

**STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION
AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT
GLENVILLE 88/11KV SUBSTATION**

Procurement Reference Number: ZETDC/INTER/06/2023

**Zimbabwe Electricity Transmission & Distribution
Company**



**STANDARD
BIDDING
DOCUMENT**



**For The
SUPPLY, DELIVERY, INSTALLATION AND
COMMISSIONING OF 20MVA, 132/88/11KV POWER
TRANSFORMER AT GLENVILLE 88/11KV
SUBSTATION**

Closing Date : 17 October 2023

Closing Time : 10:00 hours

STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

Procurement Reference No: ZETDC/INTER/06/2023
Procuring Entity: ZETDC
Date of Issue: 11 August 2023



STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

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Part 1: BIDDING PROCEDURES

1.0 References

The definitions used in the Public Procurement and Disposal of Public Assets Act [Chapter22:23] ("the Act"), the Public Procurement and Disposal of Public Assets (General) Regulations (Statutory Instrument No. 5 of 2018) ("the Regulations") and the General Conditions of Contract for the Procurement of goods apply to this Standard Bidding Document. The Act and the Regulations govern the submission of Bids and should be read by all Bidders.

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1.1 Preparation of Bids

You are requested to bid for the items described in the Statement of Requirements below, by completing and returning the following documentation:

1. The Bid Submission Sheet in this Part in the format specified in Part 1;
2. The Statement of Requirements in Part 2 in the format specified in Part 2;
3. All Bidders must complete all schedules without fail for them to be eligible bidders to attach a copy of every document necessary to demonstrate eligibility in terms of section 28 (1) of the Regulations;
4. Supplier Registration number showing that you are registered with the Procurement Regulatory Authority of Zimbabwe in the correct category for year 2023; Electrical Products: Cables and Materials, Power Back-Up Equipment, Transformers, Standby Generators, Consumables & Accessories (GE001);
5. A bid security of **USD 500.00** payable in Zimbabwean Dollars at the RBZ prevailing Interbank rate of the day for local bidders and in USD currency for foreign bidders in the format specified in this part;
6. Proof of payment of **USD 350.00** payable in Zimbabwean Dollars at the RBZ prevailing Interbank rate of the day for local bidders and in USD currency for foreign bidders to the Procurement Regulatory Authority of Zimbabwe Special Procurement Oversight Committee (SPOC) fee;
7. A copy of Certificate of Incorporation, CR 14; CR6 or equivalent company registration documents in country of residence;
8. Proof of registration with ZIMRA or equivalent reigstration with revenue authorities in country of residence;
9. The Tenderer must clearly state Sub Total, Duty, VAT and Total Tender Price separately in the Price Schedule. (N.B. Duty and VAT must be quoted by both local and foreign bidders for evaluation purposes. Customs clearance shall be done by ZETDC);
10. Payment terms are within 30 days after delivery and must be clearly stated. Invoices will be paid in Zimbabwean dollars at the prevailing Interbank rate on the date of payment to local companies and in USD currency to foreign companies;

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11. Minimum of three (3) Reference lists, i.e. letters from customers with active contact details showing Bidder's (Service Provider's) direct experience in the provision of electrical goods.
12. Minimum of three (3) Reference lists, i.e. letters from customers with active contact details showing Original Equipment Manufacturer's (OEM) direct experience in the provision of similar goods.
13. Validity of Bids shall be ninety (90) days.
14. Delivery period shall be five (5) months or better to ZETDC, Glenville Substation, Bulawayo.
15. Applicable incoterms must be C.I.P Bulawayo, ZETDC, Glenville Substation and **must** be clearly stated.
16. Valid Letter of Authorization from respective manufacturer, with tender number and description for this particular tender must be provided by Agents/Non-manufacturers.
17. Technical Guarantee Schedules (TGS) to be completed in full, signed for and shall be compliant with ZETDC requirements.
18. Valid Copy of ISO 9001/2 certification must be provided with the bid.
19. Manufacturer's supply history of at least 3 years to be provided with the bid, clearly stating, year, client, project/product and completion status.
20. Results of Type tests or type test reports carried out by independent technical institute on previously manufactured equipment similar to tendered items must be submitted with the bid.
21. Technical Brochures with detailed literature covering the tendered items to be included in the bid.
22. Drawings and Diagrams of the tendered items to be submitted with the bid.
23. Partial bid shall not be accepted.

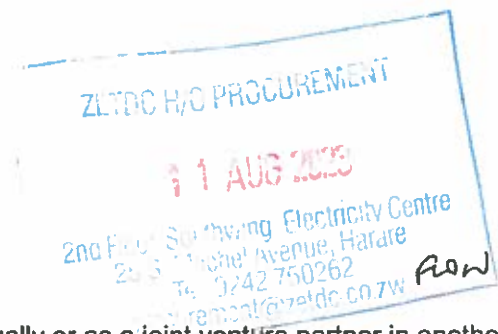
You are advised to carefully read the complete Bidding Document, as well as the Special Conditions of Contract in Part 3: Contract, which are available on the Authority's website, before preparing your Bid. Part 3: Contract is provided not for completion at this stage but to enable Bidders to note the Contract terms they will enter into if their Bid is successful. The standard forms in this document may be retyped for completion but the Bidder is responsible for their accurate reproduction. All pages of the Bid must be clearly marked with the Procurement Reference Number above, the Bidder's name, and any reference number.

1.2 Lots

There are no Lots on this tender.

1.3 Number of bids allowed

No Bidder may submit more than one Bid, either individually or as a joint venture partner in another Bid, except as a subcontractor. Conflict of interest will be deemed to arise if Bids are received from



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more than one Bidder owned, directly or indirectly, by the same person. **Bidders should note that only the main offers will be considered. No alternatives or options will be entertained unless on a separate bid.**

1.4 Clarifications

Clarification of the bidding document may be requested from ZETDC Supply Chain Manager in writing on duly signed company letterhead by email to procurement@zetdc.co.zw at any time on or before **14 September 2023**. If a prospective Tenderer sends an inquiry after the stated date or the inquiry is received by ZETDC after the stated date, ZETDC shall not respond to the inquiry but ignore it.

1.5 Responses to Clarifications

All responses to clarifications will be posted on ZETDC website www.zetdc.co.zw. Bidders should frequently check for updates on the website until the closing date of the tender.

1.6 Eligibility and qualification requirements

Bidders are required to meet the criteria in section 28 of the Act and section 28 (1) of the Regulations to be eligible to participate in public procurement and to be qualified for the proposed Contract. They must therefore

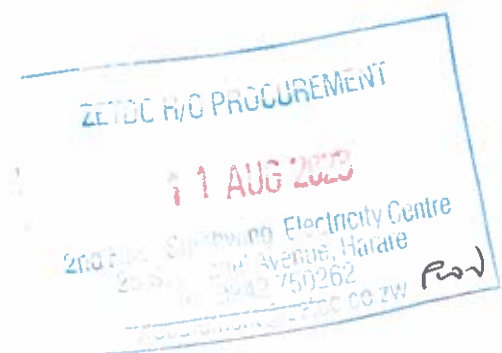
1. have the legal capacity to enter into a contract;
2. not be insolvent, in receivership, bankrupt or being wound up, not have had business activities suspended and not be the subject of legal proceedings for any of these circumstances;
3. have fulfilled their obligations to pay taxes and social security contributions in Zimbabwe;
4. not have a conflict of interest in relation to this procurement requirement;
5. not be debarred from participation in public procurement under section 72 (6) of the Act and section 74(1) I, (d) or (e) of the Regulations or declared ineligible under section 99 of the Act;
6. have the nationality of an eligible country as specified in the Special Conditions of Contract; and
7. have been registered with the Authority as a Supplier and have paid the applicable Supplier Registration Fee set out in Part III of the Fifth Schedule to the Regulations.

In addition to these eligibility requirements, Bidders must demonstrate that they have the qualifications, resources and experience to perform the contract to satisfactory standards, as indicated in the Statement of Requirements.

Participation in this bidding procedure is restricted to Zimbabwean bidders and must attach Certification of Incorporation to confirm this.

1.7 Pre-bid meeting and Site Visit

No pre-bid meeting and Site Visit has been organized.



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1.8 Validity of Bids

The minimum period for which the Bidder's bid must remain valid is ninety (90) days from the deadline for the submission of bids.

1.9 Submission of Bids

Bids must be submitted in writing in English language, in hard copy format and in a sealed envelope to the address below, not later than the date and time of the deadline below. It is the Bidder's responsibility to ensure that they receive a receipt confirming submission of their bid that has correct details of the Bidder and the number of the Bid.

The Bidder must mark the envelope with the Bidder's name and address and the Procurement Reference Number.

Bids should be submitted in duplicate with one (1) original copy marked, "ORIGINAL" AND one (1) copy marked "COPY". All two (2) copies should be in sealed envelopes clearly marked with details of the tender, and should be deposited in a tender box situated at the below address. In the event of any discrepancy between the original and the copy, the original will prevail.

Late bids will be rejected. The Procuring Entity reserves the right to extend the bid submission deadline but will notify all potential bidders who have collected the bidding documents of the amended bid submission deadline.

Date of deadline:	17 October 2023	Deadline Time:	10:00 hours
Submission address:	ZIMBABWE ELECTRICITY TRANSMISSION & DISTRIBUTION COMPANY (ZETDC) Ground Floor, Electricity Centre 25 Samora Machel Avenue Harare		
Means of acceptance:	of Bids in the sealed envelopes shall be deposited in a tender box situated at the above address. All the bidders should record their bids in the tender submission register situated thereto, in the format prescribed in the register.		

ZETDC P/C PROCUREMENT
 11 AUG 2023
 2nd Floor, Joint Training Electricity Centre
 25 Samora Machel Avenue, Harare
 Tel: +263 252 750262
 ZIMBABWE ELECTRICITY TRANSMISSION & DISTRIBUTION COMPANY (ZETDC) ZIMBABWE
 FWJ

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1.10 Bid Opening

Bidders and their representatives may witness the opening of bids which will take place at the submission address immediately following the deadline.

1.11 Withdrawal, amendment or modification of Bids

A Bidder may withdraw, substitute, or modify its Bid after it has been submitted by sending a written notice, duly signed by an authorized representative. However, no Bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of Bids and the expiration of the period of Bid validity specified by the Bidder or any extension of that period.

1.12 Bid Prices and Discounts

The prices and discounts quoted by the Bidder in the Bid Submission Form and in the Price Schedules must conform to the requirements specified in the Price Schedule included in Part 2: Statement of Requirements.

1.13 Bid Security

The Bidder must provide a bid security of **USD 500.00** payable in Zimbabwean Dollars at the RBZ prevailing Interbank rate of the day for local bidders and in USD currency for foreign bidders in the following form:

First Option. A certified bank cheque; or

Second Option. A bank guarantee; or

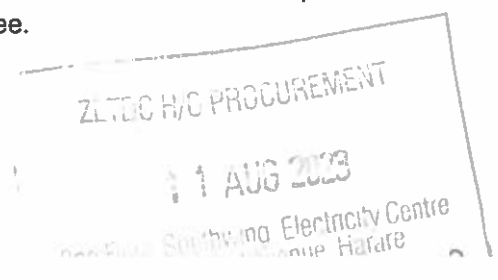
Third Option. A refundable cash deposit of **USD 500.00** payable in Zimbabwean Dollars at the RBZ prevailing Interbank rate of the day for local bidders and in USD currency for foreign bidders to the Procurement Regulatory Authority of Zimbabwe (PRAZ) – If the third option is chosen, bidders must also submit proof of payment of non-refundable Bid Bond establishment fees of **USD 150.00** payable in Zimbabwean Dollars at the RBZ prevailing Interbank rate of the day for local bidders and in USD currency for foreign bidders.

IF A BIDDER CHOOSES SECOND AND THIRD OPTIONS THE FOLLOWING SHOULD BE NOTED:

Second Option

The required Bank Guarantee should include the following features and be redeemable in Zimbabwe in order for it to be considered valid:

1. Letterhead of registered commercial bank (i.e. the Supplier of the Bank Guarantee)
2. The Header has to clearly state that it is a Bank Guarantee.



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3. Purpose of the Bank Guarantee to be clearly stated.
4. The date when the Common Seal of the said Surety was effected should be clearly shown.
5. Conditions of the said Obligations must be stated.
6. The physical address of the Surety should be given.
7. The validity period of the Bank Guarantee must be clearly stated.
8. Signature of surety and the date when it was endorsed must be clearly shown.
9. It must be an original document that is date stamped.
10. Bid Bonds from Insurance Companies are not acceptable.

The Bank Guarantee of the unsuccessful bidders will be released immediately after the award of the Tender while that of the winning bidder will only be released after signing of the contract.

Third Option

1. If Option 3 is chosen bidders must pay **USD 500.00** payable in Zimbabwean Dollars at the RBZ prevailing Interbank rate of the day for local bidders and in USD currency for foreign bidders for the Bid Security that shall be Refundable at the end of the bid validity period plus another **USD 150.00** that shall be non-refundable for cash bid bond establishment fee in line with Part V of the Procurement Regulations (S.I.193 of 2022). The amount is payable at Procurement Regulatory Authority of Zimbabwe (PRAZ), 9th Floor, Pearl House, 61 Samora Machel A venue, Harare or to be deposited in the following account numbers:

2 NON-REFUNDABLE (LOCAL)

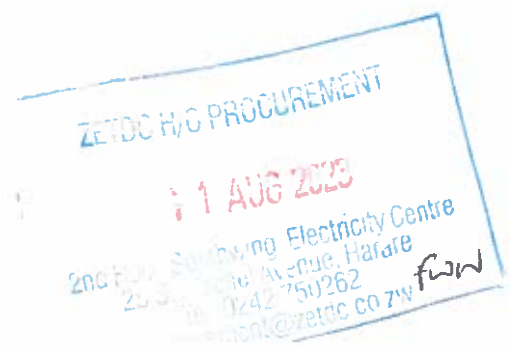
BANK NAME: COMMERCIAL BANK OF ZIMBABWE
ACCOUNT NAME: PROCUREMENT REGULATORY AUTHORITY OF ZIMBABWE
ACCOUNT NUMBER:01121064850020
BRANCH: KWAME NKRUMAH

3 REFUNDABLE (LOCAL)

BANK NAME: COMMERCIAL BANK OF ZIMBABWE
ACCOUNT NAME: PROCUREMENT REGULATORY AUTHORITY OF ZIMBABWE
ACCOUNT NUMBER:01121064850030
BRANCH: KWAME NKRUMAH

NB: The bid security shall be valid for ninety (90) days after the closing of this tender and the original proof of payment must be submitted together with the bid.

Any bid not accompanied by a Bid Security in accordance with section 26 (3) of the Regulations, will be rejected by the Procuring Entity as non-responsive.



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1.14 Evaluation of Bids

Bids will be evaluated using the following methodology:

1. Preliminary examination to confirm that all documents required have been provided, to confirm the eligibility of Bidders in terms of section 28(1) of the Regulation and to confirm that the Bid is administratively compliant in terms of section 28(2) of the Regulation.
2. Technical evaluation to determine their substantial responsiveness to the specifications in the Statement of Requirements;
3. Financial evaluation and comparison to determine the evaluated price of Bids and to determine the lowest evaluated Bid.

Bids failing any stage will be eliminated and not considered in subsequent stages.

1.15 Review by the Special Procurement Oversight Committee (SPOC)

Section 54 of the Act provides for review by the SPOC. This requirement will be subject to SPOC.

1.16 Currency

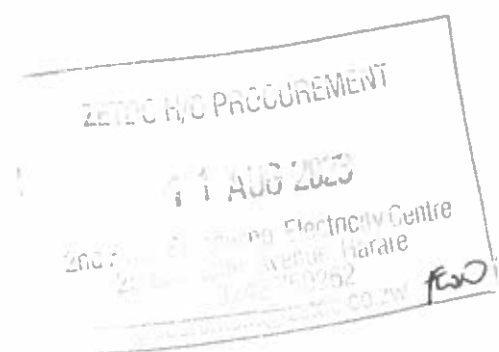
Bids should be priced in United States Dollars.

1.17 Award of Contract

The lowest evaluated bid after the application of any additional evaluation criteria, including any margin of preference, which is substantially responsive to the requirements of this Bidding Document will be recommended for award of the contract. The proposed award of contract will be by issue of a Notification of Contract Award in terms of section 55 of the Act, which will be effective until signature of the contract documents in accordance with Part 3: Contract. Unsuccessful Bidders will receive the Notification of Contract Award and, if they consider they have suffered prejudice from the process, they may, within 14 days of receiving this Notification, submit to the Procuring Entity a Challenge in terms of section 73 of the Act, subject to payment of the applicable fee set out in section 44 of and the Third Schedule to the Regulations.

1.18 Right to Reject

The Procuring Entity reserves the right to accept or reject any Bid or to cancel the procurement process and reject all Bids at any time prior to contract award.



