CLUSTER

Trading Services

UNIT

Electricity

DEPARTMENT

HV Operations

PROCUREMENT DOCUMENT

INFRASTRUCTURE

Documents are to be obtained, free of charge, in electronic format, from the National Treasury's eTenders website or the eThekwini Municipality's website.

Contract No: 31144-5E

Contract Title: Supply, Delivery, Off-loading, Installation and Testing of 275/132 kV, 132/33 kV, 132/11 kV and 33/11 kV Power Transformers for a fixed period of thirty-six months

Est. CIDB Grade/ Class: 9 EP

CLARIFICATION MEETING AND QUERIES

Clarification Meeting: No Clarification Meeting

Queries can be addressed to: The Employer's Agent's Representative: Wilson Mbhele, Tel: 031-311 9290
e-mail: Wilson.Mbhele@durban.gov.za,
All email queries are to be submitted by 22 May 2025. Emailed questions and answers will be consolidated and posted on Etenders/Municipal website/SSS for the benefit of all tenderers by 29 May 2025.

TENDER SUBMISSION

Delivery Location: The Tender Box in the foyer of the Municipal Building
166 KE Masinga Road, Durban

Bidders are required to also make an electronic submission via SSS. Bidders must ensure that the hard copy and electronic submission are the same, failing which the submission will be deemed invalid. Bidders are responsible for resolving all access rights and submission queries before the tender closing date.

SSS Queries Contact: Lindo Dlamini: Tel: 031-3227133/031-3227153
email: supplier.selfservice@durban.gov.za

Closing Date/ Time: Friday, 06 June 2025 **at** 11h00

FACSIMILE, eMAIL, or POSTED TENDERS WILL NOT BE ACCEPTED

Issued by:

ETHEKWINI MUNICIPALITY

Deputy Head: HV Operations

Date of Issue: 02/05/2025

Document Version 01/03/2024

Tenderer Name:			VAT Registered: Yes No
	Price (excl)	VAT	Price (incl)
Submitted:	R	R	R
Corrected:	R	R	R

INDEX to PROCUREMENT DOCUMENT

PART T1: TENDERING PROCEDURES

T1.1.1: TENDER NOTICE AND INVITATION TO TENDER

Tenders are hereby invited for the works to Supply, Delivery, Off-loading, Installation and Testing of 275/132 kV, 132/33 kV, 132/11 kV and 33/11 kV Power Transformers for a fixed period of thirty-six months

Subject	Description	Tender Data Ref.
Employer	The Employer is the eThekwini Municipality as represented by: Deputy Head: **HV Operations**	F.1.1.1
Tender Documents	Documents can only be obtained in electronic format, issued by the eThekwini Municipality. Documentation can be downloaded from the **National Treasury's eTenders website** or the **eThekwini Municipality's Website**. The entire document should be printed (on A4 paper) and suitably bound by the tenderer.	F.1.2
Eligibility	It is estimated that tenderers should have a CIDB contractor grading designation of **9 EP** (or higher). The CIDB provisions in relation to a Contractor's Potentially Emerging (PE) status do not apply.	F.2.1.1
Clarification Meeting	**Not Applicable**	F.2.7
Seek Clarification	Queries relating to these documents are to be addressed to the Employer's Agent's Representative whose contact details are: **Wilson Mbhele, Tel: 031-311 9290** **e-mail: Wilson.Mbhele@durban.gov.za,** **All email queries are to be submitted by 22 May 2025. Emailed questions and answers will be consolidated and posted on Etenders/Municipal website/SSS for the benefit of all tenderers by 29 May 2025.**	F.2.8
Submitting a Tender Offer	Tender offers shall be delivered to: **The Tender Box in the foyer of the Municipal Building** **166 KE Masinga Road, Durban** **Bidders are required to also make an** electronic submission via SSS. Bidders must ensure that the hard copy and electronic submission are the same, failing which the submission will be deemed invalid. Bidders are responsible for resolving all access rights and submission queries before the tender closing date. **SSS Queries Contact: Lindo Dlamini**: Tel: 031-3227133/031-3227153 email: supplier.selfservice@durban.gov.za	F.2.13
Closing Time	Tender offers shall be delivered on or before **Friday, 06 June 2025** at or before **11h00**.	F.2.15
Evaluation of Tender Offers	**The 90/10** Price Preference Point System, as specified in the PPPFA Regulations 2022 will be applied in the evaluation of tenders. Refer to	F.3.11

Clause F.3.11 of the Tender Data for the **Specific Goal(S)** for the awarding of Preference Points, and other related evaluation requirements.

Requirements for sealing, addressing, delivery, opening and assessment of tenders are further stated in the Tender Data

PART T1: TENDERING PROCEDURES

T1.2: TENDER DATA

T1.2.1 STANDARD CONDITIONS OF TENDER

The conditions of tender are the Standard Conditions of Tender as contained in Annex F of the CIDB Standard for Uniformity in Construction Procurement (July 2015) as published in Government Gazette No 38960, Board Notice 136 of 2015 of 10 July 2015.

The Standard Conditions of Tender make several references to the Tender Data for details that apply specifically to this tender. The Tender Data shall have precedence in the interpretation of any ambiguity or inconsistency between it and the Standard Conditions of Tender.

T1.2.2 TENDER DATA

Each item of data given below is cross-referenced to the clause in the Standard Conditions of Tender to which it mainly applies.

F.1: GENERAL

F.1.1 **The employer**: The Employer for this Contract is the eThekwini Municipality as represented by:
Deputy Head: **HV Operations**

F.1.2 **Tender documents**: The Tender Documents issued by the Employer comprise:

1) This procurement document.

2) "General Conditions of Contract for Construction Works – 3rd Edition 2015" issued by the South African Institution of Civil Engineering (GCC 2015). This document is obtainable separately, and Tenderers shall obtain their own copies.

3) Drawings, issued separately from this document in Section T2.2.27.

4) In addition, Tenderers are advised, in their own interest, to obtain their own copies of the following acts, regulations, and standards referred to in this document as they are essential for the Tenderer to get acquainted with the basics of construction management, the implementation of preferential construction procurement policies, and the participation of targeted enterprise and labour.
   - The Employer's current (as at advertising date) Supply Chain Management Policy.
   - The Preferential Procurement Policy Framework Act No 5 of 2000, and the Preferential Procurement Policy Framework Act Regulations (2022).
   - The Occupational Health and Safety Act No 85 and Amendment Act No 181 of 1993, and the Construction Regulations (2014).
   - The Construction Industry Development Board Act No 38 of 2000 and the Regulations issued in terms of the Act (July 2013).
   - SANS 1921:2004 – Construction and Management Requirements for Works Contract, Parts 1-3.
   - Any other eThekwini Policy documents referenced in the Tender Documents.

Electronically downloaded documentation is obtainable from the National Treasury's **eTenders Website** or the **eThekwini Municipality's Website** at URLs:

- https://www.etenders.gov.za/

- https://www.durban.gov.za/pages/business/procurement

The entire downloaded document should be printed on white A4 paper (single-sided) and suitably bound by the tenderer.

F.1.4 Communication and employer's agent:

The Employer's Agent's Representative is:
Wilson Mbhele, Tel: 031-311 9290
e-mail: Wilson.Mbhele@durban.gov.za,
All email queries are to be submitted by 22 May 2025. Emailed questions and answers will be consolidated and posted on Etenders/Municipal website/SSS for the benefit of all tenderers by 29 May 2025.
The Tenderer's contact details, as indicated in the Contract Data: Clause C1.2.2.2 "Data to Be Provided by Contractor", shall be deemed as the only valid contact details for the Tenderer for use in communications between the Employer's Agent and the Tenderer.

F.2: TENDERER'S OBLIGATIONS

F.2.1.1 Eligibility: General

A Tenderer will not be eligible to submit a tender if:

(a) the Tenderer does not comply with the legal requirements as stated in the Employer's current SCM Policy.

(b) the Tenderer cannot provide proof that he is in good standing with respect to duties, taxes, levies and contributions required in terms of legislation applicable to the work in the contract.

(c) In the event of a Compulsory Clarification Meeting:
  i) the Tenderer fails to attend the Compulsory Clarification Meeting.
  ii) the Tenderer fails to have form "Certificate of Attendance at Clarification Meeting / Site Inspection" (in T2.2) signed by the Employer's Agent or his representative.

(d) in the case of JV submissions, two or more JV entities have common directors / shareholders or common entities tendering for the same works.

(e) at the time of closing of tenders, the Tenderer is not registered on the National Treasury Central Supplier Database (CSD) as a service provider. In the case of a Joint Venture, this requirement will apply individually to each party in the Joint Venture.

(f) The tenderer has not submitted, with this tender, a valid Letter of Good Standing from the Compensation Commissioner as proof of being registered and in good standing with the compensation fund. Reference is to be made to Returnable Document T2.2.13.

(g) The tender fails to complete and sign the Declaration of Municipal Fees in T2.2: "Returnable Documents" and submits the required documentation. Reference is to be made to Returnable Document T2.2.12.

SCM Policy (Cl.14(4)) requires suppliers/ service providers/ contractors to be registered on the eThekwini Municipality Central Supplier Database or be in a position to be so before the award.

In the event of the Tenderer not being registered on the eThekwini Municipality's Central Supplier Database, the tenderer must register on the internet at www.durban.gov.za by following these links:

- Business
- Supply Chain Management (SCM)
- Accredited Supplier and Contractor's Database.

The following are to be noted:

(a) The information for registration as in the possession of the eThekwini Municipality will apply.
(b) It is the Tenderer's responsibility to ensure that the details as submitted to the Municipality are correct.
(c) Tenderers are to register prior to the submission of tenders.

F.2.1.2 **Eligibility: CIDB**

Only those tenderers who are registered (as "Active") with the CIDB (at time of tender closing), in a contractor grading designation equal to or higher than a contractor grading designation determined in accordance with the sum tendered, or a value determined in accordance with Regulation 25 (1B) or 25(7A) of the Construction Industry Development Regulations, for a **EP** class of construction work, are eligible to have their tenders evaluated.

Joint ventures are eligible to submit tenders provided that:
(a) Every member of the joint venture is registered (as "Active") with the CIDB (at time of tender closing),
(b) The lead partner has a contractor grading designation in the **EP** class of construction work and has a grading designation of not lower than one level below the required grading designation, and
(c) The combined contractor grading designation calculated in accordance with the Construction Industry Development Regulations (2013) is equal to or higher than a contractor grading designation determined in accordance with the sum tendered for a **EP** class of construction work or a value determined in accordance with Regulation 25 (1B) or 25(7A) of the Construction Industry Development Regulations.

It should be noted that this contract is not part of a Targeted Development Programme (TDP). The CIDB provisions in relation to a Contractor's Potentially Emerging (PE) status do not apply.

F.2.2.2 **The cost of the tender documents:** Replace this paragraph with the following:

"Documents are to be obtained, free of charge, in electronic format, from the **National Treasury's eTenders website** or the **eThekwini Municipality's Website**. The entire electronically downloaded document should be printed on white A4 paper (single-sided) and suitably bound by the tenderer.

F.2.6 **Acknowledge addenda:** Add the following paragraphs to the clause:

"Addenda will be published, in electronic format, on the websites specified in F.1.2. Tenderers are to ensure that the eTenders website is consulted for any published addenda pertaining to this tender up to three days before the tender closing time as stated in the Tender Data."

"Acknowledgement of receipt of the addenda will be by the return of the relevant completed, dated, and signed portion of the addenda, to the physical or email address as specified on the addenda. Failure of the tenderer to comply with the requirements of the addenda may result in the tender submission being made non-responsive."

F.2.7 Clarification meeting:
Not Applicable

In the event of a Compulsory Clarification Meeting, Tenderers must sign the attendance register in the name of the tendering entity. The Tenderer's representative(s) at the clarification meeting must be able to clearly convey the discussions at the meeting to the person(s) responsible for compiling

the entity's tender offer.

F.2.12 **Alternative tender offers**: Alternative offers will only be considered from the most responsive Bidder. If a tenderer wishes to submit an alternative tender offer, the criteria permitted for such an alternative tender offer are:

a) **Individual items**

Individual items offered as alternatives to items in the Bill of Quantities will only be considered if listed and priced in Form T2.2.35: Amendments, Qualifications and Alternatives in Part T2.2, accompanied by a detailed statement as necessary.

(b) **Alternative designs**

Where a Tenderer desires to submit alternative tender involving modifications to the design or method of construction that would alter the character of the tender, the following procedure must be observed:

(1) The alternative offer must be accompanied by supporting information, drawings, calculations and a priced alternative Bill of Quantities to enable its technical acceptability, construction time and price to be fully assessed. Such information, drawings and Bill of Quantities must be sufficient for proper evaluation of the tendered alternative, otherwise the offer will not be considered;

(2) Any alternative tender involving modifications to design will be assessed on its merits and may be accepted. An accepted alternative design will become the design for the purpose of the contract.

(3) If an alternative design with its priced Bill of Quantities has been accepted, the sum thus tendered for the alternative will not be subject to re-measurement and will be the final amount payable to the Contractor, except only for variations arising from:

- Changes in design parameters ordered by the Employer's Agent;
- Changes not arising from any failure or fault of the Contractor, but from modifications requested by the Employer's Agent.

(4) A decision whether or not to adopt a technically acceptable modified design, will be governed by the amount of the overall saving and the advantages to the Employer which the modified design can be reliably expected to achieve. Matters to be considered in arriving at the overall saving will include the effect of any deferment in starting date arising from extra time needed for the preparation of an amended contract for signature.

(5) The Tenderer will be liable for all costs necessary for the Employer's Agent to check the alternative design offered.

F.2.13 **Submitting a tender offer**: Submissions must be submitted on official submission documentation issued (either in hard copy or in electronic format) by the eThekwini Municipality.

Identification details to be shown on each tender offer package are:

- Contract No. : **31144-5E**
- Contract Title : **Supply, Delivery, Off-loading, Installation and Testing of 275/132 kV, 132/33 kV, 132/11 kV and 33/11 kV Power Transformers for a fixed period of thirty-six months**

The Employer's address for delivery of tender offers is:

The Tender Box in the foyer of the Municipal Building
166 KE Masinga Road, Durban

Bidders are required to also make an electronic submission via SSS. Bidders must ensure that the hard copy and electronic submission are the same, failing which the submission will be deemed invalid. Bidders are responsible for resolving all access rights and submission queries before the tender closing date.

SSS Queries Contact: Lindo Dlamini: Tel: 031-3227133/031-3227153 email:

supplier.selfservice@durban.gov.za

Parts of each tender offer communicated on paper shall be submitted as an original.

Bidders are required to also make an electronic submission via SSS. Bidders must ensure that the hard copy and electronic submission are the same, failing which the submission will be deemed invalid. Bidders are responsible for resolving all access rights and submission queries before the tender closing date.

SSS Queries Contact: Lindo Dlamini: Tel: 031-3227133/031-3227153 email: supplier.selfservice@durban.gov.za

A one-envelope procedure is required.

Telephonic, telegraphic, telex, facsimile or e-mailed tender offers will not be accepted.

F.2.15 **Closing time**: The closing time for delivery of tender offers is:

- Date : **Friday, 06 June 2025**
- Time : **11h00**

F.2.16 **Tender offer validity**: The Tender Offer validity period is 120 Days from the closing date for submission of tenders.

F.2.20 **Submit securities, bonds, policies:** The tenderer is required to submit with his tender a letter of intent from an approved insurer undertaking to provide the Performance Bond to the format included in T2.2 of this procurement document.

F.2.23 **Certificates**: Refer to T2.1 for a listing of certificates that must be provided with the tender. All certificates must be valid at the time of tender closing.

Tenderers are to include, at the back of their tender submission document, a printout of the required documents/ certificates.

The Form of Offer (C1.1.1), Data to be provided by the Contractor (C1.2.2.2), and the Bill of Quantities (C2.2) are also required to be completed in full.

Tax Clearance

Reference is also to be made to returnable form T2.2.3: “Tax Compliance Status PIN/ Tax Clearance Certificate”.

SARS has introduced a new Tax Compliance Status System. Tenderers must submit a **Tax Compliance Status PIN** (TCS PIN) instead of an original Tax Clearance Certificate. This TCS PIN can be used by third parties to certify the taxpayer’s real-time compliance status. This TCS PIN is to be entered on Returnable Document T2.2.1: “Compulsory Enterprise Questionnaire”. Separate Tax Clearance Certificates / TCS PINs are required for each entity in a Joint Venture.

Failure to comply will make the tender non-responsive.

Compensation Commissioner

Reference is also to be made to returnable form T2.2.13: “Eligibility: Registration with Compensation Commissioner”.

The tenderer is to supply proof of being registered and in good standing with the compensation fund by submitting a valid **Letter of Good Standing** from the Compensation Commissioner.

Failure to comply will make the tender non-responsive.

Central Supplier Database (CSD)
Reference is also to be made to returnable form T2.2.14: "Eligibility: CSD Registration Report".

The entities (full) **CSD Registration Report**, obtained from the National Treasury Central Supplier Database, is to be included in the tender submission (https://secure.csd.gov.za).

Separate CSD Registration Reports are required for each entity in a Joint Venture.

CIDB Registration
Reference is also to be made to returnable form T2.2.15: "Eligibility: Verification of CIDB Registration and Status".

Registration with the CIDB must be reflected as "Active" at time of tender closing.

Tenderers are to include with their submission a printout of their **CIDB Registration**, obtained from the CIDB website (https://registers.cidb.org.za/PublicContractors/ContractorSearch).

The Joint Venture Grading Designation Calculator should be used when submitting as a Joint Venture (https://registers.cidb.org.za/PublicContractors/JVGradingDesignationCalc).

The date of obtaining the CIDB printout(s) is to be indicated on the printout.

F.3: THE EMPLOYER'S UNDERTAKINGS

F.3.1.1 **Respond to requests from the tenderer:** Replace the words "five working days" with "three working days".

F.3.2 **Issue addenda:** Add the following paragraph: "Addenda will be published, in electronic format, on the same platform(s) as the Tender Notification (refer to F.1.2).

F.3.11 **Evaluation of Tender Offers:**

Eligibility

Tenders will be checked for compliance with the ELIGIBILITY requirements, as specified in T1.2.2 Clause F.2.1. Tenderers not in compliance will be deemed non-responsive.

Functionality

FUNCTIONALITY will be evaluated to determine the responsiveness of tenders received. The minimum score for FUNCTIONALITY is 60 points. Those tenders not achieving the minimum score will be deemed non-responsive.

The functionality Criteria, Sub-Criteria, Points per Criteria/ Sub-Criteria, Returnable Documentation and Schedules, Method of Evaluation, and Prompts for Judgement are as specified in T1.2.3: "Additional Conditions of Tender".

Preference Point System

The financial offer will be reduced to a comparative basis using the **Tender Assessment Schedule**.

The procedure for the evaluation of responsive tenders is **PRICE AND PREFERENCE** in accordance with

the Employer's current SCM Policy, the Preferential Procurement Policy Framework Act (5 of 2000), and the Preferential Procurement Policy Framework Act Regulations (2022).

Price Points

The **90/10** preference points system will be applied. The Formula used to calculate the **Price Points (max. 90)** will be according to that specified Regulation 5.1.

Preference Points

Reference is also to be made to T2.2.7: "MBD 6.1: Preference Points Claim".

The Preference Points (either 20 or 10) will be derived from points allocated/ claimed for **Specific Goals** as indicated in the table(s) below, according to the specified **Goal/ Category Weightings**.

- **Ownership Goal**

Goal Weighting: 40%

The tendering entity's **Percentage Ownership**, in terms of the **Ownership Category(s)** listed below, is to be used in the determination of the tenderer's claim for **Preference Points**.

Ownership Categories	Criteria	80/20	90/10
Race: Black (50%)	Equals 0%	n/a	0
	Between 0% and 51%	n/a	4
	Greater or equal to 51% and less than 100%	n/a	8
	Equals 100%	n/a	10
Gender: Female (30%)	Equals 0%	n/a	0
	Between 0% and 51%	n/a	4
	Greater or equal to 51% and less than 100%	n/a	8
	Equals 100%	n/a	10
Disabilities (20%)	Equals 0%	n/a	0
	Between 0% and 51%	n/a	4
	Greater or equal to 51% and less than 100%	n/a	8
	Equals 100%	n/a	10
	Maximum Goal Points:	n/a	30

The **Weightings** of the **Ownership Categories** will be:

- w1 = xxx%, w2=xxx%, w3=xxx% (where: w1 + w2 + w3 = 100%)

Proof of claim as declared on MBD 6.1 (1 or more of the following will be used in verifying the tenderer's status)

- Companies and Intellectual Property Commission registration document (CIPC)
- CSD report.
- B-BBEE Certificate of the tendering entity.
- Consolidated BBBEE Certificate if the tendering entity is a Consortium, Joint Venture, or Trust (Issued by verification agency accredited by the South African Accreditation System).
- Agreement for a Consortium, Joint Venture, or Trust.

- **RDP Goal: The promotion of South African owned enterprises**
  Goal Weighting: 60%

  The tendering entity's Address (as stated on the National Treasury Central Supplier Database (CSD) or on the eThekwini Municipality Vendor Portal) is to be used in the determination of the tenderer's claim for Preference Points for this Specific Goal.

Location	80/20	90/10
Not in South Africa	n/a	0
South Africa	n/a	10
Maximum Goal Points:	n/a	10

Proof of claim as declared on MBD 6.1 (1 or more of the following will be used in verifying the tenderer's status) - CSD report

F.3.13 **Acceptance of tender offer:** In addition to the requirements of Clause F.3.13 of the Standard Conditions of Tender, tender offers will only be accepted if:

(a) The tenderer submits a **valid Tax Clearance Certificate OR Tax Compliance Status PIN**, issued by the TCS System of the South African Revenue Services, or has made arrangements to meet outstanding tax obligations.
(b) The tenderer is **registered, and "Active", with the Construction Industry Development Board**, at time of tender closing, in an appropriate contractor grading designation.
(c) The tenderer or any of its directors/shareholders is n**ot listed on the Register of Tender Defaulters** in terms of the Prevention and Combating of Corrupt Activities Act of 2004 as a person prohibited from doing business with the public sector.
(d) The tenderer has not:
  - Abused the Employer's Supply Chain Management System; or
  - Failed to perform on any previous contract and has been given a written notice to this effect.
(e) The tenderer has completed the **Compulsory Enterprise Questionnaire** and there are no conflicts of interest which may impact on the tenderer's ability to perform the contract in the best interests of the Employer or potentially compromise the tender process.
(f) The tenderer is **registered and in good standing with the compensation fund or** with a **licensed compensation insurer**.
(g) The Employer is reasonably satisfied that the tenderer has in terms of the Construction Regulations, 2014, issued in terms of the Occupational Health and Safety Act, 1993, the **necessary competencies and resources to carry out the work safely**.

The Municipality does not bind itself to accept the lowest or any tender. It reserves the right to accept the whole or any part of a tender to place orders. Bidders shall not bind the Municipality to any minimum quantity per order. The successful Tenderer (s) shall be bound to provide any quantities stipulated in the specification.

The municipality has a firm intention to proceed with the work, subject to funding being identified. Notwithstanding clause F.1.1.3 of the Standard Conditions of Tender, the municipality reserves the right to award or not award the tender based on the municipalities available budget.

F.3.15 **Complete adjudicator's contract:** Refer to the General Conditions of Contract and the Contract Data.

F.3.17 **Copies of contract:** The number of paper copies of the signed contract to be provided by the Employer is ONE (1).

Tenderers are to include, with their "hard copy" submission, a memory-stick containing an electronically scanned (300 dpi resolution) Public Document Format (PDF) copy of their complete bid submission. This PDF file should be named using the contract number and the Tenderer's name, eg. **"31144-5E – Tenderers Name.PDF**". The memory-stick must be labelled with the Tenderer's name and securely fixed to the paper submission.

T1.2.3 ADDITIONAL CONDITIONS OF TENDER

T1.2.3.1 Appeals

In terms of Regulation 49 of the Municipal Supply Chain Management Regulations persons aggrieved by decisions or actions taken by the Municipality, may lodge an appeal within 14 days of the decision or action, in writing to the Municipality. All appeals (clearly setting out the reasons for the appeal) and queries with regard to the decision of award are to be directed to:

The City Manager
Attention Ms S. Pillay eMail: Simone.Pillay@durban.gov.za
P O Box 1394
DURBAN, 4000

T1.2.3.2 Prohibition on awards to persons in the service of the state

Clause 44 of the Supply Chain Management Regulations states that the Municipality or Municipal Entity may not make any award to a person:

(a) Who is in the service of the State;
(b) If that person is not a natural person, of which a director, manager, principal shareholder or stakeholder is a person in the service of the state; or
(c) Who is an advisor or consultant contracted with the municipality or a municipal entity.

Should a contract be awarded, and it is subsequently established that Clause 44 has been breached, the Employer shall have the right to terminate the contract with immediate effect.

T1.2.3.3 Code of Conduct and Local Labour

The Tenderers shall make themselves familiar with the requirements of the following policies that are available on web address: ftp://ftp.durban.gov.za/cesu/StdContractDocs/:

- Code of Conduct;
- The Use of CLOs and Local Labour.

T1.2.3.4 Targeted Procurement

SCMP Cl.52.21(d) If feasible to contract for a contract above R30m, an organ of state must apply subcontracting to advance designated groups.

T1.2.3.5 Functionality Specification

Functionality Evaluation is applicable to this tender.

The value of W_2 is 100. The Functionality criteria (and sub criteria if applicable) and maximum score in respect of each of the criteria are as follows:

Functionality Criteria / Sub Criteria		**Maximum Points Score**
Tenderer's Experience		25
Project Organogram and Experience of Key Staff	Projects Manager	10
	Professional Design Engineer	10
	Factory Acceptance Test (FAT) Engineers	5
	Commissioning Engineer	10
	Quality Control Officer	5
	Site Supervisor	10
Preliminary Programme		5
Construction Methodology		10
Quality Control Plan		10
	Maximum possible score for Functionality (M_s)	100

The minimum number of evaluation points for Functionality is 60. Only those tenderers who achieve the minimum number of Functionality evaluation points (or greater) will be eligible to have their tenders further evaluated.

Functionality shall be scored by not less than three evaluators and the scores of each of the evaluators will be averaged, weighted and then totalled to obtain the final score for Functionality. Each evaluation criteria will be assessed in terms of six indicators and scores allocated according to the following table:

Level 0	**Level 1**	**Level 2**	**Level 3**	**Level 4**	**Level 5**
0	20	40	60	80	100

Evaluation criteria will be adjudicated according to submissions made in accordance with the following schedules, which are found in T2.2: Returnable Schedules:

Functionality Criteria	**Returnable Schedules**
Tenderer's Experience	• Experience of Tenderer
Project Organogram and Experience of Key Staff	• Proposed Organisation and Staffing • Key Personnel • CV's with Experience of Key Personnel
Preliminary Programme	• Preliminary Programme
Construction Methodology & Quality Control Plan	• Construction Approach, • Methodology, and Quality Control • Schedule of Proposed Subcontractors • Plant and Equipment

Unless otherwise stated, evaluation criteria will be adjudicated with respect to the contract specific Scope of Work, as specified in C.3. In this regard the following definitions apply to the evaluation criteria prompts for judgement:

- "**successfully completed**" implies a project has been completed on time and to specification;
- "**similar nature**" implies projects that include supply, delivery, off-loading, installation and testing of power transformers of the same rating or higher;
- "**experience**" implies experience on projects of a similar nature;
- "**accredited degree / diploma**" implies a minimum 3 year qualification within the built environment, from a registered University or University of Technology.

Criterion: Tenderer's Experience	
Level 0	No information provided; OR submission of no substance / irrelevant information provided
Level 1	To have successfully completed (i.e. on time and to specification) 1 project of a similar nature within the past 15 years.
Level 2	To have successfully completed (i.e. on time and to specification) 2 projects of a similar nature within the past 15 years.
Level 3	To have successfully completed (i.e. on time and to specification) 3 projects of a similar nature within the past 15 years.
Level 4	To have successfully completed (i.e. on time and to specification) 4 projects of a similar nature within the past 15 years.
Level 5	To have successfully completed (i.e. on time and to specification) 5 projects of a similar nature within the past 15 years.

Criterion: Project Organogram and Experience of Key Staff Note 1: "experience" implies experience on projects of a similar nature as outlined above. Note 2: "accredited degree / diploma" implies a minimum 3-year relevant qualification from a registered University or University of Technology.	
Level 0	No information provided; OR submission of no substance/irrelevant information provided
Level 1	**Proposed Organisation and Staffing:** To have provided an incomplete organogram **Project Manager**: Minimum 2 years relevant experience and accredited 3-year diploma/degree in Engineering. **Professional Design Engineer**: Minimum 2 years relevant experience and relevant accredited 4 year degree & registered with ECSA as Professional Engineer. **FAT Engineers**: Minimum 2 years relevant experience and accredited 3-year diploma/degree in Electrical Engineering. **Commissioning Engineer:** Minimum 4 years relevant experience or relevant accredited 3 or 4 year Electrical Engineering diploma/degree. **Quality Control Officer**: Minimum 3 years relevant experience and accredited 3-year diploma/degree in Electrical Engineering. **Installation Team:** **Site Supervisor:** Minimum 3 years relevant experience on projects and trade tested or accredited 3-year diploma/degree in Electrical Engineering.
Level 2	**Project Manager**: Minimum 4 years relevant experience and relevant accredited 3 year diploma/degree in Engineering. **Professional Design Engineer**: Minimum 4 years relevant experience and relevant accredited 4 year degree & registered with ECSA as Professional Engineer. **FAT Engineers**: Minimum 4 years relevant experience and relevant accredited 3 year diploma/degree in Engineering. **Commissioning Engineer**: Minimum 4 years relevant experience or relevant accredited 3 or 4 year Electrical Engineering diploma/degree. **Quality Control Officer**: Minimum 4 years relevant experience and relevant accredited 3 year diploma/degree in Electrical Engineering. **Installation Team:** **Site Supervisor:** Minimum 4 years relevant experience and relevant accredited 3 or 4 year diploma/degree in Electrical Engineering.

Level 3	**Project Manager**: Minimum 5 years relevant experience and relevant accredited 3 year diploma/degree in Engineering. **Professional Design Engineer**: Minimum 5 years relevant experience and relevant accredited 4 year degree & registered with ECSA as Professional Engineer. **FAT Engineers**: Minimum 5 years relevant experience and relevant accredited 3 year diploma/degree in Electrical Engineering. **Commissioning Engineer**: Minimum 5 years relevant experience and relevant accredited 3 or 4 year Electrical Engineering diploma/degree. **Quality Control Officer**: Minimum 5 years relevant experience and relevant accredited 3 year diploma/degree in Electrical Engineering. **Installation Team:** **Site Supervisor:** Minimum 5 years relevant experience on projects and trade tested or relevant accredited 3 or 4 year diploma/degree in Electrical Engineering.
Level 4	**Project Manager**: Minimum 8 years relevant experience and relevant accredited 3 year diploma/degree in Engineering and 8 years relevant experience. **Professional Design Engineer**: Minimum 8 years relevant experience and relevant accredited 4 year degree & registered with ECSA as Professional Engineer. **FAT Engineers**: Minimum 8 years relevant experience and relevant accredited 3 year diploma/degree in Electrical Engineering. **Commissioning Engineer**: Minimum 8 years relevant experience and relevant accredited 3 or 4 year Electrical Engineering diploma/degree. **Quality Control Officer**: Minimum 8 years relevant experience and relevant accredited 3 year diploma/degree in Electrical Engineering. **Installation Team:** **Site Supervisor:** Minimum 8 years relevant experience on projects and trade tested or relevant accredited 3 or 4 year diploma/degree in Electrical Engineering.
Level 5	**Project Manager**: Minimum 15 years relevant experience and relevant accredited 3 year diploma/degree in Engineering. **Professional Design Engineer**: Minimum 15 years relevant experience and relevant accredited 4 year degree & registered with ECSA as Professional Engineer. **FAT Engineers**: Minimum 10 years relevant experience and relevant accredited 3 year diploma/degree in Electrical Engineering. **Commissioning Engineer**: Minimum 10 years relevant experience or relevant accredited 3 or 4 year Electrical Engineering diploma/degree. **Quality Control Officer**: Minimum 10 years relevant experience and relevant accredited 3 year diploma/degree in Electrical Engineering. **Site Supervisor:** Minimum 10 years relevant experience on projects and trade tested or relevant accredited 3 or 4 year diploma/degree in Electrical Engineering.

Criterion: Preliminary Programme	
Level 0	No information provided; OR submission of no substance / irrelevant information provided
Level 1	The tenderer has misunderstood certain aspects of the Scope of Work and does not deal with the critical aspects of the project.
Level 2	The programme does not adequately deal with the critical characteristics of the project or the plan and manner in which risk is to be managed.
Level 3	Programme covers all the applicable individual activities which are in an acceptable sequence, with appropriate durations, and is in accordance with generally accepted construction practice, and is in line with Clause 1.1.1.14 of the Conditions of Contract (time for achieving Practical Completion). Programme must show the critical path
Level 4	In addition to the requirements of level 3, the programme covers all activities, meetings, requirements and is sufficiently flexible to accommodate changes that may be required during execution within project completion time.
Level 5	In addition to the requirements of level 4, the program covers all activities, meetings, requirements and accommodates changes and details ways to improve the overall project outcome within the completion time.

Criterion: Construction Methodology & Quality Control Plan	
Level 0	No information provided; OR submission of no substance / irrelevant information provided
Level 1	The technical approach / methodology, plant and equipment is poor and gives no relevant information in satisfying the projects objectives. Quality control statement is poor with no relevant information
Level 2	The technical approach and/or methodology is less than acceptable and unlikely to satisfy project objectives or requirements. Plant and equipment is unlikely to provide adequate protection of the works. Quality control statement is generic.
Level 3	Brief overview of a site specific methodology which encompasses all programmed activities in appropriate order and includes staff, plant and equipment resources, including subcontractors if applicable, a brief description of preparatory work, construction processes including finishing works for each activity. Quality Control Officer must administer all activities. Quality control statements are site specific, with statements covering the required sampling and testing requirements for the programmed activities.
Level 4	The methodology is specifically tailored to address specific project requirements. The methods and approach to managing risk etc. are specifically tailored to the critical characteristics of the project. The plant and equipment are specifically tailored to the project requirements and are sufficiently adaptable to accommodate changes that may be required during execution. Quality Control Officer must administer all activities Quality control statements are site specific covering required sampling and testing for programmed activities including site specific quality control checklist for programmed activities
Level 5	Besides meeting the “above Level 4” rating, the important issues are approached in an innovative and efficient way, indicating that the tenderer has excellent knowledge of working in the projects environment and producing the required final product. Plant and equipment proposals and ownership/provision arrangements are most likely to ensure a satisfactory project outcome. Quality Control Officer must administer all activities. Quality control statements are site specific covering required sampling and testing for all programmed activities including site specific quality control checklist for all programmed activities

PART T2: RETURNABLE DOCUMENTS

T2.1 LIST OF RETURNABLE DOCUMENTS

T2.1.1 General

The Tender Submission Documentation must be submitted in its entirety. All forms must be properly completed as required.

The Tenderer is required to complete each and every Schedule and Form listed below to the best of their ability as the evaluation of tenders and the eventual contract will be based on the information provided by the Tenderer. Failure of a Tenderer to complete the Schedules and Forms to the satisfaction of the Employer will inevitably prejudice the tender and may lead to rejection on the grounds that the tender is non-responsive.

T2.2 Returnable Schedules, Forms and Certificates

Entity Specific

Eligibility

Technical or Functionality Evaluation

T2.2 RETURNABLE SCHEDULES, FORMS, AND CERTIFICATES

The returnable schedules, forms, and certificates, as listed in T2.2, can be found on pages 21 to 196.

NOTE

The **Form of Offer** (C1.1.1), The **Data to be Provided by Contractor** (C1.2.2.2), and the **Bill of Quantities** (C2.2) are also required to be completed by the tenderer.

T2.2.1 COMPULSORY ENTERPRISE QUESTIONNAIRE

Ref	Description	Complete or Circle Applicable
1.1	Name of enterprise	
1.2	Name of enterprise's representative	
1.3	ID Number of enterprise's representative	
1.4	Position enterprise's representative occupies in the enterprise	
1.5	National Treasury Central Supplier Database Registration number	**MAAA**
1.6	eThekwini Supplier Database: Reference number (PR), if any:	**PR**
1.7	VAT registration number, if any:	
1.8	CIDB registration number, if any:	
1.9	Department of Labour: Registration number	
1.10	Department of Labour: Letter of Good Standing Certificate number	

2.0 **Particulars of sole proprietors and partners in partnerships (attach separate pages if more than 4 partners)**

	Full Name	Identity No.	Personal income tax No. *
2.1			
2.2			
2.3			
2.4			

3.0 **Particulars of companies and close corporations**

3.1	Company registration number, if applicable:	
3.2	Close corporation number, if applicable:	
3.3	Tax Reference number, if any:	
3.4	South African Revenue Service: Tax Compliance Status PIN:	

4.0 **Record in the service of the state** (Insert on a separate page if necessary)

Indicate by marking the relevant boxes with a cross, if any sole proprietor, partner in a partnership or director, manager, principal shareholder or stakeholder in a company or close corporation is currently or has been within the last 12 months in the service of any of the following:

- ☐ a member of any municipal council
- ☐ a member of any provincial legislature
- ☐ an official of any municipality or municipal entity
- ☐ a member of an accounting authority of any national or provincial public entity
- ☐ a member of the board of directors of any municipal entity
- ☐ a member of the National Assembly or the National Council of Province
- ☐ an employee of any provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act 1 of 1999)
- ☐ an employee of Parliament or a provincial legislature

Name of sole proprietor, partner, director, manager, principal shareholder or stakeholder	Name of institution, public office, board or organ of state and position held	Status of service (tick appropriate column)	
		Current	Within last 12 mths

5.0 **Record of spouses, children and parents in the service of the state** (Insert on a separate page if necessary)

Indicate by marking the relevant boxes with a cross, if any spouse, child or parent of a sole proprietor, partner in a partnership or director, manager, principal shareholder or stakeholder in a company or close corporation is currently or has been within the last 12 months in the service of any of the following:

- ☐ a member of any municipal council
- ☐ a member of any provincial legislature
- ☐ an official of any municipality or municipal entity
- ☐ a member of an accounting authority of any national or provincial public entity
- ☐ a member of the board of directors of any municipal entity
- ☐ a member of the National Assembly or the National Council of Province
- ☐ an employee of any provincial department, national or provincial public entity or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act 1 of 1999)
- ☐ an employee of Parliament or a provincial legislature

Name of spouse, child or parent	Name of institution, public office, board or organ of state and position held	Status of service (tick appropriate column)	
		Current	Within last 12 mths

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise:

i) authorizes the Employer to verify the tenderers tax clearance status from the South African Revenue Services that it is in order.
ii) confirms that the neither the name of the enterprise or the name of any partner, manager, director or other person, who wholly or partly exercises or may exercise, control over the enterprise appears on the Register of Tender Defaulters established in terms of the Prevention and Combating of Corrupt Activities Act of 2004.
iii) confirms that no partner, member, director or other person, who wholly or partly exercises, or may exercise, control over the enterprise appears, has within the last five years been convicted of fraud or corruption.
iv) confirms that I / we are not associated, linked or involved with any other tendering entities submitting tender offers and have no other relationship with any of the tenderers or those responsible for compiling the scope of work that could cause or be interpreted as a conflict of interest.
v) confirms that the contents of this questionnaire are within my personal knowledge and are to the best of my belief both true and correct.

NAME (Block Capitals): **Date**

SIGNATURE:

T2.2.2 CERTIFICATE OF ATTENDANCE AT CLARIFICATION MEETING / SITE INSPECTION

Reference is to be made to Clauses F.2.1(c) and F.2.7 of the Tender Data.

This is to certify that:

(entity name): .....

of (address): .....

.....

.....

was represented by the person(s) named below at the Clarification Meeting held for all tenderers, the details of which are stated in the Tender Data (F.2.7).

I / We acknowledge that the purpose of the meeting was to acquaint myself / ourselves with the site of the works and / or matters incidental to doing the work specified in the tender documents in order for me / us to take account of everything necessary when compiling our rates and prices included in the tender.

Particulars of person(s) attending the meeting:

Name: ……..…….. Name: ..... ……

Signature: ……..…….. Signature: ..... ……

Capacity: …… Capacity:……..……..……

Attendance of the above person(s) at the meeting is confirmed by the Employer's Agent's Representative, namely:

Name: ……

Signature: ……

Date: ……..…..

T2.2.3 TAX COMPLIANCE STATUS PIN

Reference is to be made to Clauses F.2.23 and F.3.13(a) of the Tender Data.

SARS has introduced a new Tax Compliance Status System. Tenderers can submit a Tax Compliance Status PIN (TCS PIN) instead of an original Tax Clearance Certificate. This TCS PIN can be used by third parties to certify the taxpayer's real-time compliance status.

Separate TCS PINs are required for each entity in a Joint Venture.

The TCS PIN(s) are to be entered under item 3.4 on form **T2.1.2.1: Compulsory Enterprise Questionnaire**.

Tenderers are to include, at the back of their submission document, a printout of their Tax Compliance Status PIN (TCS PIN) OR an original Tax Clearance Certificate.

Failure to include the required document will make the tender submission non-responsive.

I, the undersigned, who warrants that they are authorised to sign on behalf of the entity, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct, ***and that the requested documentation has been included in the submission****.*

NAME (Block Capitals): _____ **Date**

SIGNATURE: ---------- ----------

T2.2.4 CONTRACTOR'S HEALTH AND SAFETY DECLARATION

If Functionality is applicable as part of tender evaluation, reference is to be made to Clause F3.11.9 of the of the Conditions of Tender.

Reference is to be made to Clauses F.2.1(e) and F.2.23 of the Tender Data.

In terms of Clause 5(1)(h) of the OHSA 1993 Construction Regulations 2014 (referred to as "the Regulations" hereafter), a Principal Contractor may only be appointed to perform construction work if the Client is satisfied that the Principal Contractor has the necessary competencies and resources to carry out the work safely in accordance with the Occupational Health and Safety Act No 85 of 1993 and the OHSA 1993 Construction Regulations 2014.

To that effect, a person duly authorised by the tenderer, must complete and sign the declaration hereafter in detail.

Declaration by Tenderer

1 I, the undersigned, hereby declare and confirm that I am fully conversant with the Occupational Health and Safety Act No 85 of 1993 (as amended by the Occupational Health and Safety Amendment Act No 181 of 1993), and the OHSA 1993 Construction Regulations 2014.

2 I hereby declare that my company has the competence and the necessary resources to safely carry out the construction work under this contract in compliance with the Construction Regulations and the Employer's Health and Safety Specifications.

3 I propose to achieve compliance with the Regulations by one of the following **(Tenderers are to Circle Applicable - Yes or No)**:

	Circle Applicable	
(a) From my own competent resources as detailed in 4(a) hereafter.	Yes	NO
(b) From my own resources still to be appointed or trained until competency is achieved, as detailed in 4(b) hereafter:	Yes	NO
(c) From outside sources by appointment of competent specialist Subcontractors as detailed in 4(c) hereafter:	YES	NO

4 Details of resources I propose:
(Note: Competent resources shall include safety personnel such as a construction supervisor and construction safety officer as defined in Regulation 8, and competent persons as defined in Regulations 9, 10, 11, 12, 13, 14, 16, 17, 20, 21, 22, 23(1), 24, 25, 26, 27, 28 and 29, as applicable).

(a) Details of the competent and qualified key persons from my company's own resources, who will form part of the contract team:

NAMES OF COMPETENT PERSONS	POSITIONS TO BE FILLED BY COMPETENT PERSONS

(b) Details of training of persons from my company's own resources (or to be hired) who still have to be trained to achieve the necessary competency:

(i) By whom will training be provided?	
(ii) When will training be undertaken?	
(iii) Positions to be filled by persons to be trained or hired:	

(c) Details of competent resources to be appointed as subcontractors if competent persons cannot be supplied from own company:

Name of proposed subcontractor:	
Qualifications or details of competency of the subcontractor:	

5 I, the undersigned, hereby undertake, if this tender is accepted, to provide, before commencement of the works under the contract, a suitable and sufficiently documented Health and Safety Plan in accordance with Regulation 7(1) of the Construction Regulations, which plan shall be subject to approval by the Client.

6 I, the undersigned, confirm that copies of this company's approved Health and Safety Plan, the Client's Safety Specifications as well as the OHSA 1993 Construction Regulations 2014 will be provided on site and will at all times be available for inspection by the Principal Contractor's personnel, the Client's personnel, the Employer's Agent, visitors, and officials and inspectors of the Department of Labour.

7 I, the undersigned, hereby confirm that adequate provision has been made in the tendered rates and prices in the Bill of Quantities to cover the cost of all resources, actions, training and all health and safety measures envisaged in the OHSA 1993 Construction Regulations 2014, and that I will be liable for any penalties that may be applied by the Client in terms of the said Regulations (Regulation 33) for failure on the Principal Contractor's part to comply with the provisions of the Act and the Regulations.

8 I, the undersigned, agree that failure to complete and execute this declaration to the satisfaction of the Client will mean that this company is unable to comply with the requirements of the OHSA 1993 Construction Regulations (2014) and accept that this tender will be prejudiced and may be rejected at the discretion of the Client.

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

NAME (Block Capitals): **Date**

SIGNATURE:

T2.2.5 MBD 4: DECLARATION OF INTEREST

MSCM Regulations: "**in the service of the state**" means to be:

(a) a member of:
  (i) any municipal council.
  (ii) any provincial legislature.
  (iii) the national Assembly or the national Council of provinces.
(b) a member of the board of directors of any municipal enterprise.
(c) an official of any municipality or municipal enterprise.
(d) an employee of any national or provincial department, national or provincial public enterprise or constitutional institution within the meaning of the Public Finance Management Act, 1999 (Act No.1 of 1999).
(e) a member of the accounting authority of any national or provincial public enterprise.
(f) an employee of Parliament or a provincial legislature.

"**Shareholder**" means a person who owns shares in the company and is actively involved in the management of the company or business and exercises control over the company.

1 No bid will be accepted from persons **in the service of the state[1].**

2 Any person, having a kinship with persons **in the service of the state**, including a blood relationship, may make an offer or offers in terms of this invitation to bid. In view of possible allegations of favouritism, should the resulting bid, or part thereof, be awarded to persons connected with or related to **persons in service of the state**, it is required that the bidder or their authorised representative declare their position in relation to the evaluating/adjudicating authority and/or take an oath declaring his/her interest.

3 In order to give effect to the above, the following questionnaire must be completed and submitted with the bid.

3.1	Name of enterprise	Complete T2.1.2.1 Item 1.1
	Name of enterprise's representative	Complete T2.1.2.1 Item 1.2
3.2	ID Number of enterprise's representative	Complete T2.1.2.1 Item 1.3
3.3	Position enterprise's representative occupies in the enterprise	Complete T2.1.2.1 Item 1.4
3.4	Company Registration number	Complete T2.1.2.1 Item 3.1 or 3.2
3.5	Tax Reference number	Complete T2.1.2.1 Item 3.3
3.6	VAT registration number	Complete T2.1.2.1 Item 1.7

3.7 The names of all directors / trustees / shareholders / members / sole proprietors / partners in partnerships, their individual identity numbers and state employee numbers must be indicated in paragraph 4 below. In the case of a joint venture, information in respect of each partnering enterprise must be completed and submitted.

	Circle Applicable	
3.8 Are you presently in the service of the state?	YES	NO
If yes, furnish particulars:		
.....		
3.9 Have you been in the service of the state for the past twelve months?	YES	NO
If yes, furnish particulars:		
.....		

3.10 Do you have any relationship (family, friend, other) with persons in the service of the state and who may be involved with the evaluation and or adjudication of this bid? If yes, furnish particulars:	YES	NO
3.11 Are you, aware of any relationship (family, friend, other) between any other bidder and any persons in the service of the state who may be involved with the evaluation and or adjudication of this bid? If yes, furnish particulars:	YES	NO
3.12 Are any of the company's directors, trustees, managers, principle shareholders or stakeholders in service of the state? If yes, furnish particulars:	YES	NO
3.13 Are any spouse, child or parent of the company's directors, trustees, managers, principle shareholders or stakeholders in service of the state? If yes, furnish particulars:	YES	NO
3.14 Do you or any of the directors, trustees, managers, principle shareholders, or stakeholders of this company have any interest in any other related companies or business whether or not they are bidding for this contract ? If yes, furnish particulars:	YES	NO

4 The names of all directors / trustees / shareholders / members / sole proprietors / partners in partnerships, their individual identity numbers and state employee numbers must be indicated below. In the case of a joint venture, information in respect of each partnering enterprise must be completed and submitted

Full Name	Identity No.	State Employee No.	Personal income tax No.

Use additional pages if necessary

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

NAME (Block Capitals): **Date**

SIGNATURE:

T2.2.6 MBD 5: DECLARATION FOR PROCUREMENT ABOVE R10 MILLION
(ALL APPLICABLE TAXES INCLUDED)

For all procurement expected to exceed R10 million (all applicable taxes included), bidders must complete the following questionnaire.

		Circle Applicable	
1.0	Are you by law required to prepare annual financial statements for auditing?	YES	NO
1.1	**If YES, submit audited annual financial statements for the past three years or since the date of establishment if established during the past three years.**		
2.0	Do you have any outstanding undisputed commitments for municipal services towards any municipality for more than three months or any other service provider in respect of which payment is overdue for more than 30 days?	YES	NO
2.1	If NO, this serves to certify that the bidder has no undisputed commitments for municipal services towards any municipality for more than three months or other service provider in respect of which payment is overdue for more than 30 days.		
2.2	If YES, provide particulars.		
	……..……..		
	……..……..		
3.0	Has any contract been awarded to you by an organ of state during the past five years, including particulars of any material non-compliance or dispute concerning the execution of such contract?	YES	NO
3.1	If YES, provide particulars.		
	……..……..		
	……..……..		
4.0	Will any portion of goods or services be sourced from outside the Republic, and, if so, what portion and whether any portion of payment from the municipality / municipal entity is expected to be transferred out of the Republic?	YES	NO
4.1	If YES, provide particulars.		
	……..……..		
	……..……..		

If required by 1.1 above, tenderers are to include, at the back of their tender submission document, a printout of their audited annual financial statements.

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct, ***and, if required, that the requested documentation has been included in the tender submission****.*

NAME (Block Capitals): ..... **Date**

SIGNATURE: ....

T2.2.7 MBD 6.1: PREFERENCE POINTS CLAIM
In terms of THE PREFERENTIAL PROCUREMENT REGULATIONS (2022)

Reference is to be made to Clause F.3.11 of the Tender Data.

This preference form must form part of all tenders invited. It contains general information and serves as a claim form for preference points for specific goals.

NB: BEFORE COMPLETING THIS FORM, TENDERERS MUST STUDY THE GENERAL CONDITIONS, DEFINITIONS AND DIRECTIVES APPLICABLE IN RESPECT OF THE TENDER AND PREFERENTIAL PROCUREMENT REGULATIONS, 2022

1.0 GENERAL CONDITIONS

1.1 The following preference point systems are applicable to invitations to tender:

- the 80/20 system for requirements with a Rand value of up to R50 000 000 (all applicable taxes included).
- the 90/10 system for requirements with a Rand value above R50 000 000 (all applicable taxes included).

1.2 The applicable preference point system for this tender is the 90/10 preference point system.

1.3 Preference Points for this tender shall be awarded for:

- **Price** and **Specific Goals**: Either 80 or 90 (price) and 20 or 10 (specific goals), in terms of 1.2 above.
- The total Preference Points, for Price and Specific Goals, is 100.

1.4 Failure on the part of the tenderer to submit the required proof or documentation, in terms of the requirements in the Conditions of Tender for claiming specific goal preference points, will be interpreted that preference points for specific goals are not claimed.

1.5 The Municipality reserves the right to require of a tenderer, either before a tender is adjudicated or at any time subsequently, to substantiate any claim in regard of preferences, in any manner required by the Municipality.

2.0 DEFINITIONS

2.1 "**tender**" means a written offer in the form determined by an organ of state in response to an invitation to provide goods or services through price quotations, competitive tendering process or any other method envisaged in legislation.

2.2 "**price**" means an amount of money tendered for goods or services and includes all applicable taxes less all unconditional discounts.

2.3 "**rand value**" means the total estimated value of a contract in Rand, calculated at the time of bid invitation, and includes all applicable taxes.

2.4 "**tender for income-generating contracts**" means a written offer in the form determined by Municipality in response to an invitation for the origination of income-generating contracts through any method envisaged in legislation that will result in a legal agreement between the Municipality and a third party that produces revenue for the Municipality, and includes, but is not limited to, leasing and disposal of assets and concession contracts, excluding direct sales and disposal of assets through public auctions.

2.5 "**the Act**" means the Preferential Procurement Policy Framework Act, 2000 (Act No. 5 of 2000).

3.0 FORMULA FOR CALCULATION OF PREFERENCE PRICE POINTS

3.1 PROCUREMENT OF GOODS AND SERVICES

POINTS AWARDED FOR PRICE: A maximum of 90 points is allocated for price on the following basis:

90 / 10 Points System

$$Ps = 90\left(1 - \frac{Pt - Pmin}{Pmin}\right)$$

Where:
Ps = Points scored for price of tender under consideration
Pt = Price of tender under consideration
Pmin = Price of lowest acceptable tender

4.0 POINTS AWARDED FOR SPECIFIC GOALS

4.1 In terms of Regulation 4(2); 5(2); 6(2) and 7(2) of the Preferential Procurement Regulations, preference points must be awarded for specific goals stated in the tender. For the purposes of this tender the tenderer will be allocated points based on the goal(s) stated in **Table 1** below, as supported by proof/ documentation stated in the **Conditions of Tender**:

4.2 In cases where organs of state intend to use Regulation 3(2) of the Regulations, which states that if it is unclear whether the 80/20 or 90/10 preference point system applies, an organ of state must, in the tender documents, stipulate in the case of:

(a) an invitation for tender for income-generating contracts, that either the 80/20 or 90/10 preference point system will apply and that the highest acceptable tender will be used to determine the applicable preference point system, or
(b) any other invitation for tender, that either the 80/20 or 90/10 preference point system will apply and that the lowest acceptable tender will be used to determine the applicable preference point system,

then the organ of state must indicate the points allocated for specific goals for both the 90/10 and 80/20 preference point system.

TABLE 1: Specific Goals for the tender and maximum points for each goal are indicated per the table below.

Tenderers are to indicate their points claim for each of the Specific Goals in the shaded blocks.

The Specific Goals to be allocated points in terms of this tender	**Maximum Number of points ALLOCATED (80/20 system)**	**Maximum Number of points ALLOCATED (90/10 system)**	**Number of points CLAIMED (80/20 system)**	**Number of points CLAIMED (90/10 system)**
Ownership Goal: Race (black)	n/a	4	n/a	
RDP Goal: The promotion of South African owned enterprises.	n/a	6	n/a	
Total CLAIMED Points (10 Maximum)			n/a	

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, certify that the points claimed, based on the specific goals as specified in the tender, qualifies the tendering entity for the preference(s) shown.

I acknowledge that:

1) The information furnished is true and correct.

2) The preference points claimed are in accordance with the General Conditions as indicated in paragraph 1 of this form.

3) In the event of a contract being awarded as a result of points claimed as shown in paragraphs 1.4 and 4.2, the contractor may be required to furnish documentary proof to the satisfaction of the organ of state that the claims are correct.

4) If the specific goals have been claimed or obtained on a fraudulent basis, or any of the conditions of contract have not been fulfilled, the organ of state may, in addition to any other remedy it may have:

   (a) disqualify the person from the tendering process.
   (b) recover costs, losses or damages it has incurred or suffered as a result of that person's conduct.
   (c) cancel the contract and claim any damages which it has suffered as a result of having to make less favourable arrangements due to such cancellation.
   (d) recommend that the tenderer or contractor, its shareholders and directors, or only the shareholders and directors who acted on a fraudulent basis, be restricted from obtaining business from any organ of state for a period not exceeding 10 years, after the *audi alteram partem* (hear the other side) rule has been applied; and
   (e) forward the matter for criminal prosecution, if deemed necessary.

NAME (Block Capitals): ---------- **Date**

SIGNATURE: ---------- ----------

T2.2.8 MBD 8: DECLARATION OF BIDDER'S PAST SUPPLY CHAIN MANAGEMENT PRACTICES

1.0 This Municipal Bidding Document must form part of all bids invited.

2.0 It serves as a declaration to be used by municipalities and municipal entities in ensuring that when goods and services are being procured, all reasonable steps are taken to combat the abuse of the supply chain management system.

3.0 The bid of any bidder may be rejected if that bidder, or any of its directors have:

a) abused the municipal entity's supply chain management system or committed any improper conduct in relation to such system.
b) been convicted for fraud or corruption during the past five years.
c) wilfully neglected, reneged on or failed to comply with any government, municipal or other public sector contract during the past five years.
d) been listed in the Register for Tender Defaulters in terms of section 29 of the Prevention and Combating of Corrupt Activities Act (No 12 of 2004).

4.0 In order to give effect to the above, the following questions must be completed and submitted with the bid.

		Circle Applicable	
4.1	Is the bidder or any of its directors listed on the National Treasury's Database of Restricted Suppliers as companies or persons prohibited from doing business with the public sector? (Companies or persons who are listed on this Database were informed in writing of this restriction by the Accounting Officer / Authority of the institution that imposed the restriction after the audi alteram partem rule was applied.) The Database of Restricted Suppliers now resides on the National Treasury's website (www.treasury.gov.za) and can be accessed by clicking on its link at the bottom of the home page.	YES	NO

4.1.1 If YES, provide particulars.

.....

.....

4.2	Is the bidder or any of its directors listed on the Register for Tender Defaulters in terms of section 29 of the Prevention and Combating of Corrupt Activities Act (No 12 of 2004)? The Register for Tender Defaulters can be accessed on the National Treasury's website (www.treasury.gov.za) by clicking on its link at the bottom of the home page.	YES	NO

4.2.1 If YES, provide particulars.

.....

.....

