Reg No 2003/011612/30

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DESIGN, MANUFACTURE, SUPPLY, DELIVERY, INSTALLATION, ERECTION AND COLD COMMISSIONING OF HIGH AND MEDIUM VOLTAGE POWER TRANSFORMERS AND ALL RELATED EQUIPMENT

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1. STATEMENT OF INVITATION

CENTLEC (SOC) Ltd (hereafter CENTLEC), a municipal entity distributing electricity in Mangaung, and other municipalities invites competent and experienced electrical professional engineering consultants and their professional teams for a period of thirty-six (36) months, for:

The design, manufacture, supply, delivery, installation, erection, and commissioning of various sizes of high and medium voltage power transformers with all their related equipment. Design and install neutral earth compensators (NEC), neutral earth resister (NER) or neutral earth compensator resistor transformer (NECRT). This must be monitored by a reactor, single phase 5kVA and neutral earth resistor monitor relay (NERM).

The implementation of new installations into existing distribution centres that must match the existing equipment, control, and protection schemes in the CENTLEC area of supply. The disassemble and removal of the old, redundant transformers and their associated equipment. The design, supply, and installation of all steel structures for the 132/33/11kV electrical equipment, including their associated foundations and plinths.

2. MINIMUM REQUIREMENTS

2.1 Supply unique security personal identification number (PIN) and/or original TAX Clearance Certificate for TAX compliant status.

2.2 Supply municipal services (water, sanitation, rates and electricity) clearance certificate or Lease Agreement with a current Bill and rates clearances, or Current Bill of Account not owing more than 90 days. In a case where the services are paid by the Landlord, the signed lease agreement and statement of account must be submitted by the bidder.

2.2.1 In an event, that the Bidder utilizes prepaid services (e.g., Water or electricity) a valid municipal clearance certificate(s) must still be provided.

2.3 The bidder must be registered on the National Treasury Centralized Suppliers Database.

2.4 A valid letter of good standing from the Compensation Commissioner with the Department of Labour or from relevant bodies

2.5 CIDB Grading level 7 EP and 7 CE or above.

3. SCOPE OF WORK – POWER TRANSFORMERS AND ASSOCIATED EQUIPMENT

3.1 The design, manufacture, supply, delivery, installation, erection, and commissioning of:

3.1.1 Power transformers as listed in item 3.2 below. The power transformers will be designed in accordance with IEC 600076 and it should be noted that the transformers referred to in this document are Class 1 transformers manufactured in RSA only.
3.1.2 Neutral earthing resistor (NER), 600 Amp, 10Ω and/or 300Amp, 20 Ω.
3.1.3 Neutral earthing compensator (NEC), 200kVA. The distribution transformers will be manufactured according to the relevant SABS specifications.
3.1.4 Neutral earth compensator resistor transformer (NECRT) 200kVA, 600Amp, 10Ω and/or the 300Amp 20 Ω. These must be monitored by a reactor and neutral earthing monitor system (NERM) for items (3.1.1) and (3.1.2).
3.1.5 The new installation into existing distribution centres must be compatible with the existing equipment, control and protection schemes in the CENTLEC (SOC) Ltd area of supply. The disassemble and removal of the old, redundant existing transformers and related equipment must be included.

3.2 The following Power transformers are applicable:

3.2.1 5 MVA, 33/2.2kV Power transformers (Delta/Star).
3.2.2 10MVA, 33/2.2kV Power Transformers. (Delta/Star).
3.2.3 10MVA, 33/11kV Power Transformers. (Delta/Star).
3.2.4 20MVA, 33/11KV Power Transformers. (Delta/Star).
3.2.5 20MVA, 132/11kV Power Transformers. (Star/Star) and (Star/Delta)
3.2.6 25MVA,33/11kV, Power Transformers. (Delta/Star).
3.2.7 30MVA, 132/11kV Power Transformers. (Star/Star) and (Star/Delta)
3.2.8 40MVA, 132/11kV Power Transformers. (Star/ Delta)
3.2.9 45MVA, 132/11kV Power Transformers. (Star/Delta) and (Star/Star)
3.2.10 80MVA, 132/33 kV Power Transformers. (Star/Delta)
3.2.11 90MVA 132/33kV Power transformers. (Star/Delta)
3.2.12 200kVA, Neutral Earthing Compensator Transformers. (NECRT)
3.2.13 Neutral Earthing Resistors. (NER)
3.2.14 5 kVA Single Phase Reactors.
3.2.15 200kVA, 2.2kV/400V power transformer (Delta/star) hand tap changers.
3.2.16 500kVA, 2.2kV/400V power transformer (Delta/star) hand tap changers
3.2.17 800kVA, 2.2kV/400V Power transformers (Delta/Star) hand tap changers

4. DEFINITIONS AND ABBREVIATIONS

4.1 SANS: South African National Standard
4.2 SLA: Services Level Agreement

4.3 NER: Neutral Earth Resistor
4.4 NECRT: Neutral Earth Compensation Resistance transformer
4.5 kV: Kilo Volt
4.6 MVA: Mega Volt Ampere
4.7 Pt: Power Transformer
4.8 Ct: Current Transformer
4.9 SOP: Standard Operating Procedures
4.10 ECSA: Engineering Council of South Africa
4.11 RSA: Republic of South Africa
4.12 NERM: Neutral Earth Resistor Monitor
4.13 PVC: Polyvinyl Chloride
4.14 BS: British Standard
4.15 IEC: International Electrotechnical Commission
4.16 IP: Degrees of Protection
4.17 PCB: Polycarbonate Chlorite Bisphenols
4.18 SF6 gas: Sulphur Hexafluoride Gas
4.19 DC: Direct current
4.20 AC: Alternating Current
4.21 RMS: root mean square
4.22 A: Ampere
4.23 V: Voltage
4.24 Ω: Ohm
4.25 Pd: Partial discharge
4.26 kN/m²: Kilo Newton per square meter
4.27 FAT: Factory Acceptance Tests
4.28 OLTC: On Load Tap Changer
4.29 SCADA: Supervisory Control and Data Acquisition
4.30 C.M.R: Continuous Maximum Rating
4.31 PCB: Polychlorinated biphenyls.
4.32 HGIS : (HV) Hybrid Gas Insulated Switchgear
4.33 DSB : Double Side Break
4.34 CB : Circuit breaker
4.35 CTI : Comparative tracking index
4.36 MR : Maschinenfabrik Reinhausen

5. PART A:-TRANSFORMERS AND ASSOCIATED EQUIPMENT TECHNICAL SPECIFICATION

5.1 GENERAL TECHNICAL SPECIFICATION – PART 1.

5.1.1 DESIGN AND STANDARDISATION

All apparatus shall be designed to ensure satisfactory operation in all atmospheric conditions prevailing at the site and under such sudden variation of load and voltage as may be met with under working conditions on the system, including those due to faulty synchronizing and short circuit. The design shall incorporate all reasonable precautions and provision of the safety of those concerned in the operation, maintenance and of associated works on site.
All outdoor apparatus and fittings shall be designed so that water cannot collect at any point. All oil pipe flanges shall be to BS 4504 (or most recent standards) as regards both dimensions and drilling.

Cast iron shall not be used for chambers of oil filled apparatus or for any part of the equipment which is in tension or subject to impact stresses. Kiosks, cubicles and similar enclosed compartments shall be adequately ventilated to restrict condensation. All contactor or relay coils and other parts shall be suitably protected against corrosion.

All apparatus shall be designed to obviate the risk of accidental short circuit due to animals, birds, insects, termites, rodents or micro-organisms. Terminal boxes, cubicles, panels and mechanism boxes shall be complete with all necessary aluminium gland plates, approved cable glands and vermin proofing, whether specified in detail or not.

5.1.2 **BOLTS AND NUTS**

All bolts, studs, screw threads, pipe thread, bolt heads and nuts shall comply with the appropriate National Standards for metric threads, or technical equivalent. Except for small wiring current carrying terminal bolts or studs, for mechanical reasons, shall not be less than 6 mm in diameter. All nuts and pins shall be adequately locked. Wherever possible, bolts shall be fitted in such a manner that in the event of failure of locking resulting in the nuts working loose and falling off, the bolt will remain in position.

All bolts, nuts and washers placed in outdoor positions shall be treated to prevent corrosion of the threads and electrolytic action between dissimilar metal. Where bolts are used on external horizontal surfaces where water can collect, methods of preventing the ingress of moisture to the thread shall be provided. Each bolt or stud shall project at least one thread but not more than three threads through its nut, except when otherwise approved for terminal board studs or relay stems. If bolts and nuts are placed so that they are inaccessible by means of ordinary spanners, special spanners shall be provided. The length of the screwed portion of the bolts shall be such that no screw thread may form part of a shear plane between members. Taper washers shall be provided where necessary.

5.1.3 **GALVANIZING**

All galvanizing shall be applied by the hot dip process and shall comply with the requirements of SANS 763 or SANS 935 (or most recent standards) as applicable.

Galvanizing of wires shall be applied by the hot dip process and shall meet the requirements of BS 443 (or most recent standards).
All welds shall be de-scaled, all machining carried out and all parts shall be adequately cleaned prior to Galvanizing. The preparation for Galvanizing and the Galvanizing itself shall not adversely affect the mechanical properties of the coated materials.
The threads of all Galvanized bolts and screwed rods shall be cleared of splatter by spinning or brushing. A die shall not be used for cleaning the threads unless specially approved by the Engineer. All nuts shall be galvanized except for the threads which shall be oiled. Surfaces which are in contact with oil shall not be galvanized or cadmium plated. Partial immersion of the work will not be permitted, and the Galvanizing tank must therefore be sufficiently large to permit Galvanizing to be carried out by one immersion.

5.1.4 **ALUMINIUM AND ALUMINIUM ALLOYS**

Aluminium alloy castings shall be sound and free from porosity.

5.1.5 **LABELS AND PLATES**

All apparatus should be clearly labelled indicating, where necessary, its purpose and service positions. Warning labels shall be provided at all points where no operation interlocking is provided or when operation is possible which could damage equipment or endanger operating and maintenance personnel. Each phase of alternating current and each pole of direct current equipment and connections shall be colored in an approved manner to distinguish phase or polarity. The material of all labels and the dimensions, legend, and method of printing shall be approved. Inscriptions shall be consistent with CENTLEC's established practices.

The surface of indoor labels shall have a matt or satin finish to avoid dazzle from reflected light. The inscriptions shall comply with the minimum requirements given in the Schedules. Indoor labels shall preferably be made from engraved three-layer sandwich board. Painting of labels will not be permitted except on control/indication mimics and for identifying individual gas compartments on switchgear. The colours to be used shall be as specified in the Schedules. They shall be permanent and free from fading (Ultraviolet resistant).

All labels and plates for outdoor use shall be of in-corrodible material. Where the use of enamelled iron plates is approved, the whole surface including the back and edges, shall be properly covered and resistant to corrosion. Protective washers of suitable material shall be provided front and back on the securing screws. Unless separately itemized in the Schedules, all labels will be deemed to be included in the prices of the associated equipment in the Schedules.

5.1.6 **CLEANING AND PAINTING**

All metal parts shall be painted or coated except where galvanized or non-corrodible material is used. The painting or coating system adopted, and surface preparation process shall be suitable for:

Application on the base material, with due consideration to any previous treatment or surface process carried out.
The atmospheric conditions at the place of manufacture and site and to which the equipment may be subject during transport to site.
The purpose for and position in which the item will be used in service.
Readily making good any damage after delivery and erection.
The transformer shall be admiral grey.
The reservoir tank shall be white.

All paints, coatings, and process to be used shall be in accordance with the plant manufacturers' specifications.
The dry film thickness of all painting and coating systems shall be as per specification.
The colours of the finished surfaces shall preferably be as specified in the Schedules.
After erection at Site, surfaces shall be thoroughly examined, and any damage made good to the original full specification. The methods of making good shall be specified by the paint manufacturer. Any nuts, bolts, washers, etc., which have been removed during site erection, or which may be required to be removed for maintenance purposes shall be restored to their original condition or replaced with new ones. All paintwork shall be left clean and perfect on completion of the Works.

5.1.7 TRANSFORMER OIL AND INSULATING COMPOUND

Sufficient oil shall be supplied for the first filling of all oil portions of the equipment. The oil shall comply with the requirements of SANS 555 or IEC 296 (or the most recent standard) and shall be suitable in all respects for use in the equipment when operated under the conditions laid down in this Specification. **Oil shall be PCB free with a di-electric strength of 80kV.**

The breathers will be easily accessible from ground level and be equivalent to Whitley's type of breathers. The silica gel must be of the environmentally friendly type. The size will be determined by the volume of oil in the transformer. Insulating compound shall comply with the requirements of BS 1858 (or most recent standards). Resin insulation shall comply with the requirements of IEC 455 (or most recent standards).

5.1.8 SULPHUR HEXAFLUORIDE GAS (Sf6)

The Sf6 gas shall comply with the requirements of IEC 376 (or most recent standards), and enough shall be provided to fill all SF6 equipment supplied under this Contract plus an additional 10 %. The high-pressure cylinders in which the SF6 gas is shipped, and stored on site, shall comply with the requirements of local regulations and by-laws.

5.1.9 EARTHING AND AUXILIARY EQUIPMENT

All metal parts, other than those forming part of any electrical circuit, shall be connected to the main earth system by means of hard drawn high conductivity copper earth bar with a cross section area such that the current density is not greater than 200 A/mm² for a one second fault durations and 100 A/mm² for 3 second fault durations with a minimum of 30 mm². All the equipment will be earthed to the main earth grid of the substation. The earths will be Cad welded or braised (the 75mm overlap must be allowed for) where connected to the grid. All equipment will be double earthed.

5.1.10 **LUBRICATION**

Bearings which require lubrication either with oil or grease shall be fitted with nipples complying with BS 1486 Table 1 (or most recent standards). Where necessary for accessibility, adaptors or bushings shall be provided.

5.1.11 **MOTORS**

All motors shall comply with or IEC 34 (or most recent standards) and dimensions with IEC 72 (or most recent standards). They shall be capable of operating continuously under actual service conditions without exceeding the specified temperature rise, determined by resistance, at any frequency between 49 and 51 Hz together with any voltage between ± 5 % of the nominal value.

All motors shall be totally enclosed, and if situated in the open they shall be weatherproof and suitable for outdoor working. They shall be provided with a suitable means of drainage to prevent accumulation of water due to condensation and with suitable means of breathing.
Motors operating in an ambient temperature not exceeding 40 °C shall have Class 'B' insulation or better but where the ambient temperature may exceed this figure or where the motor may be appreciably affected by conducted heat, Class 'F', insulation or better shall be used.

The temperature rise of motors at rated output shall not exceed the allowable rise for the type of insulation used under worst case conditions. A safety margin on temperature rise is preferred e.g., Class B rise at rated output with Class F insulation.

All motors shall be suitable for direct starting at full voltage. Motors shall be sealed ball or roller bearings.

The three-line connections of ac motors shall be brought out to a terminal box. The terminal arrangement shall be suitable for the reception of copper cable. Terminal markings shall be made in a clear and permanent manner and shall comply with or IEC 34 (or most recent standards). A permanently attached diagram or instruction sheet shall be provided giving the connections for the required direction of rotation. All joints shall be flanged with gaskets of neoprene or other approved material. Natural rubber insulation shall not be used.

Where single phase motors are employed, the motors shall be grouped to form, approximately, a balanced three phase load.

5.1.12 **MOTOR CONTROL GEAR**

Control gear shall comply with the requirements of IEC 292 (or most recent standards), the control gear being rated according to the duty imposed by the application. Motor contactors shall comply with IEC 158 (or most recent standards) class of intermittent duty 0-3 with type 52 enclosure protection and a utilization category AC4. They, and their associated apparatus shall be capable of switching the stalled current and shall have a continuous current rating of at least 50 % greater than the full load current of the motors they control.

The operating current of overload trips fitted to motor contactors shall be substantially independent of ambient temperature conditions, including the effect of direct sunlight on the enclosure in which the contactors are installed. Where small motors are connected in groups, the group protection shall be arranged so that it will operate satisfactorily in the event of a fault occurring on a single motor. The control and protection equipment shall be accommodated in the control cabinet or marshalling kiosk.

Each motor or group of motors shall be provided with control gear for starting and stopping by hand and automatically. Overload and single-phasing protection shall be provided.

5.1.13 **DEGREES OF PROTECTION**

The following degrees of protection shall be provided in accordance with IEC 144 and IEC 529 (or most recent standards). For outdoor applications, IP 55 (or most recent standards).

For indoor applications where purpose-built accommodation is provided, e.g. Switch and control and relays rooms IP 41(or most recent standards). Where dust can adversely affect equipment housed with a degree of protection of IP 50 (or most recent standards).

5.1.14 **MAINS SUPPLY CONNECTION**

All incoming supplies of greater than 125 V to earth shall have their terminations shrouded by a suitable insulating material. DC (Red) and AC (Orange) volt connections must be clearly labelled and marked.

5.1.15 **GASKETS AND PACKINGS.**

All packings and gaskets must be clean cork and rubber free. Type TE Z1 of Cork Rite Grade or the equivalent. Only the best quality O-ring caskets to be used where applicable.

5.1.16 **FUSES AND LINKS**

Carriers and bases for fuses and links shall be in accordance with IEC 269 (or most recent standards) and Colour coded to permit identification of the circuit rating.

The fuses and links mounted in cubicles for tripping circuits and protective gear test links shall be mounted on the front of the panel. Other links and fuses shall be accommodated within the cubicle or above the cubicle doors. Fuses and links shall be grouped and spaced according to their function to facilitate identification.

All incoming circuits in which the voltage exceeds 125 volts shall be fed through insulated fuses and/or links, the supplies being connected to the bottom terminal. The contacts of the fixed portion of the fuse or link shall be shrouded so that accidental contact with live metal cannot be made when the moving portion is withdrawn.

Main supply fuse links shall be of the high rupturing capacity cartridge type. Where fuse carriers are mounted vertically the incoming (supply) side shall be the bottom terminal. Where either fuses or circuit breakers are used it should be ensured that proper discrimination between main and sub-circuits is maintained.

5.1.17 **MINIATURE OR MOULDED CASE CIRCUIT BREAKERS**

Miniature or moulded case circuit breakers shall be designed and tested in accordance with IEC 157 (or most recent standards) and supplementary requirements of this specification. They shall be suitable for use over the full range of expected voltage variation as specified in the Detail Technical Specification.

They shall be suitably rated for both the continuous and short circuit loadings of the circuits they are protecting under all service and atmospheric conditions stated in the specification and ensure that correct discrimination is maintained between main and sub-circuits.

For three phase circuits, the miniature circuit breaker shall be of the three-pole type; for single phase circuits they shall be of the single pole type and for dc circuits they shall be of the double pole type.

Where miniature circuit breakers are used in circuits containing inductive loads e.g., operating coils, they shall be suitable for satisfactory operation in the circuit in which they are used.

Miniature circuit breakers shall be mounted in such a manner to give easily visible indication of breaker position and shall be grouped and spaced according to their function

to facilitate identification and easy replacement.

5.1.18 CURRENT RATING AND TEMPERATURE LIMITATIONS

Every current carrying part of the equipment including isolating equipment and connections, shall be capable of carrying under the atmospheric conditions existing at Site, its specified rated current continuously and in no part shall the temperature rise exceed the values specified in BS 115, BS 169 (or most recent standards) and other relevant Standards.

5.1.19 CORONA DISCHARGE AND RADIO INTERFERENCE

All equipment shall be designed to minimize electrical discharges and interferences with radio and TV receiving equipment.

5.1.20 GUARD RINGS AND ARCING HORNS

Guard rings or arcing horns or rings of approved types, size and material shall be attached in an approved manner to all suspension and tension insulator sets. The design of the arcing horns or rings shall be such as to reduce, as far as reasonably possible, cascading and damage to the conductors, clamps, insulator units, and to other fittings under all flash-over conditions. The guard rings or arcing horns shall be of substantial design if they are applicable.

5.1.21 BI-METALLIC CONNECTORS

Bi-metallic connectors or clamps shall be of approved aluminium-to-copper type in which the aluminium fitting shall be of the compression type and the copper fitting shall be of the bolted type, unless otherwise approved. Exposed contact between copper and aluminium shall be prevented by watertight insulating washers.

5.2 PART 2: GENERAL TECHNICAL SPECIFICATION – PART 2

5.2.1 INSTRUMENT TRANSFORMERS (CURRENT TRANSFORMERS installed in existing equipment)

5.2.1.1 Current transformers shall comply in all respects with BS 3938: 1973 (or most recent standards), and the P1 terminal shall be towards the circuit breaker.

5.2.1.2 Each current transformer shall have an output which is adequate for the working current of the associated protection devices and instruments over the required range of load and fault duties as per protection function diagram.

5.2.1.3 Each current transformer secondary winding circuit shall be earthed at only one point. Earthing of a current transformer winding circuit shall be via a link which shall be mounted in the associated protection or instrument cubicle. Wherever possible the connection to earth shall be to the S2 terminals.

5.2.1.4 When multi-ratio transformer windings are specified, the requirements shall be met by using sectioned secondary windings.