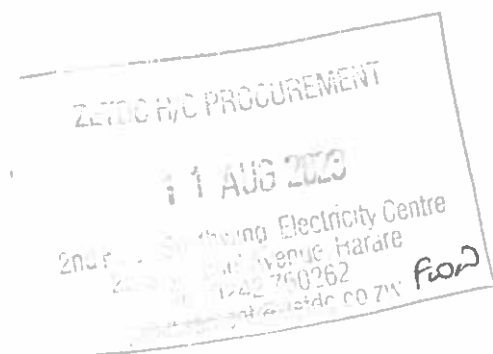
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1.19 Corrupt Practices

The Government of Zimbabwe requires that Procuring Entities, as well as Bidders and Contractors, observe the highest standard of ethics during the procurement and execution of contracts. In pursuit of this policy:

1. the Procuring Entity will reject a recommendation for award if it determines that the Bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive or coercive practices in competing for the Contract or has been declared ineligible to be awarded a procurement contract under section 99 of the Act;
2. the Authority may under section 72 (6) of the Act impose debarment and other sanctions under section 74 (1) of the Regulations; and
3. Any conflict of interest on the part of the Bidder must be declared.



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1.20 Bid Submission Sheet

{Note to Bidders: Complete this form with all the requested details and submit it as the first page of your Bid. Attach the Price Schedule and Statement of Methodology, Work Plan and Schedule together with any other documents requested in Part 1. Any variation from the Statement of Requirements should be indicated in the Statement of Methodology, Work Plan and Schedule, otherwise you commit to complying fully with these Requirements.

Ensure that your Bid is authorised in the signature block below. A signature and authorisation on this form will confirm that the terms and conditions of this Bid prevail over any attachments. If your Bid is not authorised, it may be rejected. If the Bidder is a Joint Venture (JV), the Bid must be signed by an authorized representative of the JV on behalf of the JV, and so as to be legally binding on all the members as evidenced by a power of attorney signed by their legally authorized representatives.

Bidders should mark as "CONFIDENTIAL" information in their Bids which is confidential to their business. This may include proprietary information, trade secrets, or commercial or financially sensitive information}.

Procurement Reference Number:	
Subject of Procurement:	
Name of Bidder:	
Bidder's Reference Number:	
Date of Bid:	

We offer to perform the services listed in the Statement of Requirements to the indicated specifications and standards, at the prices indicated on the attached Price Schedule and in accordance with the terms and conditions stated in your Bidding Document referenced above.

We confirm that we meet the eligibility criteria specified in Part 1: Procedures of Bidding.

We declare that we are not debarred from bidding and that the documents we submit are true and correct.

The validity period of our bid is:{days} from the date of submission.

We confirm that the prices quoted in the attached Price Schedule are fixed and firm for the duration of the validity period and will not be subject to revision, variation or adjustment.

Bid Authorised By:

Signature	Name:
Position:	Date:(DD/MM/YY)
Authorised for and on behalf of:	
Company	
Address:	
.....	

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Part 2: STATEMENT OF REQUIREMENTS

2.1 List of Services and Price Schedule

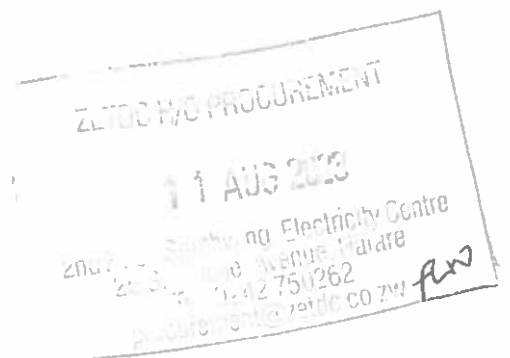
Procurement Reference Number: ZETDC/INTER/06/2023

Bidder's Name: _____

Bidder's Reference Number: _____

Currency of Bid - USD

Item No	Description of Goods	UOM	Qty	Unit Price Excl. Duty & VAT	Total Price
				[to be provided by the Bidder]	[to be provided by the Bidder]
1	20MVA, 132/88/11kV Power Transformer (complete with spares)	Each	1		
2	11kV Lighting Arrestors (Line Type)	Each	1		
3	Overcurrent and Earth Fault Protection	Each	1		
4	Transformer Differential Protection Relay	Each	1		
5	Multi-Function Configurable Electrical Transducer	Each	1		
	Sub-Total (1) Excluding Duty and VAT				
	Duty				
	Sub-Total (2) Including Duty				
	VAT (15%)				
	Total Tender Price Including Duty and VAT				



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2.2 Delivery Schedule

Procurement Reference No.: ZETDC/INTER/06/2023

Bidder's Name:

Bidder's Reference Number:

{Note to Bidders: If the delivery period offered, or any other details, differ from the requirements below, this should be stated in your tender}.

Item No.	Description of Goods	Qty	UOM	Delivery Date Required by Procuring Entity and applicable INCOTERM	Bidder's offered Delivery period & Incoterm
					<i>N.B. Insert Delivery Period & Applicable Incoterm in the row below under this column</i>
1	20MVA, 132/88/11kV Power Transformer (complete with spares)	1	Each	5 Months or better; CIP Glenville Substation Bulawayo	
2	11kV Lighting Arrestors (Line Type)	1	Each	5 Months or better; CIP Glenville Substation Bulawayo	
3	Overcurrent and Earth Fault Protection	1	Each	5 Months or better; CIP Glenville Substation Bulawayo	
4	Transformer Differential Protection Relay	1	Each	5 Months or better; CIP Glenville Substation Bulawayo	
5	Multi-Function Configurable Electrical Transducer	1	Each	5 Months or better; CIP Glenville Substation Bulawayo	

The delivery period required is measured from the date of receipt of official order after signing of the Contract between the Procuring Entity and the Bidder.

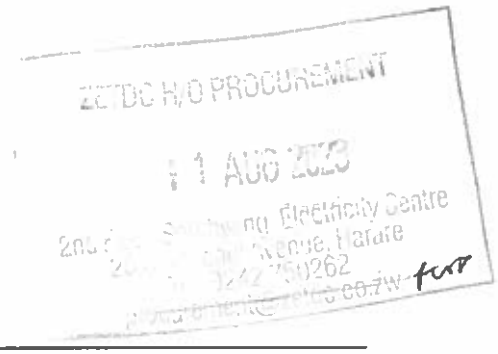
The Project Site for delivery of the goods is the final destination:	ZETDC, Glenville Substation, Bulawayo, Zimbabwe
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2.3 Bidder's Details

Tender Number: ZETDC/INTER/06/2023



Name of Bidder: _____

Physical Address: _____

Active Telephone Numbers: _____

Active email Address: _____

Tick the Option chosen to pay Bid Security

First Option. A certified bank cheque; or

Second Option. A bank guarantee; or
Name of the Bank: _____

Third Option. A refundable cash deposit of **USD 500.00** and Bid Bond establishment fee of **USD 150.00** payable at interbank rate as at date of payment for local bidders and in USD currency for foreign bidders to the Procurement Regulatory Authority of Zimbabwe (PRAZ)

Banking Details

Account Name: _____

Bank: _____

Branch: _____

Account Number: _____

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2.4 TECHNICAL STATEMENT OF REQUIRMENTS

FOR

20MVA, 132/88/11KV POWER TRANSFORMER AND ASSOCIATED EQUIPMENT/ACCESSORIES (SEE BELOW TECHNICAL SPECIFICATIONS)



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2.4.1 20MVA, 132-88/11KV POWER TRANSFORMER

ZETDC SPECIFICATION NO DS17072018PT

20 MVA POWER TRANSFORMER

1. SCOPE

This specification covers the design, manufacture, sampling and Factory Testing before dispatch, supply, delivery, installation and commissioning of a 20MVA, 132-88/11kV Power Transformer to be installed in the outdoor switchyard at Glenville Substation in Bulawayo.

The transformer shall be supplied together with all ancillary equipment for a complete installation.

The Supplier shall state name, place and country of manufacture. The Supplier shall state whether or not the transformers are produced under license, in which case the licence holder's name shall be stated.

The following spares should form part of scope of supply.

Quantity	Type of Spare
1	HV Bushing
1	LV Bushing
1	LV Neutral Bushing
1	Diverter Switch Contact
1	Selector Switch Contact
1	Fan Motor for ONAF type of transformer
1	Silica Gel Unit

ZETDC PROCUREMENT
1 AUG 2023
Zimbabwe Electricity Centre
2000, Water Works, Harare
12 751262
procurement@zetdc.co.zw
FUN

2. INSPECTION OF TRANSFORMER

At least two (2) ZETDC representatives shall witness the transformer final factory tests. The supplier shall meet all the costs associated with the factory tests.

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3. PARTICULARS OF ELECTRICAL SYSTEM

Unless otherwise specified in the Schedule of Requirements, it must be assumed that the system on which the equipment will operate is:

- a) Three phase, overhead and underground system. The maximum earth fault factor on the network is 1.5.
- b) Operated at 50 Hz variable between plus or minus 2.5%.
- c) The highest system voltage does not normally exceed the nominal system voltage by more than 10%. The nominal system voltages are 33kV and 11kV.

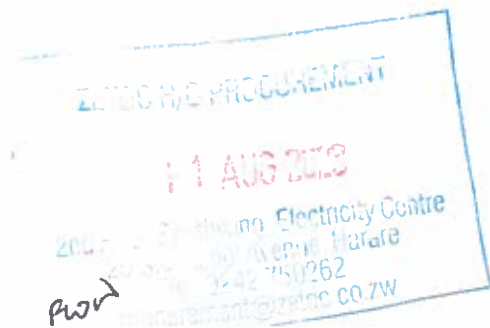
Designs should allow for these variations.

4. PARTICULARS OF THE ENVIRONMENT

The transformers shall be capable of operating under the following environmental conditions.

- a) Ambient temperatures:
 - i. Maximum: +45 °C
 - ii. Minimum: - 10 °C
 - iii. Maximum daily average: +35 °C

All transformers shall be capable of being loaded continuously at the full rating at ambient temperatures of 35 °C, while exposed to direct tropical sun. Wherever any of these maximum or 24 hour average temperatures exceed the normal service condition temperatures of the IEC Recommendations for the relevant equipment, or of such other standard which is approved to be applied, the permissible temperature rises of the IEC Recommendations or the standard shall be reduced by the same amount as the difference between the above figures and the normal service condition temperatures.



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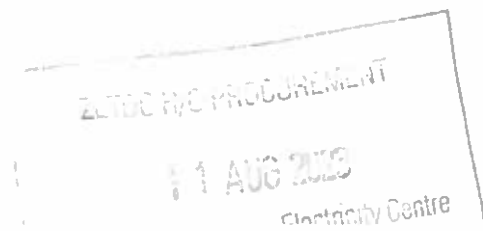
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These reduced temperature rises shall be guaranteed by the Tenderer

- b) Altitude: The transformer will operate at an average altitude of 1 500m above sea level at typical air pressure of 860 mbar.
- c) The transformers will be exposed to direct tropical sunlight.
- d) Humidity: Humidity of 13mg per cubic metre absolute and 65% relative before storms with vapour pressure of 17mmHg.
- e) Transformers will operate within the tropics and will be subjected to sudden ambient air temperature changes of the order of 10 °C per hour, occurring at the onset of rain, but the barometric pressure at any given place does not vary by more than approximately 10mm Mercury. Frequent and severe lightning storms occur during summer months, with isoceraunic levels varying between 50 and 110 thunderstorm days per annum.
- f) Relative humidity - 80%
- g) Maximum wind pressure on project area of conductors and cylindrical objects - 430 N/m²
- h) Maximum wind pressure on steel members on 1.5 times projected area - 820 N/m²
- i) Rainfall conditions - 800-1700 mm/year
Maximum - 160mm in 24 hrs
- j) Maximum solar radiation shall be 1200W/m²

It is the manufacturer responsibility to make himself familiar with any other climatic and physical conditions pertaining in Zimbabwe and to allow for all conditions in his designs.

Particular attention should be paid in the design of all equipment to ensure that there is no possibility of ingress of dust, insects or vermin.



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All orifices and air vents should be covered by easily replaceable weather resisting, fine mesh wire where practicable.

5. STANDARDS, LANGUAGE AND UNITS

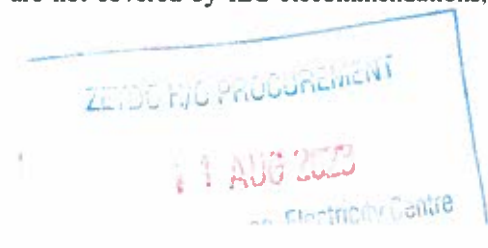
Except where modified by ZETDC's Specifications, the following standards shall apply in this Specification:

- a) IEC Recommendations (IEC 76) shall apply or British Standards (BS) where they amplify the IEC 76.
 - i) IEC 76-1: Power Transformers-General
 - ii) IEC 76-2: Power Transformers-Temperature rise
 - iii) IEC 76-3: Power Transformers-Insulation levels, dielectric tests and external clearances in air
 - iv) IEC 60076-4: Guide to the Lightning Impulse and Switching Impulse testing – Power Transformers and Reactors
 - v) IEC 60076-5: Ability to withstand short circuit
 - vi) IEC 60076-7: Loading Guide for oil immersed power transformers
 - vii) IEC 60076-8: Application guide
 - viii) IEC 60076-10: Determination of sound levels
 - ix) IEC 60076-14: Design and application of liquid immersed power transformers using high - temperature insulation materials

- b) IEC 354 Second addition: Loading guide for oil-immersed Power Transformers

- c) IEC 542 First Edition: Application guide for on-load tap-changers and its latest amendment.

Ratings, characteristics, tests and test procedures, etc. for the electrical equipment encompassed by this specification shall comply with the provisions and requirements of the Recommendations of the British Standards where they amplify IEC, unless expressly stated otherwise. Where the IEC Recommendations do not fully cover all provisions and requirements for the design, construction, testing, etc. and for equipment and components which are not covered by IEC Recommendations,



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recognized national standards shall be applied. The rules of CEE (International Commission for the approval of electrical equipment) and the standards of CENELEC (Comite European de Normalisation Electrotechnique) may also be applied.

The latest revision or edition in effect at the time of Bid Invitation shall apply.

In case of conflict or disagreement between the particulars of the Standard Specification adopted by the Tenderer and the particulars of this Standard Specification, the ruling of this Specification shall prevail. All conflicts or disagreements, mentioned above, must be clearly stated, failing which the materials and equipment offered shall be deemed to comply in every respect with this Specification both in manufacture and in performance, and compliance thereof be insisted upon without additional cost to ZETDC.

The transformers shall be sourced from manufacturers who have ISO 9001/2 Certification. Documentary evidence of the ISO 9001/2 Certification shall be provided with the bid. Manufacturers who cannot submit such certification are liable to be rejected.

All tenders, correspondence, description upon drawings, illustrations or instructions shall be in unambiguous English.

SI Units of measurements shall be used throughout.

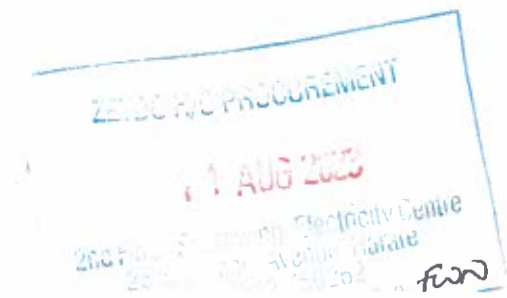
All materials used in the manufacture of the transformer shall be new and of high commercial quality.

The transformer shall be manufactured to high quality standards.

6 DESIGN

6.1 General

The transformer shall be of the oil-immersed type suitable for outdoor use. They shall be dried out at the manufacturer's works and it should be possible to commission them without further drying out.



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Designs shall be such that water does not collect on any part of the equipment. Particular attention shall be paid in the design of all equipment to ensure that there is no damage to working parts or insulation through the ingress of dust, insects or vermin which are prevalent for long periods in the year.

Live metal of auxiliary connections in air shall be screened to prevent accidental contact and shall be enclosed in compartments which are fitted with approved means to provide reasonable dry conditions within the compartments. In addition, where there are auxiliary connections at 380 volts or more, "Danger" notices shall be affixed to the outside of the compartments.

6.2 Cores

The transformer core shall be built up of laminations of the best quality, non-ageing, cold-rolled, grain oriented, silicon sheet steel of high permeability and low loss coefficient.

All joints between laminations shall be of the interleaved type and the laminations shall be clamped securely. Bolting of the core should be avoided to reduce losses. The cross-section of the core shall form an approximate circle.

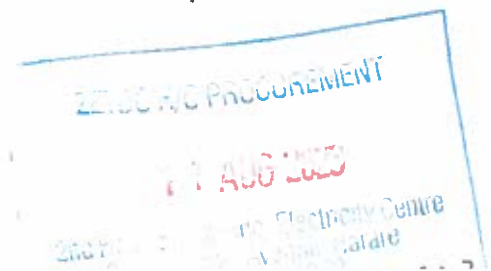
The laminations shall be separated by hot oil-proof insulation, and the clamping of the frame shall be firm to ensure even pressure over the whole of the core laminations so as to prevent undue vibrations or noises.

The core sheets shall be insulated with high-grade oil-proof insulation, for example magnesium-silicate-phosphate. Paper will not be accepted.

The magnetic circuit shall be designed to avoid the production of flux components at right angles to the plane of laminations, which may cause excessive local heating.

The core clamping arrangement and framework shall be efficiently insulated from the cores and withstand 2kV, 50 HZ applied for 1 minute. The core shall be designed and built up in such a manner as to avoid accidental or slow development of short circuit paths through the iron and framework.

Each part of the core shall be electrically earthed to the transformer tank. The internal earth connection shall be of the detachable link type and shall be located in an accessible position.



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The core, framework, clamping arrangements and general structure of the transformer shall be of robust design, capable of withstanding any shock to which they may be subjected during transport, installation or service.

