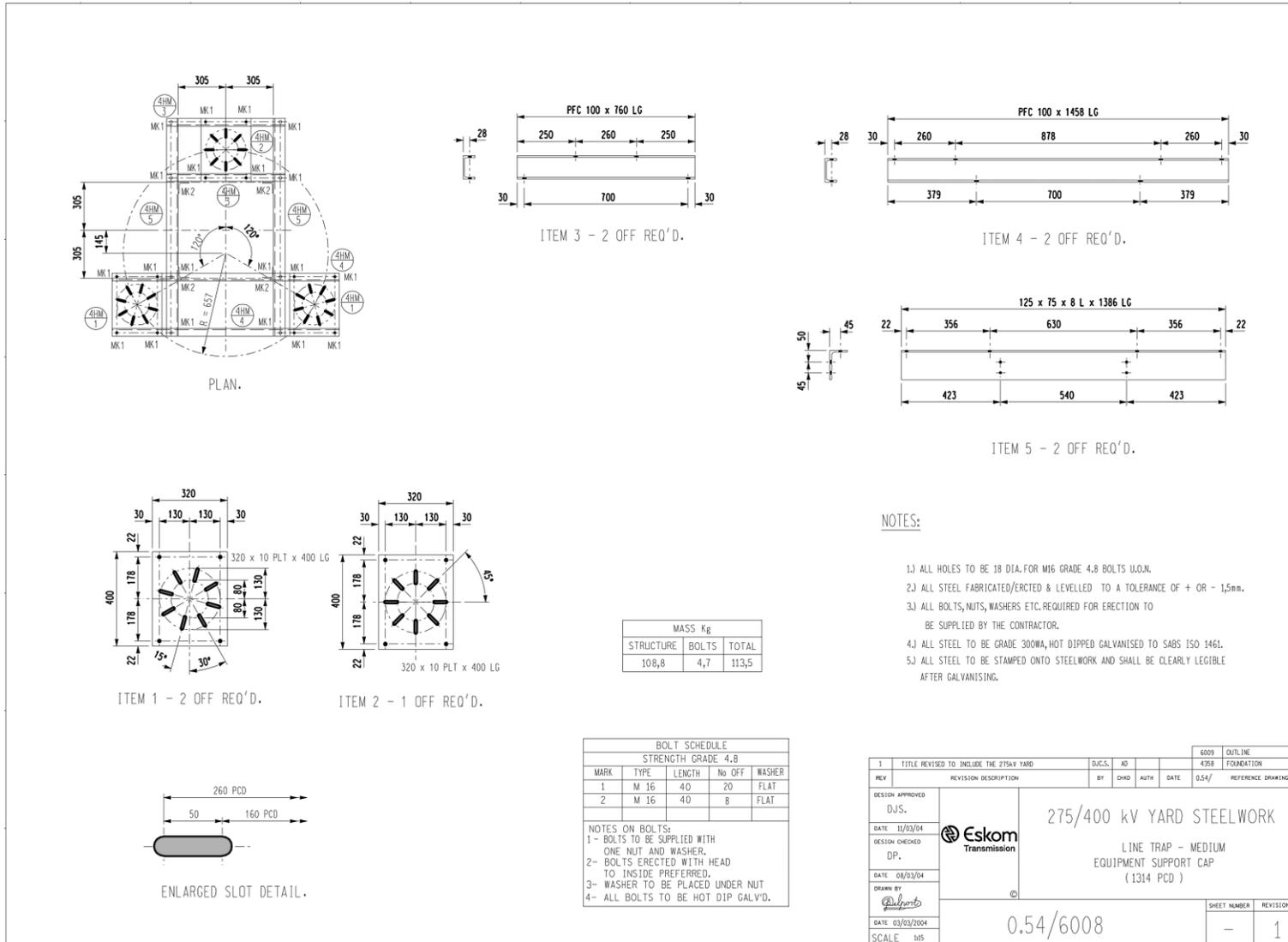
Annex H – Equipment support & Support Cap Drawings



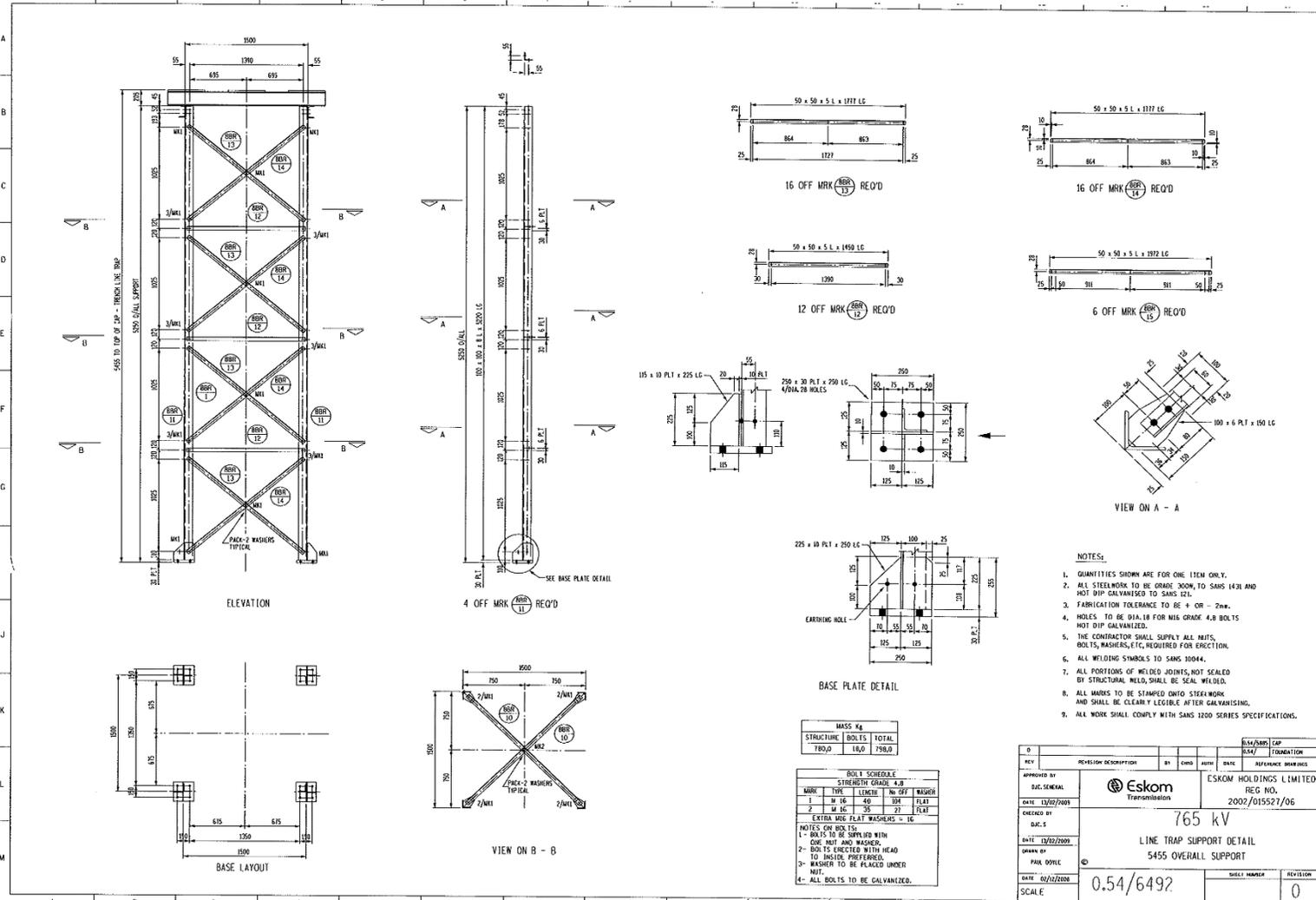
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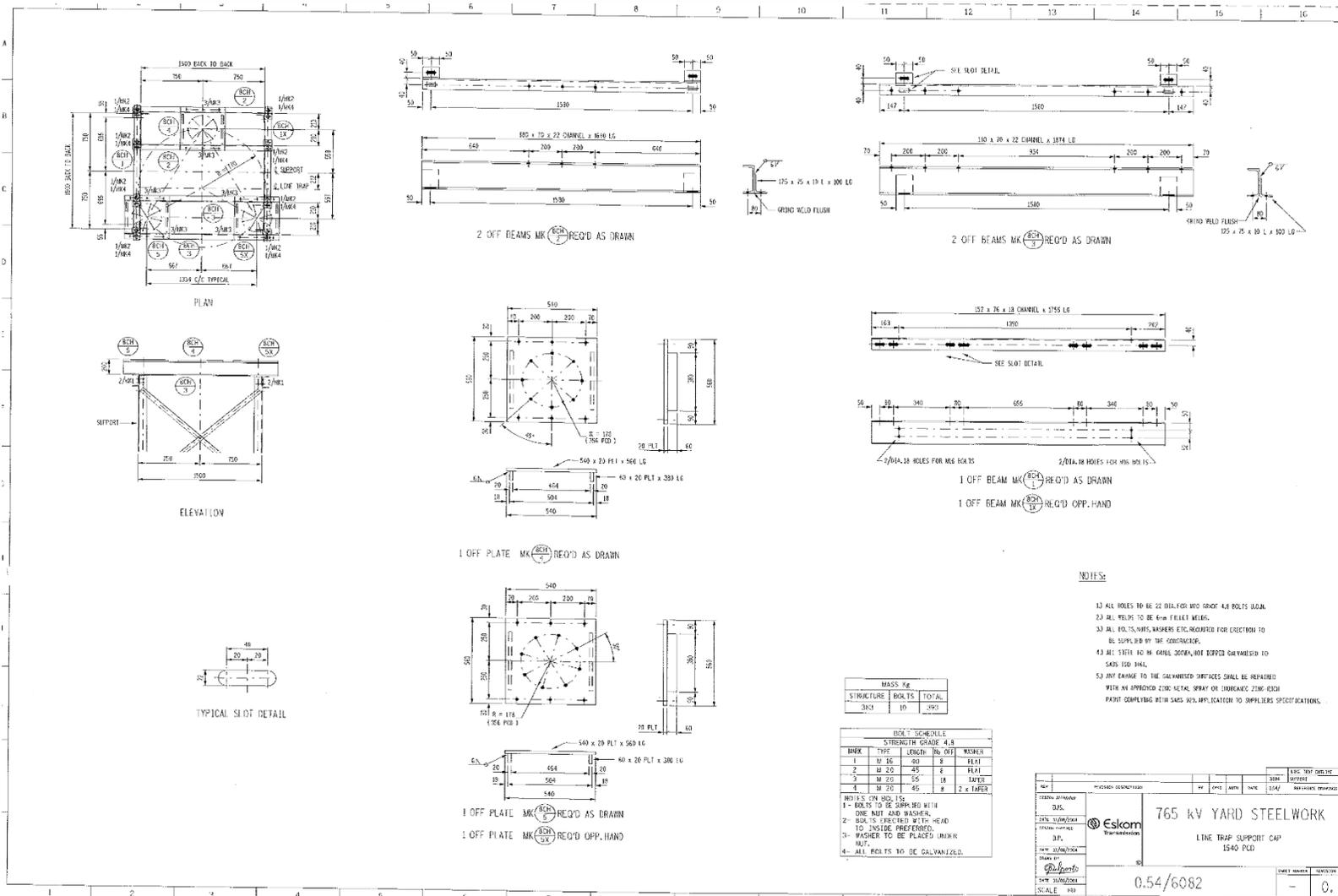
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POWER LINE CARRIER LINE TRAPS AND ASSOCIATED  
POST SUPPORT INSULATORS STANDARD

Unique Identifier: 240-57648739

Revision: 3

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### Annex I – Technical Schedules A&B

The technical schedules A & B in this Appendix need to be completed where the supplier needs to complete 'Schedule B' for the enquiry.