4.3	Was the bidder or any of its directors convicted by a court of law (including a court of law outside the Republic of South Africa) for fraud or corruption during the past five years?	YES	NO

4.3.1 If YES, provide particulars.

.....

.....

4.4	Does the bidder or any of its directors owe any municipal rates and taxes or municipal charges to the municipality / municipal entity, or to any other municipality / municipal entity, that is in arrears for more than three months?	YES	NO

4.4.1 If YES, provide particulars.

……

……

4.5	Was any contract between the bidder and the municipality / municipal entity or any other organ of state terminated during the past five years on account of failure to perform on or comply with the contract?	YES	NO

4.5.1 If YES, provide particulars.

……

……

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

I accept that, in addition to cancellation of a contract, action may be taken against me should this declaration prove to be false.

NAME (Block Capitals): **Date**

SIGNATURE:

T2.2.9 MBD 9: CERTIFICATE OF INDEPENDENT BID DETERMINATION

NOTES

[1] Includes price quotations, advertised competitive bids, limited bids and proposals.

[2] Bid rigging (or collusive bidding) occurs when businesses, that would otherwise be expected to compete, secretly conspire to raise prices or lower the quality of goods and / or services for purchasers who wish to acquire goods and / or services through a bidding process. Bid rigging is, therefore, an agreement between competitors not to compete.

[3] Joint venture or Consortium means an association of persons for the purpose of combining their expertise, property, capital, efforts, skill and knowledge in an activity for the execution of a contract.

1.0 This Municipal Bidding Document (MBD) must form part of all **bids**[1] invited.

2.0 Section 4 (1) (b) (iii) of the Competition Act No. 89 of 1998, as amended, prohibits an agreement between, or concerted practice by, firms, or a decision by an association of firms, if it is between parties in a horizontal relationship and if it involves collusive bidding (or **bid rigging**).[2] Collusive bidding is a *pe se* prohibition meaning that it cannot be justified under any grounds.

3.0 Municipal Supply Regulation 38 (1) prescribes that a supply chain management policy must provide measures for the combating of abuse of the supply chain management system, and must enable the accounting officer, among others, to:

a. take all reasonable steps to prevent such abuse;
b. reject the bid of any bidder if that bidder or any of its directors has abused the supply chain management system of the municipality or municipal entity or has committed any improper conduct in relation to such system; and
c. cancel a contract awarded to a person if the person committed any corrupt or fraudulent act during the bidding process or the execution of the contract.

4.0 This MBD serves as a certificate of declaration that would be used by institutions to ensure that, when bids are considered, reasonable steps are taken to prevent any form of **bid rigging**.

5.0 In order to give effect to the above, the attached Certificate of Bid Determination (MBD 9) must be completed and submitted with the bid.

CERTIFICATE OF INDEPENDENT BID DETERMINATION

I, the undersigned, in submitting the accompanying bid:

(Bid Number and Description)

in response to the invitation for the bid made by:

(Name of Municipality / Municipal Entity)

do hereby make the following statements that I certify to be true and complete in every respect.

I certify, on behalf of:

(Name of Bidder)

that:

1. I have read and I understand the contents of this Certificate.

2. I understand that the accompanying bid will be disqualified if this Certificate is found not to be true and complete in every respect.

3. I am authorized by the bidder to sign this Certificate, and to submit the accompanying bid, on behalf of the bidder;

4. Each person whose signature appears on the accompanying bid has been authorized by the bidder to determine the terms of, and to sign, the bid, on behalf of the bidder;

5. For the purposes of this Certificate and the accompanying bid, I understand that the word "competitor" shall include any individual or organization, other than the bidder, whether or not affiliated with the bidder, who:
   (a) has been requested to submit a bid in response to this bid invitation.
   (b) could potentially submit a bid in response to this bid invitation, based on their qualifications, abilities or experience.
   (c) provides the same goods and services as the bidder and/or is in the same line of business as the bidder.

6. The bidder has arrived at the accompanying bid independently from, and without consultation, communication, agreement, or arrangement with any competitor. However, communication between partners in a joint venture or consortium[3] will not be construed as collusive bidding.

7. In particular, without limiting the generality of paragraphs 6 above, there has been no consultation, communication, agreement or arrangement with any competitor regarding:
   (a) prices.
   (b) geographical area where product or service will be rendered (market allocation).
   (c) methods, factors or formulas used to calculate prices.
   (d) the intention or decision to submit or not to submit, a bid.
   (e) the submission of a bid which does not meet the specifications and conditions of the bid.
   (f) bidding with the intention not to win the bid.

8. In addition, there have been no consultations, communications, agreements, or arrangements with any competitor regarding the quality, quantity, specifications and conditions or delivery particulars of the products or services to which this bid invitation relates.

9. The terms of the accompanying bid have not been, and will not be, disclosed by the bidder, directly or indirectly, to any competitor, prior to the date and time of the official bid opening or of the awarding of the contract.

10. I am aware that, in addition and without prejudice to any other remedy provided to combat any restrictive practices related to bids and contracts, bids that are suspicious will be reported to the Competition Commission for investigation and possible imposition of administrative penalties in terms of section 59 of the Competition Act No 89 of 1998 and or may be reported to the National Prosecuting Authority (NPA) for criminal investigation and or may be restricted from conducting business with the public sector for a period not exceeding ten (10) years in terms of the Prevention and Combating of Corrupt Activities Act No 12 of 2004 or any other applicable legislation.

NAME (Block Capitals): ---------- **Date**

SIGNATURE: _____ ----------

T2.2.10 JOINT VENTURES AGREEMENTS

Joint Venture agreement and Power of Attorney Agreements to be attached here (if applicable).

T2.2.11 RECORD OF ADDENDA TO TENDER DOCUMENTS

I / We confirm that the following communications received from the Employer or his representative before the date of submission of this tender offer, amending the tender documents, have been taken into account in this tender offer.

ADD.No	DATE	TITLE OR DETAILS
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

It is also confirmed that the requirements, as stated on the Addenda, have been complied with.

NAME (Block Capitals): _____ **Date**

SIGNATURE: ..... _____

T2.2.12 ELIGIBILITY: DECLARATION OF MUNICIPAL FEES

Reference is to be made to Clause F.2.1(f)(ii) of the Tender Data.

I, the undersigned, do hereby declare that the Municipal fees of:

.....
(full name of Company / Close Corporation / partnership / sole proprietary/Joint Venture)

(hereinafter referred to as the TENDERER) are, as at the date hereunder, fully paid or an Acknowledgement of Debt has been concluded with the Municipality to pay the said charges in instalments.

The following account details relate to property of the said TENDERER:

Account	**Account Number: to be completed by tenderer**											
Consolidated Account												
Electricity												
Water												
Rates												
JSB Levies												
Other												

I acknowledge that should the aforesaid Municipal charges fall into arrears, the Municipality may take such remedial action as is required, including termination of any contract, and any payments due to the Contractor by the Municipality shall be first set off against such arrears.

- Where the tenderer's place of business or business interests are outside the jurisdiction of eThekwini municipality, a copy of the accounts/ agreements from the relevant municipality are to be provided.

- Where the tenderer's Municipal Accounts are part of their lease agreement, then a copy of the agreement, or an official letter to that effect, is to be provided.

Tenderers are to include, at the back of their tender submission document, a printout of the above account's and or agreements signed with the municipality.

Failure to include the required document will make the tender submission non-responsive.

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct, ***and that the requested documentation has been included in the tender submission****.*

NAME (Block Capitals): **Date**

SIGNATURE:

T2.2.13 ELIGIBILITY: REGISTRATION WITH COMPENSATION COMMISSIONER

Reference is to be made to Clause F.2.1(f)(i) of the Tender Data.

The Occupational Injuries and Diseases Act (130 of 1993 as amended) (the Act) refers. A summary of the pertinent Clauses are listed below. The act is to be referenced for the full text of the clauses.

Clause 80: Employer to register with commissioner and furnish him with particulars
The Act requires that an Employer carrying out business in the Republic to register with the Compensation Commissioner. Any person who fails to comply with the provisions of this clause is guilty of an offence.

Clause 82: Employer to furnish returns of earnings
The Act requires an Employer to furnish the commissioner with a return showing:

- The amount of earnings paid by him to his employees.
- Any further information as may be prescribed or as the commissioner may require.

Any Employer who fails to comply with the provisions of this clause is guilty of an offence.

Clause 86: Assessment to be paid by an employer to commissioner
The Act states that an Employer will receive notices of assessment from the commissioner. The Employer must pay the commissioner the assessment amount on the notices.

Clause 89: Mandators and contractors
The Act requires a contractor (a person with a contract with a mandator) to register as an Employer in accordance with the provisions of the Act and pay the necessary assessments. Failing registration or payment of assessments, the mandator is required to pay the assessments in respect of the employees of the contractor. The mandator is allowed to recover the assessment amounts paid from the contractor.

The Department of labour issues contractors with a **Letter of Good Standing** if the contractor has complied with the requirement(s) of the Act and is in "good standing" with the Compensation Fund. Employers can check the validity of such Letters of Good Standing on the internet (https://cfonline.labour.gov.za/VerifyLOGS).

Tenderers are to include, at the back of their tender submission document, a printout of their most recent Letter of Good Standing from the Department of Labour.

Failure to include the required document will make the tender submission non-responsive.

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct, ***and that the requested documentation has been included in the tender submission****.*

NAME (Block Capitals): _____ **Date**

SIGNATURE: _____ _____

T2.2.14 ELIGIBILITY: CSD REGISTRATION REPORT

Reference is to be made to Clauses F.2.1(e) and F.2.23 of the Tender Data.

The Conditions of Tender, Clause F.2.1: Eligibility, requires a tenderer to be registered, at the time of tender closing, on the **National Treasury Central Supplier Database (CSD)** as a service provider.

CSD Registration Reports can be obtained from the National Treasury's CSD website at https://secure.csd.gov.za/Account/Login.

The date of obtaining the printout is to be indicated on the printout.

The following is an example of the beginning of the printout obtained from the above website.

CENTRAL SUPPLIER DATABASE FOR GOVERNMENT

Report Date:

Report Ran By:

CSD REGISTRATION REPORT

SUPPLIER IDENTIFICATION

Supplier number		Have Bank Account	
Is supplier active?		Total annual turnover	
Supplier type		Financial year start date	
Supplier sub-type		Registration date	
Legal name		Created by	
Trading name		Created date	
Identification type		Edit by	
Government breakdown		Edit date	
Business status		Restricted Supplier	
Country of origin		Restriction Last Verification Date	
South African company/CC registration number			

Tenderers are to include, at the back of their tender submission document, a printout of their (full) CSD Registration Report.

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct, ***and that the requested documentation has been included in the tender submission****.*

NAME (Block Capitals): _____ **Date**

SIGNATURE: _____ _____

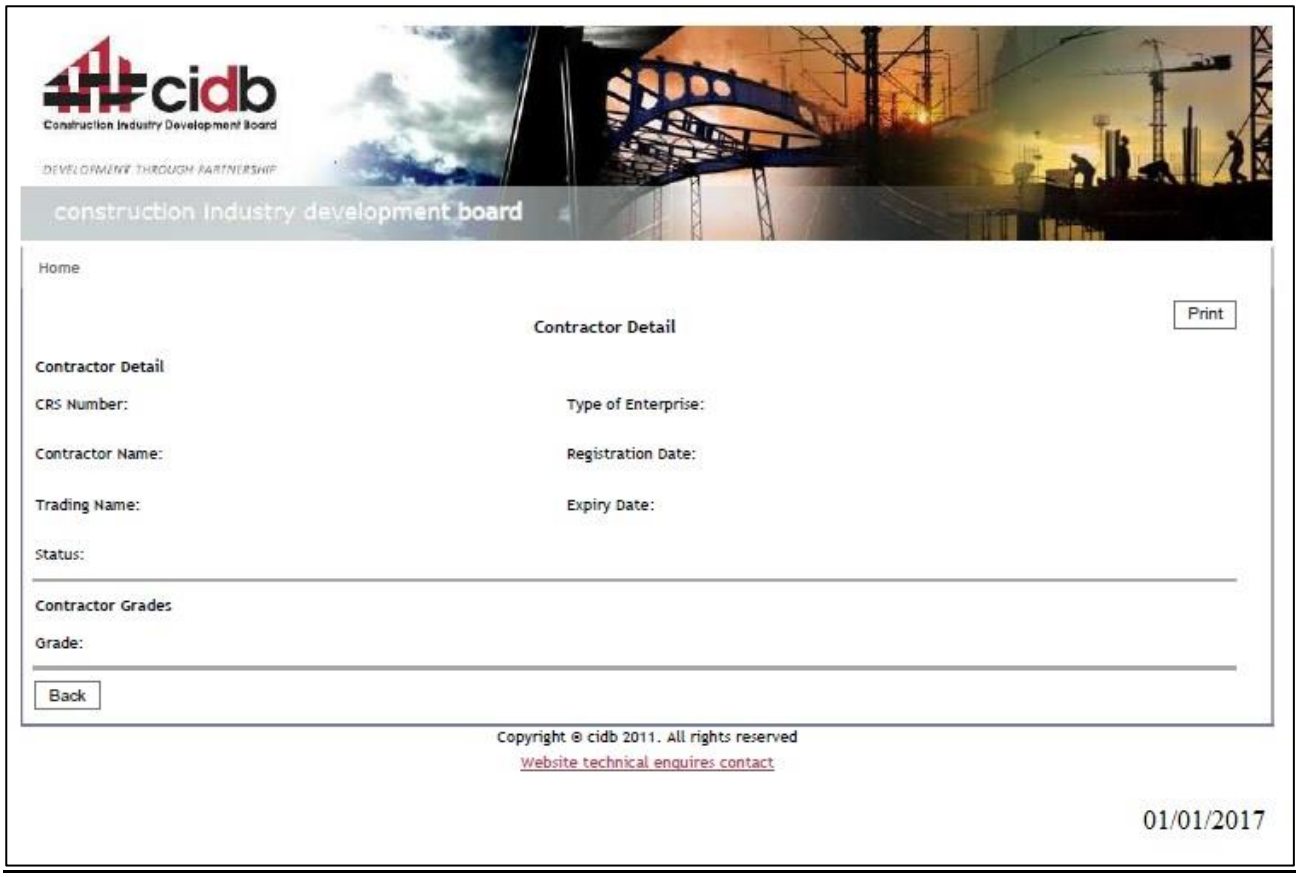
T2.2.15 ELIGIBILITY: VERIFICATION OF CIDB REGISTRATION AND STATUS

Reference is to be made to Clause F.2.1.1 and F.2.23 of the Tender Data.

The Conditions of Tender, **Clause F.2.1.1: Eligibility**, requires a tenderer to be registered, as "Active", with the CIDB (at time of tender closing), in a contractor grading designation equal to or higher than a contractor grading designation determined in accordance with the sum tendered, or a value determined in accordance with Regulation 25 (1B) or 25(7A) of the Construction Industry Development Regulations. The required class of construction work is specified in Clause F.2.1.1.

CIDB Registrations can be obtained from the CIDB website at https://registers.cidb.org.za/PublicContractors/ContractorSearch. The date of obtaining the printout is to be indicated on the printout.

The following is an example of the beginning of the printout obtained from the above website.



Tenderers are to include, at the back of their tender submission document, a printout of their registration with the CIDB.

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct, ***and that the requested documentation has been included in the tender submission****.*

NAME (Block Capitals): _____ **Date**

SIGNATURE: _____ _____

T2.2.16 (a) ELIGIBILITY: EXPERIENCE OF TENDERER

Reference is to be made to Clause F.2.1.2 of the Tender Data.
This form is to be copied and used for each submission of experience, as may be required.

Where options are provided (*), only one (1) selected option should be clearly marked with an " **X** ".

Tenderer's CIDB Grade:	1* 2* 3* 4* 5* 6* 7* 8* 9*	Experience as a:	Sub-Contractor* / Main Contractor*
Client / Employer:	Entity Name:		
	Contact Name:		
	Contact Tel:		0 0 0 - 0 0 0 0 - 0 0 0 0
	Contact Cell:		0 0 0 - 0 0 0 0 - 0 0 0 0
	Contact email / other:		
Client OR Main Contractor's Details Should the Employer's reasonable attempts to make contact, to verify the information provided, fail (for whatever reason) this experience submission will be considered invalid.	Entity Name:		
	Contact Name:		
	Contact Tel:		0 0 0 - 0 0 0 0 - 0 0 0 0
	Contact Cell:		0 0 0 - 0 0 0 0 - 0 0 0 0
	Contact email / other:		
Contract Details	Contract Number:		
	Contract Title:		
	Has this Contract been completed?	Y* N*	Commencement Date: d d m m 2 0 y y Completion Date (if applicable): d d m m 2 0 y y
Tendered Value (Contract Sum) OR Sub-Contract Value:	**R**	Final Contract Price OR Final Value of Sub-Contract:	**R**

Contract Scope-of-Work (Description of Works components)	If available in hard copy, the Scope-of-Work can be attached. Only include the Scope-of-Work (contract description). The Specification is not required.

In addition to the Scope-of-Work (entered above or attached) the following documentation / information is required to be attached to the back of this form.

Contractor Type and Contract Status	Proof of Sub-Contract Agreement	Letter of Award OR Form of Offer & Acceptance	Most recent Payment Certificate, OR most recent INVOICE, with Quantities summary	Final Payment Certificate, OR most recent INVOICE, with Quantities summary	Completion Certificate
Current Contract as Sub-Contractor	X		X		
Completed Contract as Sub-Contractor	X			X	
Current Contract as Main Contractor		X	X		
Completed Contract as Main Contractor		X		X	X

Failure to submit this returnable form, and provide the above supporting documentation/ information, for each submission of experience, will invalidate that experience submission

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct, ***and that the requested documentation has been included in the tender submission****.*

NAME (Block Capitals): **Date**

SIGNATURE:

T2.2.16 (b) EXPERIENCE OF TENDERER

Refer to Clause F3.11.9 for Functionality Points evaluation prompts (if applicable).

The following is a statement of works of similar nature (in relation to the scope of works) recently (within the past 5 years) executed by myself / ourselves.

Tenderers are to submit copies of signed completion certificates for all projects submitted.

EMPLOYER: CONTACT PERSON AND TELEPHONE NUMBER	CONSULTING ENGINEER: CONTACT PERSON AND TELEPHONE NUMBER	NATURE OF WORK	VALUE OF WORK (inclusive of VAT)	DATE COMPLETED

Attach additional pages if more space is required

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

NAME (Block Capitals): -- **Date**

SIGNATURE: -- ----------------------------

T2.2.17 PROPOSED ORGANISATION and STAFFING

Refer to Clause F3.11.9 for Functionality Points evaluation prompts (if applicable).

The tenderer should propose the structure and composition of their team i.e. the main disciplines involved, the key staff member / expert responsible for each discipline, and the proposed technical and support staff and site staff.

The roles and responsibilities of each key staff member / expert should be set out as job descriptions. In the case of an association / joint venture / consortium, it should, indicate how the duties and responsibilities are to be shared.

The tenderer must attach his / her organization and staffing proposals to this page. (this is to include both the on-site and off-site staffing resources used for this project)

In addition to any lists, this information should also be shown in an organogram format (flow chart) clearly indicating the staff hierarchy and reporting lines, again for on- and off-site resources.

The undersigned, who warrants that he / she is duly authorised to do so on behalf of the enterprise, confirms that the contents of this schedule are within my personal knowledge and are to the best of my belief both true and correct.

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

NAME (Block Capitals): _____ **Date**

SIGNATURE: _____ _____

T2.2.18 KEY PERSONNEL

Refer to Clause F3.11.9 for Functionality Points evaluation prompts (if applicable).

The Tenderer shall list below the personnel which he intends to utilize on the Works, including key personnel (Project Manager, Design Engineer, FAT Engineer, Commissioning Engineer, Quality Control Officer, and Site Supervisor) which may have to be brought in from outside if not available locally.

CATEGORY OF EMPLOYEE	NUMBER OF PERSONS	
	KEY PERSONNEL, PART OF THE CONTRACTOR'S ORGANISATION	KEY PERSONNEL TO BE IMPORTED IF NOT AVAILABLE LOCALLY
1) Project Manager		
2) Professional Design Engineer(s)		
3) FAT Engineer(s)		
4) Commissioning Engineer(s)		
5) Quality Control Officer		
6) Installation Team:		
a) Site Supervisor		
b) Unskilled Workers		
Others:		
.....		

Note: CVs of key personnel may be requested during the contract period.

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

NAME (Block Capitals): _____ **Date**

SIGNATURE: _____ _____

T2.2.19 EXPERIENCE OF KEY PERSONNEL

Refer to Clause F3.11.9 for Functionality Points evaluation prompts (if applicable).

The experience of assigned staff member in relation to the Scope of Work will be evaluated from three different points of view:

1) General experience (total duration of professional activity), level of education and training and positions held of each discipline specific team leader.
2) The education, training, skills and experience of the Assigned Staff in the specific sector, field, subject, etc which is directly linked to the scope of work.
3) The key staff members' / experts' knowledge of issues which the tenderer considers pertinent to the project e.g. local conditions, affected communities, legislation, techniques etc.

A CV of the Project Manager, Design Engineer, FAT Engineer, Commissioning Engineer, Quality Control Officer, and Site Supervisor of not more than 2 pages should be attached to this schedule:

Each CV should be structured under the following headings:

a) Personal particulars
- name
- date and place of birth
- place (s) of tertiary education and dates associated therewith
- professional awards

b) Qualifications (degrees, diplomas, grades of membership of professional societies and professional registrations)

c) Skills

d) Name of current employer and position in enterprise

e) Overview of post-graduate / diploma experience (year, organization and position)

f) Outline of recent assignments / experience that has a bearing on the scope of work

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

NAME (Block Capitals): _____ **Date**

SIGNATURE: _____ _____

T2.2.20 PRELIMINARY PROGRAMME

This schedule shall be completed, signed and returned with the tender documents of which it forms part.

1.0 REQUIREMENTS

Item	Details	Week	Bidders' ability to meet required lead times (Yes/No)
1.1	Date of order	0	
1.2	Submission of outstanding information and drawings for approval	≤ 8	
1.3	Delivery of equipment to site	≤ 36	
1.4	Completion of equipment installation and site testing	≤ 40	
1.5	Submission of all "as-tested" information	≤ 40	

Failure to meet lead times specified above would result in the tender being deemed non-responsive.

2.0 TENDERERS GUARANTEES

The following periods are to be given in weeks from date of each official order, whether or not it is possible to meet the required periods. Tenders will be adjudicated according to this information.

Item	Details	Week
1.1	Date of order	……weeks
1.2	Submission of outstanding information and drawings for approval	……weeks from order
1.3	Delivery of equipment to site	……weeks from order
1.4	Completion of equipment installation and site testing	……weeks from order
	Submission of all "as-tested" information	……weeks from order

NAME: ……..... (Block Capitals)

SIGNATURE: ……..……..…..…… DATE: .....

(of person authorised to sign on behalf of the Tenderer)

T2.2.21 CONSTRUCTION APPROACH, METHODOLOGY, AND QUALITY CONTROL

Refer to Clause F3.11.9 for Functionality Points evaluation prompts (if applicable).

Construction Approach and Methodology

The construction approach and methodology must respond to the Scope of Work and outline the proposed approach to undertake the work showing a detailed programme including health and safety aspects, the use of plant and resources for this Project.

Quality Control

The quality control statement must discuss what tests and control measures are to be employed in the factory and on site to attain the specified results and is to cover the program associated activities.

The tenderer must attach his / her Construction Methodology and Quality Control information to this page.

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

NAME (Block Capitals): _____ **Date**

SIGNATURE: ..... _____

T2.2.22 SCHEDULE OF PROPOSED SUBCONTRACTORS

The following firms have been identified as possible subcontractors for work in this contract.

NAMES AND ADDRESSES OF PROPOSED SUBCONTRACTORS	NATURE AND EXTENT OF WORK TO BE SUBCONTRACTED	PREVIOUS EXPERIENCE WITH SUBCONTRACTOR

Attach additional pages if more space is required

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

NAME (Block Capitals): ______________________ **Date**

SIGNATURE: ______________________ ______________

T2.2.23 PLANT and EQUIPMENT

Refer to Clause F3.11.9 for Functionality Points evaluation prompts (if applicable).

The following are lists of major items of relevant equipment that I / we presently own or lease and will have available for this contract if my / our tender is accepted.

(a) Details of major equipment that is owned by me / us and immediately available for this contract.

DESCRIPTION (type, size, capacity etc)	QUANTITY	YEAR OF MANUFACTURE

Attach additional pages if more space is required

(b) Details of major equipment that will be hired, or acquired for this contract if my / our tender is accepted

DESCRIPTION (type, size, capacity etc)	QUANTITY	HOW ACQUIRED	
		HIRE/ BUY	SOURCE

Attach additional pages if more space is required

The Tenderer undertakes to bring onto site without additional cost to the Employer any additional plant not listed but which may be necessary to complete the contract within the specified contract period.

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

NAME (Block Capitals): _____ **Date**

SIGNATURE: ..... _____

T2.2.24 CONTRACTOR'S HEALTH AND SAFETY PLAN

Refer to Clause F3.11.9 for Functionality Points evaluation prompts (if applicable).

At tender stage only a brief overview (**to be attached to this page**) of the tenderers perception on the safety requirements for this contract will be adequate.

Only the successful Tenderer shall submit separately the Contractor's Health and Safety Plan as required in terms of Regulation 7 of the Occupational Health and Safety Act 1993 Construction Regulations 2014.

The detailed safety plan will take into consideration the Project specific risks as mentioned under C.3: Project Specification. A generic plan will not be acceptable.

I, the undersigned, who warrants that they are authorised to sign on behalf of the Tenderer, confirms that the information contained in this form is within my personal knowledge and is to the best of my belief both true and correct.

NAME (Block Capitals): _____ **Date**

SIGNATURE: _____ _____

T2.2.25 TENDERER'S INFORMATION FOR POWER TRANSFORMERS

This schedule shall be completed, signed and returned with the tender documents of which it forms part.

1.0 Requirements:

Item	Description	Manufacturer	Place of Manufacture	Place of Testing	Place of Inspection
1.1	275/132 kV Power Transformers				
1.2	132/33 kV Power Transformers				
1.3	132/11 kV Power Transformers				
1.4	33/11 kV Power Transformers				
1.5	Vacuum Tap-Changers				
1.6	Tap-Change Control Panel				
1.7	Current Transformers				
1.8	**Bushings:**				
	HV				
	LV				
	HV Neutral				
	LV Neutral				
	Tertiary				
1.9	132 kV Plug-in cable Terminations				
1.10	33 kV Plug-in cable Terminations				
1.11	11 kV Plug-in cable Terminations				

1.12	Dehydrating Breathers				
1.13	Forced Cooling Equipment				
1.14	Tap-Change Control Relays				
1.15	Motors				
1.16	Neutral Earthing Resistors				
1.17	Structures for Neutral Earthing Resistors				
1.18	Continuous On-line Condition Monitoring Equipment				

Name: ..... (Block Capitals)

Signature: ..... Date: .....

(of person authorised to sign on behalf of the Tenderer)

T2.2.26 GUARANTEES AND PARTICULARS OF EQUIPMENT

This schedule shall be completed, signed and returned with the tender documents of which it forms part.

SECTION 1 275/132 kV 315 MVA Power Transformer

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
1.0	**Transformer General Information**		
1.1	Name of Manufacturer	---	
1.2	Country of Origin	---	
1.3	Do the transformers comply in all respects with the standard specifications quoted in section C3.2 *"General Technical Specification"*? (If not, indicate deviations)	Yes	Yes/No*
1.4	**Manufacturing Experience**		
	a) Number of 275 kV transformers manufactured at the factory in the last twelve (12) months	---	Transformer(s)
	b) Factory failure rate in five (5) years where transformers above 15 MVA form the sample group	---	%
1.5	**Type of Transformers**		
	Core	Core-form	
1.6	**Core Steel**		
	a) Manufacturer of core steel	---	
	b) Type of core steel [conventional grain oriented or high permeability]	Yes	
	c) Grade of core steel	---	
	d) Thickness of core steel	---	mm
1.7	**Core Dimensions**		
	a) Window height	---	mm
	b) Distance between core limb centres	---	mm
	c) Core diameter	---	mm
	d) Filling factor	---	
1.8	**Cross Sectional Areas**		

Item	Description		Technical Details	
			eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
			* Complete with whichever is applicable	
	a) Wound limbs		---	mm^2
	b) Yoke		---	mm^2
1.9	**Total core mass**		---	kg
1.10	The design flux density at nominal voltage for:			
	a) Wound limbs		[1,75 T	T
	b) Yoke		[1,75 T	T
1.11	**Volts/turn at the above flux**		---	V/turn
2.0	**Ratings**			
2.1	Supply Frequency		50 Hz	Hz
2.2	Number Phases		3	
2.3	Nominal Voltage at no load on nominal tap:			
	a) Primary		275 kV	kV
	b) Secondary		132 kV	kV
	c) Tertiary		22 kV	kV
2.4	Maximum Primary Operating Voltage		300 kV	kV
2.5	Connections		Star/Star	
2.6	Vector Group		YNa0(d1)	
2.7	Full load rating (on any tap position)		315 MVA	MVA
2.8	Tertiary winding rated to withstand maximum short circuit currents		Yes	Yes/No*
2.9	Type of cooling		ONAN/ONAF	
2.10	ONAN rating when operating under the specified site conditions (on any tap position):		221 MVA	MVA
2.11	**Short circuit design**			
	a) Transformer three-phase designed fault level value, r.m.s.:	HV	As per IEC	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m..s}$
		TV	As per IEC	$kA_{r.m.s.}$
	b) Transformer three-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}

Item	Description		Technical Details	
			eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
			* Complete with whichever is applicable	
		LV	As per IEC	kA_{peak}
		TV	As per IEC	kA_{peak}
	c) Transformer single-phase designed fault level value, r.m.s.:	HV	As per IEC	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m.s.}$
		TV	As per IEC	$kA_{r.m.s.}$
	d) Transformer single-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}
		LV	As per IEC	kA_{peak}
		TV	As per IEC	kA_{peak}
	e) Designed number of through faults in transformer life time:	HV	---	
		LV	---	
		TV	---	
	f) Transformer is designed to withstand a full three-phase short circuit on the TV, LV terminals and supplied from the HV side		Yes	Yes/No*
2.12	**Positive Phase Sequence Impedance at 75°C and rated frequency, phase to neutral, viewed from HV windings:**			
2.12.1	a) Minimum IEC Impedance		---	Ω
	b) Corresponding % Impedance		---	%
	c) Corresponding X/R ratio		---	
	d) Corresponding Tap Number		---	
2.12.2	a) Maximum IEC Impedance		---	Ω
	b) Corresponding % Impedance		---	%
	c) Corresponding X/R ratio		---	
	d) Corresponding Tap Number		---	
2.12.3	a) IEC Impedance at nominal tap position		---	Ω
	b) Corresponding % Impedance		11%	%
	c) Corresponding X/R ratio		---	

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
	d) Corresponding Tap Number	5	
2.13	**Zero Phase Sequence Impedance at 75°C and rated frequency, phase to neutral, viewed from HV windings:**		
2.13.1	a) Minimum Zero Phase Sequence IEC Impedance	---	Ω
	b) Corresponding % Impedance	---	%
	c) Corresponding X/R ratio	---	
	d) Corresponding Tap Number	---	
2.13.2	a) Maximum Zero Phase Sequence IEC Impedance	---	Ω
	b) Corresponding % Impedance	---	%
	c) Corresponding X/R ratio	---	
	d) Corresponding Tap Number	---	
2.13.3	a) Zero Phase Sequence IEC Impedance at nominal tap position	---	Ω
	b) Corresponding % Impedance	---	%
	c) Corresponding X/R ratio	---	
	d) Corresponding Tap Number	5	
3.0	**Winding design**		
	a) Winding arrangement	CORE-TV-LV-TAP-HV	
	b) Conductor yield strength	---	N/mm^2
	c) **Normal insulation resistance between:**		
	• CPrimary and Tertiary Windings	---	MΩ
	• TPrimary Windings and Core	---	MΩ
	• SCore and Tank	---	MΩ
	• TCore bolts and core	---	MΩ
3.1	**Winding 1**	**Tertiary (TV)**	
	a) Type (i.e. multi-layer helix)	---	
	b) Type of axial coil support	---	

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
	c) Lead type (End Fed/Centre Fed)	---	
	d) Number of turns	---	
	e) Inner diameter	---	mm
	f) Outer diameter	---	mm
	g) Radial build	---	mm
	h) Magnetic height	---	mm
	Normal insulation resistance between:		
	Primary and Tertiary Windings	---	MΩ
	Primary Windings and Core	---	MΩ
	Core and Tank	---	MΩ
	Core bolts and core	---	MΩ
	i) **Conductor configuration:**		
	• Size	---	
	• Number	---	
	j) Conductor insulation	Full	mm
	k) Dry mass insulation	---	kg
	l) Winding impulse withstand voltage	150 kV_p	kV_p
	m) Maximum current density at full load rating	---	A/mm^2
	n) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A
	o) **Temperature rise limits:**		
	• Top oil temperature rise	55 K	K
	• Average winding temperature rise	60 K	K
	• Winding hottest-spot temperature rise	73 K	K
	p) Total conductor mass	---	kg
3.2	**Winding 2**	**Secondary (LV)**	
	a) Type (i.e. multi-layer helix)	---	

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
	b) Type of axial coil support	---	
	c) Lead type (End Fed/Centre Fed)	---	
	d) Number of turns	---	
	e) Inner diameter	---	mm
	f) Outer diameter	---	mm
	g) Radial build	---	mm
	h) Magnetic height	---	mm
	Normal insulation resistance between:		
	Primary and Tertiary Windings	---	MΩ
	Primary Windings and Core	---	MΩ
	Core and Tank	---	MΩ
	Core bolts and core	---	MΩ
	i) **Conductor configuration:**		
	• Size	---	
	• Number	---	
	j) Conductor insulation	Graded	mm
	k) Dry mass insulation	---	kg
	l) Winding impulse withstand voltage	550 kV_p	kV_p
	m) Maximum current density at full load rating	---	A/mm^2
	n) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A
	o) **Temperature rise limits:**		
	• Top oil temperature rise	55 K	K
	• Average winding temperature rise	60 K	K
	• Winding hottest-spot temperature rise	73 K	K
	p) Total conductor mass	---	kg
3.3	**Winding 3**	**Regulating (TAP)**	

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
	a) Type (i.e. multi-layer helix)	---	
	b) Type of axial coil support	---	
	c) Lead type (End Fed/Centre Fed)	---	
	d) Number of turns	---	
	e) Inner diameter	---	mm
	f) Outer diameter	---	mm
	g) Radial build	---	mm
	h) Magnetic height	---	mm
	Normal insulation resistance between:		
	Primary and Tertiary Windings	---	MΩ
	Primary Windings and Core	---	MΩ
	Core and Tank	---	MΩ
	Core bolts and core	---	MΩ
	i) **Conductor configuration:**		
	• Size	---	
	• Number	---	
	j) Conductor insulation	Graded	mm
	k) Dry mass insulation	---	kg
	l) Winding impulse withstand voltage	As per IEC	kVp
	m) Maximum current density at full load rating	---	A/mm^2
	n) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A
	o) **Temperature rise limits:**		
	• Top oil temperature rise	55 K	K
	• Average winding temperature rise	60 K	K
	• Winding hottest-spot temperature rise	73 K	K
	p) Total conductor mass	---	kg

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
3.4	**Winding 4**	**Primary (HV)**	
	a) Type (i.e. multi-layer helix)	---	
	b) Type of axial coil support	---	
	c) Lead type (End Fed/Centre Fed)	---	
	d) Number of turns	---	
	e) Inner diameter	---	mm
	f) Outer diameter	---	mm
	g) Radial build	---	mm
	h) Magnetic height	---	mm
	Normal insulation resistance between:		
	Primary and Tertiary Windings	---	MΩ
	Primary Windings and Core	---	MΩ
	Core and Tank	---	MΩ
	Core bolts and core	---	MΩ
	i) **Conductor configuration:**		
	• Size	---	
	• Number	---	
	j) Conductor insulation	Full	mm
	k) Dry mass insulation	---	kg
	l) Winding impulse withstand voltage	1 050 kVp	kVp
	m) Maximum current density at full load rating	---	A/mm^2
	n) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A
	o) **Temperature rise limits:**		
	• Top oil temperature rise	55 K	K
	• Average winding temperature rise	60 K	K
	• Winding hottest-spot temperature rise	73 K	K

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
	p) Total conductor mass	---	kg
3.5	**Inter-winding Insulation**		
3.5.1	**CORE – TV winding:**		
	a) Number of barriers	---	
	b) Barrier thickness	---	mm
	c) Distance from windings	---	mm
	d) Distance between barriers	---	mm
3.5.2	**TV winding to LV winding**		
	a) Number of barriers	---	
	b) Barrier thickness	---	mm
	c) Distance from windings	---	mm
	d) Distance between barriers	---	mm
3.5.3	**LV winding to TAP winding**		
	a) Number of barriers	---	
	b) Barrier thickness	---	mm
	c) Distance from windings	---	mm
	d) Distance between barriers	---	mm
3.5.4	**TAP winding to HV winding**		
	a) Number of barriers	---	
	b) Barrier thickness	---	mm
	c) Distance from windings	---	mm
	d) Distance between barriers	---	mm
4.0	**Losses and Efficiency**		
4.1	**Guaranteed no-load losses at normal ratio and normal voltage:**		
	a) No-load losses excluding input to cooling plant	---	kW
	b) Input to cooling plant required at full load rating	---	kW

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
4.2	**Guaranteed load losses at 75°C and normal ratio and nominal voltage:**		
	a) Full Load Rating	---	kW
	b) ONAN rating	---	kW
	c) At 50 % full load rating	---	kW
4.3	**Total guaranteed losses at 75°C and normal ratio and nominal voltage:**		
	a) At full load rating including input to cooling plant	---	kW
	b) At ONAN rating	---	kW
	c) At 50% full Load rating	---	kW
4.4	**Efficiency at normal ratio and 0,8 lagging power factor:**		
	a) At full load rating including input to cooling plant	---	%
	b) ONAN rating	---	%
	c) At 50% full load rating	---	%
4.5	**Inherent regulation at 75°C normal ratio and full load rating expressed as percent of rated voltage:**		
	a) At unity power factor percent	---	%
	b) At 0,8 lagging power factor	---	%
	c) At 100% full load	---	kW
4.6	**Calculated thermal time constant:**		
	a) Natural Cooling	---	hrs
	b) Forced Cooling	---	hrs
4.7	**Heat dissipation anticipated from transformer tank walls of transformer:**		
	a) At 60% full load	---	kW
	b) At 100% full load	---	kW
5.0	**Terminals:**		
5.1	**Details of 275 kV Outdoor Bushings:**		
	a) Bushing Type	capacitive type	

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
		resin impregnated paper with silicone sheds	
	b) Bushing Impulse Withstand Voltage	1 050 kV_p	kV_p
	c) Minimum Total Creepage Distance (at a unified specific creepage distance of 54 mm/kV)	14 850 mm	mm
	d) Stem Diameter	26 mm	mm
	e) Tan Delta Test Facility	Yes	Yes/No*
5.2	**Details of 132 kV Outdoor Bushings:**		
	a) Bushing Type	capacitive type	
		resin impregnated paper with silicone sheds	
	b) Bushing Impulse Withstand Voltage	550 kV_p	kV_p
	c) Minimum Total Creepage Distance (at a unified specific creepage distance of 54 mm/kV)	7 130 mm	mm
	d) Stem Diameter	38 mm	mm
	e) Tan Delta Test Facility	Yes	Yes/No*
5.3	**Details of Tertiary Bushings:**		
	a) Bushing Type	capacitive type	
		resin impregnated paper with silicone sheds	
	b) Bushing Impulse Withstand Voltage	150 kV_p	kV_p
	c) Minimum Total Creepage Distance (at a unified specific creepage distance of 54 mm/kV)	1 190 mm	mm
	d) Stem Diameter	38 mm	mm
	e) Tan Delta Test Facility	Yes	Yes/No*
5.4	**Details of HV Neutral Bushings:**		
	a) Bushing Type: capacitive type resin impregnated paper with silicone rubber sheds	capacitive type	
		resin impregnated	
		paper with silicone sheds	
	b) Bushing Impulse Withstand Voltage	200 kV_p	kV_p

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
	c) Minimum Total Creepage Distance	1 190 mm	mm
	d) Clamp suitable for 50 × 6 mm Copper Earth bar	Yes	Yes/No*
	e) Rated Voltage of Bushing	24 kV	kV
6.0	**On-load tap-changer**		
6.1	**Details of on-load tap-changer:**	Vacuum	
	a) Manufacturer	---	
	b) Resistor type, reactor type etc	---	
	c) Manufacturer's type designation	---	
	d) Can oil from the on-load transfer switch compartment mix with the oil in the main tank?	No	Yes/No*
	e) Diverter switch with vacuum interrupters	Yes	Yes/No*
6.2	**Tappings:**		
	a) Which winding is tapped and where	---	
	b) Range of tappings (primary/secondary ratios per unit of ratio at nominal tap)	Maximum 1,05 pu	pu
		Minimum 0,85 pu	pu
	c) Size of step as percentage of winding rated voltage at no load	Maximum 1,25%	
	d) Number of steps	16 steps	steps
6.3	**Number and type of tap position indication devices provided in tap-change drive mechanism:**		
	a) Binary coded decimal type	2	
	b) Resistor divider type (resistance to be specified at time of order, typically 400 Ω per step)	1	
	c) Voltage free contacts with common connection (one contact per tap)	2	
6.4	**Tap-change alarm and indication signals required:**		
	a) Tap-change on Manual	Yes	Yes/No*
	b) Tap-change not healthy	Yes	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*
	d) Tap-change fail	Yes	Yes/No*
	e) Tap-change d.c. fail	Yes	Yes/No*

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
	f) Tap-change VT fail	Yes	Yes/No*
	g) Tap-change voltage abnormal	Yes	Yes/No*
	h) Tap-change voltage high	Yes	Yes/No*
	i) Tap-change voltage low	Yes	Yes/No*
	j) Tap-change in progress	Yes	Yes/No*
	k) Tap-change on manual control	Yes	Yes/No*
	l) Tap-change motor drive trip	Yes	Yes/No*
	m) Tap-change position	Yes	Yes/No*
6.5	**Tap-change control signals required:**		
	a) Tap-change raise	Yes	Yes/No*
	b) Tap-change lower	Yes	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*
	d) Tap-change overcurrent blocking	Yes	Yes/No*
	e) Labelling of all tap-changer control wiring	Yes	Yes/No*
6.6	**Provide the following trip signals:**		
	a) Top oil temperature very high	Yes	Yes/No*
	b) Top winding temperature very high	Yes	Yes/No*
	c) PRV operation	Yes	Yes/No*
	d) Buchholz high gasses operation	Yes	Yes/No*
6.7	**Provide the following supply circuits:**		
	a) 220 V a.c. (15 A) plug with earth leakage protection (30 mA)	Yes	Yes/No*
	b) 5 × 6 A MCB with earth leakage protection (30 mA)	Yes	Yes/No*
6.8	**Provide the following analogue outputs:**		
	a) Top oil temperature reading 4 mA to 20 mA	Yes	Yes/No*
	b) Top winding temperature 4 mA to 20 mA	Yes	Yes/No*

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
	c) Combustible gas reading 4 mA to 20 mA	Yes	Yes/No*
	d) Temperature sensor on cooler in and outlet	Yes	Yes/No*
7.0	**Cooling:**		
	a) Auxiliary equipment for forced air cooling: Fans blowing on radiators on main tank	Yes	Yes/No*
	b) Number of fans per transformer	---	
	c) Rated output of each fan	---	m^3/min
	d) Speed of fan	---	rpm
	e) Type of fan motor	---	
	f) Rating of each fan motor	---	kW
	g) Starting current of fan motor	---	A
	h) Normal working load on fan motor	---	kW
	i) Recommended cut-in temperature for the forced cooling plant	---	^oC
	j) Maximum temperature of oil:		
	• At inlet to cooler	---	^oC
	• At outlet from cooler	---	^oC
	k) Thickness of radiator plates and/or cooling tubes	≥ 1 mm	mm
8.0	**General Information:**		
8.1	**Thickness of Transformer tank:**		
	a) Sides	≥ 8 mm	mm
	b) Bottom	≥ 25 mm	mm
8.2	**Overall dimensions of transformer:**		
	a) Tank only	---	mm
	b) Coolers only	---	mm
	c) Height over Conservator	---	mm
8.3	Total oil required (including cooling system)	---	litres
8.4	Minimum quantity of oil to be removed from transformer including conservator to expose the top of the core	---	litres

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
8.5	Total volume of conservator	---	litres
8.6	Volume of oil in conservator between the highest and lowest visible levels	---	litres
8.7	Maximum permissible vacuum in tank excluding tap changer, bushings, etc.	---	kPA
8.8	Maximum permissible vacuum in tank fitted as on site with tap changer, bushings etc.	---	kPa
8.9	Detailed painting process included	Yes	Yes/No*
8.10	Mass of core	---	kg
8.11	Mass of Windings	---	kg
8.12	Mass of separate cooler bank complete with oil	---	kg
8.13	Total mass of complete transformer including oil and tank mounted radiators	---	kg
8.14	Mass of transformer as arranged for transport	---	kg
8.15	Repair for any winding fault up to 20 years offered?	---	
8.16	**Guarantees:**		
	a) Transformer and auxiliary equipment	10 years	years
	b) Leaks and corrosion	10 years	years
9.0	**Indicating and Protective Devices Details:**		
9.1	Anti-corrosion and Anti-vibration pad material	---	
9.2	**Vibration and Noise:**		
	a) Average noise level of the transformer *without* fans in service	---	dB
	b) Average noise level of the transformer *with* fans in service	< 80 dB	dB
9.3	**Self-Dehydrating Breathers (SDB):**		
	a) Number of SDBs required per transformer	---	
	b) Quantity of silica-gel in each SDB	---	kg
	c) Clear silica gel	Yes	Yes/No*
9.4	**Winding temperature:**		
	a) Winding temperature thermometer type	---	
	b) Fibre optic temperature sensors	Yes	Yes/No*

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
9.5	Oil temperature thermometer type	---	
9.6	Oil-and gas-actuated relay type	---	
9.7	**Pressure relief device:**		
	a) Type	---	
	b) Mesh to prevent vermin from entering	Yes	Yes/No*
9.8	**Conservator:**		
	a) Conservator bag	Yes	Yes/No*
	b) Conservator bag leak detection system type	---	
	c) Details of bag leak detection system supplied with tender	Yes	Yes/No*
	d) Oil level indicators	Yes	Yes/No*
9.9	Tap-changer protective device (detail)	Specify type	
10.0	**Delivery and off-loading**		
	a) Filling medium of transformer tank for transportation	Dry air	
	b) Quantity of oil required to cover windings for transportation	---	litres
	c) Supplied transformer filled with new oil	---	Yes/No*
	d) Type of oil to be used	Mineral oil (uninhibited) IEC 60296	
	e) Transformer delivered to	As per purchase order	Yes/No*
	f) Delivery effected not before	As per purchase order	Yes/No*
	g) Off-loaded from transport vehicle by Supplier	Yes	Yes/No*
	h) Transport transferred to intended operating position by Supplier	Yes	Yes/No*
11.0	**Erection and oil filling**		
	a) Erected ready for service	Yes	Yes/No*
	b) Erection completed not later than	As per purchase order	Yes/No*
	c) Place three layers of 6 ply 2,8 mm Malthoid mat under transformer on plinth	Yes	Yes/No*
	d) Place one layer of 4 mm index unigum under transformer on plinth	Yes	Yes/No*

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
12.0	**Active Part**		
12.1	**Thermal constraints and considerations with regard to the paper insulation system:**		
	a) Life expectancy at required operating and environmental conditions, designed to be for at least:	40 years	years
	b) Type of paper to be used: Thermally upgraded paper	Yes	Yes/No*
	c) DP of wrap and board used:		
	d) DP of new paper	---	
	e) Percentage moisture in paper after dry-out	---	%
	f) DP after final dry-out in factory	min 1 000 DP	
	g) Number and details of test blocks to be left in completed transformer	---	
	h) Details of test dry-out/heating blocks dimensions, positioning and testing during manufacture	---	
13.0	**Testing:**		
13.1	Are the test results of the following type tests performed on similar transformers available and submitted with this tender? (The degree of similarity of the transformers previously tested to those specified in this contract must be documented)	Yes	Yes/No*
	a) Impulse test	Yes	Yes/No*
	b) Temperature rise test	Yes	Yes/No*
	c) Sound level measurements	Yes	Yes/No*
	d) Short circuit test	Yes	Yes/No*
13.2	**On Site Oil Tests:**		
	a) Fourier Transform Infrared Spectroscopy (FTIR): Oil type verification	Yes	Yes/No*
	b) Dissolved Gas Analysis (DGA): two weeks after energizing	Yes	Yes/No*
	c) Test for Silicone and other metal contaminants	Yes	Yes/No*
	d) Test for Corrosive sulphur (to be done in accordance with extended Doble method)	Yes	Yes/No*
14.0	**Special Requirements**		
14.1	a) On-line eight (8) gas dissolved gas analyser (DGA) for transformer monitoring	Yes	Yes/No*
	b) Gases trended separately	Yes	Yes/No*

Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN/ONAF) Offered
		* Complete with whichever is applicable	
	c) Transformer operating temperatures monitoring	Yes	Yes/No*
	d) On-load tap changer (OLTC) monitoring	Yes	Yes/No*
	e) Cooling group control monitoring	Yes	Yes/No*
	f) Bushing monitoring	Yes	Yes/No*
	g) Partial Discharge monitoring	Yes	Yes/No*
	h) Type of valves to use	Gate/Butterfly	
	i) Spare bushing to be supplied with oil vessels for long term storage	Yes	Yes/No*
14.2	**Existing Transformer:**		
	a) Disassembling, loading, transporting and off-loading of existing power transformer within a 30 km radius	Yes	Yes/No*
	b) Oil Handling	Yes	Yes/No*
	c) Disposal of transformer oil and old transformer components	Yes	Yes/No*
	d) Time required to remove the old transformer	[2 weeks	week(s)

Item	Description	Technical Details		Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN) Offered			eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
15.0	**Detailed Technical Information and Data Sheets**						
	Detailed information and data sheets including all the relevant Type Test Certificates of the following components shall be included (specify in which section of tender the information is found):						
15.1.1	**HV Bushing:**			**15.1.2**	**LV Bushing:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Certificate	Yes	Yes/No*		f) Type Certificate	Yes	Yes/No*
				15.2	**Cooler Units, Motors and Fans**		
15.1.3	**TV Bushing:**			**15.2.1**	**Cooler Units:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Certificate	Yes	Yes/No*		f) Type Certificate	Yes	Yes/No*
15.2.2	**Fans:**			**15.3**	**Tap-changer:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Certificate	Yes	Yes/No*		f) Type Certificate	Yes	Yes/No*
15.4	**Buchholz Relays:**			**15.5**	**Pressure Relief Device:**		
	a) Manufacturer				a) Manufacturer		

Item	Description	Technical Details		Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN) Offered			eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Material of bag		
	f) Type Test Certificate	Yes	Yes/No*		f) Technical Data	Yes	Yes/No*
					g) Type Test	Yes	Yes/No*
15.6	**Winding Temperature Measurement**						
15.6	**Tap-changer:**			**15.6.2**	**Measuring Equipment e.g. CT:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
15.7	**Oil Temperature Measurement**						
15.7.1	**Instrument:**			**15.7.2**	**Measuring Equipment e.g. PT100s or Sensors:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
15.8	**Tap-changer Pressure Relay:**			**15.9**	**Dehydrating Breathers**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		

Item	Description	Technical Details			Item	Description	Technical Details	
		eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN) Offered				eThekwini Electricity Requirement	275/132 kV 315 MVA (ONAN) Offered
		* Complete with whichever is applicable					* Complete with whichever is applicable	
	d) Supplier					d) Supplier		
	e) Technical Data	Yes	Yes/No*			e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*			f) Type Test	Yes	Yes/No*
15.10	**Conservator Bag:**				**15.11**	**Oil Level Indicators:**		
	a) Manufacturer					a) Manufacturer		
	b) Type Number					b) Type Number		
	c) Part Number					c) Part Number		
	d) Supplier					d) Supplier		
	e) Technical Data	Yes	Yes/No*			e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*			f) Type Test	Yes	Yes/No*
16.0	**General**							
	Further information that tenderers may wish to submit							

SECTION 2(a): 132/11 kV 30 MVA Type 1, Type 2, Type 3 and Type 4 Power Transformers

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
			* Complete with whichever is applicable			
1.0	**Transformer General Information**					
1.1	Name of manufacturer	---				
1.2	Country of origin	---				
1.3	Do the transformers comply in all respects with the standard specifications quoted in the Technical Specification? (If not, indicate deviations)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
1.4	**Manufacturing Experience**					
	a) Number of 132 kV transformers manufactured at the factory in the last twelve (12) months	---	transformer(s)	transformer(s)	transformer(s)	transformer(s)
	b) Factory failure rate in five (5) years where transformers above 15 MVA form the sample group	---	%	%	%	%
1.5	**Type of Transformers:**					
	Core	Core-form				
1.6	**Core Steel**					
	a) Manufacturer of core steel	---				
	c) Type of core steel (conventional grain oriented or high permeability)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Grade of core steel	---				
	c) Thickness of core steel	---	mm	mm	mm	mm
1.7	**Core dimensions**					
	a) Window height	---	mm	mm	mm	mm
	b) Distance between core limb centres	---	mm	mm	mm	mm
	c) Core diameter	---	mm	mm	mm	mm
	d) Filling factor	---				
1.8	**Cross sectional areas**					
	a) Wound limbs	---	mm^2	mm^2	mm^2	mm^2

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	b) Yoke	---	mm^2	mm^2	mm^2	mm^2
1.9	**Total core mass**	---	kg	kg	kg	kg
1.10	The design flux density at nominal voltage for:					
	a) Wound limbs	1,75 T	T	T	T	T
	b) Yoke	1,75 T	T	T	T	T
1.11	**Volts/turn at the above flux**	---	V/turn	V/turn	V/turn	V/turn
2.0	**Ratings**					
2.1	Supply frequency	50 Hz	Hz	Hz	Hz	Hz
2.2	Number phases	3				
2.3	Nominal system voltage at no load on nominal tap:					
	a) Primary	132 kV	kV	kV	kV	kV
	b) Secondary	11 kV	kV	kV	kV	kV
2.4	Maximum primary operating voltage	145 kV	kV	kV	kV	kV
2.5	Connections	Star/Star				
2.6	Vector group	YNyn0				
2.7	Full load rating (on any tap position)	30 MVA	MVA	MVA	MVA	MVA
2.8	Continuous rating when operating under the specified site conditions (on any tap position):	30 MVA	MVA	MVA	MVA	MVA
2.9	Type of cooling	Type 1: ONAF				
		Type 2: ONAN				
		Type 3: ONAF				
		Type 4: ONAN				
2.10	ONAN rating when operating under the specified site conditions (on any tap position):	Type 1: 18 MVA	MVA	MVA	MVA	MVA
		Type 2: 30 MVA	MVA	MVA	MVA	MVA
		Type 3: 18 MVA	MVA	MVA	MVA	MVA
		Type 4: 30 MVA	MVA	MVA	MVA	MVA

LOW IMPEDANCE TRANSFORMERS			Technical Details				
Item	Description		eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
			* Complete with whichever is applicable				
2.11	**Short circuit design:**						
	a) Transformer three-phase designed fault level value r.m.s:	HV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$
	b) Transformer three-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}	kA_{peak}	kA_{peak}	kA_{peak}
		LV	As per IEC	kA_{peak}	kA_{peak}	kA_{peak}	kA_{peak}
	c) Transformer single-phase designed fault level value, r.m.s.:	HV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$
	d) Transformer single-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}	kA_{peak}	kA_{peak}	kA_{peak}
		LV	As per IEC	kA_{peak}	kA_{peak}	kA_{peak}	kA_{peak}
	e) Designed number of through faults in transformer lifetime:	HV	---				
		LV	---				
	f) Transformer is designed to withstand a full three-phase short circuit on the LV terminals and supplied from the HV side		Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
2.12	**Positive phase sequence impedance at 75°C and rated frequency, phase to neutral, viewed from HV**						
2.12.1	a) Minimum Ohmic impedance		93,5 Ω	Ω	Ω	Ω	Ω
	b) Corresponding % impedance		---	%	%	%	%
	c) Corresponding X/R ratio		---				
	d) Corresponding tap number		---				
2.12.2	a) Maximum Ohmic impedance		112,2 Ω	Ω	Ω	Ω	Ω
	b) Corresponding % impedance		---	%	%	%	%
	c) Corresponding X/R ratio		---				
	d) Corresponding tap number		---				
2.12.3	a) Ohmic impedance at nominal tap position		---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance		16,1%	%	%	%	%
	c) Corresponding X/R ratio		---				
	d) Corresponding tap number		5				

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
2.12.4	a) Minimum IEC impedance	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	16,1 %	%	%	%	%
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	---				
2.12.5	a) Maximum IEC impedance	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%	%	%
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	---				
2.12.6	a) IEC impedance at nominal tap position	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	16,1 %	%	%	%	%
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	5				
2.13	**Zero phase sequence impedance at 75°C and rated frequency, phase to neutral, viewed from HV windings:**					
2.13.1	a) Minimum zero Phase sequence Ohmic impedance	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%	%	%
	c) Corresponding tap number	---				
2.13.2	a) Maximum zero phase sequence Ohmic impedance	---				
	b) Corresponding % impedance	---				
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	---				
2.13.3	a) Zero phase sequence Ohmic impedance at nominal tap position	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%	%	%
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	5				
2.13.4	a) Minimum zero Phase sequence IEC impedance	---	Ω	Ω	Ω	Ω