5.2.1.5 Current transformers secondary circuits for bus bar one protection and for tariff metering duties shall be routed via suitable test blocks in easily accessible locations. Test blocks shall also be provided in current transformer secondary circuits associated with general protection and indication.

5.2.1.6 All current transformers will be stutted type, 6mm brass, for “S” connections where cabling connections is done.

Table 1: Installed Current transformers.

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side
i.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAN porcelain bushings	100/1 10P10 15VA	100/1 CL X kpV = 180V 10mA	100/1 CL X kpV = 300V 10mA	1600/1400/1 15VA 5P10 kpV = 300V 10mA	1600/1400/1 CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
ii.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAN Composite silicon Insulators	100/1 10P10 15VA	100/1 CL X kpV = 180V 10mA	100/1 CL X kpV = 300V 10mA	1600/1400/1 15VA 5P10 kpV = 300V 10mA	1600/1400/1 CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
iii.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAF porcelain bushings	100/1 10P10 15VA	100/1 CL X kpV = 180V 10mA	100/1 CL X kpV = 300V 10mA	1600/1400/1 15VA 5P10 kpV = 300V 10mA	1600/1400/1 CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
iv.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAF Composite silicon Insulators	100/1 10P10 15VA	100/1 CL X kpV = 180V 10mA	100/1 CL X kpV = 300V 10mA	1600/1400/1 15VA 5P10 kpV = 300V 10mA	1600/1400/1 CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
v.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAN porcelain bushings	200/1 10P10 15VA	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	1600/1400/1 15VA 5P10 kpV = 300V 10mA	1600/1400/1 CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
vi.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAN	200/1 10P10 15VA	200/1 CL X kpV = 180V	200/1 CL X kpV = 300V	2700/1 (or the nearest ratio) 15VA	2700/1 (or the nearest ratio)	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side
	Composite silicon Insulators		10mA	10mA	5P10 kpV = 300V 10mA	CL X 300V			
vii.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAF porcelain bushings	200/1 10P10 15VA	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	2700/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	2700/1 *(or the nearest ratio)* CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
viii.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAF Composite silicon Insulators	200/1 10P10 15VA	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	2700/1 (or the nearest ratio) 15VA 5P10 kpV = 300V 10mA	2700/1 (or the nearest ratio) CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
ix.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAN porcelain bushings	200/1 10P10 15VA	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	600/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	600/1 *(or the nearest ratio)* CL X 300V	600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
x.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAN Composite silicon Insulators	200/1 10P10 15VA Rs =1.9 Ω	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	600/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	600/1 *(or the nearest ratio)* CL X 300V	600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xi.	10MVA 33/11 kV Power Transformer	200/1 10P10	200/1 CL X	200/1 CL X	600/1 *(or the nearest ratio)*	600/1 *(or the nearest ratio)*	600/1 300V	100/1 10 VA	100/1 10 VA 10P10

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side
	(Delta/Star) ONAF porcelain bushings	15VA Rs =1.9 Ω	kpV = 180V 10mA	kpV = 300V 10mA	15VA 5P10 kpV = 300V 10mA	CL X 300V		10P10	
xii.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAF Composite silicon Insulators	200/1 10P10 15VA Rs =1.9 Ω	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	600/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	600/1 *(or the nearest ratio)* CL X 300V	600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xiii.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAN porcelain bushings	400/1 10P10 15VA Rs =1.9 Ω	400/1 CL X kpV = 180V 10mA	400/1 CL X kpV = 300V 10mA	1200/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1200/1 *(or the nearest ratio)* CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xiv.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAN Composite silicon Insulators	400/1 10P10 15VA Rs =1.9 Ω	400/1 CL X kpV = 180V 10mA	400/1 CL X kpV = 300V 10mA	1200/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1200/1 *(or the nearest ratio)* CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xv.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAF porcelain bushings	400/1 10P10 15VA Rs =1.9 Ω	400/1 CL X kpV = 180V 10mA	400/1 CL X kpV = 300V 10mA	1200/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1200/1 *(or the nearest ratio)* CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xvi.	20MVA 33/11 kV	400/1	400/1	400/1	1200/1 *(or the*	1200/1 *(or*	1200/1	100/1	100/1

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side
	Power Transformer (Delta/Star) ONAF Composite silicon Insulators	10P10 15VA Rs =1.9 Ω	CL X kpV = 180V 10mA	CL X kpV = 300V 10mA	*nearest ratio)* 15VA 5P10 kpV = 300V 10mA	*the nearest ratio)* CL X 300V	300V	10 VA 10P10	10 VA 10P10
xvii.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAN porcelain bushings	200/1 10P20 15VA Rs = 15Ω	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xviii.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	200/1 10P20 15VA Rs = 15Ω	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xix.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAN porcelain bushings	200/1 10P20 15VA Rs = 15Ω	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xx.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAN Composite silicon Insulators	200/1 10P20 15VA Rs = 15Ω	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxi.	20MVA, 132/11kV Power	200/1 10P20	200/1 CL X	200/1 CL X	1200/1 15VA	1200/1 CL X	1200/1 300V	100/1 10 VA	100/1 10 VA 10P10

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side
	Transformers. (Star/Star) ONAF porcelain bushings	15VA Rs = 15Ω	kpV = 300V 10mA	kpV = 300V 10mA	5P10 kpV = 300V 10mA	300V		10P10	
xxii.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	200/1 10P20 15VA	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxiii.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAF porcelain bushings	200/1 10P20 15VA	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxiv.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAF Composite silicon Insulators	200/1 10P20 15VA	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxv.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAN porcelain bushings	500/1 10P10 15VA Rs =1.9 Ω	500/1 CL X kpV = 180V 10mA	500/1 CL X kpV = 300V 10mA	1500/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1500/1 *(or the nearest ratio)* CL X 300V	1500/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxvi.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAN	500/1 10P10 15VA Rs =1.9 Ω	500/1 CL X kpV = 180V 10mA	500/1 CL X kpV = 300V 10mA	1500/1 *(or the nearest ratio)* 15VA 5P10	1500/1 *(or the nearest ratio)* CL X	1500/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side
	Composite silicon Insulators				kpV = 300V 10mA	300V			
xxvii.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAF porcelain bushings	500/1 10P10 15VA Rs =1.9 Ω	500/1 CL X kpV = 180V 10mA	500/1 CL X kpV = 300V 10mA	1500/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1500/1 *(or the nearest ratio)* CL X 300V	1500/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxviii.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAF Composite silicon Insulators	500/1 10P10 15VA Rs =1.9 Ω	500/1 CL X kpV = 180V 10mA	500/1 CL X kpV = 300V 10mA	1500/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1500/1 *(or the nearest ratio)* CL X 300V	1500/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxix.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAN porcelain bushings	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxx.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	200/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxxi.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAN	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side
	porcelain bushings				10mA				
xxxii.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxiii.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAF porcelain bushings	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxiv.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxxv.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAF porcelain bushings	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10
xxvi.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAF Composite silicon	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side
	Insulators								
xxvii.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAN porcelain bushings	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
xxviii.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
xxix.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAN porcelain bushings	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
xl.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
xli.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAF	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v	100/1 10 VA 10P10	100/1 10 VA 10P10

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side
	porcelain bushings						Rs = 3.6Ω		
xlii.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
xliii.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAF porcelain bushings	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
xliv.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
xlv.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAN porcelain bushings	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
xlvi.	80MVA, 132/33 kV Power Transformers.	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V	400/1 CL X kpV = 300V	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp =	100/1 10 VA 10P10	100/1 10 VA 10P10

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side
	(Star/Star) ONAN Composite silicon Insulators		10mA	10mA			167v Rs = 3.6Ω		
xlvii.	80MVA,132/33 kV Power Transformers. (Star/Delta) ONAN porcelain bushings	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
xlviii.	80MVA,132/33 kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
xlix.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAF porcelain bushings	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
l.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10
li.	80MVA, 132/33 kV Power	400/1 12VA,	400/1 Class X	400/1 CL X	1500/1 15 VA	1500/1 CLX Vkp = 167v	1500/1 CLX	100/1 10 VA	100/1 10 VA 10P10

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side
	Transformers. (Star/Delta) ONAF porcelain bushings	Rs = 1.1 Ω	300V 10mA	kpV = 300V 10mA		Rs = 3.6Ω	Vkp = 167v Rs = 3.6Ω	10P10	
lii.	80MVA, 132/33 kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	400/1 12VA, Rs = 1.1 Ω	400/1 Class X Vkp = 300V 10mA	400/1 CL X Vkp = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10

NB: THE CURRENT TRANSFORMERS LISTED IN TABLE 1, ARE INDICATIVE RATIOS AND CLASSES. THE MANUFACTURER MAY SPECIFY BETTER WITH GOOD REASON. SECONDLY, THE TRANSFORMER WINDING TEMPERATURE CURRENT TRANSFORMERS ARE NOT SPECIFIED AND THE MANUFACTURER SHOULD SPECIFY THEM AND PROPOSE TO CENTLEC.

5.3 CABLES AND ACCESSORIES

5.3.1 **DESIGN**

Technical data affecting the design of the cables is given in the Schedules. The equipment shall further be designed to meet the tests specified in the Schedules. The Contractor shall specify particulars and required performance of the cables offered in the Schedules. Changes in make-ups or minus tolerances in material thickness will not be permitted.

5.3.2 **CONDUCTORS**

The conductor shall be composed of plain annealed copper or aluminium wires as stated in the Schedules, which before shaping shall be smooth, uniform in quality, free from scale, inequalities, spills, splits and other defects. The conductor properties shall comply with the requirements of IEC 28 (or most recent standards) in case of copper and with IEC 111 (or most recent standards) in case of Aluminium.

5.3.3 **FILLERS AND BEDDING OF SOLID INSULATION CABLES**

The type and application of fillers shall be such as to facilitate the flow of heat away from the cores. Bedding shall consist of a continuous impermeable extruded layer of polyvinyl chloride (PVC), closely fitting the equalizing binder. The bedding shall be treated to make it fire retardant.

5.3.4 **ARMOURING**

Single core cables shall be arranged with one layer of tinned hard-drawn copper wires to provide a degree of mechanical cable protection. Armouring of pressurized cables shall withstand radial forces due to static internal pressure, changes in internal pressure due to load cycles and axial forces due to installation methods. Armouring in conjunction with other metal sheathing (if any) shall provide an earth continuity path of the quality required by the Specification. The Bidder shall submit proposals for bonding and earthing the Armouring of the cable installation.

Where joints in the Armouring are necessary, they shall be brazed or welded, and any surface irregularities shall be removed. A joint in any wire shall be not less than 2 m from the nearest joint in any other reinforcement wire in the completed cable. Armouring shall be laid on helically to an approved lay. Means shall, however, be provided to establish electrical contact between the sheath of paper insulated cables and the Armouring.
The lay of Armouring shall be such that no buckling or over-riding of wires takes place when the completed cable is wound in coils or on to drums of an approved diameter or the cable is bent round the approved minimum bending radius specified in the Schedules.

5.3.5 **OUTER COVERING**

The outer covering of the cable shall consist of a continuous, impermeable extruded layer of PVC, closely fitting the underlying armor wires or the equalizing binder and shall be of an approved flame-retardant type.

The PVC shall comply with the requirements of the relevant sections of BS 6746 (or most recent standards). The design and efficiency of the coverings shall not be affected by the cleating or clamping arrangements supporting the cable.

5.3.6 **CUBICLE WIRING**

Cubicle connections shall be insulated with PVC to SANS 150-1970 or IEC 228 (or most recent standards). Wires shall not be jointed between terminal points. Bus wires shall be fully insulated and run separately from one another, along the top or bottom of the cubicle. Fuses and links shall be provided to enable all circuits in a cubicle, except a lighting circuit, to be isolated from the bus wires.

The DC circuit Trip and AC circuit voltage supplies and wiring to main protective gear shall be segregated from those for back-up protection and from protective apparatus for special purposes. Each such group shall be supplied through separate fuses from the bus wires. There shall not be more than one set of supplies to the apparatus comprising each group. All wires associated with the tripping circuits shall be provided with red cable markers indicating “Trip" and all wiring will be according to applicable standards.

It shall be possible to work on small wiring for maintenance or testing purposes without making the switchboard dead. All small wiring and multi core cables shall be fitted with interlocking numbered lugs in accordance with the circuit diagram. All conductor ends shall be terminated with pre-insulated crimped lugs of the proper type and size for the terminals in use. Only the correct crimping tool and dies shall be used strictly in accordance with the manufacturer's instructions. Cable tails shall be neatly laced in a cable form, each core branching off to its appropriate terminal.

Identification ferrules shall be of insulating material with a glossy finish to prevent the adhesion of dirt and shall not be affected by damp or oil. Ferrules (core or cable markers) shall be engraved black on a white background. For tripping circuits an additional ferrule with a letter T engraved black on a red background shall be provided. Insulated stranded wire shall not have less than seven strands and each strand shall not be less than 0,67 mm^2 diameter. If single conductor is used it shall be annealed copper of circular cross-sectional area of not less than 2.5 mm^2. When connections rated at 400 volt and above are taken through junction boxes they shall be adequately screened and "DANGER 230/400 volts" notices shall be affixed to the outsides of junction boxes or marshalling kiosks. The Notice must be white lettering with a red background. Where connections to other equipment and telemetry-control equipment are required, the connections shall be grouped together. The Colour code for cubicle wiring is specified in the Schedules.

5.3.7 **MULTI CORE CABLES AND CONDUIT WIRING**

The external cabling between the main equipment and the ancillary equipment shall form part of the Contract Works and shall consist of PVC insulated and sheathed steel wire armoured cable with PVC overall, to IEC 228 or SANS 150 (or most recent standards). Where conduit is used the runs shall be laid with suitable falls and the lowest parts of the run shall be external to the equipment. All conduit runs shall be adequately drained and ventilated. Conduits shall not be run at or below ground level.

Multi core cable tails shall be so bound that each wire may be traced without difficulty to its cable. The spare cores of all multi core cables shall be numbered and terminated at a terminal block in the cubicle. Where cables are terminated in a junction box and the connections to a relay or control cubicle are continued in conduit, several spare cores shall be taken through the conduit and terminated in a cubicle. The screens of screened pairs of multi core cables shall be earthed at one end of the cable only. The position of the earthing connections shall be shown clearly on the diagram.

All wires on panels and all multicore cables shall have ferrules (cable or core markers) which bear the same number at both ends. At those points of interconnection between the wiring carried out by separate contractors where a change of number cannot be avoided double ferrules (cable or core markers) shall be provided on each wire. The change of numbering shall be shown in the appropriate diagram of the equipment. The same ferrule (cable or core markers) number shall be used on wires in different circuits on the same panels.

Where cables are laid to equipment provided on other contracts the contractor will be responsible for leaving sufficient lengths of tails at each end of the multi core cables to connect to the terminal boards. He shall strip, insulate, ring through and tag the tails, and seal the cable boxes. The other contractors shall be responsible for re-checking the individual cores and for the final connecting and fitting of numbered ferrules (cable or core markers).

5.3.8 **TERMINAL BOARDS AND TERMINAL BLOCKS**

Terminal boards shall be of good quality non-flammable insulating materials, with a comparative tracking index (CTI) of not less than 500, to IEV 112(or most recent standards). Thermoplastic terminal insulation material will not be acceptable. Rows of terminals shall be spaced not less than 100 mm apart. For relay and control panels they shall be mounted at the sides of the cubicle and set obliquely towards the rear doors to give easy access to terminals and to enable ferrule numbers to be read without difficulty. The bottom of the terminal boards shall be spaced at least 200 mm above the cable crutch of incoming multi core cables.

Insulating barriers shall be provided between adjacent pairs of terminals. The height of the barriers and the spacing of the terminals should be such as to give adequate protection while allowing access to terminals. Terminations shall be grouped according to function and on terminal blocks assembled from individual terminals, separating

insulating barriers shall be inserted between groups. Labels shall be provided on the fixed portion of the terminal boards showing the function of the group. Terminals shall be of the stud type, alternatively for up to and including 4 mm^2 wire size, insertion clamp type terminals of approved type may be used in relay in control panels and the like.

Terminal boards for stud type terminals shall have pairs of terminals for incoming and outgoing wires and not more than two wires shall be connected to any one terminal. All connections shall be made to the front of the terminal boards. Current shall not be carried through the board by the studs. Covers in insulating material, preferably transparent, shall be provided on terminal boards on which connections for circuits with a voltage reader than 125 volts are terminated. No live metal shall be exposed at the back of the terminal boards.

Studs of stud type terminal boards shall be locked in the base to prevent turning and all connections shall be made on the front of the terminal board using lock nuts or lock washers. Where crimped type terminations are provided at least two sets of crimping tools must be supplied for each installation. Terminals of the insertion clamps type shall incorporate captive pressure screws which do not bear directly on the wire but on a serrated clamping plate. The pressure screws shall have an inherent locking feature.

Where connections are to be made between the multi core cables supplied and telephone type multi core cables, then the terminal board shall comprise a stud or clamp type terminal for the multi core cable and a soldered tag for the telephone cable joined by a with draw able insulated link. These terminals shall also be provided with facilities for the insertion of test probes on both sides of the link. The use of terminal boards as junction points for wires which are not required in the associated cubicles shall be avoided wherever practical be. Terminals used shall be approved and all terminal boards shall have a minimum of 10% spare terminals.

5.3.9 **MARSHALLING KIOSKS AND JUNCTION BOXES**

All outdoor boxes and kiosks shall be protected in accordance with Class IP55 or IEC 144 (or most recent standards) and shall be insect, termite and rodent proof. Heaters shall be provided and shall be controlled by a watertight switch mounted externally. Ventilation louvres shall be provided and divisions between compartments shall be perforated. At least one single phase switched socket outlet with earth leakage protection shall be provided in each marshalling kiosk. Earth leakage must be in concealed enclosure. All cables shall enter boxes and kiosks at the base. The base plate will be 3mm thick Aluminium and will be earthed with an earth stud of 6mm brass. This will be used to gland the cables properly.

Each compartment of all kiosks and junction boxes shall be provided with access doors at the front and rear. Doors and access covers shall not be secured by nuts and bolts but shall be fastened with integral handles with provision for locking. Doors for kiosks shall be of the lift off and hinged type and shall be provided with glazed windows of adequate size to facilitate reading of indicators from outside the kiosk. Facilities shall

be provided to permit removal of the temperature indicators without the need to pass the capillary tubing and bulb through the various compartments.

Doors and covers under 15 kg mass may be of the slide on pattern but above this mass hinged doors shall be used. If three phase connections are taken through a box or kiosk they shall be adequately screened or insulated and suitably marked with the phase Colour code; a danger notice stating the voltage shall be fixed on the inside and outside of the kiosk or box. Labels shall be provided inside each kiosk or box to describe the functions of the various items of equipment.

5.3.10 **NEUTRAL EARTH RESISTOR (NER)**

The neutral earth resistor will be connected directly to the 11 kV Star point of 33/11kV or 132kV transformers. (Delta /Star) Resistor size are 600 Amp, 10Ω or 300Amp, 20Ω. The resistors will be of the metal grid- or oil submersed metal element type. Must be easily accessible to be replaced on site. The resistor side of the NECRT must be equipped in such a manner that the equipment can be earth solid to the earth when needed. Referring to the metal grid type, all the grids which form the resistor must be of a robust steel alloy and mounted on a framework. All metal parts will be protected against rust.

All the resistors will be cooled to such an extent as to eliminate overheating, especially when the specified earth fault current flows for the period mentioned. The design of the resistors will be such that the fault current will be between 50 to 150 percent of the specified current for all periods until the maximum. All bushings and interconnections will be such that the through-fault current may be carried for a minimum period of ten seconds in the event of an internal fault. All sheet metal will be of a sufficient quality and gauge for the application. The necessary attachments to lift the resistor must be fitted.

Oil filled resistors will not be sealed units and oil level indicators of high quality must be fitted. If the oil is to be used as a coolant as well, overpressure valve, Breathers and temperature indicators must be fitted. The resistors will be of the outdoor type. The tanks will be painted admiral grey and reservoir tanks white. The 5kVA, single phase reactor and neutral resistor monitor system (NERM) must be installed with the installation. **(Supply all the clamps to connect)**

5.3.11 **NEUTRAL EARTH COMPENSATOR RESISTER AND TRANSFORMER (NECRT) 200kVA.**

The neutral earth compensator resistor Transformer, 200 kVA, will be connected directly to the 11 kV side of 33 kV/11 kV or 132/11kV transformers (Delta/ Star), with a 50mm, PLIC, single core, cable. Resistor sizes are 600 Amp 10Ω or 300Amp 20Ω. The resistor side of the NECRT must be equipped in such a manner that the equipment can be earth solid to the earth when needed. The resistors will be of the metal grid- or oil submersed metal element type. Must be easily accessible to be replaced on site. The resistor must be in its own compartment of the NECRT so that when it faltered no contamination must be in the transformer side. The resistor compartment must be fitted

with the overpressure valve as well as a breather.