**Schedule A: Purchaser's specific requirements**

**Schedule B: Particulars of equipment to be supplied**

| 1<br>Item     | 2<br>Description  |           | 3<br>Schedule A                     | 4<br>Schedule B |
|---------------|---|-----------|-------------------------------------|-----------------|
| <b>Q</b>      | <b>400 kV line traps (LT)</b>   |           |                                     |                 |
|               | 1 Manufacturer  |           |                                     |                 |
| Annex E       | 2 i) Minimum value of resistance component of line trap impedance in the frequency bands specified for carrier signal blocking. ( $Z_r$ ) | ohms      | 400                                 |                 |
|               | Or  |           |                                     |                 |
|               | ii) Maximum value of shunt loss of line trap with reactive component on a 400 $\Omega$ line ( $A_{tn}$ )                                  | dB        | 3,52                                |                 |
|               | 3 Type of trap  |           | Broad-band                          |                 |
|               | 4 System conditions for which traps shall be suitable:  |           |                                     |                 |
|               | i) Rated frequency  | Hz        | 50                                  |                 |
|               | ii) System neutral  |           | Effectively earthed                 |                 |
|               | iii) Rated r.m.s. line-to-line voltage  | kV        | 400                                 |                 |
|               | iv) Maximum continuous r.m.s. line-to-line voltage  | kV        | 420                                 |                 |
| 3.1.3.2 & 3.3 | 5 Mounting insulation   |           |                                     |                 |
|               | Method of mounting  |           | On post insulators supplied with LT |                 |
|               | Post insulator mounted traps  |           |                                     |                 |
| Annex A       | i) Minimum crest value of full wave lightning impulse type test withstand voltage to earth at sea level                                   | kV        | 1425                                |                 |
|               | ii) Characteristic of lightning impulse wave  |           | 1.2/50 $\mu$ s                      |                 |
| Annex A       | iii) Minimum crest value of full wave switching impulse type test withstand voltage to earth at sea level                                 | kV        | 1050                                |                 |
|               | iv) Characteristic of switching impulse wave  |           | 250/2500 $\mu$ s                    |                 |
| Annex A       | v) Minimum 60 s power frequency wet withstand type test voltage to earth at sea level.  | kV r.m.s. | 630                                 |                 |

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| 1<br>Item | 2<br>Description  |              | 3<br>Schedule A                       | 4<br>Schedule B |
|-----------|---|--------------|---------------------------------------|-----------------|
| Annex A   | vi) Minimum 60 s power frequency dry withstand type test voltage to earth at sea level. | kV<br>r.m.s. | 630                                   |                 |
| Annex A   | vii) Creepage distance of post insulators   |              |                                       |                 |
|           | a) Very Heavy pollution total   | mm           | 13020                                 |                 |
| 3.2.9     | 6 Main terminals  |              |                                       |                 |
|           | i) Terminal material and finish   |              | Aluminium<br>(pads)                   |                 |
|           | ii) Preferred arrangement of terminals  |              |                                       |                 |
|           | a) Upper  |              | Horizontal at<br>periphery of<br>trap |                 |
|           | b) Lower  |              | Horizontal at<br>periphery of<br>trap |                 |
|           | iii) a) Withstand force without failure   | kN           | 3                                     |                 |
|           | b) Withstand force without distortion   | kN           | 1,5                                   |                 |
|           | iv) Dimensions and configuration of terminals   |              |                                       |                 |
|           | a) 2500 A rated current   |              |                                       |                 |
|           | Pad in accordance with IEC 60518; 8 hole  |              | Yes                                   |                 |
|           | b) 3150 A rated current   |              |                                       |                 |
|           | Pad in accordance with IEC 60518; 8 hole  |              | Yes                                   |                 |
|           | c) 4000 A rated current   |              |                                       |                 |
|           | Pad in accordance with IEC 60518; 8 hole  |              | Yes                                   |                 |
|           | 7 Bird Barriers – the supplier to provide information and is it acceptable to Eskom     |              | Yes/No                                |                 |
|           |   |              |                                       |                 |
| <b>Q1</b> | <b>400 kV LT 2500 A 50 kA 0.5 mH</b>  |              |                                       |                 |
|           | 1 Manufacturer's type reference   |              |                                       |                 |
|           | 2 Current rating:   |              |                                       |                 |
| Annex C   | i) Rated current at site altitude   | A            | 2500                                  |                 |
| Annex C   | ii) Rated short-time current for 1 s  | kA           | 50                                    |                 |
| 3.2.2.3   | iii) Asymmetrical peak current rating (2.55 x short-time current rating)                | kA           | 127.5                                 |                 |
| 3.2.2.1   | 3 Nominal inductance at 50 Hz   | mH           | 0.5                                   |                 |
| 4.4.3.4   | 4 Self resonant frequency of main coil  | kHz          |                                       |                 |

| 1<br>Item             | 2<br>Description  |     | 3<br>Schedule A | 4<br>Schedule B |
|-----------------------|---|-----|-----------------|-----------------|
| Annex E               | 5 Blocking frequency bandwidths   | kHz |                 |                 |
|                       |   | 1   | 48 to 78        |                 |
|                       |   | 2   | 70 to 156       |                 |
|                       |   | 3   | 101 to 500      |                 |
|                       |   | 4   | _____           |                 |
| 3.2.2.5 &<br>Annex D  | 6 Temperature rise at rated current   |     | Annex D         |                 |
|                       | i) Class of insulation  |     |                 |                 |
|                       | ii) Maximum temperature rise  |     |                 |                 |
|                       | a) Measured by thermometer  | °C  |                 |                 |
|                       | b) Measured by increase in resistance   | °C  |                 |                 |
|                       | 7 Tuning unit type reference  |     |                 |                 |
| 3.2.4.4               | 8 Generic type of protective arrester   |     |                 |                 |
|                       | i) Gapped silicon carbide   |     | No              |                 |
|                       | ii) Magnetically blown  |     | No              |                 |
|                       | iii) Zinc oxide   |     | Yes             |                 |
|                       | 9 Tuning unit protection co-ordination  |     |                 |                 |
|                       | i) Manufacturer's type number of arrester   |     |                 |                 |
| 3.2.2.4               | ii) Voltage developed across trap by the rated short-time current                 | kV  | U               |                 |
|                       | iii) Rated voltage of surge arrester (50 Hz)                                      | kV  |                 |                 |
|                       | iv) Maximum continuous overvoltage level  | kV  |                 |                 |
|                       | v) 1 s temporary overvoltage level (TOV)  | kV  |                 |                 |
| 3.2.4.3               | vi) 8/20µs (10 kA) residual voltage (protective level)                            | kV  |                 |                 |
|                       | vii) Impulse test voltage (200 kV/µs) of tuning unit                              | kV  |                 |                 |
|                       | viii) Factor of safety between vii) and vi)                                       |     | 3               |                 |
| 4.4.3.7               | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units | kV  | 1.3 x TOV       |                 |
| 4.4.3.10 &<br>Annex B | 11 Radio influence test   |     |                 |                 |
|                       | i) Test voltage   | kV  | 280             |                 |
|                       | ii) Maximum radio influence voltage   | µV  | 250             |                 |
| 4.4.3.8               | 12 Surge arrester impulse discharge current rating (8/20µs wave)                  | kA  | 10              |                 |

| 1<br>Item | 2<br>Description   |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-----------|--|----------|---|-----------------|
| 3.2.5     | 13 PEP carrier frequency withstand across line trap and tuning unit  | W        | 500 (minimum)                                       |                 |
|           | 14 Sealed tuning unit  |          | Yes/No  |                 |
| 3.2.4.5   | 15 Tuning units directly interchangeable between traps with identical rating (both mechanically and electrically interchangeable)? |          | Yes   |                 |
|           | 16 Bird barriers fitted?   |          | Yes/No/n/a  |                 |
| 3.2.4.5   | 17 Simple field replacement of tuning units  |          | Yes   |                 |
|           | 18 Mounting arrangement  |          | On post insulators                                  |                 |
|           | 20 Mass, diameter and height of trap   | kg/m/m   |   |                 |
|           | 21 Drawings showing:   |          |   |                 |
|           | i) a) Actual or typical variation of resistive component with frequency  | Dwg. No. |   |                 |
|           | Or   |          |   |                 |
|           | b) Tapping loss vs frequency with reactive component compensated   | Dwg. No. |   |                 |
|           | ii) Dimensions and details of connecting terminals and mounting arrangements   | Dwg. No. |   |                 |
|           | iii) Electrical circuit  | Dwg. No. |   |                 |
| 4.4.3     | 22 Type test reports   |          |   |                 |
|           | i) Are the type test reports available and provide the location of the reports in the tender documentation                         |          | Yes/No and specify location in tender documentation |                 |
| <b>Q3</b> | <b>400 kV LT 2500 A 50 kA 1.2 mH</b>   |          |   |                 |
|           | 1 Manufacturer's type reference  |          |   |                 |
|           | 2 Current rating:  |          |   |                 |
| Annex C   | i) Rated current at site altitude  | A        | 2500  |                 |
| Annex C   | ii) Rated short-time current for 1 s   | kA       | 50  |                 |
| 3.2.2.3   | iii) Asymmetrical peak current rating (2.55 x short-time current rating)   | kA       | 127.5   |                 |
| 3.2.2.1   | 3 Nominal inductance at 50 Hz  | mH       | 1.2   |                 |
| 4.4.3.4   | 4 Self resonant frequency of main coil   | kHz      |   |                 |

| 1<br>Item             | 2<br>Description  |     | 3<br>Schedule A | 4<br>Schedule B |
|-----------------------|---|-----|-----------------|-----------------|
| Annex E               | 5 Blocking frequency bandwidths   | kHz |                 |                 |
|                       |   | 1   | 40 to 500       |                 |
|                       |   | 2   | _____           |                 |
|                       |   | 3   | _____           |                 |
|                       |   | 4   | _____           |                 |
| 3.2.2.5 &<br>Annex D  | 6 Temperature rise at rated current   |     | Annex D         |                 |
|                       | i) Class of insulation  |     |                 |                 |
|                       | ii) Maximum temperature rise  |     |                 |                 |
|                       | a) Measured by thermometer  | °C  |                 |                 |
|                       | b) Measured by increase in resistance   | °C  |                 |                 |
|                       | 7 Tuning unit type reference  |     |                 |                 |
| 3.2.4.4               | 8 Generic type of protective arrester   |     |                 |                 |
|                       | i) Gapped silicon carbide   |     | No              |                 |
|                       | ii) Magnetically blown  |     | No              |                 |
|                       | iii) Zinc oxide   |     | Yes             |                 |
|                       | 9 Tuning unit protection co-ordination  |     |                 |                 |
|                       | i) Manufacturer's type number of arrester   |     |                 |                 |
| 3.2.2.4               | ii) Voltage developed across trap by the rated short-time current                 | kV  | U               |                 |
|                       | iii) Rated voltage of surge arrester (50 Hz)                                      | kV  |                 |                 |
|                       | iv) Maximum continuous overvoltage level  | kV  |                 |                 |
|                       | v) 1 s temporary overvoltage level (TOV)  | kV  |                 |                 |
| 3.2.4.3               | vi) 8/20µs (10 kA) residual voltage (protective level)                            | kV  |                 |                 |
|                       | vii) Impulse test voltage (200 kV/µs) of tuning unit                              | kV  |                 |                 |
|                       | viii) Factor of safety between vii) and vi)                                       |     | 3               |                 |
| 4.4.3.7               | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units | kV  | 1.3 x TOV       |                 |
| 4.4.3.10 &<br>Annex B | 11 Radio influence test   |     |                 |                 |
|                       | i) Test voltage   | kV  | 280             |                 |
|                       | ii) Maximum radio influence voltage   | µV  | 250             |                 |
| 4.4.3.8               | 12 Surge arrester impulse discharge current rating (8/20µs wave)                  | kA  | 10              |                 |

| 1<br>Item | 2<br>Description   |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-----------|--|----------|---|-----------------|
| 3.2.5     | 13 PEP carrier frequency withstand across line trap and tuning unit  | W        | 500 (minimum)                                       |                 |
|           | 14 Sealed tuning unit  |          | Yes/No  |                 |
| 3.2.4.5   | 15 Tuning units directly interchangeable between traps with identical rating (both mechanically and electrically interchangeable)? |          | Yes   |                 |
|           | 16 Bird barriers fitted?   |          | Yes/No/n/a  |                 |
| 3.2.4.5   | 17 Simple field replacement of tuning units  |          | Yes   |                 |
|           | 18 Mounting arrangement  |          | On post insulators                                  |                 |
|           | 20 Mass, diameter and height of trap   | kg/m/m   |   |                 |
|           | 21 Drawings showing:   |          |   |                 |
|           | i) a) Actual or typical variation of resistive component with frequency  | Dwg. No. |   |                 |
|           | Or   |          |   |                 |
|           | b) Tapping loss vs frequency with reactive component compensated   | Dwg. No. |   |                 |
|           | ii) Dimensions and details of connecting terminals and mounting arrangements   | Dwg. No. |   |                 |
|           | iii) Electrical circuit  | Dwg. No. |   |                 |
| 4.4.3     | 22 Type test reports   |          |   |                 |
|           | i) Are the type test reports available and provide the location of the reports in the tender documentation                         |          | Yes/No and specify location in tender documentation |                 |
| <b>Q6</b> | <b>400 kV LT 3150 A 50 kA 0.5 mH</b>   |          |   |                 |
|           | 1 Manufacturer's type reference  |          |   |                 |
|           | 2 Current rating:  |          |   |                 |
| Annex C   | i) Rated current at site altitude  | A        | 3150  |                 |
| Annex C   | ii) Rated short-time current for 1 s   | kA       | 50  |                 |
| 3.2.2.3   | iii) Asymmetrical peak current rating (2.55 x short-time current rating)   | kA       | 127.5   |                 |
| 3.2.2.1   | 3 Nominal inductance at 50 Hz  | mH       | 0.5   |                 |
| 4.4.3.4   | 4 Self resonant frequency of main coil   | kHz      |   |                 |