Suitable axial cooling ducts shall be provided to ensure free circulation of oil and efficient cooling of the core. The ducts shall be proportioned so that the maximum temperature at any point will be within the prescribed limits of temperature rise.

Lifting lugs or other similar means shall be provided for conveniently lifting the complete assembly (with windings).

Provision shall be made for efficient arrangement of guides to prevent movement of the core and windings during transport, installation or service.

The framework of the core shall be so designed as to prevent the presence of oil pockets, which would prevent complete emptying of the oil from the tank through the drain valve.

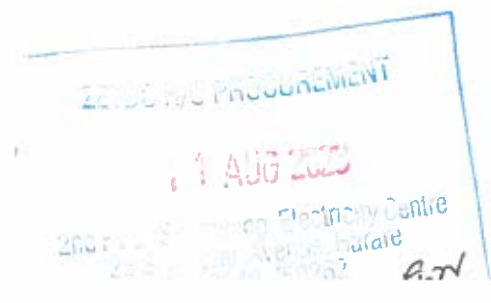
Maximum flux density at rated voltage on principal tap and rated frequency to be 1.7Tesla and
Maximum flux density at most onerous voltage and frequency conditions to be 1.9Tesla

6.3 Windings

The windings shall be circular and consist of high quality rectangular section copper, wound with age resisting paper of high dielectric strength. Aluminium winding **SHALL NOT** be accepted.

The amount of insulation between turns shall be determined not merely by normal volts per turn, but also by due consideration of the line voltages and the service conditions, under heavy lightning storms.

Adequate insulation and clearances between the windings shall be provided and all insulation and clearance between live parts must be adequate for operation at a voltage of 10% above nominal on all windings. The insulation of the end turns of each winding adjacent to the transformer terminals shall be reinforced between turns to protect the windings satisfactorily against surges and transients. Details of the reinforcements shall be given in the Bid.



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The insulation of the transformer windings and connections shall be free from insulating compositions likely to soften, ooze out, shrink or collapse during service. None of the materials used shall shrink, disintegrate, carbonise or become brittle under the action of hot oil, when the transformer is operated continuously at the maximum specified over loading.

The windings shall be so placed that they remain electrostatically balanced with their magnetic centres coincident under all conditions of operation. To prevent excessive static voltage, static end rings shall be provided, wherever necessary, at the live end of the windings.

The windings, connections and tappings of the transformer shall be clamped in position and braced so as to withstand shocks or undue stresses during transport, short circuit conditions, and other transient causes. No distortion of the coils should be possible with dead short circuit on the transformers.

All windings and all fibrous and hygroscopic materials used in the construction of the transformer shall be dried under vacuum and impregnated with hot oil. Full details of the drying out and vacuum treatment shall be furnished by the Bidder. Leads from windings to terminal board and bushings shall be rigidly supported to prevent injury from vibration and short circuit forces.

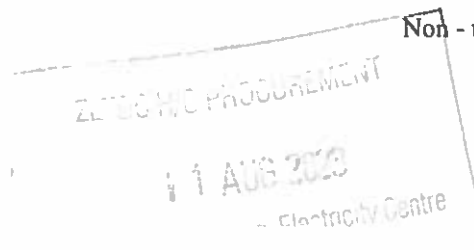
Adequate provision shall be made for the circulation of oil round and between the windings so that a low temperature gradient between the conductors and the oil is assured and any danger of excessive local heating is avoided.

The finished width of any duct and clamping arrangement shall be such as not to impede the free circulation of oil through the ducts.

It is essential that the windings shall be subjected to a thorough shrinking and seasoning process, so that no further shrinking of windings occurs at site. However, the clamping arrangement shall be provided for taking up any possible shrinking of coils when in service.

The windings should have the following characteristics

- | | |
|---|----------------------|
| a) Winding wire: | Copper |
| b) Maximum current density in windings at rated output; | 3.5A/mm ² |
| c) Maximum hot spot temperature of winding: | 120°C |
| d) Winding insulation: | Non - uniform |



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All similar coils shall be interchangeable.

Full detailed description of the windings shall be submitted with the Bid.

When specified in the Schedule of Requirements stabilizing windings shall be provided. The windings shall be capable of withstanding the forces to which they are subjected under all conditions, particularly the forces due to a short circuit between terminals or between any terminal and earth with full voltage maintained on all other windings intended for connection to external sources of supply. When stabilising windings are to be used for purposes other than decreasing zero sequence impedance, this will be declared in the Schedule of Requirements and the windings must be designed accordingly.

Unless otherwise specified, only one terminal of the stabilising winding shall be brought outside the tank and a suitable bushing shall be provided for this purpose through the tank cover. When used additionally for an auxiliary supply each corner of the winding shall be brought out.

It shall be possible to earth the winding externally to the main tank by means of a flexible bolted link to be provided by the supplier between the terminal and a suitable pad on the tank cover.

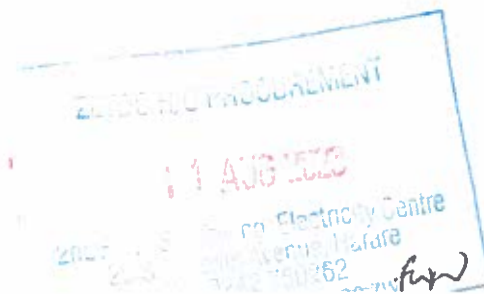
The neutral points of star connected windings shall be brought out to bushings located on the tank cover and connected to an earthing bus attached to the main transformer earth terminal.

6.4 Current Transformers

Current transformers for winding temperature measurements shall be mounted on the bushings inside the transformer. Accuracy class 3 shall be used for temperature indication.

6.5 Internal Earthing

The top main core clamping structure shall be connected to the tank body by copper strap. The bottom clamping structure shall be earthed by one or more of the following methods:



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- a) by connection through vertical tie rods to the top structure.

- b) by connection to the top structure on the same side of the core as the main earth connection to the tank.

The magnetic circuit shall be earthed to the clamping structure at one point only through a removable link placed in an accessible position beneath an inspection opening in the tank cover. The connection to the link shall be on the same side of the core as the main earth connection and be taken from the extreme edge of the top yoke.

Magnetic circuits having an insulated sectional construction shall be provided with a separate link for each individual section and the arrangement of the connections shall be to approval.

Where oil ducts or insulation parallel to the plane of the laminations divide the magnetic circuit into two or more electrically separate parts, the ducts or barriers shall be bridged and the magnetic circuit shall not be regarded as being of sectional construction.

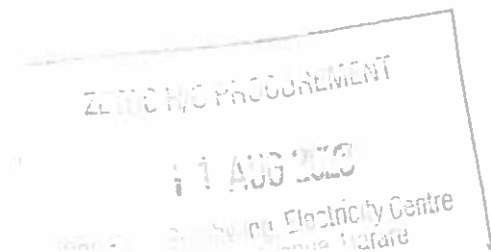
Where coil-clamping rings are of metal, each ring shall be connected to the adjacent core clamping structure on the same side of the transformer as the main earth connection.

All earthing connections, with the exception of those from the individual coil clamping rings, shall have a cross-sectional area of not less than 90 mm². Connections inserted between laminations may have the cross-sectional area reduced to 25 mm² where in close thermal contact with the core.

6.6 Tanks

Tanks shall be complete with all accessories and shall be designed to allow the complete transformer in the tank and filled with oil, to be lifted by crane or jacks, transported by road, rail and water without overstraining any joints and without causing subsequent leakage of oil. Corrugated tanks are not acceptable.

Each transformer shall be enclosed in a steel tank of welded construction, suitably stiffened by means of channel or angle sections welded to the tank, for withstanding the stresses imposed during transit to site and subsequent operation with no signs of oil leakage. Bell type transformer tanks are not permitted.



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The tanks must be so constructed as to be capable of withstanding an internal positive pressure of not less than 70 kPA without any permanent deflection of any parts. The tank must also be capable of withstanding a vacuum of 50 mm of mercury absolute when emptied of oil.

Guides shall be provided inside the tank to facilitate the lowering into the tank of the core and coils and their raising and correct positioning. The guides shall extend from the bottom of the tank to within 150mm of the top of the tank.

The tank covers shall be of adequate strength and shall not be distorted when lifted. Inspection openings suitably bolted shall be provided as necessary to give easy access to bushings, tap changer connections and earth connections. Each inspection opening shall be of ample size for the purpose for which it is provided. Manhole covers must be provided with lifting lugs where necessary. The tank cover and all inspection covers shall be provided with lifting lugs.

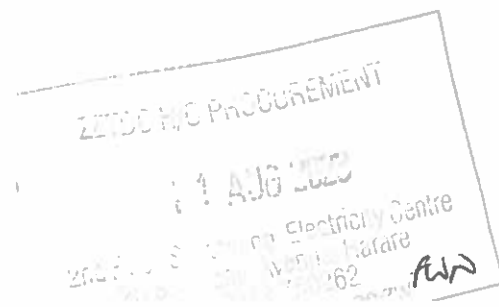
Detachable radiators shall have lifting lugs and shall be provided with drain plugs or valves at their lowest points and vent plugs in the headers. Isolating valves shall be provided immediately adjacent to the main tank or headers to enable the radiators to be removed without handling the oil in the transformer tank.

All oil-pipe connections shall have flanged joints provided with gaskets, preferably set in grooves or held in position by stops to prevent over-compression of the gaskets.

The base of the tank shall be so designed that it shall have maximum stability during movement in any direction without injury when using rollers, plates or rails. A design that necessitates rails being placed in a particular position will be rejected.

Lifting lugs shall be fitted capable of lifting the transformer complete with windings and filled with oil.

Four jacking lugs shall be fitted 500mm above ground level and four holes with a diameter of not less than 50 mm shall be provided on the jacking lugs in order to permit the transformer to be slewed in any direction.



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The tank cover shall be fitted with pockets for a thermometer and for the bulbs of the winding temperature and oil temperature indicators. Protection shall be provided when necessary for each capillary tube. The thermometer pocket shall be fitted with a captive screwed cap to prevent ingress of water. The pockets shall be located in the position of maximum oil temperature and it shall be possible to remove the instrument bulbs without lowering the oil in the tank.

The tank cooling equipment shall be designed to permit vacuum treatment on site. The maximum safe permissible vacuum (millimetres of mercury) which may be applied above oil level, to the tank, cooling equipment and to the conservator, without causing permanent distortion, shall be stated in the Bid.

Two earthing terminals located at opposite sides of the tank, capable of carrying for 30 seconds the full lower voltage current of the transformer, shall be provided. Provision shall be made at positions close to each of the four bottom corners of the tank for bolting the earth terminals to the tank structure to suit local conditions.

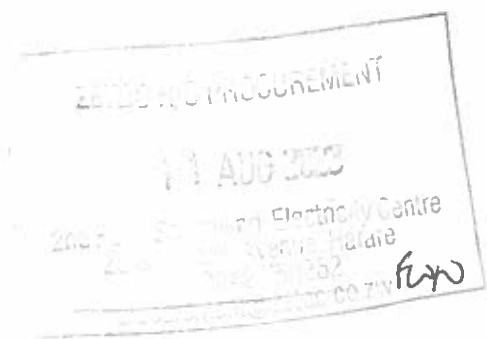
A rating plate shall be fixed to the tank at a height of not more than 1,5 m above ground level. A diagram plate shall also be fixed to the tank in an easily accessible position.

6.7 GASKETS

Oil-resisting synthetic rubber shall be used as a bonding medium for gaskets. All gaskets shall be of the rubber type. Cork gaskets are not acceptable

The Contractor shall submit details of gasket material for approval.

A full set of spare gaskets shall be supplied for use on site for all positions where joints have to be made after transportation of the transformer.



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6.8 BUSHINGS

Bushings shall be fitted to the equipment, on all phases and neutral star points.

All terminals shall be marked to correspond with the markings on the diagram plate.

The transformer bushings shall withstand accidental arcing or flashover without seals or other vital parts becoming damaged. Stresses due to expansion and contraction in any part of the bushing shall not lead to development of bulges, hairline cracks or other defects. Suitable connecting clamps shall be able to absorb shocks due to vibration of the connecting jumpers. The bushings shall withstand internal vacuum in the transformer tank.

All the bushings of any transformer shall have a rated current of at least 120% of the rated currents of the windings to which they are connected (in order not to limit over-loads).

The bushings shall have a creepage of at least 25mm per kV of rated Nominal Voltage. The types of bushings shall be silicone rubber and the principal bushing insulator material shall be silicone.

6.8.1 SPARK GAPS SETTINGS

132 kV - 650 mm, 33 kV - 135 mm

6.9 PAINTING AND GALVANISING

These shall be as follows:-

- i) The oil transformers shall have their interior surfaces sandblasted and finished with two coats of anti-corrosive and oil-resistant priming paint. Exterior surfaces shall be sand-blasted and have two rust inhibiting priming coats and one intermediate coat with paint on zinc chromate or urethane alkyd basis or equivalent; one final coat of weather and oil resistant paint. Minimum total thickness 0.16 mm.
- ii) The radiator external surfaces shall be hot-dip galvanized with a zinc deposit on average not less than 400g/m².



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- iii) Outdoor cabinets shall have at least one prime coat and two layers of paint on zinc powder basis to be applied after perfect cleaning.

The particulars of priming and finishing paintings shall be stated in the Bid, with specifications of paint, together with a listing of colours available, for each of the plant and equipment. The colour of the transformer shall be medium sea grey, Colour No.637 to BS 381C.

ZETDC is not bound to accept the finishing colour proposed by the Bidder. Determination of colour shall be at the option of ZETDC and shall be finalised at the time of approval of drawings.

The exterior finish of outdoor control cabinets shall be in the same colour as that for the transformer.

Should any paintwork be damaged during transit or erection, this shall be made good on site.

All interior and exterior surfaces, subject to corrosion, that cannot readily be painted shall be hot-dip galvanised with an average thickness of not less than 0.1 mm. Bolts and nuts associated with galvanised parts shall be hot-dip galvanised, electro-galvanised or sheradised and shall meet the test prescribed in BS 729, i.e. four dips in Copper Sulphate solution.

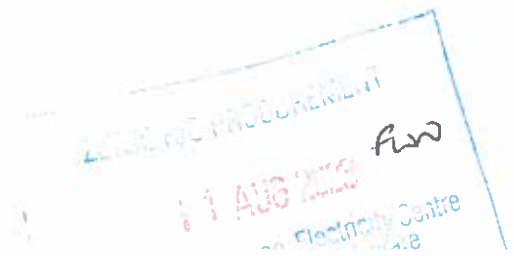
6.10 BOLTS, STUDS, NUTS, SCREWS, WASHERS, ETC.

All bolts, studs, nuts, etc., shall have a standard metric threading and conform to the relevant standards as regards shape and tolerance. They shall be marked by the manufacturer's symbol and class of strength.

All bolts, studs, nuts, washers, screws, etc., shall be made of stainless steel.

All bolts, nuts and screws shall be secured in an approved manner against becoming loose during operation.

Taper pins shall have threaded stems with nuts where dismantling of the pins is likely to be required.



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6.11 FITTINGS

The transformer shall be supplied with the following fittings:-

- (a) On load Tap changer as specified in the Schedule of Requirements.
- (b) Conservator
- (c) Oil gauges
- (d) Silica-Gel Breathers
- (e) Explosion vents
- (f) Bucholz Relays
- (g) Temperature indicators complete with alarm and trip contacts
- (h) Drain, filter and sampling valves
- (i) Rating and Diagram plate
- (j) Skid under-base
- (k) Wheels-when specified in Schedule of Requirements
- (l) Voltage Control equipment when on load Tap changing transformers are specified.
- (m) Cooling Radiators. Cooling Fans to be procured for ONAF transformers.

6.12 ON-LOAD TAP CHANGER

Tap changers with mercury sealing glands are not acceptable.

ZETDC has standardized on MR (Machinenfabrik Reinhausen) tap changers and this is the make that should be offered.

The tapping range shall be as specified in the technical guarantee schedule.



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6.13 CONSERVATOR

The conservator shall be mounted on the main tank.

The conservator shall be fitted with plates, on which shall be mounted the oil gauges. One on each side for the transformer and the tap changer respectively.

The pipe connecting the conservator to the tank shall extend at least 50 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 and bushing turrets of the main tank shall be connected into this pipe between the transformer and the Buchholz relay.

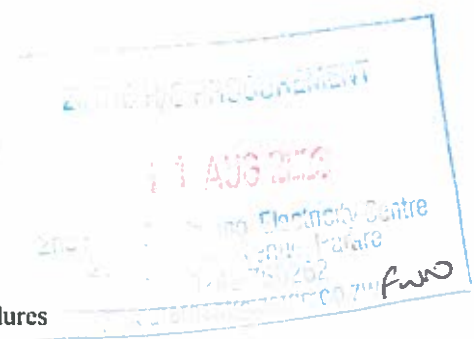
The conservator shall be so dimensioned that it will permit all expansion over the working range of temperatures from no load with the transformer cold and at -10°C ambient air temperature to full load at 40°C ambient air temperature while the sump pipe remains covered with oil and the oil level is visible or indicated. In any case, the volume of the conservator shall be at least 10% of the transformer oil volume.

The oil connections from the transformer tank to the conservator vessel shall be arranged at rising angle to the horizontal. A valve shall be provided between the conservator and the relay.