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	b) Corresponding % impedance	---	%	%	%	%
	c) Corresponding tap number	---				
2.13.5	a) Maximum zero phase sequence IEC impedance	---				
	b) Corresponding % impedance	---				
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	---				
2.13.6	a) Zero phase sequence IEC impedance at nominal tap position	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%	%	%
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	5				
3.0	**Winding design**					
	a) Winding arrangement	CORE-MV-HV-TAP				
	b) Conductor Yield strength	---	N/mm^2	N/mm^2	N/mm^2	
	c) **Normal insulation resistance between:**					
	• CPrimary and Tertiary Windings	---	MΩ	MΩ	MΩ	MΩ
	• SPrimary Windings and Core	---	MΩ	MΩ	MΩ	MΩ
	• PCore and Tank	---	MΩ	MΩ	MΩ	MΩ
	• CCore bolts and core	---	MΩ	MΩ	MΩ	MΩ
3.1	**Winding 1**	**Secondary (LV)**				
	a) Type	multi-layer helix				
	b) Type of axial coil support	---				
	c) Lead type (End Fed/Centre Fed)	---				
	d) Number of turns	---				
	e) Inner diameter	---	mm	mm	mm	mm
	f) Outer diameter	---	mm	mm	mm	mm

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	g) Radial build	---	mm	mm	mm	mm
	h) Magnetic height	---	mm	mm	mm	mm
	ormal insulation resistance between:					
	rimary and Tertiary Windings	-	Ω	Ω	Ω	Ω
	rimary Windings and Core	-	Ω	Ω	Ω	Ω
	ore and Tank	-	Ω	Ω	Ω	Ω
	ore bolts and core	-	Ω	Ω	Ω	Ω
	i) **Conductor configuration:**					
	• Size	---				
	• Number	---				
	a) Conductor insulation	Full	mm	mm	mm	mm
	b) Dry mass insulation	---	kg	kg	kg	kg
	c) Winding impulse withstand voltage	95 kV_p	kV_p	kV_p	kV_p	kV_p
	d) Maximum current density at full load rating	---	A/mm^2	A/mm^2	A/mm^2	A/mm^2
	e) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A	A	A
	f) **Temperature rise limits:**					
	• Top oil temperature rise	55 K	K	K	K	K
	• Average winding temperature rise	60 K	K	K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K	K	K
	g) Total conductor mass	---	kg	kg	kg	kg
3.2	**Winding 2**	**Primary (HV)**				
	a) Type	multi-layer helix				
	b) Type of axial coil support	---				
	c) Lead type (End Fed/Centre Fed)	---				
	d) Number of turns	---				
	e) Inner diameter	---	mm	mm	mm	mm

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	f) Outer diameter	---	mm	mm	mm	mm
	g) Radial build	---	mm	mm	mm	mm
	h) Magnetic height	---	mm	mm	mm	mm
	ormal insulation resistance between:					
	imary and Tertiary Windings	-	Ω	Ω	Ω	Ω
	imary Windings and Core	-	Ω	Ω	Ω	Ω
	ore and Tank	-	Ω	Ω	Ω	Ω
	ore bolts and core	-	Ω	Ω	Ω	Ω
	i) Conductor configuration:					
	• Size	---				
	• Number	---				
	a) Conductor insulation	Graded	mm	mm	mm	mm
	b) Dry mass insulation	---	kg	kg	kg	kg
	c) Winding impulse withstand voltage	550 kV_p	kV_p	kV_p	kV_p	kV_p
	d) Maximum current density at full load rating	---	A/mm^2	A/mm^2	A/mm^2	A/mm^2
	e) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A	A	A
	f) **Temperature rise limits:**					
	• Top oil temperature rise	55 K	K	K	K	K
	• Average winding temperature rise	60 K	K	K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K	K	K
	g) Total conductor mass	---	kg	kg	kg	kg
3.3	**Winding 3**	**Regulating (TAP)**				
	a) Type	multi-layer helix				
	b) Type of axial coil support	---				
	c) Lead type (End Fed/Centre Fed)	---				
	d) Number of turns	---				

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	e) Inner diameter	---	mm	mm	mm	mm
	f) Outer diameter	---	mm	mm	mm	mm
	g) Radial build	---	mm	mm	mm	mm
	h) Magnetic height	---	mm	mm	mm	mm
	Normal insulation resistance between:					
	Primary and Tertiary Windings	---	MΩ	MΩ	MΩ	MΩ
	Primary Windings and Core	---	MΩ	MΩ	MΩ	MΩ
	Core and Tank	---	MΩ	MΩ	MΩ	MΩ
	Core bolts and core	---	MΩ	MΩ	MΩ	MΩ
	i) Conductor configuration:					
	• Size	---				
	• Number	---				
	a) Conductor insulation	Full	mm	mm	mm	mm
	b) Dry mass insulation	---	kg	kg	kg	kg
	c) Winding impulse withstand voltage	As per IEC	kV_p	kV_p	kV_p	kV_p
	d) Maximum current density at full load rating	---	A/mm^2	A/mm^2	A/mm^2	A/mm^2
	e) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A	A	A
	f) **Temperature rise limits:**					
	• Top oil temperature rise	55 K	K	K	K	K
	• Average winding temperature rise	60 K	K	K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K	K	K
	g) Total conductor mass	---	kg	kg	kg	kg
3.4	**Inter-winding Insulation**					
3.4.1	**CORE – LV winding:**					
	a) Number of barriers	---				
	b) Barrier thickness	---	mm	mm	mm	mm

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	c) Distance from windings	---	mm	mm	mm	mm
	d) Distance between barriers	---	mm	mm	mm	mm
3.4.2	**LV winding to HV winding**					
	a) Number of barriers	---				
	b) Barrier thickness	---	mm	mm	mm	mm
	c) Distance from windings	---	mm	mm	mm	mm
	d) Distance between barriers	---	mm	mm	mm	mm
3.4.3	**HV winding to TAP winding**					
	a) Number of barriers	---				
	b) Barrier thickness	---	mm	mm	mm	mm
	c) Distance from windings	---	mm	mm	mm	mm
	d) Distance between barriers	---	mm	mm	mm	mm
4.0	**Losses and Efficiency**					
4.1	**Guaranteed no-load losses at normal ratio and normal voltage:**					
	a) No-load losses excluding input to cooling plant	---	kW	kW	kW	kW
	b) Input to cooling plant required at full load rating	---	kW	kW	kW	kW
4.2	**Guaranteed load losses at 75°C and normal ratio and nominal voltage:**					
	a) Full load rating	---	kW	kW	kW	kW
	b) ONAN rating	---	kW	kW	kW	kW
	c) At 50% full load rating	---	kW	kW	kW	kW
4.3	**Total guaranteed losses at 75°C and normal ratio and nominal voltage:**					
	a) At full load rating including input to cooling plant	---	kW	kW	kW	kW
	b) At ONAN rating	---	kW	kW	kW	kW
	c) At 50 % full load rating	---	kW	kW	kW	kW
4.4	**Efficiency at normal ratio and 0,8 lagging power**					

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	a) At full load rating including input to cooling plant	---	%	%	%	%
	b) At ONAN rating	---	%	%	%	%
	c) At 50 % full load rating	---	%	%	%	%
4.5	**Inherent regulation at 75°C normal ratio and full load rating expressed as percent of rated voltage:**					
	a) At unity power factor percent	---	%	%	%	%
	b) At 0,8 lagging power factor	---	%	%	%	%
	c) At 100% full load	---	%	%	%	kW
5.0	**Terminals**					
5.1	**Details of 132 kV outdoor bushings:**					
	a) Bushing type	Resin impregnated paper with silicone rubber sheds		N/A	Resin impregnated paper with silicone rubber sheds	N/A
	b) Bushing impulse withstand voltage	650 kV_p	kV_p		kV_p	N/A
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	7 130 mm	mm	N/A	mm	N/A
	d) Stem diameter	26 mm	mm	N/A	mm	N/A
	e) Tan-delta test facility	Yes	Yes/No*	N/A	Yes/No*	N/A
5.2	**Details of 132 kV oil filled cable boxes:**					
	a) Compliance with IEC 60859	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Bushing impulse withstand voltage	650 kV_p	kV_p	kV_p	kV_p	kV_p
	c) Individual oil valves required to isolate each phase cable box from conservator	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
5.3	**Details of HV neutral bushing:**					
	a) Bushing type	Resin impregnated paper with silicone rubber sheds				
	b) Bushing impulse withstand voltage	200 kV_p	kV_p	kV_p	kV_p	kV_p

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
			* Complete with whichever is applicable			
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	1 780 mm	mm	mm	mm	mm
	d) Clamp suitable for 50 mm by 6 mm copper earth bar	Yes				
	e) Voltage rating of bushing	36 kV	kV	kV	kV	kV
5.4	**Details of LV neutral bushing:**					
	a) Bushing type	Resin impregnated paper with silicone rubber sheds				
	b) Bushing impulse withstand voltage	95 kV_p	kV_p	kV_p	kV_p	kV_p
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	---	mm	mm	mm	mm
	d) Clamp suitable for 50 mm by 6 mm copper earth bar	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	e) Voltage rating of bushing	12 kV	kV	kV	kV	kV
5.5	**Details of LV plug connectors:**					
	a) Type (Plug: For 630 mm^2 conductor and 42.2 mm OD insulation for outdoor use)					
	b) Cable connector size	3				
	c) Rated service voltage	12 kV	kV	kV	kV	kV
	d) Rated nominal current	1 250 A	A	A	A	A
	e) Number of sockets per phase	2				
	f) Plugs for fitting onto cables to be supplied	Yes				
5.6	**Details of 11 kV oil filled cable box and bushings:**					
	a) Compliance with IEC 60859	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Bushing impulse withstand voltage	95 kV_p	kV_p	kV_p	kV_p	kV_p
	c) Suitable for number and size of cables per phase (2 × 630 mm^2 Copper)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Rated service voltage	12 kV	kV	kV	kV	kV
6.0	**On-load Tap-changer (Vacuum Type)**					

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
6.1	a) Manufacturer	---				
	b) Resistor type, reactor type etc	---				
	c) Manufacturer's type designation	---				
	d) Can oil from the on-load transfer switch compartment mix with the oil in the main tank?	No	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	e) Diverter switch with vacuum interrupters	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
6.2	**Tappings:**					
	a) Which winding is tapped and where	HV Neutral end				
	b) Range of tappings (primary/secondary ratios per unit at nominal tap)	Maximum 1.05 pu	pu	pu	pu	pu
		Minimum 0.85 pu	pu	pu	pu	pu
	c) Size of step as percentage of winding rated voltage at no-load	Maximum 1.25%	%	%	%	%
	d) Number of steps	16 steps	steps	steps	steps	steps
6.3	**Number and type of tap position indication devices provided in tap-change drive mechanism:**					
	a) Binary coded decimal type	2				
	b) Resistor divider type (resistance to be specified at time of order, typically 400 Ω per step)	1				
	c) Voltage free contacts with common connection (one contact per tap)	2				
	d) Number of steps	16 steps	steps	steps	steps	steps
6.4	**Tap-change alarm and indication signals required:**					
	a) Tap-change on Manual	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Tap-change not healthy	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Tap-change fail	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	e) Tap-change d.c. fail	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	f) Tap-change VT fail	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*

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Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	g) Tap-change voltage abnormal	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	h) Tap-change voltage high	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	i) Tap-change voltage low	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	j) Tap-change in progress	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	k) Tap-change on manual control	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	l) Tap-change motor drive trip	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	m) Tap-change position	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
6.5	**Tapchange control signals required:**					
	a) Tapchange raise	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Tap-change lower	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Tap-change overcurrent blocking	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	e) Labelling of all tap changer control wiring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
6.6	**Provide the following trip signals:**					
	a) Top oil temperature very high	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Top winding temperature very high	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) PRV operation	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Buchholz high gasses operation	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
6.7	**Provide the following supply circuits:**					
	a) 220 V AC (15 A) plug with earth leakage protection (30 mA)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) 5 × 6A MCB with earth leakage protection (30 mA)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
6.8	**Provide the following analogue outputs:**					
	a) Top oil temperature reading 4 mA to 20 mA	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Top winding temperature 4 mA to 20 mA	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Combustible gas reading 4 mA to 20 mA	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Temperature sensor on cooler in and outlet	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*

LOW IMPEDANCE TRANSFORMERS		Technical Details				
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		* Complete with whichever is applicable				
7.0	**Cooling:**					
7.1	Auxiliary equipment for forced air cooling:	Fans blowing on radiators				N/A
7.2	Direction fans are blowing	Sidewards				
7.3	Number of fans per transformer	≥ 2 fans	fans	fans	fans	N/A
7.4	Rated output of each fan	---	m^3/s	m^3/s	m^3/s	N/A
7.5	Speed of fan	---	rpm	rpm	rpm	N/A
7.6	Type of fan motor	---				N/A
7.7	Rating of each fan motor	---	kW	kW	kW	N/A
7.8	Starting current of fan motor	---	A	A	A	N/A
7.9	Maximum temperature of oil:					
	a) At inlet to cooler	---	°C	°C	°C	°C
	b) At outlet from cooler	---	°C	°C	°C	°C
8.0	**General Information**					
8.1	Thickness of radiator plates and/or cooling tubes	≥ 1 mm	mm	mm	mm	mm
8.2	Thickness of transformer tank:					
	a) Sides	≥ 8 mm	mm	mm	mm	mm
	b) Bottom	≥ 25 mm	mm	mm	mm	mm
8.3	Overall dimensions of transformer:					
	a) Tank only	---	mm	mm	mm	mm
	b) Coolers only	---	mm	mm	mm	mm
	c) Height over Conservator	---	mm	mm	mm	mm
8.4	Mass of core	---	kg	kg	kg	kg
8.5	Mass of windings	---	kg	kg	kg	kg
8.6	Mass of separate cooler bank complete with oil	---				kg
8.7	Total mass of complete transformer including oil and tank mounted radiators (if applicable)	---	kg	kg	kg	kg

LOW IMPEDANCE TRANSFORMERS		Technical Details				
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		* Complete with whichever is applicable				
8.8	Mass of transformer as arranged for transport	---	kg	kg	kg	kg
8.9	Total oil required (including cooling system)	---	litres	litres	litres	litres
8.10	Minimum quantity of oil to be removed from transformer including conservator to expose the top of the core	---	litres	litres	litres	litres
8.11	Total volume of conservator	---	litres	litres	litres	litres
8.12	Volume of oil in conservator between the highest and lowest visible levels	---	litres	litres	litres	litres
8.13	Maximum permissible vacuum in tank excluding tap-changer, bushings, etc.	---	kPa	kPa	kPa	kPa
8.14	Maximum permissible vacuum in tank fitted as on site with tap-changer, bushings etc.	---	kPa	kPa	kPa	kPa
8.15	Detailed painting process included	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
8.16	Repair for any winding fault up to 20 years offered?	---				
8.17	Guarantees:					
	a) Transformer and auxiliary equipment	10 years	years	years	years	years
	b) Leaks and corrosion	10 years	years	years	years	years
9.0	**Indicating and Protective Devices Details**					
9.1	Anti-corrosion and anti-vibration pad material	---				
9.2	**Vibration and noise:**					
	a) Average noise level of the transformer *without* fans in service	---	dB	dB	dB	dB
	b) Average noise level of the transformer *with* fans in service	< 76 dB	dB	dB	dB	dB
9.3	**Self-Dehydrating Breathers (SDB):**					
	a) Number of SDBs required per transformer	---	kg	kg	kg	kg
	b) Quantity of silica-gel in each SDB	---				
	c) Clear silica gel	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
9.4	**Winding temperature:**					

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		* Complete with whichever is applicable				
	a) Winding temperature thermometer type	---				
	b) Alternative option for fibre optic temperature sensors	---				
9.5	Oil temperature thermometer type	---				
9.6	Oil-and gas-actuated relay type	---				
9.7	**Pressure relief device:**					
	a) Type	---				
	b) Mesh to prevent vermin from entering	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
9.8	**Conservator:**					
	a) Conservator bag	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Conservator bag leak detection system type	---				
	c) Details of bag leak detection system supplied with tender	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Oil level indicators	---				
9.9	Tap-changer protective device (detail)	Specify type				
10.0	**Delivery and off-loading**					
	a) Filling medium of transformer tank for transportation	Dry air				
	b) Quantity of oil required to cover windings for	---	litres	litres	litres	litres
	c) Supplied transformer to be filled with new oil	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Type of oil to be used	Mineral oil (uninhibited) IEC 60296				
		Natural Ester IEC 62270				
	e) Transformer delivered to	As per purchase order	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	f) Delivery effected not before	As per purchase order				
	g) Off-loaded from transport vehicle by Supplier	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	h) Transport transferred to intended operating position	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
11.0	**Erection and oil filling**					
	a) Erected ready for service	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Erection completed not later than	As per purchase order				
	c) Place three layers of 5 ply 2,8 mm Malthoid mat under transformer on plinth	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Place one layer of 4 mm index unigum under transformer on plinth	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
12.0	**Active Part**					
12.1	**Thermal constraints and considerations with regard to the paper insulation system:**					
	a) Life expectancy at required operating and environmental conditions, designed to be for at least:	40 years	years	years	years	years
	b) Type of paper to be used: Thermally upgraded paper	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) DP of wrap and board used:	---				
	d) DP of new paper	---				
	e) Percentage moisture in paper after dry-out	---	%	%	%	%
	f) DP after final dry-out in factory	min 1 000 DP				
	g) Number and details of test blocks to be left in completed transformer	---				
	h) Details of test dry-out/heating blocks dimensions, positioning and testing during manufacture	---	Yes/No*	Yes/No*	Yes/No*	Yes/No*
13.0	**Testing**					
13.1						

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	Are the test results of the following type tests performed on similar transformers available and submitted with this tender? (The degree of similarity of the transformers previously tested to those specified in this contract must					
	a) Impulse test	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Temperature rise test	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Noise level measurements	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Short circuit test	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
13.2	**On Site Oil Tests:**					
	a) Fourier Transform Infrared Spectroscopy (FTIR): Oil type verification	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Dissolved Gas Analysis (DGA): two weeks after energizing	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Test for Silicone and other metal contaminants	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Test for Corrosive sulphur (to be done in accordance with extended Doble method)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
14.0	**Special Requirements**					
14.1	a) On-line single gas dissolved gas analyser (DGA) for transformer monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Transformer operating temperatures monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) On-load tap changer (OLTC) monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Cooling group control monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	e) Bushing monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	f) Partial Discharge monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	g) Type of valves to use	Gate/Butterfly				
	h) Spare bushing to be supplied with oil vessels for long term storage	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
14.2	**Existing Transformer:**					

LOW IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	a) Disassembling, loading, transporting and off-loading of existing power transformer within a 30 km radius	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Oil Handling	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Disposal of transformer oil and old transformer components	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Time required to remove the old transformer	2 weeks	week(s)			week(s)
15.0	**NEC/NER**					
	a) Type	Liquid immersed Metallic				
	b) Short time current rating (10 s)	800	A			A
	c) Filling medium	Mineral oil (uninhibited) IEC 60296				
		Natural Ester IEC 62270				
	d) Overall base dimensions	<	mm			mm
	e) Height	---	mm			mm
	f) Total Mass	---	kg			kg
	g) Reactance at 100°C	---	Ω			Ω
	h) Resistance at 100°C	8 Ω	Ω			Ω
	i) Resistance after passing 800 A for 10 s	---	Ω			Ω
	j) Temperature of metallic resistor after passing 800 A for 10 s	---	°C			°C

LOW IMPEDANCE TRNSFORMER		Technical Details		STANDARD IMPEDANCE TRNSFORMER		Technical Details	
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered	Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
16.0	**Detailed Technical Information and Data Sheets**						
	Detailed information and data sheets including all the relevant Type Test Certificates of the following components shall be included (specify in which section of tender the information is found):						
16.1.1	**HV Outdoor Bushing:**			16.1.2	**132 kV Oil Filled Cable Box and Bushings:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.1.3	**11 kV Oil Filled Cable Box and Bushings:**			16.1.4	**LV Plug Connectors:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.1.5	**HV Neutral Bushing:**			16.1.6	**LV Neutral Bushing:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.2	**Cooler Units, Motors and Fans**						
16.2.1	**Cooler Units:**			16.2.2	**Fans:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		

LOW IMPEDANCE TRNSFORMER		Technical Details	
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable	
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*
16.3	**Tap-changer:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*
16.5	**Pressure Reducing Device:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Material of bag		
	f) Technical Data	Yes	Yes/No*
	g) Type Test Certificate	Yes	Yes/No*
16.6.2	**Measuring Equipment e.g. CT:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*

STANDARD IMPEDANCE TRNSFORMER		Technical Details	
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable	
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
16.4	**Buchholz Relays:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
16.6	**Winding Temperature Measurement**		
16.6.1	**Instrument:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
16.7	**Oil Temperature Measurement**		
16.7.1	**Instrument:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*

LOW IMPEDANCE TRNSFORMER		Technical Details		STANDARD IMPEDANCE TRNSFORMER		Technical Details	
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered	Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
16.7.2	**Measuring Equipment e.g. PT100s or Sensors:**			16.8	**Tap-changer Pressure Relay:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.9	**Dehydrating Breathers**			16.10	**Conservator Bag:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.11	**Oil Level Indicators**			16.12	**NEC/NER**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
17.0	**General**						
	Further information that tenderers may wish to submit						

SECTION 2(b): 132/11 kV 30 MVA Type 1, Type 2, Type 3 and Type 4 Power Transformers

HIGH IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
			* Complete with whichever is applicable			
1.0	**Transformer General Information**					
1.1	Name of manufacturer	---				
1.2	Country of origin	---				
1.3	Do the transformers comply in all respects with the standard specifications quoted in the Technical Specification? (If not, indicate deviations)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
1.4	**Manufacturing Experience**					
	a) Number of 132 kV transformers manufactured at the factory in the last twelve (12) months	---	transformer(s)	transformer(s)	transformer(s)	transformer(s)
	b) Factory failure rate in five (5) years where transformers above 15 MVA form the sample group	---	%	%	%	%
1.5	**Type of Transformers:**					
	Core	Core-form				
1.6	**Core Steel**					
	a) Manufacturer of core steel	---				
	b) Type of core steel (conventional grain oriented or high permeability)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Grade of core steel	---				
	d) Thickness of core steel	---	mm	mm	mm	mm
1.7	**Core dimensions**					
	a) Window height	---	mm	mm	mm	mm
	b) Distance between core limb centres	---	mm	mm	mm	mm
	c) Core diameter	---	mm	mm	mm	mm
	d) Filling factor	---				
1.8	**Cross sectional areas**					
	a) Wound limbs	---	mm^2	mm^2	mm^2	mm^2

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		* Complete with whichever is applicable				
	b) Yoke	---	mm^2	mm^2	mm^2	mm^2
1.9	**Total core mass**	---	kg	kg	kg	kg
1.10	The design flux density at nominal voltage for:					
	a) Wound limbs	1,75 T	T	T	T	T
	b) Yoke	1,75 T	T	T	T	T
1.11	**Volts/turn at the above flux**	---	V/turn	V/turn	V/turn	V/turn
2.0	**Ratings**					
2.1	Supply frequency	50 Hz	Hz	Hz	Hz	Hz
2.2	Number phases	3				
2.3	Nominal system voltage at no load on nominal tap:					
	a) Primary	132 kV	kV	kV	kV	kV
	b) Secondary	11 kV	kV	kV	kV	kV
2.4	Maximum primary operating voltage	145 kV	kV	kV	kV	kV
2.5	Connections	Star/Star				
2.6	Vector group	YNyn0				
2.7	Full load rating (on any tap position)	30 MVA	MVA	MVA	MVA	MVA
2.8	Continuous rating when operating under the specified site conditions (on any tap position):	30 MVA	MVA	MVA	MVA	MVA
2.9	Type of cooling	Type 1: ONAF				
		Type 2: ONAN				
		Type 3: ONAF				
		Type 4: ONAN				
2.10	ONAN rating when operating under the specified site conditions (on any tap position):	Type 1: 18 MVA	MVA	MVA	MVA	MVA
		Type 2: 30 MVA	MVA	MVA	MVA	MVA
		Type 3: 18 MVA	MVA	MVA	MVA	MVA
		Type 4: 30 MVA	MVA	MVA	MVA	MVA

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			* Complete with whichever is applicable				
2.11	**Short circuit design:**						
	a) Transformer three-phase designed fault level value r.m.s:	HV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$
	b) Transformer three-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}	kA_{peak}	kA_{peak}	kA_{peak}
		LV	As per IEC	kA_{peak}	kA_{peak}	kA_{peak}	kA_{peak}
	c) Transformer single-phase designed fault level value, r.m.s.:	HV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$	$kA_{r.m.s.}$
	d) Transformer single-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}	kA_{peak}	kA_{peak}	kA_{peak}
		LV	As per IEC	kA_{peak}	kA_{peak}	kA_{peak}	kA_{peak}
	e) Designed number of through faults in transformer lifetime:	HV	---				
		LV	---				
	f) Transformer is designed to withstand a full three-phase short circuit on the LV terminals and supplied from the HV side		Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
2.12	**Positive phase sequence impedance at 75°C and rated frequency, phase to neutral, viewed from HV**						
2.12.1	a) Minimum Ohmic impedance		93,5 Ω	Ω	Ω	Ω	Ω
	b) Corresponding % impedance		---	%	%	%	%
	c) Corresponding X/R ratio		---				
	d) Corresponding tap number		---				
2.12.2	a) Maximum Ohmic impedance		112,2 Ω	Ω	Ω	Ω	Ω
	b) Corresponding % impedance		---	%	%	%	%
	c) Corresponding X/R ratio		---				
	d) Corresponding tap number		---				
2.12.3	a) Ohmic impedance at nominal tap position		---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance		22,0%	%	%	%	%
	c) Corresponding X/R ratio		---				
	d) Corresponding tap number		5				

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		* Complete with whichever is applicable				
2.12.4	a) Minimum IEC impedance	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%	%	%
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	---				
2.12.5	a) Maximum IEC impedance	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%	%	%
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	---				
2.12.6	a) IEC impedance at nominal tap position	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	22,0%	%	%	%	%
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	5				
2.13	**Zero phase sequence impedance at 75°C and rated frequency, phase to neutral, viewed from HV windings:**					
2.13.1	a) Minimum zero Phase sequence Ohmic impedance	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%	%	%
	c) Corresponding tap number	---				
2.13.2	a) Maximum zero phase sequence Ohmic impedance	---				
	b) Corresponding % impedance	---				
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	---				
2.13.3	a) Zero phase sequence Ohmic impedance at nominal tap position	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%	%	%
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	5				
2.13.4	a) Minimum zero Phase sequence IEC impedance	---	Ω	Ω	Ω	Ω

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		* Complete with whichever is applicable				
	b) Corresponding % impedance	---	%	%	%	%
	c) Corresponding tap number	---				
2.13.5	a) Maximum zero phase sequence IEC impedance	---				
	b) Corresponding % impedance	---				
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	---				
2.13.6	a) Zero phase sequence IEC impedance at nominal tap position	---	Ω	Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%	%	%
	c) Corresponding X/R ratio	---				
	d) Corresponding tap number	5				
3.0	**Winding design**					
	a) Winding arrangement	CORE-MV-HV-TAP				
	b) Conductor Yield strength	---	N/mm^2	N/mm^2	N/mm^2	
	c) **Normal insulation resistance between:**					
	• CPrimary and Tertiary Windings	---	MΩ	MΩ	MΩ	MΩ
	• SPrimary Windings and Core	---	MΩ	MΩ	MΩ	MΩ
	• PCore and Tank	---	MΩ	MΩ	MΩ	MΩ
	• CCore bolts and core	---	MΩ	MΩ	MΩ	MΩ
3.1	**Winding 1**	**Secondary (LV)**				
	a) Type	multi-layer helix				
	b) Type of axial coil support	---				
	c) Lead type (End Fed/Centre Fed)	---				
	d) Number of turns	---				
	e) Inner diameter	---	mm	mm	mm	mm
	f) Outer diameter	---	mm	mm	mm	mm

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		* Complete with whichever is applicable				
	g) Radial build	---	mm	mm	mm	mm
	h) Magnetic height	---	mm	mm	mm	mm
	ormal insulation resistance between:					
	imary and Tertiary Windings	-	Ω	Ω	Ω	Ω
	imary Windings and Core	-	Ω	Ω	Ω	Ω
	ore and Tank	-	Ω	Ω	Ω	Ω
	ore bolts and core	-	Ω	Ω	Ω	Ω
	i) **Conductor configuration:**					
	• Size	---				
	• Number	---				
	h) Conductor insulation	Full	mm	mm	mm	mm
	i) Dry mass insulation	---	kg	kg	kg	kg
	j) Winding impulse withstand voltage	95 kV_p	kV_p	kV_p	kV_p	kV_p
	k) Maximum current density at full load rating	---	A/mm^2	A/mm^2	A/mm^2	A/mm^2
	l) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A	A	A
	m) **Temperature rise limits:**					
	• Top oil temperature rise	55 K	K	K	K	K
	• Average winding temperature rise	60 K	K	K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K	K	K
	n) Total conductor mass	---	kg	kg	kg	kg
3.2	**Winding 2**	**Primary (HV)**				
	a) Type	multi-layer helix				
	b) Type of axial coil support	---				
	c) Lead type (End Fed/Centre Fed)	---				
	d) Number of turns	---				
	e) Inner diameter	---	mm	mm	mm	mm

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		* Complete with whichever is applicable				
	f) Outer diameter	---	mm	mm	mm	mm
	g) Radial build	---	mm	mm	mm	mm
	h) Magnetic height	---	mm	mm	mm	mm
	ormal insulation resistance between:					
	imary and Tertiary Windings	-	Ω	Ω	Ω	Ω
	imary Windings and Core	-	Ω	Ω	Ω	Ω
	ore and Tank	-	Ω	Ω	Ω	Ω
	ore bolts and core	-	Ω	Ω	Ω	Ω
	i) Conductor configuration:					
	• Size	---				
	• Number	---				
	h) Conductor insulation	Graded	mm	mm	mm	mm
	i) Dry mass insulation	---	kg	kg	kg	kg
	j) Winding impulse withstand voltage	550 kV_p	kV_p	kV_p	kV_p	kV_p
	k) Maximum current density at full load rating	---	A/mm^2	A/mm^2	A/mm^2	A/mm^2
	l) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A	A	A
	m) **Temperature rise limits:**					
	• Top oil temperature rise	55 K	K	K	K	K
	• Average winding temperature rise	60 K	K	K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K	K	K
	n) Total conductor mass	---	kg	kg	kg	kg
3.3	**Winding 3**	**Regulating (TAP)**				
	a) Type	multi-layer helix				
	b) Type of axial coil support	---				
	c) Lead type (End Fed/Centre Fed)	---				
	d) Number of turns	---				

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		* Complete with whichever is applicable				
	e) Inner diameter	---	mm	mm	mm	mm
	f) Outer diameter	---	mm	mm	mm	mm
	g) Radial build	---	mm	mm	mm	mm
	h) Magnetic height	---	mm	mm	mm	mm
	Normal insulation resistance between:					
	Primary and Tertiary Windings	---	MΩ	MΩ	MΩ	MΩ
	Primary Windings and Core	---	MΩ	MΩ	MΩ	MΩ
	Core and Tank	---	MΩ	MΩ	MΩ	MΩ
	Core bolts and core	---	MΩ	MΩ	MΩ	MΩ
	i) Conductor configuration:					
	• Size	---				
	• Number	---				
	h) Conductor insulation	Full	mm	mm	mm	mm
	i) Dry mass insulation	---	kg	kg	kg	kg
	j) Winding impulse withstand voltage	As per IEC	kV_p	kV_p	kV_p	kV_p
	k) Maximum current density at full load rating	---	A/mm^2	A/mm^2	A/mm^2	A/mm^2
	l) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A	A	A
	m) **Temperature rise limits:**					
	• Top oil temperature rise	55 K	K	K	K	K
	• Average winding temperature rise	60 K	K	K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K	K	K
	n) Total conductor mass	---	kg	kg	kg	kg
3.4	**Inter-winding Insulation**					
3.4.1	**CORE – LV winding:**					
	a) Number of barriers	---				
	b) Barrier thickness	---	mm	mm	mm	mm

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		* Complete with whichever is applicable				
	c) Distance from windings	---	mm	mm	mm	mm
	d) Distance between barriers	---	mm	mm	mm	mm
3.4.2	**LV winding to HV winding**					
	a) Number of barriers	---				
	b) Barrier thickness	---	mm	mm	mm	mm
	c) Distance from windings	---	mm	mm	mm	mm
	d) Distance between barriers	---	mm	mm	mm	mm
3.4.3	**HV winding to TAP winding**					
	a) Number of barriers	---				
	b) Barrier thickness	---	mm	mm	mm	mm
	c) Distance from windings	---	mm	mm	mm	mm
	d) Distance between barriers	---	mm	mm	mm	mm
4.0	**Losses and Efficiency**					
4.1	**Guaranteed no-load losses at normal ratio and normal voltage:**					
	a) No-load losses excluding input to cooling plant	---	kW	kW	kW	kW
	b) Input to cooling plant required at full load rating	---	kW	kW	kW	kW
4.2	**Guaranteed load losses at 75°C and normal ratio and nominal voltage:**					
	a) Full load rating	---	kW	kW	kW	kW
	b) ONAN rating	---	kW	kW	kW	kW
	c) At 50% full load rating	---	kW	kW	kW	kW
4.3	**Total guaranteed losses at 75°C and normal ratio and nominal voltage:**					
	a) At full load rating including input to cooling plant	---	kW	kW	kW	kW
	b) At ONAN rating	---	kW	kW	kW	kW
	c) At 50% full load rating	---	kW	kW	kW	kW
4.4	**Efficiency at normal ratio and 0,8 lagging power**					

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		* Complete with whichever is applicable				
	a) At full load rating including input to cooling plant	---	%	%	%	%
	b) At ONAN rating	---	%	%	%	%
	c) At 50% full load rating	---	%	%	%	%
4.5	**Inherent regulation at 75°C normal ratio and full load rating expressed as percent of rated voltage:**					
	a) At unity power factor percent	---	%	%	%	%
	b) At 0,8 lagging power factor	---	%	%	%	%
	c) At 100% full load	---	%	%	%	kW
5.0	**Terminals**					
5.1	**Details of 132 kV outdoor bushings:**					
	a) Bushing type	Resin impregnated paper with silicone rubber sheds		N/A	Resin impregnated paper with silicone rubber sheds	N/A
	b) Bushing impulse withstand voltage	650 kV_p	kV_p		kV_p	N/A
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	7 130 mm	mm	N/A	mm	N/A
	d) Stem diameter	26 mm	mm	N/A	mm	N/A
	e) Tan-delta test facility	Yes	Yes/No*	N/A	Yes/No*	N/A
5.2	**Details of 132 kV oil filled cable boxes:**					
	a) Compliance with IEC 60859	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Bushing impulse withstand voltage	650 kV_p	kV_p	kV_p	kV_p	kV_p
	c) Individual oil valves required to isolate each phase cable box from conservator	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
5.3	**Details of HV neutral bushing:**					
	a) Bushing type	Resin impregnated paper with silicone rubber sheds				
	b) Bushing impulse withstand voltage	200 kV_p	kV_p	kV_p	kV_p	kV_p

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		* Complete with whichever is applicable				
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	1 780 mm	mm	mm	mm	mm
	d) Clamp suitable for 50 mm by 6 mm copper earth bar	Yes				
	e) Voltage rating of bushing	36 kV	kV	kV	kV	kV
5.4	**Details of LV neutral bushing:**					
	a) Bushing type	Resin impregnated paper with silicone rubber sheds				
	b) Bushing impulse withstand voltage	95 kV_p	kV_p	kV_p	kV_p	kV_p
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	---	mm	mm	mm	mm
	d) Clamp suitable for 50 mm by 6 mm copper earth bar	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	e) Voltage rating of bushing	12 kV	kV	kV	kV	kV
5.5	**Details of LV plug connectors:**					
	a) Type (Plug: For 630 mm2 conductor and 42.2 mm OD insulation for outdoor use)					
	b) Cable connector size	3				
	c) Rated service voltage	12 kV	kV	kV	kV	kV
	d) Rated nominal current	1 250 A	A	A	A	A
	e) Number of sockets per phase	2				
	f) Plugs for fitting onto cables to be supplied	Yes				
5.6	**Details of 11 kV oil filled cable box and bushings:**					
	a) Compliance with IEC 60859	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Bushing impulse withstand voltage	95 kV_p	kV_p	kV_p	kV_p	kV_p
	c) Suitable for number and size of cables per phase (2 × 630 mm² Copper)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Rated service voltage	12 kV	kV	kV	kV	kV
6.0	**On-load Tap-changer (Vacuum Type)**					

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		* Complete with whichever is applicable				
6.1	a) Manufacturer	---				
	b) Resistor type, reactor type etc	---				
	c) Manufacturer's type designation	---				
	d) Can oil from the on-load transfer switch compartment mix with the oil in the main tank?	No	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	e) Diverter switch with vacuum interrupters	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
6.2	**Tappings:**					
	a) Which winding is tapped and where	HV Neutral end				
	b) Range of tappings (primary/secondary ratios per unit at nominal tap)	Maximum 1.05 pu	pu	pu	pu	pu
		Minimum 0.85 pu	pu	pu	pu	pu
	c) Size of step as percentage of winding rated voltage at no-load	Maximum 1.25%	%	%	%	%
	d) Number of steps	16 steps	steps	steps	steps	steps
6.3	**Number and type of tap position indication devices provided in tap-change drive mechanism:**					
	a) Binary coded decimal type	2				
	b) Resistor divider type (resistance to be specified at time of order, typically 400 Ω per step)	1				
	c) Voltage free contacts with common connection (one contact per tap)	2				
	d) Number of steps	16 steps	steps	steps	steps	steps
6.4	**Tap-change alarm and indication signals required:**					
	a) Tap-change on Manual	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Tap-change not healthy	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Tap-change fail	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	e) Tap-change d.c. fail	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	f) Tap-change VT fail	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*

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		* Complete with whichever is applicable				
	g) Tap-change voltage abnormal	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	h) Tap-change voltage high	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	i) Tap-change voltage low	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	j) Tap-change in progress	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	k) Tap-change on manual control	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	l) Tap-change motor drive trip	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	m) Tap-change position	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
6.5	**Tapchange control signals required:**					
	a) Tapchange raise	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Tap-change lower	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Tap-change overcurrent blocking	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	e) Labelling of all tap changer control wiring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
6.6	**Provide the following trip signals:**					
	a) Top oil temperature very high	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Top winding temperature very high	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) PRV operation	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Buchholz high gasses operation	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
6.7	**Provide the following supply circuits:**					
	a) 220 V AC (15 A) plug with earth leakage protection (30 mA)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) 5 × 6A MCB with earth leakage protection (30 mA)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
6.8	**Provide the following analogue outputs:**					
	a) Top oil temperature reading 4 mA to 20 mA	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Top winding temperature 4 mA to 20 mA	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Combustible gas reading 4 mA to 20 mA	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Temperature sensor on cooler in and outlet	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*

HIGH IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
7.0	**Cooling:**					
7.1	Auxiliary equipment for forced air cooling:	Fans blowing on radiators				N/A
7.2	Direction fans are blowing	Sidewards				
7.3	Number of fans per transformer	≥ 2 fans	fans	fans	fans	N/A
7.4	Rated output of each fan	---	m^3/s	m^3/s	m^3/s	N/A
7.5	Speed of fan	---	rpm	rpm	rpm	N/A
7.6	Type of fan motor	---				N/A
7.7	Rating of each fan motor	---	kW	kW	kW	N/A
7.8	Starting current of fan motor	---	A	A	A	N/A
7.9	Maximum temperature of oil:					
	a) At inlet to cooler	---	°C	°C	°C	°C
	b) At outlet from cooler	---	°C	°C	°C	°C
8.0	**General Information**					
8.1	Thickness of radiator plates and/or cooling tubes	≥ 1 mm	mm	mm	mm	mm
8.2	Thickness of transformer tank:					
	a) Sides	≥ 8 mm	mm	mm	mm	mm
	b) Bottom	≥ 25 mm	mm	mm	mm	mm
8.3	Overall dimensions of transformer:					
	a) Tank only	---	mm	mm	mm	mm
	b) Coolers only	---	mm	mm	mm	mm
	c) Height over Conservator	---	mm	mm	mm	mm
8.4	Mass of core	---	kg	kg	kg	kg
8.5	Mass of windings	---	kg	kg	kg	kg
8.6	Mass of separate cooler bank complete with oil	---				kg
8.7	Total mass of complete transformer including oil and tank mounted radiators (if applicable)	---	kg	kg	kg	kg

HIGH IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
8.8	Mass of transformer as arranged for transport	---	kg	kg	kg	kg
8.9	Total oil required (including cooling system)	---	litres	litres	litres	litres
8.10	Minimum quantity of oil to be removed from transformer including conservator to expose the top of the core	---	litres	litres	litres	litres
8.11	Total volume of conservator	---	litres	litres	litres	litres
8.12	Volume of oil in conservator between the highest and lowest visible levels	---	litres	litres	litres	litres
8.13	Maximum permissible vacuum in tank excluding tap-changer, bushings, etc.	---	kPa	kPa	kPa	kPa
8.14	Maximum permissible vacuum in tank fitted as on site with tap-changer, bushings etc.	---	kPa	kPa	kPa	kPa
8.15	Detailed painting process included	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
8.16	Repair for any winding fault up to 20 years offered?	---				
8.17	Guarantees:					
	a) Transformer and auxiliary equipment	10 years	years	years	years	years
	b) Leaks and corrosion	10 years	years	years	years	years
9.0	**Indicating and Protective Devices Details**					
9.1	Anti-corrosion and anti-vibration pad material	---				
9.2	**Vibration and noise:**					
	a) Average noise level of the transformer without fans in service	---	dB	dB	dB	dB
	b) Average noise level of the transformer *with* fans in service	< 76 dB	dB	dB	dB	dB
9.3	**Self-Dehydrating Breathers (SDB):**					
	a) Number of SDBs required per transformer	---	kg	kg	kg	kg
	b) Quantity of silica-gel in each SDB	---				
	c) Clear silica gel	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
9.4	**Winding temperature:**					

HIGH IMPEDANCE TRANSFORMERS		Technical Details				
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		* Complete with whichever is applicable				
	a) Winding temperature thermometer type	---				
	b) Alternative option for fibre optic temperature sensors	---				
9.5	Oil temperature thermometer type	---				
9.6	Oil-and gas-actuated relay type	---				
9.7	**Pressure relief device:**					
	a) Type	---				
	b) Mesh to prevent vermin from entering	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
9.8	**Conservator:**					
	a) Conservator bag	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Conservator bag leak detection system type	---				
	c) Details of bag leak detection system supplied with tender	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Oil level indicators	---				
9.9	Tap-changer protective device (detail)	Specify type				
10.0	**Delivery and off-loading**					
	a) Filling medium of transformer tank for transportation	Dry air				
	b) Quantity of oil required to cover windings for transportation	---	litres	litres	litres	litres
	c) Supplied transformer to be filled with new oil	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Type of oil to be used	Mineral oil (uninhibited) IEC 60296				
		Natural Ester IEC 62270				
	e) Transformer delivered to	As per purchase order	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	f) Delivery effected not before	As per purchase order				

HIGH IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	g) Off-loaded from transport vehicle by Supplier	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	h) Transport transferred to intended operating position	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
11.0	**Erection and oil filling**					
	a) Erected ready for service	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Erection completed not later than	As per purchase order				
	c) Place three layers of 5 ply 2,8 mm Malthoid mat under transformer on plinth	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Place one layer of 4 mm index unigum under transformer on plinth	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
12.0	**Active Part**					
12.1	**Thermal constraints and considerations with regard to the paper insulation system:**					
	a) Life expectancy at required operating and environmental conditions, designed to be for at least:	40 years	years	years	years	years
	b) Type of paper to be used: Thermally upgraded paper	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) DP of wrap and board used:	---				
	d) DP of new paper	---				
	e) Percentage moisture in paper after dry-out	---	%	%	%	%
	f) DP after final dry-out in factory	min 1 000 DP				
	g) Number and details of test blocks to be left in completed transformer	---				
	h) Details of test dry-out/heating blocks dimensions, positioning and testing during manufacture	---	Yes/No*	Yes/No*	Yes/No*	Yes/No*
13.0	**Testing**					
13.1						

HIGH IMPEDANCE TRANSFORMERS		Technical Details				
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA Type 1 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 2 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 3 (ONAN/ONAF) Offered	132/11 kV 30 MVA Type 4 (ONAN) Offered
		* Complete with whichever is applicable				
	Are the test results of the following type tests performed on similar transformers available and submitted with this tender? (The degree of similarity of the transformers previously tested to those specified in this contract must					
	a) Impulse test	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Temperature rise test	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Noise level measurements	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Short circuit test	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
13.2	**On Site Oil Tests:**					
	a) Fourier Transform Infrared Spectroscopy (FTIR): Oil type verification	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Dissolved Gas Analysis (DGA): two weeks after energizing	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Test for Silicone and other metal contaminants	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Test for Corrosive sulphur (to be done in accordance with extended Doble method)	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
14.0	**Special Requirements**					
14.1	a) On-line single gas dissolved gas analyser (DGA) for transformer monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Transformer operating temperatures monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) On-load tap changer (OLTC) monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Cooling group control monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	e) Bushing monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	f) Partial Discharge monitoring	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	g) Type of valves to use	Gate/Butterfly				
	h) Spare bushing to be supplied with oil vessels for long term storage	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
14.2	**Existing Transformer:**					

HIGH IMPEDANCE TRANSFORMERS		Technical Details				
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		* Complete with whichever is applicable				
	a) Disassembling, loading, transporting and off-loading of existing power transformer within a 30 km radius	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	b) Oil Handling	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	c) Disposal of transformer oil and old transformer components	Yes	Yes/No*	Yes/No*	Yes/No*	Yes/No*
	d) Time required to remove the old transformer	2 weeks	week(s)			week(s)
15.0	**NEC/NER**					
	a) Type	Liquid immersed Metallic				
	b) Short time current rating (10 s)	800	A			A
	c) Filling medium	Mineral oil (uninhibited) IEC 60296				
		Natural Ester IEC 62270				
	d) Overall base dimensions	<	mm			mm
	e) Height	---	mm			mm
	f) Total Mass	---	kg			kg
	g) Reactance at 100°C	---	Ω			Ω
	h) Resistance at 100°C	8 Ω	Ω			Ω
	i) Resistance after passing 800 A for 10 s	---	Ω			Ω
	j) Temperature of metallic resistor after passing 800 A for 10 s	---	°C			°C

HIGH IMPEDANCE TRANSFORMER		Technical Details			HIGH IMPEDANCE TRANSFORMER		Technical Details	
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered		Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable					* Complete with whichever is applicable	
16.0	**Detailed Technical Information and Data Sheets**							
	Detailed information and data sheets including all the relevant Type Test Certificates of the following components shall be included (specify in which section of tender the information is found):							
16.1.1	**HV Outdoor Bushing:**				16.1.2	**132 kV Oil Filled Cable Box and Bushings:**		
	a) Manufacturer					a) Manufacturer		
	b) Type Number					b) Type Number		
	c) Part Number					c) Part Number		
	d) Supplier					d) Supplier		
	e) Technical Data	Yes	Yes/No*			e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*			f) Type Test	Yes	Yes/No*
16.1.3	**11 kV Oil Filled Cable Box and Bushings:**				16.1.4	**LV Plug Connectors:**		
	a) Manufacturer					a) Manufacturer		
	b) Type Number					b) Type Number		
	c) Part Number					c) Part Number		
	d) Supplier					d) Supplier		
	e) Technical Data	Yes	Yes/No*			e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*			f) Type Test	Yes	Yes/No*
16.1.5	**HV Neutral Bushing:**				16.1.6	**LV Neutral Bushing:**		
	a) Manufacturer					a) Manufacturer		
	b) Type Number					b) Type Number		
	c) Part Number					c) Part Number		
	d) Supplier					d) Supplier		
	e) Technical Data	Yes	Yes/No*			e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*			f) Type Test	Yes	Yes/No*
16.2	**Cooler Units, Motors and Fans**							
16.2.1	**Cooler Units:**				16.2.2	**Fans:**		
	a) Manufacturer					a) Manufacturer		
	b) Type Number					b) Type Number		

HIGH IMPEDANCE TRANSFORMER		Technical Details	
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable	
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*
16.3	**Tap-changer:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*
16.5	**Pressure Reducing Device:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Material of bag		
	f) Technical Data	Yes	Yes/No*
	g) Type Test Certificate	Yes	Yes/No*
16.6.2	**Measuring Equipment e.g. CT:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*

HIGH IMPEDANCE TRANSFORMER		Technical Details	
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable	
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
16.4	**Buchholz Relays:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
16.6	**Winding Temperature Measurement**		
16.6.1	**Instrument:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
16.7	**Oil Temperature Measurement**		
16.7.1	**Instrument:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*

HIGH IMPEDANCE TRANSFORMER		Technical Details		HIGH IMPEDANCE TRANSFORMER		Technical Details	
Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered	Item	Description	eThekwini Electricity Requirement	132/11 kV 30 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
16.7.2	**Measuring Equipment e.g. PT100s or Sensors:**			16.8	**Tap-changer Pressure Relay:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.9	**Dehydrating Breathers**			16.10	**Conservator Bag:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.11	**Oil Level Indicators**			16.12	**NEC/NER**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
17.0	**General**						
	Further information that tenderers may wish to submit						

SECTION 3 (a): 132/33 kV 50 MVA Power Transformers

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
1.0	**Transformer General Information**			
1.1	Name of manufacturer	---		
1.2	Country of origin	---		
1.3	Do the transformers comply in all respects with the standard specifications quoted in the Technical Specification? (If not, indicate deviations)	Yes	Yes/No*	Yes/No*
1.4	**Manufacturing Experience**			
	a) Number of 132 kV transformers manufactured at the factory in the last twelve (12) months	---	transformer(s)	transformer(s)
	b) Factory failure rate in five (5) years where transformers above 15 MVA form the sample group	---	%	%
1.5	**Type of Transformers:**			
	Core	Core-form		
1.6	**Core Steel**			
	a) Manufacturer of core steel	---		
	b) Type of core steel (conventional grain oriented or high permeability)	Yes	Yes/No*	Yes/No*
	c) Grade of core steel	---		
	d) Thickness of core steel	---	mm	mm
1.7	**Core dimensions**			
	a) Window height	---	mm	mm
	b) Distance between core limb centres	---	mm	mm
	c) Core diameter	---	mm	mm
	d) Filling factor	---		
1.8	**Cross sectional areas**			
	a) Wound limbs	---	mm^2	mm^2
	b) Yoke	---	mm^2	mm^2
1.9	**Total core mass**	---	kg	kg
1.10	The design flux density at nominal voltage for:			

Item	Description		Technical Details		
			eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
				* Complete with whichever is applicable	
	a) Wound limbs		1,75 T	T	T
	b) Yoke		1,75 T	T	T
1.11	**Volts/turn at the above flux**		---	V/turn	V/turn
2.0	**Ratings**				
2.1	Supply frequency		50 Hz	Hz	Hz
2.2	Number phases		3		
2.3	Nominal system voltage at no load on nominal tap:				
	a) Primary		132 kV	kV	kV
	b) Secondary		33 kV	kV	kV
2.4	Maximum primary operating voltage		145 kV	kV	kV
2.5	Connections		Star/Delta		
2.6	Vector group		YNd1		
2.7	Full load rating (on any tap position)		50 MVA	MVA	MVA
2.8	Continuous rating when operating under the specified site conditions (on any tap position):		50 MVA	MVA	MVA
2.9	Type of cooling		Type 1: ONAF		
			Type 2: ONAN		
			Type 3: ONAF		
			Type 4: ONAN		
2.10	ONAN rating when operating under the specified site conditions (on any tap position):		Type 1: 30 MVA	MVA	MVA
			Type 2: 50 MVA	MVA	MVA
			Type 3: 30 MVA	MVA	MVA
			Type 4: 50 MVA	MVA	MVA
2.11	**Short circuit design:**				
	a) Transformer three-phase designed fault level value, rms:	HV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
	b) Transformer three-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}	kA_{peak}
		LV	As per IEC	kA_{peak}	kA_{peak}

Item	Description		Technical Details		
			eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
				* Complete with whichever is applicable	
	c) Transformer single-phase designed fault level value, rms:	HV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
	d) Transformer single-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}	kA_{peak}
		LV	As per IEC	kA_{peak}	kA_{peak}
	e) Designed number of through faults in transformer lifetime:	HV	---		
		LV	---		
	f) Transformer is designed to withstand a full three-phase short circuit on the LV terminals and supplied from the HV side		Yes	Yes/No*	Yes/No*
2.12	**Positive phase sequence impedance at 75°C and rated frequency, phase to neutral, viewed from HV windings:**				
2.12.1	a) Minimum Ohmic impedance		31,0 Ω	Ω	Ω
	b) Corresponding % impedance		---	%	%
	c) Corresponding X/R ratio		---		
	d) Corresponding tap number		---		
2.12.2	a) Maximum Ohmic impedance		46,5 Ω	Ω	Ω
	b) Corresponding % impedance		---	%	%
	c) Corresponding X/R ratio		---		
	d) Corresponding tap number		---		
2.12.3	a) Ohmic impedance at nominal tap position		---	Ω	Ω
	b) Corresponding % impedance		12,1 %	%	%
	c) Corresponding X/R ratio		---		
	d) Corresponding tap number		5		
2.12.4	a) Minimum IEC impedance		---	Ω	Ω
	b) Corresponding % impedance		---	%	%
	c) Corresponding X/R ratio		---		
	d) Corresponding tap number		---		
2.12.5	a) Maximum IEC impedance		---	Ω	Ω
	b) Corresponding % impedance		---	%	%

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	---		
2.12.6	a) IEC impedance at nominal tap position	---	Ω	Ω
	b) Corresponding % impedance	12,1 %	%	%
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	5		
2.13	**Zero phase sequence impedance at 75°C and rated frequency, phase to neutral, viewed from HV windings:**			
2.13.1	a) Minimum zero Phase sequence Ohmic impedance	---	Ω	Ω
	b) Corresponding % impedance	---	%	%
	c) Corresponding tap number	---		
2.13.2	a) Maximum zero phase sequence Ohmic impedance	---		
	b) Corresponding % impedance	---		
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	---		
2.13.3	a) Zero phase sequence Ohmic impedance at nominal tap position	---	Ω	Ω
	b) Corresponding % impedance	---	%	%
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	5		
2.13.4	a) Minimum zero Phase sequence IEC impedance	---	Ω	Ω
	b) Corresponding % impedance	---	%	%
	c) Corresponding tap number	---		
2.13.5	a) Maximum zero phase sequence IEC impedance	---		
	b) Corresponding % impedance	---		
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	---		
2.13.6	a) Zero phase sequence IEC impedance at nominal tap position	---	Ω	Ω

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
	b) Corresponding % impedance	---	%	%
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	5		
3.0	**Winding design**			
	a) Winding arrangement	CORE-LV-HV-TAP		
	b) Conductor Yield strength	---	N/mm^2	
	c) **Normal insulation resistance between:**			
	• CLPrimary and Tertiary Windings	---	MΩ	MΩ
	• SLPrimary Windings and Core	---	MΩ	MΩ
	• PCore and Tank	---	MΩ	MΩ
	• CCore bolts and core	---	MΩ	MΩ
3.1	**Winding 1**	**Secondary (LV)**		
	a) Type	multi-layer helix		
	b) Type of axial coil support	---		
	c) Lead type	End Fed/Centre		
	d) Number of turns	---		
	e) Inner diameter	---	mm	mm
	f) Outer diameter	---	mm	mm
	g) Radial build	---	mm	mm
	h) Magnetic height	---	mm	mm
	Normal insulation resistance between:			
	Primary and Tertiary Windings	---	MΩ	MΩ
	Primary Windings and Core	---	MΩ	MΩ
	Core and Tank	---	MΩ	MΩ
	Core bolts and core	---	MΩ	MΩ
	i) **Conductor configuration:**			
	• Size	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
	• Number	---		
	o) Conductor insulation	Full	mm	mm
	p) Dry mass insulation	---	kg	kg
	q) Winding impulse withstand voltage	200 kV_p	kV_p	kV_p
	r) Maximum current density at full load rating	---	A/mm^2	A/mm^2
	s) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A
	t) **Temperature rise limits:**			
	• Top oil temperature rise	55 K	K	K
	• Average winding temperature rise	60 K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K
	u) Total conductor mass	---	kg	kg
3.2	**Winding 2**	**Primary (HV)**		
	a) Type (i.e. multi-layer helix)	---		
	b) Type of axial coil support	---		
	c) Lead type (End Fed/Centre Fed)	---		
	d) Number of turns	---		
	e) Inner diameter	---	mm	mm
	f) Outer diameter	---	mm	mm
	g) Radial build	---	mm	mm
	h) Magnetic height	---	mm	mm
	Normal insulation resistance between:			
	Primary and Tertiary Windings	---	MΩ	MΩ
	Primary Windings and Core	---	MΩ	MΩ
	Core and Tank	---	MΩ	MΩ
	Core bolts and core	---	MΩ	MΩ
	i) Conductor configuration:			
	• Size	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
	• Number	---		
	o) Conductor insulation	Graded	mm	mm
	p) Dry mass insulation	---	kg	kg
	q) Winding impulse withstand voltage	550 kV_p	kV_p	kV_p
	r) Maximum current density at full load rating	---	A/mm^2	A/mm^2
	s) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A
	t) **Temperature rise limits:**			
	• Top oil temperature rise	55 K	K	K
	• Average winding temperature rise	60 K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K
	u) Total conductor mass	---	kg	kg
3.3	**Winding 3**	**Regulating (TAP)**		
	a) Type (i.e. multi-layer helix)	---		
	b) Type of axial coil support	---		
	c) Lead type (End Fed/Centre Fed)	---		
	d) Number of turns	---		
	e) Inner diameter	---	mm	mm
	f) Outer diameter	---	mm	mm
	g) Radial build	---	mm	mm
	h) Magnetic height	---	mm	mm
	Normal insulation resistance between:			
	Primary and Tertiary Windings	---	MΩ	MΩ
	Primary Windings and Core	---	MΩ	MΩ
	Core and Tank	---	MΩ	MΩ
	Core bolts and core	---	MΩ	MΩ
	i) Conductor configuration:			
	• Size	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
	• Number	---		
	o) Conductor insulation	Full	mm	mm
	p) Dry mass insulation	---	kg	kg
	q) Winding impulse withstand voltage	As per IEC	kV_p	kV_p
	r) Maximum current density at full load rating	---	A/mm^2	A/mm^2
	s) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A
	t) **Temperature rise limits:**			
	• Top oil temperature rise	55 K	K	K
	• Average winding temperature rise	60 K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K
	u) Total conductor mass	---	kg	kg
3.4	**Inter-winding Insulation**			
3.4.1	**CORE – LV winding:**			
	a) Number of barriers	---		
	b) Barrier thickness	---	mm	mm
	c) Distance from windings	---	mm	mm
	d) Distance between barriers	---	mm	mm
3.4.2	**LV winding to HV winding**			
	a) Number of barriers	---		
	b) Barrier thickness	---	mm	mm
	c) Distance from windings	---	mm	mm
	d) Distance between barriers	---	mm	mm
3.4.3	**HV winding to TAP winding**			
	a) Number of barriers	---		
	b) Barrier thickness	---	mm	mm
	c) Distance from windings	---	mm	mm
	d) Distance between barriers	---	mm	mm