| 1<br>Item            | 2<br>Description  |     | 3<br>Schedule A | 4<br>Schedule B |
|----------------------|---|-----|-----------------|-----------------|
| Annex E              | 5 Blocking frequency bandwidths   | kHz |                 |                 |
|                      |   | 1   | 48 to 78        |                 |
|                      |   | 2   | 70 to 156       |                 |
|                      |   | 3   | 101 to 500      |                 |
|                      |   | 4   | _____           |                 |
| 3.2.2.5 &<br>Annex D | 6 Temperature rise at rated current   |     | Annex D         |                 |
|                      | i) Class of insulation  |     |                 |                 |
|                      | ii) Maximum temperature rise  |     |                 |                 |
|                      | a) Measured by thermometer  | °C  |                 |                 |
|                      | b) Measured by increase in resistance   | °C  |                 |                 |
|                      | 7 Tuning unit type reference  |     |                 |                 |
| 3.2.4.4              | 8 Generic type of protective arrester   |     |                 |                 |
|                      | i) Gapped silicon carbide   |     | No              |                 |
|                      | ii) Magnetically blown  |     | No              |                 |
|                      | iii) Zinc oxide   |     | Yes             |                 |
|                      | 9 Tuning unit protection co-ordination  |     |                 |                 |
|                      | i) Manufacturer's type number of arrester   |     |                 |                 |
| 3.2.2.4              | ii) Voltage developed across trap by the rated short-time current                 | kV  | U               |                 |
|                      | iii) Rated voltage of surge arrester (50 Hz)                                      | kV  |                 |                 |
|                      | iv) Maximum continuous overvoltage level  | kV  |                 |                 |
|                      | v) 1 s temporary overvoltage level (TOV)  | kV  |                 |                 |
| 3.2.4.3              | vi) 8/20µs (10 kA) residual voltage (protective level)                            | kV  |                 |                 |
|                      | vii) Impulse test voltage (200 kV/µs) of tuning unit                              | kV  |                 |                 |
|                      | viii) Factor of safety between vii) and vi)                                       |     | 3               |                 |
| 4.4.3.7              | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units | kV  | 1.3 x TOV       |                 |
| 4.4.3.1 &<br>Annex B | 11 Radio influence test   |     |                 |                 |
|                      | i) Test voltage   | kV  | 280             |                 |
|                      | ii) Maximum radio influence voltage   | µV  | 250             |                 |
| 4.4.3.8              | 12 Surge arrester impulse discharge current rating (8/20µs wave)                  | kA  | 10              |                 |

| 1<br>Item | 2<br>Description   |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-----------|--|----------|---|-----------------|
| 3.2.5     | 13 PEP carrier frequency withstand across line trap and tuning unit  | W        | 500 (minimum)                                       |                 |
|           | 14 Sealed tuning unit  |          | Yes/No  |                 |
| 3.2.4.5   | 15 Tuning units directly interchangeable between traps with identical rating (both mechanically and electrically interchangeable)? |          | Yes   |                 |
|           | 16 Bird barriers fitted?   |          | Yes/No/n/a  |                 |
| 3.2.4.5   | 17 Simple field replacement of tuning units  |          | Yes   |                 |
|           | 18 Mounting arrangement  |          | On post insulators                                  |                 |
|           | 20 Mass, diameter and height of trap   | kg/m/m   |   |                 |
|           | 21 Drawings showing:   |          |   |                 |
|           | i) a) Actual or typical variation of resistive component with frequency  | Dwg. No. |   |                 |
|           | Or   |          |   |                 |
|           | b) Tapping loss vs frequency with reactive component compensated   | Dwg. No. |   |                 |
|           | ii) Dimensions and details of connecting terminals and mounting arrangements   | Dwg. No. |   |                 |
|           | iii) Electrical circuit  | Dwg. No. |   |                 |
| 4.4.3     | 22 Type test reports   |          |   |                 |
|           | i) Are the type test reports available and provide the location of the reports in the tender documentation                         |          | Yes/No and specify location in tender documentation |                 |
| <b>Q7</b> | <b>400 kV LT 3150 A 63 kA 0.5 mH</b>   |          |   |                 |
|           | 1 Manufacturer's type reference  |          |   |                 |
|           | 2 Current rating:  |          |   |                 |
| Annex C   | i) Rated current at site altitude  | A        | 3150  |                 |
| Annex C   | ii) Rated short-time current for 1 s   | kA       | 63  |                 |
| 3.2.2.3   | iii) Asymmetrical peak current rating (2.55 x short-time current rating)   | kA       | 160.7   |                 |
| 3.2.2.1   | 3 Nominal inductance at 50 Hz  | mH       | 0.5   |                 |

| 1<br>Item             | 2<br>Description  |     | 3<br>Schedule A | 4<br>Schedule B |
|-----------------------|---|-----|-----------------|-----------------|
| 4.4.3.4               | 4 Self resonant frequency of main coil  | kHz |                 |                 |
| Annex E               | 5 Blocking frequency bandwidths   | kHz |                 |                 |
|                       |   | 1   | 48 to 78        |                 |
|                       |   | 2   | 70 to 156       |                 |
|                       |   | 3   | 101 to 500      |                 |
|                       |   | 4   | _____           |                 |
| 3.2.2.5 &<br>Annex D  | 6 Temperature rise at rated current   |     | Annex D         |                 |
|                       | i) Class of insulation  |     |                 |                 |
|                       | ii) Maximum temperature rise  |     |                 |                 |
|                       | a) Measured by thermometer  | °C  |                 |                 |
|                       | b) Measured by increase in resistance   | °C  |                 |                 |
|                       | 7 Tuning unit type reference  |     |                 |                 |
| 3.2.4.4               | 8 Generic type of protective arrester   |     |                 |                 |
|                       | i) Gapped silicon carbide   |     | No              |                 |
|                       | ii) Magnetically blown  |     | No              |                 |
|                       | iii) Zinc oxide   |     | Yes             |                 |
|                       | 9 Tuning unit protection co-ordination  |     |                 |                 |
|                       | i) Manufacturer's type number of arrester   |     |                 |                 |
| 3.2.2.4               | ii) Voltage developed across trap by the rated short-time current                 | kV  | U               |                 |
|                       | iii) Rated voltage of surge arrester (50 Hz)                                      | kV  |                 |                 |
|                       | iv) Maximum continuous overvoltage level  | kV  |                 |                 |
|                       | v) 1 s temporary overvoltage level (TOV)  | kV  |                 |                 |
| 3.2.4.3               | vi) 8/20µs (10 kA) residual voltage (protective level)                            | kV  |                 |                 |
|                       | vii) Impulse test voltage (200 kV/µs) of tuning unit                              | kV  |                 |                 |
|                       | viii) Factor of safety between vii) and vi)                                       |     | 3               |                 |
| 4.4.3.7               | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units | kV  | 1.3 x TOV       |                 |
| 4.4.3.10 &<br>Annex B | 11 Radio influence test   |     |                 |                 |
|                       | i) Test voltage   | kV  | 280             |                 |
|                       | ii) Maximum radio influence voltage   | µV  | 250             |                 |
| 4.4.3.8               | 12 Surge arrester impulse discharge current rating (8/20µs wave)                  | kA  | 10              |                 |

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| 1<br>Item | 2<br>Description   |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-----------|--|----------|---|-----------------|
| 3.2.5     | 13 PEP carrier frequency withstand across line trap and tuning unit  | W        | 500 (minimum)                                       |                 |
|           | 14 Sealed tuning unit  |          | Yes/No  |                 |
| 3.2.4.5   | 15 Tuning units directly interchangeable between traps with identical rating (both mechanically and electrically interchangeable)? |          | Yes   |                 |
|           | 16 Bird barriers fitted?   |          | Yes/No/n/a  |                 |
| 3.2.4.5   | 17 Simple field replacement of tuning units  |          | Yes   |                 |
|           | 18 Mounting arrangement  |          | On post insulators                                  |                 |
|           | 20 Mass, diameter and height of trap   | kg/m/m   |   |                 |
|           | 21 Drawings showing:   |          |   |                 |
|           | i) a) Actual or typical variation of resistive component with frequency  | Dwg. No. |   |                 |
|           | Or   |          |   |                 |
|           | b) Tapping loss vs frequency with reactive component compensated   | Dwg. No. |   |                 |
|           | ii) Dimensions and details of connecting terminals and mounting arrangements   | Dwg. No. |   |                 |
|           | iii) Electrical circuit  | Dwg. No. |   |                 |
| 4.4.3     | 22 Type test reports   |          |   |                 |
|           | i) Are the type test reports available and provide the location of the reports in the tender documentation                         |          | Yes/No and specify location in tender documentation |                 |
| <b>Q8</b> | <b>400 kV LT 3150 A 50 kA 1.2 mH</b>   |          |   |                 |
|           | 1 Manufacturer's type reference  |          |   |                 |
|           | 2 Current rating:  |          |   |                 |
| Annex C   | i) Rated current at site altitude  | A        | 3150  |                 |
| Annex C   | ii) Rated short-time current for 1 s   | kA       | 50  |                 |
| 3.2.2.3   | iii) Asymmetrical peak current rating (2.55 x short-time current rating)   | kA       | 127.5   |                 |
| 3.2.2.1   | 3 Nominal inductance at 50 Hz  | mH       | 1.2   |                 |

| 1<br>Item             | 2<br>Description  |     | 3<br>Schedule A | 4<br>Schedule B |
|-----------------------|---|-----|-----------------|-----------------|
| 4.4.3.4               | 4 Self resonant frequency of main coil  | kHz |                 |                 |
| Annex E               | 5 Blocking frequency bandwidths   | kHz |                 |                 |
|                       |   | 1   | 40 to 500       |                 |
|                       |   | 2   | _____           |                 |
|                       |   | 3   | _____           |                 |
|                       |   | 4   | _____           |                 |
| 3.2.2.5 &<br>Annex D  | 6 Temperature rise at rated current   |     | Annex D         |                 |
|                       | i) Class of insulation  |     |                 |                 |
|                       | ii) Maximum temperature rise  |     |                 |                 |
|                       | a) Measured by thermometer  | °C  |                 |                 |
|                       | b) Measured by increase in resistance   | °C  |                 |                 |
|                       | 7 Tuning unit type reference  |     |                 |                 |
| 3.2.4.4               | 8 Generic type of protective arrester   |     |                 |                 |
|                       | i) Gapped silicon carbide   |     | No              |                 |
|                       | ii) Magnetically blown  |     | No              |                 |
|                       | iii) Zinc oxide   |     | Yes             |                 |
|                       | 9 Tuning unit protection co-ordination  |     |                 |                 |
|                       | i) Manufacturer's type number of arrester   |     |                 |                 |
| 3.2.2.4               | ii) Voltage developed across trap by the rated short-time current                 | kV  | U               |                 |
|                       | iii) Rated voltage of surge arrester (50 Hz)                                      | kV  |                 |                 |
|                       | iv) Maximum continuous overvoltage level  | kV  |                 |                 |
|                       | v) 1 s temporary overvoltage level (TOV)  | kV  |                 |                 |
| 3.2.4.3               | vi) 8/20µs (10 kA) residual voltage (protective level)                            | kV  |                 |                 |
|                       | vii) Impulse test voltage (200 kV/µs) of tuning unit                              | kV  |                 |                 |
|                       | viii) Factor of safety between vii) and vi)                                       |     | 3               |                 |
| 4.4.3.7               | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units | kV  | 1.3 x TOV       |                 |
| 4.4.3.10 &<br>Annex B | 11 Radio influence test   |     |                 |                 |
|                       | i) Test voltage   | kV  | 190             |                 |
|                       | ii) Maximum radio influence voltage   | µV  | 250             |                 |
| 4.4.3.8               | 12 Surge arrester impulse discharge current rating (8/20µs wave)                  | kA  | 10              |                 |