Referring to the metal grid type, all the grids which form the resistor must be of a robust steel alloy and mounted on a framework. All metal parts will be protected against rust. All the resistors will be cooled to eliminate overheating, especially when the specified earth fault current flows for the period mentioned. The design of the resistors will be such that the fault current will be between 50 to 150 percent of the specified current for all periods until the maximum. All bushings and interconnections will be such that the through-fault current may be carried for a minimum period of ten seconds in the event of an internal fault.

All sheet metal will be of a sufficient quality and gauge for the application. The necessary attachments to lift the resistor must be fitted. Oil filled resistors will not be sealed units and oil level indicators of high quality must be fitted. If the oil is to be used as a coolant as well, overpressure valve, Breathers and temperature indicators must be fitted on both sides. The NECRT's must be of the outdoor type. The tanks will be painted admiral grey and reservoir tanks white. The 5kVA, single phase reactor and neutral resistor monitor system (NERM) must be installed with the installation. **(Supply all the clamps to connect)**

5.4 **POWER TRANSFORMER** - **PART 3**

5.4.1 STANDARD SPECIFICATION

The transformers shall comply with BS 171 - 1970 of British or South African manufacture and with the requirements of this specification and the data must be submitted by bidders on the relevant Detail Technical Specification. Please complete the manufacturer part of the document.

5.4.2 TYPE OF TRANSFORMER

The transformers shall be of double wound fully insulated oil immersed core type having a no-load voltage of as specified in the detail specification. Rating shall be continuous with type ONAN cooling. An alternative design and offer must be submitted to overload the transformers up to 10% of their full rated load capacity and will depend on factors such as building constraints, as well as the continuous load (load curve included under Section 4). This will probably enforce the use of forced cooling. (ONAF)

Windings shall be connected according to the vector group as specified in the detail specification. Means shall be provided for adjustment of the voltage ratio while under load as specified later, and all provisions of this specification shall apply irrespective of the tap position under which operation occurs. Transformers must also be suitable to operate in parallel with each other.

5.4.2.1 TERMINAL ARRANGEMENTS

On the 132 kV and 33 kV, Delta/star or Star/star, side bushings shall be provided, 1200mm centre to centre, on top plate of the transformer tank, suitable for connection to overhead bus bars. (Supply with flag clamps) On the 11 kV side bushings shall be provided on top plate of the transformer tank, 600mm centre to centre, suitable for the connection of copper bus bars leading from the terminals of 11 kV outdoor terminations. (Supply with flag clamps)

On the 132 kV and 33 kV, Star/Delta, side bushings shall be provided, 1200mm centre to centre, on top plate of the transformer tank, suitable for connection to overhead bus bars. (Supply with flag clamps). On the 11 kV side bushings shall be provided on top of the tank, 600mm centre to centre, suitable for the connection of copper bus bars leading from the terminals of 11 kV outdoor terminations. (Supply with flag clamps)
Supply flag clamps for neutral bushings on all the transformers.

All terminals shall be clearly and permanently marked according to the BS Specification. Please note that the surge arrestors on the primary side, 132kV and 33kV, must be fitted in line with the bushings. This means that the HT conductor must be easily connected through the surge arrestors clamps to the bushing clamps. (Supply with trough clamps for Centipede). All bushing must have test certificates that show the approved tests results even when ordered separately. This is for all the bushings installed.

5.4.2.2 COOLING ARRANGEMENTS: TANKS AND RADIATORS

The transformers shall be fitted with built-on cooling radiators. The tank cover shall be fitted with pockets in the positions of maximum oil temperature at C.M.R. for the fitting of thermometers and winding temperature indicator bulbs. Such pockets shall be designed to prevent the ingress of water and to allow the removal of the indicator bulbs without lowering the oil level in the tank. Special protection shall be provided for capillary tubes.

No holes shall be drilled to bolt the cover to the tank. The main tank/cover joint shall be welded. A fire-proof gasket shall be included to prevent foreign material entering the transformer during welding or de-welding. The joint shall be designed to permit removal of the weld with minimum damage to mating flanges, and to leave them adequate for re-welding. Prior to welding, a suitable seal shall be placed between the cover and tank and the two shall then be clamped together to form an oil tight sealed unit.

Corrugated tanks are not acceptable. Tanks and fittings shall be of such a shape that water cannot collect at any point on the outside surfaces. It must also not be possible for gas to collect inside the tank unless such voids are connected by means of pipes to the main explosion ventilator (High pressure) valve that is installed on the low voltage side in the middle and at the top of the transformer.

Guides shall be provided inside each tank to locate the core and windings centrally. The tank base of each transformer shall be so designed that it shall be possible to move the complete transformer, filled with oil, in any direction or to jack it up without structural injury or impairment of the oil-tightness of the transformer. A design which necessitates slide rails being placed in a particular position or special detachable base, shall not be used unless specifically approved.

Suitably proportioned manhole covers shall be provided in the tank cover to afford easy access to the lower ends of bushings and upper portions of the core and winding assembly. The radiators shall be detachable with lifting eyes and shall be provided with drain plugs of valves at the lower points and vent plugs at the highest point. Isolating valves shall be provided immediately adjacent to the main tank to enable the radiators to be removed without draining the oil in the transformer tank.

All oil-pipe connections above 12 mm diameter shall be flanged. Supply on bottom main tank a flange with drain valve for easy oil sampling. The transformer tank, radiators and complete tap-changer (including boards) shall be capable of withstanding a full vacuum (i.e., 760 mm of mercury at sea level).

The tank and cooling equipment shall be so designed that the vacuum treatment can be done on site. Tank stiffeners shall not be installed in positions where welded seams can be covered up. The tank and cover shall be designed so that local heating due to stray flux in any structural parts, shall not exceed the temperature limit specified for the transformer, and shall not cause temperature indication errors in the thermometer pockets.

5.4.2.3 GASKETS

Gasket joints shall be of the groove and "O"-ring type. Grooves shall be properly dimensioned, and the mating surfaces machined. Gaskets shall be replaced each time a seal is broken. Where cork packing is used it must be clean cork of high quality like Cork rite **Type TE Z1** or equivalent.

5.4.2.4 TRANSFORMER OIL

Each transformer shall be supplied complete with the first filling of class B.30 Oil to BSS 148 (or most recent standards). Oil dielectric strength must be **80kV** and above. The oil must be **PCB free** and **sticker** that indicates it must be on the transformer. Submit oil test reports after installation of transformer, Tap Changer, NER/NECRT and all other oil filled equipment.

5.4.2.5 ON-LOAD VOLTAGE CONTROL (vacuum and transformer oil type tap changers)

An on-load tap changing mechanism shall be provided on each transformer with full capacity tapping's on the primary windings for adjustment of the transformation ratio in stages of 1.25 %. This tap changer must be suitable for parallel operation. The driving motor for the mechanism shall be suitable for a Three (3) phase 50 Hz, 400 Volt supply and shall be complete with protection.

The electrical operation of each transformer shall be controlled from a control panel, housed indoors in an adjacent building. Please tender on vacuum and transformer oil tap changers. The tap changer must be mounted to the side of the transformer so that maintenance can be done at ground level. (MR or Equivalent Type)

5.4.2.6 CONTROL EQUIPMENT

The on-load tap changing equipment shall be arranged for the following methods of control: Please tender on **vacuum and transformer oil tap changers**.

5.4.2.6.1 Hand operation: In case of emergency, means shall be provided to enable the tap changer to be operated by hand. A Tap position indicator with associated transformation ratio plate shall be provided on the transformer. Means shall be provided to operate the tap changer electrically by hand from the tap change control panel.

5.4.2.6.2 Fully automatic operation: Fully local automatic control shall be provided for the transformer with a variable time delay which can be set to prevent operation until the deviation in voltage has persisted for a specified period. The reference voltage shall be 110 volt 50 cycles per second, yellow phase earthed. Suitable interlocking being provided to prevent simultaneous operation by hand and automatically.

5.4.2.6.3 Parallel operation: The transformers will at the option of CENTLEC be operated as follows:

a) As an individual (automatic/manual) unit.

b) Automatically in parallel with each other.

c) Controllable by means of CENTLEC's supervisory control system.

5.4.2.6.4 Lamp indications and alarm relays: The following lamp indication (LED) and alarm relays shall be included in the tap change control panel:

a) Indication of tap positions with associated transformation ratios.
b) Indication of tap changer supply, with alarm.
c) Indication of incompleteness of tap change or failure to operate, with alarm.
d) Indication of tap change in progress.
e) Indication of out-of-step, with alarm, when operated in parallel.
f) Indication of interlocking device in operation. An interlock device shall be fitted on the tap changer to prevent operation of the tap changer driving motor when more than two steps out-of-step operation should occur.
g) A registering device shall be fitted to the tap change mechanism to indicate the number of operations completed.

5.4.2.6.5 The tap change mechanism shall be designed so that a tap change operation, once initiated, will be completed irrespective of the positions or the operation of control switches and relays.

5.4.2.6.6 No hazard shall, however, result in any part of the tap change mechanism or the transformer should a tap change operation be interrupted.

5.4.2.6.7 Additional requirements for tap-changers in connection with supervisory control.

5.4.2.6.8 The required operation should be as follows from Control room for item no. a, b, c and d above:

a) Activate control (a) i.e., supervisory control over the group.
b) Activate control (c) or (d) on one transformer as circumstances require.
c) Activate control (b) Reset transformer group.

5.4.2.6.9 Indication: a normally open contact is required to indicate that the tap-changer has been override by the supervisory control. This is common for all transformers.

5.4.2.6.10 Tap position indication. For this purpose, a rotary, multi-position switch, coupled to the tap-change mechanism is required. Contacts, which are normally open, should be provided for i.e., K, k1 --- k17 as shown on schematic diagram.

5.4.2.6.11 These contacts should be extended by means of a multi-core cable to the control panel where all the other Supervisory control terminals are to be terminated.

5.4.2.6.12 Over and above the normal alarms, the following alarms are required for the Supervisory control (Normally open contacts).

a. Tap-changer (fault 11D and 11D3)
b. Out of step
c. Supply faulty.
d. Tap-changer in progress.

5.4.2.7 GENERAL:

All wiring required for the supervisory control should be provided for, on the terminal point in the tap-change control panel. The Supervisory control override relay should be common to all operations i.e., all the transformers in the group should be able to be controlled by means of the Supervisory control irrespective of local control settings. Only the increase or decrease of the tap position should be able to be done individually.

No supply is provided for from the Supervisory control equipment therefore the local 110 Volt DC supply should be used. In the case where a group of transformers is taken over by the Supervisory control, the out of step alarm should still operate but the tap-changer control equipment should not lock-out under these circumstances, although this facility is required when the tap-changer operated under normal conditions.

5.4.2.8 TRANSFORMER SAFETY ACCESSORIES

The transformer shall be fitted with the following safety equipment:

5.4.2.8.1 An oil temperature dial type indicator with maximum temperature point which can be reset by hand. Alarm contact and tripping contact, adjustable between 0^{o} C and 150^{o} C and shall be fitted to the indicator.

5.4.2.8.2 A winding temperature indicating device to register the winding temperature with the same tripping and alarm adjustable setting range as above.

5.4.2.8.3 Indication shall be on a dial with a maximum temperature pointer which can be reset by hand. Alarm contacts shall be fitted to this indicator and shall be adjustable over the range 0^{o} C to 150^{0} C.

5.4.2.8.4 A double element combined type gas and oil actuated relay situated in the pipe between the highest point of the transformer tank and the conservator. The relay shall have alarm contacts which close on collection of gas of low oil level, and tripping contacts which close following and oil surge. Facilities for testing the relay shall be provided. (Buchholz Relay)

5.4.2.8.5 A low oil level alarm actuated by a float switch situated in the oil conservator shall be fitted. All the above alarm contacts shall be wired to the Marshalling Kiosk and clearly labelled and conveniently placed to facilitate further wiring.

5.4.2.8.6 The tripping contact of the Buchholz relay shall be wired to suitable terminals in the Marshalling Kiosk and clearly labelled and conveniently placed to facilitate further wiring.

5.4.2.8.7 Both the transformer winding oil compartment and the tap-change panel oil compartment will be equipped with the above-mentioned equipment. The oil of these two compartments will in no way be allowed to mix.

5.4.2.8.8 An over pressure valve must be installed close to the top of the transformer between the yellow and blue phases on the secondary side. This must have a trip output contact and must be wired to the transformer marshalling kiosk.

5.4.2.9 HANDLING FACILITIES

To handle the units effectively the following handing facilities shall be provided:

5.4.2.9.1 On the transformer-tank: Install flat bottom plate which also allows for bi-directional rotation jacking pads on the tank sides for lifting by means of jacks. Install integral lifting lugs or eyes, capable of supporting the gross mass of the transformer, including the oil. Install lifting eyes on all heavy components such as tap changer tank, conservator, etc.

5.4.2.9.2 On the radiator assembly, if supplied: Lifting lugs or eyes to support the total mass without oil.

5.4.2.9.3 When placing the transformer on plinths install “Mal-Veloid (durable damp membrane)” packing between plinths and transformer to avoid moister accumulation.

5.4.2.10 TRANSFORMER TESTS

Each transformer shall be fully tested in accordance with BS Specification No 171 and the latest SANS and IEC specifications.

5.4.2.10.1 Testing of all transformer protection:

5.4.2.10.2 DC Winding Resistance,

5.4.2.10.3 Ratio,
5.4.2.10.4 Current Transformers,
5.4.2.10.5 SFRA test,
5.4.2.10.6 Leakage Reactance,
5.4.2.10.7 Excitation Current,
5.4.2.10.8 Tan-delta (bushings and windings),
5.4.2.10.9 Ancillary tests, Insulation Resistance tests
5.4.2.10.10 Buchholz relay
5.4.2.10.11 Test the thermal protection and cooling system of the transformer.
5.4.2.10.12 Test the oil at an accredited laboratory.
5.4.2.10.13 Test the Oil level indicator, Low oil and High oil.
5.4.2.10.14 Furan,
5.4.2.10.15 Dissolved Gas Analyses,
5.4.2.10.16 Acid,
5.4.2.10.17 Di-electric strength,
5.4.2.10.18 Corrosive Sulphur,
5.4.2.10.19 PCB tests
5.4.2.10.20 The Tan Delta of the oil must comply with IEC 60422 specifications.
5.4.2.10.21 Oil leakage pressure test 24 hours. Certificates of test covering all details in accordance with these standards shall be submitted in duplicate. The factory acceptance tests (FAT) must be witnessed and arranged for four (4) x CENTLEC (SoC) Ltd employees that include all flight arrangements, transport and accommodations (not less than three (3) star rated). This is for the successful bidder's cost.

All transformers will be transported with **event recorders**. The transformers will be tested before loading, after the loading and then transported. The transformer will be tested before off loading and again when placed on the plinth on site.

5.4.2.11 OFF-LOADING AND PAINTING

The bidder shall take full responsibility for off-loading on site, and shall provide all transport, tackle, tools, rigging and equipment to carry out this work. The transformer will be placed on six (6) layers of "Mal-Veloid (durable damp membrane)" packing to prevent rust and moisture accumulation between plinth and the transformer tank.

The entire transformer unit shall be finished in a high gloss admiral grey Colour best quality paint to BSS No 381 C, Shade 631. The reservoirs will be painted white gloss of the same quality.

5.4.2.12 DRAWINGS, MAINTENANCE MANUALS AND INSTRUCTION

5.4.2.12.1 Tender drawings: Each Order shall be accompanied by the drawings:

a) General arrangement, showing all elevations and plan giving major dimensions.
b) Typical sectional drawing giving main constructional details.
c) On-load tap change mechanism details.
d) Tap change control gear details drawings.
e) Small wiring drawings.
f) CT drawings.
g) Kiosk drawings.

5.4.2.12.2 Contract drawings: The successful bidder shall submit the following drawings in duplicate hard copies and a soft copy (.dgn file) as soon as possible and in any case prior to dispatch of the transformer from his premises. The listed drawings below are to be delivered with reasonable as agreed to by the service provider(s) and the client:

a) Details of foundations required.
b) Outline, general arrangements, sectional, and detail drawings of the transformer.
c) Diagram of connections of the transformer and voltage control equipment showing exact turns ratios, voltage ratios, impedance values and the polarity of the transformer.
d) Full details of tap changing mechanism
e) Diagram of connections of tap change mechanism
f) Diagram of connections of tap change control panel.

5.4.2.12.3 Instruction and operating manuals: The successful bidder shall supply, together with the drawings under (a) above, three copies each of the following installation, operation and maintenance instructions:

a) Transformer unit.
b) Protective relays and indicators
c) Tap changer mechanism.
d) Tap change control panel.
e) NECRT’s
f) NER’s
g) Reactor and NERM systems

5.4.2.13 SPECIAL TOOLS

The bidder shall state in his tender which special maintenance or assembly tools are necessary and shall, in his price schedule, allow for the supply of such tools in a lockable (Haspel & Staple), wall mounted, steel cabinet. The maintenance

manual for the transformer, Tap- changer and Bushings, inside this cabinet, and will be delivered with the transformer on site.

5.4.2.14 GUARANTEE

The successful bidder shall guarantee to replace, free of cost to CENTLEC for a period of twelve months calculated from the date of energization any or all parts of the equipment covered under this contract which may fail mechanically or electrically due to faulty design, bad workmanship or material. Please provide a full break down on the guarantee; what is covered and for how long in months for a transformer that is delivered, installed, and energized. Furthermore, please provide same for a transformer that is delivered and stored.

5.4.2.15 SURGE ARRESTORS

The surge arrestor shall be mounted on the transformer top plate in line with the primary bushings. The design of equipment shall be approved and shall be in accordance with the recommendations of IEC 99.1. The surge arrestors shall be suitable for operation under the conditions specified in the Detail Technical Specification and for rainy conditions.

Surge arrestors shall be designed to pass the rated impulse rest discharge current and the low amplitude long time current specified in the Schedules. The rated voltage of the arrestor shall be the maximum RMS power frequency line to earth voltage at which the arrestor can operate continuously. This voltage shall be as stated in the Schedules.

The arrestors shall be of robust construction and shall be designed to facilitate handling, erection and cleaning, and to avoid pockets in which water can collect. The method of assembly of the arrestor shall be such that adequate contact pressure is at all times maintained between the faces of the series non-linear resistance blocks and the design of the series gaps and voltage grading resistors, when used shall be such that the gap setting cannot be affected by vibration, mechanical shock or change in temperature. All joints shall be made in an approved manner such that the arrestor is hermetically sealed with material which will not deteriorate under any service conditions.
There must be indication indicator fitted that will indicate arrestor failure, that is visible from ground level. The set of arrestors installed will be earthed on both sides with 50 x 3 mm copper busbars, and Kwenna back-up conductors, directly to the main earth of the substation.

5.4.2.16 SECTION PROJECT INFORMATION

5.4.2.16.1 NATURE OF WORK

This Specification provides for the design, manufacture testing at factory and all transformer tests, supply, delivery and off-loading on site onto an existing concrete plinth or a newly constructed plinth if existing plinths need to be altered. The power

transformers should also be erected, cold commissioned. The transport of transformers will always be recorded and monitored with event recorders. The equipment will be used to supply electrical energy in the distribution area of CENTLEC. Include the dismantlement and removal of the old transformer which is replaced and relocate to a space on site that will be determined.

5.4.2.16.2 OPERATIONAL CONDITIONS

Electrical energy will be supplied from one or more power stations and substations as three-phase current and at a frequency of 50 Hz.
Electrical energy will be transmitted by means overhead transmission lines and/or underground cables.
The system will be in continuous operation during the varying atmospheric and climatic conditions occurring at all seasons, and the plant shall be suitable in all respects to work continuously at its rated capacity under the Site conditions as specified in the Detail Technical Specification.
The system's highest voltage and the system nominal voltage will be as stated in Detail Technical Specification.
The neutral points of the various sections of the system will be grounded, through a resistance (NER 300A, 20Ω) or NECRT 200kVA,300A, 20Ω) with a single-phase reactor and Neutral Earth Resistor Monitor (NERM) system that must be supplied on this contract. The NERM relay must also be provided and installed. Also provide prices on NER 600A, 10Ω and NECRT 200kVA, 600A, 10Ω with single-phase reactor and NERM system.
The load on the system will or may consist of domestic loads, static transformers, induction and synchronous motors, static converters, power-factor correction equipment, filters, and rectifiers for the supply of motive power, traction, lighting, control, and electro-chemical work.

5.4.2.16.3 TESTING AND INSPECTION

The appointed service provider shall carry out the tests stated in accordance with the conditions of this Specification and without extra charge, to determine that the Contract Works comply with the Specification.
All tests shall be carried out to the satisfaction of CENTLEC and in the presence of CENTLEC project personnel at such times as CENTLEC may reasonably require.
The service provider shall be responsible for notifying CENTLEC of readiness for testing at least a week before testing at the factory and one day before on site.

All labour apparatus, instruments, connections and material required for the tests shall be provided by the service provider. No inspection or lack of inspection or passing by CENTLEC of work, plant or materials, whether carried out or supplied by the service provider or sub-contractor, shall relieve the service provider from his liability to complete the Contract Works in accordance with the Contract or exonerate him from any of his guarantees.