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
4.0	**Losses and Efficiency**			
4.1	**Guaranteed no-load losses at normal ratio and normal voltage:**			
	a) No-load losses excluding input to cooling plant	---	kW	kW
	b) Input to cooling plant required at full load rating	---	kW	kW
4.2	**Guaranteed load losses at 75°C and normal ratio and nominal voltage:**			
	a) Full load rating	---	kW	kW
	b) ONAN rating	---	kW	kW
	c) At 50% full load rating	---	kW	kW
4.3	**Total guaranteed losses at 75°C and normal ratio and nominal voltage:**			
	a) At full load rating including input to cooling plant	---	kW	kW
	b) At ONAN rating	---	kW	kW
	c) At 50% full load rating	---	kW	kW
4.4	**Efficiency at normal ratio and 0,8 lagging power factor:**			
	a) At full load rating including input to cooling plant	---	%	%
	b) At ONAN rating	---	%	%
	c) At 50% full load rating	---	%	%
4.5	**Inherent regulation at 75°C normal ratio and full load rating expressed as percent of rated voltage:**			
	a) At unity power factor percent	---	%	%
	b) At 0,8 lagging power factor	---	%	%
	c) At 100% full load	---	%	%
5.0	**Terminals**			
5.1	**Details of 132 kV outdoor bushings:**			
	a) Bushing type	Resin impregnated		
		paper with silicone rubber sheds		
	b) Bushing impulse withstand voltage	550 kV_p	kV_p	N/A
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	7 130 mm	mm	N/A

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
	d) Stem diameter	26 mm	mm	N/A
	e) Tan delta test facility	Yes		N/A
5.2	**Details of 132 kV oil filled cable boxes:**			
	a) Compliance with IEC 60859	Yes	Yes/No*	Yes/No*
	b) Bushing impulse withstand voltage	550 kV_p	kV_p	kV_p
	c) Individual oil valves required to isolate each phase cable box from conservator	Yes	Yes/No*	Yes/No*
5.3	**Details of HV neutral bushing:**			
	a) Bushing type	Resin paper with silicone rubber sheds		
	b) Bushing impulse withstand voltage	200 kV_p	kV_p	kV_p
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	1 780 mm	mm	mm
	d) Clamp suitable for 50 mm by 6 mm copper clad steel earth bar	Yes		
	e) Voltage rating of bushing	36 kV	kV	kV
5.4	**Details of 33 kV plug connectors:**			
	a) Type (Plug: For 630 mm^2 conductor and 42,2 mm OD insulation for outdoor use)			
	b) Cable connector size	3		
	c) Rated service voltage	36 kV	kV	kV
	d) Rated nominal current	1 250 A	A	A
	e) Number of sockets per phase	3		
	f) Plugs for fitting onto cables to be supplied	Yes	Yes/No*	Yes/No*
5.5	**Details of 33 kV oil filled cable box and bushings:**			
	a) Bushing type	---		
	b) Bushing impulse withstand voltage	200 kV_p	kV_p	kV_p
	c) Suitable for number and size of cables per phase (2 × 630 mm^2 Copper)	Yes	Yes/No*	Yes/No*
	d) Rated voltage of bushing	36 kV	kV	kV
6.0	**On-load Tap-changer (Vacuum Type)**			

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
6.1	a) Manufacturer	---		
	b) Resistor type, reactor type etc	---		
	c) Manufacturer's type designation	---		
	d) Can oil from the on-load transfer switch compartment mix with the oil in the main tank?	No	Yes/No*	Yes/No*
	e) Diverter switch with vacuum interrupters	Yes	Yes/No*	Yes/No*
6.2	**Tappings:**			
	a) Which winding is tapped and where	HV Neutral end		
	b) Range of tappings (primary/secondary ratios per unit of ratio at nominal tap)	Maximum 1,05		pu
		Minimum 0,85 pu		pu
	c) Size of step as percentage of winding rated voltage at no-load	Maximum 1,25%	%	%
	d) Number of steps	16 steps	steps	steps
6.3	**Number and type of tap position indication devices provided in tap-change drive mechanism:**			
	a) Binary coded decimal type	2		
	b) Resistor divider type (resistance to be specified at time of order, typically 400 Ω per step)	1		
	c) Voltage free contacts with common connection (one contact per tap)	2		
	d) Number of steps	16 steps		steps
6.4	**Tap-change alarm and indication signals required:**			
	a) Tap-change on manual	Yes	Yes/No*	Yes/No*
	b) Tap-change not healthy	Yes	Yes/No*	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*	Yes/No*
	d) Tap-change fail	Yes	Yes/No*	Yes/No*
	e) Tap-change d.c. fail	Yes	Yes/No*	Yes/No*
	f) Tap-change VT fail	Yes	Yes/No*	Yes/No*
	g) Tap-change voltage abnormal	Yes	Yes/No*	Yes/No*
	h) Tap-change voltage high	Yes	Yes/No*	Yes/No*
	i) Tap-change voltage low	Yes	Yes/No*	Yes/No*
	j) Tap-change in progress	Yes	Yes/No*	Yes/No*

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
	k) Tap-change on manual control	Yes	Yes/No*	Yes/No*
	l) Tap-change motor drive trip	Yes	Yes/No*	Yes/No*
	m) Tap-change position	Yes	Yes/No*	Yes/No*
6.5	**Tapchange control signals required:**			
	a) Tap-change raise	Yes	Yes/No*	Yes/No*
	b) Tap-change lower	Yes	Yes/No*	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*	Yes/No*
	d) Tap-change overcurrent blocking	Yes	Yes/No*	Yes/No*
	e) Labelling of all tap changer control wiring	Yes	Yes/No*	Yes/No*
6.6	**Provide the following trip signals:**			
	a) Top oil temperature very high	Yes	Yes/No*	Yes/No*
	b) Top winding temperature very high	Yes	Yes/No*	Yes/No*
	c) PRV operation	Yes	Yes/No*	Yes/No*
	d) Buchholz high gasses operation	Yes	Yes/No*	Yes/No*
6.7	**Provide the following supply circuits:**			
	a) 220 V a.c. (15 A) plug with earth leakage protection (30 mA)	Yes	Yes/No*	Yes/No*
	b) 5 × 6 A MCB with earth leakage protection (30 mA)	Yes	Yes/No*	Yes/No*
6.8	**Provide the following analogue outputs:**			
	a) Top oil temperature reading 4 mA to 20 mA	Yes	Yes/No*	Yes/No*
	b) Top winding temperature 4 mA to 20 mA	Yes	Yes/No*	Yes/No*
	c) Combustible gas reading 4 mA to 20 mA	Yes	Yes/No*	Yes/No*
	d) Temperature sensor on cooler in and outlet	Yes	Yes/No*	Yes/No*
7.0	**Cooling:**			
7.1	Auxiliary equipment for forced air cooling:	Fans blowing on radiators		
7.2	Direction fans are blowing	Sidewards		
7.3	Number of fans per transformer	≥ 2 fans	fans	fans

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
7.4	Rated output of each fan	---	m^3/s	m^3/s
7.5	Speed of fan	---	rpm	rpm
7.6	Type of fan motor	---		
7.7	Rating of each fan motor	---	kW	kW
7.8	Starting current of fan motor	---	A	A
7.9	Maximum temperature of oil:			
	a) At inlet to cooler	---	°C	°C
	b) At outlet from cooler	---	°C	°C
8.0	**General Information**			
8.1	Thickness of radiator plates and/or cooling tubes	≥ 1 mm	mm	mm
8.2	Thickness of transformer tank:			
	a) Sides	≥ 8 mm	mm	mm
	b) Bottom	≥ 25 mm	mm	mm
8.3	Overall dimensions of transformer:			
	a) Tank only	---	mm	mm
	b) Coolers only	---	mm	mm
	c) Height over Conservator	---	mm	mm
8.4	Mass of core	---	kg	kg
8.5	Mass of windings	---	kg	kg
8.6	Mass of separate cooler bank complete with oil	---	N/A	kg
8.7	Total mass of complete transformer including oil and tank mounted radiators (if applicable)			
8.8	Mass of transformer as arranged for transport	---	kg	kg
8.9	Total oil required (including cooling system)	---	litres	litres
8.10	Minimum quantity of oil to be removed from transformer including conservator to expose the top of the core	---	litres	litres
8.11	Total volume of conservator	---	litres	litres
8.12	Volume of oil in conservator between the highest and lowest visible levels	---	litres	litres

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
8.13	Maximum permissible vacuum in tank excluding tap-changer, bushings, etc	---	litres	litres
8.14	Maximum permissible vacuum in tank fitted as on site with tap-changer, bushings etc	---	kPa	kPa
8.15	Detailed painting process included	Yes	Yes/No*	Yes/No*
8.16	Repair for any winding fault up to 20 years offered?	---		
8.17	Guarantees:			
	a) Transformer and auxiliary equipment	10 years	years	years
	b) Leaks and corrosion	10 years	years	years
9.0	**Indicating and Protective Devices Details**			
9.1	Anti-corrosion and anti-vibration pad material	---		
9.2	**Vibration and noise:**			
	a) Average noise level of the transformer *without* fans in service	---	dB	dB
	b) Average noise level of the transformer *with* fans in service	< 80 dB	dB	dB
9.3	**Self-Dehydrating Breathers (SDB):**			
	a) Number of SDBs required per transformer	---	kg	kg
	b) Quantity of silica-gel in each SDB	---		
	c) Clear silica gel	Yes	Yes/No*	Yes/No*
9.4	**Winding temperature:**			
	a) Winding temperature thermometer type	---		
	b) Alternative option for fibre optic temperature sensors	---		
9.5	Oil temperature thermometer type	---		
9.6	Oil-and gas-actuated relay type	---		
9.7	**Pressure relief device:**			
	a) Type	---		
	b) Mesh to prevent vermin from entering	Yes	Yes/No*	Yes/No*
9.8	**Conservator:**			
	a) Conservator bag	Yes	Yes/No*	Yes/No*
	b) Conservator bag leak detection system type	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
	c) Details of bag leak detection system supplied with tender	Yes	Yes/No*	Yes/No*
	d) Oil level indicators	---		
9.9	Tap-changer protective device (detail)	Specify type		
10.0	**Delivery and off-loading**			
	a) Filling medium of transformer tank for transportation	Dry air		
	b) Quantity of oil required to cover windings for transportation	---	litres	litres
	c) Supplied transformer filled with new oil	---	Yes/No*	Yes/No*
	d) Type of oil to be used	Mineral oil (uninhibited) IEC 60422		
		Natural Ester IEC 62270		
	e) Transformer delivered to	As per order		
	f) Delivery effected not before	As per order		
	g) Off-loaded from transport vehicle by Supplier	Yes	Yes/No*	Yes/No*
	h) Transport transferred to intended operating position by Supplier	Yes	Yes/No*	Yes/No*
11.0	**Erection and oil filling**			
	a) Erected ready for service	Yes	Yes/No*	Yes/No*
	b) Erection completed not later than	As per order		
	c) Place three layers of 5 ply 2,8 mm Malthoid mat under transformer on plinth	Yes	Yes/No*	Yes/No*
	d) Place one layer of 4 mm index unigum under transformer on plinth	Yes	Yes/No*	Yes/No*
12.0	**Active Part**			
12.1	**Thermal constraints and considerations with regard to the paper insulation system:**			
	a) Life expectancy at required operating and environmental conditions, designed to be for at least:	40 years	years	years
	b) Type of paper to be used: Thermally upgraded paper	Yes	Yes/No*	Yes/No*
	c) DP of wrap and board used:	---		
	d) DP of new paper	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
	e) Percentage moisture in paper after dry-out	---	%	%
	f) DP after final dry-out in factory	min 1 000 DP		
	g) Number and details of test blocks to be left in completed transformer	---		
	h) Details of test dry-out/heating blocks dimensions, positioning and testing during manufacture	---	Yes/No*	Yes/No*
13.0	**Testing**			
13.1	Are the test results of the following type tests performed on similar transformers available and submitted with this tender? (The degree of similarity of the transformers previously tested to those specified in this contract must be documented):			
	a) Impulse test	Yes	Yes/No*	Yes/No*
	b) Temperature rise test	Yes	Yes/No*	Yes/No*
	c) Noise level measurements	Yes	Yes/No*	Yes/No*
	d) Short circuit tests	Yes	Yes/No*	Yes/No*
13.2	**On Site Oil Tests:**			
	a) Fourier Transform Infrared Spectroscopy (FTIR): Oil type verification	Yes	Yes/No*	Yes/No*
	b) Dissolved Gas Analysis (DGA): two weeks after energizing	Yes	Yes/No*	Yes/No*
	c) Test for Silicone and other metal contaminants	Yes	Yes/No*	Yes/No*
	d) Test for Corrosive sulphur (to be done in accordance with extended Doble method)	Yes	Yes/No*	Yes/No*
14.0	**Special Requirements**			
14.1	a) On-line single gas dissolved gas analyser (DGA) for transformer monitoring	Yes	Yes/No*	Yes/No*
	b) Transformer operating temperatures monitoring	Yes	Yes/No*	Yes/No*
	c) On-load tap changer (OLTC) monitoring	Yes	Yes/No*	Yes/No*
	d) Cooling group control monitoring	Yes	Yes/No*	Yes/No*
	e) Bushing monitoring	Yes	Yes/No*	Yes/No*
	f) Partial Discharge monitoring	Yes	Yes/No*	Yes/No*
	g) Type of valves to use	Gate/Butterfly		
	h) Spare bushing to be supplied with oil vessels for long term storage	Yes	Yes/No*	Yes/No*
14.2	**Existing Transformer:**			
	a) Disassembling, loading, transporting and off-loading of existing power transformer within a 30 km radius	Yes	Yes/No*	Yes/No*

Item	Description	Technical Details		
		eThekwini Electricity Requirement	132/33 kV 50 MVA Type 1 & Type 3 (ONAN/ONAF) Offered	132/33 kV 50 MVA Type 2 & Type 4 (ONAN/ONAF)) Offered
			* Complete with whichever is applicable	
	b) Oil Handling	Yes	Yes/No*	Yes/No*
	c) Disposal of transformer oil and old transformer components	Yes	Yes/No*	Yes/No*
	d) Time required to remove the old transformer	⌈ 2 weeks	week(s)	week(s)

Item	Description	Technical Details		Item	Description	Technical Details	
		eThekwini Electricity Requirement	132/33 kV 50 MVA (ONAF/ONAN) Offered			eThekwini Electricity Requirement	132/33 kV 50 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
15.0	**Detailed Technical Information and Data Sheets**						
	Detailed information and data sheets including all the relevant Type Test Certificates of the following components shall be included (specify in which section of tender the information is found):						
15.1.1	**HV Outdoor Bushing:**			**15.1.2**	**132 kV Oil Filled Cable Box and Bushing:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Certificate	Yes	Yes/No*		f) Type Certificate	Yes	Yes/No*
15.1.3	**11 kV Oil Filled Cable Box and Bushings:**			**15.1.4**	**LV Plug Connectors:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Certificate	Yes	Yes/No*		f) Type Certificate	Yes	Yes/No*
15.1.5	**HV Neutral Bushing:**			**15.2**	**Conservator Bag:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Material of bag		
	f) Type Certificate	Yes	Yes/No*		f) Technical Data	Yes	Yes/No*
					g) Type Certificate	Yes	Yes/No*
15.3	**Cooler Units, Motors and Fans**						
15.3.1	**Cooler Units:**			**15.3.2**	**Fans:**		

Item	Description	Technical Details	
		eThekwini Electricity Requirement	132/33 kV 50 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable	
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*
15.4	**Tap-changer:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*
15.6	**Pressure Relief Device:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*
15.7.2	**Measuring Equipment e.g. CT:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		

Item	Description	Technical Details	
		eThekwini Electricity Requirement	132/33 kV 50 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable	
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
15.5	**Buchholz Relays:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
15.7	**Winding Temperature Measurement**		
15.7.1	**Instrument:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
15.8	**Oil Temperature Measurement**		
15.8.1	**Instrument:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		

Item	Description	Technical Details		Item	Description	Technical Details	
		eThekwini Electricity Requirement	132/33 kV 50 MVA (ONAF/ONAN) Offered			eThekwini Electricity Requirement	132/33 kV 50 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
15.8.2	**Measuring Equipment e.g. PT100s or Sensors:**			**15.9**	**Tap-changer Pressure Relay:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
15.10	**Dehydrating Breathers**			**15.11**	**Oil Level Indicators:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.0	**General**						
	Further information that tenderers may wish to submit						

SECTION 3 (b): 33/11 kV 25 MVA Type 1 & Type 2 Power Transformers

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
1.0	**Transformer General Information**			
1.1	Name of manufacturer	---		
1.2	Country of origin	---		
1.3	Do the transformers comply in all respects with the standard specifications quoted in the General Technical Specification? (If not, indicate deviations)	Yes	Yes/No*	Yes/No*
1.4	**Manufacturing Experience**			
	a) Number of 132 kV transformers manufactured at the factory in the last twelve (12) months	---	transformer(s)	transformer(s)
	b) Factory failure rate in five (5) years where transformers above 15 MVA form the sample	---	%	%
1.5	**Type of Transformers:**			
	a) Core	Core-form		
1.6	**Core Steel**			
	a) Manufacturer of core steel	---		
	b) Type of core steel (conventional grain oriented or high permeability)	Yes	Yes/No*	Yes/No*
	c) Grade of core steel	---		
	d) Thickness of core steel	---	mm	mm
1.7	**Core Dimensions**			
	a) Window height	---	mm	mm
	b) Distance between core limb centres	---	mm	mm
	c) Core diameter	---	mm	mm
	d) Filling factor	---		
1.8	**Cross Sectional Areas**			
	a) Wound limbs	---	mm^2	mm^2
	b) Yoke	---	mm^2	mm^2
1.9	Total Core Mass	---	kg	kg
1.10	The design flux density at nominal voltage for:			
	a) Wound limbs	1,75 T	T	T

Item	Description		Technical Details		
			eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
			* Complete with whichever is applicable		
	b) Yoke		1,75 T	T	T
1.11	Volts/turn at the above flux		---	V/turn	V/turn
2.0	**Ratings**				
2.1	Supply frequency		50 Hz	Hz	Hz
2.2	Number phases		3		
2.3	Nominal system voltage at no load on nominal tap:				
	a) Primary		33 kV	kV	kV
	b) Secondary		11 kV	kV	kV
2.4	Maximum primary operating voltage		36 kV	kV	kV
2.5	Connections		Delta/Star		
2.6	Vector group		Dyn11		
2.7	Full load rating (on any tap position)		25 MVA	MVA	MVA
2.8	Continuous rating when operating under the specified site conditions (on any tap position):		25 MVA	MVA	MVA
2.9	Type of cooling		Type 1: ONAF		
			Type 2: ONAN		
2.10	ONAN rating when operating under the specified site conditions (on any tap position):		Type 1: 15 MVA	MVA	MVA
			Type 2: 25 MVA	MVA	MVA
2.11	**Short circuit design:**				
	a) Transformer three-phase designed fault level value, rms:	HV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
	b) Transformer three-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}	kA_{peak}
		LV	As per IEC	kA_{peak}	kA_{peak}
	c) Transformer single-phase designed fault level value, rms:	HV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
	d) Transformer single-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}	kA_{peak}
		LV	As per IEC	kA_{peak}	kA_{peak}
	e) Designed number of through faults in transformer lifetime:	HV	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	LV	---		
	f) Transformer is designed to withstand a full three-phase short circuit on the LV terminals and supplied from the HV side	Yes	Yes/No*	Yes/No*
2.12	**Positive phase sequence impedance at 75°C and rated frequency, phase to neutral, viewed from HV windings:**			
2.12.1	a) Minimum Ohmic impedance	5,2 Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	---		
2.12.2	a) Maximum Ohmic impedance	6,3 Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	---		
2.12.3	a) Ohmic impedance at nominal tap position	---	Ω	Ω
	b) Corresponding % impedance	10.8%	%	%
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	8		
3.0	**Winding design**			
	a) Winding arrangement	CORE-LV-HV-TAP		
	b) Conductor Yield strength	---	N/mm^2	
	c) **Normal insulation resistance between:**			
	• CLPrimary and Tertiary Windings	---	MΩ	MΩ
	• SLPrimary Windings and Core	---	MΩ	MΩ
	• PCore and Tank	---	MΩ	MΩ
	• CCore bolts and core	---	MΩ	MΩ
3.1	**Winding 1**	**Secondary (LV)**		
	a) Type	multi-layer helix		
	b) Type of axial coil support	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	c) Lead type (End Fed/Centre Fed)	---		
	d) Number of turns	---		
	e) Inner diameter	---	mm	mm
	f) Outer diameter	---	mm	mm
	g) Radial build	---	mm	mm
	h) Magnetic height	---	mm	mm
	Normal insulation resistance between:			
	Primary and Tertiary Windings	---	MΩ	MΩ
	Primary Windings and Core	---	MΩ	MΩ
	Core and Tank	---	MΩ	MΩ
	Core bolts and core	---	MΩ	MΩ
	i) **Conductor configuration:**			
	• Size	---		
	• Number	---		
	a) Conductor insulation	Full	mm	mm
	b) Dry mass insulation	---	kg	kg
	c) Winding impulse withstand voltage	95 kV_p	kV_p	kV_p
	d) Maximum current density at full load rating	---	A/mm^2	A/mm^2
	e) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A
	f) **Temperature rise limits:**			
	• Top oil temperature rise	55 K	K	K
	• Average winding temperature rise	60 K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K
	g) Total conductor mass	---	kg	kg
3.2	**Winding 2**	**Primary (HV)**		
	a) Type	multi-layer helix		
	b) Type of axial coil support	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	c) Lead type (End Fed/Centre Fed)	---		
	d) Number of turns	---		
	e) Inner diameter	---	mm	mm
	f) Outer diameter	---	mm	mm
	g) Radial build	---	mm	mm
	h) Magnetic height	---	mm	mm
	Normal insulation resistance between:			
	Primary and Tertiary Windings	---	MΩ	MΩ
	Primary Windings and Core	---	MΩ	MΩ
	Core and Tank	---	MΩ	MΩ
	Core bolts and core	---	MΩ	MΩ
	i) Conductor configuration:			
	• Size	---		
	• Number	---		
	a) Conductor insulation	Graded	mm	mm
	b) Dry mass insulation	---	kg	kg
	c) Winding impulse withstand voltage	200 kV_p	kV_p	kV_p
	d) Maximum current density at full load rating	---	A/mm^2	A/mm^2
	e) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A
	f) **Temperature rise limits:**			
	• Top oil temperature rise	55 K	K	K
	• Average winding temperature rise	60 K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K
	g) Total conductor mass	---	kg	kg
3.3	**Winding 3**	**Regulating (TAP)**		
	a) Type	multi-layer helix		
	b) Type of axial coil support	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	c) Lead type (End Fed/Centre Fed)	---		
	d) Number of turns	---		
	e) Inner diameter	---	mm	mm
	f) Outer diameter	---	mm	mm
	g) Radial build	---	mm	mm
	h) Magnetic height	---	mm	mm
	Normal insulation resistance between:			
	Primary and Tertiary Windings	---	MΩ	MΩ
	Primary Windings and Core	---	MΩ	MΩ
	Core and Tank	---	MΩ	MΩ
	Core bolts and core	---	MΩ	MΩ
	i) Conductor configuration:			
	• Size	---		
	• Number	---		
	e) Conductor insulation	Full	mm	mm
	f) Dry mass insulation	---	kg	kg
	g) Winding impulse withstand voltage	As per IEC	kV_p	kV_p
	h) Maximum current density at full load rating	---	A/mm^2	A/mm^2
	i) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A
	j) **Temperature rise limits:**			
	• Top oil temperature rise	55 K	K	K
	• Average winding temperature rise	60 K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K
	k) Total conductor mass	---	kg	kg
3.4	**Inter-winding Insulation**			
3.4.1	**CORE – LV winding:**			
	a) Number of barriers	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	b) Barrier thickness	---	mm	mm
	c) Distance from windings	---	mm	mm
	d) Distance between barriers	---	mm	mm
3.4.2	**LV winding to HV winding**			
	a) Number of barriers	---		
	b) Barrier thickness	---	mm	mm
	c) Distance from windings	---	mm	mm
	d) Distance between barriers	---	mm	mm
3.4.3	**HV winding to TAP winding**			
	a) Number of barriers	---		
	b) Barrier thickness	---	mm	mm
	c) Distance from windings	---	mm	mm
	d) Distance between barriers	---	mm	mm
4.0	**Losses and Efficiency**			
4.1	**Guaranteed no-load losses at normal ratio and normal voltage:**			
	a) No-load losses excluding input to cooling plant	---	kW	kW
	b) Input to cooling plant required at full load rating	---	kW	kW
4.2	**Guaranteed load losses at 75°C and normal ratio and nominal voltage:**			
	a) Full load rating	---	kW	kW
	b) ONAN rating	---	kW	kW
	c) At 50% full load rating	---	kW	kW
4.3	**Total guaranteed losses at 75°C and normal ratio and nominal voltage:**			
	a) At full load rating including input to cooling plant	---	kW	kW
	b) At ONAN rating	---	kW	kW
	c) At 50% full load rating	---	kW	kW
4.4	**Efficiency at normal ratio and 0,8 lagging power factor:**			
	a) At full load rating including input to cooling plant	---	%	%

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	b) At ONAN rating	---	%	%
	c) At 50% full load rating	---	%	%
4.5	**Inherent regulation at 75°C normal ratio and full load rating expressed as percent of rated voltage:**			
	a) At unity power factor percent	---	%	%
	b) At 0,8 lagging power factor	---	%	%
	c) At 100% full load		kW	kW
5.0	**Terminals**			
5.1	**Details of 33 kV outdoor bushings:**			
	a) Bushing type	Resin impregnated paper with silicone rubber sheds		N/A
	b) Bushing impulse withstand voltage	200 kV_p	kV_p	N/A
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	1 780 mm4 500	mm	N/A
	d) Stem diameter	-26 mm	mm	N/A
	e) Tan delta test facility	Yes	Yes/No*	N/A
5.2	Details of 33 kV compound filled cable box and bushings:			
	a) Bushing type			
	b) Bushing impulse withstand voltage	200 kV_p	kV_p	kV_p
	c) Suitable for number and size of cables per phase (1 × Paper insulated lead sheath cable or 1 × XLPE cable)			
	d) Rated voltage of bushing	36 kV	kV	kV
5.3	Details of HV plug connectors:			
	a) Type (Plug: For 240 mm^2 conductor and 36 mm OD insulation for outdoor use)			
	b) Cable connector size	3		
	c) Rated service voltage	36 kV	kV	kV
	d) Number of sockets per phase	1		
	e) Plugs for fitting onto cables to be supplied	Yes	Yes/No*	Yes/No*
5.4	Details of LV neutral bushing:			

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	a) Bushing type	Resin impregnated paper with silicone rubber sheds		
	b) Bushing impulse withstand voltage	95 kV_p	kV_p	kV_p
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	600 mm	mm	mm
	d) Clamp suitable for 50 mm by 6 mm copper earth bar	Yes	Yes/No*	Yes/No*
	e) Rated voltage of bushing	12 kV	kV	kV
5.5	Details of LV plug connectors:			
	a) Type (Plug: For 630 mm^2 conductor and 42.2 mm OD insulation for outdoor use)			
	b) Cable connector size	3		
	c) Rated voltage of LV plug connector	12 kV	kV	kV
	d) Rated nominal current	1 250 A	A	A
	e) Number of sockets per phase	2		
	f) Plugs for fitting onto cables to be supplied	Yes	Yes/No*	Yes/No*
5.6	Details of 11 kV oil filled cable box and bushings:			
	a) Bushing type	---		
	b) Bushing impulse withstand voltage	95 kV_p	kV_p	kV_p
	c) Suitable for number and size of cables per phase (2 × 630 mm^2 Copper)	Yes	Yes/No*	Yes/No*
	d) Rated voltage of cable box and bushings	12 kV	kV	kV
6.0	**On-load Tap-changer (Vacuum Type)**			
6.1	a) Manufacturer	---		
	b) Resistor type, reactor type etc.	---		
	c) Manufacturer's type designation	---		
	d) Can oil from the on-load transfer switch compartment mix with the oil in the main tank?	No	Yes/No*	Yes/No*
	e) Diverter switch with vacuum interrupters	Yes	Yes/No*	Yes/No*
6.2	**Tappings:**			
	a) Which winding is tapped and where (HV Corner of Delta)	Yes	Yes/No*	Yes/No*
	b) Range of tappings (primary/secondary ratios per unit of ratio at nominal tap)	Maximum 1,1 pu	pu	pu

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
		Minimum 0,9 pu	pu	pu
	c) Size of step as percentage of winding rated voltage at no-load	Maximum 1,43%	%	%
	d) Number of steps	14 steps	steps	steps
6.3	**Number and type of tap position indication devices provided in tap-change drive mechanism:**			
	a) Binary coded decimal type	0		
	b) Resistor divider type (resistance to be specified at time of order, typically 400 Ω per step)	1		
	c) Voltage free contacts with common connection (one contact per tap)	2		
	d) Number of steps	14 steps	steps	steps
6.4	**Tap-change alarm and indication signals required:**			
	a) Tap-change on manual	Yes	Yes/No*	Yes/No*
	b) Tap-change not healthy	Yes	Yes/No*	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*	Yes/No*
	d) Tap-change fail	Yes	Yes/No*	Yes/No*
	e) Tap-change d.c. fail	Yes	Yes/No*	Yes/No*
	f) Tap-change VT fail	Yes	Yes/No*	Yes/No*
	g) Tap-change voltage abnormal	Yes	Yes/No*	Yes/No*
	h) Tap-change voltage high	Yes	Yes/No*	Yes/No*
	i) Tap-change voltage low	Yes	Yes/No*	Yes/No*
	j) Tap-change in progress	Yes	Yes/No*	Yes/No*
	k) Tap-change on manual control	Yes	Yes/No*	Yes/No*
	l) Tap-change motor drive trip	Yes	Yes/No*	Yes/No*
	m) Tap-change position	Yes	Yes/No*	Yes/No*
6.5	**Tap-change control signals required:**			
	a) Tap-change raise	Yes	Yes/No*	Yes/No*
	b) Tap-change lower	Yes	Yes/No*	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*	Yes/No*
	d) Tap-change overcurrent blocking	Yes	Yes/No*	Yes/No*

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	e) Labelling of all tap changer control wiring	Yes	Yes/No*	Yes/No*
6.6	**Provide the following trip signals:**			
	a) Top oil temperature very high	Yes	Yes/No*	Yes/No*
	b) Top winding temperature very high	Yes	Yes/No*	Yes/No*
	c) PRV operation	Yes	Yes/No*	Yes/No*
	d) Buchholz high gasses operation	Yes	Yes/No*	Yes/No*
6.7	**Provide the following supply circuits:**			
	a) 220 V a.c. (15 A) plug with earth leakage protection (30 mA)	Yes	Yes/No*	Yes/No*
	b) 5 × 6A MCB with earth leakage protection (30 mA)	Yes	Yes/No*	Yes/No*
6.8	**Provide the following analogue outputs:**			
	a) Top oil temperature reading 4 mA to 20 mA	Yes	Yes/No*	Yes/No*
	b) Top winding temperature 4 mA to 20 mA	Yes	Yes/No*	Yes/No*
	c) Combustible gas reading 4 mA to 20 mA	Yes	Yes/No*	Yes/No*
	d) Temperature sensor on cooler in and outlet	Yes	Yes/No*	Yes/No*
7.0	**Cooling:**			
7.1	Auxiliary equipment for forced air cooling:	Fans blowing on radiators		N/A
7.2	Direction fans are blowing	Sidewards		
7.3	Number of fans per transformer	≥ 2 fans	fans	N/A
7.4	Rated output of each fan	---	m^3/s	N/A
7.5	Speed of fan	---	rpm	N/A
7.6	Type of fan motor	---		N/A
7.7	Rating of each fan motor	---	kW	N/A
7.8	Starting current of fan motor	---	A	N/A
7.9	Maximum temperature of oil:			
	a) At inlet to cooler	---	°C	°C
	b) At outlet from cooler	---	°C	°C
8.0	**General Information**			

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
8.1	Thickness of radiator plates and/or cooling tubes	≥ 1 mm	mm	mm
8.2	Thickness of transformer tank:			
	a) Sides	≥ 6 mm	mm	mm
	b) Bottom	≥ 20 mm	mm	mm
8.3	Overall dimensions of transformer:			
	a) Tank only	---	mm	mm
	b) Coolers only	---	mm	mm
	c) Height over Conservator	---	mm	mm
8.4	Mass of core	---	kg	kg
8.5	Mass of windings	---	kg	kg
8.6	Mass of separate cooler bank complete with oil	---	kg	kg
8.7	Total mass of complete transformer including oil and tank mounted radiators (if applicable)	---	kg	kg
8.8	Mass of transformer as arranged for transport	---	kg	kg
8.9	Total oil required (including cooling system)	---	litres	litres
8.10	Minimum quantity of oil to be removed from transformer including conservator to expose the top of the core	---	litres	litres
8.11	Total volume of conservator	---	litres	litres
8.12	Volume of oil in conservator between the highest and lowest visible levels	---	litres	litres
8.13	Maximum permissible vacuum in tank excluding tap-changer, bushings, etc	---	kPa	kPa
8.14	Maximum permissible vacuum in tank fitted as on site with tap-changer, bushings etc	---	kPa	kPa
8.15	Detailed painting process included	Yes	Yes/No*	Yes/No*
8.16	Repair for any winding fault up to 20 years offered?	---		
8.17	Guarantees:			
	a) Transformer and auxiliary equipment	10 years	years	years
	b) Leaks and corrosion	10 years	years	years
9.0	**Indicating and Protective Devices Details**			
9.1	Anti-corrosion and anti-vibration pad material	---		
9.2	**Vibration and noise:**			

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	a) Average noise level of the transformer *without* fans in service	---	dB	dB
	b) Average noise level of the transformer *with* fans in service	< 73 dB	dB	dB
9.3	**Self-Dehydrating Breathers (SDB):**			
	a) Number of SDBs required per transformer	---	kg	kg
	b) Quantity of silica-gel in each SDB	---		
	c) Clear silica gel	Yes	Yes/No*	Yes/No*
9.4	**Winding temperature:**			
	a) Winding temperature thermometer type	---		
	b) Alternative option for fibre optic temperature sensors	---		
9.5	Oil temperature thermometer type	---		
9.6	Oil-and gas-actuated relay type	---		
9.7	**Pressure relief device:**			
	a) Type	---		
	b) Mesh to prevent vermin from entering	Yes	Yes/No*	Yes/No*
9.8	**Conservator:**			
	a) Conservator bag	Yes	Yes/No*	Yes/No*
	b) Conservator bag leak detection system type	---		
	c) Details of bag leak detection system supplied with tender	Yes	Yes/No*	Yes/No*
	d) Oil level indicators	---		
9.9	Tap-changer indicative device (detail)	Specify type		
10.0	**Delivery and off-loading**			
	a) Filling medium of transformer tank for transportation	Dry air		
	b) Quantity of oil required to cover windings for transportation	---	litres	litres
	c) Supplied transformer filled with new oil	---	Yes/No*	Yes/No*
	d) Type of oil to be used	Mineral oil (uninhibited) IEC 60296		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	e) Transformer delivered to	As per purchase order	Yes/No*	Yes/No*
	f) Delivery effected not before	As per purchase order		
	g) Off-loaded from transport vehicle by Supplier	Yes	Yes/No*	Yes/No*
	h) Transport transferred to intended operating position by Supplier	Yes	Yes/No*	Yes/No*
11.0	**Erection and oil filling**			
	a) Erected ready for service	Yes	Yes/No*	Yes/No*
	b) Erection completed not later than	As per purchase order		
	c) Place three layers of 5 ply 2,8 mm Malthoid mat under transformer on plinth	Yes	Yes/No*	Yes/No*
	d) Place one layer of 4 mm index unigum under transformer on plinth	Yes	Yes/No*	Yes/No*
12.0	**Active Part**			
12.1	**Thermal constraints and considerations with regard to the paper insulation system:**			
	a) Life expectancy at required operating and environmental conditions, designed to be for at	40 years	years	years
	b) Type of paper to be used: Thermally upgraded paper	Yes	Yes/No*	Yes/No*
	c) DP of wrap and board used:	---		
	d) DP of new paper	---		
	e) Percentage moisture in paper after dry-out	---	%	%
	f) DP after final dry-out in factory	min 1 000 DP		
	g) Number and details of test blocks to be left in completed transformer	---		
	h) Details of test dry-out/heating blocks dimensions, positioning and testing during	---	Yes/No*	Yes/No*
13.0	**Testing**			
13.1	Are the test results of the following type tests performed on similar transformers available and submitted with this tender? (The degree of similarity of the transformers previously tested to those specified in this contract must be documented):			
	a) Impulse test	Yes	Yes/No*	Yes/No*
	b) Temperature rise test	Yes	Yes/No*	Yes/No*
	c) Noise level measurements	Yes	Yes/No*	Yes/No*

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	d) Short circuit test	Yes	Yes/No*	Yes/No*
13.2	**On Site Oil Tests:**			
	a) Fourier Transform Infrared Spectroscopy (FTIR): Oil type verification	Yes	Yes/No*	Yes/No*
	b) Dissolved Gas Analysis (DGA): two weeks after energizing	Yes	Yes/No*	Yes/No*
	c) Test for Silicone and other metal contaminants	Yes	Yes/No*	Yes/No*
	d) Test for Corrosive sulphur (to be done in accordance with extended Doble method)	Yes	Yes/No*	Yes/No*
14.0	**Special Requirements**			
14.1	a) On-line single gas dissolved gas analyser (DGA) for transformer monitoring	Yes	Yes/No*	Yes/No*
	b) Transformer operating temperatures monitoring	Yes	Yes/No*	Yes/No*
	c) On-load tap changer (OLTC) monitoring	Yes	Yes/No*	Yes/No*
	d) Cooling group control monitoring	Yes	Yes/No*	Yes/No*
	e) Bushing monitoring	Yes	Yes/No*	Yes/No*
	f) Partial Discharge monitoring and diagnosis	Yes	Yes/No*	Yes/No*
	g) Type of valves to use	Gate/Butterfly		
	h) Spare bushing to be supplied with oil vessels for long term storage	Yes	Yes/No*	Yes/No*
14.2	**Existing Transformer:**			
	a) Disassembling, loading, transporting and off-loading of existing power transformer within a 30 km radius	Yes	Yes/No*	Yes/No*
	b) Oil Handling	Yes	Yes/No*	Yes/No*
	c) Disposal of transformer oil and old transformer components	Yes	Yes/No*	Yes/No*
	d) Time required to remove the old transformer	[2 weeks	week(s)	week(s)
15.0	**33 kV NEC/NER/Aux Transformer (NECRT):**			
	a) Manufacturer			
	b) Nominal system voltage			
	• Primary	33 kV	kV	
	• Secondary	400 V	V	
	c) Nominal short time current rating (10 seconds)	800 A	A	
	d) Nominal continuous current	10 A	A	

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 25 MVA Type 1 (ONAF) Offered	33/11 kV 25 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	e) Zero sequence reactance at 20°C	≥ 23,2	Ω/phase	
	f) Zero sequence resistance at 20°C	≥ 46,4	Ω/phase	
	g) Zero sequence impedance at 20°C	---	Ω/phase	
	h) Filling medium	Mineral oil (uninhibited) IEC 60296		
	i) Type of NER	Liquid immersed Metallic		
	j) Overall base dimensions	---	mm × mm	
	k) Height	---	mm	
	l) Total mass	---	kg	
	m) Auxiliary transformer			
	• 100 kVA NECRT nominal rating	100 kVA	kVA	
	• 200 kVA NECRT nominal rating	200 kVA	kVA	
	• Load loss	---	kW	
	• No load loss	---	kW	
	• Percentage impedance	As per SANS 780	%	
	• Vector group	Zyn11		
	n) 33 kV connections			
	• Manufacturer and type for 100 kVA	Cable/Overhead		
	• Manufacturer and type for 200 kVA	Cable/Overhead		

Item	Description	Technical Details		Item	Description	Technical Details	
		eThekwini Electricity Requirement	33/11 kV 25 MVA (ONAF/ONAN) Offered			eThekwini Electricity Requirement	33/11 kV 25 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
16.0	**Detailed Technical Information and Data Sheets**						
	Detailed information and data sheets including all the relevant Type Test Certificates of the following components shall be included (specify in which section of tender the information is found):						
16.1.1	**HV Bushing:**			16.1.2	**33 kV Oil Filled Cable Box and Bushings:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.1.3	**11 kV Oil Filled Cable Box and Bushings:**			16.1.4	**33 kV and LV Plug Connectors:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.1.5	**HV Neutral Bushing:**			16.1.6	**LV Neutral Bushing:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.2	**Cooler Units, Motors and Fans**						
16.2.1	**Cooler Units:**			16.2.2	**Fans:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		

Item	Description	Technical Details	
		eThekwini Electricity Requirement	33/11 kV 25 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable	
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Certificate	Yes	Yes/No*
16.3	**Tap-changer:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*
16.5	**Pressure Relief Device:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*
16.6.2	**Measuring Equipment e.g. CT:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*
16.7.2	**Measuring Equipment e.g. PT100s or Sensors:**		

Item	Description	Technical Details	
		eThekwini Electricity Requirement	33/11 kV 25 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable	
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Certificate	Yes	Yes/No*
16.4	**Buchholz Relays:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
16.6	**Winding Temperature Measurement**		
16.6.1	**Instrument:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
16.7	**Oil Temperature Measurement**		
16.7.1	**Instrument:**		
	a) Manufacturer		
	b) Type Number		
	c) Part Number		
	d) Supplier		
	e) Technical Data	Yes	Yes/No*
	f) Type Test	Yes	Yes/No*
16.8	**Tap-changer Pressure Relay:**		

Item	Description	Technical Details		Item	Description	Technical Details	
		eThekwini Electricity Requirement	33/11 kV 25 MVA (ONAF/ONAN) Offered			eThekwini Electricity Requirement	33/11 kV 25 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
16.9	**Dehydrating Breathers:**			16.10	**Conservator Bag:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Material of bag		
	f) Type Test Certificate	Yes	Yes/No*		f) Technical Data	Yes	Yes/No*
					g) Type Test	Yes	Yes/No*
16.11	**Oil Level Indicators:**			16.12	**NECRT:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test	Yes	Yes/No*
17.0	**General**						
	Further information that tenderers may wish to submit						

SECTION 3 (c): 33/11 kV 15 MVA Type 1 & Type 2 Power Transformers

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
1.0	**Transformer General Information**			
1.1	Name of manufacturer	---		
1.2	Country of origin	---		
1.3	Do the transformers comply in all respects with the standard specifications quoted in the Technical Specification? (If not, indicate deviations)	Yes	Yes/No*	Yes/No*
1.4	**Manufacturing Experience**			
	a) Number of 33 kV transformers manufactured at the factory in the last twelve (12) months	---	transformer(s)	transformer(s)
	b) Factory failure rate in five (5) years where transformers above 15 MVA form the sample	---	%	%
1.5	**Type of Transformers**			
	Core	Core-form		
1.6	**Core Steel**			
	a) Manufacturer of core steel	---		
	b) Type of core steel (conventional grain oriented or high permeability)	Yes	Yes/No*	Yes/No*
	c) Grade of core steel	---		
	d) Thickness of core steel	---	mm	mm
1.7	**Core Dimensions**			
	a) Window height	---	mm	mm
	b) Distance between core limb centres	---	mm	mm
	c) Core diameter	---	mm	mm
	d) Filling factor	---		
1.8	**Cross Sectional Areas**			
	a) Wound limbs	---	mm^2	mm^2
	b) Yoke	---	mm^2	mm^2
1.9	Total core mass	---	kg	kg
1.10	The design flux density at nominal voltage for:			
	a) Wound limbs	1,75 T	T	T

Item	Description		Technical Details		
			eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
			* Complete with whichever is applicable		
	b) Yoke		1,75 T	T	T
1.11	Volts/turn at the above flux		---	V/turn	V/turn
2.0	**Ratings**				
2.1	Supply frequency		50 Hz	Hz	Hz
2.2	Number phases		3		
2.3	Nominal system voltage at no load on nominal tap:				
	a) Primary		33 kV	kV	kV
	b) Secondary		11 kV	kV	kV
2.4	Maximum primary operating voltage		36 kV	kV	kV
2.5	Connections		Delta/Star		
2.6	Vector group		Dyn11		
2.7	Full load rating (on any tap position)		15 MVA	MVA	MVA
2.8	Continuous rating when operating under the specified site conditions (on any tap position):		15 MVA	MVA	MVA
2.9	Type of cooling		Type 1: ONAF		
			Type 2: ONAN		
2.10	ONAN rating when operating under the specified site conditions (on any tap position):		Type 1: 10 MVA	MVA	MVA
			Type 2: 15 MVA	MVA	MVA
2.11	**Short circuit design:**				
	a) Transformer three-phase designed fault level value, rms:	HV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
	b) Transformer three-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}	kA_{peak}
		LV	As per IEC	kA_{peak}	kA_{peak}
	c) Transformer single-phase designed fault level value, rms:	HV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
		LV	As per IEC	$kA_{r.m.s.}$	$kA_{r.m.s.}$
	d) Transformer single-phase designed fault level value, peak:	HV	As per IEC	kA_{peak}	kA_{peak}
		LV	As per IEC	kA_{peak}	kA_{peak}
	e) Designed number of through faults in transformer lifetime:	HV	---		
		LV	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	f) Transformer is designed to withstand a full three-phase short circuit on the LV terminals and supplied from the HV side	Yes	Yes/No*	Yes/No*
2.12	**Positive phase sequence impedance at 75°C and rated frequency, phase to neutral, viewed from HV windings:**			
2.12.1	a) Minimum Ohmic impedance	7,2 Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	---		
2.12.2	a) Maximum Ohmic impedance	8,7 Ω	Ω	Ω
	b) Corresponding % impedance	---	%	%
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	---		
2.12.3	a) Ohmic impedance at nominal tap position	---	Ω	Ω
	b) Corresponding % impedance	10.8%	%	%
	c) Corresponding X/R ratio	---		
	d) Corresponding tap number	8		
3.0	**Winding design**			
	a) Winding arrangement	CORE-MV-HV-TAP		
	b) Conductor Yield strength	---	N/mm^2	
	c) **Normal insulation resistance between:**			
	• CPrimary and Tertiary Windings	---	MΩ	MΩ
	• SPrimary Windings and Core	---	MΩ	MΩ
	• PCore and Tank	---	MΩ	MΩ
	• CCore bolts and core	---	MΩ	MΩ
3.1	**Winding 1**	**Secondary (MV)**		
	a) Type	multi-layer helix		
	b) Type of axial coil support	---		
	c) Lead type (End Fed/Centre Fed)	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	d) Number of turns	---		
	e) Inner diameter	---	mm	mm
	f) Outer diameter	---	mm	mm
	g) Radial build	---	mm	mm
	h) Magnetic height	---	mm	mm
	Normal insulation resistance between:			
	Primary and Tertiary Windings	---	MΩ	MΩ
	Primary Windings and Core	---	MΩ	MΩ
	Core and Tank	---	MΩ	MΩ
	Core bolts and core	---	MΩ	MΩ
	i) **Conductor configuration:**			
	• Size	---		
	• Number	---		
	e) Conductor insulation	Full	mm	mm
	f) Dry mass insulation	---	kg	kg
	g) Winding impulse withstand voltage	95 kV_p	kV_p	kV_p
	h) Maximum current density at full load rating	---	A/mm^2	A/mm^2
	i) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A
	j) **Temperature rise limits:**			
	• Top oil temperature rise	55 K	K	K
	• Average winding temperature rise	60 K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K
	k) Total conductor mass	---	kg	kg
3.2	**Winding 2**	**Primary (HV)**		
	a) Type (i.e. multi-layer helix)	multi-layer helix		
	b) Type of axial coil support	---		
	c) Lead type (End Fed/Centre Fed)	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	d) Number of turns	---		
	e) Inner diameter	---	mm	mm
	f) Outer diameter	---	mm	mm
	g) Radial build	---	mm	mm
	h) Magnetic height	---	mm	mm
	Normal insulation resistance between:			
	Primary and Tertiary Windings	---	MΩ	MΩ
	Primary Windings and Core	---	MΩ	MΩ
	Core and Tank	---	MΩ	MΩ
	Core bolts and core	---	MΩ	MΩ
	i) Conductor configuration:			
	• Size	---		
	• Number	---		
	e) Conductor insulation	Graded	mm	mm
	f) Dry mass insulation	---	kg	kg
	g) Winding impulse withstand voltage	200 kV_p	kV_p	kV_p
	h) Maximum current density at full load rating	---	A/mm^2	A/mm^2
	i) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A
	j) **Temperature rise limits:**			
	• Top oil temperature rise	55 K	K	K
	• Average winding temperature rise	60 K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K
	k) Total conductor mass	---	kg	kg
3.3	**Winding 3**	**Regulating (TAP)**		
	a) Type	multi-layer helix		
	b) Type of axial coil support	---		
	c) Lead type (End Fed/Centre Fed)	---		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	d) Number of turns	---		
	e) Inner diameter	---	mm	mm
	f) Outer diameter	---	mm	mm
	g) Radial build	---	mm	mm
	h) Magnetic height	---	mm	mm
	Normal insulation resistance between:			
	Primary and Tertiary Windings	---	MΩ	MΩ
	Primary Windings and Core	---	MΩ	MΩ
	Core and Tank	---	MΩ	MΩ
	Core bolts and core	---	MΩ	MΩ
	i) Conductor configuration:			
	• Size	---		
	• Number	---		
	i) Conductor insulation	Full	mm	mm
	j) Dry mass insulation	---	kg	kg
	k) Winding impulse withstand voltage	As per IEC	kV_p	kV_p
	l) Maximum current density at full load rating	---	A/mm^2	A/mm^2
	m) Approximate magnetising current at rated voltage plus 5% and nominal ratio	---	A	A
	n) **Temperature rise limits:**			
	• Top oil temperature rise	55 K	K	K
	• Average winding temperature rise	60 K	K	K
	• Winding hottest-spot temperature rise	73 K	K	K
	o) Total conductor mass	---	kg	kg
3.4	**Inter-winding Insulation**			
3.4.1	**CORE – MV winding:**			
	a) Number of barriers	---		
	b) Barrier thickness	---	mm	mm

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	c) Distance from windings	---	mm	mm
	d) Distance between barriers	---	mm	mm
3.4.2	**MV winding to HV winding**			
	a) Number of barriers	---		
	b) Barrier thickness	---	mm	mm
	c) Distance from windings	---	mm	mm
	d) Distance between barriers	---	mm	mm
3.4.3	**HV winding to TAP winding**			
	a) Number of barriers	---		
	b) Barrier thickness	---	mm	mm
	c) Distance from windings	---	mm	mm
	d) Distance between barriers	---	mm	mm
4.0	**Losses and Efficiency**			
4.1	**Guaranteed no-load losses at normal ratio and normal voltage:**			
	a) No-load losses excluding input to cooling plant	---	kW	kW
	b) Input to cooling plant required at full load rating	---	kW	kW
4.2	**Guaranteed load losses at 75°C and normal ratio and nominal voltage:**			
	a) Full load rating	---	kW	kW
	b) ONAN rating	---	kW	kW
	c) At 50% full load rating	---	kW	kW
4.3	**Total guaranteed losses at 75°C and normal ratio and nominal voltage:**			
	a) At full load rating including input to cooling plant	---	kW	kW
	b) At ONAN rating	---	kW	kW
	c) At 50% full load rating	---	kW	kW
4.4	**Efficiency at normal ratio and 0,8 lagging power factor:**			
	a) At full load rating including input to cooling plant	---	%	%
	b) At ONAN rating	---	%	%

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	c) At 50% full load rating	---	%	%
4.5	**Inherent regulation at 75°C normal ratio and full load rating expressed as percent of rated voltage:**			
	a) At unity power factor percent	---	%	%
	b) At 0,8 lagging power factor	---	%	%
	c) At 100% full load	---	kW	kW
5.0	**Terminals**			
5.1	**Details of 33 kV outdoor bushings:**			
	a) Bushing type	Resin impregnated paper with silicone rubber sheds		N/A
	b) Bushing impulse withstand voltage	200 kV_p	kV_p	N/A
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	1 780 mm	mm	N/A
	d) Stem diameter	-26 mm	mm	N/A
	e) Tan delta test facility	Yes		N/A
5.2	Details of 33 kV compound filled cable box and bushings:			
	a) Bushing type			
	b) Bushing impulse withstand voltage	200 kV_p	kV_p	kV_p
	c) Suitable for number and size of cables per phase (1 × Paper insulated lead sheath cable or 1 × XLPE cable)			
	d) Rated voltage of bushing	36 kV	kV	kV
5.3	Details of HV plug connectors:			
	a) Type (Plug: For 240 mm^2 conductor and 36 mm OD insulation for outdoor use)			
	b) Cable connector size	3		
	c) Rated voltage of HV plug connectors	36 kV	kV	kV
	d) Number of sockets per phase	1		
	e) Plugs for fitting onto cables to be supplied	Yes	Yes/No*	Yes/No*
5.4	Details of LV neutral bushing:			
	a) Bushing type	Resin impregnated		

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
		paper with silicone rubber sheds		
	b) Bushing impulse withstand voltage	95 kV_p	kV_p	kV_p
	c) Minimum total creepage distance (at a unified specific creepage distance of 54 mm/kV)	600 mm	mm	mm
	d) Clamp suitable for 50 mm by 6 mm copper earth bar	Yes	Yes/No*	Yes/No*
	e) Rated voltage of bushing	12 kV	kV	kV
5.5	Details of LV plug connectors:			
	a) Type (Plug: For 630 mm^2 conductor and 42.2 mm OD insulation for outdoor use)			
	b) Cable connector size	3		
	c) Rated service voltage	12 kV	kV	kV
	d) Rated nominal current	1 250 A	A	A
	e) Number of sockets per phase	2		
	f) Plugs for fitting onto cables to be supplied	Yes		
5.6	Details of 11 kV oil filled cable box and bushings:			
	a) Bushing type	---		
	b) Bushing impulse withstand voltage	95 kV_p	kV_p	kV_p
	c) Suitable for number and size of cables per phase (2 × 630 mm^2 Copper)	Yes	Yes/No*	Yes/No*
	d) Rated service voltage	12 kV	kV	kV
6.0	**On-load Tap-changer (Vacuum Type)**			
6.1	a) Manufacturer	---		
	b) Resistor type, reactor type etc	---		
	c) Manufacturer's type designation	---		
	d) Can oil from the on-load transfer switch compartment mix with the oil in the main tank?	No	Yes/No*	Yes/No*
	e) Diverter switch with vacuum interrupters	Yes	Yes/No*	Yes/No*
6.2	**Tappings:**			
	a) Which winding is tapped and where (HV Corner of Delta)	Yes	Yes/No*	Yes/No*
	b) Range of tappings (primary/secondary ratios per unit of ratio at nominal tap)	Maximum 1,1 pu	pu	pu
		Minimum 0,9 pu	pu	pu

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
			* Complete with whichever is applicable	
	c) Size of step as percentage of winding rated voltage at no-load	Maximum 1,43%	%	%
	d) Number of steps	14 steps	steps	steps
6.3	**Number and type of tap position indication devices provided in tap-change drive mechanism:**			
	a) Binary coded decimal type	0		
	b) Resistor divider type (resistance to be specified at time of order, typically 400 Ω per step)	1		
	c) Voltage free contacts with common connection (one contact per tap)	2		
	d) Number of steps	14 steps		steps
6.4	**Tap-change alarm and indication signals required:**			
	a) Tap-change on Manual	Yes	Yes/No*	Yes/No*
	b) Tap-change not healthy	Yes	Yes/No*	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*	Yes/No*
	d) Tap-change fail	Yes	Yes/No*	Yes/No*
	e) Tap-change d.c. fail	Yes	Yes/No*	Yes/No*
	f) Tap-change VT fail	Yes	Yes/No*	Yes/No*
	g) Tap-change voltage abnormal	Yes	Yes/No*	Yes/No*
	h) Tap-change voltage high	Yes	Yes/No*	Yes/No*
	i) Tap-change voltage low	Yes	Yes/No*	Yes/No*
	j) Tap-change in progress	Yes	Yes/No*	Yes/No*
	k) Tap-change on manual control	Yes	Yes/No*	Yes/No*
	l) Tap-change motor drive trip	Yes	Yes/No*	Yes/No*
	m) Tap-change position	Yes	Yes/No*	Yes/No*
6.5	**Tap-change control signals required:**			
	a) Tap-change raise	Yes	Yes/No*	Yes/No*
	b) Tap-change lower	Yes	Yes/No*	Yes/No*
	c) Tap-change lockout	Yes	Yes/No*	Yes/No*
	d) Tap-change overcurrent blocking	Yes	Yes/No*	Yes/No*
	e) Labelling of all tap changer control wiring	Yes	Yes/No*	Yes/No*