| 1<br>Item | 2<br>Description   |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-----------|--|----------|---|-----------------|
| 3.2.5     | 13 PEP carrier frequency withstand across line trap and tuning unit  | W        | 500 (minimum)                                       |                 |
|           | 14 Sealed tuning unit  |          | Yes/No  |                 |
| 3.2.4.5   | 15 Tuning units directly interchangeable between traps with identical rating (both mechanically and electrically interchangeable)? |          | Yes   |                 |
|           | 16 Bird barriers fitted?   |          | Yes/No/n/a  |                 |
| 3.2.4.5   | 17 Simple field replacement of tuning units  |          | Yes   |                 |
|           | 18 Mounting arrangement  |          | On post insulators                                  |                 |
|           | 20 Mass, diameter and height of trap   | kg/m/m   |   |                 |
|           | 21 Drawings showing:   |          |   |                 |
|           | i) a) Actual or typical variation of resistive component with frequency  | Dwg. No. |   |                 |
|           | Or   |          |   |                 |
|           | b) Tapping loss vs frequency with reactive component compensated   | Dwg. No. |   |                 |
|           | ii) Dimensions and details of connecting terminals and mounting arrangements   | Dwg. No. |   |                 |
|           | iii) Electrical circuit  | Dwg. No. |   |                 |
| 4.4.3     | 22 Type test reports   |          |   |                 |
|           | i) Are the type test reports available and provide the location of the reports in the tender documentation                         |          | Yes/No and specify location in tender documentation |                 |
| <b>Q9</b> | <b>400 kV LT 3150 A 63 kA 1.2 mH</b>   |          |   |                 |
|           | 1 Manufacturer's type reference  |          |   |                 |
|           | 2 Current rating:  |          |   |                 |
| Annex C   | i) Rated current at site altitude  | A        | 3150  |                 |
| Annex C   | ii) Rated short-time current for 1 s   | kA       | 63  |                 |
| 3.2.2.3   | iii) Asymmetrical peak current rating (2.55 x short-time current rating)   | kA       | 160.7   |                 |
| 3.2.2.1   | 3 Nominal inductance at 50 Hz  | mH       | 1.2   |                 |

| 1<br>Item             | 2<br>Description  |     | 3<br>Schedule A | 4<br>Schedule B |
|-----------------------|---|-----|-----------------|-----------------|
| 4.4.3.4               | 4 Self resonant frequency of main coil  | kHz |                 |                 |
| Annex E               | 5 Blocking frequency bandwidths   | kHz |                 |                 |
|                       |   | 1   | 40 to 500       |                 |
|                       |   | 2   | _____           |                 |
|                       |   | 3   | _____           |                 |
|                       |   | 4   | _____           |                 |
| 3.2.2.5 &<br>Annex D  | 6 Temperature rise at rated current   |     | Annex D         |                 |
|                       | i) Class of insulation  |     |                 |                 |
|                       | ii) Maximum temperature rise  |     |                 |                 |
|                       | a) Measured by thermometer  | °C  |                 |                 |
|                       | b) Measured by increase in resistance   | °C  |                 |                 |
|                       | 7 Tuning unit type reference  |     |                 |                 |
| 3.2.4.4               | 8 Generic type of protective arrester   |     |                 |                 |
|                       | i) Gapped silicon carbide   |     | No              |                 |
|                       | ii) Magnetically blown  |     | No              |                 |
|                       | iii) Zinc oxide   |     | Yes             |                 |
|                       | 9 Tuning unit protection co-ordination  |     |                 |                 |
|                       | i) Manufacturer's type number of arrester   |     |                 |                 |
| 3.2.2.4               | ii) Voltage developed across trap by the rated short-time current                 | kV  | U               |                 |
|                       | iii) Rated voltage of surge arrester (50 Hz)                                      | kV  |                 |                 |
|                       | iv) Maximum continuous overvoltage level  | kV  |                 |                 |
|                       | v) 1 s temporary overvoltage level (TOV)  | kV  |                 |                 |
| 3.2.4.3               | vi) 8/20µs (10 kA) residual voltage (protective level)                            | kV  |                 |                 |
|                       | vii) Impulse test voltage (200 kV/µs) of tuning unit                              | kV  |                 |                 |
|                       | viii) Factor of safety between vii) and vi)                                       |     | 3               |                 |
| 4.4.3.7               | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units | kV  | 1.3 x TOV       |                 |
| 4.4.3.10 &<br>Annex B | 11 Radio influence test   |     |                 |                 |
|                       | i) Test voltage   | kV  | 280             |                 |
|                       | ii) Maximum radio influence voltage   | µV  | 250             |                 |
| 4.4.3.8               | 12 Surge arrester impulse discharge current rating (8/20µs wave)                  | kA  | 10              |                 |

| 1<br>Item  | 2<br>Description   |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|------------|--|----------|---|-----------------|
| 3.2.5      | 13 PEP carrier frequency withstand across line trap and tuning unit  | W        | 500 (minimum)                                       |                 |
|            | 14 Sealed tuning unit  |          | Yes/No  |                 |
| 3.2.4.5    | 15 Tuning units directly interchangeable between traps with identical rating (both mechanically and electrically interchangeable)? |          | Yes   |                 |
|            | 16 Bird barriers fitted?   |          | Yes/No/n/a  |                 |
| 3.2.4.5    | 17 Simple field replacement of tuning units  |          | Yes   |                 |
|            | 18 Mounting arrangement  |          | On post insulators                                  |                 |
|            | 20 Mass, diameter and height of trap   | kg/m/m   |   |                 |
|            | 21 Drawings showing:   |          |   |                 |
|            | i) a) Actual or typical variation of resistive component with frequency  | Dwg. No. |   |                 |
|            | Or   |          |   |                 |
|            | b) Tapping loss vs frequency with reactive component compensated   | Dwg. No. |   |                 |
|            | ii) Dimensions and details of connecting terminals and mounting arrangements   | Dwg. No. |   |                 |
|            | iii) Electrical circuit  | Dwg. No. |   |                 |
| 4.4.3      | 22 Type test reports   |          |   |                 |
|            | i) Are the type test reports available and provide the location of the reports in the tender documentation                         |          | Yes/No and specify location in tender documentation |                 |
| <b>Q10</b> | <b>400 kV LT 4000 A 63 kA 0.5 mH</b>   |          |   |                 |
|            | 1 Manufacturer's type reference  |          |   |                 |
|            | 2 Current rating:  |          |   |                 |
| Annex C    | i) Rated current at site altitude  | A        | 4000  |                 |
| Annex C    | ii) Rated short-time current for 1 s   | kA       | 63  |                 |
| 3.2.2.3    | iii) Asymmetrical peak current rating (2.55 x short-time current rating)   | kA       | 160.7   |                 |
| 3.2.2.1    | 3 Nominal inductance at 50 Hz  | mH       | 0.5   |                 |
| 4.4.3.4    | 4 Self resonant frequency of main coil   | kHz      |   |                 |

| 1<br>Item             | 2<br>Description  |     | 3<br>Schedule A | 4<br>Schedule B |
|-----------------------|---|-----|-----------------|-----------------|
| Annex E               | 5 Blocking frequency bandwidths   | kHz |                 |                 |
|                       |   | 1   | 48 to 78        |                 |
|                       |   | 2   | 70 to 156       |                 |
|                       |   | 3   | 101 to 500      |                 |
|                       |   | 4   | _____           |                 |
| 3.2.2.5 &<br>Annex D  | 6 Temperature rise at rated current   |     | Annex D         |                 |
|                       | i) Class of insulation  |     |                 |                 |
|                       | ii) Maximum temperature rise  |     |                 |                 |
|                       | a) Measured by thermometer  | °C  |                 |                 |
|                       | b) Measured by increase in resistance   | °C  |                 |                 |
|                       | 7 Tuning unit type reference  |     |                 |                 |
| 3.2.4.4               | 8 Generic type of protective arrester   |     |                 |                 |
|                       | i) Gapped silicon carbide   |     | No              |                 |
|                       | ii) Magnetically blown  |     | No              |                 |
|                       | iii) Zinc oxide   |     | Yes             |                 |
|                       | 9 Tuning unit protection co-ordination  |     |                 |                 |
|                       | i) Manufacturer's type number of arrester   |     |                 |                 |
| 3.2.2.4               | ii) Voltage developed across trap by the rated short-time current                 | kV  | U               |                 |
|                       | iii) Rated voltage of surge arrester (50 Hz)                                      | kV  |                 |                 |
|                       | iv) Maximum continuous overvoltage level  | kV  |                 |                 |
|                       | v) 1 s temporary overvoltage level (TOV)  | kV  |                 |                 |
| 3.2.4.3               | vi) 8/20µs (10 kA) residual voltage (protective level)                            | kV  |                 |                 |
|                       | vii) Impulse test voltage (200 kV/µs) of tuning unit                              | kV  |                 |                 |
|                       | viii) Factor of safety between vii) and vi)                                       |     | 3               |                 |
| 4.4.3.7               | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units | kV  | 1.3 x TOV       |                 |
| 4.4.3.10 &<br>Annex B | 11 Radio influence test   |     |                 |                 |
|                       | i) Test voltage   | kV  | 280             |                 |
|                       | ii) Maximum radio influence voltage   | µV  | 250             |                 |
| 4.4.3.8               | 12 Surge arrester impulse discharge current rating (8/20µs wave)                  | kA  | 10              |                 |

| 1<br>Item | 2<br>Description  |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-----------|---|----------|---|-----------------|
| 3.2.5     | 13 PEP carrier frequency withstand across line trap and tuning unit   | W        | 500 (minimum)                                       |                 |
|           | 14 Sealed tuning unit   |          | Yes/No  |                 |
| 3.2.4.5   | 15 Tuning units directly interchangeable between traps with identical rating (both mechanically and electrically interchangeable)?        |          | Yes   |                 |
|           | 16 Bird barriers fitted?  |          | Yes/No/n/a  |                 |
| 3.2.4.5   | 17 Simple field replacement of tuning units   |          | Yes   |                 |
|           | 18 Mounting arrangement   |          | On post insulators                                  |                 |
|           | 20 Mass, diameter and height of trap  | kg/m/m   |   |                 |
|           | 21 Drawings showing:  |          |   |                 |
|           | i) a) Actual or typical variation of resistive component with frequency   | Dwg. No. |   |                 |
|           | Or  |          |   |                 |
|           | b) Tapping loss vs frequency with reactive component compensated  | Dwg. No. |   |                 |
|           | ii) Dimensions and details of connecting terminals and mounting arrangements  | Dwg. No. |   |                 |
|           | iii) Electrical circuit   | Dwg. No. |   |                 |
| 4.4.3     | 22 Type test reports  |          |   |                 |
|           | i) Are the type test reports available and provide the location of the reports in the tender documentation                                |          | Yes/No and specify location in tender documentation |                 |
| <b>S</b>  | <b>275 kV Line Traps (LT)</b>   |          |   |                 |
|           | 1 Manufacturer  |          |   |                 |
| Annex E   | 2 i) Minimum value of resistance component of line trap impedance in the frequency bands specified for carrier signal blocking. ( $Z_r$ ) | ohms     | 400   |                 |
|           | Or  |          |   |                 |
|           | ii) Maximum value of shunt loss of line trap with reactive component on a 400Ω line ( $A_{tn}$ )  | dB       | 3.52  |                 |
|           | 3 Type of trap  |          | Broad-band  |                 |

| 1<br>Item     | 2<br>Description   |          | 3<br>Schedule A                     | 4<br>Schedule B |
|---------------|--|----------|-------------------------------------|-----------------|
|               | 4 System conditions for which traps shall be suitable:   |          |                                     |                 |
|               | i) Rated frequency   | Hz       | 50                                  |                 |
|               | ii) System neutral   |          | Effectively earthed                 |                 |
|               | iii) Rated r.m.s. line-to-line voltage   | kV       | 275                                 |                 |
|               | iv) Maximum continuous r.m.s. line-to-line voltage   | kV       | 300                                 |                 |
| 3.1.3.2 & 3.3 | 5 Mounting insulation  |          |                                     |                 |
|               | Method of mounting   |          | On post insulators supplied with LT |                 |
|               | Post insulator mounted traps   |          |                                     |                 |
| Annex A       | i) Minimum crest value of full wave lightning impulse type test withstand voltage to earth at sea level                | kV       | 1050                                |                 |
|               | ii) Characteristic of lightning impulse wave   |          | 1.2/50 $\mu$ s                      |                 |
| Annex A       | iii) Minimum crest value of full wave switching impulse type test withstand voltage to earth at sea level              | kV       | 850                                 |                 |
|               | iv) Characteristics of switching impulse wave  |          | 250/2500 $\mu$ s                    |                 |
| Annex A       | v) Minimum 60 s power frequency wet withstand type test voltage to earth at sea level. According to IEC 60044-5 (2004) | kV r.m.s | 460                                 |                 |
| Annex A       | vi) Minimum 60 s power type test voltage to earth at sea level. According to IEC 60044-5 (2004)                        | kV r.m.s | 460                                 |                 |
| Annex A       | vii) Creepage distance of post insulators  |          |                                     |                 |
|               | b) Very Heavy pollution total  | mm       | 9300                                |                 |
| 3.2.9         | 6 Main terminals   |          |                                     |                 |
|               | i) Terminal material and finish  |          | Aluminium (pads)                    |                 |
|               | ii) Preferred arrangement of terminals   |          |                                     |                 |
|               | a) Upper   |          | Horizontal at periphery of trap     |                 |
|               | b) Lower   |          | Horizontal at periphery of trap     |                 |
|               | iii) a) Withstand force without failure  | kN       | 3                                   |                 |