The conservator shall be split into two parts for transformers with On Load Tap Changers (OLTC)

Each part of the conservator shall have:

- (i) Dehydrating Breathers (silica gel type)
- (ii) Oil Draining valves
- (iii) Oil level Indicators
- (iv) Oil sump for sedimentation
- (v) Equalising Connection flanges for vacuum filling procedures
- (vi) Bolted (flanged) Endplates
- (vii) Shut Off (isolating valves) between the protective relays and the conservator tanks



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6.14 DIAL-TYPE OIL GAUGES

Dial-type oil gauges, shall be of the magnetically operated type, in which breaking of the gauge glass will not release any oil. The gauge shall be fitted with at least two circuit-closing, ungrounded, low-oil-level alarm contacts.

6.15 SILICA-GEL BREATHERS

Each conservator shall be fitted with a silica-gel type dehydrating breather to approval. The breather shall be provided with an oil cup or other device which prevents contact between the dehydrating agent and the air outside the transformer. If an oil cup is provided, the oil should be visible from the outside and the lowest oil level should be marked.

The weight of the dehydrating agent shall not be less than 0,5 kg per 1500 litres of oil in the transformer radiators.

Unless the silica-gel container is transparent the breathers shall have a window for inspection of the colour and condition of the silica-gel and oil cup or other device to prevent continuous contact of the silica-gel with the air outside the transformer.

6.16 EXPLOSION-VENTS

Explosion-vent pipes shall have a diaphragm of approved material fitted at the upper end only. An equalising non-ferrous pipe shall connect the air space of the explosion vent with the air space of the conservator, but where this pipe would be unduly long or its presence affect electrical clearances, a small silica-gel breather may be fitted at ground level and connected to the upper end of the vent pipe by means of a small-bore non-ferrous pipe. If the explosion-vent pipe is connected to the top of the main tank, it shall either extend 50 mm into the main tank or be provided at the lower end with a gas deflector.



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The explosion-vent shall be provided of sufficient size for the rapid release of any pressure which may be generated within the tank and which might result in damage to the equipment. The device if used shall be so placed that any discharge from it will not be deposited on any part of the transformer or its associated equipment.

The diaphragm shall be of approved design and material and shall be provided with a protective cover during transport.

6.17 BUCHOLZ RELAYS

Bucholz relays shall be of the double-float type with separate floats for alarm and shut-down at low and high speed gas development and shall be of approved manufacture suitable for operation in transformer oil as specified over the temperature range -10°C to 115°C. The two contact sets shall not be exposed to oil and shall be wired to the marshalling box.

The relays must be interposed in the connecting pipe between the oil conservator and the transformer tank in such a manner that all gas from the tank must pass through the relay as it rises to the oil conservator.

Two copper pipes shall be connected to the two pet cocks on the relay and extended to position 1 m above ground level and fitted with stop cocks for sampling and testing purposes. The stop cocks are to be labeled and easily accessible and be clear of surrounding steel-work. The sight window of the relay shall be readily visible from ground level.

6.18 TEMPERATURE INDICATORS

The local temperature indicators shall be of the dial-type graded in °C with a manually resettable pointer to register the highest temperature reached. The local indicators shall be mounted on the transformer tank, preferably in a suitable weatherproof steel cabinet with a lockable door. The cabinet shall be so positioned as to allow easy access to and readability of the gauges.

Each transformer shall be provided with winding temperature indicators of the "thermal image" type compensated for changes in ambient temperature (one for each winding type: common, series, HV,

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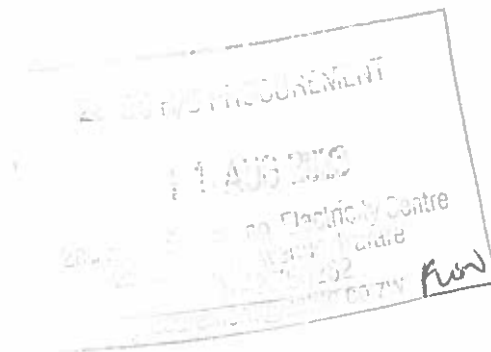
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LV and tertiary as appropriate). The indicator shall have a load - temperature characteristic approximately the same as the hottest part of the windings. The primary current transformer for operating the indicator shall be built into the main transformer tank on the bushings. Information shall be included in the maintenance instructions in the form of either a graph or table showing the relationship between current injected into the heater coil and the corresponding temperature reading.

The indicators shall be provided with two sets of alarm/trip contacts, adjustable to close at any temperature between 45° and 150°C such adjustment being possible without dismantling the instrument. Where supplementary forced cooling is specified, two additional sets of contacts shall be provided on the winding temperature indicators, for automatic start of the cooling fans in two stages. The differential between "switch on" and "switch off" temperatures must also be variable in the range 15°C to 30°C.

The instrument and set points shall have an accuracy of $\pm 1\%$ of full scale deflection and the indicated temperature must reflect the hot spot temperature to within ± 3 degrees Celsius under all operating conditions. Test links are to be provided for calibration purposes.

One temperature indicator of the capillary type for measurement of the top oil temperature shall be provided for each transformer.



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6.19 ALARM AND TRIP CONTACTS

All alarm contacts shall have ample inductive making and breaking at the specified alarm and tripping voltage.

Any auxiliary relays associated with the trip circuits shall be DC operated and suitable for the specified alarm and tripping voltage.

Alarm and trip contacts shall be provided with independent potential free contact.

6.20 DRAIN, FILTER AND SAMPLING VALVES

6.20.1 General

All valves shall be attached by bolted-on flanges and shall not be screwed or welded to the tank. Drain valves or isolating valves larger than 100 mm and of the double-flanged gate-type construction may have bodies of cast iron or cast steel. All valves shall be opened by turning counter-clockwise when facing the hand wheel. Every valve shall be provided with an indicator to show clearly the position of the valve.

Means shall be provided for padlocking the valves in their open and closed position.

All valves shall be suitable for operation in conjunction with transformer oil as specified in IEC Publication 296 at temperatures up to 115°C.

6.20.2 Drain Valves

Drain valves shall be of suitable dimensions in relation to the volume of oil in the transformer tank and coolers.



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6.20.3 Oil Sampling Valves

Oil sampling valves shall be of the screwed globe type, handle or gate valves located so as to permit sampling of oil from the extreme bottom of the transformer tank and the bottom of the tap changer compartment.

6.20.4 FILTRATION CONNECTIONS

Filtration connections, which shall have flanges drilled to BS 4504 Table 6, for 50mm valves, or screwed 50mm female, shall be as follows:

- a) A valve at the top and bottom of the main tank. The drain valve of the main tank may be used for this purpose if it is of the size described above.
- b) 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.

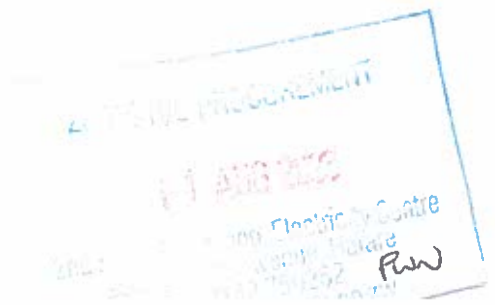
6.20.5 VALVE ENTRIES

All valve entries shall be blanked off with gasketed bolted-on plates or plugs.

6.21 RATING AND DIAGRAM PLATES

Rating and diagram plates shall be to IEC 76 or BS 171 or equivalent specification stamped or embossed on brass or stainless steel. They shall show ZETDC's Order and Tender Numbers and shall have a blank space for ZETDC's Serial Number. The diagram plate shall show the internal connections and the voltage vector relationship of the windings in addition to a plan view of the transformer giving the correct physical relationship of the terminals.

Where applicable, rating or diagram plates shall show locations, ratio, rating and accuracy class of current transformer. Rating and diagram plates shall be approved by ZETDC



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6.22 SKID UNDER BASE

Skid under base shall be positioned to give maximum stability during rigging (On/Off Loading), where specified. It shall be reinforced to permit moving the transformer in directions perpendicular to the base. Hauling eyes shall be provided on the under base.

6.24 VOLTAGE CONTROL EQUIPMENT

6.24.1 On Load Tap Changers

6.24.1.1 General

The equipment shall be so arranged as to ensure that when a tap change has commenced, it shall be completed independently of the operations of the control relays or switches. Failure of the auxiliary supply during a tap change operation must not inhibit the independent completion of the tap change operation.

An auxiliary supply of 230/380 volts, 50 Hz, 3-phase 4-wire ac will be available for operating the tap changing equipment and all its accessories. All equipment shall operate correctly at any voltage between the limits of 85% and 115% of nominal value.

Tap changing equipment shall be capable of carrying the same currents due to external short-circuit as the transformer windings and shall withstand the impulse and dielectric tests of the associated winding. The tap changer connection and switches shall be capable of handling continuously currents at least 20% above the highest operating current in order not to limit overloading.

It shall not be possible for the insulating oil in those compartments which contain contacts for making or breaking current to mix with the oil in the main transformer tank or with the oil in compartments containing contacts not used for making or breaking current.



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Where it is necessary to remove parts, or the whole of the on-load tap changer for transport purpose, it shall be possible to complete erection on site with the transformer windings covered with oil.

6.24.1.2 Construction

The number of the tappings in use shall be indicated mechanically at the transformer and electrically at the local control room panel. A potentiometer shall be provided for the local control room panel indication. The potentiometer switch shall be of the make-before-break type.

The tap changing switches and mechanism shall be mounted in an easily accessible cabinet on the transformer tank and shall be supported from the main tank or its base.

The oil compartment for the tap changing switch shall be fitted with its own over-pressure device and conservator. The conservator shall be dimensioned such that the expansion rates as specified in this specification can be met together with suitable oil level indication and drain valves.

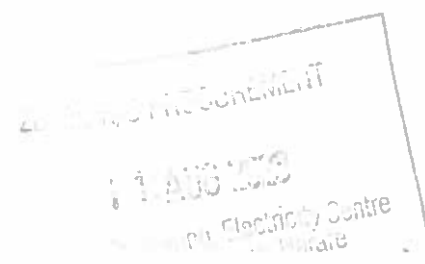
All switches forming part of the main tap-changing apparatus shall be oil immersed and readily accessible and it shall be possible to examine or repair such apparatus without lowering the oil level in the main transformer tank.

Each compartment in which the oil level is not maintained from the conservator shall be provided with an oil gauge of approved design.

Limit switches shall be provided to prevent the over-running of the mechanism and shall be connected directly in the circuit of the operating motor. In addition, mechanical stops or other approved devices shall be provided to prevent the overrunning of the mechanism under any condition.

Approved means shall be provided to protect the motor and control circuits.

The whole tap-changing equipment shall be of robust design and capable of giving satisfactory service without undue maintenance under the conditions to be met in service, including frequent operation.



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An externally visible mechanical recorder shall be fitted to the mechanism to indicate the number of tap-change operations completed by the equipment. At least five digits must be provided. No provision for resetting the counter is to be made.

6.23.1.3 Operation

The tap changer shall be operated in the following modes:

- Directly on the motor control cabinet in the switchyard (local control)
- From the control room in the substation (remote control)
- Automatically by means of a voltage regulating relay.

A blocking switch shall be provided on the motor control cabinet with two positions: local/remote.

When the switch is in local position, control can only take place from the control cabinet on the transformer and vice versa for the other position.

All the necessary equipment like relays, contactors, etc. shall be provided, wired up to terminal blocks to facilitate the functions outlined above. A potentiometer switch of the make before break type shall be provided for remote and supervisory tap position indication. The numbers shall range from 1 upwards, the lowest number representing a tapping position corresponding to the maximum number of high voltage winding turns, i.e. the highest plus-percent positions. The lowest minus-percent position shall be represented by the highest number.

Unless specifically asked for in this document, all equipment for control and indication required in the control room shall not be provided. Operating voltage for control shall be 110 V DC or as stated in the Schedule of Requirements.

Facilities shall also be provided to prepare the transformer for parallel operation with one or more transformers on the master - slave principle. An out-of-step device shall be provided and arranged to prevent further tap changing after a definite time interval when the transformer on parallel control is one tap out of step.

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Alarms and Trip Signals

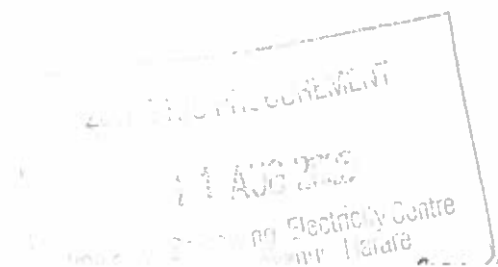
The following alarms shall be provided, wired up to terminal blocks in the transformer cabinet:

- Tap changer not operating.
- Transformers on parallel control are out of step.
- Partial or complete failure of the voltage transformer supply to the voltage regulating relay.
This alarm shall be inoperative when the transformer is on non-automatic control.
- Fan failure, alarm.
- Gas relay transformer, alarm.
- Gas relay transformer, trip.
- Protective relay OLTC, trip.
- Oil gauge low level transformer, alarm.
- Oil gauge low level transformer, trip
- Oil gauge low level OLTC, alarm.
- Oil gauge low level OLTC, trip.
- Pressure relief device transformer operated, trip.
- Pressure relief device OLTC operated, trip.
- Top oil temperature high, alarm.
- Top oil temperature critical, trip.
- Winding temperature high, alarm.
- Winding temperature critical, trip.

6.24.2 Local Tap Changer Control Cubicles and Wiring Cabinets

Each power transformer equipped for on-load tap changing shall be provided with a weatherproof local mechanism/control cubicle for control of the tap changer. The cubicle shall preferably be mounted on the side of the transformer tank but for larger units, a separate free standing marshalling kiosk would be considered.

A separate cabinet, also preferably mounted on the transformer shall be provided to facilitate connection of all wiring required for indication, control, alarm and trip signals in addition to the control of the cooling equipment.



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All cubicles and cabinets shall be complete with the requisite front panels. Bidders shall provide in their bids a complete list of all control, alarm, protection and indication facilities and equipment included in the bid price. Each item to be identified with its function.

Outdoor cubicles, cabinets and enclosed compartments shall be adequately ventilated to prevent condensation. All contactor or relay coils and other susceptible parts shall be suitably protected against corrosion.

All control cubicles and cabinets shall be identical in respect of all secondary control circuits and equipment. All cubicles shall be equipped with removable gland plates, and terminals to approval.

A voltmeter, suitably calibrated and indicating the secondary voltage shall be fitted on the panel of each remote control cubicle.

All suppliers wiring shall be carried out in PVC or similar insulated wire supported clear of the panel surface and identified by ferrules at all terminations; in addition colour identification may be used. No ferrule number shall appear on more than one circuit and the ferrule number shall change at every break in the circuit, i.e. all switches, coils contacts, etc. Particular attention shall be paid to ensuring that ferrule numbers conform to those on the wiring diagram.

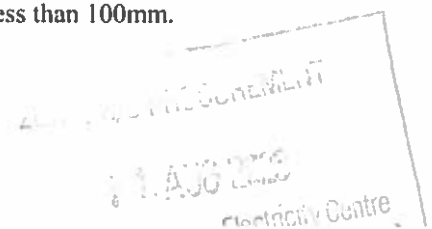
Terminals should be arranged so that terminations of any incoming wiring provided at site under separate contract are directly visible.

Terminal boards shall be placed in accessible positions adjacent to the incoming cable entries.

Terminations shall be grouped according to their functions and labels shall be provided on the fixed portion of the terminal boards showing the functions of the groups. All terminal boards shall have a minimum of 20% spare terminals.

All incoming and outgoing connections shall be terminated at a terminal block. Direct termination on to auxiliary switches will not be accepted.

All indicating analogue instruments shall be flush mounted and the dials shall preferably not be less than 100mm diameter if circular or, if rectangular have no side less than 100mm.



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Low energy thermostat operated heaters shall be provided in each cubicle and cabinet to prevent condensation and the internal design shall be such as to permit free circulation of air without the ingress of dust or vermin. A manual heater control switch shall be provided inside the cubicle.

Doors shall be provided with integral handles and shall have provision for padlocking.

A stay shall be provided for holding the door open without impeding access to the cubicle while work is being done in the cubicle.

An easily removable undrilled gland plate shall be supplied.

An indelible chart showing lubrication points and specifying recommended lubricants and frequency of application shall be provided in all mechanism cubicles.

6.24.3 Voltage Control Panel

a) General

Each transformer equipped with an On load tap changer shall be provided with a voltage control panel. The panels for transformers rated less than 10 MVA shall be suitable for outdoor installation. The panels for larger transformers will be installed indoors

b) Relay Functions and Settings

i) Functions

The relay shall control a tap changer to regulate the system voltage within the finite limits to provide a stable voltage to electricity powered equipment connected to the power system.

The relay shall include an extensive range of control and data gathering functions to provide a completely integrated system of control, instrumentation, data logging and event recording. Also, by utilising the simple 2-wire communication link, it shall be possible to read, reset and change on



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demand from a local or remote personal computer PC, loaded with the relevant software, all of the relay functions.

Integral features in the relays should include inverse or definite time operating characteristic, line drop compensation, under-voltage and over-voltage detectors, blocked tap change operation, over-current and circulating current supervision, load shedding/boosting capabilities, reverse reactance or circulating current tap position indication. The relays shall also have integral serial communication facilities.

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ii) Relay settings

All the settings should be entered into the relay via the front keypad or using a PC.

The following settings shall be available on the voltage control relay.