5.4.2.16.4 FIRE PRECAUTIONS

All apparatus, connections and cabling shall be designed and arranged to minimize the risk of fire and any damage which might be caused by fire.

5.4.2.16.5 ERECTION AT SITE AND ACCOMMODATION

The appointed service provider shall provide, at his own cost and expense, all Labour, plant and material necessary for unloading and erection at the Site and shall be entirely responsible for its efficient and correct operation.

The appointed service provider shall be responsible for arranging and providing all living accommodation, services and amenities required by his employees.

5.4.2.16.6 SPANNERS AND SPECIAL TOOLS

A complete set of spanners shall be supplied for each station to fit every nut and bolt head on the apparatus supplied under this Contract, together with all special tools required for the adjustment and maintenance of the equipment. These tools shall be mounted in a lockable cabinet at each station also to be provided under this Contract.

Eye bolts which must be removed after use shall be accommodated in the cabinets. Spanners and other maintenance equipment provided under the Contract shall not be used for the purpose of erection of the Contract Works. Any special devices, slings or tackle necessary for the complete overhaul of the plant shall be handed over to CENTLEC in working order on completion of the Contract.

Before delivery of any or all these tools to CENTLEC, invoices shall be presented, and a signature obtained from the Engineer or CENTLEC's representative. Any tools not signed for shall be deemed not to have been delivered.

5.4.2.16.7 SLINGS, EYE BOLTS AND LIFTING TACKLE

All slings, eye bolts and other lifting tackle provided shall be proof tested to twice the safe working load and suitably marked with embossed labels to clearly show the safe working loads.

5.4.2.16.8 SUPERVISION AND CHECKING OF WORK ON SITE

The carrying out of all work on Site included in the Contract shall be supervised throughout by enough qualified representatives of the appointed service provider.

The appointed service provider is responsible for the cold commissioning of the installed unit(s) and that all the wiring of all items are wired to the kiosk. The appointed service provider shall not be relieved from the liability to complete the Contract Works in accordance with the Contract or exonerate him from any of his guarantees.

The appointed service provider shall be deemed to have allowed for working such hours per week at the Site as are consistent with completing the Contract Works in the time specified whilst maintaining working conditions for his personnel on a level comparable with that for other kindred classes of work being carried out on the Site.
All work permits must be signed and signed off after completion of the contract works.

5.4.3 INSPECTION AND TESTS

The plant and equipment are subject to inspection and testing by CENTLEC during the course and on completion of manufacture and erection to ensure compliance with this Specification and to provide the necessary operating data. Each transformer, including all its components and accessories shall be fully tested in accordance with the latest SANS and IEC specifications and standards.

The service provider or his Sub-Contractor shall supply to CENTLEC, as soon as practicable after works tests, site tests and commissioning have been witnessed, three (3) x copies and a soft copy (dgn file) of the relevant test certificates which shall contain details of each test performed and shall be prepared as required by CENTLEC; records, results and calculations of all electrical tests shall be provided. After that the service provider shall submit the small cabling drawings and all wiring diagrams.

After the plant has passed the site tests required under this Contract, and he became available for commercial operation, certain additional tests may be carried out to investigate the response and recovery of the system during events such as the switching of various items of plant, system faults and load rejection.

Routine, type and special tests shall be carried out in accordance with IEC 76. The tapping connection to be used for the impulse tests shall be the one on which the highest voltage stresses occur. Verification of the correct choice of tapping shall be provided. Impulse tests shall be applied by direct application to each line terminal in turn except where, by agreement with Centlec, the transferred surge method of test may be adopted for tests on lower voltage windings.

5.4.4 SURGE ARRESTORS

Tests on Surge Arrestors: Routine, Manufacturer's control, and standard acceptance tests in accordance with the latest revision of IEC Publication 99-1 shall

be conducted on each arrestor assembly.
Tests on Surge Counters: The rated minimum operating current stated in the Schedules shall be passed through the surge counter ten times and operation shall be registered on each occasion. The surge counter shall correctly register and withstand the current waves as specified in BS 2914 Clause 14(c) at twice the rated arrestor current. The peak voltage across the counter during this test shall not exceed the value stated in the Schedules.

5.4.5 OTHER TESTS

After the plant and auxiliary equipment have been erected and connected on site, the Contractor shall carry out to prove compliance with the Specification, independently of any tests carried out at the manufacturer's works. (Cold Commissioning)
CENTLEC shall have the right to witness all tests, and the results must be available to him as the tests proceed.
Clear records of all tests necessary before the plant can be regarded as ready to be first connected to the CENTLEC network shall be maintained by the Contractor and submitted to the Engineer in triplicate.
The Contractor shall submit to the Engineer for approval a list of recommended settings for all protection and other types of automatic equipment. Where the settings involve discrimination with settings of an existing network the relevant information will be supplied to CENTLEC.

5.4.6 EARTHING AND AUXILIARY TRANSFORMERS

The following tests shall be conducted in accordance with the requirements of BS 171 as detailed in Schedule F A.1, as follows: The transformer shall be connected to the main earth grid of the substation.

a) Routine tests: (a), (b), (e), (f), (g), (j), (1) and BS 171 Clause 38
b) Type Tests: (q)
c) Short Circuit :
d) Tests: The test shall be conducted at a current equal to the 10 second rated current prior to carrying out test (j)

5.4.7 TECHNICAL SPECS SCHEDULE DETAIL TECHNICAL SPECIFICATION GENERAL

The Detail Technical Specification (The Schedules) should be read in conjunction with the General Technical Specifications, the Project Information and the contract drawings. In case of any contradiction between the said specifications, instructions as given in the Detail Specification must be adhered to. Any discrepancy between the contract drawings and the documents must be brought to the attention of the Engineer,

who will resolve the matter in writing. All the offered equipment shall comply with the relevant tests.

5.4.8 FACTORY INSPECTION AND TESTS

The bidder shall allow in his rates in the schedule of prices for the following:

5.4.8.1 3 x Copies of operation and maintenance manuals per transformer

5.4.8.2 All cost for at least four (4) delegates of CENTLEC to witness the routine tests conducted on complete assembled transformer(s). (FAT). These should include return airfare costs from Bloemfontein airport to the airport closest to factory, vehicle transport from airport to place of test, accommodation, subsistence costs and other related costs as identified by the services provider. This will be the cost to the service provider for each order under the duration of the contract.

5.4.8.3 The contractor must allow at his own discretion for all cost involved for additional factory inspections due to the following matters:

5.4.8.3.1 Transformer failed the routine tests.

5.4.8.3.2 The transformer(s) does not comply with specification as per a fault list issued by Centlec and requires further inspection(s) before the unit(s) leave the factory.

5.4.9 TEST TRANSFORMERS

a) Insulation resistance of core and windings.
b) Dielectric strength of oil samples.
c) Ratio and no-load current at low voltage (e.g., 400V) on all tapping's.
d) Vector relation check.
e) Calibration checks of temperature instruments, including secondary current injection and providing contact settings.
f) Air injection tests of gas/oil-actuated relays
g) Setting check of oil-level, oil-flow and water-flow
h) Complete functional tests of cooling equipment and tap change equipment, including manual/automatic sequences, indications, alarms and interlocks, measurement of motor current, adoption of suitable motor protection settings and proof of protection operation for stalled or single phasing conditions.
i) Operation tests of 'Silica gel' type breathers (size related to amount of oil in transformer)
j) Insulation resistance of all secondary circuits.
k) Final checks before energizing:
l) Venting, position and locking of valves, earthing of star-point(s) and of tank, state of breathers and of pressure-relief devices, oil levels, absence of oil leakage, operation of kiosk heaters, tap-change counter readings, resetting of maximum temperature indicators, final proving of alarms and trips.
m) Tests when energized:
n) On-load tap changer operation throughout range (subject no exceeding 1.1 pu volts on any windings).

o) Maintenance of 1.1 pu volts on untapped windings for 15 minutes (but no exceeding this value on tapped winding).
p) Test on load:
q) Temperature instrument readings
r) Measurements of WTI CT secondary current

5.4.10 GENERAL PARTICULARS OF WORK

Table 2: GENERAL PARTICULARS OF WORK

ITEM	DESCRIPTION	PARTICULARS
1.	Relay Panels	N/A
2.	Multicore cables (supply, trenching and laying)	N/A
3.	Facilities for Tele control / Supervisory	Yes
4.	Led Lamps in all kiosks (15 Watt) on when doors open/off when doors close	Yes
5.	Anti-condensation heaters	Yes
6.	Locks/padlocks to be provided	Yes (Padlocks by CENTLEC)
7.	Special requirements, refer IEC 56 and IEC 29 Wind pressure kPA Seismic	760kPA in the case of Bloemfontein/Free State area (to be checked and confirmed) None
8.	Maintenance equipment	N/A please submit a detailed maintenance manual.
9.	Spares	Please complete the spare list and add if there are any omissions on spares. (Compulsory)
10.	Quality Assurance Programme required	Yes
11.	Construction electricity power supply	Yes. Must be supplied by contractor 3 Phase generator.
12.	Construction water supply provided on site by CENTLEC (Subject to reasonable use)	Yes

ITEM	DESCRIPTION	PARTICULARS
13.	Programme Access to site Contract complete	1) Access permit will be issued by CENTLEC on site. 2) Permits must be signed on site. 3) The contractor must barricade the working area off with orange netting. 4) Take over forms must be completed on site. 5) During the project the contractor will issue a progress report that will indicate the status of the project weekly.

5.4.11 CLIMATOLOGICAL DATA

Table 3: CLIMATOLOGICAL DATA

ITEM	DESCRIPTION	PARTICULARS
1.	Outdoor temperatures: (^{0}C)	(^{0}C)
	i) Annual mean	17
	ii) Maximum	40
	iii) Minimum	-10
	iv) Highest mean monthly diurnal range	17

ITEM	DESCRIPTION	PARTICULARS
2.	Wind: • Prevailing wind bearing • Maximum gust speed (recorded m/s) • Maximum expected gust speeds: • 25-year return period m/s • 50-year return period m/s	 Northerly 42 45,5 49,3
3.	Maximum solar radiation kW/m²	1,12
4.	Pollution	Dust storms
5.	Thunderstorm activity: 1. Isocyanic level (thunderstorm days) 2. Lightning ground flash density No/km²/annum	 65 4,9
6.	Mean annual rainfall: • July - September mm • December - February mm	 33 230
7.	Average relative humidity: • 08h00 % • 14h00 %	 64 33

5.4.12 MANUFACTURERS

5.4.12.1 TESTING AND INSPECTION

Table 4:Information to be supplied with Tender.

ITEM	DESCRIPTION	MANUFACTURER	LOCATION OF TESTING AND INSPECTION
1.	Main Transformers		
2.	NER		

ITEM	DESCRIPTION	MANUFACTURER	LOCATION OF TESTING AND INSPECTION
3.	NERCT 200kVA		
4.	Core Plates		
5.	Tanks		
6.	Radiators		
7.	Bushing: HV Bushing: LV Bushing: HV Neutral Bushing: LV Neutral		
8.	Current Transformers		
9.	Porcelain for Insulators: HV Polymer (silicone rubber): HV Porcelain for Insulators: LV Polymer (silicone rubber): LV		
10.	On-load Tap Changers (side fitted)		
11.	Marshalling Kiosk		
12.	Voltage Control Panel	N/A	N/A
13.	Temperature Indicators		
14.	Oil		
15.	Oil Valves		
16.	Oil Coolers		
17.	Air Blowers		
18.	Fan Motors		
19.	Motor Control Gear		
20.	Alarm Devices		
21.	Gas and Oil Actuated Relays		
22.	Tank Over pressure Device		
23.	Surge Arrestors (Primary side)		
24.	Surge Arrestors (Secondary side)		

SCHEDULE D-1

5.4.13 GENERAL REQUIREMENTS

Table 5: GENERAL REQUIREMENTS

ITEM	DESCRIPTION	UNITS	132kV SYSTEM Voltage	33kV SYSTEM Voltage	11kV SYSTEM Voltage
1.	System voltage: • Nominal • Maximum	 kV kV	 132 145	 33 36	 11 12
2.	System fault levels	kA	20	20	20
3.	Short time rating	Sec	3	3	3
4.	Frequency	HZ	50	50	50
5.	Phase rotation. 1. A-Red Phase 2. B-Yellow Phase 3. C-Blue Phase		Nonstandard	Nonstandard	Nonstandard
6.	Method of earthing		Effective	Effective	Non-Effective (600/300 A NER) (200kVA 600/300A NECRT)
7.	Minimum Withstand Insulation Impulse Level (At Sea Level)	kV Crest	550	200	95
8.	Dry and wet power frequency voltage	kV min	230	70	28
9.	Critical corona voltage	kV		100	100
10.	Noise level for radio interference voltage test measured at 110 per cent of line to ground operating voltage at 1 000 kHZ.	uV	<2500	< 2 500	<2 500

ITEM	DESCRIPTION	UNITS	132kV SYSTEM Voltage	33kV SYSTEM Voltage	11kV SYSTEM Voltage
11.	Pollution design				
	a) Moderate polluted atmosphere (creepage of 16 mm per kV Um)	mm	N/A	N/A	N/A
	b) Moderate polluted atmosphere (creepage of 20 mm per kV Um)	mm	N/A	N/A	N/A
	Heavily polluted atmosphere (creepage of 25 mm per kV Um)	mm	Yes (3625 mm)	Yes (900 mm)	Yes (300 mm)

SCHEDULE D-2

5.4.14 INFORMATION TO BIDDERS AND SPECIFICATIONS THAT EQUIPMENT MUST COMPLY THREE PHASE POWER TRANSFORMERS

Table 6: INFORMATION TO BIDDERS AND SPECIFICATIONS THAT EQUIPMENT MUST COMPLY THREE PHASE POWER TRANSFORMERS

ITEM	DESCRIPTION	DETAIL
1.	Quantity required	As per “Ad Hoc” order
2.	1. Type of cooling* 2. Alternative design and offer	100% CMR ONAN Forced cooling for 10% overload. ONAF
3.	Primary line voltage	132 kV and 33 kV Normal 132 kV and 36 kV Maximum
4.	Secondary voltage	11 kV Normal and 12 kV Max 2.2kV Normal and 2.5kV Max

ITEM	DESCRIPTION	DETAIL
5.	Fault level of system at transformers operated in parallel. 1. Symmetrical RMS current (3 sec) 2. Asymmetrical peak factor	 Primary: 21 kA Secondary: 18 kA
6.	Transformer earthing: 1. 132kV - Side 2. 33 kV - Side 3. 11 kV – Side 4. 2.2kV - Side	 1. Effective (solid) 2.Effective NER/NECRT 3.Effective_(600/300A, NER/NECRT) 4.Effective (solid)NER
7.	11 kV Earth fault current	600/300 AMP
8.	Impulse withstand voltage: 1. Windings: 132 kV windings 33 kV windings 11 kV & 2.2kV windings 2. Bushings 132kV 33 kV 11 kV & 2.2kV	 550 kV peak 200 kV peak 95 kV peak 550 kV peak 200 kV peak 95 kV peak
9.	Wet and dry withstand level at power frequency voltage: 3. Windings: 132 kV windings 33 kV windings 11 kV & 2.2kV windings 4. Bushings 132 kV 33 kV 11 kV & 2.2kV	 230kV 70 kV 28 kV 230 kV 70 kV peak 28 kV peak
10.	33/11kV Impedance (@ 75 Deg C°)) 132/11kV Impedance (@ 75 Deg C°) 33/2.2kV Impedance (@ 75 Deg C°)	10 MVA: 13% Minimum on any tap. 20MVA All sizes of transformers as indicate 30MVA

ITEM	DESCRIPTION	DETAIL
11.	Windings: a) insulation; HV LV b) Winding connection: 132kV 33kV 11kV 2.2kV c) Vector group and neutral designation d) Tapped winding (HV Neutral) e) Type of tap changer	 Fully insulated Fully insulated Star or Delta Delta Star or Delta Star YNyn0 (132/11kV) YNd1 (132/11kV) YNd11 (132/11kV) DYn11 (132/11kV) YNd11 (132/33kV) Dyn1 (33/11kV) Dyn11 (33/2.2kV) Optional OLTC / Vacuum
12.	On-load tap changer: 1. Steps 2. Number of steps 3. Minimum Voltage ratio (132kV) (33kV) 4. Maximum Voltage ratio (132kV) (33kV) The tap changer must be able to operate as follows: 5. Individual (Hand and Auto) 6. Automatic and in parallel with each other 7. Remote control	 In 1.25 % steps Total of 17 positions 120 000 V to 11000 V (-10%) 29 700 V to 11 000 V (-10 %) 145000V to 11000 V (+5%) 36 300 V to 11 000 V (+10%) Yes Yes Yes
13.	Must transformer and accessories be filled with oil	Yes – 80kV tested
14.	Transformer marshalling kiosk: Transformer mounted	Transformer mounted

ITEM	DESCRIPTION	DETAIL
15.	Pressure relief valve installed	Yes
16.	Type of breather	Silica Gel (size equivalent to volume of oil in transformer.)
17.	Supply voltage for transformer accessories	230/400 +/- 10% RMS AC
18.	Final paint finish: Transformer Conservator Tap changer control panel kiosk	 SANS 1091 - G12 (Dark Grey) SANS 1091 - W (White) SANS 1091 -G54 (Dark Grey)
19.	Current transformers required as per schedule	Yes
20.	Surge arrestors required on 33 kV side of transformer	Yes (10 kA Station Class)
21.	Mounting of transformer 21.1 Distribution Centre 21.2 Optional Transformers	 On concrete plinth with suitable pitch under-base in open air On concrete plinth with suitable pitch under-base in open air
22.	Optional tests The cost of the following test shall be shown separately in the Schedule of prices. a) Temperature - rise test on one unit b) Impulse test c) Acoustic noise level measurement d) Overload test	 Yes Yes Yes Yes
23.	Accessories required	1. Rating plate 2. Diagram Plate 3. Drain Valves 4. Earthing terminals (LT) 5. x Earthing Terminals (HT Tank) 6. Dehydrating breather (Silica Gel) 7. Pressure Relief Valve 8. Oil Temperature thermometer 9. Winding temperature thermometer including CT. 10. Gas and oil relay – transformer, Buchholz 11. Gas and oil relay - tap changer, Buchholz.

ITEM	DESCRIPTION	DETAIL
24.	Main offer	Transformer with conventional bushing (132kV with test point) mounted onto transformer top plate.
25.	Special Tools, Handles, Maintenance Manuals and All the wiring diagrams.	Must be provided with transformer on site. The manuals and drawings must be 3 x copies.
26.	Optional offer	Transformer with conventional bushing (132kV with test point) mounted onto transformer top plate.

SCHEDULE D-3

5.4.15 POWER TRANSFORMERS: OPERATION, CONTROL, IDENTIFICATION AND ALARM CIRCUITS

Table 7: POWER TRANSFORMERS: OPERATION, CONTROL, IDENTIFICATION AND ALARM CIRCUITS

ITEM	DESCRIPTION	FUNCTION	SUPPLY/ CONTROL VOLTAGE	WHERE REQUIRED	TO BE SUPPLIED BY BIDDER
1.	Relay for gas and/or oil activated	a) Alarm b) Trip	110 V DC	HT & LT	Yes
2.	Winding temperature	a) Alarm b) Trip c) Cooler control d) Indication on transformer	110 V DC	On LT	Yes
3.	Oil Temperature	a) Alarm b) Trip c) Indication on transformer	110 V DC		Yes
4.	Fan Fail	a) Alarm	110 V DC		Yes

ITEM	DESCRIPTION	FUNCTION	SUPPLY/ CONTROL VOLTAGE	WHERE REQUIRED	TO BE SUPPLIED BY BIDDER
5.	Tap changer equipment.				
	1. Tap position with corresponding voltage ratio.	a) Indication	110 V DC		Yes
	2. Power supply fail	a) Indication b) Alarm	110 V DC		Yes
	3. Tap changer fail.	a) Indication b) Alarm	110 V DC		Yes
	4. Tap changer in process.	a) Indication b) Alarm	110 V DC		Yes
	5. Tap changer out of step.	a) Indication b) Alarm	110 V DC		Yes
	6. Voltmeter	a) Indication	110 V DC		Yes
6.	Oil level	a) Indication b) Alarm	110 V DC		Yes
7.	Overpressure Valve **must be installed between the yellow and blue phases on the low voltage side.**	a. Trip	110 V DC		Yes

All trip-, alarm, and other indications must be extended to and visible on the tap change control panel. All alarms and trips of the transformer, tap changer, voltage control and cooling apparatus must be visible with a flag indication on the tap changer control panel. These contacts must be voltage free and suitable for computer control.

CENTLEC shall provide and install the cables from the marshalling kiosk to the tap change control panel.