| 1<br>Item         | 2<br>Description  |     | 3<br>Schedule A | 4<br>Schedule B |
|-------------------|---|-----|-----------------|-----------------|
|                   | b) Withstand force without distortion   | kN  | 1.5             |                 |
|                   | iv) Dimensions and configuration of terminals                                       |     |                 |                 |
|                   | a) 2500 A rated current Pad in accordance with IEC60518; 8 hole                     |     | Yes             |                 |
|                   |   |     |                 |                 |
|                   | b) 3150 A rated current Pad in accordance with IEC60518; 8 hole                     |     | Yes             |                 |
|                   | 7 Bird Barriers – the supplier to provide information and is it acceptable to Eskom |     | Yes/No/n/a      |                 |
|                   |   |     |                 |                 |
| <b>S1</b>         | <b>275 kV LT 2500 A 50 kA 0.2 mH</b>  |     |                 |                 |
|                   | 1 Manufacturer's type reference   |     |                 |                 |
|                   | 2 Current rating:   |     |                 |                 |
| Annex C           | i) Rated current at site altitude   | A   | 2500            |                 |
| Annex C           | ii) Rated short time current for 1 s  | kA  | 50              |                 |
| 3.2.2.3           | iii) Asymmetrical peak current rating (2.55 x short-time current rating)            | kA  | 127.5           |                 |
| 3.2.2.1           | 3 Nominal inductance at 50 Hz   | mH  | 0.2             |                 |
| 4.4.3.4           | 4 Self resonant frequency of main coil  | kHz |                 |                 |
| Annex E           | 5 Blocking frequency bandwidths   | kHz |                 |                 |
|                   |   | 1   | 80 to 108       |                 |
|                   |   | 2   | 104 to 156      |                 |
|                   |   | 3   | 124 to 204      |                 |
|                   |   | 4   | 194 to 500      |                 |
| 3.2.2.5 & Annex D | 6 Temperature rise at rated current   |     | Annex D         |                 |
|                   | i) Class of insulation  |     |                 |                 |
|                   | ii) Maximum temperature rise  |     |                 |                 |
|                   | a) Measured by thermometer  | °C  |                 |                 |
|                   | b) Measured by increase in resistance   | °C  |                 |                 |
|                   | 7 Tuning unit type reference  |     |                 |                 |

| 1<br>Item          | 2<br>Description  |          | 3<br>Schedule A    | 4<br>Schedule B |
|--------------------|---|----------|--------------------|-----------------|
| 3.2.4.4            | 8 Generic type of protective arrester   |          |                    |                 |
|                    | i) Gapped silicon carbide   |          | No                 |                 |
|                    | ii) Magnetically blown  |          | No                 |                 |
|                    | iii) Zinc oxide   |          | Yes                |                 |
|                    | 9 Tuning unit protection co-ordination  |          |                    |                 |
|                    | i) Manufacturer's type number of arrester   |          |                    |                 |
| 3.2.2.4            | ii) Voltage developed across trap by the rated short time current   | kV       | U                  |                 |
|                    | iii) Rated voltage of surge arrester (50 Hz)  | kV       |                    |                 |
|                    | iv) Maximum continuous overvoltage level  | kV       |                    |                 |
|                    | v) 1 s temporary overvoltage level (TOV)  | kV       |                    |                 |
| 3.2.4.3            | vi) 8/20 $\mu$ s (10 kA) residual voltage (protective level)  | kV       |                    |                 |
|                    | vii) Impulse test voltage (200 kV/ $\mu$ s) of tuning unit  | kV       |                    |                 |
|                    | viii) Factor of safety between vii) and vi)   |          | 3                  |                 |
| 4.4.3.7            | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units   | kV       | 1.3 x TOV          |                 |
| 4.4.3.10 & Annex B | 11 Radio influence test   |          |                    |                 |
|                    | i) Test voltage   | kV       | 199                |                 |
|                    | ii) Maximum radio influence voltage   | $\mu$ V  | 250                |                 |
| 4.4.3.8            | 12 Surge arrester impulse discharge current rating (8/20 $\mu$ s wave)  | kA       | 10                 |                 |
| 3.2.5              | 13 PEP carrier frequency withstand across line trap and tuning unit   | W        | 500 (minimum)      |                 |
|                    | 14 Sealed tuning unit   |          | Yes/No             |                 |
| 3.2.4.5            | 15 Tuning units directly interchangeable between traps with identical ratings (both mechanically and electrically interchangeable)? |          | Yes                |                 |
|                    | 16 Bird barriers fitted?  |          | Yes/No/n/a         |                 |
| 3.2.4.5            | 17 Simple field replacement of tuning units   |          | Yes                |                 |
|                    | 18 Mounting arrangement   |          | On post insulators |                 |
|                    | 19 Mass, diameter and height of trap  | kg/m/m   |                    |                 |
|                    | 20 Drawings showing:  |          |                    |                 |
|                    | i) a) Actual or typical variation of resistive component with frequency   | Dwg. No. |                    |                 |

| 1<br>Item         | 2<br>Description  |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-------------------|---|----------|---|-----------------|
|                   | Or  |          |   |                 |
|                   | b) Tapping loss vs frequency with reactive component compensated  | Dwg. No. |   |                 |
|                   | ii) Dimensions and details of connecting terminals and mounting arrangements                                | Dwg. No. |   |                 |
|                   | iii) Electrical circuit   | Dwg. No. |   |                 |
| 4.4.3             | 21 Type test reports  |          |   |                 |
|                   | i) Are the type test reports available and provide the location of the reports in the tender documentation. |          | Yes/No and specify location in tender documentation |                 |
|                   |   |          |   |                 |
| <b>S3</b>         | <b>275 kV LT 2500 A 50 kA 0.5 mH</b>  |          |   |                 |
|                   | 1 Manufacturer's type reference   |          |   |                 |
|                   | 2 Current rating:   |          |   |                 |
| Annex C           | i) Rated current at site altitude   | A        | 2500  |                 |
| Annex C           | ii) Rated short time current for 1 s  | kA       | 50  |                 |
| 3.2.2.3           | iii) Asymmetrical peak current rating (2.55 x short-time current rating)                                    | kA       | 127.5   |                 |
| 3.2.2.1           | 3 Nominal inductance at 50 Hz   | mH       | 0.5   |                 |
| 4.4.3.4           | 4 Self resonant frequency of main coil  | kHz      |   |                 |
| Annex E           | 5 Blocking frequency bandwidths   | kHz      |   |                 |
|                   |   | 1        | 48 to 78  |                 |
|                   |   | 2        | 70 to 156   |                 |
|                   |   | 3        | 101 to 500  |                 |
|                   |   | 4        | _____   |                 |
| 3.2.2.5 & Annex D | 6 Temperature rise at rated current   |          | Annex D   |                 |
|                   | i) Class of insulation  |          |   |                 |
|                   | ii) Maximum temperature rise  |          |   |                 |
|                   | a) Measured by thermometer  | °C       |   |                 |
|                   | b) Measured by increase in resistance   | °C       |   |                 |
|                   | 7 Tuning unit type reference  |          |   |                 |

| 1<br>Item          | 2<br>Description  |          | 3<br>Schedule A    | 4<br>Schedule B |
|--------------------|---|----------|--------------------|-----------------|
| 3.2.4.4            | 8 Generic type of protective arrester   |          |                    |                 |
|                    | i) Gapped silicon carbide   |          | No                 |                 |
|                    | ii) Magnetically blown  |          | No                 |                 |
|                    | iii) Zinc oxide   |          | Yes                |                 |
|                    | 9 Tuning unit protection co-ordination  |          |                    |                 |
|                    | i) Manufacturer's type number of arrester   |          |                    |                 |
| 3.2.2.4            | ii) Voltage developed across trap by the rated short time current   | kV       | U                  |                 |
|                    | iii) Rated voltage of surge arrester (50 Hz)  | kV       |                    |                 |
|                    | iv) Maximum continuous overvoltage level  | kV       |                    |                 |
|                    | v) 1 s temporary overvoltage level (TOV)  | kV       |                    |                 |
| 3.2.4.3            | vi) 8/20µs (10 kA) residual voltage (protective level)  | kV       |                    |                 |
|                    | vii) Impulse test voltage (200 kV/µs) of tuning unit  | kV       |                    |                 |
|                    | viii) Factor of safety between vii) and vi)   |          | 3                  |                 |
| 4.4.3.7            | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units   | kV       | 1.3 x TOV          |                 |
| 4.4.3.10 & Annex B | 11 Radio influence test   |          |                    |                 |
|                    | i) Test voltage   | kV       | 199                |                 |
|                    | ii) Maximum radio influence voltage   | µV       | 250                |                 |
| 4.4.3.8            | 12 Surge arrester impulse discharge current rating (8/20µs wave)  | kA       | 10                 |                 |
| 3.2.5              | 13 PEP carrier frequency withstand across line trap and tuning unit   | W        | 500 (minimum)      |                 |
|                    | 14 Sealed tuning unit   |          | Yes/No             |                 |
| 3.2.4.5            | 15 Tuning units directly interchangeable between traps with identical ratings (both mechanically and electrically interchangeable)? |          | Yes                |                 |
|                    | 16 Bird barriers fitted?  |          | Yes/No/n/a         |                 |
| 3.2.4.5            | 17 Simple field replacement of tuning units   |          | Yes                |                 |
|                    | 18 Mounting arrangement   |          | On post insulators |                 |
|                    | 19 Mass, diameter and height of trap  | kg/m/m   |                    |                 |
|                    | 20 Drawings showing:  |          |                    |                 |
|                    | i) a) Actual or typical variation of resistive component with frequency   | Dwg. No. |                    |                 |

| 1<br>Item         | 2<br>Description  |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-------------------|---|----------|---|-----------------|
|                   | or  |          |   |                 |
|                   | b) Tapping loss vs frequency with reactive component compensated  | Dwg. No. |   |                 |
|                   | ii) Dimensions and details of connecting terminals and mounting arrangements                                | Dwg. No. |   |                 |
|                   | iii) Electrical circuit   | Dwg. No. |   |                 |
| 4.4.3             | 21 Type test reports  |          |   |                 |
|                   | i) Are the type test reports available and provide the location of the reports in the tender documentation. |          | Yes/No and specify location in tender documentation |                 |
|                   |   |          |   |                 |
|                   |   |          |   |                 |
| <b>S5</b>         | <b>275 kV LT 2500 A 50 kA 1.2 mH</b>  |          |   |                 |
|                   | 1 Manufacturer's type reference   |          |   |                 |
|                   | 2 Current rating:   |          |   |                 |
| Annex C           | i) Rated current at site altitude   | A        | 2500  |                 |
| Annex C           | ii) Rated short time current for 1 s  | kA       | 50  |                 |
| 3.2.2.3           | iii) Asymmetrical peak current rating (2.55 x short-time current rating)                                    | kA       | 127.5   |                 |
| 3.2.2.1           | 3 Nominal inductance at 50 Hz   | mH       | 1.2   |                 |
| 4.4.3.4           | 4 Self resonant frequency of main coil  | kHz      |   |                 |
| Annex E           | 5 Blocking frequency bandwidths   | kHz      |   |                 |
|                   |   | 1        | 40 to 500   |                 |
|                   |   | 2        | _____   |                 |
|                   |   | 3        | _____   |                 |
|                   |   | 4        | _____   |                 |
| 3.2.2.5 & Annex D | 6 Temperature rise at rated current   |          | Annex D   |                 |
|                   | i) Class of insulation  |          |   |                 |
|                   | ii) Maximum temperature rise  |          |   |                 |
|                   | a) Measured by thermometer  | °C       |   |                 |
|                   | b) Measured by increase in resistance   | °C       |   |                 |
|                   | 7 Tuning unit type reference  |          |   |                 |
| 3.2.4.4           | 8 Generic type of protective arrester   |          |   |                 |