Setting	Symbols	Adjustment Range	In steps of
Setting voltage	Vs	90- 139V	0.1V
Dead band	dVs	$\pm 0.5\%$ to $\pm 5\%$ of Vs	0.1%
Circulating current	Ic	0.05 – 0.5A (In = 1A)	0.05A
Load current	IL	0.25 – 2.5A (In = 5A)	0.005A
Circulating current compensation	Vc	0.5 – 2A (In = 1A) 2.5 – 10A (In = 5A)	1.0V
Resistive line drop compensation	Vr	0 – 50V	1.0V
Reactive line drop compensation	Vxl	0 – 50V	1.0V
Reverse reactance control		Internal reversal of VXL vector	
Initial delay (tINIT):	Definite Inverse	0 – 20 secs 20 – 120 secs	
Intertap delay	tINTER	0 – 120 secs	1 sec 10 secs
Tap pulse duration	tPULSE	0.5 – 5 sec	0.1 sec
Load (3 Steps shedding/boosting)		0 - $\pm 10\%$ of Vs	0.5 sec
Under voltage detection	V<	80 – 120V	1%
Over voltage detection	V>	110 – 160V	1.0V
Under voltage blocking	V<<	6- - 130V	1.0V
Total taps available	TapsAvail	1 - 40	1.0V
Maximum tap position	TP>	1 - 40	1

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Maximum tap position	TP<	1 - 40	1
Total no. of tap changes	TotalOps	1 - 10000	1
Tap changer operations	Ops/tP>	1 - 100	1
Time period	tP	1 - 24 hrs	1hr
Excessive circulating current time delay	tIC	0 - 180 secs	10 sec
Alarm initiation time delay	tFAIL	0 - 15 min	30 sec
Phase angle setting	Angle	0 - 90 degrees	1 degree

ZETDC/INTER/06/2023
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 Mr. Electric Centre
 Mr. Hardie
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 ZETDC/INTER/06/2023 CO TW *for*

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6.25 COOLING

6.25.1 Definitions

The types of cooling shall be designated by the IEC lettering symbols:

- a. Natural Air Circulation (ONAN) - By radiators directly attached to the tank.
- b. Forced Air Circulation (ONAF) - By fan cooled radiators attached directly to the tank.

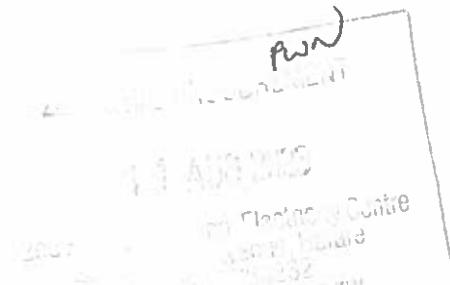
6.25.2 Declaration of Ratings

The Bidder shall declare in the Schedule of Technical Guarantees the rated power available under the operating conditions ONAN or ONAF and the ratings shall be indicated on the rating plate.

Unless indicated in the schedule of requirements, the transformers shall be Oil Natural and Air Natural (ONAN) cooled. The percentage impedances and ratings shall relate to ONAN ratings. However, the ratings of the ONAN transformers rated MVA shall be capable of being increased by 50% by adding forced cooling. The bushings and other associated equipment for such transformer shall be designed for 180% of transformer ONAN rating. The bidder shall indicate the cost of the cooling plant required to raise the ONAN rating by 50%. Drawings indicating arrangement of cooling plant shall be submitted in the bid.

6.25.3 Radiators

Where detachable radiators are fitted, suitable valves, with blanking plates shall be provided at the inlet and outlet of each radiator so that it may be removed without draining oil from the tank. Inlet and outlet valve "OPEN" and "CLOSED" positions shall be clearly marked. The valves shall be readily accessible and easy to operate. Lifting facilities, a drain cock and an air release vent shall be provided on each radiator.



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Radiators shall be designed so that it is possible for the whole of the cooling surface to be cleaned and, if necessary, subsequently painted by brushing and spraying. They shall also be designed so that they shall withstand dry-out vacuum without distortion or causing leakage of hot oil.

Transformers with tubular cooling fins are not desirable, and will be rejected by ZETDC.

6.25.4 Supplementary Cooling Plant

Where supplementary cooling is specified for transformer in the Schedule of Requirements the following shall apply:

6.25.4.1 Natural cooling with additional Forced-Air Cooling ONAN/ONAF

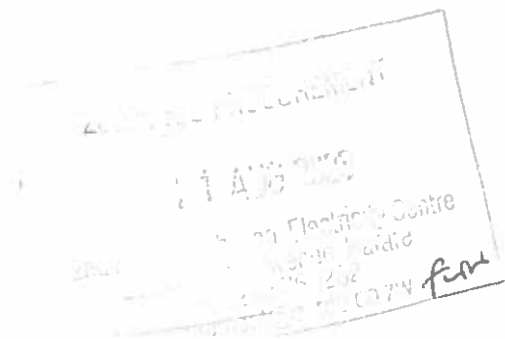
Where mixed cooling is specified in the Schedule of Requirements, the natural (ONAN) rating shall generally not be less than $\frac{2}{3}$ of the total specified forced-cooling capacity, unless otherwise specified.

The forced-cooling equipment shall be designed to operate automatically from winding-temperature relay control at predetermined temperatures recommended by the manufacturer. The equipment shall be designed to start in 2 stages at preset temperatures.

Indicative setting values are as follows:

	On	Off
Stage 1	65°C	50°C
Stage 2	75°C	60°C

The cooler arrangement must allow for the maintenance or failure of any one fan or radiator without losing more than 20% of the total cooling capacity.



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6.25.4.2 Fans

Fan blades and fan ducting shall be of aluminium alloy, stainless steel, galvanised steel, or other corrosion-resistant metal and shall be designed to keep noise and vibration to a minimum. All fans shall be provided with galvanised wire-mesh guards. It shall be possible to remove fan assemblies completely without dismantling other equipment.

6.25.4.3 Motors

All motors shall comply with IEC 34 and dimensions with IEC 72. They shall be capable of operating continuously under actual service conditions without exceeding the specified temperature rises, determined by resistance, at any frequency between 48 and 51 Hertz together with any voltage between +/-5 percent of the nominal value.

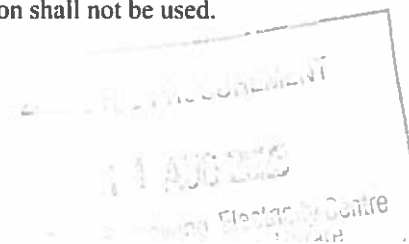
All motors shall be totally enclosed, and if situated in the open they shall be weatherproof and suitable for outdoor operation. They shall be provided with a suitable means of drainage to prevent accumulation of water due to condensation and with suitable means of breathing.

Motors operating in an ambient temperature not exceeding 40⁰C shall have Class 'E' insulation or better, but where the ambient temperature may exceed this figure or where the motor may be appreciably affected by conducted heat, Class 'B' insulation or better shall be used.

All motors shall be suitable for direct starting at full voltage as well as 10% over-voltage.

Motors shall have sealed ball or roller bearings.

The three phase connections of ac motors shall be brought out to a terminal box. The terminal arrangement shall be suitable for the reception of aluminium cable. Terminal markings shall be made in a clear and permanent manner and shall comply with IEC 34. A permanently attached diagram or instruction sheet shall be provided giving the connections for the required direction of rotation. All terminal boxes shall be of the totally enclosed type designed to exclude the entry of dust and moisture and sealed from the internal air circuit of the motor. All joints shall be flanged with gaskets of neoprene or other approved material. Natural rubber insulation shall not be used.



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

Motors shall be provided with starters, overload protection (three-phase where applicable) and in the case of three-phase motors, single-phasing protection. They shall be provided with manual push button start/stop in addition to the automatic start/stop from the winding temperature indicator.

All necessary holding-down bolts shall be supplied.

6.25.4.4 Motor Control Gear

Control gear shall comply with the requirements of IEC 292, the control gear being rated according to the duty imposed by the particular application.

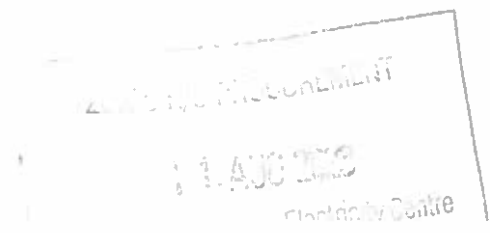
Motor contactors shall comply with IEC 158 class of intermittent duty 0-3 with type IP 52 enclosure protection and a utilization category AC4. The contactors, and their associated apparatus shall be capable of switching the stalled current, and shall have a continuous current rating of at least 50% greater than the full load current of the motors they control.

The operating currents of overload trips fitted to motor contactors shall be substantially independent of ambient temperature conditions, including the effect of direct sunlight on the enclosure in which the contactors are installed.

Where small motors are connected in groups, the group protection shall be arranged so that it will operate satisfactorily in the event of a fault occurring on a single motor. The control and protection equipment shall be accommodated in the control cabinet or marshalling kiosk. Each motor or group of motors shall be provided with control gear for starting and stopping by hand and automatically from the winding temperature indicator. Overload and single-phasing protection shall be provided.

6.25.5 Cooler Control Equipment

All the necessary automatic control, motor contactors, protective devices and switches for the forced-cooling equipment shall be assembled in a dust-proof, weatherproof and vermin-proof cabinet preferably mounted on the transformer.



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The cooler control equipment shall include:-

- An isolating switch rated to carry and break full-load current for each group of fan motors.
- A "Cooler Auto" - "Cooler-Manual" changeover switch.
- Magnetic contactor for each group of fan motors. Contactor coil leads shall be wired to the terminal board. A set of normally-closed contacts shall be provided on each motor contactor for alarm purposes.
- Overload and single-phasing relays.

6.25.6 Rating

The transformer shall comply with the ratings specified in the Schedule of Requirements under the stated service conditions without exceeding the temperature rise limits over the complete tapping range. The maximum temperature rise shall not exceed 55 °C and 60 °C for the top oil level and the winding respectively above the maximum ambient temperature of 40 °C. If the voltage on the secondary (LV) side is reduced or raised by up to 5% from the rated voltage, the temperature rises of any part shall not rise by more than 5°C (at rated power on any primary tapping).

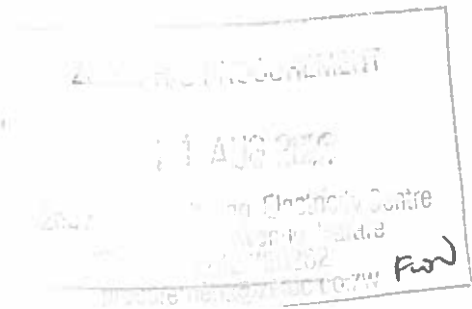
The normal standard rating of the transformer is with ONAN ratings of, 20 MVA.

6.25.7 Tapping

All tapplings shall be designed for constant kVA output, the rated voltage of each winding of the transformer on the principal tapping shall be as specified in the Schedule of Requirements and unless otherwise specified, shall correspond to the system nominal operating voltage.

6.25.8 Noise

The transformer tap-changing equipment and supplementary cooling equipment shall operate without undue noise and every care shall be taken in the design and manufacture to reduce noise to the level of that obtained in good modern practice. The noise level of the transformer shall not exceed 78 dB when tested in accordance with IEC Publication 551.



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6.25.9 Radio Interference

The design of the transformer shall be such that they will not cause any objectionable interference with radio reception in the vicinity of the transformer, either by direct radiation or by transmission through the power-lines and system to which the transformer may be connected, when energising at full rated voltage and when delivering any load up to the continuous maximum rating.

6.25.10 Interchangeability and Paralleled Operation

All transformers of any one type shall be identical and interchangeable with one another. No alteration to control circuits shall be permissible for this purpose except by means of built-in terminal boards fitted with links for effecting the alteration. All parts are to be made accurately to dimensions so that any corresponding parts will be interchangeable and any spare parts will fit into place without need for adjustments. Where similar equipment has previously been supplied, components shall interchange with those on previous contracts, unless otherwise approved.

The transformers shall be suitable for parallel master-follower operation with each other and with transformers of a similar rating, previously supplied, both in respect of transformer characteristics and control circuits on all relevant taps, under which conditions they shall share the load subject to the tolerances of impedance and voltage laid down in BS 171, IEC Publication 76 or equivalent standards.

6.25.11 Insulation Levels

When assembled complete with connections as in service, electrical clearances in air shall be adequate to withstand the required impulse withstand voltage. The insulation level for bushings must be corrected for high altitude and particular reference is made to IEC Publication 137, Clause 16 in this respect. Minimum bushing BIL insulation levels at sea altitude shall be at least one voltage class (according to IEC) higher than the winding insulation levels e.g. 750 kV for 132 kV operating voltages, etc. The Bidder shall propose in his Bid details of bushings with drawings showing air clearances and creepage distances. The creepage distance shall not be less than 31 mm/kV line voltage. Care shall be taken to ensure that no fittings are located so as to interfere with the external connections to the bushing terminals.

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The windings at voltages above the 36kV level shall have graded insulation with, the neutral points being solidly connected to earth, otherwise all windings shall have full insulation. The insulation levels at sea level for the various windings shall be as follows:

Operating voltage	Highest System Voltage	Impulse Test Voltage	Power Frequency Test Voltage
kV rms.	kV rms.	kV peak	kV rms.
33	36	170	70
132	145	650	275

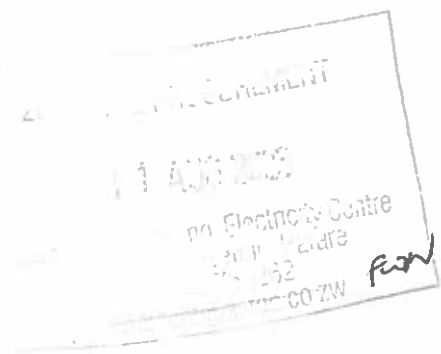
6.25.12 Short Circuit Performance

The transformer shall be capable of withstanding, without damage, the effects of a symmetrical three-phase short circuit and a phase to earth short circuit under conditions specified in IEC 76 or in relevant sections of other approved standards.

It can be assumed that during a short circuit, nominal voltage will be maintained on one side of the transformer with a short on the other, the external impedance being zero. It can also be assumed that up to four transformers may be connected in parallel between HV and LV busbars.

The impedances of transformers shall be based on the ONAN rating. The impedances of the transformers shall be as follows:-

Rating MVA (ONAN)	% Impedance
20MVA	6 - 7%



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6.25.13 Frequency

The normal frequency will be 50 cycles per second. The transformer shall, however, be suitable for continuous operation with frequency variation of plus or minus 2½ per cent from the normal, without exceeding the temperature rise limit specified in this Specification.

6.25.14 Flux Density

The flux density shall be such that noise pollution levels are not exceeded.

6.26 Secondary Wiring, Cabling and Terminal Blocks

Multi-core cabling to the remote control point and power supply cables shall be provided for complete functioning of the transformer. All internal cabling between the transformer primary points and local cubicles and cabinets shall be provided by the transformer manufacturer.

All secondary and panel wiring shall withstand a test voltage of 2 kV to earth for one minute.

Provision for outgoing connections from the transformer control cubicles and cabinets shall be made for multi-core cables. An undrilled removable gland plate to accommodate a compression-type gland provided by ZETDC shall be supplied adjacent to a terminal board. Each terminal box shall have an earthing stud for earthing of the incoming cable screens.

6.27 Spares

The contractor shall supply all spares specified in the Schedule of Requirements and these shall be included separately priced in the Bid. In addition bidders are requested to state their recommendations at the time of bidding for extra spares bearing in mind that the transformer shall be in continuous uninterrupted operation for 30 years.

Spares shall be delivered with the associated equipment and, in order that spares may be placed on order at short notice, full details including catalogue and/or spare part numbers of all spares should be supplied with the bid.



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Spares shall be priced item wise.

Spares shall be strictly interchangeable with the corresponding parts supplied with the original equipment. Spares for identical transformers shall be strictly interchangeable and to the highest extent possible also between the different transformers.

Each spare part shall be labeled with the following:

- The ZETDC Order number on which the part was supplied.
- The Item No. on the Order which specified the part.
- The serial number of the equipment for which the part may be used.
- The part number.

All spares must be packed to be suitable for indefinite storage and special precautions must be taken to ensure that insulating materials included in the spares do not deteriorate during storage.

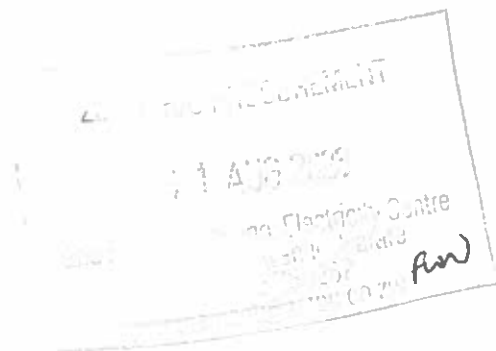
Cases in which spares are packed shall be indelibly marked with the applicable ZETDC order numbers.

Tenderers must state how long they anticipate that replacement spares will be available in stock.

6.28 Oil

The oil shall be of the uninhibited mineral type and comply to BS 148, IEC 296 or equivalent standard.

Oil shall preferably be dried and cleaned on site. If oil is provided in drums, these shall have a volume of approximately 210 litres and be full.