SCHEDULE D-4-A

5.4.16 CURRENT TRANSFORMER SCHEDULE FOR 10 MVA TRANSFORMER

Table 8: CURRENT TRANSFORMER SCHEDULE FOR 10 MVA TRANSFORMER

ITEM	DESCRIPTION		POSITION OF CURRENT TRANSFORMER	NO	DESCRIPTION
1.	Detail of CT's in list		33 kV Transformer	11 kV	11 kV Neutral

	formation		bushing	Transformer bushing	bushing
2.			Terminal to winding	Terminal to winding	Terminal to winding
3.	Core 1				
4.	Primary current capacity	A		1 155	600
5.	Winding ratio	N		1 200/1	1200/1
6.	Min. Knee voltage	V		N/A	300
7.	Max. secondary resistance	OMH		N/A	5,5
8.	Max. Energizing current	mA		N/A	50
9.	Rating	VA		15	N/A
10.	Class			10P15	X
11.					
12.	Core 2				
13.	Primary current capacity	A		1 155	600
14.	Winding ratio	N		1 200/1	600/1
15.	Minimum knee voltage	V		N/A	N/A
16.	Maximum secondary resistance	OMH		N/A	N/A
17.	Maximum energizing current	mA		N/A	N/A
18.	Rating	VA		15	15
19.	Class			10P15	10P15

NOTE:

5.4.16.1 The current transformer for the winding temperature apparatus, etc. is not included in the above schedule. This detail should be supplied by the Bidder.

5.4.16.2 Test windings shall be provided for internal current transformers.

SHEDULE D-5

5.4.17 LIGHTNING ARRESTORS

Table 9: LIGHTNING ARRESTORS

ITEM	DESCRIPTION	PARTICULARS
1.	Arrestor current rating	10 000 amps
2.	Rated RMS voltage between phase and earth	36 kV/145 kV

ITEM	DESCRIPTION	PARTICULARS
3.	Rated system frequency	50 Hz
4.	Indoor or outdoor	Outdoor
5.	Condition of transformer star point (Secondary side)	Earthed NER
6.	Whether there are any special operating conditions such as exposure to fumes, dust, salt, spray, excessive humidity, vibration, wind high, altitude or excessive temperature range	Dust and high temperature
7.	Highest system voltage between phases	36 kV/145kV
8.	Type of mounting	Pedestal - Mounted on transformer
9.	Feeder cable length	7 km
10.	Class of arrestor	Station Type to ANSI, or to IEC equivalent
11.	Level of over voltage developed (over voltage factor)	3,0
12.	Minimum rated voltage of arrestor SiC type. ZnO Type.	 N/A 36 kV/145kV
13.	Maximum radio influence voltage	2 500 uV
14.	Minimum corona existing voltage	25 kV RMS
15.	Minimum creepage insulation (RMS phase-phase)	25 mm/kV
16.	Rating of earth connections	12.5/3 kA/S/21/3 kA/S

SCHEDULE D-6

5.4.18 COLOUR CODE FOR CONTROL AND INSTRUMENT WIRING

Table 10: COLOUR CODE FOR CONTROL AND INSTRUMENT WIRING

Red White Blue	Phase Connection, whether earthed or unearthed, either directly connected to the primary circuits of CT'S and VT'S
Green	Neutral connections, whether earthed or unearthed insulated earthed wires

Black	Connections in AC circuits other than CT and VT circuits and connections in AC/DC circuits
Grey	All DC circuits

Solid state and electronic equipment:

Required voltage withstand levels for input/output and power supply circuits:

For protection relays: 5 kV impulse to BEMA 219 and 220 VAC for one minute

Other than protection relays: 2 kV impulse to BEMA 219 and 220 VAC for one minute

If approved, the power frequency voltage withstand capability may be achieved by initiating of a protective device requiring resetting or replacement to re-establish the original equipment performance.

5.5 SPECIFICATION FOR DRY RESIN TYPE POWER TRANSFORMERS (5MVA to 10MVA)

5.5.1 SPECIFICATION FOR POWER TRANSFORMERS.

Table 11: SPECIFICATION FOR DRY RESIN TYPE POWER TRANSFORMERS

TECHNICAL SPECIFICATION FOR DRY TYPE POWER TRANSFORMERS			
ITEM	**DESCRIPTION**	**UNIT**	**RANGE**
A.	**General**		
1.	Manufacturer		
2.	South African Standard		IEC600076-11
3.	International standard		IEC600076-11
4.	Type		Cast Resin Type Power Transformer
5.	Installation		**Indoor (IP00)**
6.	Max Ambient temperature		-5 to 40°C
7.	Altitude	m.a.s.l	<1800 m
8.	Nominal power	kVA	10 000 / 12 000
9.	Primary Voltage	kV	33
10.	Secondary Voltage	kV	11
11.	Rated Frequency	Hz	50
12.	Cooling system		AN/AF (Air Natural / Air Forced)
13.	Number of windings per leg		2
14.	Number of phases		3
15.	Tap changer		ON-load Vacuum
16.	Tap range		+/- 2.5 % & +/- 5%
17.	Insulation Class		Class F - 155°C
18.	No-load losses	kW	+/- 18.700
19.	Load Losses	kW	+/- 72.500
20.	Impedance	%	+/- 10.00
B.	**Basic Insulation Level**		
1.	Primary	kV	170
2.	Secondary	kV	75

TECHNICAL SPECIFICATION FOR DRY TYPE POWER TRANSFORMERS			
ITEM	**DESCRIPTION**	**UNIT**	**RANGE**
C.	**Power Frequency Withstand Voltages**		
1.	Primary	kV	70
2.	Secondary	kV	28
3.	Vector Group		DyN11
4.	Core Material		Grain oriented silicon steel
5.	Transformer Construction		Cast Resin Glass Fibre reinforced with Epoxy Resin
6.	Temperature Rise	K	100
7.	Noise Level	dB	+/- 76
D.	**TRANSFORMER DIMENSIONS INCLUDING ALL FITTINGS AND WEIGHT**		
1.			Please indicate the dimensions
2.	Length	mm	
3.	Width	mm	
4.	Height	mm	
5.	Weight	kg	
E.	**ACCESSORIES**		
1.	Temperature Controller Relay	Yes/No	Yes
2.	3 x Winding PT 100's	Yes/No	Yes
3.	Cooling Cylinder Fans	Yes/No	Yes
4.	Anti-Vibration Clamps	Yes/No	Yes
5.	IP31 Enclosure	Yes/No	Yes / Optional (Only needed where not in an enclosed compartment)
6.	Stainless Steel Rating Plates	Yes/No	Yes
7.	HT Lightning arrestors all three phases	Yes/No	Yes
8.	LT Lightning arrestors all three phases	Yes/No	Yes
F.	**ROUTINE TESTS**		
1.	Measurement of Insulation Resistance	Yes/No	Yes
2.	Voltages Ratio Measurement and Vector Group Verification Test.	Yes/No	Yes
3.	No-Load Loss test and conformation of No-Load Current.	Yes/No	Yes
4.	Measurement of DC Winding Resistance	Yes/No	Yes
5.	Load Loss test and Conformation of Impedance Voltage	Yes/No	Yes
6.	Induced Voltage Withstand Test	Yes/No	Yes
7.	Separate – Source Power – Frequency Voltage Withstand Test	Yes/No	Yes

TECHNICAL SPECIFICATION FOR DRY TYPE POWER TRANSFORMERS			
ITEM	**DESCRIPTION**	**UNIT**	**RANGE**
8.	Partial Discharge test	Yes/No	Yes

5.5.2 LABELS AND PLATES

Table 12: LABELS AND PLATES

ITEM	DEVICE	LANGUAGES OF INSCRIPTION	COLOURS	PLATE DIMENSIONS mm	LETTER HEIGHT mm	STROKE WIDTH mm
1.	**OUTDOOR** • Circuit/Busbar • Phase identification • Yard gear, items • Kiosks, junction boxes	English English English English	Black on orange Red / Yellow/ Blue White on black Black on white	200 high 100 diameters As required. As required	150 80 70 15	15 10 10 2
2.	**INDOOR** 1. GIS 2. Equipment labels 3. Panel labels 4. Panel equipment labels	English English English English	Black on orange Black on orange White on Green Black on white	As required. Yes Yes Yes	As required. 15 25 5	As required. 2 3 1
3.	**DANGER, CAUTION**	English, Sesotho, and Afrikaans	Black on Yellow	As required	25	3

SCHEDULE D-8

5.5.3 CLEARANCES FOR OUTDOOR BUSBARS AND CONNECTIONS

Table13: CLEARANCES FOR OUTDOOR BUSBARS AND CONNECTIONS

		RATED SYSTEM VOLTAGE kV										
Item No.	Rated Voltage kV	12 and below	24	36	72	100	123	145	245	300	362	420
1.	Minimum clearance between live metal and earth in meters	0,20	0.30	0,38	0,70	1,00	1,15	1,30	2,00	2,40	2,80	3,36
2.	Minimum clearance between live metal of different phases in meters	0,25	0,34	0,43	0,82	1,16	1,22	1,50	2,30	2,80	3,40	3,90
3.	Minimum safety clearance between live metal and positions to which access is permissible with other equipment alive in meters	2,60	2,80	2,90	3,00	3,50	3,60	3,80	4,50	4,80	5,30	5,5
4.	Minimum clearance from ground level to base of insulation		2,5 not voltages									

Note:

1. Clearance applies to all equipment.
2. They apply to conditions of maximum conductor swing and sag.

SCHEDULE D-9

5.5.4 EARTH CONDUCTOR SIZES

Table 14: EARTH CONDUCTOR SIZES

RATED SHORT CIRCUIT CURRENT kA	**8,0**	**10,0**	**12,5**	**16,0**	**20**	**25**	**31,5**	**40,0**
Minimum cross section area for a conductor required to carry full fault current.								
3 s rating mm²	61	76	95	122	153	191	241	306
1 s rating mm²	35	44	55	71	88	110	139	176
Minimum cross-sectional area for a conductor in a mesh system								
3 s rating mm²	40	51	63	81	102	127	160	204
1 s rating mm²	23	29	36	47	58	73	92	117

SCHEDULE E-1

5.5.5 MANUFACTURER TECHNICAL PARTICULARS AND GUARANTEES
(INFORMATION TO BE SUPPLIED AND SUBMITTED BY THE BIDDER)

Please complete and submit the following information for each type of transformer on the pricing schedule. (Compulsory) Utilise blank spaces where the latest data exists.

Note: Please duplicate Table 15 to indicate required performance data for all transformers listed in the Scope of work, point 3.2. The tables must be added as an annexure to the BID Document.

Table 15: Please complete and submit the following information for each type of transformer on the pricing schedule.

Item	**REQUIRED PERFORMANCE DATA**	**5 MVA**
1.	Continuous rating in MVA of windings on any tapping with maximum cooling in service HV MVA LV MVA	

Item	REQUIRED PERFORMANCE DATA	5 MVA
2.	Continuous rating in MVA of windings on any tapping with ONAN cooling HV MVA LV MVA	
3.	Maximum current density in windings in A/mm² HV A/mm² LV A/mm²	
4.	Short-circuit current that transformers are designed to withstand, in per unit of rated current. HV p.u. LV p.u.	
5.	No-load loss on principal tapping in kW at 0.90 Ut kW at 1.00 Ut kW at 1.10 Ut kW	
6.	Maximum flux density at rate frequency for any voltage ratio specified	
7.	Magnetising current, at rated frequency, on principal tapping, in percent of rated current at maximum HV rating at 0.90 Ut % at 1.00 Ut % at 1.10 Ut %	
8.	Load loss (I^2R + stray) at 75°C and at maximum rating in kW a) On principal tapping kW b) On extreme plus tapping kW c) On extreme minus tapping kW	
9.	**Fans** in kW kW in A, at rated voltage A	
10.	**Oil pumps** in kW kW in A, at rated voltage A	
11.	Ohmic impedance at 75°C and rated frequency based on maximum rated power of HV winding in percent. a) On principal tapping % b) On extreme plus tapping % c) On extreme minus tapping %	
12.	Tolerances applicable to required impedance, in percent of values. a) on principal tapping Max % b) On extreme plus tapping Min% c) On extreme minus tapping %	

Item	REQUIRED PERFORMANCE DATA	5 MVA
13.	Temperature rises at 1800 m in °C a) Top oil °C b) Windings (by resistance) °C	
14.	Percentage of total losses that will be supplied for a temperature rise test. %	
15.	Maximum acoustic noise, in dB(A) dB(A)	
Part B REQUIRED MINIMUM INSULATION		
1.	**Windings**	
2.	Impulse withstand test voltage (1.2/50 microsecond full wave) in kV crest HV kV peak LV kV peak	
3.	Sixty second, separate source, withstand test voltage to earth, in kV rms HV kV rms LV kV rms	
4.	Induced voltage withstand test between line terminals and, for graded insulation only, between each line terminal and the core, frame and tank connected together and to earth, in kV rms	
5.	Between line terminals and earth HV kV rms LV kV rms	
6.	Between line terminals HV kV rms LV kV rms	
7.	Test frequency Hz	
8.	Test duration SEC	
Part C	**Main terminal bushings**	
1.	Impulse withstand test voltage at sea level, (1,2/50 microsecond full wave) in kV crest HV kV peak LV kV peak HV Neutral kV peak	
2.	Sixty-second, power frequency, wet withstand test voltage at sea level, in kV rms HV kV rms LV kV rms HV Neutral kV rms	

Item	REQUIRED PERFORMANCE DATA	5 MVA
3.	Total creepage distance in mm HV mm LV mm HV Neutral mm	
4.	Protected creepage distance in mm (90° rain) HV mm LV mm HV Neutral mm	
Part D	**GENERAL INFORMATION**	
	Transformer	
1.	Manufacturer	
2.	Type of transformer (core or shell)	
3.	Number of limbs	
4.	Type of cooling (to IEC 76)- see typical load profiles included under Section 4	
	Oil quantities in litres:	
1.	Transformer tank litre	
2.	Coolers and conservator litre	
3.	Tap changer litre	
	Masses in kg:	
1.	Core and windings kg	
2.	Core steel kg	
3.	Winding copper (insulation excluded) kg	
4.	Tank and fittings kg	
5.	Coolers kg	
6.	Oil kg	
7.	Total kg	
8.	Largest transportation mass (excl. Oil) kg	
9.	Filling medium of transport	
	Overall dimensions in mm:	
1.	Complete unit height mm length mm breadth mm	

Item	REQUIRED PERFORMANCE DATA	5 MVA
2.	Tank only (if separate cooler bank) height mm length mm breadth mm	
3.	Height over HV bushings mm	
4.	Wheel gauge mm	
5.	Distance between axles mm	
	Tank and cooler material thickness in mm	
1.	Sides mm	
2.	Bottom mm	
3.	Top mm	
4.	Conservator mm	
5.	Cooler tubes mm	
6.	Pressed-sheet radiators mm	
7.	Safe withstand vacuum at sea level, absolute internal pressure in kPa of transformer, including tank and cooling apparatus, bushings, conservator and tap changer, including barrier boards kPa	
	Bushings Type (e.g., make and reference number or voltage/current rating) HV LV HV Neutral	
	Motors (forced cooling) Make Type	
	On-load tap changers	
1.	Manufacturer and type designation	
2.	State precise electrical location of tappings	
3.	Diagrammatic arrangement shown on Drawing number	
4.	Tapping range of HV/LV ratio in per unit of the ratio on the principal tapping Maximum p.u. Minimum p.u.	

Item	REQUIRED PERFORMANCE DATA	5 MVA
5.	Number of steps	
6.	Size of steps, in present %	
7.	Number of positions (including transition position)	
8.	Nominal voltage and current rating of tap changer in kV kV in A A	
	Nominal voltage and current rating of tap changer	
1.	Connectors Selector kV/A Selector switch kV/A Divertor switch kV/A	
2.	Resistor kV/A	
3.	Driving motor input in kW kW in A A	
4.	Type of driving motor, i.e., three phase split-phase	
5.	Tap changer over current protection: Have all requirements been met?	
	Contract Drawings The supply of design drawings is compulsory	
	Type Test Certificates Type test certificates shall be submitted with the tender for approval, otherwise it will be assumed that no type test certificates for identical units are available.	
	Indicating and Protective Devices Give the make, type and catalogue number for each of the following devices:	
1.	Winding temperature thermometer(s)	
2.	Oil temperature thermometer	
3.	Oil- and gas actuated relay	
4.	Pressure relief device	
5.	Tap changer protective device (detail)	
6.	Dehydrating breathers	
7.	Conservator	
8.	Oil level indicators	
9.	Current transformers Manufacturer Test Certificates	

5.6 12 kV SURGE ARRESTORS

Information to be supplied and submitted by Bidder (To be mounted onto transformer top plate, porcelain or composite silicon rubber type)

SCHEDULE E-2

Table 16: Information to be supplied and submitted by Bidder (To be mounted onto transformer top plate, porcelain or composite silicon rubber type)

ITEM	DESCRIPTION	PARTICULARS and Brand name
1.	Manufacturers' type and number	
2.	Gapped or gapless construction	
3.	Rated voltage of arrestor	
4.	Continuous operating voltage	
5.	Arrestor current rating	
6.	Indoor or outdoor	
7.	Type of mounting	
8.	Radio influence voltage measured at 0,635 Um at 1 MHz	
9.	Minimum dry power frequency spark over voltage of complete arrestor	
10.	Switching sure performance of complete arrestor Gaped construction Minimum spark over Maximum spark over Gapless construction Maximum residual voltage at 3 kA (30/60 microsec wave)	
11.	Impulse performance of complete arrestor (1,2/50 microsec wave) Gapped construction Minimum spark-over in kVP Maximum spark over in kVP	

ITEM	DESCRIPTION	PARTICULARS and Brand name
12.	Steep front performance of complete arrestor Gapped construction Maximum spark over on wave front Nominal steepness of wave front Gapless construction Maximum residual voltage at 10 kA (1/5 microsec wave)	
13.	Maximum residual voltage of complete arrestor with 8/20 microsec wave at: 5 kA 10 kA 20 kA 40 kA	
14.	Leakage current through complete arrestor At rated voltage At continuous operated voltage	
15.	Energy discharge capability of arrestor at rated voltage in one discharge kJ/kV of rated voltage IEC long duration discharge class	
16.	Class of arrestor station/intermediate/distribution	
17.	Total creepage distance across outer insulator shedding of complete diverter arrestor	
18.	Mass of each arrestor	
19.	Height of complete arrestor	
20.	Cantilever strength	

5.7 36 kV and 132kV SURGE ARRESTORS

(Information to be supplied and submitted by Bidder (To be mounted onto transformer top plate, porcelain or composite silicon rubber type)

Table 17:(Information to be supplied and submitted by Bidder (To be mounted onto transformer top plate, porcelain or composite silicon rubber type)

ITEM	DESCRIPTION	PARTICULARSand Brand name
1.	Manufacturers' type and number	
2.	Gapped or gapless construction	
3.	Rated voltage of arrestor	
4.	Continuous operating voltage	
5.	Arrestor current rating	
6.	Indoor or outdoor	
7.	Type of mounting	
8.	Radio influence voltage measured at 0,635 Um at 1 MHz	
9.	Minimum dry power frequency spark over voltage of complete arrestor	
10.	Switching sure performance of complete arrestor Gaped construction Minimum spark over Maximum spark over Gapless construction Maximum residual voltage at 3 kA (30/60 microsec wave)	
11.	Impulse performance of complete arrestor (1,2/50 microsec wave) Gapped construction Minimum spark-over in kVP Maximum spark over in kVP	
12.	Steep front performance of complete arrestor Gapped construction Maximum spark over on wave front Nominal steepness of wave front Gapless construction Maximum residual voltage at 10 kA (1/5 microsec wave)	

ITEM	DESCRIPTION	PARTICULARSand Brand name
13.	Maximum residual voltage of complete arrestor with 8/20 microsec wave at: 5 kA 10 kA 20 kA 40 kA	
14.	Leakage current through complete arrestor At rated voltage At continuous operated voltage	
15.	Energy discharge capability of arrestor at rated voltage in one discharge kJ/kV of rated voltage IEC long duration discharge class	
16.	Class of arrestor station/intermediate/distribution	
17.	Total creepage distance across outer insulator shedding of complete diverter arrestor	
18.	Mass of each arrestor	
19.	Height of complete arrestor	
20.	Cantilever strength	

5.8 PART G:-TECHNICAL SPECIFICATION – INSTALLATION WORKS FOR TRANSFORMERS. (Turnkey)

5.8.1.1 Works for installing new transformers:

5.8.1.1.1 Transport and installation of new transformer.
5.8.1.1.2 Recording must be done during transport.
5.8.1.1.3 Disconnecting, Dismantling removes old transformer and reassemble it. Prepare the plinth for the new transformer.
5.8.1.1.4 Install new transformer and test on plinth.
5.8.1.1.5 Re-install all small cabling.

5.8.1.1.6 Test all protection.
5.8.1.1.7 Cold commissioning and energization.
5.8.1.1.8 Take over forms completed and invoicing.
5.8.1.1.9 Ensure that all areas are cleaned and that all chippings is backfilled.