| 1<br>Item          | 2<br>Description  |          | 3<br>Schedule A    | 4<br>Schedule B |
|--------------------|---|----------|--------------------|-----------------|
|                    | i) Gapped silicon carbide   |          | No                 |                 |
|                    | ii) Magnetically blown  |          | No                 |                 |
|                    | iii) Zinc oxide   |          | Yes                |                 |
|                    | 9 Tuning unit protection co-ordination  |          |                    |                 |
|                    | i) Manufacturer's type number of arrester   |          |                    |                 |
| 3.2.2.4            | ii) Voltage developed across trap by the rated short time current   | kV       | U                  |                 |
|                    | iii) Rated voltage of surge arrester (50 Hz)  | kV       |                    |                 |
|                    | iv) Maximum continuous overvoltage level  | kV       |                    |                 |
|                    | v) 1 s temporary overvoltage level (TOV)  | kV       |                    |                 |
| 3.2.4.3            | vi) 8/20µs (10 kA) residual voltage (protective level)  | kV       |                    |                 |
|                    | vii) Impulse test voltage (200 kV/µs) of tuning unit  | kV       |                    |                 |
|                    | viii) Factor of safety between vii) and vi)   |          | 3                  |                 |
| 4.4.3.7            | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units   | kV       | 1.3 x TOV          |                 |
| 4.4.3.10 & Annex B | 11 Radio influence test   |          |                    |                 |
|                    | i) Test voltage   | kV       | 199                |                 |
|                    | ii) Maximum radio influence voltage   | µV       | 250                |                 |
| 4.4.3.8            | 12 Surge arrester impulse discharge current rating (8/20µs wave)  | kA       | 10                 |                 |
| 3.2.5              | 13 PEP carrier frequency withstand across line trap and tuning unit   | W        | 500 (minimum)      |                 |
|                    | 14 Sealed tuning unit   |          | Yes/No             |                 |
| 3.2.4.5            | 15 Tuning units directly interchangeable between traps with identical ratings (both mechanically and electrically interchangeable)? |          | Yes                |                 |
|                    | 16 Bird barriers fitted?  |          | Yes/No/n/a         |                 |
| 3.2.4.5            | 17 Simple field replacement of tuning units   |          | Yes                |                 |
|                    | 18 Mounting arrangement   |          | On post insulators |                 |
|                    | 19 Mass, diameter and height of trap  | kg/m/m   |                    |                 |
|                    | 20 Drawings showing:  |          |                    |                 |
|                    | i) a) Actual or typical variation of resistive component with frequency   | Dwg. No. |                    |                 |
|                    | or  |          |                    |                 |

| 1<br>Item         | 2<br>Description  |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-------------------|---|----------|---|-----------------|
|                   | b) Tapping loss vs frequency with reactive component compensated  | Dwg. No. |   |                 |
|                   | ii) Dimensions and details of connecting terminals and mounting arrangements                                | Dwg. No. |   |                 |
|                   | iii) Electrical circuit   | Dwg. No. |   |                 |
| 4.4.3             | 21 Type test reports  |          |   |                 |
|                   | i) Are the type test reports available and provide the location of the reports in the tender documentation. |          | Yes/No and specify location in tender documentation |                 |
|                   |   |          |   |                 |
|                   |   |          |   |                 |
| <b>S8</b>         | <b>275 kV LT 3150 A 50 kA 0.5 mH</b>  |          |   |                 |
|                   | 1 Manufacturer's type reference   |          |   |                 |
|                   | 2 Current rating:   |          |   |                 |
| Annex C           | i) Rated current at site altitude   | A        | 3150  |                 |
| Annex C           | ii) Rated short time current for 1 s  | kA       | 50  |                 |
| 3.2.2.3           | iii) Asymmetrical peak current rating (2.55 x short-time current rating)                                    | kA       | 127.5   |                 |
| 3.2.2.1           | 3 Nominal inductance at 50 Hz   | mH       | 0.5   |                 |
| 4.4.3.4           | 4 Self resonant frequency of main coil  | kHz      |   |                 |
| Annex E           | 5 Blocking frequency bandwidths   | kHz      |   |                 |
|                   |   | 1        | 48 to 78  |                 |
|                   |   | 2        | 70 to 156   |                 |
|                   |   | 3        | 101 to 500  |                 |
|                   |   | 4        | _____   |                 |
| 3.2.2.5 & Annex D | 6 Temperature rise at rated current   |          | Annex D   |                 |
|                   | i) Class of insulation  |          |   |                 |
|                   | ii) Maximum temperature rise  |          |   |                 |
|                   | a) Measured by thermometer  | °C       |   |                 |
|                   | b) Measured by increase in resistance   | °C       |   |                 |
|                   | 7 Tuning unit type reference  |          |   |                 |
| 3.2.4.4           | 8 Generic type of protective arrester   |          |   |                 |
|                   | i) Gapped silicon carbide   |          | No  |                 |

| 1<br>Item          | 2<br>Description  |          | 3<br>Schedule A    | 4<br>Schedule B |
|--------------------|---|----------|--------------------|-----------------|
|                    | ii) Magnetically blown  |          | No                 |                 |
|                    | iii) Zinc oxide   |          | Yes                |                 |
|                    | 9 Tuning unit protection co-ordination  |          |                    |                 |
|                    | i) Manufacturer's type number of arrester   |          |                    |                 |
| 3.2.2.4            | ii) Voltage developed across trap by the rated short time current   | kV       | U                  |                 |
|                    | iii) Rated voltage of surge arrester (50 Hz)  | kV       |                    |                 |
|                    | iv) Maximum continuous overvoltage level  | kV       |                    |                 |
|                    | v) 1 s temporary overvoltage level (TOV)  | kV       |                    |                 |
| 3.2.4.3            | vi) 8/20µs (10 kA) residual voltage (protective level)  | kV       |                    |                 |
|                    | vii) Impulse test voltage (200 kV/µs) of tuning unit  | kV       |                    |                 |
|                    | viii) Factor of safety between vii) and vi)   |          | 3                  |                 |
| 4.4.3.7            | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units   | kV       | 1.3 x TOV          |                 |
| 4.4.3.10 & Annex B | 11 Radio influence test   |          |                    |                 |
|                    | i) Test voltage   | kV       | 199                |                 |
|                    | ii) Maximum radio influence voltage   | µV       | 250                |                 |
| 4.4.3.8            | 12 Surge arrester impulse discharge current rating (8/20µs wave)  | kA       | 10                 |                 |
| 3.2.5              | 13 PEP carrier frequency withstand across line trap and tuning unit   | W        | 500 (minimum)      |                 |
|                    | 14 Sealed tuning unit   |          | Yes/No             |                 |
| 3.2.4.5            | 15 Tuning units directly interchangeable between traps with identical ratings (both mechanically and electrically interchangeable)? |          | Yes                |                 |
|                    | 16 Bird barriers fitted?  |          | Yes/No/n/a         |                 |
| 3.2.4.5            | 17 Simple field replacement of tuning units   |          | Yes                |                 |
|                    | 18 Mounting arrangement   |          | On post insulators |                 |
|                    | 19 Mass, diameter and height of trap  | kg/m/m   |                    |                 |
|                    | 20 Drawings showing:  |          |                    |                 |
|                    | i) a) Actual or typical variation of resistive component with frequency   | Dwg. No. |                    |                 |
|                    | or  |          |                    |                 |
|                    | b) Tapping loss vs frequency with reactive  | Dwg. No. |                    |                 |

| 1<br>Item         | 2<br>Description  |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-------------------|---|----------|---|-----------------|
|                   | component compensated   |          |   |                 |
|                   | ii) Dimensions and details of connecting terminals and mounting arrangements                                | Dwg. No. |   |                 |
|                   | iii) Electrical circuit   | Dwg. No. |   |                 |
| 4.4.3             | 21 Type test reports  |          |   |                 |
|                   | i) Are the type test reports available and provide the location of the reports in the tender documentation. |          | Yes/No and specify location in tender documentation |                 |
|                   |   |          |   |                 |
| <b>S9</b>         | <b>275 kV LT 3150 A 50 kA 1.2 mH</b>  |          |   |                 |
|                   | 1 Manufacturer's type reference   |          |   |                 |
|                   | 2 Current rating:   |          |   |                 |
| Annex C           | i) Rated current at site altitude   | A        | 3150  |                 |
| Annex C           | ii) Rated short time current for 1 s  | kA       | 50  |                 |
| 3.2.2.3           | iii) Asymmetrical peak current rating (2.55 x short-time current rating)                                    | kA       | 127.5   |                 |
| 3.2.2.1           | 3 Nominal inductance at 50 Hz   | mH       | 12  |                 |
| 4.4.3.4           | 4 Self resonant frequency of main coil  | kHz      |   |                 |
| Annex E           | 5 Blocking frequency bandwidths   | kHz      |   |                 |
|                   |   | 1        | 40 to 500   |                 |
|                   |   | 2        | _____   |                 |
|                   |   | 3        | _____   |                 |
|                   |   | 4        | _____   |                 |
| 3.2.2.5 & Annex D | 6 Temperature rise at rated current   |          | Annex D   |                 |
|                   | i) Class of insulation  |          |   |                 |
|                   | ii) Maximum temperature rise  |          |   |                 |
|                   | a) Measured by thermometer  | °C       |   |                 |
|                   | b) Measured by increase in resistance   | °C       |   |                 |
|                   | 7 Tuning unit type reference  |          |   |                 |
| 3.2.4.4           | 8 Generic type of protective arrester   |          |   |                 |
|                   | i) Gapped silicon carbide   |          | No  |                 |
|                   | ii) Magnetically blown  |          | No  |                 |

| 1<br>Item | 2<br>Description                          |  | 3<br>Schedule A | 4<br>Schedule B |
|-----------|---|--|-----------------|-----------------|
|           | iii) Zinc oxide                           |  | Yes             |                 |
|           | 9 Tuning unit protection co-ordination    |  |                 |                 |
|           | i) Manufacturer's type number of arrester |  |                 |                 |

| 1<br>Item          | 2<br>Description  |          | 3<br>Schedule A    | 4<br>Schedule B |
|--------------------|---|----------|--------------------|-----------------|
| 3.2.2.4            | ii) Voltage developed across trap by the rated short time current   | kV       | U                  |                 |
|                    | iii) Rated voltage of surge arrester (50 Hz)  | kV       |                    |                 |
|                    | iv) Maximum continuous overvoltage level  | kV       |                    |                 |
|                    | v) 1 s temporary overvoltage level (TOV)  | kV       |                    |                 |
| 3.2.4.3            | vi) 8/20 $\mu$ s (10 kA) residual voltage (protective level)  | kV       |                    |                 |
|                    | vii) Impulse test voltage (200 kV/ $\mu$ s) of tuning unit  | kV       |                    |                 |
|                    | viii) Factor of safety between vii) and vi)   |          | 3                  |                 |
| 4.4.3.7            | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units   | kV       | 1.3 x TOV          |                 |
| 4.4.3.10 & Annex B | 11 Radio influence test   |          |                    |                 |
|                    | i) Test voltage   | kV       | 199                |                 |
|                    | ii) Maximum radio influence voltage   | $\mu$ V  | 250                |                 |
| 4.4.3.8            | 12 Surge arrester impulse discharge current rating (8/20 $\mu$ s wave)  | kA       | 10                 |                 |
| 3.2.5              | 13 PEP carrier frequency withstand across line trap and tuning unit   | W        | 500 (minimum)      |                 |
|                    | 14 Sealed tuning unit   |          | Yes/No             |                 |
| 3.2.4.5            | 15 Tuning units directly interchangeable between traps with identical ratings (both mechanically and electrically interchangeable)? |          | Yes                |                 |
|                    | 16 Bird barriers fitted?  |          | Yes/No/n/a         |                 |
| 3.2.4.5            | 17 Simple field replacement of tuning units   |          | Yes                |                 |
|                    | 18 Mounting arrangement   |          | On post insulators |                 |
|                    | 19 Mass, diameter and height of trap  | kg/m/m   |                    |                 |
|                    | 20 Drawings showing:  |          |                    |                 |
|                    | i) a) Actual or typical variation of resistive component with frequency   | Dwg. No. |                    |                 |
|                    | or  |          |                    |                 |
|                    | b) Tapping loss vs frequency with reactive component compensated  | Dwg. No. |                    |                 |
|                    | ii) Dimensions and details of connecting terminals and mounting arrangements  | Dwg. No. |                    |                 |
|                    | iii) Electrical circuit   | Dwg. No. |                    |                 |

| 1<br>Item         | 2<br>Description  |     | 3<br>Schedule A                                     | 4<br>Schedule B |
|-------------------|---|-----|---|-----------------|
| 4.4.3             | 21 Type test reports  |     |   |                 |
|                   | i) Are the type test reports available and provide the location of the reports in the tender documentation. |     | Yes/No and specify location in tender documentation |                 |
|                   |   |     |   |                 |
| <b>S10</b>        | <b>275 kV LT 4000 A 50 kA 0.5 mH</b>  |     |   |                 |
|                   | 1 Manufacturer's type reference   |     |   |                 |
|                   | 2 Current rating:   |     |   |                 |
| Annex C           | i) Rated current at site altitude   | A   | 4000  |                 |
| Annex C           | ii) Rated short time current for 1 s  | kA  | 50  |                 |
| 3.2.2.3           | iii) Asymmetrical peak current rating (2.55 x short-time current rating)                                    | kA  | 127.5   |                 |
| 3.2.2.1           | 3 Nominal inductance at 50 Hz   | mH  | 0.5   |                 |
| 4.4.3.4           | 4 Self resonant frequency of main coil  | kHz |   |                 |
| Annex E           | 5 Blocking frequency bandwidths   | kHz |   |                 |
|                   |   | 1   | 48 to 78  |                 |
|                   |   | 2   | 70 to 156   |                 |
|                   |   | 3   | 101 to 500  |                 |
|                   |   | 4   | _____   |                 |
| 3.2.2.5 & Annex D | 6 Temperature rise at rated current   |     | Annex D   |                 |
|                   | i) Class of insulation  |     |   |                 |
|                   | ii) Maximum temperature rise  |     |   |                 |
|                   | a) Measured by thermometer  | °C  |   |                 |
|                   | b) Measured by increase in resistance   | °C  |   |                 |
|                   | 7 Tuning unit type reference  |     |   |                 |
| 3.2.4.4           | 8 Generic type of protective arrester   |     |   |                 |
|                   | i) Gapped silicon carbide   |     | No  |                 |
|                   | ii) Magnetically blown  |     | No  |                 |
|                   | iii) Zinc oxide   |     | Yes   |                 |
|                   | 9 Tuning unit protection co-ordination  |     |   |                 |
|                   | i) Manufacturer's type number of arrester   |     |   |                 |
| 3.2.2.4           | ii) Voltage developed across trap by the rated short time current   | kV  | U   |                 |