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6.29 Inspection and Tests

6.29.1 Inspection/Witnessing of Tests

ZETDC or its Representative, reserves the right to inspect the transformer at any stage of manufacture or to be present at any of the tests specified. Such inspection shall not relieve the manufacturer of his responsibility for meeting all the requirements of the specification, and it shall not prevent subsequent rejection if such material or equipment is later found to be defective. The supplier will meet all costs for two ZETDC Engineers witnessing tests.

The manufacturer shall in good time inform when testing will take place and shall give ZETDC not less than fourteen days notice in advance. No transformer shall be tanked, or dispatched from the manufacturer's works without the approval of ZETDC or its Representative. Based on the manufacturer's manufacturing program, factory inspection will take place as required by ZETDC.

6.29.2 Factory Tests

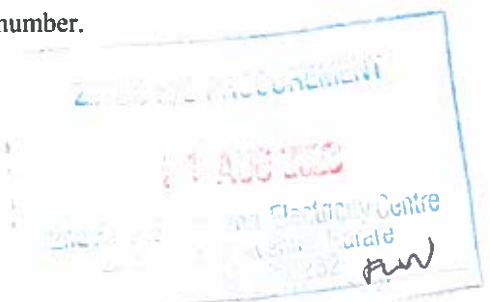
The supplier will meet all costs associated with two ZETDC engineers witnessing tests at the factory

6.29.2.1 Bushing Tests

Note shall be taken that the bushings shall have adequate insulation level for operating at 1500 m above sea level. It is not required to perform separate bushing tests if the contractor selects bushings which have insulation levels compensated for the altitude. Nevertheless, the contractor shall submit for approval test records and data for all bushings. These records shall show the test performed on the bushings including but not necessarily restricted to the following tests:

- Standard, one minute, 50 Hz dry withstand tests for all bushings.
- Type test of impulse withstand voltage.

All recorded test figures shall be given with the bushing serial number.



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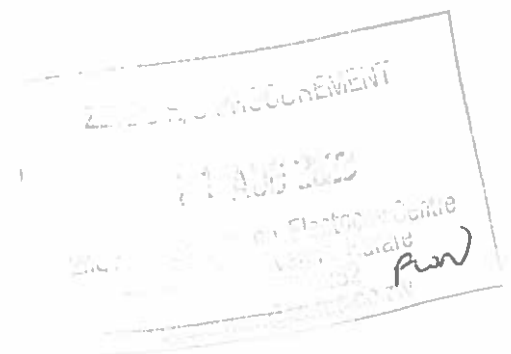
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6.29.2.2 Routine Tests

Routine tests as far as applicable shall be carried out according to IEC Publication 76.

The following routine tests shall be applied to all transformers:

- Resistance measurements of all windings for all tapplings.
- Ratio tests for all tapplings and vector relationship tests.
- Measurement of no-load losses and currents.
- Measurements of impedance voltages (at maximum, principal and minimum tapplings), short circuit impedances and load losses. Load losses shall be measured at both rated currents when ONAN and ONAF cooling are specified.
- Determination of efficiencies at 50%, 75%, 100% and 120% load at maximum temperature of the winding and 0.8 power factor lagging and unity power factor for all ratings (ONAN, ONAF ratings).
- Zero sequence impedance measurement.
- Induced voltage and separate source voltage withstand power frequency, dielectric tests on all windings on all phases including neutral points.
- Full wave impulse-withstand tests. The transformer shall be subjected to a complete series of tests. Such tests shall be applied to the HV winding line terminal of each phase as well as to the neutral points.
- Tests on on-load tap changers.
- Routine tests on all transformer accessories such as motors, contactors wiring, etc.
- Partial discharge measurements (corona testing) during the power frequency dielectric tests. The test procedures shall be as described in NEMA Publications 107, 1964 or other approved method to be agreed between the contractor and ZETDC
- Measurements of capacitance between the windings and each winding and ground.
- Oil leakage test. The complete oil filled transformer with bushings and radiators fitted and any other attachments normally in contact with oil shall be tested at a positive pressure measured at the tank bottom of twice the column of oil in the transformer when the transformer is cold, but in any case not less than 170 pa. Alternatively, the radiators may be tested separately with the same pressure.
The test period shall not be less than 12 hours.
- Core insulation test, 2 kV, 50 Hz for one minute.



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6.29.2.3 Type Tests

The following type tests shall be carried out on one transformer of each type:

- Temperature rise test. Details of the test procedure shall be agreed between the contractor and ZETDC before testing commences.
- Noise measurements.
- Vacuum test. The transformer tank and radiators filled with oil shall be subjected to a vacuum test to comply with the method detailed in this Specification. Bushings need not be fitted and the radiators and conservator may be tested as separate units.

6.29.2.4 Site Tests

Testing at site by the contractor shall be carried out to prove that the transformer in all respects complies with provisions and guarantees set forth in the Contract.

Tests shall include but not be limited to the following:

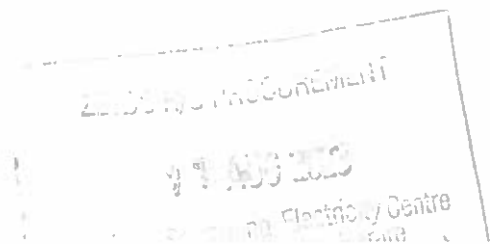
- Dielectric oil tests.
- Insulation dryness by an agreed method.
- Electrical and functional control of voltage control equipment and cooling system.
- Core to tank insulation.

6.29.3 Test Certificates

Two copies of test results showing the results of all routine and type tests performed shall be supplied to ZETDC prior to the dispatch of the transformer from the contractor's works.

6.29.4 Failure of Tests

In the event of transformers failing tests, ZETDC will give the manufacturer a chance to rectify the defects. In the event of a second failure you may cancel the contract. However where three test failures occur ZETDC will cancel the contract. The costs of all tests will be met by the supplier.



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6.30 Contract Drawings and Manuals

All manufacturer's drawings shall be marked with the ZETDC Order Number and related transformer serial number.

Copies of any manufacturer's standard operating and maintenance instruction manuals relating to voltage control equipment and transformer shall be included in the Bid.

The manufacturer shall submit all drawings for approval in sufficient time to permit modifications to be made and the drawings or samples re-submitted without delaying the initial deliveries.

Three copies of all drawings shall be submitted for approval and three copies of any subsequent revision.

All dimensions marked on the drawings shall be considered correct although measurement by scale may differ there from. Detailed drawings shall be worked to where they differ from general arrangement drawings.

Drawings submitted by the contractor and approved by ZETDC (and such drawings as shall be thereafter submitted by the contractor and approved by ZETDC) shall not be departed from without instructions in writing by ZETDC.

All drawings shall be submitted in accordance with the provisions in this Section and shall become the property of ZETDC.

Drawings shall be of a convenient size to permit their clear interpretation and the minimum size of the condensed drawings will be subject to individual approval.

6.30.1 Drawings to be submitted with the Bid

The following shall be included with the bid:

(Note: if complete design drawings are not available, drawings should be submitted of an existing design equivalent in all essential detail to that being offered).



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- a. Dimensioned outline drawings of the transformer and any auxiliary plant showing:
 - The arrangement and position of all fittings and accessories.
 - Any section to be removed for shipment and their separate dimensions and weights.
 - Principal dimensions and minimum clearances (phase/phase and phase/earth).
 - Weight, sling angles and height from ground level to crane-hook applicable for lifting:
 - The tank cover
 - The complete transformer
 - The cores and coils out of the tank
 - Position and function of all valves.
 - Position and function of all access openings
 - Total weight and distribution of weight to enable foundations to be designed (to be designed by ZETDC or its representatives).
- b. Drawings showing the arrangement of the core and windings including core clamping arrangement.
- c. Detailed drawings of the tapping switch showing internal details of switch and mechanism, tapping connections and change-over link board.
- d. Fully dimensioned drawings of all proposed bushings including cross-sections and full electrical characteristics.
- e. Arrangement drawings of items of automatic voltage control equipment and of control panels. Full physical and technical details of the voltage regulating relay and associated time delay device.
- f. Schematic wiring diagrams of automatic voltage control, cooler control, and protection systems with fully detailed description of the operation.
- g. -Drawings of proposed rating and diagram plates.
- h. Catalogues of all accessory equipment and fittings.



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6.30.2 Drawings for Approval

Before any manufacturing starts, 3 sets of all relevant drawings shall be submitted for approval. Unless stated otherwise corrected drawings shall be resubmitted for final approval. The drawings shall include but not be limited to those specified in Clause 6.29.2 above. Detailed drawings shall be submitted as required including schematic diagrams of all control systems.

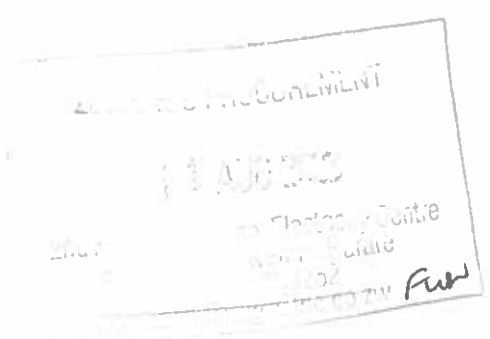
The following drawings shall also be submitted:

- Multi-core cable schedule.

6.30.3 Erection Drawings

Three copies of each of the final erection drawings shall be submitted not later than one month after receipt by the Manufacturer of the last approved drawing and at least four months before the equipment is due at destination, in accordance with the Terms of Contract. Information listed below shall be included in addition to any other relevant information:

- Details showing the arrangement of the transformer on rail and road transport.
- Winding details including tapping connections, changeover link board, insulation thickness, core earthing, core bracing, coil clamping, oil flow, disposition of CT.
- Schematic and detailed wiring diagrams of the automatic tap change system, systems of protection and cooler operation. Ferrule numbering must be approved in writing by ZETDC before manufacture is commenced and the diagrams must show the sizes of cores and the identifying colours.
- Arrangement drawing showing details of the outdoor mechanism/control cubicle and marshalling kiosk.
- Arrangement of remote voltage control cubicle (if included in supply).
- Rating and diagram plate.
- Detailed drawing of cooling plant and apparatus.
- Multi-core cable schedule.
- Step by step erection manual.



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6.30.4 Operating and Maintenance Instructions for Approval

Three sets of draft operating and maintenance instructions shall be submitted for approval four months before the equipment is due at destination. The instructions shall contain but not limited to the following details:

- A fully detailed description of the operation of the plant and auxiliary equipment.
- Assembly instruction for transformer and auxiliary equipment.
- Recommended site commissioning tests.
- Maintenance instructions for transformer and auxiliary equipment.
- Instructions regarding vacuum dry out of the transformer both fully assembled and under oil and also during commissioning before oil filling together with details of any precautions which must be taken before dry out.
- The maximum vacuum which may be applied to the transformer when filled with oil, without special precautionary measures being taken, shall be declared.
- A complete list of spare parts as supplied in the contract. Each item on the list of spares shall be marked with a number which shall also be shown on the relevant assembly drawings.

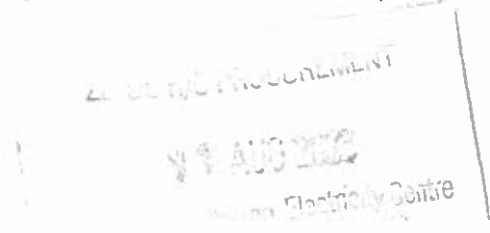
All materials used in the Contract Works are subject to inspection by ZETDC and it is the Contractor's responsibility to advise ZETDC when equipment and materials are available for inspection, at least one month in advance.

Factory tests on equipment shall be made according to the applicable IEC Standards, or as specifically specified or according to standards approved by ZETDC

Routine tests shall be made on each unit of all equipment.

Type tests shall be made on one unit of each type of different equipment. Instead of carrying out the type tests the manufacturer may submit suitable certificates of tests made on equipment of the same type. However, ZETDC reserves the right of accepting these certificates or to reject them partially or totally.

ZETDC shall be at liberty to demand any additional testing at the manufacturer's works, at site or elsewhere in order to verify that the equipment complies with the conditions of the Specification.



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A test programme shall be submitted to ZETDC for approval at least 1 month ahead of the commencement of testing.

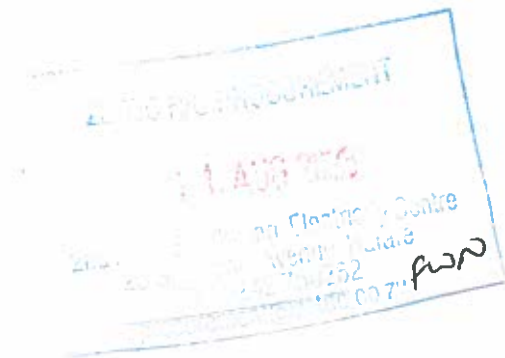
Measuring apparatus shall be approved by ZETDC and if required shall be calibrated at the expense of the Contractor at an approved laboratory.

7 PACKING, TRANSPORTATION AND STORAGE

The Supplier shall provide such packing of the Goods as is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperatures, salt and precipitation during transit and open storage. Packing case size and weights shall take into consideration, where appropriate, the remoteness of the Goods' final destination and the absence of heavy handling facilities at all points in transit.

The following information must be clearly stenciled or printed on each packing case, crate, cask, drum, bundle or loose piece, care being taken that the number and other particulars on each package agree with those entered in the packing list accompanying the Invoice:

- ZETDC's Identity
- Supplier's Identity
- Destination
- Contract No.
- Package No.
- Item Code
- Weight, dimensions
- Sub-Project (Substation Identity).



The part on which the marking is done must be clear and smooth with the lettering in black on a white painted background. In the case of wooden packing cases, crates, casks and metal drums, the marking must be upon the body of the package and will not be accepted upon a batten fastened on the case, etc.

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In the case of bags, bundles and loose pieces, the shapes of which do not permit the marks to be put on the actual package, each bag, bundle or loose piece shall have two metal labels securely fastened to it by wire no smaller than 16 SWG each label being die-stamped with the above particulars. The label must have two holes preferably one at each end, which must be fastened to the package by wire, passing through the two holes, each fastening being independent of the other.

Goods belonging to different substations shall not be mixed, but kept in separate packing cases, bundles or similar.

8. DELIVERY AND TRANSPORT

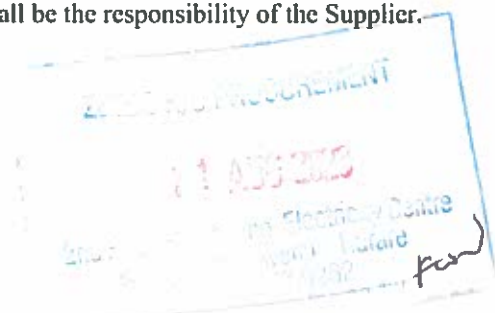
Shipment of a transformer in any position other than the upright is not permissible.

All shafts, bearings and machined surfaces exposed for transport to the 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 shall be provided.

Where the supply of oil is included in the contract, and transport weight limitations permit, the transformer shall preferably be transported with sufficient oil to cover the core and windings. The tank shall be sealed for transport to prevent all breathing. The remainder of the oil to be supplied separately at the time of delivery shall be in 200 litre drums.

Alternatively, where the above method is not applicable or practicable, the transformer shall be transported filled with dry air or nitrogen under slight positive pressure. This pressure and the temperature at the time of filling shall be communicated to ZETDC and a pressure gauge suitably protected is to be fitted to each transformer to facilitate inspection of the gas pressure on arrival at site. Every precaution shall be taken to ensure that the transformer arrives at site in a satisfactory condition so that subsequent to oil filling, it may be put into service without the necessity for further drying out. Should the positive gas pressure disappear during transport and the transformer allowed to breathe, additional drying out at site if required shall be the responsibility of the Supplier.



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All accessories and spares which are shipped separately must be clearly marked for identification with the transformer for which they are intended. All pipe work and valves shall have further markings showing the correct points of assembly which shall also be shown on assembly drawing to be supplied.

Full details must be supplied on methods of drying out the windings, if found necessary, on arrival and on the method to be adopted for oil filling and oil purification on site.

Full details of the proposed methods of transport shall be submitted for approval.

9. TECHNICAL SCHEDULES

9.1 The Technical Schedules shall be filled in and completed by the Bidder, and submitted with the Bid.

9.2 All documentation necessary to evaluate whether the equipment offered is in accordance with this Specification shall be submitted with the Bid.

9.3 All data entered in the Schedules of Technical Guarantees are guaranteed values by the Bidder and cannot be departed from whatsoever.

9.4 All data entered in the Schedules of Informative Data are also guaranteed values by the Bidder. These data may only be altered following ZETDC's written consent.

Tenderers shall include a complete statement of compliance with this specification. For every clause in this specification the Tenderer shall state compliance or non-compliance and shall elaborate where appropriate.

Tenderers shall use the words "comply ", "do not comply" for this specification or in the clauses of an informative nature, "noted".



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9.1 TECHNICAL GUARANTEE SCHEDULE: 20 MVA, 132-88/11kV Power Transformer

Please complete this schedule by stating the actual tendered specification and sign as indicated.