5.8.1.2 Submit all the following test results:

5.8.1.2.1 Transformer test results Testing of all transformer protection devices in co-operation with CENTLEC (SOC) Ltd.'s technicians. (DC Winding Resistance, Ratio, Current Transformers, SFRA test, Leakage Reactance, Excitation Current, Tan-delta (bushings and winding), Ancillary tests, Insulation Resistance tests and Buchholtz relay.)
5.8.1.2.2 Test the thermal protection and cooling system of the transformer.
5.8.1.2.3 Submit data of transport recorder.
5.8.1.2.4 Test the oil at an accredited laboratory. (Furan, Dissolved Gas Analyses, Acid, Di-electric strength, Corrosive Sulphur, Tan Delta and PCB tests) Oil will be filtered and cleaned on site or replaced with regenerated oil. The Tan Delta of the oil must comply with IEC 60422 specifications. (No PCB in oil is excepted) Oil must be **60KV** dielectric strength tested.
5.8.1.2.5 Submit all drawings, maintenance documentation and relevant equipment to the Project leader of CENTLEC.

6. 36kV NER's, NEC's and NECRT's (60kV dielectric tested oil or the air-cooled type with built-in cooling fans)

6.1 Designing NER's, NEC and NECRT's the following factors must be considered:

6.1.1 Rated voltage: 36kV
6.1.2 Connection Vector Group: Dyn 11
6.1.3 Rated kVA: 200
6.1.4 Rated Short Time Neutral Currents for 10s: 800A
6.1.5 Continuous rated current: According to manufactures specifications.
6.1.6 Rated current: maximum current that will flow through resistor when it is cold.
6.1.7 Duty rating or time rating: length of time the NER must tolerate rated current as per manufacturers specifications.
6.1.8 Short time current rating: 10 seconds.
6.1.9 Typically, 10A, the continuous current can be incorporated as 10% of the short time rated current. Normally 10% of full load current for healthy system neutral earthing resistor is designed for continuous rating of 5% to 10 % of full load current.

6.1.10 Insulation Level kV: 35 / 70 / 170.

6.1.11 Temperature rise: the maximum short time temperature rise for the resistive element is 450°C according to IEEE32.

6.2 Testing of **36kV NER's, NEC's and NECRT's**

6.2.1 Measurement of winding resistance (only applicable to the NEC and NECRT combinations)

6.2.2 Measurement of voltage ratio and verification of polarity

6.2.3 Short circuit withstand test (subject to limitations of SANS high current laboratory equipment)

6.2.4 Measurement of audio sound level

6.3 TECHNICAL SPECIFICATION

6.3.1 Indicate the connection symbol (only applicable to the auxiliary transformer in the NECRT).

6.3.2 Measurement of impedance voltage and load loss (only applicable to the NEC and NECRT combinations)

6.3.3 Measurement of no - load loss and no - load current (only applicable to the NEC and NECRT combinations)

6.3.4 Induced overvoltage withstand test.

6.3.5 Separate - source voltage withstand test.

6.3.6 Measurement of paint thickness

6.3.7 Test for effectiveness of sealing

6.3.8 Install overpressure valve: Type 80T, KpA 70 with a Tripping Facility.

6.3.9 Install a visible analogue temperature gauge with alarm and tripping capabilities.

6.3.10 Oil test 60kV dielectric strength and PCB free.

6.3.11 Air-cooled option force air cooling on alarm setting of temperature meter.(already wired in and in a kiosk).

6.3.12 Low voltage side 300A Circuit Breakers.

6.3.13 Current Transformers to be installed internally and wired to kiosk as follow:

6.3.13.1 Class x – 1200/1

6.3.13.2 5P10 – 150 / 1

6.4 RATING, SPECIFICATION AND DIMENSIONS. (Please supply your dimensions with you submissions).

6.4.1 Neutral Earthing Resistors (Combination Unit) (NECRT) System Voltage 36kV.

6.4.2 Neutral current rating and duration with a maximum voltage of 36kV Up to and including 960A for a duration of up to 30 seconds and 10A continuous rating or 10% of short time current rating (The standard is 10A).

6.4.3 Rated short time neutral current for 10s: 800A

Table 18: Designing NER's, NEC and NECRT's

Description	Length (mm)	Width (mm)	Height (mm)	Mass (kg)
NER				
NEC				
NECRT				

7. SPECIAL CONDITIONS

7.1 The successful bidder will be expected to enter into a Service Level Agreement with CENTLEC after receiving the appointment letter.

7.2 Any amendments to the legal and procedural content of this bid shall be addressed in the SLA and entered into agreement with CENTLEC and successful bidder(s).

7.3 Two weeks after receiving the appointment letter the successful bidder(s) must submit the health and Safety file to the SHERQ manager.

7.4 The appointed service providers utilized by the successful bidder must complete a Standard Operating Procedures Course at CENTLEC training Centre, and the passing grade will be 80% for the relevant modules related to this project.

7.5 Factory Acceptance Test for four (4) CENTLEC personnel must include transport (flight arrangements) and accommodation. This should be according to table 33 below.

7.6 All the equipment delivered must be accompanied with protection wiring diagrams, layout drawings, factory test results, special Tools, and maintenance manuals.

7.7 All the internal current transformer information will be indicated on the Transformer Nameplate. (UV Protected and Engraved)

7.8 The service provider will train CENTLEC personnel during the cold commissioning of the transformer(s) for the duration of this contract. For every order received the project will be "Turnkey" up till energization.

7.9 The service provider will submit a Health and Safety Risk Assessment for each site before commencement of installation on sites.

7.10 The appointed service provider will submit progress reports to the relevant manager for the duration of works on site, monthly or weekly progress reports as applicable.

7.11 All work will be done in accordance with the technical specification in this document.

7.12 The spares / parts on new equipment offered, pricing list must be completed (compulsory).

7.13 The IEC/BS/SANS(SABS) standards mentioned in the document should be adhered to. Alternatively, the most recent standards shall apply even to the pages where same is not specified next to the applicable standards.

7.14 Substation buildings shall be according to the National Building Regulations and Building Standards Act 103 of 1997 or latest publication.

7.15 The Bidder must submit all the Manufacturer Schedules and submit it. Spare list must be completed.

7.16 One complete set of as-built drawings in electronic format (Dgn or Dxf) will be submitted with the manuals.

7.17 No Taking over Certificate will be issued before all the manuals have not yet been received.

7.18 Must provide a commitment letter indicating the availability of a field service team that can install, transport and place transformers for the duration of this “turn-key” projects.

8. EVALUATION CRITERIA

All proposals submitted will be evaluated in accordance with the criteria set out in the policy of Supply Chain Management of the Entity. The most suitable candidate will then be selected. Please take note that CENTLEC is not bound to select any of the bidders’ submitting proposals. Furthermore, technical competence is the principal selection criteria, CENTLEC will evaluate the technical criteria first, and will only look at the price and specified goals if it is satisfied with the technical evaluation. As a result of this, CENTLEC does not bind itself in any way to select the bidder offering the lowest price.

8.1 The relative evaluation criteria are as follows:

Table 19: Evaluation Criteria

No.	Criteria	Description	Points
8.1.1	Track record and experience	Submit a minimum of two (2) reference letter(s), signed off by an Authorised official to confirm the successful completion of manufacturing, supplying, delivering, installation and commissioning of similar equipment to a local authority. Two (2) separate letters or one letter stating two successfully completed projects = **5 points.** Three (3) or more separate letters or one letter stating three (3) or more successfully completed projects = **10 points.**	10
8.1.2	Capability	The bidder(s) must provide proof of their ability to manufacture and install this equipment by submitting the following: Confirmation that all manufacturing of power transformers will be done in accordance with IEC 600076 = **20 Points**	20
8.1.3	Competency	The bidder must submit proof that their manufacturing facility complies to: 1. ISO 9001(quality management) = **10 Points** 2. ISO 14001(environmental impact) = **5 Points**	15
8.1.4	Guarantee After Hot Commissioning	Submit the applicable guarantee as required in this specification (Item 5.4.2.14) as follows: After hot commissioning 1. 12 – 18 Months = **5 points.** 2. Longer than 18 Months = **10 points**	10
8.1.5	Guarantee In storage after cold commissioning	Submit the applicable guarantee as required in this specification (Item 5.4.2.14) as follows: In storage after cold commissioning 1. 12 – 18 Months = **5 points.** 2. 19 – 24 Months = **10 points** 3. Longer than 24 months **= 15 points**	15
8.1.6	Local (RSA) Manufacturing Plant and Testing Facilities	Does the bidder have an established local facility with manufacturing and testing capability? (a) Existing and established local facility within RSA = **20 points**	20

No.	Criteria	Description	Points
		Bidder must submit pictures of the premises. The Bid Evaluation Committee has the right to verify the existence of premises before the allocation of points. (b) If not in RSA= **0 points**	
8.1.7	Local (Mangaung) operational capability and economic investment	Does the bidder have an established local office with operational capability? (a) Existing and established local office within Mangaung Metro Municipality = **10 points** **Bidder must submit pictures of the premises. The Bid Evaluation Committee has the right to verify the existence of premises before the allocation of points.** (b) If not in Mangaung, but within RSA = **5 points**	10
TOTAL			**100**

A bidder who gets a minimum of 70 points and above will qualify to the next stage. Individual tenders would have to be evaluated according to the preferential point system. The bidder must score minimum points as follows:

Item 8.1.1 – 5 points
Item 8.1.2 – 20 points
Item 8.1.3 – 10 points
Item 8.1.4 – 5 points
Item 8.1.5 – 5 points
Item 8.1.6 – 20 points
Item 8.1.7 - 5 points in the Evaluation Criteria

8.2 PRICE AND REFERENTIAL POINTS SCORING – STAGE 2 (Price and Specified Goals)

All Bidders that have passed the technical evaluation threshold of 70 points would also be scored based the 90/10 principle where 90 Points is for the Price and 10 points for Specified Goals as per the detail given below.

8.3 Points awarded for price.

A maximum of 90 Points is allocated for price on the following basis:

Where $Ps = 90[1 - \frac{\text{Pt} - \text{P min}}{\text{P min}}]$

Ps = Points Scored for comparative price of bid under consideration
Pt = Comparative Price of bid under consideration
P min = Comparative Price of lowest acceptable bid

8.4 Points awarded for Specific Goals Requirement

In terms of Regulation 3.(1) An organ of state must, in the tender documents, stipulate— (a) the applicable preference point system as envisaged in regulations 4, 5, 6 or 7; (b) the specific goal in the invitation to submit the tender for which a point may be awarded, and the number of points that will be awarded to each goal, and proof of the claim for such goals in accordance with the table below;

Table 20: Specified Goals for Preferential Point System

Specified Goals	**Points Allocation**
50% Black owned	6
50% Women owned	2
50% Youth owned <35 years	2
Total Points	**10**

9. PRICING SCHEDULES

9.1 Contract Price:

The contract price(s) shall preferably be a SEIFSA based price,

The contract price(s) shall be subject to negotiated increase.

Are the quoted prices firm for the full duration of the contract? Yes/No

If not, indicate CPA or SEIFSA price adjustment method: _____

CPA- Suppliers price list date: _____ or

SEIFSA indexes – Price basis month and year _____

9.2 PRICING SCHEDULE FOR POWER TRANSFORMERS

PRICE SCHEDULE FOR TRANSFORMERS EXCLUSIVE OF VAT. (The prices also include vacuum or transformer oil tap changers.)

Table 21: PRICE SCHEDULE FOR TRANSFORMERS EXCLUSIVE OF VAT

ITEM	DESCRIPTION	UNIT	Manufacturer	Transformer Price with vacuum Tap Changer per unit	Transformer Price with Oil Tap Changer per unit	Delivery Period
1.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAN porcelain bushings	Each				
2.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAN Composite silicon Insulators	Each				
3.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAF porcelain bushings	Each				
4.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAF Composite silicon Insulators	Each				
5.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAN porcelain bushings	Each				
6.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAN Composite silicon Insulators	Each				
7.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAF porcelain bushings	Each				

ITEM	DESCRIPTION	UNIT	Manufacturer	Transformer Price with vacuum Tap Changer per unit	Transformer Price with Oil Tap Changer per unit	Delivery Period
8.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAF Composite silicon Insulators	Each				
9.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAN porcelain bushings	Each				
10.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAN Composite silicon Insulators	Each				
11.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAF porcelain bushings	Each				
12.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAF Composite silicon Insulators	Each				
13.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAN porcelain bushings	Each				
14.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAN Composite silicon Insulators	Each				
15.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAF porcelain bushings	Each				
16.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAF Composite silicon Insulators	Each				

ITEM	DESCRIPTION	UNIT	Manufacturer	Transformer Price with vacuum Tap Changer per unit	Transformer Price with Oil Tap Changer per unit	Delivery Period
17.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAN porcelain bushings	Each				
18.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	Each				
19.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAN porcelain bushings	Each				
20.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAN Composite silicon Insulators	Each				
21.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAF porcelain bushings	Each				
22.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	Each				
23.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAF porcelain bushings	Each				
24.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAF Composite silicon Insulators	Each				
25.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAN porcelain bushings	Each				

ITEM	DESCRIPTION	UNIT	Manufacturer	Transformer Price with vacuum Tap Changer per unit	Transformer Price with Oil Tap Changer per unit	Delivery Period
26.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAN Composite silicon Insulators	Each				
27.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAF porcelain bushings	Each				
28.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAF Composite silicon Insulators	Each				
29.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAN porcelain bushings	Each				
30.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	Each				
31.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAN porcelain bushings	Each				
32.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	Each				
33.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAF porcelain bushings	Each				
34.	30MVA, 132/11kV Power	Each				

ITEM	DESCRIPTION	UNIT	Manufacturer	Transformer Price with vacuum Tap Changer per unit	Transformer Price with Oil Tap Changer per unit	Delivery Period
	Transformers. (Star/Star) ONAF Composite silicon Insulators					
35.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAF porcelain bushings	Each				
36.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	Each				
37.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAN porcelain bushings	Each				
38.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	Each				
39.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAN porcelain bushings	Each				
40.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	Each				
41.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAF porcelain bushings	Each				
42.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	Each				

ITEM	DESCRIPTION	UNIT	Manufacturer	Transformer Price with vacuum Tap Changer per unit	Transformer Price with Oil Tap Changer per unit	Delivery Period
43.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAF porcelain bushings	Each				
44.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	Each				
45.	80MVA,132/33 kV Power Transformers. (Star/Delta) ONAN porcelain bushings	Each				
46.	80MVA,132/33 kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	Each				
47.	80MVA, 132/33 kV Power Transformers. (Star/Delta) ONAF porcelain bushings	Each				
48.	80MVA, 132/33 kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	Each				
49.	90MVA,132/33 kV Power Transformers. (Star/Delta) ONAN porcelain bushings	Each				
50.	90MVA,132/33 kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	Each				

ITEM	DESCRIPTION	UNIT	Manufacturer	Transformer Price with vacuum Tap Changer per unit	Transformer Price with Oil Tap Changer per unit	Delivery Period
51.	90MVA, 132/33 kV Power Transformers. (Star/Delta) ONAF porcelain bushings	Each				
52.	90MVA, 132/33 kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	Each				
53.	5 MVA, Delta/Star, 33/11kV, Dry Type with vacuum Tap changer and Cooling ONAF	Each				
54.	10 MVA, Delta/star, 33/11kV, Dry type with vacuum tap changer and Cooling ONAF	Each				
55.	5MVA 33/2.2 kV power transformer (Delta/Star) Dry type with vacuum tap changer and Cooling ONAF	Each				
56.	10MVA 33/2.2 kV power transformer (Delta/Star) Dry type with vacuum tap changer and Cooling ONAF	Each				
57.	200kVA, 2.2kV/400V power transformer (Delta/star) hand tap changers .	Each				
58.	500kVA, 2.2kV/400V power transformer (Delta/star) hand tap changers	Each				

ITEM	DESCRIPTION	UNIT	Manufacturer	Transformer Price with vacuum Tap Changer per unit	Transformer Price with Oil Tap Changer per unit	Delivery Period
59.	800kVA, 2.2kV/400V Power transformers (Delta/Star) hand tap changers	Each				

9.3 Pricing Site establishment.

Table 22: Pricing Site establishment

ITEM	DESCRIPTION	UNIT OF MEASUREMENT	PRICE PER EACH IN RAND
1.	Site establishment per site, including security for the duration of project	Each	

9.4 PRICE SCHEDULE FOR INSTALLATION AND COMMISSIONING OF TRANSFORMERS, LIGHTNING ARRESTORS, NECRT'S OR NER'S ON SITE. (All cost for installation complete without the unit cost)

Table 23: PRICE SCHEDULE FOR INSTALLATION AND COMMISSIONING OF TRANSFORMERS, LIGHTNING ARRESTORS, NECRT'S OR NER'S ON SITE

ITEM	DESCRIPTION	UNIT OF MEASURE	TRANSPORT COST PER KM IN RANDS	PRICE PER EACH INSTALLATION IN RAND	LEAD TIME
1.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAN porcelain bushings	Each			
2.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAN Composite silicon Insulators	Each			
3.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAF porcelain bushings	Each			
4.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAF Composite silicon Insulators	Each			
5.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAN porcelain bushings	Each			
6.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAN Composite silicon Insulators	Each			
7.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAF porcelain bushings	Each			
8.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAF Composite silicon Insulators	Each			
9.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAN porcelain bushings	Each			

ITEM	DESCRIPTION	UNIT OF MEASURE	TRANSPORT COST PER KM IN RANDS	PRICE PER EACH INSTALLATION IN RAND	LEAD TIME
10.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAN Composite silicon Insulators	Each			
11.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAF porcelain bushings	Each			
12.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAF Composite silicon Insulators	Each			
13.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAN porcelain bushings	Each			
14.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAN Composite silicon Insulators	Each			
15.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAF porcelain bushings	Each			
16.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAF Composite silicon Insulators	Each			
17.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAN porcelain bushings	Each			
18.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	Each			
19.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAN porcelain bushings	Each			
20.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAN Composite silicon Insulators	Each			
21.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAF porcelain bushings	Each			

ITEM	DESCRIPTION	UNIT OF MEASURE	TRANSPORT COST PER KM IN RANDS	PRICE PER EACH INSTALLATION IN RAND	LEAD TIME
22.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	Each			
23.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAF porcelain bushings	Each			
24.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAF Composite silicon Insulators	Each			
25.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAN porcelain bushings	Each			
26.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAN Composite silicon Insulators	Each			
27.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAF porcelain bushings	Each			
28.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAF Composite silicon Insulators	Each			
29.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAN porcelain bushings	Each			
30.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	Each			
31.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAN porcelain bushings	Each			
32.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	Each			
33.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAF porcelain bushings	Each			
34.	30MVA, 132/11kV Power Transformers.	Each			

ITEM	DESCRIPTION	UNIT OF MEASURE	TRANSPORT COST PER KM IN RANDS	PRICE PER EACH INSTALLATION IN RAND	LEAD TIME
	(Star/Star) ONAF Composite silicon Insulators				
35.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAF porcelain bushings	Each			
36.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	Each			
37.	40 MVA,132/11kV Power Transformers. (Star/ Delta), ONAF, porcelain bushings	Each			
38.	40 MVA,132/11kV Power Transformers. (Star/ Delta), ONAF, Composite silicon Insulators	Each			
39.	40 MVA,132/11kV Power Transformers. (Star/ Delta), ONAN, porcelain bushings	Each			
40.	40 MVA,132/11kV Power Transformers. (Star/ Delta), ONAN, Composite silicon Insulators	Each			
41.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAN porcelain bushings	Each			
42.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	Each			
43.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAN porcelain bushings	Each			
44.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	Each			
45.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAF porcelain bushings	Each			
46.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	Each			
47.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAF porcelain bushings	Each			

ITEM	DESCRIPTION	UNIT OF MEASURE	TRANSPORT COST PER KM IN RANDS	PRICE PER EACH INSTALLATION IN RAND	LEAD TIME
48.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	Each			
49.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAN porcelain bushings	Each			
50.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	Each			
51.	80MVA,132/33 kV Power Transformers. (Star/Delta) ONAN porcelain bushings	Each			
52.	80MVA,132/33 kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	Each			
53.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAF porcelain bushings	Each			
54.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	Each			
55.	80MVA, 132/33 kV Power Transformers. (Star/Delta) ONAF porcelain bushings	Each			
56.	80MVA, 132/33 kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	Each			
57.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAN porcelain bushings	Each			
58.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	Each			
59.	80MVA,132/33 kV Power Transformers. (Star/Delta) ONAN porcelain bushings	Each			
60.	80MVA,132/33 kV Power Transformers. (Star/Delta) ONAN Composite silicon	Each			

ITEM	DESCRIPTION	UNIT OF MEASURE	TRANSPORT COST PER KM IN RANDS	PRICE PER EACH INSTALLATION IN RAND	LEAD TIME
	Insulators				
61.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAF porcelain bushings	Each			
62.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	Each			
63.	80MVA, 132/33 kV Power Transformers. (Star/Delta) ONAF porcelain bushings	Each			
64.	80MVA, 132/33 kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	Each			
65.	5MVA 33/2.2 kV power transformer (Delta/Star) Dry type with vacuum tap changer and Cooling ONAF	Each			
66.	10MVA 33/2.2 kV power transformer (Delta/Star) Dry type with vacuum tap changer and Cooling ONAF	Each			

9.5 Pricing schedule for Current transformers.

Table 24: Pricing schedule for Current transformers.