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
6.6	**Provide the following trip signals:**			
	a) Top oil temperature very high	Yes	Yes/No*	Yes/No*
	b) Top winding temperature very high	Yes	Yes/No*	Yes/No*
	c) PRV operation	Yes	Yes/No*	Yes/No*
	d) Buchholz high gasses operation	Yes	Yes/No*	Yes/No*
6.7	**Provide the following supply circuits:**			
	a) 220 V a.c. (15 A) plug with earth leakage protection (30 mA)	Yes	Yes/No*	Yes/No*
	b) 5 × 6 A MCB with earth leakage protection (30 mA)	Yes	Yes/No*	Yes/No*
6.8	**Provide the following analogue outputs:**			
	a) Top oil temperature reading 4 mA to 20 mA	Yes	Yes/No*	Yes/No*
	b) Top winding temperature 4 mA to 20 mA	Yes	Yes/No*	Yes/No*
	c) Combustible gas reading 4 mA to 20 mA	Yes	Yes/No*	Yes/No*
	d) Temperature sensor on cooler in and outlet	Yes	Yes/No*	Yes/No*
7.0	**Cooling:**			
7.1	Auxiliary equipment for forced air cooling:	Fans blowing on radiators		N/A
7.2	Direction fans are blowing	Sidewards		
7.3	Number of fans per transformer	≥ 2 fans	fans	N/A
7.4	Rated output of each fan	---	m^3/s	N/A
7.5	Speed of fan	---	rpm	N/A
7.6	Type of fan motor	---		N/A
7.7	Rating of each fan motor	---	kW	N/A
7.8	Starting current of fan motor	---	A	N/A
7.9	Maximum temperature of oil:			
	a) At inlet to cooler	---	°C	°C
	b) At outlet from cooler	---	°C	°C
8.0	**General Information**			
8.1	Thickness of radiator plates and/or cooling tubes	≥ 1 mm	mm	mm

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
8.2	Thickness of transformer tank:			
	a) Sides	≥ 6 mm	mm	mm
	b) Bottom	≥ 20 mm	mm	mm
8.3	Overall dimensions of transformer:			
	a) Tank only	---	mm	mm
	b) Coolers only	---	mm	mm
	c) Height over Conservator	---	mm	mm
8.4	Mass of core	---	kg	kg
8.5	Mass of windings	---	kg	kg
8.6	Mass of separate cooler bank complete with oil	---	N/A	kg
8.7	Total mass of complete transformer including oil and tank mounted radiators (if applicable)	---	kg	kg
8.8	Mass of transformer as arranged for transport	---	kg	kg
8.9	Total oil required (including cooling system)	---	litres	litres
8.10	Minimum quantity of oil to be removed from transformer including conservator to expose the top of the core	---	litres	litres
8.11	Total volume of conservator	---	litres	litres
8.12	Volume of oil in conservator between the highest and lowest visible levels	---	litres	litres
8.13	Maximum permissible vacuum in tank excluding tap-changer, bushings, etc	---	kPa	kPa
8.14	Maximum permissible vacuum in tank fitted as on site with tap-changer, bushings etc	---	kPa	kPa
8.15	Detailed painting process included	Yes	Yes/No*	Yes/No*
8.16	Repair for any winding fault up to 20 years offered?	---		
8.17	Guarantees:			
	a) Transformer and auxiliary equipment	10 years	years	years
	b) Leaks and corrosion	10 years	years	years
9.0	**Indicating and Protective Devices Details**			
9.1	Anti-corrosion and anti-vibration pad material	---		
9.2	**Vibration and noise:**			
	a) Average noise level of the transformer *without* fans in service	---	dB	dB

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
	b) Average noise level of the transformer *with* fans in service	< 71 dB	dB	dB
9.3	**Self-Dehydrating Breathers (SDB):**			
	a) Number of SDBs required per transformer	---	kg	kg
	b) Quantity of silica-gel in each SDB	---		
	c) Clear silica gel	Yes	Yes/No*	Yes/No*
9.4	**Winding temperature:**			
	a) Winding temperature thermometer type	---		
	b) Alternative option for fibre optic temperature sensors	---		
9.5	Oil temperature thermometer type	---		
9.6	Oil-and gas-actuated relay type	---		
9.7	**Pressure relief device:**			
	a) Type	---		
	b) Mesh to prevent vermin from entering	Yes	Yes/No*	Yes/No*
9.8	**Conservator:**			
	a) Conservator bag	Yes	Yes/No*	Yes/No*
	b) Conservator bag leak detection system type	---		
	c) Details of bag leak detection system supplied with tender	Yes	Yes/No*	Yes/No*
	d) Oil level indicators	---		
9.9	Tap-changer protective device (detail)	Specify type		
10.0	**Delivery and off-loading**			
	a) Filling medium of transformer tank for transportation	Dry air		
	b) Quantity of oil required to cover windings for transportation	---	litres	litres
	c) Supplied transformer filled with new oil	---	Yes/No*	Yes/No*
	d) Type of oil to be used	Mineral oil (uninhibited) IEC 60296		
	e) Transformer delivered to	As per order	Yes/No*	Yes/No*

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
			* Complete with whichever is applicable	
	f) Delivery effected not before	As per order	Yes/No*	Yes/No*
	g) Off-loaded from transport vehicle by Supplier	Yes	Yes/No*	Yes/No*
	h) Transport transferred to intended operating position by Supplier	Yes	Yes/No*	Yes/No*
11.0	**Erection and oil filling**			
	a) Erected ready for service	Yes	Yes/No*	Yes/No*
	b) Erection completed not later than	As per order	Yes/No*	Yes/No*
	c) Place two layers of 3 ply 2,8 mm Malthoid mat under transformer on plinth	Yes	Yes/No*	Yes/No*
	d) Place one layer of 4 mm index unigum under transformer on plinth	Yes	Yes/No*	Yes/No*
12.0	**Active Part**			
12.1	**Thermal constraints and considerations with regard to the paper insulation system:**			
	a) Life expectancy at required operating and environmental conditions, designed to be for at	40 years	years	years
	b) Type of paper to be used: Thermally upgraded paper	Yes	Yes/No*	Yes/No*
	c) DP of wrap and board used:	---	.	
	d) DP of new paper	---		
	e) Percentage moisture in paper after dry-out	---	%	%
	f) DP after final dry-out in factory	min 1 000 DP		
	g) Number and details of test blocks to be left in completed transformer	---		
	h) Details of test dry-out/heating blocks dimensions, positioning and testing during manufacture	---	Yes/No*	Yes/No*
13.0	**Testing**			
13.1	Are the test results of the following type tests performed on similar transformers available and submitted with this tender? (The degree of similarity of the transformers previously tested to those specified in this contract must be documented):			
	a) Impulse test	Yes	Yes/No*	Yes/No*
	b) Temperature rise test	Yes	Yes/No*	Yes/No*
	c) Noise level measurements	Yes	Yes/No*	Yes/No*
	d) Short circuit test	Yes	Yes/No*	Yes/No*

Item	Description	Technical Details		
		eThekwini Electricity Requirement	33/11 kV 15 MVA Type 1 (ONAF) Offered	33/11 kV 15 MVA Type 2 (ONAN) Offered
		* Complete with whichever is applicable		
13.2	**On Site Oil Tests:**			
	a) Fourier Transform Infrared Spectroscopy (FTIR): Oil type verification	Yes	Yes/No*	Yes/No*
	b) Dissolved Gas Analysis (DGA): two weeks after energizing	Yes	Yes/No*	Yes/No*
	c) Test for Silicone and other metal contaminants	Yes	Yes/No*	Yes/No*
	d) Test for Corrosive sulphur (to be done in accordance with extended Doble method)	Yes	Yes/No*	Yes/No*
14.0	**Special Requirements**			
14.1	a) On-line single gas dissolved gas analyser (DGA) for transformer monitoring	Yes	Yes/No*	Yes/No*
	b) On-line eight (8) gas dissolved gas analyser (DGA) for transformer monitoring	No	Yes/No*	Yes/No*
	c) Gases trended separately	No	Yes/No*	Yes/No*
	d) Transformer operating temperatures monitoring	Yes	Yes/No*	Yes/No*
	e) On-load tap changer (OLTC) monitoring	Yes	Yes/No*	Yes/No*
	f) Cooling group control monitoring	Yes	Yes/No*	Yes/No*
	g) Bushing monitoring	Yes	Yes/No*	Yes/No*
	h) Partial Discharge monitoring	Yes	Yes/No*	Yes/No*
	i) Type of valves to use	Gate/Butterfly		
	j) Spare bushing to be supplied with oil vessels for long term storage	Yes	Yes/No*	Yes/No*
14.2	**Existing Transformer:**			
	a) Disassembling, loading, transporting and off-loading of existing power transformer within a 30 km radius	Yes	Yes/No*	Yes/No*
	b) Oil Handling	Yes	Yes/No*	Yes/No*
	c) Disposal of oil and old transformers	Yes	Yes/No*	Yes/No*
	d) Time required to remove the old transformer	[2 weeks	week(s)	week(s)

Item	Description	Technical Details		Item	Description	Technical Details	
		eThekwini Electricity Requirement	33/11 kV 15 MVA (ONAF/ONAN) Offered			eThekwini Electricity Requirement	33/11 kV 15 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
15.0	**Detailed Technical Information and Data Sheets**						
	Detailed information and data sheets including all the relevant Type Test Certificates of the following components shall be included (specify in which section of tender the information is found):						
15.1.1	**HV Outdoor Bushing:**			15.1.	**33 kV Oil Filled Cable Box and Bushings:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test Certificate	Yes	Yes/No*
15.1.3	**11 kV Oil Filled Cable Box and Bushings:**			15.1.	**HV and LV Plug Connectors:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test Certificate	Yes	Yes/No*
15.1.5	**HV Neutral Bushing:**			15.1.	**LV Neutral Bushing:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test Certificate	Yes	Yes/No*
15.2	**Cooler Units, Motors and Fans**						
15.2.1	**Cooler Units:**			15.2.	**Fans:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		

Item	Description	Technical Details		Item	Description	Technical Details	
		eThekwini Electricity Requirement	33/11 kV 15 MVA (ONAF/ONAN) Offered			eThekwini Electricity Requirement	33/11 kV 15 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test Certificate	Yes	Yes/No*
15.3	**Tap-changer:**			15.4	**Buchholz Relays:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test Certificate	Yes	Yes/No*
				15.6	**Winding Temperature Measurement**		
15.5	**Pressure Relief Device:**			15.6.	**Instrument:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test Certificate	Yes	Yes/No*
				15.7	**Oil Temperature Measurement**		
15.6.2	**Measuring Equipment e.g. CT:**			15.7.	**Instrument:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test Certificate	Yes	Yes/No*
15.7.2	**Measuring Equipment e.g. PT100s or Sensors:**			15.8	**Tap-changer Pressure Relay:**		

Item	Description	Technical Details		Item	Description	Technical Details	
		eThekwini Electricity Requirement	33/11 kV 15 MVA (ONAF/ONAN) Offered			eThekwini Electricity Requirement	33/11 kV 15 MVA (ONAF/ONAN) Offered
		* Complete with whichever is applicable				* Complete with whichever is applicable	
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Supplier		
	e) Technical Data	Yes	Yes/No*		e) Technical Data	Yes	Yes/No*
	f) Type Test Certificate	Yes	Yes/No*		f) Type Test Certificate	Yes	Yes/No*
15.9	**Dehydrating Breathers**			15.1	**Conservator Bag:**		
	a) Manufacturer				a) Manufacturer		
	b) Type Number				b) Type Number		
	c) Part Number				c) Part Number		
	d) Supplier				d) Material Type		
	e) Technical Data	Yes	Yes/No*		e) Supplier		
	f) Type Test Certificate	Yes	Yes/No*		f) Technical Data	Yes	Yes/No*
					g) Type Test Certificate	Yes	Yes/No*
15.11	**Oil Level Indicators**						
	a) Manufacturer						
	b) Type Number						
	c) Part Number						
	d) Supplier						
	e) Technical Data	Yes	Yes/No*				
	f) Type Test Certificate	Yes	Yes/No*				
16.0	**General**						
	Further information that tenderers may wish to submit						

SECTION18 4: Continuous On-line Condition Monitoring Multi-Gas Analyser Specific Requirements

Item	Description	Technical Details	
		eThekwini Electricity Requirement	Offered
		* Complete with whichever is applicable	
1.0	**Details of OEM**		
	a) Name of the manufacturer		
	b) Country		
	c) Supplier		
2.0	**General site conditions**		
	a) Installation	Indoor or Outdoor	
	b) Site altitude above sea level	1 000 m	m
	c) Air ambient temperature	0°C to 50°C	°C
	d) Barometric pressure	± 40 kPa	kPa
	e) Relative humidity	5% to 30%	%
	f) Supply voltage (a.c.)	230 V	V
	g) Current	16 A	A
	h) Frequency	50 Hz	Hz
	i) Life expectancy	≥ 10 years	years
3.0	**Gas detection**	Comply with Table 9 of this specification for all gases and moisture	
	a) Hydrogen (H_2)	Range: 5 ppm to 3 000 ppm Accuracy: 5 ppm	ppm
	b) Methane (CH_4)	Range: 5 ppm to 3 000 ppm Accuracy: 5 ppm	ppm
	c) Ethane (C_2H_6)	Range: 5 ppm to 3 000 ppm Accuracy: 5 ppm	ppm
	d) Ethylene (C_2H_4)	Range: 5 ppm to 3 000 ppm Accuracy: 5 ppm	ppm
	e) Acetylene (C_2H_2)	Range: 1 ppm to 3 000 ppm Accuracy: 2 ppm	ppm
	f) Carbon monoxide (CO)	Range: 20 ppm to 30 000 ppm Accuracy: 20 ppm	ppm

Item	Description	Technical Details	
		eThekwini Electricity Requirement	Offered
		* Complete with whichever is applicable	
	g) Carbon dioxide (CO_2)	Range: 20 ppm to 30 000 ppm Accuracy: 20 ppm	ppm
	h) Oxygen (O2)	Range: 50 ppm to 10 000 ppm Accuracy: 20 ppm	ppm
4.0	**External sensors - inputs**		
	a) Load CT: Analogue clip-on load CT, Nominal 0 A to 5 A	Required, 0 A to 5 A range. Provide data sheet	
	b) Transformer winding temperature - Fibre Optic Hot Spot sensors:	2 channels minimum Neoptix or Lumasense (Luxtron)	
	c) Oil temp probe input: Interface with an oil temperature signal on 4 mA to 20 mA or RTD	Required via 4 mA to 20 mA	
	d) Partial Discharge unit interface input IP network	Required, will use the ethernet interfaces for primary communication	
	e) 4 mA to 20 mA inputs: Spare inputs for other devices	Required, 4 × Spare 4 mA to 20 mA inputs	
	f) Serial RS485 inputs: Spare inputs for other devices	Required: 2 × RS485 inputs	
5.0	**Perfomance**		
	a) Sampling rate	Configurable 1 min to 5 hours	
	b) Accuracy measurement for gases	± 5%	%
	c) Accuracy measurement for moisture	± 2%	%
6.0	**DGA connection**		
	a) Oil connection valve(s) required	Yes	Yes/No*
	b) Modified flange for main drain valve	Yes	Yes/No*
7.0	**Communication and Data**		
	a) Remote programming capabilities provided	Yes	Yes/No*
	b) Front panel display requirements	Yes	Yes/No*
	c) Communication protocols	DNP3/IP and IEC 61850/IP	
	d) Local communication port via USB port	Yes	Yes/No*
	e) Remote communication port	Ethernet 100 BaseT	Yes/No*
	f) Number of digital communication ports	4	ports
	g) Capability to self-calibration and measurement	Yes	Yes/No*
	h) Data storage space	----	Gb
	i) Duration of data storage	1 year at fastest sampling rate	year(s)
8.0	**Interface software**		

Item	Description	Technical Details	
		eThekwini Electricity Requirement	Offered
		* Complete with whichever is applicable	
	a) Detail of software used	----	
9.0	**Reliability**		
	a) Comply to SANS/IEC 61000-5-1	Yes	Yes/No*
10.0	**Enclosure**		
	a) IP 56 rating in accordance to SANS/IEC 60529	Yes	Yes/No*
	b) Stainless steel Grade 316 for accessories	Yes	Yes/No*
11.0	**Installation requirements**		
	a) As per specification	Yes	Yes/No*
12.0	**Earthing**		
	a) Equipment bonding according to SANS ISO 8528	Yes	Yes/No*
13.0	**Tests**		
	a) Tests performed according to SANS/IEC 61000	Yes	Yes/No*
14.0	**Documentation**		
	a) Product technical information submitted	Yes	Yes/No*
	b) Drawings submitted	Yes	Yes/No*
	c) Maintenance and contact numbers required	Yes	Yes/No*
	d) Software instructions and calibration certificates provided	Yes	Yes/No*
	e) Training provided	Yes	Yes/No*
15.0	**Quality management**		
	ISO 9001 Quality management accreditation provided	Yes	Yes/No*
16.0	**Environmental management**		
	ISO 14001 Environmental management accreditation provided	Yes	Yes/No*
17.0	**Moisture detection**		
	a) Water in oil	Range 2% to 100% Relative Saturation or 2 ppm - Accuracy: 2 ppm	

T2.2.27 T2.2.19: DETAILS OF DRAWINGS ISSUED AND REQUIRED

1.0 Drawings Issued with this Specification

The purpose of the schematic drawings issued with this enquiry is to clarify the requirements detailed in this specification. The issue of these does not absolve the contractor from the normal responsibilities of providing a satisfactory scheme or submitting drawings of systems proposed for each order for approval by the Engineer.

The drawings listed below show the proposed layout of equipment and basic circuit schematic requirements.

Reference	Description
a) PE79/S/99	Proposed Addition of one 275/132 kV Transformer at Ottawa Substation
b) PE79/S/98	Proposed Basic Schematic for New 275/132 kV Transformer at Ottawa Substation
c) PE14/S/82 Rev 1	Proposed Basic Schematic for New 275/132 kV Transformer at Durban South
d) PE127/S/42	Proposed Basic 132/33 kV Schematic Diagram
e) TD 19	Typical Layout of Substation with 132/11 kV 30 MVA Type 1 Transformers
f) TD 20	Typical Layout of Substation with 132/11 kV 30 MVA Type 2 Transformers
g) TD 21	General Protection and Control Schematics for Power Transformers
h) TD 40	Brackets and Cleats for 11 kV Loop Cables, Transformers and 11 kV Switchgear
i) TD 84	Illustration of a Bracket Required for 132 kV Loop Cable Support on a Transformer
j) SP 630	General Arrangement of 11 kV 2000 A Transformer Cable End Box
k) SP 673	Proposed Transformer Arrangement to Accommodate Plug-in Type Connector for Medium Voltage
l) SP 617	Diagram of Cable Cleat Supporting Structure

2.0 Drawings required with tender

The following tender drawing and descriptive data shall be included with the tender:

a) Outline and general arrangements of transformer and cooler unit indicating weights of equipment and loading.
b) Dimensioned drawing of required plinths for all transformers.
c) Internal arrangement of the core and windings, showing lead support and winding clamp arrangements.
d) Details of core and core-clamping.
e) Sectional arrangement drawings of the windings showing sufficient details of the conductors and insulation for local maintenance purposes.
f) Rating and diagram plates.
g) Drawings showing all details of external oil piping, including valves and flanges.
h) Outline and details of earthing device (NER, NEC or NECRT), indicating weights of equipment, loading and overall dimensions and foundation details.
i) Detailed schematic and wiring drawings of fan motor, pump-motor, and on-load tap-changer control circuits showing terminal arrangements.
j) Wiring diagrams and dimensioned outline drawings of tap-changer control panel.
k) Wiring diagrams and dimensioned outline drawings, including foundation details of secondary cabling marshalling cabinet.
l) Magnetisation curves of all current transformers.
m) Bidders are to declare the period of the active phase (end of product commercialisation) and classic phase (end of full spare parts availability) for transformers.

3.0 Working Drawings

These shall be submitted 6 weeks upon award of contract. Final as-built drawings shall also be submitted by the contractor on compact disc in AutoCAD version 2025 or earlier version.

T2.2.28 T2.2.20: TESTING REQUIRED

1.0 General

Tests shall be carried out on all of the following items/units in accordance with the General Technical Specification as a routine of the manufacture of each item/unit.

a) Transformer
b) Voltage control equipment
c) Bushings
d) Tanks and coolers
e) Pipework and valves
f) Gas and oil actuated relays
g) Secondary wiring
h) Current and voltage transformers

If available, results of type tests performed on transformers similar to those specified in this Contract shall be submitted. Relevant similarities must be documented.

1.2 Manufacturer's Tests

TEST DESCRIPTION	SPECIFICATION	ROUTINE	TYPE	SPECIAL
(a) Oil	IEC 60296/ IEC 60422/ IEC 62270	✓		
(b) Winding resistance	IEC 60076-1	✓		
(c) Voltage ratio and of phase displacement	IEC 60076-1	✓		
(d) Measurement of short-circuit impedance and load losses	IEC 60076-1	✓		
(e) Core/frame insulation resistance	IEC 60076-1	✓		
(f) Winding insulation resistance	IEC 60076-1	✓		
(g) Secondary wiring (voltage and insulation resistance tests)	Clause11.4.13	✓		
(h) Winding capacitance and power factor	IEC 60076-1	✓		
(i) Sweep frequency response analysis (SFRA)	IEC 60076-18	✓		
(j) Lightning impulse (line and neutral)	IEC 60076-3	✓		
(k) Short duration induced ac voltage	IEC 60076-3	✓		
(l) Applied a.c. voltage	IEC 60076-3	✓		
(m) Neutral earthing compensators and resistors	IEC 60076	✓		
(n) No-load losses and current measurements (at 90%, 100% and 110% excitation)	IEC 60076-1	✓	✓	
(o) On-load tap-changer tests	IEC 60214	✓	✓	
(p) Current transformer tests	IEC 60185	✓	✓	
(q) Transformer tank tests and ON coolers	Clause 11.4.9	✓	✓	
(r) Bushing tests	IEC 60137	✓	✓	
(s) Gas and oil actuated relays	Clause 11.4.12	✓	✓	
(t) Temperature rise test including hot spot measurement at ONAN and ONAF	IEC 60076-2		✓	
(u) Sound level measurements	IEC 60076-10		✓	
(v) Galvanising	SABS 0214		✓	
(w) Cooler power consumption	IEC 60076-1		✓	
(x) Zero-sequence impedance	IEC 60076-1			✓

ADDITIONAL TESTS	SPECIFICATION	LEVEL	COMPLIANCE CRITERIA
(y) Cyclic Temperature and Humidity	IEC 60068-2-30	Db	25°C and 95% relative humidity/ 55°C and 95% relative humidity, 12 + 12-hour cycle

(z) Enclosure Protection	SANS 60529	IP53	Protection against ingress of dust particles, spraying water
(aa) Dye Penetration Testing	Clause 11.4.16 *"General Technical Specification"*	---	---

The manufacturer shall perform the routine tests on each unit during the various stages of manufacturing as well as complete type test for each design.

The costs that would be incurred, for any type tests, if any of these tests are deemed necessary shall be stated in C2.3.

3.0 Site Tests

The following tests shall be carried out on site to ensure that the transformers and associated equipment are ready for handing over and putting into commercial use. Test results shall be submitted for approval before take-over:

3.1 Transformer Site Tests:

a) Voltage ratio checks (all tapping positions at 10 kV);
b) Vector group checks;
c) Oil dielectric strength (all sampling points);
d) Temperature indicator calibration;
e) DC winding resistance (static and dynamic);
f) Exciting current at 10 kV;
g) Core insulation resistance test;
h) Nameplate impedance to be verified with short circuit impedance or leakage reactance test;
i) Tan delta for windings and bushings at 10 kV;
j) Main tank and tap-change oil levels to be checked;
k) Sweep frequency response analysis;
l) Check silica gel;
m) Oil leakage test;
n) 2 kV Insulation resistance test between core and earth after transformer has been installed; and
o) Power factor on winding insulation.

3.2 Tap-changer Site Tests:

a) Tap-change controls (local/remote/manual/automatic);
b) Oil dielectric strength (all sampling points);
c) Tap-change oil levels to be checked;
d) Sweep frequency response analysis; and
e) Oil leakage test.

3.3 NER/NECRT Site Tests:

a) Oil dielectric strength (all sampling points);
b) Temperature indicator calibration;
c) Sweep frequency response analysis; and
d) Check silica gel.

3.4 Current Transformers Site Tests:

a) Current transformer magnetisation characteristics;
b) Polarity checks of current transformers; and
c) Core insulation resistance test.

3.5 Radiator Site Tests:

Forced cooling system checks.

3.6 Marshalling Kiosk Site Tests:

a) Alarms, trips and indications; and
b) Control/power cabling insulation (min 1 kV).

3.7 Bushing Site Tests:

Tan delta for windings and bushings at 10 kV.

T2.2.29 DIVERGENCES OF THE BID FROM THE TECHNICAL SPECIFICATIONS

This schedule shall be completed, signed and returned with the bid documents of which it forms part.

If the bid does not comply technically with this specification, in any respect, such divergences shall be detailed below in addition to any other reference thereto contained elsewhere in the bid or accompanying letter.

NAME : ..... (Block Capitals)

SIGNATURE : ……..……..…….. DATE: .....
(of person authorised to sign on behalf of the Tenderer)

T2.2.30 SURETY FORM PROFORMA

The Tenderer is required to submit with his tender a letter of intent from an approved insurer/banker undertaking to provide the Surety/Performance Bond in the format given below.

Contract No. _____

SURETY BOND-Proforma

..... (hereinafter referred to as the Surety) hereby binds itself as Surety for and co-principal debtor with …… (hereinafter referred to as the Contractor) unto the ETHEKWINI MUNICIPALITY (hereinafter referred to as the Council) for the due and complete performance by the Contractor of all the Contractor's obligations and liabilities under Contract……..with the terms of which the Surety agrees that the Surety is acquainted, including any obligations or liabilities undertaken by the Contractor as a variations of, or in substitution for, any obligations or liabilities under the said contract. The suretyship shall be on the following conditions:-

1. The Surety shall remain bound notwithstanding any relaxation, indulgence or any extension of time granted to the Contractor, whether in accordance with the said Contract or otherwise, notwithstanding that any such relaxation, indulgence or extension might operate or has operated to the prejudice of the Surety.
2. The Surety shall remain bound in terms of this agreement notwithstanding that the Council may release any securities held by it for the fulfilment of the obligation of the Contractor or may release any other surety or sureties liable in respect of all or any obligations in respect of which the Surety is liable.
3. Unless the Surety has discharged its obligations hereunder in full and there is no obligation or liability whatsoever of any nature outstanding which the Surety is or may be liable to perform, the Council shall have the sole right to the exclusion of any right which the Surety might otherwise have, to claim and to be regarded as a Creditor in the event of the insolvency, liquidation or judicial management of the Contractor.
4. The Council may settle or comprise any claim which it might have against the Contractor arising of the Contractor's liabilities or obligations under the said Contract or any variation thereof or substitution therefor, and in the event of any such settlement or compromise the Surety shall be liable to carry out any obligation or liability of the Contractor in terms of any such settlement or compromise.
5. The Surety hereby renounces all benefits which would otherwise be available to the Surety and in the particular, but without affecting the generality of the foregoing, the beneficia ordinis seu excussionis. Divisionis. novae constitutionis.de doubus vel puribus reis debendi.non causa debiti.non numeratae pecuniae. erroris calculi and the benefit of revision of account.
6. Notwithstanding anything herein contained, the total liability of the Surety to the Council arising from this bond shall not exceed the sum of _____ together with such further sums for interest and costs as may in law be claimed from the Surety.
7. Upon the issue of a certificate signed by the City Treasurer or either of his authorised deputies as to the amount due, owing and payable by the Contractor to the Council, the Surety shall be obliged forthwith to pay such a sum as is mentioned in the said certificate, to the City Treasurer. Such payment shall be subject to adjustment as between the Surety and the Council as and when final details of the Council's damages arising from the said Contract are ascertained.

SIGNED by the said _____ at _____ on this the ___ day of _____

AS WITNESSES: 1. _____ 2. _____

_____
Signature of Surety

Postal Address of Surety:
PO Box _____

NAME : ..... (Block Capitals)

SIGNATURE : ……..……..…… DATE: .....

(of person authorised to sign on behalf of the Tenderer)

T2.2.31 ALTERATIONS BY BIDDER

This schedule shall be completed, signed and returned with bid documents of which it forms part.

Should the Bidder desire to make any departures from, or modifications to, the ETHEKWINI MUNICIPALITY'S Special Conditions of Tender/Contract (Goods/Services) and Government Procurement General Condition of Contract, or the Technical Specification, or to qualify his Bid in any way, he shall set out his/her proposals clearly hereunder or alternatively state them in a covering letter attached to his bid and referred to hereunder, failing which the bid will be deemed to be unqualified.

Page	Clause or Item

NAME : ..... (Block Capitals)

SIGNATURE : ..... DATE: .....

(of person authorised to sign on behalf of the Tenderer)

T2.2.32 DIVERGENCES OF THE BID FROM THE CONTRACTUAL SPECIFICATIONS

This schedule shall be completed, signed and returned with the bid documents of which it forms part.

If the bid does not comply contractually with this specification or with the Municipality's Special Conditions of Bid/Contract (Goods and Services), in any respect, such divergences shall be detailed below in addition to any other reference thereto contained elsewhere in the bid or accompanying letter.

NAME : ..... (Block Capitals)

SIGNATURE : ..... DATE: .....

(of person authorised to sign on behalf of the Tenderer)

T2.2.33 BIDDER'S QUESTIONNAIRE

This schedule shall be completed, signed and returned with the bid documents of which it forms part.

***Bidder to complete Questionnaire by deleting that which is not applicable**

Ref.	Question	Employer's Requirement	Bidder's Response
1	Are contractual specifications and conditions understood?	Yes	*Yes/No
2	Are the technical specifications understood?	Yes	*Yes/No
3	Is the scope of work understood?	Yes	*Yes/No
4	Is Declaration of Municipal Fees Schedule completed?	Yes	*Yes/No
5	Is the Compulsory Enterprise Questionnaire completed?	Yes	*Yes/No
6	Has a **valid SARS Tax Clearance Certificate** been submitted as per MBD2?	Yes	*Yes/No
7	Is Declaration of Interest Schedule (MBD4) completed?	Yes	*Yes/No
8	Is the Declaration for Procurement above R10 million form (MBD5) completed?	Yes	*Yes/No
9	Is the Preferential Points document (MBD6.1) completed?	Yes	*Yes/No
10	Is the Declaration of Bidder's Past Supply Chain Management Practices form (MBD8) completed?	Yes	*Yes/No
11	Is the Certificate of Independent Bid Determination (MBD9) completed?	Yes	*Yes/No
12	Are the returnable schedules for the functionality criteria completed and supporting documents included with the bid?	Yes	*Yes/No
13	Is the delivery/ programme schedule completed?	Yes	*Yes/No
14	Is the list of Project References stated in the returnable schedule completed?	Yes	*Yes/No
15	Are the details of manufacturer's name and places of manufacture, testing and inspection of plant and equipment completed?	Yes	*Yes/No
16	Are the type test results or certificates submitted?	Yes	*Yes/No

NAME :..... (Block Capitals)

SIGNATURE : ……..……..…… DATE: .....

(of person authorised to sign on behalf of the Tenderer)

T2.2.33 BIDDER'S QUESTIONNAIRE (CONTINUED)

Ref.	Question	Employer's Requirement	Bidder's Response
17	Are all relevant technical schedules completed and required documentation included with the bid?	Yes	*Yes/No
18	Are there any deviations from the Technical Specification? If yes, specify all deviations in the returnable schedule.		*Yes/No
19	Is the confirmation of CIDB Registration submitted?	Yes	*Yes/No
20	Is the JV/ partnership agreement submitted (if applicable)?		*Yes/No
21	Is Acceptance of Undertaking in Terms of OHS Act completed?	Yes	*Yes/No
22	Are there any deviations from the Contractual Specification? If **yes**, specify all deviations in the returnable schedule.		*Yes/No
23	Has the previous 3 years audited financial statements been submitted?	Yes	*Yes/No
24	**Bid Prices:**		
24.1	Is the Form of Offer completed?	Yes	*Yes/No
24.2	Is the Price Schedule completed?	Yes	*Yes/No
24.3	Are the bid prices subject to Exchange Rate Variations? **If Yes, complete Rate of Exchange Questionnaire**.		*Yes/No
24.4	Are the bid prices subject to Contract Price Adjustments (CPA)? **If Yes, submit details to calculate Contract Price Adjustments**.		*Yes/No
25	Is the Bid complete with all the required information given?	Yes	*Yes/No

*Delete that which is not applicable

NAME : ..... (Block Capitals)

SIGNATURE : ..... DATE: .....

(of person authorised to sign on behalf of the Tenderer)

T2.2.34 AMENDMENTS, QUALIFICATIONS AND ALTERNATIVES

(This is not an invitation for amendments, deviations or alternatives but should the Tenderer desire to make any departures from the provisions of this contract he shall set out his proposals clearly hereunder. The Employer will not consider any amendment, alternative offers or discounts unless forms (a), (b) and (c) have been completed to the satisfaction of the Employer).

I / We herewith propose the amendments, alternatives and discounts as set out in the tables below:

(a) AMENDMENTS

PAGE, CLAUSE OR ITEM NO	PROPOSED AMENDMENT

(1) Amendments to the General and Special Conditions of Contract are not acceptable;
(2) The Tenderer must give full details of all the financial implications of the amendments and qualifications in a covering letter attached to his tender.

(b) ALTERNATIVES

PROPOSED ALTERNATIVE	DESCRIPTION OF ALTERNATIVE

(1) Individual alternative items that do not justify an alternative tender, and an alternative offer for time for completion should be listed here.
(2) In the case of a major alternative to any part of the work, a separate Bill of Quantities, programme, etc, and a detailed statement setting out the salient features of the proposed alternatives must accompany the tender.
(3) Alternative tenders involving technical modifications to the design of the works and methods of construction shall be treated separately from the main tender offer.

(c) DISCOUNTS

ITEM ON WHICH DISCOUNT IS OFFERED	DESCRIPTION OF DISCOUNT OFFERED

(1) The Tenderer must give full details of the discounts offered in a covering letter attached to his tender, failing which, the offer will be prejudiced.

NAME : ..... (Block Capitals)

SIGNATURE : ..... DATE: .....

(of person authorised to sign on behalf of the Tenderer)

T2.2.35 GUARANTEE PERIOD

This schedule shall be completed, signed and returned with the bid documents of which it forms part.

The Bidder confirms that all of the equipment offered carry a ten-year guarantee from handover date to the eThekwini Engineer. The Bidder further undertakes, to replace with new units, any of the equipment failing within the guarantee period.

NAME : ..... (Block Capitals)

SIGNATURE : ……..……..…… DATE: .....

(of person authorised to sign on behalf of the Tenderer)

PART C1: AGREEMENT AND CONTRACT DATA

C1.1: FORM OF OFFER AND ACCEPTANCE

C1.1.1: OFFER

The Employer, identified in the Acceptance signature block, has solicited offers to enter into a contract in respect of the following works:

Contract No:	**31144-5E**
Contract Title:	Supply, delivery, off-loading, installation and testing of 275/132 kV, 132/33 kV, 132/11 kV and 33/11 kV power transformers for a fixed period of thirty-six months

The Tenderer, identified in the Offer signature block below, has examined the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, and by submitting this Offer has accepted the Conditions of Tender.

By the representative of the Tenderer, deemed to be duly authorised, signing this part of this Form of Offer and Acceptance, the Tenderer offers to perform all of the obligations and liabilities of the Contractor under the Contract including compliance with all its terms and conditions according to their true intent and meaning for an amount to be determined in accordance with the Conditions of Contract identified in the Contract Data.

*** The offered total of the prices inclusive of Value Added Tax is:**

R..... (*In words* .....

.....)

This Offer may be accepted by the Employer by signing the Acceptance part of this Form of Offer and Acceptance and returning one copy of this document to the Tenderer before the end of the period of validity stated in the Tender Data, whereupon the Tenderer becomes the party named as the Contractor in the Conditions of Contract identified in the Contract Data.

For the Tenderer:

*** Name of Tenderer** *(organisation)* **:** .....

*** Signature** *(of person authorized to sign the tender)* **:** .....

*** Name** *(of signatory in capitals)* **:** .....

Capacity *(of Signatory)* **:** .....

Address : .....

: .....

Telephone : .....

Witness:

Signature : ..... **Date** : .....

Name *(in capitals)* : : .....

Notes:
*** Indicates what information is mandatory.**
Failure to complete the mandatory information and sign this form will invalidate the tender.

C1.1: FORM OF OFFER AND ACCEPTANCE

C1.1.2: FORM OF ACCEPTANCE

This Form will be completed by the Employer

By signing this part of the Form of Offer and Acceptance, the Employer identified below accepts the Tenderer's Offer. In consideration thereof, the Employer shall pay the Contractor the amount due in accordance with the Conditions of Contract identified in the Contract Data. Acceptance of the Tenderer's Offer shall form an agreement between the Employer and the Tenderer upon the terms and conditions contained in this Agreement and in the Contract that is the subject of this Agreement.

The terms of the contract are contained in:

- Part C1 : Agreement and Contract Data, (which includes this Agreement)
- Part C2 : Pricing Data, including the Bill of Quantities
- Part C3 : Scope of Work
- Part C4 : Site Information

and the schedules, forms, drawings and documents or parts thereof, which may be incorporated by reference into Parts C1 to C4 above.

Deviations from and amendments to the documents listed in the Tender Data and any addenda thereto listed in the Tender Schedules as well as any changes to the terms of the Offer agreed by the Tenderer and the Employer during this process of offer and acceptance, are contained in the Schedule of Deviations attached to and forming part of this Agreement. No amendments to or deviations from said documents are valid unless contained in this Schedule, which must be duly signed by the authorised representatives of both parties.

The Tenderer shall within two weeks after receiving a completed copy of this Agreement, including the Schedule of Deviations (if any), contact the Employer's agent (whose details are given in the Contract Data) to arrange the delivery of any bonds, guarantees, proof of insurance and any other documentation to be provided in terms of the Conditions of Contract identified in the Contract Data at, or just after, the date this Agreement comes into effect. Failure to fulfill any of these obligations in accordance with those terms shall constitute a repudiation of this Agreement.

Notwithstanding anything contained herein, this Agreement comes into effect on the date when the Tenderer receives one fully completed original copy of this document, including the Schedule of Deviations (if any). Unless the Tenderer (now Contractor) within five days of the date of such receipt notifies the Employer in writing of any reason why he cannot accept the contents of this Agreement, this Agreement shall constitute a binding contract between the parties.

Signature *(person authorized to sign the acceptance)* **:** .....

Name *(of signatory in capitals)* **:** .....

Capacity *(of Signatory)* **:** .....

Name of Employer *(organisation)* **:** .....

Address : .....

: .....

Witness:

Signature : ..... **Date** : .....

Name*(in capitals)* : .....

C1.1: FORM OF OFFER AND ACCEPTANCE
C1.1.3: SCHEDULE OF DEVIATIONS

This form will be completed by THE EMPLOYER and ONLY THE SUCCESSFUL TENDERER

1. **Subject** : ……..

Details : ……..

: ……..

2. **Subject** : ……..

Details : ……..

: ……..

3. **Subject** : ……..

Details : ……..

: ……..

By the duly authorised representatives signing this Schedule of Deviations, the Employer and the Tenderer agree to and accept the foregoing Schedule of Deviations as the only deviations from and amendments to the documents listed in the Tender Data and addenda thereto as listed in the Tender Schedules, as well as any confirmation, clarification or change to the terms of the offer agreed by the Tenderer and the Employer during this process of offer and acceptance.

It is expressly agreed that no other matter whether in writing, oral communication or implied during the period between the issue of the tender documents and the receipt by the Tenderer of a completed signed copy of this Agreement shall have any meaning or effect in the contract between the parties arising from this Agreement.

FOR THE TENDERER		**FOR THE EMPLOYER**
……..……..	Signature	……..……..
……..……..	Name *(in capitals)*	……..……..
……..……..	Capacity	……..……..
……..……	Name and Address of	……..……
……..	Organisation	……..
……..		……..
……..		……..
……	Witness Signature	……
……..	Witness Name	……..
……..	Date	……..

C1.2: CONTRACT DATA

C1.2.1 CONDITIONS OF CONTRACT

C1.2.1.1 GENERAL CONDITIONS OF CONTRACT

The Conditions of Contract are the General Conditions of Contract for Construction Works (2015 3rd Edition), (GCC 2015) published by the South African Institution of Civil Engineering. Copies of these conditions of contract may be obtained from the South African Institution of Civil Engineering (Tel: 011-805-5947, Fax: 011-805-5971, E-mail: civilinfo@saice.org.za).

The Contract Data (including variations and additions) shall amplify, modify, or supersede, the GCC 2015 to the extent specified below, and shall take precedence and shall govern.

Each item of data given below is cross-referenced to the clause in the GCC 2015 to which it mainly applies.

C1.2.2 CONTRACT DATA

C1.2.2.1 DATA TO BE PROVIDED BY THE EMPLOYER

1.1.1.13 The **Defects Liability Period**, from the date of the Certificate of Completion, is **10 Years**.

1.1.1.14 The **time for achieving Practical Completion**, will be defined upon issue of respective orders as and when issued by the Employer within the contract period of 36 months.

The period as stated in 5.3.2, and the 7 days referred to in 5.3.3, are included in the above time for achieving Practical Completion. The special non-working days as stated in 5.8.1 are excluded from the above time for achieving Practical Completion.

1.1.1.15 The Employer is the eThekwini Municipality as represented by:
Deputy Head: **HV Operations**

1.2.1.2 The address of the Employer is:
Physical: Electricity Unit, 1 Jelf Taylor Crescent, DURBAN, 4001
Postal: Electricity Unit, 1 Jelf Taylor Crescent, DURBAN, 4001
Telephone: 031-311-9006 (t)
Fax: 031-311-9556 (f)
E-Mail: veer.ramnarain@durban.gov.za

1.1.1.16 The **name of the Employer's Agent** is
1.2.1.2 The address of the Employer' Agent is:
Physical: Electricity Unit, 1 Jelf Taylor Crescent, DURBAN, 4001
Postal: Electricity Unit, 1 Jelf Taylor Crescent, DURBAN, 4001
Telephone: 031-311-9290 (t)
Fax: 031-311-9556 (f)
E-Mail: Wilson.Mbhele@durban.gov.za

1.1.1.26 The **Pricing Strategy** is by **Re-measurement Contract**.

3.2.3 The Employer's Agent shall obtain the **specific approval of the Employer** before executing any of his functions or duties according to the following Clauses of the General Conditions of Contract:

- 6.3: Council approval in order to authorise any expenditure in excess of the Tender Sum plus **20%** contingencies.

4.11.1 To carry out and complete the works, the Contractor shall employ a competent Project Manager, Professional Design Engineer, FAT Engineer, Site Engineer, Quality Control Officer, and Site Supervisor as part of the key staff. It is a requirement for the Project Manager, Professional Design Engineer, FAT Engineer, Site Engineer, Quality Control Officer, and Site Supervisor to each have a minimum of 3 years relevant experience including experience on projects of a similar nature. The CV's of the Project Manager, Professional Design Engineer, FAT Engineer, Site Engineer, Quality Control Officer, and Site Supervisor should be submitted to the Employer's Agent's Representative for acceptance by the Department (reference is made to Cl.5.3.1 of the Contract Data).

Note:

i) "similar nature" implies projects that were of a value of at least 70% of this tender's value, and had a comparable Scope of Work in terms of technical requirements and operations.

ii) "experience" implies experience on projects of a similar nature.

iii) "accredited degree / diploma" implies a minimum 3-year qualification within the built environment, from a registered University or Institute of Technology.

5.3.1 The **documentation required** before commencement with Works execution are:

- Health and Safety Plan (refer to Clause 4.3)
- Initial Programme (refer to Clause 5.6)
- Security (refer to Clause 6.2)
- Insurance (refer to Clause 8.6)
- CV(s) of Key Site Staff (refer to Clause 4.11.1)
- CPG Implementation Plan (if applicable)

5.3.2 The **time to submit the documentation** required before commencement with Works is **21 Days**.

5.3.3 Add the following paragraph:

"If a construction work permit, in terms of Clause 3(1) of the Construction Regulations (2014), is applicable, the instruction to commence carrying out of the works may only be issued once the construction work permit has been obtained by the Employer's Agent. If a construction work permit is applicable, the contractor shall allow for a minimum period of 37 days, after the submission (or re-submission) of the documentation referred to in Clause 5.3.1., for the issuing of the construction work permit."

5.4.2 The access and possession of Site shall not be exclusive to the Contractor.

5.8.1 The **non-working days** are **Saturdays and** Sundays.

(5.1.1) The **special non-working** days are:

- All statutory holidays as declared by National or Regional Government.
- The year-end break:
  - Commencing on the first working day after 15 December.
  - Work resumes on the first working day after 5 January of the next year.

5.8.1 Delete the words "sunset and sunrise" and replace with "17:00 and 07:00".

5.13.1 The **penalty for delay** in failing to complete the Works is R 2 000 (per Day).

5.14.1 The **requirements for achieving Practical Completion** will be determined by the Employer's Agent (in consultation with the Contractor) and recorded in the minutes of the first Site Meeting / Handover Meeting. (Refer to 1.1.1.24 for a generic definition.) The requirements are to be regularly reviewed with respect to any variations to the Contract.

5.16.3 The **latent defect liability** period is **10 Years**.

6.2.1 **Security (Performance Guarantee)**: Delete the word "selected" and replace it with "stated".

The liability of the Performance Guarantee shall be as per the following table:

Value of Contract (incl. VAT)	Performance Guarantee Required
Less than or equal to R 1m	Nil
Greater than R 1m and less than or equal to R 10m	5% of the Contract Sum
Greater than R 10m	10% of the Contract Sum

6.10.1.5 The **percentage advance** on materials (comprising of complete billable units as per items in the Bill of Quantities) not yet built into the Permanent Works, but manufactured and delivered to site and inspected by the Employer's Agent or duly appointed Representative is: **90%**.

The **percentage advance** on Plant not yet manufactured and not delivered to site: **0%.**

6.10.3 **Retention Money:** The percentage retention on the amounts due to the Contractor is 10%. The limit of "retention money" is 10% of the material price. Interest will not be paid on retention withheld by the Employer. No bonds will be accepted in lieu of this retention.

8.6.1.1.2 The **value of Plant and materials** supplied by the Employer to be included in the insurance sum: **Not Required**.

8.6.1.1.3 The **amount to cover professional fees** for repairing damage and loss to be included in the insurance sum: **R 3 000 000**.

8.6.1.2 **SASRIA Coupon Policy** for Special Risks to be issued in joint names of Council and Contractor for the full value of the works (including VAT).

8.6.1.3 The limit of indemnity for **liability insurance**: **R 10 000 000**.

8.6.1.5 Furthermore, the insurance cover effected by the Contractor shall meet the following requirements:

Third Party Insurance (Public Liability)

- Minimum amount for any one occurrence, unlimited as to the number of occurrences, for the period of the contract, inclusive of the maintenance period: **R 3 000 000**.
- Consequential loss to be covered by policy: **No**
- Liability section of policy to be extended to cover blasting: **Nil**.
- Maximum excess per claim or series of claims arising out of any one occurrence: **R 40 000**.

Principal's own surrounding Property Insurance

- Minimum amount for any one occurrence unlimited as to the number of occurrences against any claim for damage which may occur to the Council's own surrounding property: **R 5 000 000**.
- Maximum first excess: **R 20 000**.

Insurance of Works

- Minimum amount for additional removal of debris (no damage): **Nil**.

- Minimum amount for temporary storage of materials off site, excluding Contractor's own premises: As per value of materials for each substation order.
- Minimum amount for transit of materials to site: As per value of materials for each substation order.

8.6.5 **Approval by Employer**: At the end of the sub-clause, add the following paragraph:

"Except where otherwise provided in the Special Conditions of Contract, the insurance cover effected by the Contractor in terms of this clause shall not carry a first loss amount greater than those set out below:

Contract Price	First Loss
Less than R 100,000	R 5,000
R 100,000 to R 500,000	R 10,000
R 500,000 to R 1,000,000	R 20,000
R 1,000,000 to R 2,000,000	R 30,000
R 2,000,000 to R 4,000,000	R 40,000
Greater than R 4,000,000	R 50,000

The insurance policy shall contain a specific provision whereby cancellation of the policy prior to the end of the period referred to in Cause 8.2.1 cannot take place without the prior written approval of the Employer."

10.7.1 Failing ad-hoc adjudication, the determination of disputes shall be by arbitration.

C1.2.2.2 DATA TO BE PROVIDED BY CONTRACTOR

1.1.1.9 The legal name of Contractor is:

……

……

……

……

1.2.1.2 The Physical address of the Contractor is:

……

……

……

……

The Postal address of the Contractor is:

……

……

……

……

The contact numbers of the Contractor are:

Telephone: ……

Fax: ……

The E-Mail address of the Contractor is:

……

C1.2.3 ADDITIONAL CONDITIONS OF CONTRACT

C1.2.3.3 CONTRACTOR PARTICIPATION GOAL (CPG)

It is a condition of contract that the contractor must allow for a minimum of **6%** of the labour portion (installation) of the contract value (excluding PC Sum items and Fixed Cost allowances) to be subcontracted to contractors who are **>51% PPG** (Priority Population Group) owned. Proof of payment to the subcontractors will be required to verify that the minimum has been achieved.

The penalty for not achieving the specified CPG will be 0.5% of the contract value (excluding PC Sum items and Fixed Cost allowances) for every 1% of CPG not achieved**.**

C1.2.3.4 FTE (Full Time Equivalent) EMPLOYMENT INFORMATION

It is a condition of contract that the Contractor supplies the Employer's Agent's Representative with information in respect of the employment of all foremen, artisans and labour (skilled and unskilled) employed to work on this contract. The information required is:

- Initials (per ID doc)
- Last Name (per ID doc)
- ID Number
- Disability (y / n)
- Education Level

Level 1 Unknown	**Level 2** No Schooling	**Level 3** Grade 1-3	**Level 4** Grade 4	**Level 5** Grade 5-6
Level 6 Grade 7-8	**Level 7** Grade 9	**Level 8** Grade 10-11	**Level 9** Grade 12	**Level 10** Post Matric

- Category of Employment

Category A: Employed as Local Labour for this contract only
Category B: Temporarily employed by the Contractor
Category C: Permanently employed by the Contractor

In addition, the following information is required in respect of each person listed above, on a monthly basis:

- Number of days worked during the month;
- Daily wage rate;
- Number of training days during the month.

The information is to be forwarded in a format acceptable to the Employer's Agent's Representative, but preferably in the form of an emailed EXCEL file (an original file, to be used as a template, will be issued to the Contractor). Contractors without computer facilities will be required to submit a hard copy of the information in a format as agreed to between the Contractor and the Employer's Agent's Representative.

In addition to the tax invoice, to be submitted by the Contractor with his monthly statement, mentioned in Clause 6.10.4 of GCC 2015, the Employer reserves the right to withhold payment until the monthly FTE information has been forwarded to the Employer's Agent's Representative. No additional payment for complying with the above will be made and the Contractor is to make allowance for complying through the time related P & G items (sum) under Part AA: Preliminaries, of the Bill of Quantities.

C1.2.3.5 PERFORMANCE MONITORING OF SERVICE PROVIDERS

[For contract awards over R10m] The Contractor shall be subjected to "Performance Monitoring" assessments in terms of the applicable Section (S.53) of the Employer's Supply Chain Management Policy.

Key Performance Indicators (KPIs) are specified in the C3: Scope of Works, or will be discussed and agreed with the Contractor before commencement of the contract.

C1.2.3.6 EXCEPTED RISKS (Clause 8.3)

Pursuant to Clause 8.3 of the Conditions of Contract (GCC 2015), the Employer shall not be liable for the payment of standing time costs as a result of the occurrence of any of the "Excepted Risks" as defined under Clause 8.3.

However, the Employer shall reimburse the Contractor in respect of plant de-establishment and re-establishment costs as a result of "Excepted risks" when a written instruction to de-establish is issued to the Contractor.

C1.2.3.7 DURATION OF RESPONSIBILITY OF THE CONTRACTOR

The Contractor shall be entirely responsible for the security and safe keeping of all the plant and equipment supplied on the contract up until the date of the Handing Over Certificate. Thereafter the Contractor's responsibilities will be restricted to fulfilling the conditions necessary for the issue of a Completion Certificate as well as the obligations in terms of the Guarantee/Warranty subject to any qualifications stated in the Handing Over Certificate.

The dates of the various stages of acceptance by the Municipality of the works will be recorded on certificates signed by the Engineer and these dates will take precedence over any previously agreed or accepted dates for the purpose of administration of the contract. Copies of the certificates will be sent to the Contractor who will sign the certificates.

C1.2.3.8 HANDING OVER CERTIFICATES

Handing Over Certificates will record the date on which all or any part of the plant and equipment supplied on this contract is handed over by the Contractor to the Employer in a safe and satisfactory condition for energising and commercial operation irrespective of whether or not such plant and equipment is complete in every detail as called for in the specification. The Handing Over Certificate may be issued in advance of the Certificate of Completion and on any one contract more than one Handing Over Certificate may be issued.

C1.2.3.9 COMPLETION CERTIFICATE

A completion certificate shall record the date on which the Contractor has fulfilled their obligation to supply, deliver, erect and test all the equipment called for in the specification to the satisfaction of the Engineer. This will be the date of the commencement of the guarantee / warranty and maintenance periods.

C1.2.3.10 HANDLING FEE ON MATERIALS OR SERVICES REQUIRED BUT NOT LISTED IN THE BILL OF QUANTITIES

There shall be a handling fee paid to the Contractor for any form of variation services or materials required by the Engineer that is to be undertaken by a sub-contractor.

On values ≤ R100 000,00 the handling fee shall not exceed 10%
On values between R100 000,00 and R200 000,00 the handling fee shall not exceed 7.5%
On values ≥ R200 000,00 the handling fee shall not exceed 5%

The variation order shall be approved by the Engineer and issued to the Contractor in writing before any work is undertaken or materials supplied.

C1.2.3.11 OVERTIME

Under certain conditions the Contractor shall be required to work outside of normal working hours (weekends, public holidays and 18h00 to 06h00 on weekdays).

Before any work is undertaken outside of normal working hours, the Contractor shall obtain permission from the Engineer in writing.

The Contractor shall be reimbursed for the hours worked at the hourly labour rates submitted in the bill of quantities. The hourly rate of pay for each member of staff on duty shall be 0.5 times the unit labour rate for weekday night work and Saturdays and the full unit labour rate for work on Sundays and Public holidays.

The type and number of labour resources required shall be approved by the Engineer prior to commencement of the work.

C1.2.3.12 SUPERVISION IN LIVE SUBSTATIONS

For each team working in a live substation, the Contractor shall ensure that at least one of the team or a supervisor completes the eThekwini Safety Rules training programme to become competent to enter and work within substations. Upon passing a two-day Safety Rules course the candidates will be required to compile a portfolio of evidence for a period of 3 months and thereafter undergo a site assessment. After successfully completing the site assessment the candidate will receive a card for access into substations. No work within a live substation will be permitted without the presence of such competent person. The cost of the training shall be borne by the Contractor and shall be undertaken within 3 months of the contract award. The cost of the course is currently R 1000 and is subject to change without consultation.

C1.2.3.13 NATIONAL KEY POINTS (NKPs)

EThekwini Municipality has substations which are protected by the NKP Act and compliance with the Act and associated regulations is compulsory. Access to such sites shall be as per the requirements of the Act and this shall apply to all entering the sites regardless of the reason for entry or affiliation.

C2.1: PRICING ASSUMPTIONS / INSTRUCTIONS

C2.1.1 GENERAL

The Bill of Quantities forms part of the Contract Documents and must be read and priced in conjunction with all the other documents comprising the Contract Documents (refer to F.1.2 of the Tender Data).

C2.1.2 PRICING INSTRUCTIONS AND DESCRIPTION OF ITEMS IN THE SCHEDULE

The quantities given in the Bill of Quantities are estimates only, and subject to re-measuring during the execution of the work. The Contractor shall obtain the Employer's Agent's detailed instructions for all work before ordering any materials or executing work or making arrangements for it.

The Works as finally completed in accordance with the Contract shall be measured and paid for as specified in the Bill of Quantities and in accordance with the General and Special Conditions of Contract, the Specifications and Project Specifications and the Drawings. Unless otherwise stated, items are measured net in accordance with the Drawings, and no allowance has been made for waste.

The validity of the contract will in no way be affected by differences between the quantities in the Bill of Quantities and the quantities finally certified for payment.

C2.1.3 QUANTITIES REFLECTED IN THE SCHEDULE

The prices and rates to be inserted by the Tenderer in the Bill of Quantities shall be the full inclusive prices to be paid by the Employer for the work described under the several items, and shall include full compensation for all costs and expenses that may be required in and for the completion and maintenance during the defects liability period of all the work described and as shown on the drawings as well as all overheads, profits, incidentals and the cost of all general risks, liabilities and obligations set forth or implied in the documents on which the Tender is based.

C2.1.4 Each item shall be priced and extended to the "Total" column by the Tenderer, with the exception of the items for which only rates are required (Rate Only). If the Contractor omits to price any items in the Bill of Quantities, then these items will be considered to have a nil rate or price.

C2.1.5 All items for which terminology such as "inclusive" or "not applicable" have been added by the Tenderer will be regarded as having a nil rate which shall be valid irrespective of any change in quantities during the execution of the Contract.

C2.1.6 All rates and amounts quoted in the Bill of Quantities shall be in Rands and Cents and shall include all levies and taxes (other than VAT). VAT will be added in the Summary of the Bill of Quantities.

C2.1.7 "Rate Only" items:

The Tenderer shall fill in rates for all items where the words "Rate Only" appear in the "Total" column. "Rate Only" items have been included where:

(a) an alternative item or material is contemplated;

(b) variations of specified components in the make-up of a pay item may be expected; and

(c) no work under the item is foreseen at tender stage but the possibility that such work may be required is not excluded.