Name of Manufacturer: _____

Type: _____

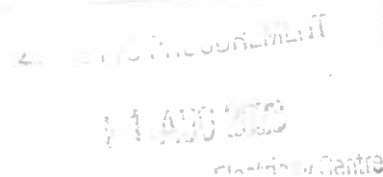
Item	Description	Units	Requirement	Guaranteed value	Reference page in technical brochure (e.g. found on page 3, section 3.2 paragraph/line etc.)
	Country of origin		specify		
	Applicable Standards				
	a) Power Transformer General		IEC 76-1		
	b) Transformer temperature rise		IEC 76-2		
	c) Insulation Level and Dielectric Tests		IEC 76-3		
	d) Loading Guide for oil immersed		IEC 76-7		
	e) Application Guide for on-load tap changers		IEC 542		
	Construction Type(Core/shell)		Core		
	Core Type		Silicon Sheet Steel		
	Winding type		Rectangular copper		

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Procurement Reference Number: ZETDC/INTER/06/2023

	Winding Temperature CT's		Mounted on bushings		
	Winding configuration (Separate Winding / Auto)		Separate Winding		
	Three Phase/ Single Phase Units		Three Phase		
	Temperature indication CT Accuracy class		Class 3		
	Tank Type		Steel Tank		
	Minimum tank internal withstand pressure	kPA	70		
	Tank internal withstand pressure when empty	mm	50mm of mercury		
	Gasket Type		Rubber		
	Installation (Indoor/ Outdoor)		Outdoor		
	Rated Power: ONAN				
-	- Primary (HV) Winding	MVA	20		
-	- Secondary (LV1) Winding	MVA	20		
	Rated Voltage, Un:				
-	- Primary (HV) Winding	kV	132-88		
-	- Secondary (LV) Winding	kV	11		
	Highest Voltage for Equipment, Um:				
-	- Primary (HV1) Winding	kV	145-96		
-	- Secondary (LV) Winding	kV	12		
	Method of System Earthing:				



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STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENNVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

-	- Primary (HV) Winding		Earthed Neutral Resistor	through Earth		
-	- Secondary (LV) Winding		Earthed Neutral Resistor	through Earth		
	Basic Insulation Level:					
-	- Primary (HV) winding, phase	kV	650			
-	- Primary (HV) winding, neutral point	kV	450			
-	- Secondary (LV1) winding, phase	kV	75			
-	- Secondary (LV1) winding, neutral point		Specify			
	No-Load losses at rated voltage and frequency	kW	Specify			
	No-load current at principal tap and rated voltage and frequency	A	Specify			
	Load-losses at 75°C, at rated currents:					
	Primary (HV) – Secondary(LV1)	kW	Specify			
	Primary (HV) – Tertiary (LV2)	kW	Specify			
	Total losses at 75°C on principal tapping and unity power factor and rated currents:					
-	- ONAN	kW	Specify			

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	Temperature rise after continuous operation with rated MVA, under the specified ambient conditions and the rated conditions giving the highest losses:			(Refer to IEC60076-2)		
-	- Top oil (by thermometer)	K	60			
	Windings (by resistance)	K	65			
	Inherent voltage regulation on principal tapping. 75°C and unity power factor:			(Bidders to provide)		
-	- 80% and 100% of full load on secondary winding	%	Specify			
	Inherent voltage regulation on principal tapping. 75°C 0.8 p.f lagging:			(Bidders to provide)		
-	- 80% and 100% of full load on secondary winding	%	Specify			
	Insulation levels of star points					
-	- Primary	kV	Refer to IEC60076-3			
-	- Secondary	kV	Refer to IEC60076-3			
	Max. Flux density at rated voltage on principal tapping and rated					



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Procurement Reference Number: ZETDC/INTER/06/2023

	frequency:				
-	- Transformer legs	T	72		
-	- Transformer yokes	T	72		
	Max. Flux density at most onerous voltage and frequency conditions:				
-	- Transformer legs	T	1.9		
-	- Transformer yokes	T	1.9		
	Max. Current density in windings at rated output:		<i>Refer to IEC60076-7</i>		
	Primary	A/mm ²	3.5		
	Secondary	A/mm ²	3.5		
	Maximum hot spot temperature of winding	°C	<i>Refer to IEC60076-7</i>		
	Maximum noise level				
-	- Transformer and tap changing equipment energised and at no load with ONAN cooling	dB	<i>Refer to IEC60076-10</i>		
	Calculated thermal time constant				
	ONAN	Hours	<i>Refer to IEC60076-7</i>		
	Materials in rating and diagram plates	-	<i>Refer to IEC60076 / BS171</i>		
	Type of bushings:		<i>(Refer to IEC60137)</i>		
	Primary bushings	-	Silicone Rubber		
	Secondary bushings	-	Silicone Rubber		
	Prim & Sec neutral bushings	-	Silicone Rubber		
	Principal bushing insulator materials:				

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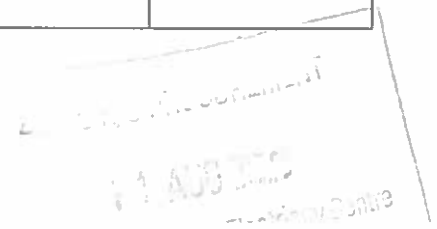
Primary bushings	-	Silicone		
Secondary bushings	-	Silicone		
Prim & Sec neutral bushings	-	Silicone		
Total creepage distance over silicon externally:		<i>(Refer to IEC60076-3)</i>		
Primary bushings	mm			
Secondary bushings	mm			
Maximum current carrying capacity of bushings:		<i>(At least <u>120%</u> of the rated currents of the windings to which they are connected).</i>		
Primary bushings	A	Specify		
Secondary bushings	A	Specify		
Tap Changer Type		Ganged On Load Tap Changer		
Transformer Working range		-10°C to 40°C		
Volume of conservator		At least 10% of transformer oil		
Dehydrating Breathers		Silica Gel Type		
Dial type oil gauges		Magnetically Operated		
Weight of silica-gel		At least 0,5kg/1500L of oil		
Bucholz Relays		Double Float Type		
Temperature Indicators		Dial Type graded in °C		
Highest temperature indicator		Resettable pointer provided		
Winding Temperature Indicators		Thermal image type		
No. Of temperature indicator alarms/contacts		2		

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Procurement Reference Number: ZETDC/INTER/06/2023

Temperature operating range	Contacts	Adjustable between 45°C and 150°C		
Auxiliary relays associated with trip circuits		DC operated		
Oil sampling valves		Screwed globe type		
Rating or Diagram plate		To IEC 76 or BS 171		
Transformer Copper losses		Bidders to specify		
Transformer Iron losses		Bidders to specify		
Tap changer arc quenching medium		Vacuum interrupters		
Tap changer insulating medium		Oil		
Tap changer operating power		380v,50Hz,3phase 4wire		
Tapping on _____ winding		Primary winding		
Number of tap positions		17		
Nominal tap position		5		
Tapping range		(+4/-12% x 1.25%)		
Number of steps		16 Steps, 17 Positions		
Voltage range for any equipment		85% to 115% of nominal		
Control Voltage		110v DC		
% impedance		Between 11 and 12%		
Vector Group		YNd1		
Type of Cooling		ONAN		
Transformer weights and dimensions:		<i>(Information to be provided by</i>		



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Procurement Reference Number: ZETDC/INTER/06/2023

			<i>Bidders)</i>		
	Weight of transformer as arranged for transport		Specify		
	Filling medium during transport		Specify		
	Overall dimensions of transformer arranged for transport:				
	Length	mm	Specify		
	Width	mm	Specify		
	Height	mm	Specify		
	Maximum lift of core/winding assembly incl. lifting beam, slings, etc. for untanking	mm	Specify		
	Total oil quantity in completely filled transformer	L	Specify		
	Total weight of oil in completely filled transformer	kg	Specify		
	Total oil quantity in conservator	L	Specify		
	Volume of conservator tank	L	Specify		
	Weight of copper in windings	kg	Specify		
	Weight of each radiator	kg	Specify		
	Weight of bushings:				
	HV	Kg/each	Specify		
	LV	Kg/each	Specify		
	Overall dimensions of transformer completely				

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	erected at site, including bushings, radiators				
	Length	mm	Specify		
	Width	mm	Specify		
	Height	mm	Specify		
	Total weight of complete transformer erected at site.	Tons	Specify		
	Maximum permitted acceleration during transport				
-	- lengthwise (x)	m/s ²	Specify		
-	- crosswise (y)	m/s ²	Specify		
-	- Vertical (z)	m/s ²	Specify		
	Accessories to be supplied:				
-	- Conservator for transformer		Yes		
-	- On-load tap changer		Yes		
-	- Current transformer (Internal and External)		Yes		
-	- Conservator for OLTC		Yes		
-	- Temperature sensors Pt 100 for oil and winding (1 for top oil and 2 for winding)		Yes		
-	- Contact thermometers for oil and winding		Yes		

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Procurement Reference Number: ZETDC/INTER/06/2023

-	- Control cubicle		Yes		
-	- Buchholz relay (Main Tank)		Yes		
-	- Buchholz relay (OLTC)		Yes		
-	- OLTC motor		Yes		
-	- Oil level gauge		Yes		
-	- Cooling Radiator Fins		Yes		
-	- Pressure relief device (Main Tank)		Yes		
-	- Pressure relief device (OLTC Tank)		Yes		
-	- Cooling Fans		Yes		
-	- AVR		Yes		
-	- Tank Earth Fault Relay		Yes		
	Spare Parts:				
-	- HV Bushing	#	1		
-	- LV Bushing	#	1		
-	- Set of contactors for tap changer driving mechanism	Set	1		
-	- Set of auxiliary relays for tap changer driving mechanism	Set	1		
-	- Oil level indicator for main tank	#	1		
-	- Oil level indicator for OLTC	#	1		

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Procurement Reference Number: ZETDC/INTER/06/2023

-	- Cooling fan complete (as % age of total fans)	%	30		
-	- OLTC motor	#	1		
-	- Oil temperature indicator with probe	#	1		
-	- Winding temperature indicator with probe	#	1		
-	- Set of OLTC contacts	Set	1		
-	- Set of OLTC transition resistors	Set	1		
-	- MCB of each type and rating installed	#	1		
-	- Buchholz relay (Main tank)	#	1		
-	- Buchholz relay (OLTC tank)	#	1		
-	- Tap Changer pressure relay	Set	1		
-	- Set of gaskets of each type and size used in the transformer	#	1		
-	- Valve of each type and size installed in the transformer	#	1		
-	- Counter for OLTC operations	#	1		
-	- Silica gel breather	#	1		

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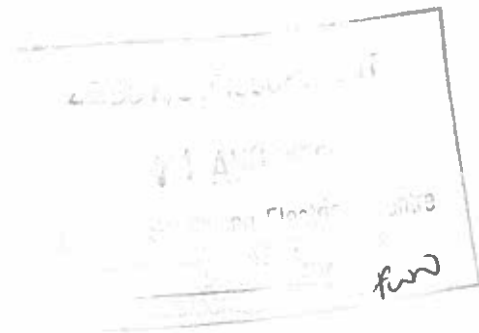
STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

	(Main tank)				
-	- Silica gel breather (OLTC tank)	#	1		
-	- Cooling Radiator Fins (as % age of total fins)	%	30		

Signed

Date.....



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Procurement Reference Number: ZETDC/INTER/06/2023

2.4.2 TECHNICAL SPECIFICATION FOR 11KV INDOOR SWITCHGEAR SINGLE BUSBAR

1. INTRODUCTION

This specification calls for the supply and delivery of 11kV indoor board made up of panels.

Tenderers shall include a complete statement of compliance with this specification. For every clause in this specification the Tenderer shall state compliance or non-compliance and shall elaborate where appropriate.

Tenderers shall use the words "comply ", "do not comply" for this specification or in the clauses of an Informative nature, "noted". Where the words "do not comply" are used the Tenderer shall state whether modifications could be made and whether modifications would be undertaken. The cost implications of such modifications must be indicated in the statement of compliance as well as the pricing schedules.

Tenderers should quote for delivery of the boards complete with cable boxes, current transformers, relays, instruments and other ancillary equipment, fully wired, but dismantled to individual panels for delivery purposes, to ZESA Stores.

Full assembly instructions, wiring diagrams and schematics together with all equipment operation and maintenance instructions and manuals which shall be in the English language shall be provided by the successful Tenderer at least two months prior to delivery of the equipment and shall be to the approval of the Employer.

The switchgear shall be provided from manufactures, who have at least 300 units in operation and manufactured such equipment for at least three years.

All tenders should be fully supported with manufacturers' brochures and technical literature, illustrations, outline dimensional drawings and copies of performance certificates.

Failure to comply with these requirements will render the tender liable to rejection.

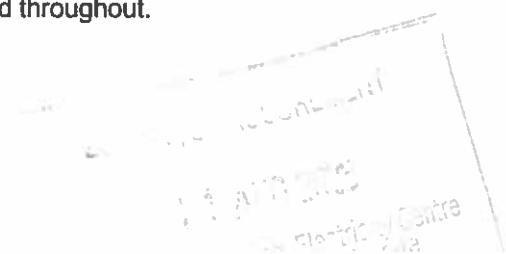
This specification covers the design, manufacture and testing before dispatch, supply and delivery of a 16 panel 11Kv board for Cement 88/11kV Substation.

2. STANDARDS, LANGUAGE AND UNITS

Except where modified by the Authority's Specification, the following standards shall apply:

- (i) IEC Standards: 62271-200 or
- (ii) BS Standard equivalent
- (iii) Any other standard, provided the Tenderer can provide documentary evidence that the standard is equal to or better than the above standards.

All tenders correspondence and all description upon drawings, illustrations or instructions shall be in the English Language. The SI system of measurements shall be used throughout.



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The panel switchboards shall be manufactured to high quality standard.

The companies manufacturing the panel switchboards shall have ISO 9001 Certification.

Unless otherwise stated all circuit breakers and cubicles shall comply with I.E.C. Publication 56 and I.E.C. 62271.

Tenderers should advise to which standard the circuit breakers are manufactured and tested, and may be requested to supply relevant test certificates, such as ASTA for tests in accordance with ASTA 18: 1966 or IEC 267.

3. PARTICULARS OF ELECTRICAL SYSTEM

The panel switchboards shall be subjected to the following system conditions:

- (a) Indoor, earthed, 3 phase.
- (b) Operated at 50Hz variable between plus or minus 2.5 %
- (c) A highest system voltage of 12.1 kV with nominal voltage 11 kV.
- (d) Resistance earthed so that the earth fault factor will be less than 1.5 at any location and the earth fault current limited to 1400 A..
- (e) Maximum short circuit ratings of 31.5kA for the 11kV network unless otherwise stated in the Schedule of Requirements.

4. PARTICULARS OF THE ENVIRONMENT

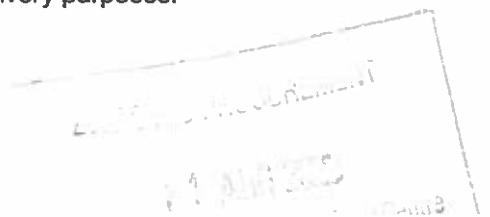
The switchgear shall be capable of operation under the following environmental conditions.

- (a) At an average altitude of 1 500m above sea level.
- (b) Ambient air temperatures of +45°C maximum and -10°C minimum with a daily maximum average of 35°C.
- (c) Particular attention should be paid in the design of all equipment to ensure that there is no damage to working parts or insulation through the ingress of dust, insects and vermin which are prevalent for long periods in the year.
- (d) Humidity 13 mg per cubic metre absolute and 65% relative before storms with vapour pressure 17 mm.hg.
- (e) Equipment will operate within the tropics and is subject to sudden ambient air temperature changes of the order of 10 degrees centigrade occurring at the onset of rain, but the barometric pressure at any given place does not vary by more than approximately 10 mm mercury.
- (f) Frequent and severe lightning storms occur during summer months, with isoceraunic levels varying between 50 and 100 thunderstorm days per annum.

5 DESIGN AND CONSTRUCTION

5.1 General

The boards shall be complete with current transformers, relays, instruments and other ancillary equipment, fully wired, but dismantled to individual panels for delivery purposes.



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The boards shall be suitable for indoor use and shall be of single busbar three-phase configuration at a rated frequency of 50 Hz. The configuration shall consist of one withdrawable circuit breaker per feeder/incomer connected to the busbars. The complete configuration has two transformer incomers, feeder cubicles and a bus section.

The cubicles shall be short circuit type tested by an internationally recognised test institution and shall be air insulated. Insulation medium of the busbar system shall be either air or SF6 gas. All busbars and primary connections shall be solidly insulated for the maximum service voltage in air. Tape insulated primary connections will not be accepted.

Pressure relief arrangements are to be provided in an upward direction wherever short circuits occur. Details are to be provided with the Tender.

The insulated Busbar conductors shall be radiused to minimise di-electric stress concentrations and shall be made of either copper or aluminium alloy.

The switchgear shall consist of cubicles of tropical design. The cubicles shall be so designed that future extension can easily be made. The cubicles shall be metal-enclosed with separate compartments for busbars, circuit breakers, cable termination and instruments.

The cubicles shall be designed according to IEC 298, with protection class IP3X for external surfaces and IP2X for internal compartmentalisation.

The circuit breakers shall fulfil the requirements specified in Clause 7.

The circuit breakers shall be mounted on trucks so that they can be moved into counter contacts of the switchgear (draw-out type). When a circuit-breaker is drawn out, the counter contacts shall be protected by means of automatically operated safety shutters.

Each cubicle shall be provided with facilities for local and remote control with position indications and for this purpose a key-locked selector switch for local and remote control is to be provided. All trucks for circuit breakers and switch disconnectors shall be incorporated in the interlocking system.