| 1<br>Item          | 2<br>Description  |          | 3<br>Schedule A    | 4<br>Schedule B |
|--------------------|---|----------|--------------------|-----------------|
|                    | iii) Rated voltage of surge arrester (50 Hz)  | kV       |                    |                 |
|                    | iv) Maximum continuous overvoltage level  | kV       |                    |                 |
|                    | v) 1 s temporary overvoltage level (TOV)  | kV       |                    |                 |
| 3.2.4.3            | vi) 8/20 $\mu$ s (10 kA) residual voltage (protective level)  | kV       |                    |                 |
|                    | vii) Impulse test voltage (200 kV/ $\mu$ s) of tuning unit  | kV       |                    |                 |
|                    | viii) Factor of safety between vii) and vi)   |          | 3                  |                 |
| 4.4.3.7            | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units   | kV       | 1.3 x TOV          |                 |
| 4.4.3.10 & Annex B | 11 Radio influence test   |          |                    |                 |
|                    | i) Test voltage   | kV       | 199                |                 |
|                    | ii) Maximum radio influence voltage   | $\mu$ V  | 250                |                 |
| 4.4.3.8            | 12 Surge arrester impulse discharge current rating (8/20 $\mu$ s wave)  | kA       | 10                 |                 |
| 3.2.5              | 13 PEP carrier frequency withstand across line trap and tuning unit   | W        | 500 (minimum)      |                 |
|                    | 14 Sealed tuning unit   |          | Yes/No             |                 |
| 3.2.4.5            | 15 Tuning units directly interchangeable between traps with identical ratings (both mechanically and electrically interchangeable)? |          | Yes                |                 |
|                    | 16 Bird barriers fitted?  |          | Yes/No/n/a         |                 |
| 3.2.4.5            | 17 Simple field replacement of tuning units   |          | Yes                |                 |
|                    | 18 Mounting arrangement   |          | On post insulators |                 |
|                    | 19 Mass, diameter and height of trap  | kg/m/m   |                    |                 |
|                    | 20 Drawings showing:  |          |                    |                 |
|                    | i) a) Actual or typical variation of resistive component with frequency   | Dwg. No. |                    |                 |
|                    | or  |          |                    |                 |
|                    | b) Tapping loss vs frequency with reactive component compensated  | Dwg. No. |                    |                 |
|                    | ii) Dimensions and details of connecting terminals and mounting arrangements  | Dwg. No. |                    |                 |
|                    | iii) Electrical circuit   | Dwg. No. |                    |                 |
| 4.4.3              | 21 Type test reports  |          |                    |                 |

| 1<br>Item     | 2<br>Description  |      | 3<br>Schedule A                                     | 4<br>Schedule B |
|---------------|---|------|---|-----------------|
|               | i) Are the type test reports available and provide the location of the reports in the tender documentation.                               |      | Yes/No and specify location in tender documentation |                 |
| <b>U</b>      | <b>132 kV line traps (LT)</b>   |      |   |                 |
|               | 1 Manufacturer  |      |   |                 |
| Annex E       | 2 i) Minimum value of resistance component of line trap impedance in the frequency bands specified for carrier signal blocking. ( $Z_r$ ) | ohms | 400   |                 |
|               | or  |      |   |                 |
|               | ii) Maximum value of shunt loss of line trap with reactive component on a 400 $\Omega$ line ( $A_m$ )                                     | dB   | 3.52  |                 |
|               | 3 Type of trap  |      | Broad-band  |                 |
|               | 4 System conditions for which traps shall be suitable:  |      |   |                 |
|               | i) Rated frequency  | Hz   | 50  |                 |
|               | ii) System neutral  |      | Effectively earthed                                 |                 |
|               | iii) Rated r.m.s. line-to-line voltage  | kV   | 132   |                 |
|               | iv) Maximum continuous r.m.s. line-to-line voltage  | kV   | 145   |                 |
| 3.1.3.2 & 3.3 | 5 Mounting insulation   |      |   |                 |
|               | Method of mounting  |      | On CC, CVT or post insulators                       |                 |
| 3.2.9         | 6 Main terminals  |      |   |                 |
|               | i) Terminal material and finish   |      | Aluminium (pads)                                    |                 |
|               | ii) Preferred arrangement of terminals  |      |   |                 |
|               | a) Upper  |      | Horizontal at periphery of trap                     |                 |
|               | b) Lower  |      | Horizontal at periphery of trap                     |                 |
|               | iii) a) Withstand force without failure   | kN   | 3   |                 |
|               | b) Withstand force without distortion   | kN   | 1.5   |                 |

| 1<br>Item         | 2<br>Description  |     | 3<br>Schedule A | 4<br>Schedule B |
|-------------------|---|-----|-----------------|-----------------|
|                   | iv) Dimensions and configuration of terminals                                       |     |                 |                 |
|                   | a) 2500 A rated current Pad in accordance with IEC 60518; 8 hole                    |     | Yes             |                 |
|                   | b) 1250 A rated current One terminal 35 mm dia<br>125 mm long                       |     | Yes             |                 |
|                   | 7 Bird Barriers – the supplier to provide information and is it acceptable to Eskom |     | Yes/No/n/a      |                 |
|                   |   |     |                 |                 |
| <b>U2</b>         | <b>132 kV LT 2500 A 40 kA 0.2 mH</b>  |     |                 |                 |
|                   | 1 Manufacturer's type reference   |     |                 |                 |
|                   | 2 Current rating:   |     |                 |                 |
| Annex C           | i) Rated current at site altitude   | A   | 2500            |                 |
| Annex C           | ii) Rated short time current for 1 s  | kA  | 40              |                 |
| 3.2.2.3           | iii) Asymmetrical peak current rating (2.55 x short-time current rating)            | kA  | 102             |                 |
| 3.2.2.1           | 3 Nominal inductance at 50 Hz   | mH  | 0.2             |                 |
| 4.4.3.4           | 4 Self resonant frequency of main coil  | kHz |                 |                 |
| Annex E           | 5 Blocking frequency bandwidths   | kHz |                 |                 |
|                   |   | 1   | 80 to 108       |                 |
|                   |   | 2   | 104 to 156      |                 |
|                   |   | 3   | 124 to 204      |                 |
|                   |   | 4   | 194 to 500      |                 |
| 3.2.2.5 & Annex D | 6 Temperature rise at rated current   |     | Annex D         |                 |
|                   | i) Class of insulation  |     |                 |                 |
|                   | ii) Maximum temperature rise  |     |                 |                 |
|                   | a) Measured by thermometer  | °C  |                 |                 |
|                   | b) Measured by increase in resistance   | °C  |                 |                 |
|                   | 7 Tuning unit type reference  |     |                 |                 |
| 1<br>Item         | 2<br>Description  |     | 3<br>Schedule A | 4<br>Schedule B |
| 3.2.4.4           | 8 Generic type of protective arrester   |     |                 |                 |
|                   | i) Gapped silicon carbide   |     | No              |                 |
|                   | ii) Magnetically blown  |     | No              |                 |
|                   | iii) Zinc oxide   |     | Yes             |                 |

| 1<br>Item          | 2<br>Description  |          | 3<br>Schedule A       | 4<br>Schedule B |
|--------------------|---|----------|-----------------------|-----------------|
|                    | 9 Tuning unit protection co-ordination  |          |                       |                 |
|                    | i) Manufacturer's type number of arrester   |          |                       |                 |
| 3.2.2.4            | ii) Voltage developed across trap by the rated short-time current   | kV       | U                     |                 |
|                    | iii) Rated voltage of surge arrester (50 Hz)  | kV       |                       |                 |
|                    | iv) Maximum continuous overvoltage level  | kV       |                       |                 |
|                    | v) 1 s temporary overvoltage level (TOV)  | kV       |                       |                 |
| 3.2.4.3            | vi) 8/20 $\mu$ s (10 kA) residual voltage (protective level)  | kV       |                       |                 |
|                    | vii) Impulse test voltage (200 kV/ $\mu$ s) of tuning unit  | kV       |                       |                 |
|                    | viii) Factor of safety between vii) and vi)   |          | 3                     |                 |
| 4.4.3.7            | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units   | kV       | 1.3 x TOV             |                 |
| 4.4.3.10 & Annex B | 11 Radio influence test   |          |                       |                 |
|                    | i) Test voltage   | kV       | 97                    |                 |
|                    | ii) Maximum radio influence voltage   | $\mu$ V  | 250                   |                 |
| 4.4.3.8            | 12 Surge arrester impulse discharge current rating (8/20 $\mu$ s wave)  | kA       | 10                    |                 |
| 3.2.5              | 13 PEP carrier frequency withstand across line trap and tuning unit   | W        | 500 (minimum)         |                 |
|                    | 14 Sealed tuning unit   |          | Yes/No                |                 |
| 3.2.4.5            | 15 Tuning units directly interchangeable between traps with identical ratings (both mechanically and electrically interchangeable)? |          | Yes                   |                 |
|                    | 16 Bird barriers fitted?  |          | Yes/No/n/a            |                 |
| 3.2.4.5            | 17 Simple field replacement of tuning units   |          | Yes                   |                 |
|                    | 18 Mounting arrangement   |          | On CC, CVT or item U5 |                 |
|                    | 20 Mass, diameter and height of trap  | kg/m/m   |                       |                 |
|                    | 21 Drawings showing:  |          |                       |                 |
|                    | i) a) Actual or typical variation of resistive component with frequency   | Dwg. No. |                       |                 |
|                    | or  |          |                       |                 |
|                    | b) Tapping loss vs frequency with reactive component compensated  | Dwg. No. |                       |                 |
|                    | ii) Dimensions and details of connecting terminals and mounting arrangements  | Dwg. No. |                       |                 |

| 1<br>Item         | 2<br>Description  |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-------------------|---|----------|---|-----------------|
|                   | iii) Electrical circuit   | Dwg. No. |   |                 |
| 4.4.3             | 22 Type test reports  |          |   |                 |
|                   | i) Are the type test reports available and provide the location of the reports in the tender documentation. |          | Yes/No and specify location in tender documentation |                 |
|                   |   |          |   |                 |
| <b>U4</b>         | <b>132 kV LT 2500 A 40 kA 0.5 mH</b>  |          |   |                 |
|                   | 1 Manufacturer's type reference   |          |   |                 |
|                   | 2 Current rating:   |          |   |                 |
| Annex C           | i) Rated current at site altitude   | A        | 2500  |                 |
| Annex C           | ii) Rated short time current for 1 s  | kA       | 40  |                 |
| 3.2.2.3           | iii) Asymmetrical peak current rating (2.55 x short-time current rating)                                    | kA       | 102   |                 |
| 3.2.2.1           | 3 Nominal inductance at 50 Hz   | mH       | 0.5   |                 |
| 4.4.3.4           | 4 Self resonant frequency of main coil  | kHz      |   |                 |
| Annex E           | 5 Blocking frequency bandwidths   | kHz      |   |                 |
|                   |   | 1        | 48 to 78  |                 |
|                   |   | 2        | 70 to 156   |                 |
|                   |   | 3        | 101 to 500  |                 |
|                   |   | 4        | _____   |                 |
| 3.2.2.5 & Annex D | 6 Temperature rise at rated current   |          | Annex D   |                 |
|                   | i) Class of insulation  |          |   |                 |
|                   | ii) Maximum temperature rise  |          |   |                 |
|                   | a) Measured by thermometer  | °C       |   |                 |
|                   | b) Measured by increase in resistance   | °C       |   |                 |
|                   | 7 Tuning unit type reference  |          |   |                 |