For "Rate Only" items no quantities are given in the "Quantity" column but the quoted rate shall apply in the event of work under this item being required. The Tenderer shall however note that in terms of the Tender Data the Tenderer may be asked to reconsider any such rates which the Employer may regard as unbalanced.

C2.1.8 The items described in "Outline Description" shall include all the accessories in terms of the Technical Specification, i.e. grouting bolts, fixing bolts, terminal connecting clamps, etc.

C2.1.9 The installation work described in "Outline Description" shall include all work necessary for the successful completion of the installation as detailed in the Technical Specification and Section C3.2 (System Parameters and Particulars of Equipment Required).

C2.1.10 The Tenderer shall not adjust any of the estimated quantities in Column 4 of the Bill of Quantities.

C2.1.11 All site establishment and Preliminary and General Contractor's expenses incurred in complying with the requirements of the tender document shall be included in the equipment installation rates.

C2.1.12 Where existing switchgear is being replaced the new switchgear may be required to be installed in phases, due to network constraints.

C2.1.13 Secondary cables, glands, lugs, ferrules, tape etc. may be supplied as part of this Contract. Secondary cables are re-measurable on site and will only be paid for the amount of secondary cables used. The contractor shall be responsible for managing the cable orders and excess for each project accordingly.

C2.1.14 Labour rates shall be used only for additional work and shall be upon approval by the Engineer.

C2.1.15 It is a condition of payment by the Municipality to registered VAT vendors that no payment for goods/services supplied shall be processed unless a tax invoice (complying with the requirements of Section 20 of the Value-Added Tax Act, 1991) is received from the supplier.

C2.1.16 Payment for Materials shall be made as follows:

1) 90% of the material price on delivery to site
2) 10% of the material price one month after the date of Handing Over
3) Delivery, erection and testing costs shall be paid for as the work proceeds and as certified by the Engineer's representative.

C2.1.17 Rate of Exchange:

Where the goods are imported the Contractor shall within seven days of date of Official Purchase Order, arrange through his bankers for the foreign commitment to be covered forward down to the Rand in order to fix the rate of exchange. The Contractor shall ensure that the forward cover is directly arranged with a reputable bank and not any other internal arrangement. The Contractor shall notify the Municipality as soon as possible thereafter regarding the rate which has been fixed on such forward exchange. The forward cover shall be from a reputable South African bank. The Contractor is to confirm with the employer prior to placing forward cover if the service provider is acceptable.

Where the contract is for the supply of an indefinite quantity of goods/services over a fixed period, the requirement to arrange forward cover in respect of variations in the rate of exchange within 7 days shall be applied to the notification of each order rather than notification of acceptance of tender. Any increase or decrease between the basic rate of exchange as at 12:00 on the date of advertisement of the bid and that existing at the date of establishment of the forward exchange cover within the period stipulated above shall be paid or deducted by the Municipality. Upon the failure of the Contractor to arrange forward exchange cover, the Contractor shall be liable should there be an increase in the basic rate of exchange occurring after the last mentioned date.

The bank charges incurred in obtaining the forward exchange cover shall be for the Municipality's account.

The Contractor shall on request:

(i) submit documentary proof of the exchange,

(ii) when an adjustment is claimed in terms of this sub-clause, whether by the Contractor or the Municipality, submit documentary proof to the satisfaction of the Municipality in respect of such claim.

C2.1.18 Freight, Duty, Landing Charges:

Where the Goods or Materials to be supplied have to be imported, the bidder shall, notwithstanding anything to the contrary contained in the General Conditions of Contract, base their tender on the duty and landing charges ruling as at the date fourteen days prior to the closing date of tenders and tenderers shall state such freight rates, duty and landing charges in the Bid. No claim by the Contractor for an adjustment will be entertained unless the details required by this Clause are included with their bid.

Where freight rates actually paid by the Contractor are higher or lower than the rates upon which the contract price was based then any difference between the freight rates upon which the tender was based and the freight rates actually paid by the Contractor shall be paid or deducted by the Municipality, as the case may be.

Where the rates of duty or landing charges are varied between the date of bid and the date of clearing, any increase or decrease in the rates ruling at the date of tender, shall be paid or deducted by the Municipality.

The Contractor shall on request:

(i) submit documentary proof of the freight rates, duty and landing charges paid by him and,

(ii) when an adjustment is claimed in terms of this sub-clause, whether by the Contractor or the Municipality, submit documentary proof to the satisfaction of the Municipality in respect of such claim.

C2.1.19 Contract Price Adjustment:

This clause shall take precedence over all other clauses with respect to price adjustments. Should the bid prices be subject to contract price adjustments during the contract, such as for labour and for raw materials, the bid shall include details for calculating above adjustments in accordance with an industrially recognised contract price adjustment formula, such as that of Steel and Engineering Industries Federation of South Africa (SEIFSA).

a) Where SEIFSA indices cannot be applied, bidders shall submit details of alternative formulae for approval.

b) Where SEIFSA indices are used, the base indices shall be those published one month prior to month of bid closing.

c) Where the base index is defined as that last published, the date of the index shall not be more than four months prior to the month of bid closing.

d) Adjustments for Supply and Delivery shall be based on the index at least two months prior to the date the goods are ready for despatch in the case of the Consumer Price Index, Material or Labour adjustments and at least four months prior to despatch in the case of copper price adjustment.

e) Adjustments for Site Erection shall be based on the index for the month which is one month prior to the contractual completion of erection.

f) The calculation of contract price adjustment shall not be applied to more than 90% of the contract value.

g) Price adjustment claims shall be submitted within 120 days from date of each delivery or service and shall be accompanied by calculations showing how the adjustments were arrived at. Claims submitted after the stipulated 120 days will not be considered.

C2.1.20 Number of Contractors & Order Quantities:

Bidders shall not bind the Employer to any minimum quantity within this Contract. The successful Bidder shall be bound to supply whatever quantities the Employer may actually require during the period of the contract, irrespective of the extent to which the total quantities ordered may be in excess of or below the estimated quantity for the period of performance described in the Contract Data.

We can award to multiple Contractors in the interest of the Municipality.

C2.1.21 Address for Springfield Depot (within a 35 km radius):

Springfield Depot
11 Electron Road,
Springfield,
Durban,
4051

C2.2: BILL OF QUANTITIES

SECTION 1A: SUPPLY, INSTALLATION AND TESTING OF 275/132 kV POWER TRANSFORMERS AND ASSOCIATED EQUIPMENT

		1	2	3	4		5	6
Item	Description	Unit Supply Price Excl. VAT R	Unit Delivery Price Excl. VAT R	Unit Installation and site Testing Price Excl. VAT R	Estimated Quantity	Unit	Total Supply And Delivery Price Excl. Vat Cols. ((1 + x2) 4) R	Total Installation & Site Testing Price Excl. Vat Cols. (3 x4) R
1	275/132 kV, 315 MVA power transformer as described in Schedule C3.1				2	each		
2	On-line eight (8) gas DGA monitor				2	each		
3	Transformer operating temperature monitor				2	each		
4	On-load tap changer (OLTC) monitor				2	each		
5	Cooling group control monitor				2	each		
6	Bushing monitor				2	each		
7	Partial Discharge monitor and diagnosis				2	each		
8	Indoor Tap Change Control Panel, complete				2	each		
9	275/1315				2	each		
10	Maintenance free breather for 275/132 kV, 315MVA, power transformer				2	each		
35	Thermally upgraded paper for 275/132 kV, 315 MVA, power transformers as described in Schedule C3.1				2	each		
12	Fibre optic winding temperature sensors for 275/132kV, 315 MVA power transformer as described in Schedule C3.1				2	each		
13	Disassemble existing 30 MVA, 132/11 kV power transformer and move all the components to the spare bay				1	each		
14	Disassembling, loading, transporting and off-loading of existing 30 MVA, 132/11 kV power transformer within a 30 km radius				1	each		

		1	2	3	4		5	6
Item	Description	Unit Supply Price Excl. VAT R	Unit Delivery Price Excl. VAT R	Unit Installation and site Testing Price Excl. VAT R	Estimated Quantity	Unit	Total Supply And Delivery Price Excl. Vat Cols. ((1 + x2) 4) R	Total Installation & Site Testing Price Excl. Vat Cols. (3 x4) R
SUB-TOTAL FOR SUPPLY AND DELIVERY OF 275/132 kV POWER TRANSFORMERS								
SUB-TOTAL FOR ERECTION AND SITE TESTING OF 275/132 kV POWER TRANSFORMERS								
TOTAL FOR SECTION 1A								

SECTION 1B: SPECIAL TYPE TESTS

		1	2		3
Item	Description	Unit Price Excl. VAT R	Estimated Quantity	Unit	Total Price Excl. Vat Cols.(1 × x2x) R
1	Impulse Type Test on transformer		1	each	
2	Short-circuit type test on 275/132 kV 315 MVA power transformer		1	each	
3	Temperature Rise Type Test on transformer		1	each	
4	Sound Level Measurement Type Test on transformer		1	each	

SUB-TOTAL FOR SPECIAL TYPE TESTS CARRIED FORWARD (SECTION 1B)	

SECTION 1C: SPARES

The following spares shall be ordered as required at the discretion of the Engineer

		1	2	3		4
Item	**Description**	**Unit Supply Price Excl. VAT** **R**	**Unit Delivery Price Excl. VAT** **R**	**Estimated Quantity**	**Unit**	**Total Supply And Delivery Price Excl. Vat Cols.((1 + 2) x3)** **R**
1	275 kV RIP Bushing			1	each	
2	132 kV RIP Bushing			1	each	
3	Bushing for HV neutral of 275/132 kV 315 MVA power transformer			1	each	
4	Bushing for LV neutral of 275/132 kV 315 MVA power transformer			1	each	
5	Cooling fan and motor for a 275/132 kV 315 MVA power transformer			1	each	
6	Three phase set of tap changer contacts for a 275/132 kV 315 MVA power transformer			1	each	
7	Tap-change drive motor for a 275/132 kV 315 MVA power transformer			1	each	
8	Additional spares which the Bidder deems necessary (Bidder to list)					

TOTAL FOR SUPPLY AND DELIVERY OF SPARES CARRIED FORWARD (SECTION 1C)	

SECTION 1D: CAPITALISATION OF LOSSES

Capitalised Losses are calculated as (**K1** x **Fe)** + (**K2** x **Cu**),
where:

Fe = Iron Loss as guaranteed in the section of **"***Guarantees and Particulars of Equipment*"; and
Cu = Copper Loss as guaranteed in the section of **"***Guarantees and Particulars of Equipment*"

		1	2	3	4	5	6	7
Item	**Description**	**No load losses as declared in the section of "*Guarantees and Particulars of Equipment*" kW**	**No load constant K1***	**Load losses as declared in the section of "*Guarantees and Particulars of Equipment*" kW**	**Full Load Constant K2****	**Capitalised Losses Per Transformer Col. ((1 x 2) + (3 x 4)) Excl. Vat R**	**Estimated Quantity**	**Total Capitalised Losses Col. (5 x6) Excl. Vat R**
1	Capitalised losses for 275/132 kV 315 MVA power transformer		123 471,24		30 867,81		2	
TOTAL FOR CAPITALISATION OF LOSSES (SECTION 1D)								

Notes: * *K1* = 8 760 × d × 100 × 100 × [((1 + (p/100))^n-1)/(n × a × p)]

** *K2* = 8 760 × d × 100 × 100 × [((1 + (p/100))^n-1)/(n × a × p)] × (LF^2)

*** a = (100/n)[(1 + (i/100))^n]

Where:

i(%)	= Average inflation rate (from 2025 to 2028) from SA Reserve Bank	= 4,5 (average)
n(yrs)	= Number of years before investment amount shall be paid back	= 20
p(%)	= Average annual increase in energy cost	= 10
d(R)	= Average energy cost rate	= 0,75
LF	= Load factor	= 0,5
8 760	= Number of hours in a year 365 days × 24 hours	
a	= Interest rate on invested amount	= 15,24

TOTAL FOR SECTION 1A	
TOTAL FOR SECTION 1B	
TOTAL FOR SECTION 1C	
TOTAL FOR SECTION 1D	

TOTAL FOR SECTION 1	

SECTION 2A: SUPPLY, DELIVERY, INSTALLATION AND TESTING OF 132/11 kV POWER TRANSFORMERS

		1	2	3	4		5	6
Item	**Description (As further outlined in section C3.1)**	**Unit Supply Price Excl. VAT R**	**Unit Delivery Price Excl. VAT R**	**Unit Installation and site Testing Price Excl. VAT R**	**Estimated Quantity**	**Unit**	**Total Supply and Delivered Price Excl. VAT Col. ((1+ 2)x4) R**	**Total Installation Price Excl. VAT Col. (3x4) R**
1	132/11 kV, 30 MVA Type 1 power transformer as described in Schedule C3.1				19	each		
2	132/11 kV, 30 MVA Type 2 power transformer as described in Schedule C3.1				2	each		
3	132/11 kV, 30 MVA Type 3 power transformer as described in Schedule C3.1				10	each		
4	132/11 kV, 30 MVA Type 4 power transformer as described in Schedule C3.1				4	each		
5	132/11 kV, 30 MVA Type 1 high impedance power transformer as described in Schedule C3.1				1	each		
6	132/11 kV, 30 MVA Type 2 high impedance power transformer as described in Schedule C3.1				1	each		
7	132/11 kV, 30 MVA Type 3 high impedance power transformer as described in Schedule C3.1				1	each		
8	132/11 kV, 30 MVA Type 4 high impedance power transformer as described in Schedule C3.1				1	each		
9	On-line single gas DGA monitor				35	each		
	Transformer operating temperature monitor				1	each		
11	On-load tap changer (OLTC) monitor				1	each		
12	Cooling group control monitor				1	each		
13	Bushing monitor				1	each		
14	Partial Discharge monitor and diagnosis				1	each		
15					2	e		

		1	2	3	4		5	6
Item	**Description (As further outlined in section C3.1)**	**Unit Supply Price Excl. VAT R**	**Unit Delivery Price Excl. VAT R**	**Unit Installation and site Testing Price Excl. VAT R**	**Estimated Quantity**	**Unit**	**Total Supply and Delivered Price Excl. VAT Col. ((1+ 2)x4) R**	**Total Installation Price Excl. VAT Col. (3x4) R**
16	ransformer Relay				1	e		
17					2			
18					1			
19					35			
2	Maintenance free breather option for 132/11 kV, 30MVA, Type 1, Type 2, Type 3 or Type 4 power transformers				35	each		
21	Thermally upgraded paper for 132/11 kV, 30 MVA Type 1, Type 2, Type 3 or Type 4 power transformers as described in Schedule C3.1				35	each		
22	Fibre optic winding temperature sensors for 132/11kV, 30 MVA Type, Type 2, Type 3 or Type 4 power transformers as described in Schedule C3.1				35	each		
2	11 kV Neutral Earthing Resistor (NER) as described in Schedule C3.1				35	each		
2	Disassemble existing 30 MVA, 132/11 kV power transformer and move all the components to the spare				1	each		
25	Disassembling, loading, transporting and off-loading of existing 30 MVA, 132/11 kV power transformer within a 30 km radius				1	each		
26	Front of ea suitable engineered (G5)to the area of 40 m^2. Place a layer of 300 mm and compact.				1	e		
TOTAL FOR SUPPLY AND DELIVERY OF POWER TRANSFORMERS								
TOTAL FOR INSTALLATION AND TESTING OF POWER TRANSFORMERS								

		1	2	3	4		5	6
Item	Description (As further outlined in section C3.1)	Unit Supply Price Excl. VAT R	Unit Delivery Price Excl. VAT R	Unit Installation and site Testing Price Excl. VAT R	Estimated Quantity	Unit	Total Supply and Delivered Price Excl. VAT Col. ((1+ 2)x4) R	Total Installation Price Excl. VAT Col. (3x4) R
TOTAL (SECTION 2A)								

SECTION 2B: SPECIAL TYPE TESTS

		1	2		3
Item	**Description (As further outlined in section C3.1)**	**Unit Price Excl. VAT R**	**Estimated Quantity**	**Unit**	**Total Price Excl. VAT Col. (1 × 2) R**
1	Impulse type test on 132/11 kV 30 MVA Type 1, Type 2, Type 3 or Type 4 power transformer		2	each	
2	Short-circuit type test on 132/11 kV 30 MVA Type 1, Type 2, Type 3 or Type 4 power transformer		1	each	
3	Temperature rise type test on 132/11 kV 30 MVA Type 1, Type 2, Type 3 or Type 4 power transformer		2	each	
4	Sound level measurement type test on any transformer		1	each	
TOTAL FOR SPECIAL TYPE TESTS (SECTION 2B)					

SECTION 2C: SPARES

The following spares shall be ordered at the discretion of the Engineer.

		1	2	3		4
Item	**Description (As further outlined in section C3.1)**	**Unit Supply Price Excl. VAT R**	**Unit Delivery Price Excl. VAT R**	**Estimated Quantity**	**Unit**	**Total Supply and Delivery Price Excl. VAT Col. ((1 + 2) × 3) R**
1	132 kV RIP bushing			1	each	
2	11 kV outdoor bushing			1	each	
3	Bushing for HV neutral of 132/11 kV 30 MVA, Type 1, Type 2, Type 3 or Type 4 power transformer			1	each	
4	Bushing for LV neutral of 132/11 kV 30 MVA, Type 1, Type 2, Type 3 or Type 4 power transformer			1	each	
5	Bushing test tap adaptor for condenser bushing (if applicable)			1	each	
6	Plug-in socket (size 3)			1	each	
7	Cable plug (size 3) for 630 mm^2 conductor and 42.2 mm OD insulation for outdoor use			1	each	
8	Cable plug (size 3) for 240 mm^2 conductor and 36 mm OD insulation for outdoor use			1	each	
9	Detachable built-on radiator bank for a 132/11 kV 30 MVA power transformer			1	each	
10	Cooling fan and motor for 132/11 kV 30 MVA, Type 1 or Type 3 power transformer			1	each	
11	Three phase set of tap-changer contacts for 132/11 kV 30 MVA, Type 1, Type 2, Type 3 or Type 4 power transformer			1	each	
12	Tap-change drive motor for 132/11 kV 30 MVA, Type 1, Type 2, Type 3 or Type 4 power transformer			1	each	
TOTAL FOR SUPPLY AND DELIVERY OF SPARES (SECTION 2C)						

SECTION 2D: CAPITALISATION OF LOSSES

		1	2	3	4	5	6	7
Item	**Outline description**	**No load losses as declared in the section of "*Guarantees and Particulars of Equipment*" kW**	**No load constant K1[1]**	**Load losses as declared in the section of "*Guarantees and Particulars of Equipment*" kW**	**Full Load Constant K2[2]**	**Capitalised Losses Per Transformer Col. ((1 × 2) + (3 × 4)) R**	**Estimated Quantity**	**Total Capitalised Losses Col. (5 × 6) R**
1	Capitalised losses for 132/11 kV 30 MVA Type 1 power transformer		123 471,24		30 867,81		19	
2	Capitalised losses for 132/11 kV 30 MVA Type 2 power transformer		123 471,24		30 867,81		2	
3	Capitalised losses for 132/11 kV 30 MVA Type 3 power transformer		123 471,24		30 867,81		10	
4	Capitalised losses for 132/11 kV 30 MVA Type 4 power transformer		123 471,24		30 867,81		4	
5	Capitalised losses for 132/11 kV 30 MVA Type 1 high impedance power transformer		123 471,24		30 867,81		1	
6	Capitalised losses for 132/11 kV 30 MVA Type 2 high impedance power transformer		123 471,24		30 867,81		1	
7	Capitalised losses for 132/11 kV 30 MVA Type 3 high impedance power transformer		123 471,24		30 867,81		1	
8	Capitalised losses for 132/11 kV 30 MVA Type 4 high impedance power transformer		123 471,24		30 867,81		1	
TOTAL FOR CAPITALISATION OF LOSSES								

Notes:

* $K1 = 8\,760 \times d \times 100 \times 100 \times [((1 + (p/100))^{n-1})/(n \times a \times p)]$

** $K2 = 8\,760 \times d \times 100 \times 100 \times [((1 + (p/100))^{n-1})/(n \times a \times p)] \times (LF^2)$

*** $a = (100/n)[(1 + (i/100))^n]$

Where:

i(%)	= Average inflation rate (from 2025 to 2028) from SA Reserve Bank	= 4,5 (average)
n(yrs)	= Number of years before investment amount shall be paid back	= 20
p(%)	= Average annual increase in energy cost	= 10
d(R)	= Average energy cost rate	= 0,75
LF	= Load factor	= 0,5
8 760	= Number of hours in a year 365 days × 24 hours	
a	= Interest rate on invested amount	= 15,24

	TOTAL
TOTAL FOR SECTION 2A	
TOTAL FOR SECTION 2B	
TOTAL FOR SECTION 2C	
TOTAL FOR SECTION 2D	

TOTAL FOR SECTION 2	
VAT	
TOTAL CARRIED FORWARD TO FORM OF OFFER (Incl. VAT)	

SECTION 3A: SUPPLY, DELIVERY, INSTALLATION AND TESTING OF 132/33 kV AND 33/11 kV POWER TRANSFORMERS

		1	2	3	4		5	6
Item	**Description (As further outlined in section C3.1)**	**Unit Supply Price Excl. VAT R**	**Unit Delivery Price Excl. VAT R**	**Unit Installation and site Testing Price Excl. VAT R**	**Estimated Quantity**	**Unit**	**Total Supply and Delivered Price Excl. VAT Col. ((1+2)x4) R**	**Total Installation Price Excl. VAT Cols. (3x4) R**
1	132/33 kV, 50 MVA Type 1 power transformer as described in Schedule C3.1				1	each		
2	132/33 kV, 50 MVA Type 2 power transformer as described in Schedule C3.1				1	each		
3	132/33 kV, 50 MVA Type 3 power transformer as described in Schedule C3.1				1	each		
4	132/33 kV, 50 MVA Type 4 power transformer as described in Schedule C3.1				1	each		
5	33/11 kV, 25 MVA Type 1 power transformer as described in Schedule C3.1				1	each		
6	33/11 kV, 25 MVA Type 2 power transformer as described in Schedule C3.1				1	each		
7	33/11 kV, 15 MVA Type 1 power transformer as described in Schedule C3.1				1	each		
8	33/11 kV, 15 MVA Type 2 power transformer as described in Schedule C3.1				1	each		
9	On-line single gas DGA monitor				1	each		
10	Transformer operating temperature monitor				1	each		
11	On-load tap changer (OLTC) monitor				1	each		
12	Cooling group control monitor				1	each		
13	Bushing monitor				1	each		
14	Partial Discharge monitor and diagnosis				1	each		
15					1	e		
16	ransformer Relay				1	e		

		1	2	3	4		5	6
Item	**Description (As further outlined in section C3.1)**	**Unit Supply Price Excl. VAT R**	**Unit Delivery Price Excl. VAT R**	**Unit Installation and site Testing Price Excl. VAT R**	**Estimated Quantity**	**Unit**	**Total Supply and Delivered Price Excl. VAT Col. ((1+2)x4) R**	**Total Installation Price Excl. VAT Cols. (3x4) R**
17	3352 and Type 4				1	each		
19	3351, Type 2, Type 34				1			
20	Vacuum tap-changer for 33/11 kV, 25 MVA Type 1 or Type 2 power transformer				1			
21	Vacuum tap-changer for 33/11 kV, 15 MVA Type 1 or Type 2 power transformer				1			
22	Maintenance free breather option for 132/33 kV, 50MVA Type 1, power transformers				1	each		
23	Thermally upgraded paper for 132/33 kV, 50 MVA, Type 1, power transformers as described in Schedule C3.1				1	each		
24	Fibre optic winding temperature sensors for 132/33kV, 50 MVA Type 1, power transformers as described in Schedule C3.1				1	each		
25	33 kV NEC\NER\Aux Trfr (NECRT) 100 kVA as described in Schedule C3.1				1	each		
26	33 kV NEC\NER\Aux Trfr (NECRT) 200 kVA as described in Schedule C3.1				1	each		
27	33 kV Plug-in Option for 132/33 kV, 50 MVA Type 1, power transformers as described in Schedule C3.1				1	each		
28	33 kV Plug-in Option for 33/11 kV, 25 MVA Type 1 and 2 power transformers as described in Schedule C3.1				1	each		
29					1	e		

		1	2	3	4		5	6
Item	**Description (As further outlined in section C3.1)**	**Unit Supply Price Excl. VAT R**	**Unit Delivery Price Excl. VAT R**	**Unit Installation and site Testing Price Excl. VAT R**	**Estimated Quantity**	**Unit**	**Total Supply and Delivered Price Excl. VAT Col. ((1+2)x4) R**	**Total Installation Price Excl. VAT Cols. (3x4) R**
30					1	e		
31					1	e		
32	D				1	e		
33	D				1	e		
34	Front of ea suitable engineered (G5)to the area of 40 m^2. Place a layer of 300 mm and compact.				1	e		
TOTAL FOR SUPPLY AND DELIVERY OF POWER TRANSFORMERS								
TOTAL FOR INSTALLATION AND TESTING OF POWER TRANSFORMERS								
TOTAL (SECTION 3A)								

SECTION 3B: SPECIAL TYPE TESTS

		1	2		3
Item	**Description (As further outlined in section C3.1)**	**Unit Price Excl. VAT R**	**Estimated Quantity**	**Unit**	**Total Price Excl. VAT Cols. (1 × 2) R**
1	Impulse type test on 132/33 kV 50 MVA Type 1, Type 2, Type 3 or Type 4 power transformer		1	each	
2	Impulse type test on 33/11 kV 25 MVA Type 1 or Type 2 power transformer		1	each	
3	Impulse type test on 33/11 kV 15 MVA Type 1 or Type 2 power transformer		1	each	
4	Short-circuit type test on 132/33 kV 50 MVA Type 1, Type 2, Type 3 or Type 4 power transformer		1	each	
5	Short-circuit type test on 33/11 kV 25 MVA Type 1 or Type 2 power transformer		1	each	
6	Short-circuit type test on 33/11 kV 15 MVA Type 1 or Type 2 power transformer		1	each	
7	Temperature rise type test on 132/33 kV 50 MVA Type 1, Type 2, Type 3 or Type 4 power transformer		1	each	
8	Temperature rise type test on 33/11 kV 25 MVA Type 1 or Type 2 power transformer		1	each	
9	Temperature rise type test on 33/11 kV 15 MVA Type 1 or Type 2 power transformer		1	each	
10	Sound level measurement type test on any transformer		1	each	
TOTAL FOR SPECIAL TYPE TESTS (SECTION 3B)					

SECTION 3C: SPARES

The following spares shall be ordered at the discretion of the Engineer.

		1	2	3		4
Item	**Description (As further outlined in section C3.1)**	**Unit Supply Price Excl. VAT R**	**Unit Delivery Price Excl. VAT R**	**Estimated Quantity**	**Unit**	**Total Supply and Delivery Price Excl. VAT Col. ((1 + 2) × 3) R**
1	132 kV RIP bushing			1	each	
2	33 kV RIP bushing			1	each	
3	11 kV outdoor bushing			1	each	
4	Bushing for HV neutral of 132/33 kV 50 MVA, Type 1, Type 2, Type 3 or Type 4 power transformer			1	each	
5	Bushing for LV neutral of 33/11 kV 25 MVA or 15 MVA, Type 1 or Type 2 power transformer			1	each	
6	Bushing test tap adaptor for condenser bushing (if applicable)			1	each	
7	Tank wall mounted plug-in connector for 33 kV			1	each	
8	Plug-in socket (size 3)			1	each	
9	Cable plug (size 3) for 630 mm^2 conductor and 42.2 mm OD insulation for outdoor use			1	each	
10	Cable plug (size 3) for 240 mm^2 conductor and 36 mm OD insulation for outdoor use			1	each	
11	Cooling fan and motor for 132/33 kV 50 MVA, Type 1, Type 2, Type 3 or Type 4 power transformer			1	each	
12	Cooling fan and motor for 33/11 kV 25 MVA, Type 1 power transformer			1	each	
13	Cooling fan and motor for 33/11 kV 15 MVA, Type 1 power transformer			1	each	
14	Three phase set of tap-changer contacts for 132/33 kV 50 MVA, Type 1 or Type 2 power transformer			1	each	
15	Three phase set of tap-changer contacts for 33/11 kV 25 MVA, Type 1 or Type 2 power transformer			1	each	
16	Three phase set of tap-changer contacts for 33/11 kV 15 MVA, Type 1 or Type 2 power transformer			1	each	

		1	2	3		4
Item	**Description (As further outlined in section C3.1)**	**Unit Supply Price Excl. VAT R**	**Unit Delivery Price Excl. VAT R**	**Estimated Quantity**	**Unit**	**Total Supply and Delivery Price Excl. VAT Col. ((1 + 2) × 3) R**
17	Tap-change drive motor for 132/33 kV 50 MVA, Type 1, Type 2, Type 3 or Type 4 power transformer			1	each	
18	Tap-change drive motor for 33/11 kV 25 MVA, Type 1 or Type 2 power transformer			1	each	
19	Tap-change drive motor contacts for 33/11 kV 15 MVA, Type 1 or Type 2 power transformer			1	each	
TOTAL FOR SUPPLY AND DELIVERY OF SPARES (SECTION 3C)						

SECTION 3D: CAPITALISATION OF LOSSES

		1	2	3	4	5	6	7
Item	**Outline description**	**No load losses as declared in the section of "*Guarantees and Particulars of Equipment*" kW**	**No load constant K1[1]**	**Load losses as declared in the section of "*Guarantees and Particulars of Equipment*" kW**	**Full Load Constant K2[2]**	**Capitalised Losses Per Transformer Col. ((1 × 2) + (3 × 4)) R**	**Estimated Quantity**	**Total Capitalised Losses Col. (5 × 6) R**
1	Capitalised losses for 132/33 kV 50 MVA Type 1 power transformer		123 471,24		30 867,81		1	
2	Capitalised losses for 132/33 kV 50 MVA Type 2 power transformer		123 471,24		30 867,81		1	
3	Capitalised losses for 132/33 kV 50 MVA Type 3 power transformer		123 471,24		30 867,81		1	
4	Capitalised losses for 132/33 kV 50 MVA Type 4 power transformer		123 471,24		30 867,81		1	
5	Capitalised losses for 33/11 kV 25 MVA Type 1 power transformer		123 471,24		30 867,81		1	
6	Capitalised losses for 33/11 kV 25 MVA Type 2 power transformer		123 471,24		30 867,81		1	
7	Capitalised losses for 33/11 kV 15 MVA Type 1 power transformer		123 471,24		30 867,81		1	
8	Capitalised losses for 33/11 kV 15 MVA Type 2 power transformer		123 471,24		30 867,81		1	
TOTAL FOR CAPITALISATION OF LOSSES								

Notes: * $K1 = 8\,760 \times d \times 100 \times 100 \times [((1 + (p/100))^{n-1})/(n \times a \times p)]$

** $K2 = 8\,760 \times d \times 100 \times 100 \times [((1 + (p/100))^{n-1})/(n \times a \times p)] \times (LF^2)$

*** $a = (100/n)[(1 + (i/100))^n]$

Where:

i(%)	= Average inflation rate (from 2025 to 2028) from SA Reserve Bank	= 4,5 (average)
n(yrs)	= Number of years before investment amount shall be paid back	= 20
p(%)	= Average annual increase in energy cost	= 10
d(R)	= Average energy cost rate	= 0,75
LF	= Load factor	= 0,5
8 760	= Number of hours in a year 365 days × 24 hours	
a	= Interest rate on invested amount	= 15,24

	TOTAL
TOTAL FOR SECTION 3A	
TOTAL FOR SECTION 3B	
TOTAL FOR SECTION 3C	
TOTAL FOR SECTION 3D	

TOTAL FOR SECTION 3	
VAT	
TOTAL CARRIED FORWARD TO FORM OF OFFER (Incl. VAT)	

TOTAL FOR SECTION 1 (as applicable)	
TOTAL FOR SECTION 2 (as applicable)	
TOTAL FOR SECTION 3 (as applicable)	
TOTAL FOR SECTION 1, 2 & 3 (Excl. VAT) (as applicable)	
VAT	
TOTAL CARRIED FORWARD TO FORM OF OFFER (Incl. VAT) (as applicable)	

C2.3: RATE OF EXCHANGE

This page to be completed by Bidders offering goods ex import.

Base rates of exchange (As published by South African Reserve Bank at the close of business 7 days prior to bid closing – proof of rate used to be attached to bid documents)	

Item	Currency applicable	FOB price

Additional items should be scheduled on a separate page which should be signed and dated by the Bidder.

Name: ..... (Block Capitals)

Signature: ..... Date: .....

(of person authorised to sign on behalf of the Tenderer)

C2.4: CONTRACT PRICE ADJUSTMENT

This page is to be completed by bidders offering goods that are subject to contract price adjustment (CPA). A minimum of 10 % of the price tendered for each item shall be fixed and accommodated for in the adjustment formula.

Item	Indices (eg: Seifsa table C2)	Percentage contribution to price	CPA formula (min 10% of price to be fixed)

Additional items should be scheduled on a separate page which should be signed and dated by the Bidder.

Name: ..... (Block Capitals)

Signature: ..... Date: .....

(of person authorised to sign on behalf of the Tenderer)

C3.1: PROJECT DESCRIPTION AND SCOPE OF CONTRACT

C3.1.1 SYSTEM PARAMETERS AND DETAILS OF EQUIPMENT REQUIRED

INDEX

1.1 Summary of requirements:

This contract is for the supply, delivery, installation and testing of 275/132 kV, 132/33 kV, 132/11 kV and 33/11 kV power transformers and associated equipment for a fixed period of 36 months.

In this contract, up to three contractors will be appointed for the following transformers:

a) 275/132 kV transformers;
b) 132/11 kV transformers (all types); and
c) 132/33 kV and 33/11 kV (all types).

These three categories of transformers will be evaluated and awarded individually.

Individual orders for each substation project will be placed on this contract during the fixed period after contract award. “Bill of Quantities” in C2.4 refer to the estimated quantity of each item anticipated to be ordered during the 36 months of the contract. Tenders will be adjudicated using the total prices arising out of these estimated quantities. The total prices quoted on the tender form will only be used for adjudication purposes. Tenders are obliged to supply quantities regardless of being less or being in excess of the quantities shown in this tender document.

2.0 Equipment Required:

Orders will be made up of the following main elements:

Item	Description
275/132 (22) kV, 315 MVA power transformer	IEC impedance Power Transformer with 221/315 MVA ONAN/ONAF rating, tank mounted radiator, 16 step tap-changer, 275 kV and 132 kV RIP air bushings
132/33 kV, 50 MVA Type 1 power transformer	Ohmic impedance Power Transformer with 30/50 MVA ONAN/ONAF rating, tank mounted radiator, 16 step tap-changer, 132 kV RIP air bushings and 33 kV plug-in connections (as described in this tender document)
132/33 kV, 50 MVA Type 2 power transformer	Ohmic impedance Power Transformer with 30/50 MVA ONAN/ONAF rating, separate free standing radiator bank, 16 step tap-changer, 132 kV oil cable boxes and 33 kV plug-in connections (as described in this tender document)
132/33 kV, 50 MVA Type 3 power transformer	IEC impedance Power Transformer with 30/50 MVA ONAN/ONAF rating, tank mounted radiator, 16 step tap-changer, 132 kV and 33 kV RIP air bushings
132/33 kV, 50 MVA Type 4 power transformer	IEC impedance Power Transformer with 30/50 MVA ONAN/ONAF rating, separate free standing radiator bank, 16 step tap-changer, 132 kV oil cable boxes and 33 kV plug-in connections (as described in this tender document)
132/11 kV, 30 MVA Type 1 power transformer	Ohmic impedance Power Transformer with 18/30 MVA ONAN/ONAF rating, tank mounted radiator, 16 step tap-changer, 132 kV RIP air bushings and 11 kV plug-in connections (as described in this tender document)
132/11 kV, 30 MVA Type 2 power transformer	Ohmic impedance Power Transformer with 30 MVA ONAN rating, separate free standing radiator bank, 16 step tap-changer, 132 kV oil cable boxes and 11 kV plug-in connections (as described in this tender document)
132/11 kV, 30 MVA Type 3 power transformer	IEC impedance Power Transformer with 18/30 MVA ONAN/ONAF rating, tank mounted radiator, 16 step tap-changer, 132 kV RIP air bushings and 11 kV plug-in connections (as described in this tender document)
132/11 kV, 30 MVA Type 4 power transformer	IEC impedance Power Transformer with 30 MVA ONAN rating, separate free standing radiator bank, 16 step tap-changer, 132 kV oil cable boxes and 11 kV plug-in connections (as described in this tender document)
132/11 kV, 30 MVA Type 1 power transformer	High Ohmic impedance Power Transformer with 21/30 MVA ONAN/ONAF rating, tank mounted radiator, 16 step tap-changer, 132 kV RIP air bushings and 11 kV plug-in connections (as described in this tender document)
132/11 kV, 30 MVA Type 2 power transformer	High Ohmic impedance Power Transformer with 30 MVA ONAN rating, separate free standing radiator bank, 16 step tap-changer, 132 kV oil cable boxes and 11 kV plug-in connections (as described in this tender document)
132/11 kV, 30 MVA Type 3 power transformer	High IEC impedance Power Transformer with 21/30 MVA ONAN/ONAF rating, tank mounted radiator, 16 step tap-changer, 132 kV RIP air bushings and 11 kV plug-in connections (as described in this tender document)

Item	Description
132/11 kV, 30 MVA Type 4 power transformer	High IEC impedance Power Transformer with 30 MVA ONAN rating, separate free standing radiator bank, 16 step tap-changer, 132 kV oil cable boxes and 11 kV plug-in connections (as described in this tender document)
33/11 kV, 25 MVA Type 1 power transformer	Power Transformer with 15/25 MVA ONAN/ONAF rating, tank mounted radiators, 16 step tap-changer, 33 kV RIP air bushings and 11 kV plug-in connections (as described in this tender document)
33/11 kV, 25 MVA Type 2 power transformer	Power Transformer with 25 MVA ONAN rating, separate free standing radiator bank, 16 step tap-changer, 33 kV RIP air bushings and 11 kV plug- in connections (as described in this tender document)
33/11 kV, 15 MVA Type 1 power transformer	Power Transformer with 10/15 MVA ONAN/ONAF rating, tank mounted radiators, 16 step tap-changer, 33 kV RIP air bushings and 11 kV plug-in connections (as described in this tender document)
33/11 kV, 15 MVA Type 2 power transformer	Power Transformer with 15 MVA ONAN rating, separate free standing radiator bank, 16 step tap-changer, 33 kV RIP air bushings and 11 kV plug- in connections (as described in this tender document)
132 kV Oil Cable Box option for 132/33 kV, 50 MVA Type 2 and Type 4 power transformer	Supply of 132 kV Oil Cable Boxes in place of 132 kV RIP air bushings for 132/33 kV, 50 MVA Type 1 and Type 3 power transformers
132 kV Oil Cable Box option for 132/11 kV, 30 MVA Type 2 and Type 4 power transformer	Supply of 132 kV Oil Cable Boxes in place of 132 kV RIP air bushings for 132/11 kV, 30 MVA Type 1 and Type 3 power transformers
Vacuum tap-changer for a 275/132 kV, 315 MVA power transformer	16 step tap-changer with vacuum interrupters
Vacuum tap-changer for 132/33 kV, 50 MVA Type 1, Type 2, Type 3 or Type 4 power transformer	16 step tap-changer with vacuum interrupters
Vacuum tap-changer for 132/11 kV, 30 MVA Type 1, Type 2, Type 3 or Type 4 power transformer	16 step tap-changer with vacuum interrupters
Vacuum tap-changer for 33/11 kV, 25 MVA Type 1 or Type 2 power transformer	16 step tap-changer with vacuum interrupters
Vacuum tap-changer for 33/11 kV, 15 MVA Type 1 or Type 2 power transformer	16 step tap-changer with vacuum interrupters
Neutral Earthing Resistor (NER)	Oil immersed metallic neutral earthing resistor, suitable for 800 A earth fault current limiting on 132/11 kV power transformers Type 1, Type 2, Type 3 and Type 4, including support structure, hold down bolts and copper between main transformer and neutral earthing resistor.
33 kV NEC\NER\Aux Trfr (NECRT) 100 kVA	Oil immersed metallic neutral earthing compensator/ resistor, suitable for 800 A earth fault current limiting on 132/33 kV power transformers, including support structure and hold down bolts. 100 kVA Auxiliary Trfr. 33 kV connection to be cable fed or overhead.
33 kV NEC\NER\Aux Trfr (NECRT) 200 kVA	Oil immersed metallic neutral earthing compensator/ resistor, suitable for 800 A earth fault current limiting on 132/33 kV power transformers, including support structure and hold down bolts. 200 kVA Auxiliary Trfr 33 kV connection to be overhead fed.
33 kV plug-in option for 132/33 kV, 50 MVA Type 1, Type 2, Type 3 and Type 4 power transformers	Supply of 33 kV plug-in connections (as described in this tender document) for 132/33 kV, 50 MVA Type 1, Type 2, Type 3 and Type 4 power transformers' tank wall mounted (three connections per phase).
33 kV plug-in option for 33/11 kV, 25 MVA Type 1 and 2 power transformers	Supply of 33 kV plug-in connections (as described in this tender document) in place of 33 kV RIP air bushings for 33/11 kV, 25 MVA Type 1 and Type 2 power transformers.
11 kV Air Bushing Option for 33/11 kV, 25 MVA Type 1 and 2 power transformers	Supply of 11 kV Air Bushings in place of 11 kV plug-in connections (as described in this tender document) for 33/11 kV, 25 MVA Type 1 and Type 2 power transformers

Item	Description
33 kV plug-in option for 33/11 kV, 15 MVA Type 1 and Type 2 power transformers	Supply of 33 kV plug-in connections (as described in this tender document) in place of 33 kV RIP air bushings for 33/11 kV, 15 MVA Type 1 and Type 2 power transformers.
11 kV Air Bushing Option for 33/11 kV, 15 MVA Type 1 and 2 power transformers	Supply of 11 kV Air Bushings in place of 11 kV plug-in connections (as described in this tender document) for 33/11 kV, 15 MVA Type 1 and Type 2 power transformers.
Indoor Tap-change Control Panel	Indoor floor mounted tap-change control panel containing voltage regulation relay compatible with existing Eberle Reg-D schemes.
Transformer Relay Panel	Indoor floor mounted panel to accommodate all the relays for a transformer switch.

Note: Transformers supplied with plug-in connections shall also be supplied with plugs for fitting onto cables by others.

3.0 General Details:

No.	Description		Detail
3.1	Climate		Tropical with high humidity and subject to salt deposit
3.2	Altitude:		Sea Level to 1 000 m
3.3	Air temperature:	a) Maximum Peak	50°C
		b) Average	25°C
		c) Minimum	0°C
3.4	Maximum relative humidity		99%
3.5	Mean annual value of solar radiation		1,0 kW/m^2
3.6	Average total annual rainfall figure		1 000 mm
3.7	Pollution		Heavy marine and industrial
3.8	Isocratic level		3 to 5 ground flashes per km per year
3.9	Earthing Conditions:	a) 275/132 kV Transformers	Common neutral solidly earthed. One corner of Delta to be earthed externally
		b) 132/33 kV Transformers	HV neutral solidly earthed
			LV neutral to be connected through NECRT
		c) 132/11 kV Transformers	HV neutral solidly earthed
			LV neutral to be connected through NER
		d) 33/11 kV Transformers	HV neutral to be connected through NECRT
			LV neutral to be solidly earthed
3.10	Primary System Fault Level:	a) 275 kV System	40 kA for 3 seconds
		b) 132 kV System	40 kA for 3 seconds
		c) 33 kV System	31,5 kA for 3 seconds
3.11	Construction supply available		Yes
3.12	Construction supply voltage		400/230 V

4.0 Auxiliary Supplies

4.1	AC supplies to auxiliaries:	a) Voltage	400/230 Volt
		b) Phases	3 Phase 4 Wire
		c) Frequency	50 Hz
4.2	Secondary wiring marshalling cabinet and control cabinet provided with glands suitable for:		600/1 000 V multi-core SWA PVC cables. Quantity as required.
4.3	Tap-change Control Voltage		110 or 220 V d.c. or a.c., as specified at time of order

5.0 Fittings (Main Transformer)

5.1	Conservator tank, segregated for main tank and tap-changer tank and includes a bladder
5.2	Dial-type oil gauge with low oil level alarm contacts
5.3	Air breather (Silica gel)
5.4	Explosion vent (with contacts)
5.5	Buchholz Relay (with trip and alarm contacts)
5.6	Tap-changer Surge Relay or approved relief device (with trip contacts)
5.7	Winding temperature indicator (with trip and alarm contacts and cooler control contacts)
5.8	Oil temperature indicator (with trip and alarm contacts)

5.9	Drain Valve
5.10	Drain plug
5.11	Sampling Valve
5.12	Oil filtration connections (50 mm ID flanged)
5.13	Rating and diagram plates
5.14	Earthing terminals
5.15	Lifting lugs
5.16	Jacking pads
5.17	Combined anti-corrosion and anti-vibration padding
5.18	Vacuum connection flange
5.19	Thermometer pockets
5.20	Cooling plant

6.0 Protection Current Transformers:

a) Provision shall be made for the termination of all CTs, including the HV, HV neutral CTs and LV neutral CTs, in the transformer marshalling kiosk.

b) All spare CTs (if any) must be shorted in the marshalling kiosk by terminal block bridging links.

TYPE	LOCATION	CORE	PROTECTION FUNCTION	No of CTs	RATIO	CLASS	BURDEN (VA)
275/132/ (22) kV 315 MVA	275 kV Bushing	1	Restricted E/F Main 1	3	1 600/1	X	-
		2	Spare	3	1 600/1	X	-
		3	Transformer Differential	3	768/2,89	X	-
		4	Spare	3	1 600/1	X	-
		5	Restricted E/F Main 2	3	1 600/1	X	-
		6A	WTI				
		6B	WTI				As requir
		6C	T.C.O.C Blocking	1	660/1	10P10	15
	HV Neutral	1	Restricted E/F Main 1	1	1 600/1	X	-
		2	Restricted E/F Main 2	1	1 600/1	X	-
		3	Neutral Check/Standby Earth Fault	1	1 600/1	10P20	15
	132 kV Bushing	1	Restricted E/F Main 1	3	1 600/1	X	-
		2	Transformer Differential	3	1 600/2,89	X	-
		3	Overcurrent & Directional E/F	3	1 600/1	5P20	15
		4	Spare	3	1 600/1	X	-
		5	Restricted E/F Main 2	3	1 600/1	X	-
		6	Quality of supply/ Metering	3	1 600/1	0,2	15
		7A	Circulating current	2	1 600/1 380/1	0,5	15
		7B	Circulating current	2	1 600/1 380/1	0,5	15
		7C	WTI	1			As

c) The order of the current transformers shall be that ‘core 1’ is furthest from the winding.

d) The order of the neutral current transformers shall be that ‘core 1’ on any neutral CT shall be the core closest to the earth point.

6.1 Protection Current Transformers for a 275/132 kV Power Transformer

6.2 Protection Current Transformers for 132/33 kV, 132/11 kV and 33/11 kV Power Transformers

LOCATION	CORE	PROTECTION FUNCTION	No of CTs	RATIO	CLASS	BURDEN (VA)	MIN V_{KP} @ LOWEST RATIO (V)	MAX (m
132 kV Bushing	1	Trfr Diff	3	800/600/400/1	X	-	300	5
	2	HV REF	3	800/600//400/1	X	-	300	5
	3	Overcurrent, E/F	3	1 600/1 200/800/1	5P20	15	-	
	4	HV Cable Differential	3	1 600/1 200/800/1	X	-	600	5
	5	Spare	3	1 600/1 200/800/400/1	X	-	300	5
132 kV Neutral	1	HV REF	1	800/600/400/1	X	-	300	5

LOCATION	CORE	PROTECTION FUNCTION	No of CTs	RATIO	CLASS	BURDEN (VA)	MIN V_{KP} @ LOWEST RATIO (V)	MAX (m
	2	Neutral Check	1	800/600/400/1	X	-	300	5
33 kV Bushing	1	Metering	3	1 000/500/5	0,2	5	-	
	2	Overcurrent, E/F	3	1 800/1	X	-	450	5
	3	Line drop com	2	1 800/900/1	10P10	10	-	
	4	WTI	1	600/2	10P1,5	10	-	
33 kV Neutral	1	LV REF	1	2 500/2 000/1	X	-	450	5
	2	Standby E/F	1	800/1	5P10	15	-	
	3	Spare	1	2 500/2 000/1 600/800/1	X	-	450	5
HV Bushing	1	Trfr Diff	3	300/1	X	-	300	5
	2	HV Bus zone	3	1 600/1 200/800/400/1	X	-	400	5
	3	HV REF	3	150/1	X	-	150	5
	4	Overcurrent	3	800/400/1	5P15	10	-	
	5	Cable Diff	3	800/400/1	X	-	400	5
HV Neutral	1	HV REF	1	150/1	X	-	150	5
	2	Neutral Check	1	150/1	5P15	10	-	
LV Bushing	1	WTI	As required					
	2	Line drop com	2	1 575/5	-	10	-	
LV Neutral	1	LV REF	1	1 800/5	X	-	300	5
	2	Standby E/F 1 & 2	1	800/5	5P10	10	-	
	3	Spare	1	800/400/1	X	-	200	5
HV Bushing	1	Trfr Diff	3	500/1	X	-	150	5
	2	Spare	3	800/400/1	X	-	300	1
	3	HV REF	3	500/1	X	-	150	5
	4	Cable Diff	3	400/1	X	-	300	1
LV Bushing	1	WTI	As required					
	2	Line drop comp	2	1 312/5	-	10	-	
LV Neutral	1	LV REF	1	1 800/5	X	-	300	5
	2	Standby E/F 1 & 2	1	800/5	5P15	10	-	
	3	Spare	1	800/400/1	X	-	200	5
HV Bushing	1	Trfr Diff	3	300/1	X	-	200	5
	2	Spare	3	800/400/1	X	-	300	1
	3	HV REF	3	300/1	X	-	200	5
	4	Cable Diff	3	400/1	X	-	300	5
LV Bushing	1	WTI	As required					
	2	Line drop comp	2	787/5	-	10	-	
LV Neutral	1	LV REF	1	1 800/5	X	-	300	5
	2	Standby E/F 1 & 2	1	800/5	5P15	10	-	
	3	Spare	1	800/400/1	X	-	200	5

C3.2: GENERAL TECHNICAL SPECIFICATION

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1.0 GENERAL CLAUSES

1.1 Definitions

For the purpose of this specification the definitions in IEC 60076-1 will apply.

Tenderer
A person or company that submits a tender.

Contractor
A person or company who provides goods or services to another entity under terms specified in a contract.

Engineer
An Engineer employed by eThekwini Electricity or any of his Representatives.

1.2 General Requirements

This specification provides for the manufacture, testing before shipment, supply, delivery, off-loading, erection and pre-commission testing of transformers and associated equipment, to the requirements as set out in the following sections and attached schedules.

The transformers shall be supplied together with all ancillary equipment necessary for a complete installation.

1.3 Quality of Goods and Materials

All goods or materials called for under the enquiry for transformers shall comply with the current editions of the following Standard Specifications and Codes of Practice, except where amended herein.

Table 2 - List of standard specifications and codes of practices

No.	Description	Reference
1.3.1	International Standard of Resistance for Copper	IEC 60028
1.3.2	Rotating Electrical Machines	IEC 60034
1.3.3	Instrument Transformers Part 1: Current Transformers	IEC 60044-1
1.3.4	Current Transformers	IEC Publication 185
1.3.5	High Voltage Test Techniques	IEC 60060
1.3.6	Environmental Testing – Test Db: Damp Heat, Cyclic (12 h +	IEC 60068-2-
1.3.7	Power Transformers	IEC 60076
1.3.8	Thermal Evaluation and Classification of Electrical Insulation	IEC 60085
1.3.9	Insulating Bushings for Alternating Voltages Above 1 000 V	IEC 60137
1.3.10	On-Load Tap-changers	IEC 60214
1.3.11	Fuses	IEC 60269
1.3.12	Partial Discharge Measurement	IEC 60270
1.3.13	Fluids for electrotechnical applications - Unused Mineral Insulating Oil for Transformers and Switchgear	IEC 60296
1.3.14	Mineral Insulating Oils in Electrical Equipment - Supervision and Maintenance Guidance	IEC 60422
1.3.15	Fluids for electrotechnical applications - Unused natural esters for transformers and similar electrical equipment	IEC 62270
1.3.16	Gassing of insulating liquids under electricat stress and	IEC 60628
1.3.17	Magnetic Materials – Cold-rolled Grain-oriented Electrical Steel Strip and Sheet Delivered in the Fully-processed State	IEC 60404-8-7
1.3.18	Determination of Transformer Sound Levels	IEC 60551
1.3.19	Terminal and Tapping Marking for Power Transformers	IEC 60616
1.3.20	Cable Connections for Gas Insulated Metalclad Switchgear for Rated Voltages of 72,5 kV and above	IEC 60859
1.3.21	Determination of Polychlorinated Biphenyls (PCBs) in Mineral Insulating Oil by Packed Column Gas Chromotography (GC)	IEC 60997

No.	Description	Reference
1.3.22	Insulating Liquids – Test Method for Detection of Potentially Corrosive Sulphur in Used and Unused Insulating Oil	IEC 62535
1.3.23	Loading Guide for Oil Immersed Power Transformers	IEC 60076-7
1.3.24	Application Guide for On Load Tap Changers	IEC 60542
1.3.25	Guide to the Lightning and Switching Impulse Testing of Power Transformers	IEC 60722
1.3.26	Communication Networks and Systems in Substations	IEC 61850
1.3.27	Hot Dip Galvanized Coatings on Iron and Steel Articles	SABS ISO
1.3.28	National Colour Standards for Paint	SANS 1091
1.3.29	Busbars	SANS 1195
1.3.30	Electric Cables with Extruded Solid Dielectric Insulation for Fixed Installations	SANS 1507
1.3.31	Electric Cables - Flexible Cords and Cables	SANS 1574
1.3.32	Degrees of Protection Provided by Enclosures (IP Code)	SANS 60529
1.3.33	Standard Specification for General Purpose Sound Level	Sl.4-1983
1.3.34	Standard Test Method for Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography	ASTM D4059
1.3.35	Standard Test Method for Interfacial Tension of Oil against Water by the Ring Method	ASTM D-971
1.3.36	Standard Test Method for Determination of Gassing Characteristics of Insulating Liquids Under Thermal Stress at	ASTM D7150
1.3.37	Preparation of Steel Substrates Before Application of Paints and Related Products – Visual Assessment of Surface	ISO 8501-1
1.3.38	Preparation of Steel Substrates Before Application of Paints and Related Products	ISO 8503
1.3.39	Paints and Varnishes – Corrosion Protection of Steel Structures by Protective Paint Systems	ISO 12944-4
1.3.40	Circular Flanges - General	BS 4504
1.3.41	Radio Interference	NEMA Publication TR 1

The Tenderer will be required to submit documentary proof of its quality control process which should be consistent with the principles as specified in ISO 9000.

1.4 Erection and Supervision

Erection, including delivery to the site, off-loading and placing in position, shall be undertaken by the Contractor who shall assume full responsibility for the handing over of the transformers completely equipped, tested and ready for commissioning. EThekwini Electricity will undertake the construction of the plinths for the transformers, earthing compensators and resistors - if supplied. Erection shall include the installation of all the associated equipment.

Any damage to fittings, paintwork or any part of the equipment, incurred during transport and erection shall be made good by replacement of the damaged parts or by repairs which shall be to the satisfaction of the Engineer.

The Contractor shall provide all labour, tools, instruments and equipment required and shall provide the services of an accredited representative of the manufacturer of the transformers and tap-changing equipment and who is fully experienced in the manufacture and installation of such equipment, for supervision during the entire period of installation.

The erection price shall include the filling of the transformers with new oil and undertaking any drying-out process which may be necessary to ensure that the transformers are ready for operation, before handing over. The Contractor shall be responsible for testing the oil in the presence of the Engineer, before filling the transformers.

A supply of 400 V, 3 phase, 4 wire, 50 Hz will normally be available at a fixed point on the site for supplying the Contractor's erection tackle, tools and lighting requirements. From the point of supply

the Contractor shall provide his own wiring and equipment which shall conform to the relevant Government Regulations.

1.5 Inspection and Testing

EThekwini Electricity may require that inspection and/or testing of the goods or materials and of the complete equipment to be supplied and erected in terms of the contract, be undertaken by eThekwini Electricity's Representative or any other authority nominated by eThekwini Electricity. Tenderers shall indicate their agreement to such inspection and testing being carried out at the manufacturer's works and at the substation site.

1.6 Supervision In Live Substation

For each team working, the contractor needs to have an approved supervisor to oversee the team. The supervisor needs to complete the eThekwini training program to become competent to enter and work within high voltage substations within 3 months of contract award. The cost of this training shall be borne by the contractor.

1.7 National Key Points (NKP) Substations

EThekwini Municipality has HV substations which are protected by the NKP Act and compliance with the Act and associated regulations is compulsory. Access to such sites shall be as per the requirements of the Act and this shall apply to all entering the sites regardless of the reasons for entry or affiliation.

2.0 DESIGN DETAILS

2.1 Ratings

2.1.1 Rated Power

The transformers shall be rated as specified in the section of **"***Guarantees and Particulars of Equipment*"and shall comply in regard to temperature rise under normal and emergency overload conditions with the requirements of the appropriate standards on any tapping at the specified maximum system voltage. This applies to the ONAN rating and the full load rating with forced cooling (ONAF). The naturally-cooled rating (ONAN) of each of the main windings shall be at least 0,60 pu of the rated power of these windings. Class 2 transformers will have a 0,7 pu ONAN rating due to their high load factor.

2.1.2 Rated Current

The rated current corresponds to the rated power at rated voltage on the principal tap position. Power transformers shall have overloading capabilities in accordance with IEC 60076-7.