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
1.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAN porcelain bushings	100/1 10P10 15VA	100/1 CL X kpV = 180V 10mA	100/1 CL X kpV = 300V 10mA	1600/1400/1 15VA 5P10 kpV = 300V 10mA	1600/1400/1 CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
2.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAN Composite silicon Insulators	100/1 10P10 15VA	100/1 CL X kpV = 180V 10mA	100/1 CL X kpV = 300V 10mA	1600/1400/1 15VA 5P10 kpV = 300V 10mA	1600/1400/1 CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
3.	5MVA 33/2.2 kV power transformer	100/1 10P10 15VA	100/1 CL X kpV =	100/1 CL X kpV =	1600/1400/1 15VA	1600/1400/1 CL X	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
	(Delta/Star) ONAF porcelain bushings		180V 10mA	300V 10mA	5P10 kpV = 300V 10mA	300V				
4.	5MVA 33/2.2 kV power transformer (Delta/Star) ONAF Composite silicon Insulators	100/1 10P10 15VA	100/1 CL X kpV = 180V 10mA	100/1 CL X kpV = 300V 10mA	1600/1400/1 15VA 5P10 kpV = 300V 10mA	1600/1400/1 CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
5.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAN porcelain bushings	200/1 10P10 15VA	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	1600/1400/1 15VA 5P10 kpV = 300V 10mA	1600/1400/1 CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
6.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAN Composite silicon Insulators	200/1 10P10 15VA	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	2700/1 (or the nearest ratio) 15VA 5P10 kpV = 300V 10mA	2700/1 (or the nearest ratio) CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
7.	10MVA 33/2.2	200/1	200/1	200/1	2700/1 *(or*	2700/1 *(or*	1400/1	100/1	100/1	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
	kV Power Transformer (Delta/Star) ONAF porcelain bushings	10P10 15VA	CL X kpV = 180V 10mA	CL X kpV = 300V 10mA	*the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	*the nearest ratio)* CL X 300V	300V	10 VA 10P10	10 VA 10P10	
8.	10MVA 33/2.2 kV Power Transformer (Delta/Star) ONAF Composite silicon Insulators	200/1 10P10 15VA	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	2700/1 (or the nearest ratio) 15VA 5P10 kpV = 300V 10mA	2700/1 (or the nearest ratio) CL X 300V	1400/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
9.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAN porcelain bushings	200/1 10P10 15VA	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	600/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	600/1 *(or the nearest ratio)* CL X 300V	600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
10.	10MVA 33/11 kV Power Transformer (Delta/Star)	200/1 10P10 15VA Rs =1.9	200/1 CL X kpV = 180V	200/1 CL X kpV = 300V	600/1 *(or the nearest ratio)* 15VA	600/1 *(or the nearest ratio)* CL X	600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
	ONAN Composite silicon Insulators	Ω	10mA	10mA	5P10 kpV = 300V 10mA	300V				
11.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAF porcelain bushings	200/1 10P10 15VA Rs =1.9 Ω	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	600/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	600/1 *(or the nearest ratio)* CL X 300V	600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
12.	10MVA 33/11 kV Power Transformer (Delta/Star) ONAF Composite silicon Insulators	200/1 10P10 15VA Rs =1.9 Ω	200/1 CL X kpV = 180V 10mA	200/1 CL X kpV = 300V 10mA	600/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	600/1 *(or the nearest ratio)* CL X 300V	600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
13.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAN porcelain bushings	400/1 10P10 15VA Rs =1.9 Ω	400/1 CL X kpV = 180V 10mA	400/1 CL X kpV = 300V 10mA	1200/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1200/1 *(or the nearest ratio)* CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
14.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAN Composite silicon Insulators	400/1 10P10 15VA Rs =1.9 Ω	400/1 CL X kpV = 180V 10mA	400/1 CL X kpV = 300V 10mA	1200/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1200/1 *(or the nearest ratio)* CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
15.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAF porcelain bushings	400/1 10P10 15VA Rs =1.9 Ω	400/1 CL X kpV = 180V 10mA	400/1 CL X kpV = 300V 10mA	1200/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1200/1 *(or the nearest ratio)* CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
16.	20MVA 33/11 kV Power Transformer (Delta/Star) ONAF Composite silicon Insulators	400/1 10P10 15VA Rs =1.9 Ω	400/1 CL X kpV = 180V 10mA	400/1 CL X kpV = 300V 10mA	1200/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1200/1 *(or the nearest ratio)* CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
17.	20MVA, 132/11kV Power Transformers.	200/1 10P20 15VA	200/1 CL X kpV =	200/1 CL X kpV =	1200/1 15VA 5P10	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
	(Star/Star) ONAN porcelain bushings	Rs = 15Ω	300V 10mA	300V 10mA	kpV = 300V 10mA					
18.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	200/1 10P20 15VA Rs = 15Ω	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
19.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAN porcelain bushings	200/1 10P20 15VA Rs = 15Ω	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
20.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAN Composite silicon Insulators	200/1 10P20 15VA Rs = 15Ω	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
21.	20MVA,	200/1	200/1	200/1	1200/1	1200/1	1200/1	100/1	100/1	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
	132/11kV Power Transformers. (Star/Star) ONAF porcelain bushings	10P20 15VA Rs = 15Ω	CL X kpV = 300V 10mA	CL X kpV = 300V 10mA	15VA 5P10 kpV = 300V 10mA	CL X 300V	300V	10 VA 10P10	10 VA 10P10	
22.	20MVA, 132/11kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	200/1 10P20 15VA	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
23.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAF porcelain bushings	200/1 10P20 15VA	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
24.	20MVA, 132/11kV Power Transformers (Star/Delta) ONAF Composite	200/1 10P20 15VA	200/1 CL X kpV = 300V 10mA	200/1 CL X kpV = 300V 10mA	1200/1 15VA 5P10 kpV = 300V 10mA	1200/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
	silicon Insulators									
25.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAN porcelain bushings	500/1 10P10 15VA Rs =1.9 Ω	500/1 CL X kpV = 180V 10mA	500/1 CL X kpV = 300V 10mA	1500/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1500/1 *(or the nearest ratio)* CL X 300V	1500/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
26.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAN Composite silicon Insulators	500/1 10P10 15VA Rs =1.9 Ω	500/1 CL X kpV = 180V 10mA	500/1 CL X kpV = 300V 10mA	1500/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1500/1 *(or the nearest ratio)* CL X 300V	1500/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
27.	25MVA,33/11kV, Power Transformers. (Delta/Star). ONAF porcelain bushings	500/1 10P10 15VA Rs =1.9 Ω	500/1 CL X kpV = 180V 10mA	500/1 CL X kpV = 300V 10mA	1500/1 *(or the nearest ratio)* 15VA 5P10 kpV = 300V 10mA	1500/1 *(or the nearest ratio)* CL X 300V	1500/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
28.	25MVA,33/11kV, Power	500/1 10P10	500/1 CL X	500/1 CL X	1500/1 *(or the nearest*	1500/1 *(or the nearest*	1500/1 300V	100/1 10 VA	100/1 10 VA	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
	Transformers. (Delta/Star). ONAF Composite silicon Insulators	15VA Rs =1.9 Ω	kpV = 180V 10mA	kpV = 300V 10mA	*ratio)* 15VA 5P10 kpV = 300V 10mA	*ratio)* CL X 300V		10P10	10P10	
29.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAN porcelain bushings	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
30.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	200/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1200/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
31.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAN porcelain bushings	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
32.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
33.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAF porcelain bushings	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
34.	30MVA, 132/11kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
35.	30MVA, 132/11kV Power Transformers. (Star/Delta)	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V	300/1 CL X kpV = 300V	1600/1 15VA 5P10 kpV = 300V	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
	ONAF porcelain bushings		10mA	10mA	10mA					
36.	30MVA, 132/11kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	300/1 10P20 15VA Rs = 15Ω	300/1 CL X kpV = 300V 10mA	300/1 CL X kpV = 300V 10mA	1600/1 15VA 5P10 kpV = 300V 10mA	1600/1 CL X 300V	1600/1 300V	100/1 10 VA 10P10	100/1 10 VA 10P10	
37.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAN porcelain bushings	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	
38.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAN Composite silicon Insulators	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	
39.	45MVA, 132/33kV Power	200/1 12VA,	200/1 Class X	200/1 CL X	800/1 15 VA	800/1 CLX Vkp = 167v	800/1 CLX	100/1 10 VA	100/1 10 VA	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
	Transformers. (Star/Delta) ONAN porcelain bushings	Rs = 1.1 Ω	300V 10mA	kpV = 300V 10mA		Rs = 3.6Ω	Vkp = 167v Rs = 3.6Ω	10P10	10P10	
40.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	
41.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAF porcelain bushings	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	
42.	45MVA, 132/33kV Power Transformers. (Star/Star) ONAF Composite silicon Insulators	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
43.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAF porcelain bushings	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	
44.	45MVA, 132/33kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	200/1 12VA, Rs = 1.1 Ω	200/1 Class X 300V 10mA	200/1 CL X kpV = 300V 10mA	800/1 15 VA	800/1 CLX Vkp = 167v Rs = 3.6Ω	800/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	
45.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAN porcelain bushings	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	
46.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAN	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs =	100/1 10 VA 10P10	100/1 10 VA 10P10	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
	Composite silicon Insulators						3.6Ω			
47.	80MVA,132/33 kV Power Transformers. (Star/Delta) ONAN porcelain bushings	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	
48.	80MVA,132/33 kV Power Transformers. (Star/Delta) ONAN Composite silicon Insulators	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	
49.	80MVA, 132/33 kV Power Transformers. (Star/Star) ONAF porcelain bushings	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	
50.	80MVA, 132/33 kV Power Transformers.	400/1 12VA, Rs = 1.1	400/1 Class X 300V	400/1 CL X kpV =	1500/1 15 VA	1500/1 CLX Vkp = 167v	1500/1 CLX Vkp =	100/1 10 VA 10P10	100/1 10 VA 10P10	

ITEM	DESCRIPTION	CT RATIOs for OC/EF HV Side	CT RATIOs for Differential Protection HV Side	CT RATIOs for HV REF	CT RATIOs for OC/EF LV SIDE	CT RATIOs for Differential LV Side	CT RATIOs for OC/EF LV REF	CT RATIOs Standby Earth Fault HV Side	CT RATIOs Standby Earth Fault LV Side	Price per set of three (3) in RAND and indicate delivery time.
	(Star/Star) ONAF Composite silicon Insulators	Ω	10mA	300V 10mA		Rs = 3.6Ω	167v Rs = 3.6Ω			
51.	80MVA, 132/33 kV Power Transformers. (Star/Delta) ONAF porcelain bushings	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	
52.	80MVA, 132/33 kV Power Transformers. (Star/Delta) ONAF Composite silicon Insulators	400/1 12VA, Rs = 1.1 Ω	400/1 Class X 300V 10mA	400/1 CL X kpV = 300V 10mA	1500/1 15 VA	1500/1 CLX Vkp = 167v Rs = 3.6Ω	1500/1 CLX Vkp = 167v Rs = 3.6Ω	100/1 10 VA 10P10	100/1 10 VA 10P10	

9.6 PRICING FOR 36KV STATIONARY (PORCELAIN) TYPE OF LIGHTNING ARRESTORS

Table 25: Pricing for 36kV stationery (Porcelain) Type of lightning arrestors.

Item No.	Description		Price in RAND	Delivery time weeks	Manufacturer
1.	Rated	36kV			
	Class	10kA			
	Frequency	50Hz			
	MCOV	29.0kV			

9.7 PRICING FOR 36KV STATIONARY (SILICONE / POLYMERIC) TYPE OF LIGHTNING ARRESTORS

Table 26: Pricing for 36kV stationary (Silicone / Polymeric) Type of lightning arrestors

Item No.	Description		Price in RAND	Delivery time weeks	Manufacturer
1.	YH 10 W	36/108			
	Rated	36kV			
	MCOV	29.0kV			
	Frequency	50Hz			

9.8 PRICING FOR NEUTRAL EARTH RESISTOR (NER) 36kV

Table 27: Pricing for Neutral Earth Resistor

Item No	Description	Unit of measurement	Price in (R)	Delivery Time	Manufacturer
1.	NER	**Each**			

9.9 PRICING FOR NEUTRAL EARTH COMPENSATOR (NEC) 36kV

Table 28: Pricing for Neutral Earth Compensator

Item No	Description	Unit of measurement	Price in (R)	Delivery Time	Manufacturer
2.	NEC	**Each**			

9.10 PRICING FOR NEUTRAL EARTH COMPENSATOR RESISTOR AND AUXILIARY TRANSFORMER (NECRT) 36kV

Table 29: Pricing for Neutral Earth Compensator Resistor and Auxiliary Transformer

Item No	Description	Unit of measurement	Price in (R)	Delivery Time	Manufacturer
3.	NECRT	**Each**			

9.11PRICING FOR NER MONITOR RELAY 110VDC

Table 30: Pricing for NER monitor relay 110Vdc

Item No	Description	Unit of measurement	Price in (R)	Delivery Time	Manufacturer
1.	Please provide an NER monitor relay 110Vdc, “Test a Relay” RM110 or equivalent.	**Each**			

9.12PRICING FOR REACTOR 36kV, 5kVA SINGLE CORE

Table 31: Pricing for reactor 36kV, 5kVA single core

Item No	Description	Unit of measurement	Price in (R)	Delivery Time	Manufacturer
1.	Please provide an 36kV, 5kVA, single core reactor transformer with the bushings on the low voltage side marked as a, b, c and yn.	**Each**			

9.12.1 **PRICING SCHEDULE – PART F_INSTALLATION WORKS ON TRANSFORMERS:**

Table 32: WORKS/TASKS:

Works/tasks for installing of new transformers:										
Item	**DESCRIPTION**	**Price for MVA 5**	**Price for MVA 10**	**Price for MVA 20**	**Price for MVA 25**	**Price for MVA 30**	**Price for MVA 40**	**Price for MVA 45**	**Price for MVA 80**	**Price for MVA 80**
1.	Transport and recording must be done during transport. Submit data of transport recorder.									
2.	Disconnecting, Dismantling removes old transformer and reassemble it.									
3.	Prepare the plinth for new transformer.									
4.	Install new transformer and test on plinth.									
5.	Re-install all small cabling.									

6.	Transformer test results Testing of all transformer protection devices in co-operation with CENTLEC (SOC) Ltd.'s technicians. (DC Winding Resistance, Ratio, Current Transformers, SFRA test, Leakage Reactance, Excitation Current, Tan-delta (bushings and winding), Ancillary tests, Insulation Resistance tests and Buchholtz relay.)									
7.	Test all protection. Test the thermal protection and cooling system of									

Works/tasks for installing of new transformers:										
Item	**DESCRIPTION**	**Price for MVA 5**	**Price for MVA 10**	**Price for MVA 20**	**Price for MVA 25**	**Price for MVA 30**	**Price for MVA 40**	**Price for MVA 45**	**Price for MVA 80**	**Price for MVA 80**
	the transformer. Cold commissioning and energization.									
8.	Ensure that all areas are cleaned and that all chippings are backfilled.									

9.	Test the oil at an accredited laboratory. (Furan, Dissolved Gas Analyzes, Acid, Di-electric strength, Corrosive Sulphur, Tan Delta and PCB tests) Oil will be filtered and cleaned on site or replace with regenerated oil. The Tan Delta of the oil must comply with IEC 60422 specifications. (No PCB in oil is excepted) Oil must be 60KV dielectric strength tested.									
10.	Lockable wall mounted special tools cabinet with									

Works/tasks for installing of new transformers:										
Item	**DESCRIPTION**	**Price for MVA 5**	**Price for MVA 10**	**Price for MVA 20**	**Price for MVA 25**	**Price for MVA 30**	**Price for MVA 40**	**Price for MVA 45**	**Price for MVA 80**	**Price for MVA 80**
	all needed equipment.									
	TOTAL PRICE PER TRANSFORMER									

10. TRAVEL & SUBSISTENCE

The bidder must take note that all travel and subsistence will be as per the entity`s S&T policy. The table below will be used for each CENTLEC official participating.

Table 33: Travel and Subsistence Pricing

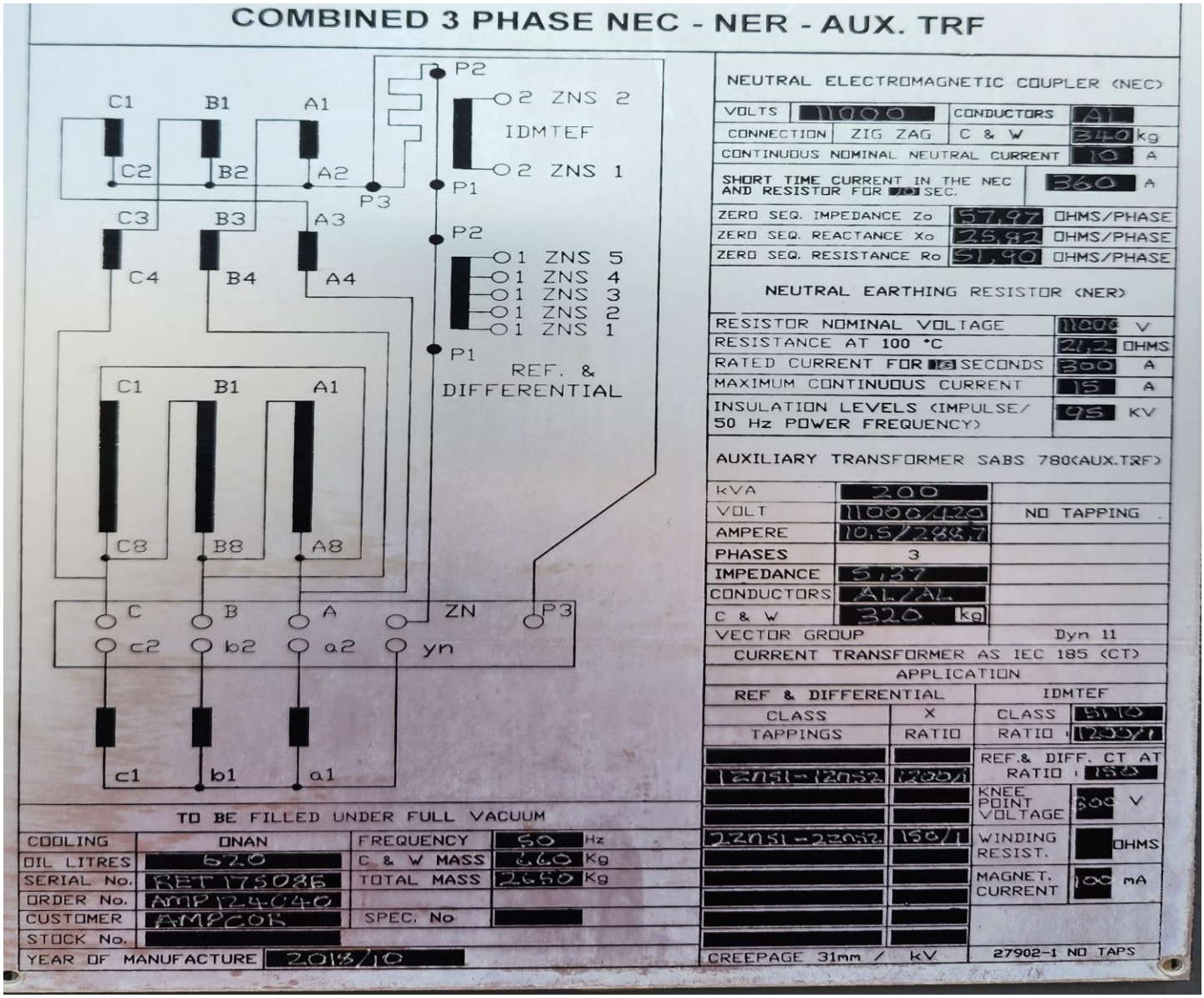
Description	Class	Unit of measure	Price in Rands (R)
Flights	Economy (Local Travel)	Per person	
Accommodation	3 Star hotel	Per person	
Meals	Breakfast, lunch, and supper	Per person	
Car Rental	Group B	Per trip	
Shuttle service (for a group)		Per trip	

11. CONTACT DETAILS

For any further technical information regarding the document contents please contact Mr. Piet Niemann, e-mail Piet.Niemann@centlec.co.za, Mme Lindiwe Kalane, e-mail Lindiwe.Kalane@centlec.co.za, Mr. Teboho Nkala, email Teboho.Nkala@centlec.co.za, Mr. Mxolisi Radebe, email Mxolisi.Radebe@centlec.co.za Such queries must be done in writing, the email address provided serves for this purpose. A copy of the enquiry should be sent to the Supply Chain Manager for the record.
For Supply Chain Related questions, please contact Palesa Makhele at 051 412 2753 or at Palesa.Makhele@centlec.co.za.