| 1<br>Item          | 2<br>Description  |          | 3<br>Schedule A       | 4<br>Schedule B |
|--------------------|---|----------|-----------------------|-----------------|
| 3.2.4.4            | 8 Generic type of protective arrester   |          |                       |                 |
|                    | i) Gapped silicon carbide   |          | No                    |                 |
|                    | ii) Magnetically blown  |          | No                    |                 |
|                    | iii) Zinc oxide   |          | Yes                   |                 |
|                    | 9 Tuning unit protection co-ordination  |          |                       |                 |
|                    | i) Manufacturer's type number of arrester   |          |                       |                 |
| 3.2.2.4            | ii) Voltage developed across trap by the rated short-time current   | kV       | U                     |                 |
|                    | iii) Rated voltage of surge arrester (50 Hz)  | kV       |                       |                 |
|                    | iv) Maximum continuous overvoltage level  | kV       |                       |                 |
|                    | v) 1 s temporary overvoltage level (TOV)  | kV       |                       |                 |
| 3.2.4.3            | vi) 8/20 $\mu$ s (10 kA) residual voltage (protective level)  | kV       |                       |                 |
|                    | vii) Impulse test voltage (200 kV/ $\mu$ s) of tuning unit  | kV       |                       |                 |
|                    | viii) Factor of safety between vii) and vi)   |          | 3                     |                 |
| 4.4.3.7            | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units   | kV       | 1.3 x TOV             |                 |
| 4.4.3.10 & Annex B | 11 Radio influence test   |          |                       |                 |
|                    | i) Test voltage   | kV       | 97                    |                 |
|                    | ii) Maximum radio influence voltage   | $\mu$ V  | 250                   |                 |
| 4.4.3.8            | 12 Surge arrester impulse discharge current rating (8/20 $\mu$ s wave)  | kA       | 10                    |                 |
| 3.2.5              | 13 PEP carrier frequency withstand across line trap and tuning unit   | W        | 500 (minimum)         |                 |
|                    | 14 Sealed tuning unit   |          | Yes/No                |                 |
| 3.2.4.5            | 15 Tuning units directly interchangeable between traps with identical ratings (both mechanically and electrically interchangeable)? |          | Yes                   |                 |
|                    | 16 Bird barriers fitted?  |          | Yes/No/n/a            |                 |
| 3.2.4.5            | 17 Simple field replacement of tuning units   |          | Yes                   |                 |
|                    | 18 Mounting arrangement   |          | On CC, CVT or item U5 |                 |
|                    | 20 Mass, diameter and height of trap  | kg/m/m   |                       |                 |
|                    | 21 Drawings showing:  |          |                       |                 |
|                    | i) a) Actual or typical variation of resistive component with frequency   | Dwg. No. |                       |                 |

| 1<br>Item | 2<br>Description  |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-----------|---|----------|---|-----------------|
|           | Or  |          |   |                 |
|           | b) Tapping loss vs frequency with reactive component compensated  | Dwg. No. |   |                 |
|           | ii) Dimensions and details of connecting terminals and mounting arrangements                                | Dwg. No. |   |                 |
|           | iii) Electrical circuit   | Dwg. No. |   |                 |
| 4.4.3     | 22 Type test reports  |          |   |                 |
|           | i) Are the type test reports available and provide the location of the reports in the tender documentation. |          | Yes/No and specify location in tender documentation |                 |
| <b>U5</b> | <b>132 kV line trap post insulators</b>   |          |   |                 |
|           | For line traps normally mounted on coupling capacitors or CVTs  |          |   |                 |
|           | 1 Manufacturer  |          |   |                 |
|           | 2 Manufacturer's type reference   |          |   |                 |
|           | 3 System conditions for which the post insulators shall be suitable   |          |   |                 |
|           | i) Rated frequency  | Hz       | 50  |                 |
|           | ii) System neutral  |          | Effectively earthed                                 |                 |
|           | iii) Rated r.m.s. line-to-line voltage  | kV       | 132   |                 |
|           | iv) Maximum continuous r.m.s. line-to-line voltage  | kV       | 145   |                 |
|           | 4 Mounting insulation   |          |   |                 |
| Annex A   | i) Minimum crest value of full wave impulse type withstand voltage to earth at sea level                    | kV       | 650   |                 |
|           | ii) Characteristics of impulse wave   |          | 1.2/50 $\mu$ s                                      |                 |
| Annex A   | iii) Minimum 60 s power frequency wet withstand type test voltage to earth at sea level                     | kV r.m.s | 275   |                 |
| Annex A   | iv) Minimum 60 s power frequency dry withstand type test voltage at sea level                               | kV r.m.s | 275   |                 |
| Annex A   | v) Creepage distance of post insulators   |          |   |                 |
|           | a) Very Heavy pollution total   | mm       | 4495  |                 |
|           | 5 Mass  |          |   |                 |
|           | 6 Drawings showing:   |          |   |                 |

| 1<br>Item     | 2<br>Description  |           | 3<br>Schedule A                     | 4<br>Schedule B |
|---------------|---|-----------|-------------------------------------|-----------------|
|               | i) Dimensions and details of mounting arrangements  | Dwg. No.  |                                     |                 |
| <b>QB</b>     | <b>765 kV line traps (LT)</b>   |           |                                     |                 |
|               | 1 Manufacturer  |           |                                     |                 |
| Annex E       | 2 i) Minimum value of resistance component of line trap impedance in the frequency bands specified for carrier signal blocking. ( $Z_r$ ) | ohms      | 400                                 |                 |
|               | Or  |           |                                     |                 |
|               | ii) Maximum value of shunt loss of line trap with reactive component on a 400 $\Omega$ line ( $A_m$ )                                     | dB        | 3.52                                |                 |
|               | 3 Type of trap  |           | Broad-band                          |                 |
|               | 4 System conditions for which traps shall be suitable:  |           |                                     |                 |
|               | i) Rated frequency  | Hz        | 50                                  |                 |
|               | ii) System neutral  |           | Effectively earthed                 |                 |
|               | iii) Rated r.m.s. line-to-line voltage  | kV        | 765                                 |                 |
|               | iv) Maximum continuous r.m.s. line-to-line voltage  | kV        | 800                                 |                 |
| 3.1.3.2 & 3.3 | 5 Mounting insulation   |           |                                     |                 |
|               | Method of mounting  |           | On post insulators supplied with LT |                 |
|               | Post insulator mounted traps  |           |                                     |                 |
| Annex A       | i) Minimum crest value of full wave lightning impulse type test withstand voltage to earth at sea level                                   | kV        | 2100                                |                 |
|               | ii) Characteristic of lightning impulse wave  |           | 1.2/50 $\mu$ s                      |                 |
| Annex A       | iii) Minimum crest value of full wave switching impulse type test withstand voltage to earth at sea level.                                | kV        | 1550                                |                 |
|               | iv) Characteristic of switching impulse wave  |           | 250/2500 $\mu$ s                    |                 |
| Annex A       | v) Minimum 60 s power frequency wet withstand type test voltage to earth at sea level.  | kV r.m.s. | 975                                 |                 |
| Annex A       | vi) Minimum 60 s power frequency dry withstand type test voltage to earth at sea level.   | kV r.m.s. | 975                                 |                 |
| Annex A       | vii) Creepage distance of post insulators   |           |                                     |                 |

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| 1<br>Item  | 2<br>Description  |     | 3<br>Schedule A                 | 4<br>Schedule B |
|------------|---|-----|---------------------------------|-----------------|
|            | a) Very Heavy pollution total   | mm  | 23715                           |                 |
| 3.2.9      | 6 Main terminals  |     |                                 |                 |
|            | i) Terminal material finish   |     | Aluminium (pads)                |                 |
|            | ii) Preferred arrangement of terminals  |     |                                 |                 |
|            | a) Upper  |     | Horizontal at periphery of trap |                 |
|            | b) Lower  |     | Horizontal at periphery of trap |                 |
|            | iii) a) Withstand force without failure   | kN  | 3                               |                 |
|            | b) Withstand force without distortion   | kN  | 1.5                             |                 |
|            | iv) Dimensions and configuration of terminals   |     |                                 |                 |
|            | a) Top terminal:  |     |                                 |                 |
|            | 8 hole pad in accordance with IEC 60518 suitable for attachment of tube clamp   |     | Yes                             |                 |
|            | b) Bottom terminal:   |     |                                 |                 |
|            | 8 hole pad in accordance with IEC60518. Arrangements shall be made to allow for relative movement between the line trap and the pad |     | Yes                             |                 |
|            | 7 Bird Barriers – the supplier to provide information and is it acceptable to Eskom   |     | Yes/No/n/a                      |                 |
|            |   |     |                                 |                 |
| <b>QB1</b> | <b>765 kV LT 5000 A 50 kA 0.5 mH</b>  |     |                                 |                 |
|            | 1 Manufacturer's type reference   |     |                                 |                 |
|            | 2 Current rating:   |     |                                 |                 |
| Annex C    | i) Rated current at site altitude   | A   | 5000                            |                 |
| Annex C    | ii) Rated short time current for 1 s  | kA  | 50                              |                 |
| 3.2.2.3    | iii) Asymmetrical peak current rating (2.55 x short-time current rating)  | kA  | 127.5                           |                 |
| 3.2.2.1    | 3 Nominal inductance at 50 Hz   | mH  | 0.5                             |                 |
| 4.4.3.4    | 4 Self resonant frequency of main coil  | kHz |                                 |                 |

| 1<br>Item             | 2<br>Description  |         | 3<br>Schedule A | 4<br>Schedule B |
|-----------------------|---|---------|-----------------|-----------------|
| Annex E               | 5 Blocking frequency bandwidths   | kHz     |                 |                 |
|                       |   | 1       | 48 to 78        |                 |
|                       |   | 2       | 70 to 156       |                 |
|                       |   | 3       | 101 to 500      |                 |
|                       |   | 4       | -               |                 |
| 3.2.2.5 &<br>Annex D  | 6 Temperature rise at rated current   |         | Annex D         |                 |
|                       | i) Class of insulation  |         |                 |                 |
|                       | ii) Maximum temperature rise  |         |                 |                 |
|                       | a) Measured by thermometer  | °C      |                 |                 |
|                       | b) Measured by increase in resistance   | °C      |                 |                 |
|                       | 7 Tuning unit type reference  |         |                 |                 |
| 3.2.4.4               | 8 Generic type of protective arrester   |         |                 |                 |
|                       | i) Gapped silicon carbide   |         | No              |                 |
|                       | ii) Magnetically blown  |         | No              |                 |
|                       | iii) Zinc oxide   |         | Yes             |                 |
|                       | 9 Tuning unit protection co-ordination  |         |                 |                 |
|                       | i) Manufacturer's type number of arrester   |         |                 |                 |
| 3.2.2.4               | ii) Voltage developed across trap by the rated short time current                 | kV      | U               |                 |
|                       | iii) Rated voltage of surge arrester (50 Hz)                                      | kV      |                 |                 |
|                       | iv) Maximum continuous overvoltage level  | kV      |                 |                 |
|                       | v) 1 s temporary overvoltage level (TOV)  | kV      |                 |                 |
| 3.2.4.3               | vi) 8/20 $\mu$ s (10 kA) residual voltage (protective level)                      | kV      |                 |                 |
|                       | vii) Impulse test voltage (200 kV/ $\mu$ s) of tuning unit                        | kV      |                 |                 |
|                       | viii) Factor of safety between vii) and vi)                                       |         | 5               |                 |
| 4.4.3.7               | 10 Minimum 5 s power frequency dry withstand routine test voltage of tuning units | kV      | 1.3 x TOV       |                 |
| 4.4.3.10 &<br>Annex B | 11 Radio influence test   |         |                 |                 |
|                       | i) Test voltage   | kV      | 531             |                 |
|                       | ii) Maximum radio influence voltage   | $\mu$ V | 250             |                 |

| 1<br>Item | 2<br>Description  |          | 3<br>Schedule A                                     | 4<br>Schedule B |
|-----------|---|----------|---|-----------------|
| 4.4.3.8   | 12 Surge arrester impulse discharge current rating (8/20 $\mu$ s wave)  | kA       | 10  |                 |
| 3.2.5     | 13 PEP carrier frequency withstand across line trap and tuning unit   | W        | 500 (minimum)                                       |                 |
|           | 14 Sealed tuning unit   |          | Yes/No  |                 |
| 3.2.4.5   | 15 Tuning units directly interchangeable between traps with identical ratings (both mechanically and electrically interchangeable)? |          | Yes   |                 |
|           | 16 Bird barriers fitted?  |          | Yes/No/n/a  |                 |
| 3.2.4.5   | 17 Simple field replacement of tuning units   |          | Yes   |                 |
|           | 18 Mounting arrangement   |          | On post insulators                                  |                 |
|           | 19 Mass, diameter and height of trap  | kg/m/m   |   |                 |
|           | 20 Drawings showing:  |          |   |                 |
|           | i) a) Actual or typical variation of resistive component with frequency   | Dwg. No. |   |                 |
|           | Or  |          |   |                 |
|           | b) Tapping loss vs frequency with reactive component compensated  | Dwg. No. |   |                 |
|           | ii) Dimensions and details of connecting terminals and mounting arrangements  | Dwg. No. |   |                 |
|           | iii) Electrical circuit   | Dwg. No. |   |                 |
| 4.4.3     | 21 Type test reports  |          |   |                 |
|           | i) Are the type test reports available and provide the location of the reports in the tender documentation.                         |          | Yes/No and specify location in tender documentation |                 |