2.1.3 Rated Voltage

The rated voltage of each winding of the transformer on the principal tapping as specified in the section of **"***Guarantees and Particulars of Equipment*" unless otherwise stated corresponds to the system nominal voltage, Vn.

2.1.4 Impedance

The transformers shall have an ohmic impedance which shall be within the absolute extreme tolerance limits specified in the section of **"***Guarantees and Particulars of Equipment*"

The 275/132 kV, 315 MVA power transformers, 132/33 kV, 50 MVA Type 3 and Type 4 power transformers and 132/11 kV, 30 MVA Type 3 and Type 4 power transformers shall have a constant percentage impedance as per section of **"***Guarantees and Particulars of Equipment*".

The transformers shall be capable of withstanding, without damage, the effects of an external short circuit between phases and between any one phase and earth on one side of the transformer whilst the specified nominal voltage is maintained on the other side of the transformer for a period of:

a) 2 seconds if the short circuit current is greater than 20 times the rated full load current.

b) 3 seconds if the short circuit current is less than or equal to 20 times the rated full load current.

2.2 Vibration and Noise

The transformers, tap-changing equipment and supplementary cooling equipment shall operate without undue noise. The average noise levels of the transformers must not exceed values as specified in section 11.5.2 “Transformer Sound Level Measurements”.

Malthoid and unigum (specified in the section of **“***Guarantees and Particulars of Equipment*”) having the combined effect of damping vibration and preventing corrosion of the bases for transformer; radiator bank or any support structure placed on concrete shall be provided between the equipment and plinth and the edges must be suitably sealed against the ingress of moisture. These shall be to the approval of the Engineer.

2.3 Radio Interference

The design of the transformers shall be such that they will not cause any objectionable interference with communication systems in the vicinity of the transformers, either by direct radiation or by transmission through the power lines and system to which the transformers may be connected.

2.4 Internal Connections

All internal connections shall be so supported as to maintain clearance to each other and to earthed metal during transport, and under short-circuit conditions and so as to be free from vibration in normal service.

2.5 External Clearance

Adequate external electrical clearance shall be provided and care shall be taken to ensure that no fittings are located so as to interfere with the clearance to external connections to the HV and LV bushings. Due consideration shall be given to the clearance between the conservator tank and primary conductors in cases where the primary conductors cross the transformer tank. Minimum phase-to-earth clearances shall be as follows:

(a) 11 kV phase-to-earth clearance = 200 mm
(b) 33 kV phase-to-earth clearance = 430 mm
(c) 132 kV phase-to-earth clearance= 1 450 mm
(d) 275 kV phase-to-earth clearance = 2 100 mm

3.0 CONSTRUCTION DETAILS

3.1 Core

3.1.1 Design

All transformers are to be of core-form construction. Shell-form construction is not permitted, owing to lack of suitable repair facilities in South Africa.

The core shall be constructed from cold-rolled grain-oriented steel in accordance with IEC 60404-8-7. Preference is to be given to high permeability grades.

3.1.2 Materials

The core shall be manufactured of high permeability; non-ageing cold rolled grain oriented steel sheet laminations having smooth, insulated surfaces. The maximum allowable size of burrs on the slit or cut edge of the electromagnetic steel shall not be capable of causing damage to the insulation between sheets. The core shall be of mitred construction for all transformers. The core sheets shall be properly stacked in the step-lap configuration and all the insulation designed in a way that no detrimental changes in physical or electrical properties will occur during the lifetime.

3.1.3 Clamping

The core is not to be secured using through bolts. Preference shall be given to core designs which do not include any unwound flux return limbs.

Lifting lugs or other means shall be provided for convenient lifting of the core and when lifting no stress shall be imposed on any core-bolt or its insulation. Unless otherwise approved, vertical tie-rods shall be provided between top and bottom clamping structures.

3.1.4 Earthing

The main magnetic core shall be directly earthed via a bushing on top of the cover with a removable external earth connection. The core shall be bonded to the core clamping structure at one point only, which is easily accessible, and protected to allow testing after installation of the transformer.

No core earthing connection shall have a cross-sectional area smaller than 80 mm², with the exception of the connections inserted between laminations which may be reduced to a cross-sectional area of 20 mm², where they are clamped between the laminations.

The core shall be insulated from the clamping frame and the tank. The clamping frame shall also be insulated from the tank. The core and clamping frame shall each be earthed at a single point. The earth connection shall be made externally, preferably in an air-filled box on the lid or side of the tank

The core earth point shall be clearly marked with a permanent label. The factory core insulation resistance value(s) shall be permanently marked at the core earth grounding point together with **"CORE EARTH MUST ALWAYS BE CONNECTED WHEN EQUIPMENT IS ENERGISED"** and indicating the terminal identification.

The core and frame earthing shall be tested using 2 kV d.c. for 1 min as part of work test and again after installation at site.

3.1.5 Electrical Continuity

Where the core laminations are divided into sections by insulating barriers or cooling ducts parallel to the plane of the laminations, tinned copper bridging strips shall be inserted to maintain electrical continuity between sections.

3.2 Windings

3.2.1 Design

All windings shall be of circular concentric type. Use of elliptical or rectangular windings is not permitted. All the conductor joints within the winding must be minimised and are only permissible at locations on the outer surface of windings. Multiple strand joints shall only be applied in areas of low stray flux density. Shell form windings are not preferred.

3.2.2 Materials

All winding conductors shall be pure copper in accordance with IEC 60028. Use of aluminium conductors is not permitted. Continuously Transposed Conductors (CTC) shall be free from inter-strand shorts after the winding has been completed. The shear or tear strength of the bond and base of enamel/ epoxy shall not be less than 40% of the room temperature strength when heated to 125°C after curing. This requirement excludes the tertiary windings of the auto transformers made from non-CTC conductors, and there non-enamelled conductor can be used.

Where high proof stress conductors are to be used, this shall be achieved by means of work hardening and not use of silver alloy.

Where conductors of different turns are in direct mechanical contact, they shall be insulated using paper in addition to any enamel.

3.2.3 Insulation

For the purpose of controlling the oscillations in the windings, especially the regulating windings, the use of adequate metal oxide surge arresters is acceptable. Such a design must ensure that the surge arresters are clamped using a spring-loaded mechanism to ensure that they remain intact for the

expected life.

All conductor insulation shall be thermally upgraded paper. The expected life of the paper insulation is 40years and the processes implemented in the factory during the manufacturing of the transformer shall not reduce the paper life to less than 1 000 DP value. The *Contractor* shall demonstrate this for each transformer using a direct DP measurement method. The test must be done using an adequate paper sample. DP values below the indicated value will entitle the *Employer* to a compensation event.

Transformer windings and bushings shall be designed to withstand the minimum values of impulse and dielectric tests specified below:

Table 3 - Minimum values of impulse and dielectric tests

Nominal voltage (kV)	Lightning impulse voltage (kV peak)		a.c. induced voltage (kV r.m.s.)	a.c. applied voltage (kV r.m.s.)
	Line terminal	Neutral terminal		
11	95	95	22	28
22	150	150	44	50
33	200	200	66	70
132	550	110	230	38 (neutral)
275	1 050	110	460	38

indings of 132 kV and above shall have graded insulation. Windings of 33 kV and below shall have full insulation.

3.2.4 Joints and Internal Connections

Copper conductor shall be used throughout, for the windings and for the leads.

There shall be no soldered joints or terminals in the transformer. All internal lead connections shall be brazed, welded, or compression type. If compression type is used, then the method employed must be approved by the eThekwini Municipality.
No joints are permitted internal to the windings unless it involves a single strand of a multiple strand (5 or more strands) conductor. Joints shall be permitted at crossovers and leads external to the windings. The manufacturer shall have an established quality assurance program to detect, prevent and repair nicks, dents, burrs and other imperfections in the conductor material. The manufacturer shall have an established quality assurance program to ensure that all joints comply with the requirements. Use of bolted connections is permitted, but shall be minimised. Adequate precautions shall be taken against loosening of bolts in service, e.g. use of spring washers.

3.2.5 Temperature Rise

Hotspot rise above ambient of metal parts in contact with oil shall not exceed 80 K under the most extreme operating circumstance.

To avoid softening during any prolonged short-circuits, any brazing material used shall have a softening temperature of at least 250°C and preferably at least 400°C.

Adequate precautions shall be taken to ensure that the windings and the associated leads are free from partial discharge during operation at 110% of rated voltage and are capable of withstanding any transient voltages which may occur during service. These shall be subject to design review and verification by testing.

3.2.6 Hot Spot Calculations

Adequate precautions shall be taken against localised overheating of the windings or the associated leads. The temperature rise hottest spot of the current-carrying path shall not exceed 73 K over ambient temperature. The thermal design of the windings shall be subject to design review and verification by testing, including direct measurement of hot spot temperature using fibre optic sensors. At least two probes shall be installed at the hottest spot. The hottest spot shall be identified using design calculations. EThekwini Municipality reserves the right to decide on the final position of the sensors.

3.2.7 Short Circuit Withstand Capability

The transformer shall have an adequate short-circuit withstand capability in accordance with IEC 60076-5. The short-circuit withstand capability of the design shall be subject to design review. EThekwini Municipality reserves the right to carry out a short-circuit withstand test, either on a transformer or a scale model.

3.3 Tank and Parts

3.3.1 Tank Design

Transformer tanks shall be designed so as to allow the complete transformer in the tank, with oil, to be lifted by crane or jacks and transported without over straining any joints and without causing subsequent leakage of oil.

The transformer tank complete with tap-changing compartments, radiators and other fittings are to be filled, re-filled or substantially topped up with oil at site, this should be done under vacuum and that the transformer tank should therefore be capable of withstanding full vacuum.

Wherever possible, the transformer tank and its accessories shall be designed without pockets wherein gas may collect. Where pockets cannot be avoided, pipes shall be provided to vent the gas into the main expansion pipe. The vent pipes shall have a minimum inside diameter of 19 mm, except for short branch pipes which shall be 10 mm inside diameter.
All joints, other than those which may have to be broken for maintenance or transport, shall be welded. The main tank cover joint shall be welded before final test. Caulking of defective welded joints will not be permitted. Such defective joints may be re-welded subject to the written approval of the Engineer.

Corrugated tanks are not acceptable.

Tank stiffeners shall be continuously welded to the tank and tanks and fittings shall be of such a shape that water cannot collect at any point on the outside surfaces.

Guides shall be provided inside each tank for locating the core and windings centrally and no projections, which may foul the windings during lowering or withdrawing the core, are permissible.

Suitably proportioned inspection holes 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.

3.3.2 Tank Base

The base of each tank shall be suitable for sliding the transformer into final position.

Unless specifically approved, detachable under-bases shall not be used.

3.3.3 Tank Main Top Cover

The top cover of the tank shall be the welded type. The positioning of the auxiliary components and pipes on the top cover must take into considerations the need to walk on the top of the tank during maintenance activities. The top cover shall be painted with a non-slippery paint to enhance safety of personnel.

3.3.4 Radiators

All radiators shall be of unit construction so that a unit may be removed or replaced independently in the case of damage or corrosion. All radiators shall be constructed in a manner as to allow easy access to each cooler tube for repainting.

Separately mounted or detachable built-on radiators shall have lifting eyes and shall be provided with drain plugs or valves at their lowest points and vent plugs in the headers, to enable the radiator and sections to be removed without handling the oil in the transformer tank. Each radiator shall be provided with top and bottom shut-off valves and shall be detachable from the main tank. Radiators shall not be positioned over manholes, hand holes or inspection covers. Radiators shall be equipped with stainless steel type DIN 42 558 bleeding and drain plugs. Seals shall be UV, heat and oil resistant. All

oil pipe connections above 12 mm bore shall have flanged joints. The general arrangement of the coolers shall be to the Engineer's approval.
The cooling tubes/fins shall be arranged in banks to enable them to be cleaned in position. It shall be possible to remove a single bank of radiators without disturbing adjacent banks.

The fittings shall be carefully located to provide the required phase to earth air clearances allowing for all likely variations in the method of terminal connections.

3.4 Sealing of Joints

Gasketed joints shall be of the O-ring and groove type. The O-ring shall be manufactured from nitrile rubber or better. The *Contractor* shall submit details of gasket arrangement for approval. Gaskets containing asbestos are not permitted.

Approved non O-ring gaskets that need re-tightening in order to avoid oil leaks as a result of shrinkage, shall be retightened in the second 6 months of service by the *Contractor* at no extra cost to the *eThekwini Municipality*. All costs to maintain the system leak free shall be for the *Contractor*'s account during the guarantee period.

3.5 Sealing of Flanges

All flanges, bolt holes and the associated fasteners shall be sealed with a suitable flexible or semi-flexible seal to stop moisture ingress and thus prevent corrosion of the flange faces and bolt holes. The seal shall be paintable. It must be possible to remove the seal without damaging the paintwork to allow for routine maintenance which may include torqueing of bolts, replacement of leaking gasket/O-ring or opening of inspection covers.

3.6 Large Pipe Flanges

The design for large pipe flanges for indoor type units should allow for the flanges to be positioned on both the long and short sides of the tank. This will enable transformer to be fitted into smaller rooms. It will also
shorten the length of the pipes and avoid lots of bends.

3.7 Terminals

The type of terminations on the transformer shall be specified in Annexure Athe section of *"Guarantees and Particulars of Equipment"*. Primary terminals shall be either, outdoor bushings or plug-in connectors. Secondary terminals shall be plug-in connectors. Neutral and tertiary terminals shall be outdoor bushings.

All terminals shall be indelibly marked to correspond with the markings on the diagram plate. The characters shall be stamped, engraved or embossed on a corrosion resistant plate which shall be securely fixed to the tank adjacent to each terminal. Minimum information required for each bushing shall be the following:

a) Manufacturer;
b) Model;
c) Year of manufacture;
d) Serial number;
e) Rated current and voltage, including BIL;
f) Factory test data (C1 and C2 percentage power factor and capacitances); and
g) Catalogue number.

3.7.1 Outdoor Terminals

The insulation of all outdoor terminals shall be designed to withstand the minimum values of impulse and dielectric tests specified in this specification.

All bushings for nominal system voltages of 132 kV shall be of the potential controlled (capacitive) type manufactured from resin impregnated paper (RIP), with silicon rubber sheds. The outer foil shall be bonded to the bushing flange metal. The condenser type bushings shall be supplied with a test tap. Minimum acceptable creepage distances are specified below.

Table 4 - Minimum nominal creepage distances for different nominal voltages

Nominal Voltage (kV)	Unified Specific Creepage Distances 54 mm/kV (mm)
11	600
22	1 190
33	1 780
132	7 130
275	14 850

Outdoor type primary bushings shall be positioned in such a manner that where the HV busbars approach the primary bushings over the tank, assuming that the busbars are running parallel with the conservator and are horizontal, there is sufficient clearance between the conservator and the busbar closest to the conservator to satisfy the statutory safety requirements.

3.7.2 Bushing Stems

The bushing terminal stem shall have the following properties:
a) A diameter of 26 mm, where the rated line current is less than or equal to 800 A.
b) A diameter of 38 mm, where the rated line current is greater than 800 A.
c) The minimum stem length shall be 125 mm, irrespective of the line current.

The neutral bushing stem (26 mm diameter) shall be provided with a tinned or plated terminal connection clamp suitable for bolting 50 mm wide 6 mm thick flat copper bar.

3.7.3 Plug-in Type Connectors for Medium Voltage

The plug-in type connectors shall comply with drawing SP 630. This drawing is not intended to give definite dimensions but should be used as a guide to the following specific requirements:
a) The type of plug-in connector plugs shall be cone 0-in type termination for connecting the 630 mm^2 11 kV single core XLPE cables. The onus is on the transformer Contractor to ensure that the termination is compatible with the cable that is going to be used.
b) The female part will be supplied and installed by the transformer Contractor. The male part of the connector shall be free issued to the transformer Contractor by the cable supplier.
c) The sockets of the connectors shall be housed in an extension of the transformer tank in such a manner that, in service, the cables shall project at an angle of 45° from the vertical. The housing arrangement and connection to the winding shall be designed to prevent mechanical stress on the current carrying components of the connector. The extension of the transformer tanks must be designed to prevent water accumulation. The plate in which the sockets are housed shall be of a non-magnetic material.
d) The plugs of the connectors shall be suitably packaged and delivered with the transformer.
e) The transformer shall be supplied with brackets for mounting of cable support structures (to be supplied by others) as shown in drawing TD 40. This arrangement shall be to the approval of the Engineer.
f) The IEC standard that the terminations need to comply with.
g) The Contractor shall supply the type test results for the offered plug-in termination.

3.7.4 Plug-in Type Connectors for 33 kV

The plug-in type connectors shall comply with drawing SP 630. This drawing is not intended to give definite dimensions but should be used as a guide to the following specific requirements:
a) The type of plug-in connector plugs shall be cone 0-in type termination for connecting the 630 mm^2 33 kV single core XLPE cables. The onus is on the transformer Contractor to ensure that the termination is compatible with the cable that is going to be used.
b) The female part will be supplied and installed by the transformer Contractor. The male part of the connector shall be free issued to the transformer Contractor by the cable supplier.
c) The plugs of the connectors shall be suitably packaged and delivered with the transformer.
d) The transformer shall be supplied with brackets for mounting of cable support structures (to be supplied by others) as shown in drawing SP 673. This arrangement shall be to the approval of the Engineer.
e) The IEC standard that the terminations need to comply with.

f) The Contractor shall supply the type test results for the offered plug-in termination.

3.7.5 Oil Filled cable boxes for 132 kV and above

132 kV cable boxes and the limit of supply of components shall comply with IEC 60859. The cable sealing ends will be supplied and installed by the cable Contractor. The transformer Contractor will be required to liaise with the cable Contractor to ensure proper co-ordination of design of the cable box base plate, interface seals, internal connections and stress relief devices required at the interface. The responsibility to install the female cable termination (cable box base plate, interface seals, internal connections and stress relief devices) at the factory or on site shall remain with the transformer Contractor. Cable boxes shall be suitable for filling with transformer oil from the main tank conservator via individual isolating valves.

When the oil from a cable box is drained, it should not affect the oil in the main transformer tank. These shall be separated. It should be possible to disconnect the cable from the transformer with a disconnecting link situated inside the cable box. This shall be approved during the design review. The Contractor shall supply the type test results for the offered plug-in termination.

The 132 kV cable box of the transformer must be suitably designed and rated to accommodate HV cable testing. The cables may be tested with an insulation tester or cable fault locating device which may have power frequency voltages of up to 10 kV. It shall be possible to perform these tests from the cable box without oil, after removing the links.

Current transformers shall be separated from the cable box such that when oil is drained from the cable box, no CTs shall be exposed.

The transformer shall be supplied with a bracket for supporting 132 kV loop cables. The bracket shall be suitable for mounting cable cleats (to be supplied by others) as shown in drawing TD 84. This arrangement shall be to the approval of the Engineer.

3.5.58 Physical Arrangement

Unless otherwise specified, the physical arrangement shall be such that:
a) Separately mounted cooler banks shall be located as indicated during order stage.
b) The maximum overall dimensions of the transformer shall be as detailed in **Table 5.**
c) The minimum base width for all units shall be 1200 mm.

Table 5 - Maximum overall dimensions

	Description	Height (mm)	Length (mm)	Width (mm)
(a)	**275/132 kV 315 MVA Transformer:**			
	Transformer with attached radiator and conservator	8 300	12 400	7 000
	Transformer without radiator and conservator	7 330	7 000	3 060
	Footprint for transformer base	---	6 360	3 520
(b)	**132/33 kV 50 MVA Transformer:**			
	Transformer with HV and LV cable box	5 170	5 660	3 810
	Separate radiator and conservator	6 660	3 740	3 560
	Outer dimension for transformer and separate radiator and conservator	---	9 800	---
	Footprint for transformer base	---	3 320	1 400
	Footprint for separate conservator and radiator base	---	2 000	2 000
(c)	**132/11 kV 30 MVA Transformer:**			
	Transformer with attached radiator and conservator	5 500	7 800	5 000
	Transformer without radiator and conservator	4 800	6 500	5 000
	Separate conservator and radiator	6 000	5 200	4 000
	Footprint for transformer base	---	4 000	2 100
	Footprint for separate conservator and radiator base	---	2 400	2 400

A typical general arrangement of the bushings, conservator, on-load tap-changer, marshalling kiosk and cooler banks can be found in **Figure 1 (a), Figure 1 (b**) and **Figure 1 (c)**. This will be the typical

layout of each transformer, unless otherwise specified. The setup may vary, depending on the terminals that will be specified.

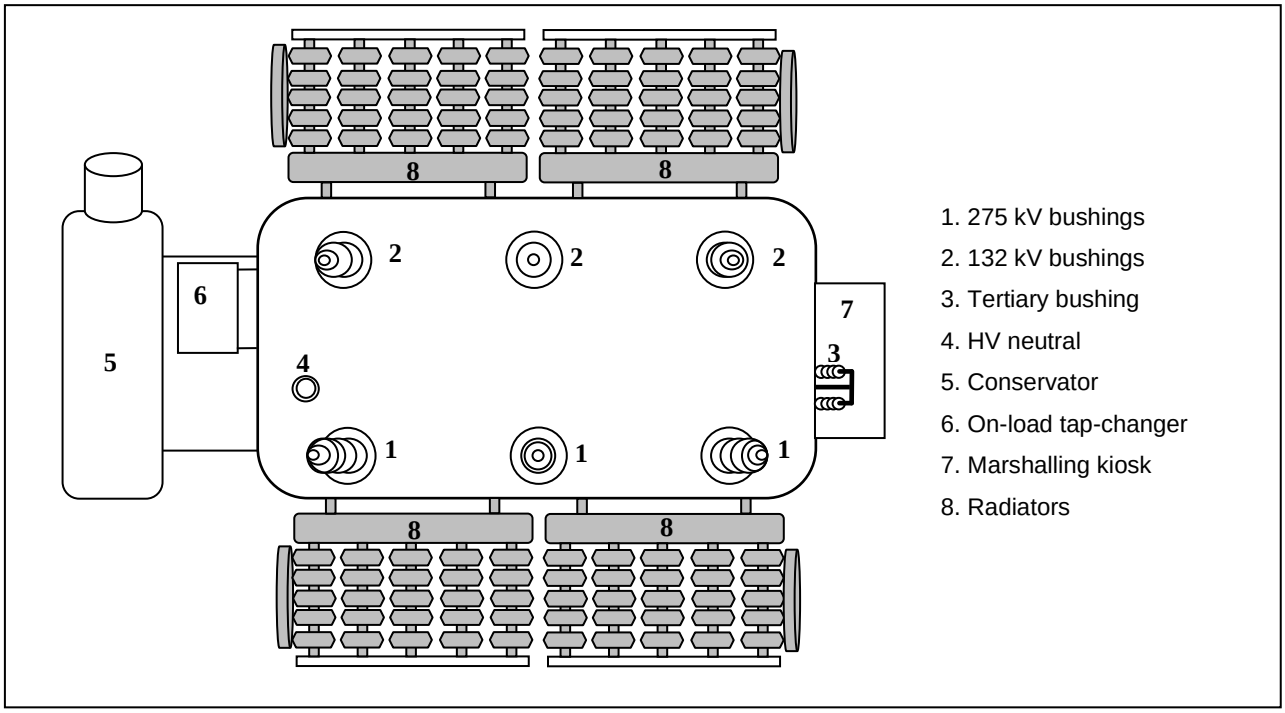

Figure 1 (a) - Typical 275/132 kV transformer layout

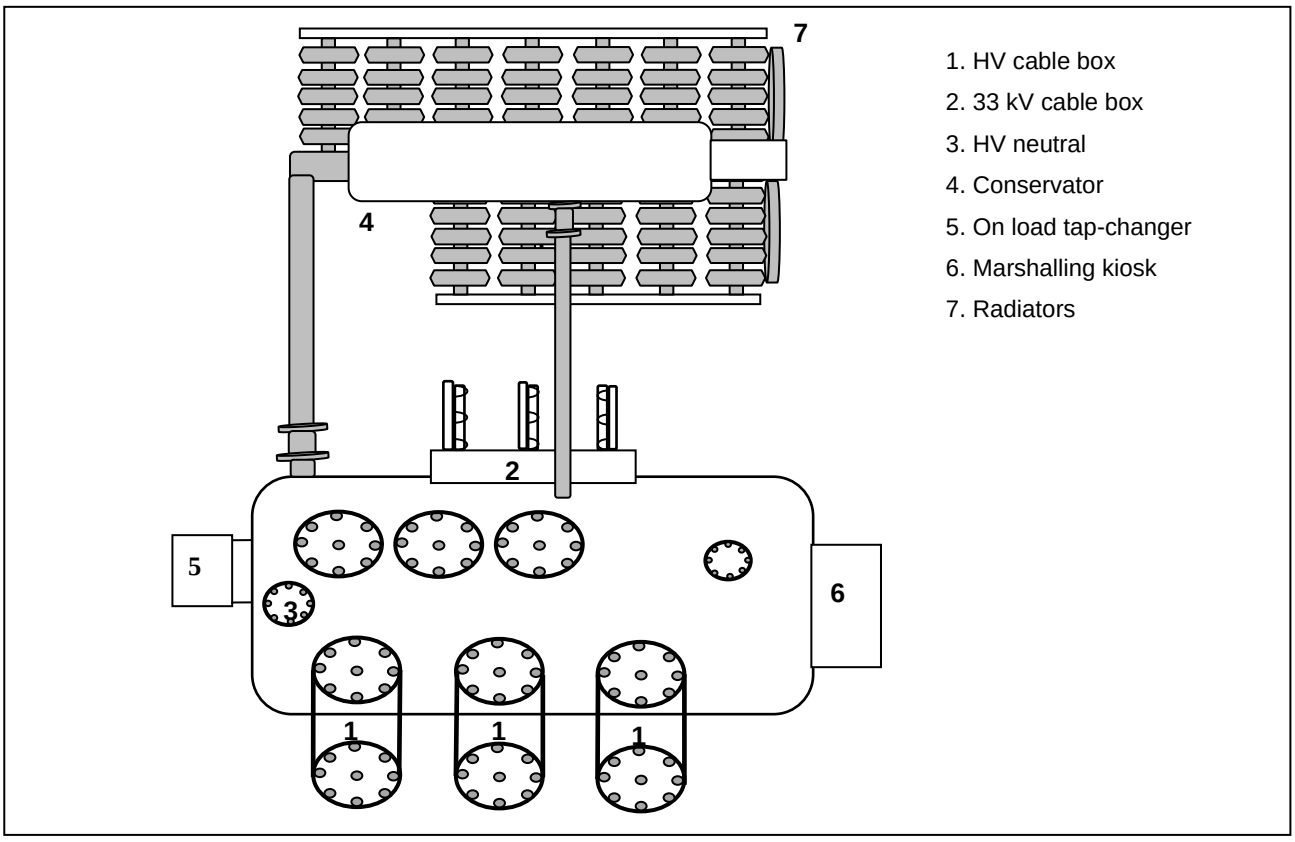

Figure 1 (b) - Typical 132/33 kV transformer layout

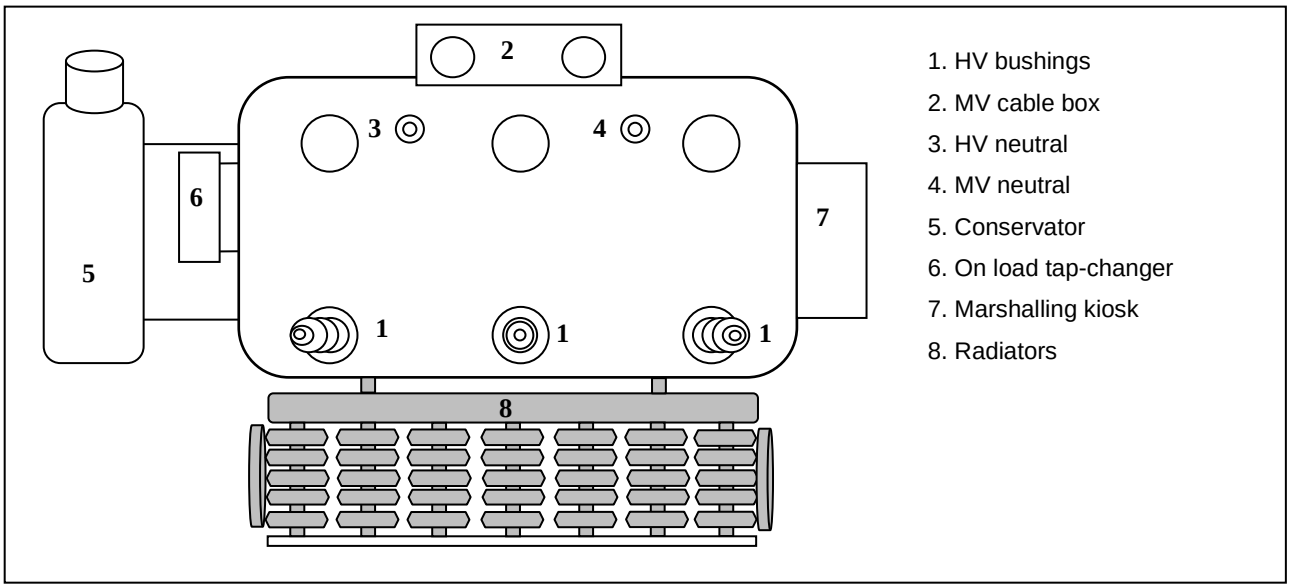

Figure 1 (c) - Typical 132/11 kV transformer layout

3.69 Neutral Earth Bar Cleat Supports

Cleats to accommodate an earth bar of approximate size 50 mm by 6 mm are to be provided down the side of the transformer tank to support the HV neutral earth bar.

3.710 Painting and Corrosion Protection

The painting process is considered to be of major importance in the highly corrosive climate of the Durban area and the following processes are recommended for guidance. Manufacturer's own painting procedure may be submitted for approval. All costs to maintain the entire transformer corrosion free during the 10 year guarantee period shall be for the contractor's account.

3.107.1 Radiators

a) Surface Preparation:
   i) Pickle the radiator banks to remove corrosion agents and other contaminants.
b) Galvanize.
i) Galvanised surfaces shall be cleaned prior to painting to provide a water break-free surface. Water rinsing after cleaning is essential to remove all traces of the cleaner.
c) Holding Primer:
   i) Prime coat the entire surface with zinc-rich holding primer, by airless spray, to a dry film thickness of 80 to 100 µm; and
   ii) Allow a minimum of 8 hrs at 25 before overcoating.
d) Protective Primer:
   i) Apply by airless spray, zinc-rich epoxy primer to a dry film thickness of 80 to 100 µm; and
   ii) Allow a minimum of 8 hrs at 25 before overcoating.
e) Finishing Coat:
   i) Apply by airless spray, one full coat of re-coatable polyurethane acrylic finishing coat to a dry film thickness of 50 to 60 µm to the required colour; and
   ii) The final coat shall be light grey paint to SANS 1091.
f) The total dry film thickness of the system shall be 210 to 260 µm excluding the galvanizing layer.

3.710.2 Transformer Tank and Ancillary Equipment

) The transformer shall be painted with all fittings removed. This includes the internal surfaces under lids of oil ring seals that are not in contact with the oil.
b) Surface Preparation:
i) Degrease the tank using a water-soluble detergent. Rinse with clean water.
ii) Abrasive blast clean to Grade Sa 2,5 of ISO 8501-1 to ensure all weld spatter, corrosion agents and other contaminants are removed. Blast profile to be in accordance with coating manufacturer's requirements.
c) Holding Primer:
i) Prime coat entire surface of transformer tank including all edges, welds, joints and corners with zinc-rich holding primer to a dry film thickness of 15 to 25 µm.
ii) Stripe coat the entire surface of transformer tank including all edges, welds, joints and corners with zinc-rich holding primer, by airless spray, to a dry film thickness of 15 to 25 µm.
iii) Allow a minimum of 8 hrs at 25 before overcoating.
d) Protective Primer:
i) Stripe coat all edges, welds, joints and corners with zinc-rich epoxy primer to a dry film thickness of 75 to 100 µm.
ii) Apply by airless spray, the entire surface of the transformer tank with zinc-rich epoxy primer to a dry film thickness of 75 to 100 µm.
iii) Allow a minimum of 8 hrs at 25 before overcoating.
e) Intermediate Coat:
i) Apply by airless spray, one full coat of micaceous iron oxide epoxy intermediate coat to a dry film thickness of 75 to 100 µm.
ii) Allow a minimum of 8 hrs at 25°C before overcoating.
f) Finishing Coat:
i) Apply by airless spray, one full coat of re-coatable polyurethane acrylic finishing coat to a dry film thickness of 40 to 60 µm to the required colour.
ii) The final coat shall be light grey paint to SANS 1091.
g) The total Dry Film Thickness of the system shall be 205 to 285 µm.

h) Paint thickness shall be measured both in the factory and on site after installation.

3.710.3 Coating of Interior Surfaces

The interior surfaces of the transformer tank, cover and conservator shall be clean and dry immediately prior to filling the transformer with oil. Interior surfaces above a line that lies at least 50 mm below the oil level shall be corrosion-protected by varnishing, priming or painting, using materials that are not affected by, or will not adversely affect the electrical or chemical properties of the insulating oil. It is preferable that the interior of the tank and the underside of the lid to be painted white, to facilitate working inside the tank should this be necessary. The choice of paint colour for the inside of the pipework, radiators and similar equipment can be made by the supplier.

3.710.4 General

a) Tenderers shall provide the detailed painting process with their tender. The process shall include the brand name and manufacturer of the various coatings. Any corrosion treatment superior to the one stipulated above may be offered, subject to the submission of the detailed process.
b) The application of the painting process shall be in accordance with the coating manufacturer's Product Data Sheets.
c) All cabinet interiors shall have at least one priming coat and one finishing coat of white gloss paint or enamel.
d) The exteriors of the control cabinets shall be finished in Eau-de-Nil, paint to SANS 1091.
e) The finishing coat on the conservator tank shall be White.
f) Should any paintwork be damaged during transit or erection, this shall be repaired on-site.
g) On completion of the transformer erection in its final position, an epoxy based putty shall be applied between the concrete plinth and transformer base-plate to seal this gap and prevent ingress of moisture. This seal shall be painted ‘black’ using a waterproof compound based paint.

h) The Contractor shall appoint an independent corrosion and coating specialist to inspect and report on the process of coating the transformer at the place of manufacture. The report shall be included as part of the transformer manual.
i) Water drainage: No part of the transformer and/or accessories shall retain water.
j) A compulsory site inspection shall be undertaken 11 months after hand over to identify any defects on the paintwork and corrosion on all transformers supplied on this contract. Details for the inspection shall be as follows:
   i) At least 1 week advanced notice shall be given to the Engineer before the inspection of the transformers.
   ii) All inspections shall be witnessed by the Engineer, who will be available between 08h30 and 15h30 on week days.
   iii) The Contractor shall supply all necessary equipment for the inspection.
   iv) The cost of this inspection shall be included in the cost of the transformer.
   v) Should corrosion or defects in the painting be identified, these defects are to be rectified to the satisfaction of the Engineer at no additional cost. In extreme cases this will require the complete re- painting of the transformer, radiator and ancillary equipment.

4.0 FITTINGS

4.1 Conservator Tank

The conservator tank shall comprise of two compartments (main transformer and tap-changer), each with its own removable end and shall be designed to slope slightly downwards towards the drain valves, which shall be adjacent to the removable ends. To facilitate access the removable ends shall preferably be located at the remote end from the entry pipe into the main tank.

The pipe connecting the conservator to the main tank shall extend at least 75 mm into the conservator and shall be brought out from the highest point of the main tank cover. A valve shall be provided immediately adjacent to the conservator. All pockets, bushing turrets of the main tank and cable-box disconnecting chambers, shall be connected into this pipe, between the transformer and the Buchholz relay with means of isolation where necessary.

The capacity of the conservator shall be such that the oil will not overflow or fall below the top of the feed pipe for oil temperatures from 0 ^{o}C to 100 ^{o}C.

The main tank conservator and tap-change conservator are to be totally segregated, i.e. two separately breathing compartments **without** a gap at the top of the internal barrier.

The transformers shall be equipped with a bagged main conservator. The materials, design and construction shall be subject to the approval of the Engineer. The materials and design shall take the long life of the transformer into account. The bag shall not prevent or restrict the normal draining of the conservator or the flow of oil to the transformer. The conservator tank fitted with an air bag shall be provided with a bag ‘tector. The function of the bag leak detector is to detect a leaking air bag. The abnormality will be detected by this detector and an alarm will be signalled to the control panel of the respective transformer. A contact will provide an alarm signal that the bag leak detector has operated to alert maintenance staff.

The air bag leak detector shall be positioned about 100 mm from the top of the conservator tank, without compromising reliability. The proposal for the installation shall be submitted at tender stage and shall form part of the mechanical design review. A bleed pipe and valve must be brought to ground level and fitted with a locking device to prevent unauthorised opening of the valve. A tag complying with shall be provided written**: “BAG LEAK DETECTOR AIR RELEASE”.**

A second valve to get the trapped air from the conservator must be provided. The associated text should read “**CONSERVATOR TANK AIR RELEASE”.** Both valves should have mechanical tamper proof covers.

Where a separate cooler bank is specified, the conservator shall be mounted above this.

4.2 Dial-Type Oil Gauges

The main tank conservator and tap-change conservator shall each be fitted with a dial type oil gauge which shall be of the magnetically operated type, in which breaking of the gauge glass will not release any oil. The gauges shall be fitted with one normally open potential-free low oil-level contact and one normally open potential-free high oil-level contact. The dial shall be marked with the correct level corresponding to 15, 30, 45, 60, 75 and 90 or alternatively, 0 to 1 in divisions of 0,1 and an engraved non- corrosive plate shall be fixed to the transformer with a table of the oil level variations with temperature.

4.3 Air Breathers

The transformer shall be fitted with a self dehydrating breather for each conservator compartment. The conservator compartments shall be equipped with the following dehydrating breathers as a minimum:

- A self dehydrating breather with two tanks containing approximately 3 kg quantity of silica-gel each on a 275 kV transformer main tank;
- A self dehydrating breather with two tanks containing approximately 2 kg quantity of silica-gel each on a 132 kV transformer main tank; and
- A self-dehydrating breather with one tank containing approximately 2 kg quantity of silica-gel on the tap changers.

Large breathers shall be flange mounted on a 100 mm diameter flange with 4 × 12 mm holes on a 75 mm PCD. Small breathers shall have ¾" BSP female pipe thread mount.

The breather shall be mounted at 1,5 m measured from the mounting flange or pipe connection point to ground level.

During the functioning of the device, the humidity of the air in the pipeline shall be continually measured by a humidity sensor and feedback sent to the controller. When the humidity of the air exceeds a certain value, a self-regulating heating element shall be activated. The water should then be condensed and removed.

4.4 Explosion Vents

(a) These shall be of a spring-loaded pressure relief type and shall be mounted in the most effective positions directly on the side walls of the tank, as near as possible to the top of the windings. The transformers shall be equipped with the pressure relief devices as follows:Two pressure relief devices (one electronic and one conventional) for the 275 kV transformer main tank;
(b) One electronic pressure relief device for the 132 kV transformer main tank; and
(c) One conventional pressure relief device on a 132 kV transformer neutral earthing resistor tanks.

Where more than one is required per transformer these shall be mounted in diagonally opposite positions and each shall be capable of preventing rupture of the tank due to the hydraulic pressure expected during an internal fault. The device shall maintain an oil seal at a static pressure of 50 kPa and be capable of withstanding the atmospheric pressure against absolute zero internal pressure. The device shall operate fully in less than 2.5 ms for an internal pressure impulse of 65 kPa.

The pressure relief device shall be fitted with a deflecting hood and pipe, to direct any oil released into the oil containment area.

The device must be provided with at least one potential-free electrical contact which closes as the device operates and a mechanical (manual reset) indicator visible from ground level.

There must be a mesh around the cover plate to prevent vermin from entering and nesting in this device. The mesh shall be of aluminium alloy, stainless steel or other corrosion-resistant material.

4.5 Gas and Oil Operated Relays

Buchholz type relays shall be of the double float or bucket type with "Alarm" and "Trip" contacts, and shall be of approved manufacture.

For the purpose of redundant protection, transformers having a voltage rating of 275 kV or a rating of 315MVA shall be provided with two electronic Buchholz relays. The relays shall be installed in series in the connecting pipe between the oil conservator and the transformer tank, mounted at least five pipe diameters apart - measured from facing flanges.

The gas release cock for the relay shall be placed within easy reach from ground level and be connected to the relay by small bore non-ferrous tubing. The sight window of the relay shall be readily visible. A test cock must also be connected by non-ferrous tubing to a convenient level so that alarm and trip conditions may be simulated. Labels shall be provided at the test cock, for sampling and bleeding purposes.

4.6 Winding Temperature Indicator

(a) Various power transformers to be supplied in this contract shall be fitted with winding temperature indicators as follows:A 132 kV transformer shall have a dial type winding temperature and oil temperature indicator fitted; and
(b) A 275 kV transformer shall have a combined electronic winding and oil temperature indicator fitted. Thermometers shall enable a direct and precise conveyance of the temperatures rise from the bulb up to the main dial. An analogue output signal in the range of 4 mA to 20 mA shall be provided. A digital output signal shall be provided by means of a modbus RTU communication protocol.

The winding temperature indicator shall be compensated for changes in ambient temperature and shall have a load temperature characteristic approximately the same as the hottest part of the windings. The indicators shall be suitable for the bag type conservators. The current transformers connected to the measurement system shall be built into the main transformer tank (and shall be located so as to reflect the total load on the transformer). Full particulars including characteristic curves are to be supplied by the successful tenderer. The current transformer connections shall be wired through test links.

A two position switch and an ammeter shall be provided for testing the winding temperature circuit. The ammeter scale shall be in accordance with the corresponding CTs secondary rating. The selector switch shall have Test/Normal positions with spring return to the Normal position. This shall be located in the transformer marshalling kiosk.

The indicator is to be provided with a dial indicating the temperature in ^{o}C and fitted with a resettable maximum temperature indicator. Adjustable alarm contacts and tripping contacts, which can be set to close at a predetermined temperature, are to be provided. The temperature differential between the selected pick-up and drop-off of the alarm and trip contacts shall be 10^{o}C. Where forced cooling is provided, an additional pair of contacts or an additional thermal or auxiliary relay shall be provided to start the fans for cooling the transformer automatically. These contacts shall be self-resetting. An analogue output signal in the range of 0 mA to 1 mA corresponding to 0^{o}C to 150^{o}C shall be provided. Accuracy shall be 0,5% of full range or better.

The instrument shall be provided with anti-vibration mountings.

An alternative pricing option to be included in Schedule C2.4 for the use of fibre optic temperature sensors. It should include the controller with all sensors and cabling. The controller offered shall be able to cater for a minimum of four transformers. At least ten sensors must be provided per transformer. Details of the system must be provided with the tender submission.

4.7 Oil Temperature Indicator

Each conservator tank (main tank and OLTC) shall be provided with a dial-type oil level indicator that will show the correct oil level inside the tank. The thermometer for registering "top oil" temperature shall be provided. The indicator is to be provided with a dial indicating the temperature in ^{o}C and fitted with a resettable maximum temperature indicator. Adjustable alarm contacts and tripping contacts, which can be set to close at a predetermined temperature, are to be provided. The temperature differential between the selected pickup and drop off of the alarm and trip contacts shall be 10^{o}C. An analogue output signal in the range of 0 mA to 1 mA corresponding to 0^{o}C to 150^{o}C shall be provided. Accuracy shall be 0,5% of full range or better.

The instrument shall be provided with anti-vibration mountings.

4.8 Thermometer Pockets

Thermometers shall be fitted with a cap threaded on the inside. Thermometer pockets shall have matching threads on the outside to enable hermetical sealing of the thermometer pocket. All thermometer pockets shall be located so as to avoid errors in temperature due to the heating effects of stray flux.

4.9 Alarm and Trip Contacts

All alarm and trip contacts shall be suitable for making and carrying continuously 5 A d.c. at 250 V. Alarm and trip contacts shall be potential-free and non-earthed.

4.10 Valves

All valves shall be attached by bolted-on flanges and shall not be screwed or welded to the tank. Valves of 50 mm ID and smaller shall be of gunmetal or similar material.

All radiator valves shall be removal/detachable and of the butterfly type. These should not be welded to the pipe. All other valves shall be of the gate type.

All valve openings shall be blanked-off with o-rings bolted-on blank plates or plugs.

All valves shall be marked for both the open and closed positions and these positions shall be depicted on an engraved valve function plate if the markings cannot be determined from ground level.

The valve shall be designed to stay secured in the closed position and shall comply with the requirements of BS 4504. Detailed drawings of all valves and flanges shall be supplied.

4.10.1 Drain Valves

Drain valves or isolating valves larger than 50 mm ID and of the double flanged gate type construction may have bodies of cast iron or cast steel. Drain valves shall be of suitable dimensions in relation to the volume of oil in the transformer tank and coolers.

4.10.2 Oil Sampling Valves

Oil sampling valves shall be screwed 15 mm ID globe, angle or gate valves located so as to permit sampling of oil from the extreme bottom of the tank as well as the top. The lower valve shall be a combined drain and filtering valve and, as such, shall be positioned so that it drains, as far as possible, all the oil from the transformer tank. For 275 kV transformers, the top filtration valve shall be routed inside the transformer tank and be brought out on ground level, and shall be clearly marked**.**

4.10.3 Filtration Valves

Filtration connections, which shall have flanges, drilled for 50 mm ID valves, or screwed 50 mm ID female, shall be as follows:

a) A valve at the top and bottom of the main tank at opposite ends. The drain valve of the main tank may be used for this purpose if of the size prescribed above.
b) A valve at the top and bottom of each separately mounted or removable cooler.
c) The oil conservator drain valve located within easy reach of the ground, by means of a pipe extension if necessary, shall be suitable for a filter connection.

4.10.4 UHF Partial Discharge Valves

For examination and diagnostics of the insulation quality of high voltage devices, the measurement of partial discharge (PD) is required. Therefore, three additional normal oil filling valves shall be provided on the transformer. These valves shall be used for measurement of partial discharges in the transformer using Ultra High Frequency (UHF) measuring method. The valves will facilitate the usage of a UHF PD measurement method as a stand-alone measurement and as a supporting measurement for both offline and online PD detection. The UHF PD probes shall be inserted into the transformer during full operation. The UHF probes shall withstand mechanical stresses caused by the oil pressure.

Three UHF Partial Discharge valves shall be located at the top of the transformer tank. The transformer contractor shall fit both the probes and the analyser. Details of the system and probes shall be submitted with the tender.

4.11 Vacuum Connection

Transformers of ratings of 100 MVA and above shall be fitted with a 150 mm nominal diameter pipe flange at the highest point of the transformer cover plate and conveniently situated for the mating of a flexible vacuum pump tube. The flange face shall be in the horizontal plane and shall be fitted with a bolted blanking plate and gasket.

4.12 Rating, Diagram Plates and Labels

Rating and diagram plates shall be to the applicable standard and shall be engraved, stamped or embossed on stainless steel. Table 6 below contains the minimum information to be supplied for each transformer:

Table 6 – Minimum information to be supplied for each transformer

Information
• Type of transformer,
• Number of the applied standard,
• Transformer DC number (specified at time of order),
• Contract/order number,
• Site reference,
• Rated power (MVA),
• Impedance voltage (based on rated power)
• Impedance rating (%),
• Rated frequency,
• Basic insulation levels,
• Rated fault level (kA),
• Short circuit impedance rating (%) i.e. positive and negative sequence,
• Short circuit duration,
• Current transformer information,

Information
• Manufacture's name,
• Year of manufacture,
• Number of phases,
• Vector group/Connection symbol,
• Rated voltage and tapping range (kV),
• Oil level indicator index marks,
• Rated currents,
• Losses (load and no-load),
• Maximum ambient temperature,
• Winding temperature rise,
• Oil temperature rise,
• Type of cooling,
• Total mass,
• Mass of core and windings,
• Mass of insulating oil,
• Transport mass (including or excluding oil).

A label shall be prominently displayed adjacent to the rating plate certifying the PCB content of the oil in units of ppm (parts per million).

Transformer designation label shall be mounted on the transformer side facing the driveway. Designation label shall be to the applicable standard and shall be engraved painted text on aluminium plate of +/- 5 mm thickness. The plate is mounted outdoors and must be resistant to ultra violet radiation.

Table 7 – Designation label dimensions

Designation & Layout	Location	Template Size (mm)	Letter Size Height (mm)	Colour
TRANSFORMER 1A	Transformer 1A	1 820 × 250	120	Black lettering; orange background
TRANSFORMER 1A	Transformer Marshalling Kiosk	300 × 50	20	Black lettering; orange background

4.13 Earthing Terminals

Four suitably rated earthing terminals or clamps shall be provided on the tank base.

4.14 Lifting Lugs

Four lifting lugs shall be fitted in suitable and symmetrical positions to provide for lifting the complete oil filled transformer (with radiators if these are not free-standing) without structural damage to any part of the transformer. The main tank cover (and all covers of mass exceeding 25 kg) shall be provided with lifting lugs as necessary.

Radiator banks and conservator shall be provided with lifting lugs as necessary. In all cases a safety factor of at least two shall apply allowing for the worst possible condition of load sharing.

4.15 Fall Arrest System

A secure point of attachment needs to be installed on top of the transformer tank as to ensure that it is not possible for correctly connected personal protective equipment to become detached unintentionally. The anchorage system must be able to support the forces exerted in arresting a fall. It may be a beam, rail or other secure device that serves as a point of attachment. It must either be installed completely around the top of the tank, or a single rail must be affixed to the top of the tank in the lengthwise direction.

Anchorages and anchorage connectors must be independent and designed, installed and used as part of a complete personal fall arrest system which maintains a safety factor of at least two.

4.16 Permanent Ladder

A permanent steel step ladder shall be provided on the transformer in order to access, for example: the Buchholz relay, the oil-pipe valves and oil level indication equipment. The ladder shall be welded to the main tank in a position to provide unrestricted access to the top of the transformer with the unit fully assembled. The ladder shall not interfere with or restrict maintenance activities and routine inspections. It shall not cover or restrict access to inspection/manhole covers and interfere with fitting of monitoring equipment. Means to prevent unauthorized or unintentional access to the tank top while the transformer is energized shall be provided. This maybe by e.g. pad locked shutter door on step ladders.

A safety harness securing point shall be positioned at the landing space immediately above the steel ladder on the top cover.

In addition to the above requirements, the ladder must:
a) have the same corrosion treatment as the transformer;
b) have rungs that are anti-slip;
c) have the anti-climb device fitted with the locking-off; and
d) not in any way compromise the withstand nor lightning impulse ratings of the transformer.

4.17 Jacking Pads

Four jacking pads shall be provided in suitable and symmetrical positions each capable of supporting at least half of the total weight of the filled transformer (with radiators if these are not free-standing) allowing a minimum safety factor of two. Unless otherwise approved, the minimum height of the pads above the base shall be 460 mm for a total filled tank mass of 25 tons or less and 650 mm for a mass above 25 tons.

Unless otherwise approved, the heights of the jacking pads above the bottom of the transformer base, and the unimpeded working surface of the jacking pads shall be as in **Table 8** (read in conjunction with **Figure 2**).

Table 8 - Jacking pad dimensions

Transformer mass complete with oil (metric tons)	**Min/max height of jacking pad above base "A"** (mm)	**Overhang to centre of jacking pad "B"** (mm)	**Unimpeded working surface of pad "C"** (mm)	**Width of symmetrical unimpeded access to jacking pad "D"** (mm)
60 and below	460/530	115	170 × 170	230
Above 60	650/700	150	210 × 210	300
Access in direction 'E' shall be unrestricted				

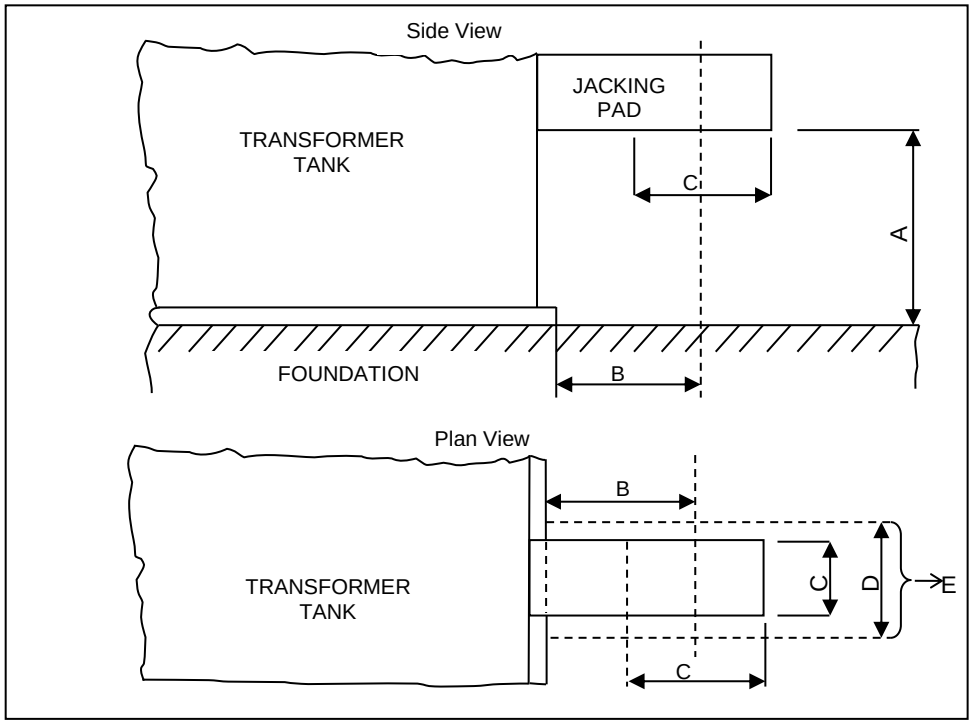

Figure 2 - Arrangement of jacking pads

4.18 Base Pads

Base pads shall be continuous and not more than 12 mm in height. The pad shall be a minimum of 3 of 5 ply malthoid. Any additional layers may be used to cater for unevenness of the plinth and/or transformer metal base. Multiple block pads which leaves voids in between shall not be acceptable. This requirement shall apply to both indoor and outdoor units. If an alternative to malthoid is offered, this shall have a maximum
continuous temperature rating of 120 °C, and will be subject to the Engineer's approval.

5.0 On-Load Tap-Changing Equipment

On-load tap-changing equipment shall be provided for the HV winding, with a range of tappings as specified in the section of **"***Guarantees and Particulars of Equipment*"

5.1 General

Tap-changing equipment shall be capable of carrying the same load currents and currents due to external short-circuit, as the transformer windings, and shall withstand the impulse and dielectric tests of the associated windings.

On-load tap-changing equipment shall be arranged for local manual and electrical control and for remote electrical operation.

On load tap changing equipment shall be designed and constructed in accordance with the latest revision of IEC 60214. The OLTC should be of the resistance bridging type. The tap changer supplied must present no risk to the transformer during any operating condition albeit on load or on no-load. Only an in-tank vacuum type will be considered.

The oil in those compartments of the main tap-change apparatus which do not contain contacts for making or breaking current shall be maintained under conservator head by means of a 25 mm inside diameter pipe connection from the highest point of the chamber to the conservator. This connection shall be controlled by a suitable valve and shall be arranged so that any gas leaving the chamber will pass into a separate surge relay. Potential free tripping contacts must be provided on this relay.

5.2 Tap-transfer Equipment

The tap-transfer equipment shall be so designed that it will not be possible either for a portion of the main transformer windings to be short-circuited, or for the main transformer windings to be open-circuited.

All contacts, where arcing takes place, shall be readily accessible for inspection and renewal, except vacuum bottles which need to be inspected and tested.

5.3 Driving Mechanism

The driving mechanism shall be such that once a tap-changing operation has been initiated, the tap-changer contacts will not remain in an intermediate position should the power supply for the driving unit fail.

Complete timing sequence of all the contacts in the tap-change operation shall be provided in the form of timing graphs with appropriate scales to identify the timing sequence.

The motor shall be totally enclosed and controlled by a contactor fitted with thermal overload and single phasing protection, where applicable. The normally closed contact of the overload shall be wired to the terminals to cater for "mechanical failure" alarm.

Mechanical end stops and electrical limit switches are to be provided to prevent the mechanism from over-running its end positions.

For emergency operation of the tap-changing equipment, a readily detachable handle shall be provided for manual operation. Provision shall be made to prevent the tap-changer contacts from being left in an intermediate position when operated manually, and to prevent power operation with the handle in position. Manual operation shall only be possible when the transformer is de-energised.

The mechanism housing shall be fabricated of 3CR12 corrosion resistant steel, shall be dust-proof, weather-proof and vermin-proof and shall be provided with:

a) Raise/lower voltage control switch or push buttons
b) Mechanically operated tap position indicator visible through door
c) Counter for indicating number of tap-changer operations
d) Driving motor, control and contactor equipment
e) Provision for fitting of handle for manual operation
f) Local/Remote, control changeover switch
g) Separately fused and switched heater
h) Tap position indication devices as specified in the section of **"***Guarantees and Particulars of Equipment*"8

All electrical controls shall be arranged for step-by-step operation.

The local control and the facilities for remote control shall comply with schematic drawings issued with this specification.

5.4 TRANSFORMER RELAY PANEL

5.4.1 The supply of the transformer relay panels will be confirmed at time of order.

5.4.2 An upright free standing relay panel shall be provided for each transformer circuit breaker to accommodate all the relays specified for a transformer switch. (The relays and instruments required for other circuit breakers shall be mounted on the circuit breaker panel).

5.4.3 The relay panel shall have dimensions of 600 × 600 × 2100 mm (W×D×H) and shall be accessible from the front or rear (as specified in schedule A) by means of hinged doors fitted with switches for automatic cubicle lighting and shall be fitted with a suitable gland plate.

5.4.4 The relays shall be mounted on the front of the control panels not lower than 600 mm above floor level and not higher than 1800 mm above floor level. All relay cases shall be earthed. All relays, push-buttons, switches, LEDs etc. are to be of the flush mounted type.

5.4.5 The relay panel shall be designed to be rodent proof.

5.4.6 All current transformer circuits shall be provided with plug in type test terminal blocks which shall be mounted on the front of the relay panel.