12. ANNEXURES

1. Combined 3phase NEC – NER – Aux. TRF
2. Health and Safety specification document as a guideline to assist with compiling of Safety File. This file shall be submitted within two weeks after the signing of the SLA agreement.
3. COMBINED 3PHASE NEC-NER-Aux. TRF



13. HEALTH AND SAFETY REQUIREMENTS

All the equipment must be plastic wrapped and secure when transport.

All the Items must be properly labelled with sticker, after wrapping, to identify the offloading without unwrapping the plastic rapping.

The offloading of equipment on CENTLEC premises must be done safely.

All chemical data sheets must be delivered with equipment.

Maintenance manuals must be delivered with equipment.

Reg No 2003/011612/30

OCCUPATIONAL HEALTH

AND

SAFETY

SPECIFICTION GUIDELINES

FOR

DESIGN, SUPPLY, DELIVERY, INSTALLATION, ERECTION AND COLD COMMISSIONING OF MEDIUM VOLTAGE SYSTEMS WITH THEIR POWER TRANSFORMERS AND ALL RELATED EQUIPMENT, INCLUDING ALL REQUIRED CIVIL WORKS

OCCUPATIONAL HEALTH AND SAFETY SPECIFICATIONS

Definitions

"Health and Safety Specification" means a documented specification of all health and safety requirements pertaining to the associated Works on a construction site, so as to ensure the health and safety of person during construction process. This document is prepared by the Client or Client agency.

"Health and Safety Plan" means a documented plan which addresses hazards identified and includes safe work procedures to mitigate, reduce or control the hazards identified. This document is prepared by the Principal Contractor or the Sub Contractor.

"**Employer"** Where used in contract documents and in this specification, means the employer as defined in the General Conditions of Contract and it shall be have the same meaning as "**Client"** as defined in the Construction Regulation 2003.
"**Employer"** and "**Client"** is therefore interchangeable and shall be read in context of the relevant document.

"**Contractor"** where used in the contract documents and in this specification shall have meaning as "contractor" as defined in the General Conditions of Contract.
In this specification the terms "**Principal Contractor"** and **"Contractor"** are replaced with **"Contractor"** and **"Sub Contractor"** respectively
For the purpose of this contract, the **Contractor** will, in terms of the OHS Act 1993, be the mandatory of the Employer, without derogating from his/her status as an employer in his/her own right.

"Engineer" where used in this specification, means the Engineer as defined in the General Conditions of Contract. In terms of the Construction Regulations the Engineer may act as agent of behalf of the Employer (the client as defined in the Construction Regulations)

"OHS Section" means Occupational Health and Safety Division within Centlec (SOC) LTD will oversees all Projects to ensure that Principal Contractor comply with Occupational Health & Safety Act 85 of 1993, Construction Regulation and all related codes of practice.

1. General Statement

It is a requirement of Centlec (SOC) Ltd that the Contractor shall provide a safe and healthy working environment and to direct all his activities in such a manner that his employees and any other persons, who may be directly affected by his activities, are not exposed to hazards to their health and safety. To this end the contractor shall take full responsibility to conform to all the provisions of the occupational health and safety Act (Act 85 0f 1993), and all relevant regulations as stated in section 44 of Occupational Health and Safety Act 85 of 1993.

For the purpose of this contract the Contractor is required to confirm his status as mandatory to Centlec (SOC) Ltd and employer representattives in his own right for the execution of the contract, and he shall enter into Section 37.2 agreement in respect of the Occupational Health and Safety Act 85of 1993.

2. Scope

This specification includes health and safety elements in terms of the Occupational Health and Safety Act 85 of 1993 and to satisfy the requirements of the Construction Regulation, which will be applicable to the Principal Contractor for the safe execution of work during the project.

3. Purpose

The purpose of this specification is to ensure that the Principal Contractor provides and maintains, as far as reasonably a safe working environment for all employees and the public at large during the construction work.

4. Project Description

The project includes all activities shown on the project drawings and provisional bills of quantities. Additional work or changes to the contract may result in a change to the scope of work. The principal contractor shall make allowance for this in their Health and Safety Plan.

5. The principle health and safety risks involved on this specific site will be that of:-

- Working at elevated position
- Along the road side
- Usage of lifting equipment's
- Back age due handling material
- Ladder usage due cabling
- Bending when working at the same level
- Fire hazards that may emanate from explosive chemicals
- Smell that may come due chemicals

6. Details of Specifications

6.1 Appointment of Health and Safety Personnel

The Contractor shall ensure that all relevant appointments specified in the Occupational Health and Safety Act 85 of 1993 and Construction Regulations are made in writing prior to commencement of the Project.

The Principal contractor shall provide adequate levels of suitable trained, experienced and competent management and supervision to ensure that the works proceed and without risks to health or environment and that all operations and personnel for whom the contractor is responsible are adequately monitored and supervised.

The Principal Contractor shall ensure that the appointments listed below are made where applicable:

- Project Manager – section 16.2 OHS ACT
- Registered electrician
- Health and safety representative section 17 of OHS Act 85 of 1993
- Principal Contractor appointment
- Contractor – CR5(1)(k)
- Construction Supervisor – CR8.2
- Assistant construction supervisor – CR8.3
- Construction safety officer – CR8.6
- Risk assessor – CR9.1
- Fall protection planner – CR10.1(a)
- Excavation supervisor – CR13(a)
- Scaffolding supervisor – CR16(1)
- Material hoist inspector – CR19(8)(a)
- Construction vehicle and mobile plant inspector –CR23.1(k)
- Stacking and storage supervisor – CR28(a)
- Fire equipment inspector – CR29(h)
- First aiders GSR3
- Health and safety committee members – Section 19(1) OHS Act 85 of 1993

6.2 Notification to Department of Labour

1. The Principal Contractor shall before commencement of the Project, notify the Department of Labour in writing of the construction work to be undertaken after the appointment letter has been received by the contractor.

The notification must be done in Annexure 2 form for notification of construction work attached in this.

A copy of the notification must be kept on site, available for inspection by inspectors, occupational health and safety unit representatives, employer, engineer, employees and persons on site.

6.3 Establishment of Health and Safety Committee

The Principal Contractor shall establish a Health and Safety Committee in terms of Section 19 of the Occupational Health and Safety Act 85 of 1993.

The Principal Contractor shall hold meeting at least once a month with appointed supervisors, Health and Safety Reps and the chairperson of the Health and Safety Committee and copies of the safety meeting to be forwarded to the client and the client health and safety representative to be informed and invited to such meetings.

Matters that are to be discussed should include at least the following as minimum:

- Make recommendations to resolve health and safety matters (i.e. internally by representatives or externally by DOL inspector)
- Accident/safety incident and they must be recorded for audit and for reporting to CENTLEC safety representative
- Hazardous conditions
- Hazardous material/substances
- Work procedures
- PPE
- Housekeeping
- Work permits
- Non conformances
- Emergency preparedness
- Traffic control
- Access control
- Training
- Forthcoming high hazard activities
- Liquor and drugs
- Occupational health and hygiene issues
- General health and safety issues
- Matters arising from principal contractor safety meetings.

6.4 Health and Safety Hazards

The Principal Contractor shall take cognisance of the following hazards that are prevalent in the project:

Hazardous Environment

- Asbestos work
- Dust
- Fumes
- Noise
- Insufficient lighting
- Weather conditions – Heat/Rain/Wind/Cold
- Working at height and on elevated structures for work above 2 meter height (fall protection plans required)
- Working in and around deep excavations (shoring and bracing required)
- Working next to moving plant
- Working with chemical products

Hazardous Equipment

- Cranes
- Earth moving equipment
- Excavators
- Trucks
- Batch plant
- Ladders
- Lifting equipment
- Chains and slings
- Fall protection equipment's

Hazardous Operations

- Crane lifts (sometimes in windy conditions)
- Excavations
- Welding if any
- Use of step ladder
- Usage of the carry picker by unauthorised personnel

Hazardous Tools

- Angle grinders
- Electric hand tools
- Circular saws

- Welding units – arc and gas
- Explosive power tool

Hazardous Substances

- Chemicals & solvents
- Liquid petroleum
- Diesel

6.5 Arrangements for controlling significant site risks

The following are some examples requiring arrangements for controlling the most significant site risks.

6.5.1 Safety Risks

- Preventing employees from falling into excavations, from trucks etc
- Control of lifting operations
- The maintenance of plant and equipment
- Poor ground conditions
- Traffic routes and segregation of vehicles and pedestrians
- Storage of hazardous materials
- Dealing with existing unstable structures/land
- Other significant safety risks as and when identified
- Usage of mobile plant

6.5.2 Health Risks

- Storage and use of hazardous chemical substances
- Manual handling
- Reducing noise and vibration
- Provision of adequate lighting
- Extreme heat and cold temperature considerations
- Dealing with HIV/Aids/COVID-19 and other illnesses
- Provision of maintaining ablution and eating facilities
- Other significant health risks as and when identified
- Distribution of condoms
- Allow employees to test when CENTLEC health and safety section arrange testing for HIV/AIDS
- Allow employees to donate blood when CENTLEC health and safety section arrange for blood donation.

All safe operating procedures, method statements or rules implemented mitigate the risk whilst performing hazardous tasks are to be effectively communicated to the contractor's staff performing the tasks.

It is to be noted that these are some of the hazards that may be prevalent in this Project.

Others may be identified during the Risk Assessment.

7. Safety File

The contractor shall appoint a suitable qualified person to prepare the Health and Safety File and to keep it up to date for the duration of the contract. The Health and Safety File shall include the following information:

- Notification of construction Work (Construction Regulation 4) (Annexure 2)
- Copy of OHS Act (updated) (General Administrative Regulation 4) and relevant regulations as stated by section 44 of OHS Act 85 of 1993.
- Proof of Registration and good standing with a COID Insurer
- Copy Health and Safety plan (Construction Regulation 7(1)) that include the followings:-

  Applicable appointments
  List of equipment's and specialised equipment's
  List of PPE issued
  Recent inspection lists
  Training records
  Medical surveillance
  Hazards identification and risk assessment
  Safe work procedure include fall protection plan, permits, locks-out procedures, method statements
  Test records for equipments and work
  Incident history
  Notices issued
  Health and safety expenses in respect of the project

- OHS programme agreed with client including the underpinning Risk Assessment and Method Statements (Construction Regulation 9(1))
- Design/ drawings (Construction Regulation 6)
- A list of Contractors (subcontractors) including copies of the agreements between the parties and the type of work being done by each Contractor (Construction Regulation 7)
- Appointment/Designation forms required by the ACT and Regulations
- Registers as follows:

8. Register required

- OHS Representatives Inspection Register (monthly)
- Excavation inspection (daily)
- Lifting equipment (before use and monthly)
- Designers Inspection of Structure record
- Arc and Gas welding and Flame Cutting Equipment Inspections (before use daily)
- Construction Vehicles and mobile plant Inspections (Daily)
- Fire equipment inspection and maintenance (monthly)
- First aid (monthly)
- Hazardous Chemical Substances (MSDS and listing of chemicals)
- Lifting Tackle and Equipment inspections (before use daily and monthly)
- Inspection of cranes (daily before use)
- Inspection of ladders (daily before use and monthly)
- Inspection of vessels and pressure (monthly and 3 yearly)
- Machinery inspections (before use and monthly)
- Drivers/Operators of mobile plant/construction vehicles daily inspections

The Health and Safety File shall be handed over to the client on completion of the contract. It must contain all the documentation handed to the contractor by any sub contractors together with a record of all drawings, designs, materials used and other similar information concerning the completed project

9. Written Safe Work Procedures and Risk Assessments

Written Safe Work Procedures are to be available in order to mitigate, reduce or control the hazards and risks identified in the Risk Assessment.

Initially a generic document can be produced, by the first three weeks of operation a tasked based document must be produced and be updated as per changes in tasks.

10. Personal Protective Equipment

The Principal Contractor shall ensure that the following minimum personal protective equipment and wear are issued to his employees:

- No person is allowed to be on site without the required PPE as prescribed by risk assessments. This must be discussed at the safety meeting and adhered to by all contractors on site.
- Principal Contractor must ensure that PPE is being used as a last resort upon trying all reasonable means to remove the hazard.
- All contractors are required to keep an updated register of all PPE issued.
- Strict compliance measures must be administered to ensure employees use PPE.

- Hard hats, safety shoes with steel toe caps and protective clothing shall be provided by the contractor free of charge for all his employees and shall be worn at all times. Employees working on site must not wear metallic helmets. Other protective equipment such as gloves, safety glasses, face shield, dust mask, ear plugs etc shall be issued and used when required as per tasks. The contractor shall ensure that his employees understand why the PPE is necessary and that they use them correctly.
- Only double lanyard safety harnesses are allowed and must be used when conducting work at elevated positions except on properly built scaffold platform.
- When handling corrosive liquids e.g. acids or caustic suitable eye protection, gloves, and special overalls shall be worn.
- Ear protection shall be worn in any designated noise zone and a signage needs to be placed in the conspicuous place.
- Suitable respirators shall be provided where gas or dust pose a hazard
- Any person refusing to wear protective clothing when instructed to do so by the responsible person shall be removed from the site.

11. Excavations

It is essential that the contractor shall follow the instructions and precautions in the standard specifications and Project Specifications as well as the provisions of the Construction Regulations to the letter as unsafe excavations can be a major hazard on any construction site. The contractor shall therefore ensure that all excavation work is carried out under the supervision of a competent person that the inspections are carried out by a professional engineer or technologist on daily bases.

Supervision by competent person will not relieve the contractor from his duties and responsibilities under Regulation 11 of Construction Regulations.

12. Explosive powered tools

The contractor shall ensure that, wherever explosive-powered tools are required to be used, all safety provisions of Regulation 19 are complied with.

It is especially important that warning notices are displayed and that the issue and return of cartridges and spent cartridges be recorded in a register to be kept on site.

13. Cranes

Wherever the use of tower cranes becomes necessary, the provisions of Regulation 20 shall be complied with.

14. Construction Vehicles and mobile plant

The contractor shall ensure that all construction vehicles and plant are in good working condition and safe for use, and that they are used in accordance with their design and intended use. The vehicles and plant shall only be operated by workers, operators who have received appropriate training, all in accordance with all the requirements of regulation 21.

All vehicles and plant must be inspected on daily basis, prior to use, by a competent person and the findings must be recorded in a register to be kept on site.

15. Electrical installation and machinery on construction sites

The contractor shall comply with the electrical installation Regulations (Government Notice R2920 of 23 October 1992) and the electrical Machinery Regulations (Government Notice R1953 of 12 August 1993). Before commencement of construction, the Contractor shall take adequate steps to ascertain the presence of, and guard against dangers and hazards due to electrical cables and apparatus under, over on site. Temporary electrical connection arrangements will be made with respective project manager from Centlec site.

All temporary electrical installations on the site shall under the control of a competent person, without relieving the Contractor of his responsibility for the health and safety of all workers and persons on site in terms of Regulation 22.

16. Use of temporary storage of flammable liquids on construction sites.

The contractor shall comply with the provisions of the General Safety Regulations (Government Notice R1031 of May 1986) and all the provisions of Regulation 23 of Construction Regulations to ensure a safe and hazard-free environment to all workers and persons on site.

17. Water environments

Where construction work is done over or in close proximity to water, the provisions of Regulation 24 shall apply. Emergency procedure for hazardous spills in water will be followed as stated in the emergency preparedness procedures.

18. Stacking and storage on construction sites

The provisions of the stacking of articles contained in the General Safety Regulations (Government notice R1031 of 30 May 1986) as well as all the provisions of Regulation 26 of the Construction Regulations shall apply.

19. Fire precautions on construction sites

The provisions of the environmental Regulations for Workplaces (Government Notice R2281 of 16 October 1987) shall apply

In addition the necessary precautions shall be taken to prevent the incidence of fires, to provide adequate and sufficient fire protection equipment, sirens, escape routes etc. all in accordance with Regulation 27 of the Construction Regulations.

No open fire will be allowed on site, unless a proper arrangement with site manager and authority has been made.

20. Construction welfare facilities

The contractor shall comply with the construction site provisions as in the Facilities Regulations (Government Notice R1593 of 12 August 1988).

21. Fall protection plan

A comprehensive fall protection plan is to be established in order to prevent employees from falling from elevated positions

a) The contractor shall stop all persons working with erection of steelwork during periods of inclement weather or if the possibility of lightning is present
b) Safety harness as fall arrest devices will be worn when working at an elevation, unless working from a safe platform
c) Working on elevated positions shall only be carried out under the supervision of a competent person.
d) Provision must be made to prevent objects and material from falling from elevated areas and the protection of persons working below.
e) All unprotected openings in floors, edges, slabs, hatchways and stairs will be adequately barricaded and suitable visible means will be used to demarcate such barricading
f) Where necessary life lines will be installed for the purpose of fall protection

All personnel working at height exceeding 2metres will be declared medically and psychological fit.

22. Permit to work.

The contractor is to ensure that the proper permit is in hand and duly authorised by appointed person before commencing with the work in question, some of the activities that require a permit to work are:

- Hot works
- Excavation work more than 1.5m deep
- Work being done 3m of an overhead power line or above the transformers.
- Use of hazardous substances e.g., asbestos, lead

Contractor shall liaise with project manager from C for the issue of work permit.

23. Housekeeping on Site

The Principal Contractor shall ensure a high level of housekeeping on site. Adequate care must be taken by the contractor to ensure that storage and stacking is correctly and safely carried out. On completion the contractor is responsible for clearing the site of all material, scrap, temporary building to the satisfaction of the client.

24. First Aid Facilities

- Adequate first aid facilities are to be available on site.
- Individuals that are trained and certified competent to administer first aid is to be on site at all times, serving as First Aid Officer.
- The following welfare facilities must be provided for and kept in clean and suitable condition, shower facility, sanitary facility, changing facility, sheltered eating facility and drinking water at strategic locations on site.

25. Health and Safety Induction

- The Principal Contractor shall ensure that all employees undergo a health and safety induction.
- Proof of induction is to be included in the "Safety File".
- The contractor is expected to have a daily safety "tool box" meeting. Subject topics that are applicable to the job at hand e.g. near misses that have happened, accident and up and coming work will be discussed along suggestion and comments.
- These meetings can be used as a training meeting with the central idea of educating employees.

26. Accident/Incident Reporting and Investigations

- All accidents/incidents shall be recorded and investigated and reported to Occupational Health & Safety Section.
- Accidents/incidents are to be reported to Centlec (SOC) LTD Project Manager.
- All reportable incidents in terms of Section 24 of the OHS ACT shall be investigated and recorded by the contractor as required by the Act and also reported to Occupational Health & Safety Unit.
- The contractor shall compile an investigation report and ensure that all the preventative actions recommended are in place.

27. Health and Safety Inspections/Audits

- The Principal Contractor shall ensure that the work area, equipment, machinery, safety equipment and wear, etc are inspected on a regular basis.
- Proof of such inspections are to be maintained in the "Safety File"
- All non-conformances revealed during the inspections are to be noted and rectified as soon as possible. The client, health and safety unit will also conduct formal audits at least once a month and deviations that are revealed must be rectified within the required time frame.
- All portable tools shall be inspected daily by the user as well as weekly recorded inspections and testing to be done.

28. Medical Surveillance

- The Principal Contractor shall ensure that all his employees undergo the appropriate medical surveillance based on the risk and hazards expose to, particular to employees working with asbestos.
- The medical surveillance records is to be included in the "Safety File"

29. Site Security

The Principal Contractor shall ensure that access to site is controlled so that children or unauthorised persons are prevented from wandering onto site.

Suitable signage to be displayed in this respect, it is imperative that the principal contractor ensures the safety of all workers as well as property and material on site.

The Principal Contractor safety officer shall also in collaboration with the sub-contractor personnel develop traffic plan for the site to ensure the safe movement of all construction related mobile plant and employees at large and this plan is to be reviewed at monthly safety meeting to ensure its applicability.

The contractor shall demarcate the route along which their employees may proceed when coming or going off shift and all security requirements shall be highlighted at the induction given by the Principal Contractor.

30. Emergency Preparedness

The Principal Contractor shall develop and implement an emergency plan for site in collaboration with sub-contractors and the client representative. The plan would have to be revised due to the changing environment on construction site. Specific requirements for first aid and medical as well as fire and rescue will be addressed. The contractor is to ensure that the necessary firefighting equipment is in place in respective area.

31. Non-Compliance to Health and Safety Standards

The CENTLEC Representatives reserve the right to stop the operations of the Principal Contractor should it be found that the operations are being undertaken in non-compliance with the laid down health and safety plan based on this specification.

The client has the authority to issue a non-conformance report to any contractor not complying to the SHE requirements on site, with necessary required rectification action required within a specific time frame.

It is noted to the contractors that any expenses incurred due to non-conformances shall be for Contractor's account in question.

Safety officers and other personnel have the authority to stop work if there is a life-threatening situation or danger of material loss/damage and direct immediate remedial action under the supervision of contractor's manager is required.

Any "stop work order' shall be followed up and the site manager shall present a written report including remedial actions to avoid the re-occurrence and disciplinary action for contravening safety regulation and if considered necessary to instruct the site manager to remove certain of his personnel from site.