5.4.7 All fuses and links with the exception of CT earthing shall be positioned on the front of the control panel unless otherwise approved. CT earthing links shall be of the screw/slider rail mounted terminal type to the approval of the Engineer.

5.4.8 Each panel shall be provided with a copper earth bar which shall be earthed using a flexible, green and yellow PVC insulated 70 mm^2 copper conductor bolted to the panel earth bar and control room earth bar by means of crimped lugs.

5.4.9 The relay panel shall be fitted with engraved labels on the front and back indicating the designation of circuits controlled, to the approval of the Engineer. Each fuse, link, protection relay, control handle and indicator LED shall be fitted with engraved labels to indicate the function.

5.4.10 Panel wiring shall comply with clause 2.15.

5.4.11 Panel wiring shall have a minimum conductor cross-sectional area of 1.5 mm^2.

5.4.12 The external surfaces of indoor control equipment shall receive a coat of an approved phosphate primer, an undercoat, and two coats of Eau de Nil colour enamel paint to SANS 1091. The internal surfaces of panels containing wiring and other apparatus shall receive a coat of an approved phosphate primer, an undercoat and two coats of white enamel paint.

5.5 Tap-Change Control Panels

The supply of indoor tap-change control panels will be confirmed at time of order.

The panels shall be 600 mm wide, floor mounted and vermin-proof, fitted with hinged doors for rear access and painted Eau-de-nil. The panels shall contain:

a) A separately fused heater and switch and separately fused lamp with door switch.
b) Isolating switches to isolate the panel from control supply and voltage transformer supply.
c) A tap-changer "Supply Failure" indicating lamp.
d) A "Raise/Lower Voltage" control switch or push buttons.
e) A "Tap-change in Progress" indicating lamp.
f) Analogue type Tap-position indicator unless permanently displayed on voltage regulating relay
g) A digital voltmeter with 3 digit display of the LED or LCD type with a minimum of 20 mm characters with 1% accuracy or better, unless permanently displayed on voltage regulating relay.
h) An Auto/Non-auto selector switch.
i) A voltage regulating relay of the numerical type, adjustable from 95% to 110% of the nominal voltage. Separate initial and inter-tap delay times shall be adjustable between 5 s and 120 s. The voltage regulating relay shall be fitted with an under voltage and over current facility to block operation of the tap-changer for those conditions. Where parallel operation is required, this shall be of the circulating current method and shall make use of digital communications between voltage regulating relays. The relays shall incorporate a line drop compensation feature. Individual or parallel operation shall be automatically determined from the racking position and status of the incomers, bus-section and bus-coupler circuit breakers. An "out of step" or excessive circulating current condition shall prevent further tap-changing after a definite time interval.
j) Fuses, links, contactors, etc.
k) Flagging relays for alarm indication as shown on drawings issued with this specification. All relays are to have self-reset contacts and hand reset flags.
l) Supervisory takeover and raise/lower relays (12 V d.c.)

6.0 COOLING PLANT

6.1 General

Where mixed cooling is specified in Schedule C3.1, the ONAN rating shall not be less than 70% of the total specified forced cooled capacity for a 275/132 kV transformer and not be less than 60% of the total specified forced cooled capacity for all other transformers required in this tender.

The forced cooling equipment shall be designed to operate automatically from the winding temperature relay control at pre-determined temperatures recommended by the manufacturer. The temperature differential between the selected pick-up and drop-off of the control contacts shall be 10^{o}C.

6.2 Fans

The radiator cooling fans shall be vertical mounted (and not horizontal).

Fan blades and fan ducting shall be of aluminium alloy, stainless steel or other corrosion-resistant material, to the approval of the Engineer, and shall be designed to keep noise and vibration to a minimum. All fans shall be provided with galvanised wire-mesh guards, both on inlet and outlet sides, and shall be painted.

6.3 Motors

All motors shall be suitable for direct starting and continuous running from the supply voltage specified in the section of **"***Guarantees and Particulars of Equipment*". Three-phase motors shall be used.

All motors shall be of the totally enclosed weather-proof type. Bearings of all motors shall be of the ball or roller bearing type and the bearings shall be grease lubricated.

Each motor shall be provided with starters with overload protection and single-phasing protection.

6.4 Cooler Control Equipment

All the necessary automatic control, motor contactors, protective devices and switches for the forced cooling equipment shall be contained in the transformer marshalling kiosk.

The cooler control equipment shall include:

a) An isolating switch for each group of fan motors.
b) Provision for manual control of fans during maintenance.
c) Magnetic contactor for each group of fan motors.
d) Under voltage and single-phasing relay(s).
e) Thermal overload protection with integral or separate over current MCB for each fan.
f) Links for testing winding temperature relay and current transformer.
g) Fuses, links and terminal boards.
h) A 'cooler fail' alarm circuit shall be wired through normally closed contacts of all contactors and thermal/over current MCBs such that an alarm shall be initiated, if any motor contactor fails to operate or MCB is open after automatic or manual switching. (Nominal delay of approximately 20 s is required to prevent spurious alarms).
i) Cooler supply fail relay connected between red and blue phases or positive and negative dc voltage, whichever is applicable. The relay shall open on de-energising with a 10 s delay before producing an alarm.

7.0 Current Transformers

7.1 Allowance must be made under this contract for the supply and installation of the various current transformers specified in Annexure A.

7.2 All current transformer secondary connections must be wired to terminals in the marshalling kiosk. The secondary connection leads of any one winding must not be separated when wired through trunking, conduit or an armoured cable.

7.3 Current transformers shall be capable of withstanding mechanically and thermally the effect of the maximum over current which is required of the associated windings of the power transformer.

7.4 Current transformers shall be capable of withstanding the effects of impulse voltages (as specified) applied to the section of the winding which they are located.

7.5 Where Class X current transformers are specified in Annexure A, the Contractor must establish, in liaison with the supplier of the associated protective relay (and associated current transformers in the case of balanced current protective schemes) that the characteristics of the current transformer proposed meet the requirements of the associated protection relays (or current transformers).

7.6 Unless otherwise approved, current transformers specified for the neutral connections shall be mounted inside the main transformer tank.

7.7 The following details must be submitted for approval:
a) Magnetisation characteristic curve;
b) Exact turns ratio;
c) Winding resistance; and
d) Leakage reactance.

7.8 Current transformers to be supplied in this contract shall have the characteristics as outlined in clause 7.9 below. Should the current transformer fail the test or its test results fall outside specified limits, the contractor shall be required to replace the current transformer at no additional cost to eThekwini Electricity. This applies to all components of the current transformer.

7.9 All current transformers to be supplied in this contract are specified in , shall have the following characteristics:
a) The knee point voltage shall not be lower than the value specified on the CT rating plate;
b) The knee point voltage must not be greater than 5% of the specified value on the CT rating plate;
c) The magnetising current shall not be greater than the value specified on the CT rating plate;
d) The internal resistance shall not be greater than the value specified on the CT rating plate; and
e) The knee point voltage and magnetising current at the knee point voltage should not differ by more than 5% when compared with the previous test results for the particular CT core, or with results from another CT of the same make, type, and batch number.
f) Where multicore CTs are specified, these shall be tested at the highest ratio.

8.0 Secondary Wiring, Marshalling Cabinet and Terminal Blocks

8.1 For each main transformer, the Contractor shall provide free standing or tank mounting (as specified in Annexure A) type marshalling cabinet, to be of IP53 rating, of approved design and construction for the termination of all multi-core cable connections associated with the transformers or ancillary apparatus. The cabinet shall be fabricated of 3CR12 corrosion resistant steel.

8.2 The cabinet shall be provided with a double hinged door (hinged in the vertical plane) with a suitable locking type handle.

8.3 The marshalling cabinet shall be fitted with terminal blocks having sufficient terminals to permit the connection of multi-core cables from all alarm and tripping relays, current transformers and any other apparatus mounted on the main transformers, neutral earthing compensators and neutral resistors to control relays, switchgear and any other apparatus situated remote from the main transformers. At least 10 % spare terminals shall be provided for the marshalling of cables associated with other switchgear and apparatus located in the vicinity of the main transformers which are required to be connected to remote equipment. Space shall also be provided for mounting any interposing current transformers and, if necessary, the cooler control equipment.

8.4 All multi-core cabling from apparatus on the main transformer to the marshalling cabinet shall be of approved stranded conductor with oil resistant insulation either armoured or in conduit. Current transformer connections from both ends of the windings shall be brought out to the marshalling cabinet but test windings may be terminated in a readily accessible terminal box. These connections and the control wiring shall be not less than 4 mm^2 in area and 7 strands. The Contractor shall supply details of any cable trenches or ducts required at the time of submitting the outline drawings for foundation works.

8.5 All terminal blocks for current transformer relay and instrument connections shall be of the spring-loaded type and shall be neatly finished and readily accessible. Pinch type terminals in which the screw bears directly on the wire strand will not be accepted.

Terminal strips which do not rely on pinch screws rotating on the wire strand are required and unless these are of a type previously accepted by eThekwini Electricity, full details must be submitted for prior approval. All wire ends shall be terminated with lugs to suit the type of terminal connector.

Terminals at 110 V or 220 V shall be segregated from other terminals and shrouded, with the voltage prominently marked on the shrouds. All terminations are to be clearly identified and connection of all wires and control cables shall be made by the manufacturer.

8.6 Provision for outgoing connections from the transformer marshalling cabinet and the control cubicle shall be made for PVC, 600 V multi-core cables. Where PVC sheathed cables are specified, a removable gland plate with holes to accommodate a compression type gland, shall be supplied, adjacent to a terminal connection.

8.7 Unless otherwise specified in Annexure A, multi-core interconnecting cabling from the marshalling cabinet to the transformer control cubicle, switchgear and control panels or other equipment situated remote from the transformers, will be supplied and laid under a separate contract. The transformer supplier will be advised of the name of such other Contractor and will be required to notify him in good time, of the number and size of cores required to be provided in all interconnecting multi-core cables, associated with the transformers and ancillary apparatus supplied under this contract.

8.8 The numbering of the circuits and terminations of the secondary wiring of the transformers and associated apparatus supplied under this contract, shall comply with tender drawings.

8.9 Fuse links shall be of the HRC pattern Class Ql AC46 or AC33 complying with AC4 or AC5 to IEC 60296.

9.0 Neutral Earthing Compensators and Resistors

9.1 Neutral Earthing Compensators

The compensators shall be of adequate rating to withstand, without undue temperature rise, earth fault currents of 800 A for a time period of not less than 30 s. The compensator shall be double wound, employing an interconnected star wound primary and, if specified in , a star wound secondary for supplying the substation auxiliary system with the continuously rated output.

The compensator shall be of the oil-filled core-type and shall be fitted with outdoor-type bushings or cable box on the HV side, with clearances to the relevant standards. The neutral point shall be brought out to a bushing terminal. Provision shall be made for the connection of a four-core low voltage PVC SWA cable via high rupturing capacity fuses if a secondary winding is specified. The fuses must be safely accessible while the transformer is energised.

A neutral earthing resistor as specified below shall be supplied for insertion between the neutral point of the compensator and the substation earth system, to limit the fault current to 800 A.

9.2 Neutral Earthing Resistors

9.2.1 A suitable resistance device shall be supplied for insertion between the neutral point of the low voltage winding and the substation earth. The resistor shall limit the low voltage neutral fault current to 800 A and shall have a short-time rating of not less than 10 s. The resistor shall be fitted with an out-door type bushing. The tanks shall be hot-dip galvanised or zinc sprayed to SABS ISO 1461.

9.2.2 The resistor shall be of the oil-immersed metallic type, and shall be immersed in a free breathing steel tank containing oil. A direct reading oil level gauge shall be provided.

9.2.3 The unit shall be equipped with an approved pressure relief valve designed to minimise the possibility of rupture of the tank in the case of the period of flow of fault current through the resistor exceeding the rated short time, or any internal fault resulting in a dangerous pressure increase in the tank. This device shall be fitted with potential-free trip and alarm contacts.

9.2.4 The temperature of the metallic resistor, after passing the nominal short-time current for the time specified shall not exceed 450°C.

9.2.5 The temperature coefficient of the resistor material, with a temperature rise not exceeding the value specified in Clause 9.2.4, shall ensure that the final resistance value of the metallic resistor, will not be more than 106% of its initial value at 100°C.

9.2.6 The resistor shall be fully insulated throughout to withstand an applied voltage test of 45 kV for 60 s.

9.2.7 The overall resistance between the neutral connected terminal and the earthed terminal of the resistor shall be measured and corrected to a reference temperature of 100°C. The measured value of resistance shall have a tolerance of not more than 5% of the designed value.

9.2.8 Test figures which show the temperature/resistance and the time/temperature relationship for currents of the order of 800 A shall be submitted.

9.2.9 Each unit shall have a stainless steel rating plate and shall be engraved, stamped or embossed with the particulars of the equipment as per the requirements of the relevant standards.

9.2.10 Lifting lugs shall be provided on the tank, for lifting the complete unit.

9.2.11 The tank shall be fitted with a self-dehydrating breather with one tank containing approximately 2 kg quantity of silica-gel.

9.2.12 The terminal box on the Neutral Earthing Resistors shall be 3CR12 corrosion resistant steel.

NOTE: All copper work between the main transformer, the neutral earthing compensator and the earthing resistor will be installed under this contract, unless specified otherwise in Annexure A.

10.0 Transformer Continuous On-Line Monitoring System

The unit shall offer both on-line and off-line monitoring.

The continuous on-line and remote monitoring system shall integrate all relevant main components of the power transformer within only one system. The database and all algorithms shall be located on only one IED. The analogue signals from the sensors shall be connected to the bus terminals inside the monitoring cubicle at the transformer. The IED shall be located in the control room in the substation. The acquisition of data shall be time and event driven. The continuous online monitoring system shall comply with the IEC 61850 specification.

All information collected by the device shall be made available in real-time to the Control Centre through a DNP3/IP communications link.

Should the communications link fail, the device shall store all information locally with an option for manual retrieval through a direct USB or TCP/IP connection. All information shall be made available through a user-friendly reporting interface.

The system shall perform monitoring of the following (where critical values of all parameters shall be included):

10.1 **Transformer operating temperatures:**
(a) Oil temperature;
(b) Winding hot-spot;
(c) Ambient temperature;
(d) Transformer lifetime consumption estimation; and
(e) Data logging.

10.2 **On-load tap changer (OLTC):**
(a) Tap position;
(b) Number of operations;
(c) Extreme taps indication;
(d) Motor run time and full diagnostics;
(e) Data logger;

(f) Position histogram;
(g) Sum of switched load current; and
(h) Oil level.

10.3 **Cooling Group Control:**
(a) Fan/pump failure alarm;
(b) Fan/pump run time;
(c) Life utilisation; and
(d) Data logging.

10.4 **Bushing:**
(a) Stray capacitance (C);
(b) Dissipation factor/power factor (DF/PF);
(c) Partial discharge (PD) at the bushing taps;
(d) Transient over-voltage recording;
(e) Temperature; and
(f) Moisture.

10.5 **Monitoring and Diagnosis for Partial Discharges**
(a) Partial discharge (PD) at the bushing taps;
(b) Gap partial discharges; and
(c) Surface partial discharges.

10.6 **On-line dissolved gas analysis**
(a) Gas in oil content;
(b) Moisture content in oil;
(c) Moisture of insulation;
(d) Ageing rate.

10.6.1 **Basic Requirements of the Dissolved Gas Analyser**

The basic functional requirements of the system are that it shall be self-contained, field robust and measure:
(a) Eight (8) fault gases for a 275 kV transformer; and
(b) One fault gas and dissolved moisture in oil for a 132 kV transformer.

The system shall indicate these locally IEC 61850/IP and also remotely via DNP3/IP communication protocol. It shall provide a continuous on-line monitoring function with automatic data acquisition with a user identified option of reducing the data collection period to hourly levels. On-board data storage of the system shall be in excess of one year at the highest sample rate. The system should contain on board intelligence capable of analysis and triggering of alarms for fault conditions both against set alarm thresholds and against international standards.

The facility to include other inputs (such as transformer load current measured via an external CT, transformer oil temperature and ambient air temperature) shall be provided by the system. These are presented in 11.6.2 below and tabled specifically in the section of **"***Guarantees and Particulars of Equipment*".

10.6.2 External Sensor Inputs

10.6.2.1 A clip on Load CT, in order to measure the load on the transformer must be provided with the installation and must interface directly with the analyser. This must be fitted to the LV side white phase.

10.6.2.2 Power transformers to be supplied shall contain fibre optic hot spot temperature probes within the winding. It is required, that the signals be input directly to the analyser and integrate with its data registers as required. The supplier should indicate what type of probes will be used. It is required that an option must be available to order a signal conditioner (which is installed within the same system and fully integrated internally) with the analyser (2 channels to be used on the 2 hottest temperature probes from the winding) for either probe type which includes the supply and installation of the suitable extension cables from the probes termination at the power transformer.

10.6.2.3 It is required that the analysers have the provision to interface an oil temperature probe signal to it,

and for this signal to be integrated in its data registers accordingly. The temperature probe shall connect via a 4 mA - 20 mA connection.

10.6.2.4 It shall be an option to integrate a portable partial discharge detection equipment (which might be over IP format) into the analyser. This shall interface physically by RJ45 100 BaseTX or LC MM 100 BaseFX connection with the analysers network switch.

10.6.2.5 It shall be possible to use the analyser as a central data marshalling point for data from other transformer condition monitoring equipment such as bushing monitoring equipment etc. also using IP format via one of the spare network ports.

10.6.2.6 To cater for miscellaneous and future sensor integration with the device the analyser board must come with a number of spare analogue 4 mA - 20 mA terminals as well as spare RS485 serial interfaces, the required numbers of each spare terminal are specified in the section of **"***Guarantees and Particulars of Equipment*"18. The intention would be for other sensors data to be appended on the data registers of the analyser.

In the section of **"***Guarantees and Particulars of Equipment*"18 the exact particulars of interface from external sensors is tabled for the above clauses.

10.6.3 Oil Interface

10.6.3.1 The system shall be provided with oil from the transformer via standard valves, which shall be reserved for on-line monitoring on all transformers to be supplied in this contract.

10.6.3.2 The vendor must provide acceptable pipe fittings and flanges such that adequate support and bracing is available for connecting pipes oriented vertically adjacent to tank or part of the transformer.

10.6.3.3 Transformer oil take-off and return may be via 50 mm or 25 mm diameter double-flange valves situated on the transformer. The standard oil sampling points on the transformer shall not be dispensed with.

10.6.3.4 An additional oil sampling point, as close as possible to the analyser, shall be provided on the incoming oil line to the monitoring system.

10.6.3.5 The analyser should be able to detect oil leaks within its oil circuit valves and alarm accordingly.

10.6.3.6 It is preferable that oil for the monitoring system be obtained as high up on the main transformer tank as possible and an available valve be used for this purpose, where practical. Oil from a cooling loop valve is also acceptable as the input to the system. A modified flange on the main drain valve of the transformer is preferred as the return port for oil from the system back to the transformer. A means of eliminating any air-in-oil return to the transformer is compulsory, for use especially during commissioning of the system. The supplier must train eThekwini Electricity staff on this item in particular.

10.6.3.7 The return oil to the transformer shall not be contaminated in any way, this include pumping any air into the transformer. Suitable in-line oil filters are to be included in the system.

10.6.3.8 It must be possible to isolate the analyser from the transformer and adequately bleed the analyser without the air evacuation route being through the transformer in any way. Proof of this using oil circuit diagrams must be submitted at tender stage for evaluation.

10.6.3.9 The system is to be capable of giving accurate and reliable results for all oil types and conditions, i.e. both new and aged in-service oils.

10.6.3.10 During the commissioning stage, all oil lines and connections are to be guaranteed oil tight and leak free. These must be leak tested prior to connecting.

10.6.4 Application

(a) The system may be installed on any power transformer of any size or rating in eThekwini Electricity. The one pre-requisite is that the transformer has two suitable oil access valves installed.

(b) All oil piping to and from the system shall be suitably sized, of stainless steel material and have a minimum of joints along their lengths and be mechanically protected over their full length.

10.6.5 Environmental, Electrical and Mechanical Requirements

The device shall be substation hardened or ruggedized to be able to withstand the following, without the performance being out of limits, reliability being compromised or the life cycle being shortened.
(a) The system hardware must have a high degree of environmental protection (minimum IP56 for all enclosures).

10.6.6 Temperature and Humidity

The device shall:
(a) Operate within an ambient temperature range of -10°C to 55° C with passive cooling;
(b) Handle the relative humidity of 0 to 100% outdoors in the specified temperature range;
(c) Comply with Class 3K7 as per IEC 60721-3-3;
(d) Handle oil temperatures from transformer from 0°C to 120°C; and
(e) Seismic activity of up to 0,3 g.

10.6.7 The minimum specific requirements of fault gas and moisture detection

These Technical Specifications make provision for the tenderer to supply a single gas (hydrogen) or multi-gas (8 gas) with moisture monitoring system as required in this tender document.

The tenderer shall supply a system which complies with the minimum requirements as specified in Table 9. If any of the applicable specifications or requirements cannot be met, the tenderer must submit a list of these deviations at the tender stage.

The gas and moisture capabilities of the analyser (based on the applicable number of gases in the section of **"***Guarantees and Particulars of Equipment*"8) will be as per Table 9. The gas analyser system shall be based on either the head space or carrier gas principles.

Table 9 - The minimum specific requirements of fault gas and moisture detection

	Range: (ppm)	Accuracy: (%) or (ppm)		Repeatability: (%)
a) Hydrogen	5 ~ 3 000	5	5	5
b) Methane	5 ~ 3 000	5	5	5
c) Ethane	5 ~ 3 000	5	5	5
d) Ethylene	5 ~ 3 000	5	5	5
e) Acetylene	1 ~ 3 000	5	2	5
f) Carbon monoxide	20 ~ 30 000	10	20	5
g) Carbon dioxide	20 ~ 30 000	10	20	5
h) Oxygen	50 ~ 10 000	10	20	5
i) Moisture in Oil	2 ppm 2 ~ 100% RS	5	2	5

11.0 TESTS

11.1 General

All tests shall be arranged to represent working conditions as closely as possible and except where specified otherwise, shall be carried out strictly in accordance with the standards as listed in the table below. The type tests shall be reviewed during the design review as described in clause 133.1.3.

The set up for factory tests shall as much as possible resemble the as commissioned environment such that there will be no bracket or any other component clashing with the connection of cables during site installation. Should there be any modification modification required on site, this shall be to the satisfaction of the Engineer and at the transformer Contractor's cost.

Tests shall be carried out on all of the following items/units in accordance with the General Technical Specification as a routine of the manufacture of each item/unit:

a) Transformer;
b) Voltage control equipment;
c) Bushings;
d) Tanks and coolers;
e) Pipework and valves;
f) Gas and oil actuated relays;
g) Secondary wiring; and
h) Current and voltage transformers.

If available, results of type tests performed on transformers similar to those specified in this contract, relevant similarities must be documented.

Table 10 - Routine, type and special testing requirements

TEST DESCRIPTION	SPECIFICATION	ROUTINE	TYPE	SPECIAL
(a) Oil	IEC 60296/ IEC 60422/ IEC 60628	✓		
(b) Winding resistance	IEC 60076-1	✓		
(c) Voltage ratio and of phase displacement	IEC 60076-1	✓		
(d) Measurement of short-circuit impedance and load losses	IEC 60076-1	✓		
(e) Core/frame insulation resistance	IEC 60076-1	✓		
(f) Winding insulation resistance	IEC 60076-1	✓		
(g) Secondary wiring (voltage and insulation resistance tests)	11.4.13 Secondary wiring	✓		
(h) Winding capacitance and power factor	IEC 60076-1	✓		
(i) Swept frequency response analysis (SFRA)	Doble	✓		
(j) Lightning impulse (line and neutral)	IEC 60076-3	✓		
(k) Short duration induced a.c. voltage	IEC 60076-3	✓		
(l) Applied a.c. voltage	IEC 60076-3	✓		
(m) Neutral earthing compensators and	IEC 60076	✓		
(n) No-load losses and current measurements (at 90 %, 100 % and 110 % excitation)	IEC 60076-1	✓	✓	
(o) On-load tap-changer tests	IEC 60214	✓	✓	
(p) Current transformer tests	IEC 60185	✓	✓	
(q) Transformer tank tests and ON coolers	11.4.9 Transformer tank and ON coolers	✓	✓	
(r) Bushing tests	IEC 60137	✓	✓	
(s) Gas and oil actuated relays	11.4.12 Gas and oil actuated relays	✓	✓	
(t) Temperature rise test including hot spot measurement at ONAN and ONAF	IEC 60076-2		✓	
(u) Sound level measurements	IEC 60076-10		✓	
(v) Galvanising	SANS 121 (ISO 1461)		✓	
(w) Cooler power consumption	IEC 60076-1		✓	
(x) Zero-sequence impedance	IEC 60076-1			✓
ADDITIONAL TESTS	**SPECIFICATION**	**LEVEL**	**COMPLIANCE CRITERIA**	
(y) Cyclic Temperature and Humidity	IEC 60068-2-30	Db	25°C and 95% relative humidity/ 55°C and 95% relative humidity, 12 + 12 hour cycle	

TEST DESCRIPTION	SPECIFICATION	ROUTINE	TYPE	SPECIAL
(z) Enclosure Protection	SANS 60529	IP53	Protection against ingress of dust particles, spraying water	
(aa) Dye Penetration Testing	11.4.15 Dye penetration testing	---	---	

The manufacturer shall perform the routine tests on each unit during the various stages of manufacturing as well as complete type test for each design.

The costs that would be incurred, for any type tests, if any of these tests are deemed necessary shall be stated in C2.2.

11.2 Factory Acceptance Testing

EThekwini Electricity reserves the right to appoint a representative to inspect the transformers at any stage of manufacture and to be present during any of the tests specified. Such inspection shall not relieve the Contractor of his responsibility for meeting all the requirements of the specification, and it shall not prevent subsequent rejection if such material or equipment is later found to be defective.

The Engineer will advise the Contractor whether inspection or witnessed tests, or both, are required. The Contractor shall give not less than 10 working days notice of the date on which the equipment will be ready for the inspection or witnessing of tests required. For overseas suppliers, the minimum notification time period is eight (8) weeks. No transformer shall be tanked, or despatched from the Manufacturer's Works without the prior approval of the Employer/eThekwini Electricity.

Factory acceptance testing shall include all of the site tests which can practically be carried out in the factory, in accordance with a program to be agreed with the Engineer. Two copies of the Contractor's records of all tests shall be furnished to the Engineer.

11.3 Test Certificates

Three copies of test certificates showing the results of all routine and type tests performed shall be supplied to the Engineer prior to the despatch of the transformers from the Manufacturers' Works.

The test certificates shall be fully detailed and shall show the test circuit connections and all the relevant readings taken during the tests as well as results calculated from the readings.

All test certificates shall be in English.

11.4 Details of Routine Tests

The following tests shall be carried out on every unit. These shall be carried out at the Manufacturer's Works unless otherwise specified or approved.

11.4.1 The impedance at normal frequency on the tap position of nominal voltage ratio (principal tap) and on the two extreme tap positions. The impedance shall be expressed in ohms per phase as viewed from the primary winding.

11.4.2 Load losses at rated current and normal frequency on the principal tap position, corrected to 75^{o}C.

11.4.3 All insulation resistance measurements shall be made at 2 kV d.c. for one (1) minute. The temperature at which these resistance measurements are taken shall be recorded.

11.4.4 No-load losses at normal frequency with rated voltage and also with 5% overvoltage applied to the principal tapping.

11.4.5 Capacitance - if required by the Engineer, the capacitance between windings and between each winding and earth shall be measured.

11.4.6 Oil

Samples of oil from each consignment shall be tested in accordance with appropriate standard before despatch as well as energisation. Subject to the agreement of the Engineers, a supplier certificate, confirming that the oil from which the consignment was drawn, has been tested in accordance with IEC 60296 before filling the transformer and IEC 60422 after filling the transformer, may be accepted. The minimum oil analysis shall include, but not be limited, to the following tests:

a) Dissolved gas analysis (DGA);
b) Water content;
c) Dielectric strength;
d) Acidity;
e) Furan 2-furaldehyde;
f) Dissipation factor at 90 °C as per IEC 60247;
g) Resistivity at 90 °C as per IEC 60247;
h) Colour;
i) Polychlorinated biphenyl (PCB), as per ASTM D4059;
j) Interfacial tension (IFT), as per ASTM D-971;
k) Corrosive suphur as per ASTM D1275-B;
l) Stray gassing as per IEC 60628/ASTM D7150; and
m) Gassing tendency as per IEC 60628 Method A/ASTM D7150.

11.4.7 Cable Boxes

All cable boxes shall be tested with oil having a viscosity not greater than that specified in the relevant standards at a temperature of 15^{o}C, subjected to an internal hydraulic pressure of 70 kPa for 12 hrs. During this time no leakage shall occur nor shall there be any permanent set when the pressure is released.

11.4.8 Bushings

a) One minute dry withstand tests (power frequency voltage)
b) Oil tightness test
c) Power factor/voltage test.
d) Internal discharge test - Synthetic resin-bonded paper insulators for voltage of 33 kV and above which are either complete in themselves or are a component part of a complete bushing assembly shall be subject to tests carried out in a chamber to show that acceptable capacitance levels are reached when the applied voltage is reduced to 0,67 times system voltage between phases. Failure to pass this test may cause the bushing to be rejected unless its characteristics are in all respects to the satisfaction of the Engineer.

NOTE: Where a synthetic resin-bonded or impregnated paper component of a bushing suitable for voltages of 33 kV and above is mounted in service in a porcelain outer shell, this test shall also be carried out on the component part only and the results recorded.

11.4.9 Tanks and ON Coolers

All tanks and oil filled compartments including radiators but excluding separate coolers using forced oil circulation shall be tested before painting, for oil tightness by being completely filled with insulating oil at room temperature and subject to a pressure equal to the maximum working pressure plus 35 kPa. This pressure shall be maintained for a period of not less than 24 hours, during which time no leakage shall occur.

Detachable radiators may be tested as separate units.

11.4.10 Cooling Plant with Forced Oil Circulation

a) Air/oil coolers - All coolers using forced oil circulation shall be filled with insulating oil at a temperature of 15^{o}C and subjected to a pressure equal to twice the maximum working pressure at inlet to the cooler under service conditions which shall be maintained for a period of not less than 24 hrs. During this time no leakage shall occur.
b) Water/oil coolers - The oil and water spaces of all water cooled oil coolers shall be tested separately to withstand a hydraulic pressure of 700 kPa for 15 min. During this time no leakage shall occur.

11.4.11 Pumps, Pipework and Valves

a) Oil filled equipment - The bodies of all oil pumps complete with submerged motors, if any, and the oil pipe-work and valves shall withstand an internal hydraulic pressure of 70 kPa for 1 min. During this time no leakage shall occur.
b) Water filled equipment - Water pumps, water pipework and valves shall withstand a hydraulic pressure of 70 kPa for 1 min. During this time no leakage shall occur.
c) Motors and control gear - All motors and control gear shall be subjected to the tests specified in the appropriate standards.

11.4.12 Gas and Oil Actuated Relays

The following tests shall be made on relays when completely assembled. Where oil is referred to, it shall have a viscosity not greater than that of insulating oil at 15^{o}C.

a) The relay, when filled with oil, shall be subjected to an internal pressure of 140 kPa for 15 min. No leakage shall occur either from the casing or into normally oil free spaces, such as floats, within the casing.

b) **Gas collection**

i) With the relay mounted as in service and at a rising angle of 5 ^{o}C (tank to conservator) and full of oil, gas shall be introduced into the relay until the gas collection contacts close. The oil level reading at the time of contact closing shall be recorded in the test certificate. The low oil level contacts shall not close when gas is escaping freely from the relay on the conservator side. These contacts shall, however, close when the pipe-work is empty of oil.
ii) The empty relays shall be tilted, as if mounted in pipework rising from tank to conservator, at an increasing angle until the gas collection contacts open. The angle of tilt shall then be reduced and the gas collection contacts shall close before the angle is reduced to less than 13^{o}C to the horizontal.
iii) With the relay mounted at a falling angle of 16^{o}C to the horizontal and full of oil, the gas collection contacts shall be open.

c) Oil surge - with the relay mounted as in service and full of oil at approximately 15^{o}C, the surge contacts shall close within the steady oil flow limits specified. This operation shall not be adversely affected when the gas collection contacts have already closed and gas is escaping freely.
d) Voltage - With the relay empty of oil, a voltage of 2 kV shall be applied in turn between each of the electrical circuits and the casing for one minute, the remaining circuits being connected to the casing.
e) Operation - With the transformer assembled with its cooling plant as in service, tests shall be made to demonstrate that the relay does not operate whilst the oil pump motors are being started or stopped.

11.4.13 Secondary Wiring

All secondary wiring, including panel wiring and control circuits and all apparatus connected thereto shall be subjected to the following tests:
a) Voltage – 2 kV applied for one minute.
b) Insulation resistance - by an insulation resistance tester of not less than 500 V.

11.4.14 Voltage Control Equipment (if required)

Duty cycle - Switching apparatus when completely assembled shall be operated 40 times in the normal manner through the complete cycle when the transformer is unexcited, followed by 10 operations in the normal manner through the complete cycle when transformer is alive at normal volts on open circuit, all to the satisfaction of the Engineer.

NOTE: Each complete cycle to consist of movement from minimum to maximum return to minimum tap, or equivalent.

11.4.15 Neutral Earthing Compensators and Resistors

The neutral earthing compensators and resistors shall be tested as prescribed in IEC 60076, except where otherwise stated. Test reports for the following tests would be required:

a) Di-electric test according to IEC 60076-3;
b) Measurement of zero sequence impedance;
c) Temperature rise test;
d) Short-circuit withstand in accordance to IEC 60076-5;
e) Accelerated ageing test for composite bushings; and
f) Applied voltage test.

11.4.16 Dye Penetration Testing

To avoid leaks, dye penetration testing shall be done prior to corrosion proofing of tank and other manufactured fittings after welding.

11.5 Details of Main Type Tests

The costs of performing the following extra tests on one of every design of transformer required on this Contract shall be shown in Schedule C2.3. If results of these type tests performed on similar transformers are available, these must be submitted with the tender and the similarity of the units previously tested and those specified in this contract, must be documented.

On the basis of this information the Engineer will decide which extra type tests are necessary and the required tests will be stated after award.

11.5.1 Temperature Rise Test

If specially ordered, a transformer of each design shall undergo a temperature rise test. During this test the accuracy of the oil and winding temperature indicating devices shall be determined.

The temperature rise test shall be carried out with the transformers on the extreme minus tapping to demonstrate that the transformers may be operated at nominal rated power on any tap position.

NOTE: Transformers with combined natural and forced cooling shall be tested at both ratings.

11.5.2 Transformer Sound Level Measurements

The sound level measurement tests shall be made as described in IEC 60076-10, with the following noise limits that shall apply for the different types of transformers:

a) 221/315 MVA, ONAN/ONAF< 80 dB (A)
b) 30/50 MVA, ONAN/ONAF < 80 dB (A)
c) 18/30 MVA, ONAN/ONAF = 73/76 dB (A)
d) 15/25 MVA, ONAN/ONAF = 70/73 dB (A)
e) 10/15 MVA, ONAN/ONAF = 68/71 dB (A)
f) 15 MVA, ONAF = 70 dB (A)

11.5.3 Bushings

Type and sample tests shall be carried out in accordance with the relevant standards. Type tests shall be made on a bushing that has passed its routine tests.

a) Thermal stability sample tests. Applicable to bushings having rated voltages of 132 kV which incorporate synthetic resin-bonded paper as the main insulation.
b) Temperature cycle sample test on porcelain components.
c) Porosity sample test on porcelain components.
d) Visible discharge type test (power frequency voltage).
e) Wet withstand type test (power frequency voltage).
f) Under-oil-flashover or puncture withstand type test on those bushings not required to be impulse tested (power frequency voltage).
g) Full wave withstand type test (impulse voltage).
h) Under-oil flashover or puncture withstand type test on bushings required to be impulse tested (impulse voltage).

i) Temperature rise type test on bushings intended for service as separate devices.

11.6 Details of Combined Type and Sample Tests

The following tests shall be carried out on one unit of each type or batch.

11.6.1 Voltage Control Equipment

The following tests shall be carried out on the complete voltage control equipment of one transformer.

a) High voltage between contacts and tapping connections. Unless otherwise approved, one half normal service voltage between terminals of the associated windings applied for one minute between adjacent contacts of the switching apparatus and between tapping connections while immersed in oil at 75 °C and disconnected from the transformer windings. The remaining tests must be carried out in the sequence given below:
b) Duty cycle - The switching apparatus when completely assembled shall be operated through its complete cycle, as defined above, 500 times without failure or undue wear of any part.
c) Contact Heating - One switch contact of each type shall carry 10 times its full rated current 5 times in succession, the current being maintained for 2 s each time. During these tests no damage or injurious heating shall occur and the switch contact shall not show signs of excessive burning.
d) Timing - To show the exact time sequence of operation of the various parts of on-load voltage equipment. Unless otherwise approved an oscillograph shall be used for this test.

11.6.2 Tanks and ON Coolers

a) Vacuum - One transformer tank of each size shall be subjected when empty to an absolute internal pressure of 10 kPa against atmospheric pressure at sea level. There shall be no permanent deflection of the stiffeners nor shall the permanent deflection of the panel between stiffeners exceed the value specified in the following table:

Table 11 - Dimension of panel between stiffeners and maximum permanent deflection

Minor dimension of panel between stiffeners (mm)	Maximum permanent deflection (mm)
Up to 600	3
From 600 to 1 000	6
From 1 000 to 1 500	9
From 1 500 to 2 000	12
From 2 000 to 2 500	15
From 2 500 to 3 000	18
From 3 000	21

No further permanent deflection shall be measurable after a second test.

b) Pressure - One transformer tank of each size, shall be subjected for one minute to a internal hydraulic pressure of 70 kPa or that corresponding to the normal pressure plus 35 kPa. There shall be no permanent deflection of the stiffeners nor shall the permanent deflection of panels between stiffeners exceed the value specified in the above table.

11.6.3 Pressure Relief Valve

One pressure relief valve of each make and type shall be tested for leaks by subjecting the unit to an internal hydraulic oil pressure of 50 kPa for 24 hours. The oil viscosity shall be such as to reflect normal operating conditions.

11.6.4 Gas and Oil Actuated Relays

At the discretion of the Engineer the variation of performance of the relay shall be tested. With the mounting conditions as in service, the mounting angle shall be varied within the rising angle limits and test made to demonstrate the performance of the relay in the manner prescribed for the routine tests.

11.6.5 Galvanising

Samples selected by the Engineer of all galvanizing material shall be subjected to the galvanizing tests set out in SANS 121 (ISO 1461).

11.7 Special Tests

11.7.1 Zero-Sequence Impedance Measurements

The zero-sequence impedance shall be measured at rated frequency between the line terminals of a star-connected winding connected together, and its neutral terminal. The tests shall be performed as described in IEC 60076-1.

11.8 Details of Site Tests

The following tests shall be carried out on site to ensure that the transformers and associated equipment are ready for handing over and putting into commercial use. Test results shall be submitted for approval before take over:

11.8.1 Transformer Site Tests:

- Voltage ratio checks (all tapping positions at 10 kV);
- Vector group checks;
- Oil dielectric strength (all sampling points);
- Temperature indicator calibration;
- DC winding resistance (static and dynamic);
- Exciting current at 10 kV;
- Core insulation resistance test;
- Nameplate impedance to be verified with short circuit impedance or leakage reactance test;
- Tan delta for windings and bushings at 10 kV;
- Main tank and tap-change oil levels to be checked;
- Sweep frequency response analysis;
- Check silica gel;
- Oil leakage test;
- 2 kV Insulation resistance test between core and earth after transformer has been installed; and
- Power factor on winding insulation.

11.8.2 Tap Changer Site Tests

- Tap-change controls (local/remote/manual/automatic);
- Oil dielectric strength (all sampling points);
- Tap-change oil levels to be checked;
- Sweep frequency response analysis; and
- Oil leakage test.

11.8.3 NER Site Tests

- Oil dielectric strength (all sampling points);
- Temperature indicator calibration;
- Sweep frequency response analysis; and
- Check silica gel.

11.8.4 Current Transformers Site Tests

- Current transformer magnetisation characteristics;
- Polarity checks of current transformers; and
- Core insulation resistance test.

11.8.5 Radiator Site Tests

Forced cooling system checks.

11.8.6 Marshalling Kiosk

- Alarms, trips and indications; and

a) Control/power cabling insulation (min 1 kV).

11.8.7 Bushing Site Tests

i. Tan delta for windings and bushings at 10 kV.

The Engineer may carry out any tests that are considered necessary to prove that the plant fulfils the specification requirements.

12.0 MISCELLANEOUS

12.1 Labelling

All control panel labelling shall be inscribed with black lettering on a white background that shall not discolour or distort in service.

The Durban Corporation registration numbers (DC No) shall be given at time of order and must be stamped to the approval of the Engineer on the transformer rating plate.

12.2 Spares

Spares shall be packed in separate cases, clearly labelled "Spares" and consigned to the eThekwini Electricity's HV Substations store. Each item of spares in a case shall be suitably identified by means of a metal label. The contract number shall appear on all cases containing spares.

Regardless of where the spares are to be consigned, a copy of the delivery note and packing specification shall be sent to HV Projects, eThekwini Electricity, 1 Jelf Taylor Crescent, Durban, 4001 for record purposes.

12.3 Transformer Oil, Handling and Oil Impregnation

Transformers shall be of the oil immersed type.

a) Where mineral oil filled transformers are required, the oil shall be uninhibited compliant with the IEC 60296 standard.
b) Where natural ester oil filled transformers are required, the oil shall be compliant with both the IEC 60296 and IEC 62270: 2013 standards.

Every effort must be made to handle and store oil appropriately and according to methods prescribed by the oil supplier. This is especially critical for natural ester oil and the supplier must ensure that there will be no cross contamination of natural ester oil with any other oil at any point in the manufacturing process. Due to the oxidation stability of the natural ester oil, the exposure of the natural ester oil to oxygen must be kept to a minimum. This will be verified by eThekwini Municipality at the factory accreditation stage.

The transformers shall be filled with new oil and the Contractor will be responsible for the delivery of oil to site and the filling of oil. Oil filling and oil impregnation of the cellulose insulation must be done under full vacuum in an autoclave oven. The supplier must provide method statements and documentation to prove that the temperatures, vacuum and impregnation time is suitable for the application. This is a critical process for eThekwini Municipality and special attention will be paid to this process at the factory accreditation stage.

The onus is on the supplier to ensure that all materials used in the manufacture of the transformer are compatible with each other. This requirement is off particular importance in natural ester oil filled transformers.

12.3.1 Top-up oil containers

If more than 2 000 litres of top-up oil is required, then this shall be transported in a sealed oil storage tank properly designed for such a purpose. The tank shall have inlet and outlet facilities for oil

circulation.

12.3.2 Oil topping-up

It is unavoidable that the oil will deteriorate slightly when assembling the major components, especially with the Durban weather. It should be ensured that the transformer oil and paper is at the maximum achievable quality levels, especially moisture content and dielectric strength which is easily affected by exposure during assembling.

Oil shall be topped-up on site as follows:

a) Oil in transformer tank and oil storage tank shall be circulated through purification plant to achieve a minimum of 60 kV dielectric strength and 5 ppm moisture at 40°C, and not less than one (1) complete pass. (Oil plant capacity not less than 4 500 l/hr);
b) Draw vacuum and hold at less than 5 mbar for a minimum of 2 hrs;
c) Fill oil under vacuum;
d) Bleed/remove air from void as necessary;
e) The following shall be recorded and form part of the hand-over documentation:
   i. Details for oil plant;
   ii. Oil processing hourly log sheet: date, time, plant vacuum, oil temperature in, heater temperature, oil temp out and moisture content; and
   iii. Oil moisture content and dielectric strength test results before and after top-up.

After filling, oil samples must be taken from all sampling valves and shall be tested to IEC 60422 unless otherwise approved. After site tests and at the time of hand-over the Engineer shall, at his discretion, sample the oil and have the moisture content measured by an independent laboratory. The moisture content of the oil of transformers with windings of 132 kV before filling the transformer and tap-changer shall not exceed 10 ppm. At the time of take-over, the moisture content shall not exceed 20 ppm. It shall be demonstrated that the moisture content in the paper shall not exceed 1% with the Doble power factor test.

12.4 Bolts and Nuts

All nuts and washers used on equipment shall have a stainless steel grade of 304.

All bolts used on equipment shall have a stainless steel grade of 316.

12.5 Galvanising

All ferrous materials shall be hot-dipped galvanised and un-painted. Non structural items may be zinc metal sprayed and painted where approved by the Engineer.

All items shall be hot dip galvanised in accordance with SANS 121 (ISO 1461) to a minimum coating thickness as laid down in the appropriate tables of SANS 121 (ISO 1461).

The material shall be completely shaped, cut, drilled, countersunk, welded, etc. before galvanising.

All weld areas shall be abrasively blastcleaned. Following blastcleaning of the welds, all items shall be suitably pickled, rinsed, dried and fluxed.

Surfaces which are in contact with oil in service shall not be galvanised.

13.0 SUPPLEMENTARY INFORMATION

13.1 Quality, Evaluation and Design Review Requirements

13.1.1 Quality

The Engineer reserves the right to inspect the Manufacturer's and Sub-Contractor's works and process at any stage after receiving tenders in order to assess the quality of the Manufacturer's quality of his products and processes.

13.1.2 Evaluation

The tender evaluation will be conducted after tender closure as part of the technical evaluation of the tenders. The information given in "*T2 : Returnable Documents"* will be reviewed.

13.1.3 Design Review

Design reviews will be conducted by the Consultant and the Engineer at different stages of the procurement process.

The design review will commence after contract award, but before manufacture commences. This design review will relate to the specific design of the transformer on order. For this stage, the design control element of ISO 9001 shall apply.

The scope of such a review shall include the following:
a) Core design;
b) Winding and tapping design;
c) Thermal design;
d) Insulation co-ordination;
e) Tank and auxiliaries;
f) Bushings;
g) Tap-changers;
h) Protective devices;
i) Oil preservation system;
j) Painting and corrosion protection;
k) Processing and assembly;
l) Testing;
m) Short-circuit withstand capability;
n) Transient withstand capability;
o) Noise;
p) Overload capability;
q) Operation capability beyond nameplate specification;
r) RAM (reliability, availability and maintainability);
s) Drawings (outline, rating and diagram plate and wiring diagrams); and
t) Manufacturing facility and capability.

13.2 Capitalisation of Losses

The capitalisation formula to be used in determining the cost of losses is given in Schedule C2.4. In this formula the following abbreviations are used:
a) No load losses for Transformer "guaranteed" Iron Loss in kW as completed in the section of **"***Guarantees and Particulars of Equipment*".
b) Full load losses for Transformer "guaranteed" Copper Loss in kW as completed in the section of **"***Guarantees and Particulars of Equipment*".

The basic tender price of the transformers will be adjusted by the cost of the guaranteed losses for tender adjudication purposes. If the actual losses determined by tests are found to be greater than the losses guaranteed at the time of tendering, then the basic tender price of each transformer will be reduced before payment by the difference in value of the guaranteed losses and the actual losses capitalised by the above referenced formula.

13.3 Tender Information

PPreliminary outline and general arrangement drawings of the transformer and cooler units, earthing compensator and resistor together with detailed description, leaflets and illustrations of the equipment shall accompany the tender (Refer to the section of "*Details of Drawings Issued and Required*"19).

These shall be sufficiently detailed to allow design of supporting foundations to proceed.

A design sheet with calculations shall be submitted with the tender for each type of transformer design.

13.4 Contract Drawings

Contract drawings and information as requested in the section of "*Details of Drawings Issued and Required*", shall be supplied for each transformer type supplied under this contract.

All drawings shall have titles in English and have a reference to the contract number and the substation to which they apply.

The approval of drawings by the Engineer shall not relieve the Contractor of responsibility for correctness thereof, or from the consequences of error or omission on the Contractor's behalf.

All drawings issued by the Contractor shall illustrate schematics or diagrams on a suitably sized individual page. Multi-page drawings are not acceptable. All drawings shall be drawn on a standard Autocad template which will be issued to the successful Contractor on contract award. Once these drawings have been finalised the contractor shall submit all drawings on compact disc in AutoCad version 2024 (minimum) format. The transformer layout drawings shall be produced in a 3D Packaging design software.

13.5 Project Completion Documentation

Contractors are to compile and complete a spreadsheet detailing the relevant equipment attributes upon completion of each and every project. The information that is to be included in this document shall be confirmed with the Engineer and shall be subject to change depending on the project requirements.

13.6 Instruction Manuals

Three copies of instruction manuals in English shall be supplied before the transformers are delivered to site. The manuals shall be complete with all relevant drawings to enable the equipment to be assembled, checked and overhauled. Information shall be included on the following:

a) Mechanical operation of tap-changers;
b) Electrical control of tap-changers, fan motors, etc;
c) Maintenance manuals of tap-changer, selectors and diverters;
d) Electrical operation and setting of voltage regulating relays and circuits;
e) Details relating to the type, sensitivity and the operating mechanism of the Buchholz relays;
f) Setting and testing of winding temperature and oil temperature indicators, air breather and explosion vent; and
g) On-line monitoring system manual.

13.7 Transport and Site Handling

Tenderers shall acquaint themselves of the road/rail facilities and/or limitations, restrictions or regulations for transporting the transformers to the substation sites. The successful tenderer shall satisfy himself that the type of vehicle to be used for transporting the transformers can gain access to the sites and shall be responsible for making all the necessary arrangements and for obtaining any special permits. Full details of the proposed method of transport shall be submitted by the successful tenderer for approval. The Council will provide suitable roadways within the substation sites and arrange for connection of these to the nearest suitable public roadway. The successful Tenderer shall certify to the Engineer that access facilities to the point at which the transformers are off-loaded and the facilities for handling the transformers into position on the site, are satisfactory, prior to delivery of the transformers. Adequate advance notice of any special facilities, such as pulling points, or temporary hardening etc., required to be provided or undertaken by the Council, shall be given to the Engineer.

All shafts, bearings and machined surfaces exposed for transport to site shall be given a temporary protective coating to prevent corrosion.

If it is necessary to remove bushings or radiators for transport, blanking-off plates and a spare set of gaskets, in additions to those specified under "Spares" shall be provided.

Where the supply of oil is included in the contract and transport mass limitations permit, the transformers shall preferably be transported with sufficient oil to cover the core and windings. The tanks shall be sealed for transport to prevent all breathing.
Alternatively, where the above method is not applicable or practicable, the transformers shall be transported pressurised using dry air (not nitrogen) from the time it leaves the factory and also during storage on site prior to oil top-up. The pressurization system shall consist of a minimum of two (2) bottles of dry air, a two (2) stage regulator with gauges mounted in a box, a gauge with a shut off valve at the point where the pipe connects to the transformer. The bottles shall be of suitable size to accommodate full transport and assembly
operation, including inflating the air cell in the conservator. The transformer shall be pressurised to a nominal value of 20 kPa. The pressure and the temperature at the time of filling shall be stated and a pressure gauge, suitably protected, is to be fitted to each transformer. Every precaution shall be taken to ensure that the transformers arrive at site in a satisfactory condition so that subsequent to oil-filling they may be put into service without the necessity for further drying out on site.

An impact recorder (the accelerometer) shall be attached to the top of each transformer tank as well as the active part, on centre of gravity, for the duration of the transport process. A permanent marking on centre of gravity as attachment points for impact recorders shall be made. The accelerometer shall record a shock of a minimum threshold of say 1 g and duration of 10 ms. The accelerometer shall record and also perform measurement of inclination. These recordings shall be date and time stamped. The traces shall be inspected by the Engineer as part of the quality process.

13.8 Terms of Payment

In cases where the Engineer recognises that the delivery of a power transformer unit will have to be delayed due to site access difficulties the contractual delivery date will be changed by written instruction, and where this is more than six months prior to the standing contractual delivery date the programme of manufacture of the unit must be altered to suit this revised contractual delivery date.

However, where such notice is less than six months and the Contractor can show that it is not reasonable to alter the manufacturing programme to suit the revised delivery date, the Contractor will be required to delay the delivery to site of the unit when so requested in writing by the Engineer in which case, subject to a power transformer having been manufactured and successfully factory tested and otherwise ready for delivery in terms of the standing contractual delivery date, the Engineer shall authorise payment as if the transformers were on site; subject to the provision of security acceptable to the City Treasurer to the full value of such payment claimed.

13.9 Delivery

To avoid delays in off-loading, the Contractor shall give 48 hrs notice of the arrival of transformers by road transport. Transformers will not be accepted on Saturdays, Sundays or Public Holidays or after 16h30 on normal working days.

Special arrangements under emergencies or unforeseen circumstances will be dealt with at the Engineer’s discretion.

13.10 Repair

The OEM or his representative shall repair the transformers windings, if any winding fault occurs, while transformer was operated within its operating limits and with oil and winding temperatures as specified.

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C3.3: EVALUATION CRITERIA

C3.3.1 Specification Minimum Requirements

Annexure A: Mandatory Requirements – Completeness of documents

1	Are the technical schedules completely filled and all the information provided?	Y	N	
2	Are factory failure rate figures given for the past 5 years, and the proof that the figures have been independently audited available?	Y	N	

Annexure B: Mandatory Requirements – Technical Requirements

Total Points: 19 **Pass mark:** 19

No	Item Details	Score		Remarks
1	Are the ratings (MVA and all voltages) offered correct as per section of *"Guarantees and Particulars of Equipment"*?	Y	N	
2	Are the flux densities within the specification requirements?	Y	N	
3	Is the vector group correct?	Y	N	
4	Is the winding arrangement confirmed and correct?	Y	N	
5	Are the terminal arrangements supplied as per the *"General Technical Specification"* document?	Y	N	
6	Is the tap-change positioning complying with the section of *"Guarantees and Particulars of Equipment"*?	Y	N	
7	Are all the temperature rise figures complying with the requirements as indicated in the section of *"Guarantees and Particulars of Equipment"*?	Y	N	
8	Are the transport dimensions within the requirements indicated in the section of *"Guarantees and Particulars of Equipment"*	Y	N	
9	Are the bushings offered of correct technology (capacitive type resin impregnated paper with silicone sheds for 275 kV and resin impregnated paper with silicone sheds for 132 kV) and comply with IEC?	Y	N	
10	Are the lists of tests listed by the bidder complying with IEC as in Section 11.0 of the *"General Technical Specification"*?	Y	N	
11	Are the impedances indicated as required in the section of *"Guarantees and Particulars of Equipment"*?	Y	N	
12	Is the overall magnetic circuit design accepted	Y	N	
13	Is the overall dielectric design accepted	Y	N	
14	Is the overall thermal design accepted	Y	N	
15	Is the overall design for short circuit forces accepted?	Y	N	
16	Is an outline drawing showing the provision of the gas analysers?	Y	N	

17	Are the painting requirements of the *"General Technical Specification"* met?	Y	N	
18	Is a dial type winding temperature and oil temperature indicator offered on a 132 kV transformer as per *"General Technical Specification"*?	Y	N	
19	Is a combined electronic winding and oil temperature indicator offered on a 275 kV transformer as per *"General Technical*	Y	N	

Note: 1. A "No" in any of these items will result in a score of zero.
2. Questions 12 to 15 will be evaluated by an independent consultant, based on the information provided, and his/her judgement is final.

Annexure C: Discretionary Requirements

Total Points: 18 **Pass Mark:** 13

No	Item Details	Score		Remarks
1	Is the base of each transformer suitable for sliding the transformer into final position as per the *"General Technical Specification"*?	Y	N	
2	Are the external clearances clearly indicated in the prelim drawings and complying with eThekwini Electricity's requirements?	Y	N	
3	Are the buchholz relay requirements complying with the transformer specification, the catalogue of the offered relay submitted and complying with the specification?	Y	N	
4	Is the conservator a rubber bag sealed system and is the bag information provided (catalogue)?	Y	N	
5	Is the airbag leak detector offered, technical details submitted and complying with the specification?	Y	N	
6	Are the temperature indicators information available and complying with IEC	Y	N	
7	Are the pressure relief devices offered as per transformer specification and complying with IEC requirements?	Y	N	
8	Is a self dehydrating breather for each conservator compartment offered as per *"General Technical Specification"*?	Y	N	
9	Are the details of the tap-changer protective devices supplied and meet the requirements of the IEC specification?	Y	N	
10	Is the magnetisation characteristic curve of the transformer provided?	Y	N	
11	Is a correct type of tap-changer offered?	Y	N	
12	Is a valve plate provided and complying with the requirements?	Y	N	
13	Is the on-line single gas dissolved gas analyser (DGA) for transformer continuous monitoring offered?	Y	N	
14	Is the multi-gas (8 gas) dissolved gas analyser (DGA) for transformer continuous monitoring offered?	Y	N	
15	Are the UHF partial discharge valves, probes and analyser offered as per *"General Technical Specification"*?	Y	N	
16	Is the transformer operating temperature monitoring equipment offered? (To be used with the optic fibre probes as well)	Y	N	
17	Are all transformers to be supplied with fibre optic hot spot temperature probes within the winding as per requirement?	Y	N	
18	Is a permanent steel step ladder provided on the transformer as per *"General Technical Specification"*?	Y	N	

C3.4: PARTICULAR SPECIFICATIONS

In addition to the Standardized and General Technical Specifications the following Particular Specifications / Policies shall apply to this contract and are available on web address:

ftp:\\ftp.durban.gov.za/cesu/StdContractDocs/:

C3.4.1 Application for Accreditation on Supplier Database (27 pages)

C3.4.2 Environmental Management Specifications – eThekwini Municipality (27 Pages)

C3.4.3 31144-5E Site Specific Health and Safety Specification (17 Pages)

C3.4.4 31144-5E Covid-19 Health and Safety Specification (6 Pages)

C3.4.5 31144-5E Project Baseline Risk Assessment (15 Pages)

C3.4.6 Section 37 (2) Mandatory Agreement (5 Pages)