All manual operations of circuit-breakers, disconnectors and earth switches shall be performed from outside with cubicle door closed. The cubicle door shall be shutter proof.

The instrumentation compartment shall house all secondary equipment. The compartment shall be accessible from outside without opening any of the doors to the H.V. equipment.

In cubicles housing voltage transformers, circuit breakers and switch disconnectors, the compartment shall in addition, contain fuses for secondary circuits and direct-on-line starters for the operating devices.

The Contractor shall state necessary free spaces behind and above the switchgear for pressure relief purposes. The service side of the switchgear shall be completely screened from pressure relief spaces.

The board shall support SCADA compatibility with IEC 61850 engineering.

The panels shall be of a compact design and shall be as follows:



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- The total width shall be as minimum as possible for the total Number of panels (13x feeders, 1 x bus Section and 2 x transformer incomers).

5.2 Surface Treatment And Painting

Control boards, panel boards, cubicles, cabinets, etc. if applicable shall have interior surfaces painted with at least one primary and one finishing coat of anti-corrosion paint. Exterior surfaces shall be substantially corrosion-resistant with one primary coat and one finishing coat.

The equipment shall have at least one primary layer and two secondary layers of paint on zinc powder basis applied after perfect cleaning. Parts that cannot be readily painted shall be hot-dip galvanized.

5.3 Busbar Insulating Medium

5.3.1 The insulating medium for the busbars shall be SF6. The SF6 gas used shall comply with IEC publication 376.

In addition to the quantity of gas required to fill the supplied equipment 20% shall be supplied as spare.

The supplier shall provide the user with necessary instructions for refilling the gas and maintaining its required quantity and quality.

A system for monitoring continuously the SF6 gas density shall be provided. At a certain low density, a signal shall be given to indicate that refilling should take place. At the extreme low density all circuit breakers feeding the faulty busbar shall be automatically tripped.

A pressure gauge shall be provided for registration of gas pressure.

One SF6 gas filling set mounted on a trolley complete with all necessary connections and fittings, shall be provided which can also service the circuit breakers.

Tenders for SF6 type switchgear should also specify all equipment and costs, which will be required to maintain the switchgear in a fully operative condition throughout its service life of at least twenty-five years. This should include gas leakage detection equipment, pressure testing equipment, gas cleaning equipment and gas recharging equipment.

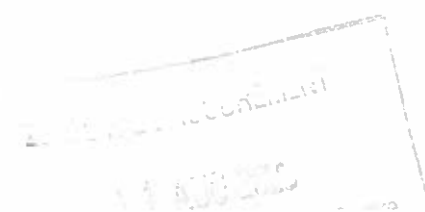
5.4 Isolating Contacts

The arrangement of the secondary isolating contacts, must be such that when the breaker is in the fully lowered position, the secondary isolating contacts are still made, so that the secondary circuits may be tested without the need for jumper connections.

5.5 Earthing, Shutter Mechanisms and Interlocks

Clearly labeled mechanical interlocks shall be provided to prevent the following:-

- i) a closed circuit breaker from being withdrawn from or inserted into the isolating contacts.



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ii) the circuit breaker from being withdrawn or replaced except when its mechanism is in the "off" position.

iii) the circuit breaker being closed in the "service" position when the secondary circuits are not properly connected.

Substantial safety shutters are to be provided to cover the circuit breaker isolating sockets, on both the bus-bars and circuit connections. These shutters are to be automatically actuated by raising or lowering the circuit breaker.

Shutters which remain open when the circuit breaker is in the isolated position but-not withdrawn, will not be acceptable since such an arrangement cannot be considered vermin-proof.

Each shutter shall be capable of being separately padlocked in the closed position.

The 11kV switchboard shall have the facility of earthing the circuit cable/s or busbars without the use of separate earthing contacts or attachments.

In all instances appropriate safety interlocks shall be provided and these should not warp.

5.6 RATINGS

5.6.1 Voltage rating

The switchgear will be used on networks with nominal voltage of 11kV and maximum voltages of 12.1kV. The power frequency withstand voltage shall be 28kV with a lightning impulse withstand voltage of 75kV in accordance with IEC 60038, 60071 Part 1 & 2.

5.6.2 Rated Normal Current

The rated normal current of the circuit breakers and busbars and connections shall not be less than the following:

Three phase busbar and bus section	<u>11kV</u> 2800 Amps
Transformer	1400 Amps
Feeders	1400 Amps
All other HV connections	2800 Amps

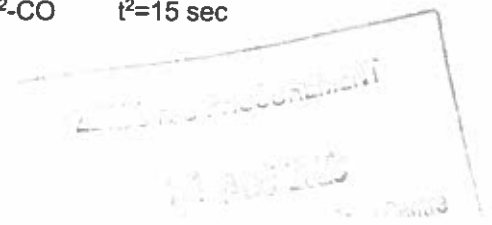
Minimum short circuit current for the transformer incomer and bus section is 31.5kA and for feeders is 31.5kA

5.7. CIRCUIT BREAKERS

The three-phase circuit breakers shall be of the withdrawable truck mounted type utilising vacuum as the interrupting medium.

The breakers shall be capable of handling the following operation cycle, according to the IEC recommendations:

O-t-CO-t¹-CO t = 0.3 sec t¹ = 3 min or CO-t²-CO t²=15 sec



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The total breaking time (opening time plus duration of the arc) of the breakers shall be as short as possible, but in no case is it to be longer than 60 msec.

The circuit breakers shall be designed for switching of capacitor banks and shall be such that re-striking during breaking operation cannot occur.

A spring operated mechanism shall be provided and the mechanism shall be equipped for electrical local (from switchyard) and remote control (from control room). If not otherwise stated in the Schedule of Requirements, the control voltage for closing and opening commands shall be:

110 V DC + 20% - 20%, unearthed, from battery

All operating mechanism motors shall be for 1-phase, 250 V, 50 Hz.

The opening device shall be provided with two independent trip coils, connected to separate terminal blocks, allowing for the connection of two independent trip commands.

A local position indicator shall be mounted in the front panel of the operating mechanism cubicle.

In the case of SF₆ circuit breakers, a system for continuously monitoring the gas density of each breaker shall be provided such as a pressure gauge. At a certain low density a signal shall be given to indicate that refilling should take place. At the extreme low density the circuit breaker should be automatically blocked against operation. SF₆ gas refilling equipment mounted on a trolley shall be provided.

A crank, lever or other similar suitable device shall be provided to permit charging the operating mechanism by hand in the event of a failure of the auxiliary supplies or in the event of a failure of the energy storing device.

The stored energy shall for all types of operating mechanisms be sufficient to allow a complete O-C-O cycle.

A sufficient number of readily wired auxiliary contacts for 110 V DC shall be provided for control and interlock purposes, the minimum number being 8.

Motors shall be designed in accordance with valid IEC publication and shall be effectively protected by miniature circuit breakers and thermal overload unit, with alarm contacts.

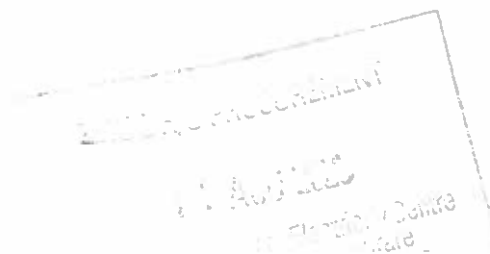
All wirings shall lead to terminals. At least 10% of the terminals shall be spare.

The closing circuit shall have an anti-pumping device to prevent contact pumping.

5.8. EARTHING SWITCHES

All switchgear cubicles shall have earthing switches. The bus section cubicle shall have one switch for earthing of either busbar section.

The contact surfaces shall be heavily silver-plated. The contact pressure shall be ensured by means of springs. All earthing switches shall have full fault making capability at the specified fault level.



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The earthing switches shall be manually operated but shall be provided with the necessary equipment for electrical or mechanical interlocking. There shall be provision for local and remote position indication.

5.9. INSTRUMENT TRANSFORMERS

5.9.1 General

All current transformers shall have bar primaries, be resin encapsulated and comply with IEC 44-6 First edition 1992-03 and B.S. 3938: 1973.

All current transformers shall have a maximum short-time current rating, at rated output of not less than 31.5kA for three seconds for the 11kV switchboard. The ratio and rated burden of current transformers shall be as stated below.

5.9.2 Feeder Circuits

Each feeder circuit shall be equipped with a three core current transformer on each phase. The current transformer ratios shall be as specified in the Schedule of Requirements.

The cores shall have the following main data:

-The first core shall have an accuracy of class 1 and will be used for metering. The rated burden for this core shall be 10 VA.

-The second core shall have an accuracy of class 5P20 and will be used for overcurrent and earth fault protection. The rated burden for this core shall be 20 VA.

-The third core shall have an accuracy of class 5P20 and shall be used for sensitive earth fault protection and/or differential protection. The rated burden for this core shall be 20 VA.

5.9.3 Transformer Incomers

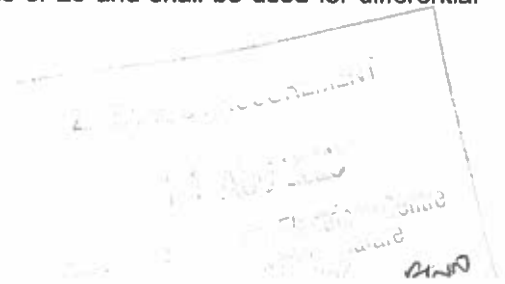
The transformer incomers shall be equipped with a current transformer on each phase. The current transformer ratios are specified in the Schedule of Requirements

The cores shall have the following main data:

-The first core shall have an accuracy of class 1 and shall be used for metering. The rated burden shall be 10 VA

-The second core shall have an accuracy of class 5P20 and shall be used for Balanced earth fault protection. The rated burden shall be 20 VA.

-The third core shall have an accuracy of class 5P20 and shall be used for differential protection. The rated burden shall be 20 VA.



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5.9.4 Voltage Transformers

Each transformer incomer shall be equipped with a three-phase voltage transformer, ratio 11/0.11kV, Class 1 capacity 100 VA.

Each voltage transformer shall be withdrawable and equipped with both primary HV and secondary LV fuses, and shall be so arranged that the HV fuses are not accessible unless the voltage transformer is withdrawn. The insulation shall be of the solid synthetic resin type.

5.9.5 CABLE COMPARTMENT

The cable compartment shall be suitable for 2 x 3 - 400 sq.mm Cu single core, 11kV XLPE cables on the respective transformer incomer circuits. The cable compartments for the remaining circuits shall be suitable for one three core (up to) 240 sq.mm XLPE S.W.A. 11kV cable.

All connecting cable lugs, glands and earthing straps shall be supplied.

5.9.6 CONTROL, PROTECTION RELAYS AND INSTRUMENTATION

(See Table C)

5.9.7 General

The control voltage shall be 110 V DC, +20%, -20% supplied from the station battery unless otherwise specified in the Schedule of Requirements.

Each panel shall be supplied complete with respective relays ammeter and thermal maximum demand ammeter, secondary fuses and any necessary auxiliary contactors and secondary terminals, fully wired. A multi-function meter incorporating the above will suffice and these should have SCADA functionality.

All MCB's shall be interchangeable and shall be to the approval of the Employer.

MCB's associated with trip circuits shall be mounted on the internal face of their respective switch control/relay panel, with their purpose clearly labeled.

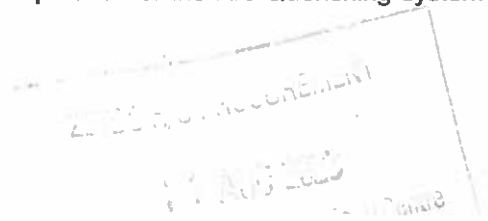
Lockable type control handles shall be fitted on all circuit breakers.

5.9.7 Protection Relay Details

All relays must be of the numeric type and IEC61850 engineered and their functions will be specified in the schedule for protection relays.

5.9.8 Arc Protection

All cubicles and the busbar system shall be equipped with detectors either reacting to arc light and or current which immediately on detection initiate operation of the Arc Quenching system



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for the board. The arc detectors shall also initiate tripping as backup, of circuit breakers to eliminate the arc in the event the arc quenching system fails to operate.

5.9.9 Transformer incomers

The Transformer Incomer Panels shall be equipped with IEDs; One main protection IED will cater for LV restricted earth fault protection, differential protection, HV & LV overcurrent and earth fault protection. A second dedicated backup protection IED for NEF, LV overcurrent and earth fault protection.

5.9.10 Feeders

Feeder panels shall be equipped with numerical relays with overcurrent and earth fault protection functionalities specified in the technical guarantee Schedules

The relay shall have an auto-reclosing scheme and shall be provided on all feeders. The auto reclose feature should be selectable to auto or non-auto, it shall be initiated by overcurrent protection when on auto.

All relays shall be to the approval of the Authority and shall be provided with an extra normally open contact for remote indication purposes.

5.9.11 Bus section

The Bus Section Panels shall be equipped with a numeric relay with overcurrent and earth fault protection functionalities specified in the technical guarantee schedule

5.9.12 Instruments

5.9.12.1 Voltmeters

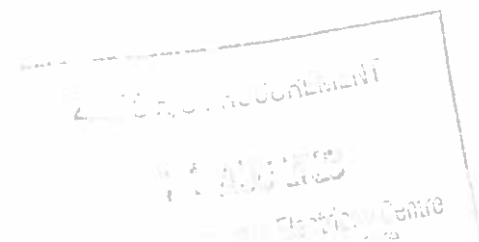
Each transformer incomer shall be provided with three, phase to neutral voltmeters suitable for flush mounting and operating from the above respective voltage transformers.

Each feeder shall be provided with one voltmeter with selector switch suitable for flush mounting.

The voltmeter shall be calibrated to the requirements of the Employer. Full technical and over-all dimensions shall be provided.

5.9.12.2 Ammeters

Ammeters with selector switches suitable for flush mounting and operating from the above respective current transformers shall be provided, and mounted on each panel. The ammeters with thermal maximum demand indication shall be calibrated to the requirements of the Employer and full technical and over-all dimensions shall be provided.



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5.9.12.3 Metering Transducers

Multifunction meters configurable for current, voltage, apparent power, true power, reactive power and power factor with IEC61850 engineering should be provided.

The transducer output shall be an impressed DC current of 0 -10mA output. The permitted resistive load shall be at least 1000 ohms. The accuracy class shall be minimum 1%. The auxiliary voltage, if required shall be 110V D.C. or the D.C. input voltage.

The panels should come with a 61850 LAN network for protection and control IEDs. The LAN network should be on managed industrial switch(es) which shall be DC powered (110V).

GPS clock and antenna for time synchronising IEDs which shall be DC powered (110V).The GPS clock shall also be on the IED LAN network.

5.10 OPTIONAL EQUIPMENT AND ACCESSORIES

Tenderers should advise and quote, in detail for accessories and maintenance tools and equipment which they recommend to be provided with such a switchboard installation.

It is emphasized that full information must be provided as to the costs of replaceable materials, such as gaskets, seals, 'O' rings spare contacts and mechanisms etc.

5.11 EVALUATION OF TENDERS

5.11.1 ZETDC does not bind itself to accept the lowest or any tender and will not be responsible for, or pay for, expenses or losses, which may be incurred by any, Tenderer in the preparation of their tender.

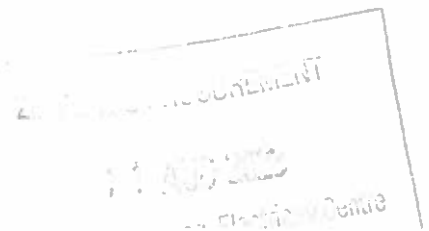
5.11.2 The Authority will evaluate and compare only those Tenders determined to be substantially responsive to the requirements of the Tender Document. The evaluation will take into account, in addition to the Tender Prices, any Arithmetic errors corrected by the Authority, any non-material deviations or reservations of the Tender Document that are quantifiable, any appropriate adjustments for acceptable quantifiable variations, deviations not reflected in the Tender Prices and other factors of a technical, financial, contractual or administrative nature as the Authority considers may have a potential impact on the Contract execution, including the effect of item or unit rates that are unbalanced or unrealistically priced.

5.12 TECHNICAL SCHEDULES

5.12.1 Preamble

5.12.2 The Technical Schedules shall be filled in and completed by the Bidder, and submitted with the Bid.

5.12.3 All documentation necessary to ascertain compliance with the Specification shall be submitted with the Bid.



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- 5.12.4 The performance of the switchboards shall not fall below the parameters stated in the guarantee schedules.
- 5.12.5 All data entered in the Schedules of Informative Data are also guaranteed values by the Bidder. This data may only be altered following the Engineer's written consent.
- 5.12.6 Equipment or Systems offered which are not in accordance with this Specification shall be listed in Schedule III-9.

5.13 Definitions and Abbreviations

The following terms may be met in these Technical Schedules and shall be interpreted as follows:

Hz	shall mean hertz
kW	shall mean kilowatt
MW	shall mean megawatt
VA (kVA, MVA)	shall mean volt-ampere (kilo-, mega-)
A (kA)	shall mean ampere (kilo-)
V (kV)	shall mean volt (kilo-)
W/m	shall mean watt per metre
AC	shall mean alternating current
DC	shall mean direct current
I _N	shall mean rated (nominal) current
U _N	shall mean rated (nominal) voltage
Ah	shall mean ampere-hours
lm	shall mean lumen
lm/w	shall mean lumen per watt
min	shall mean minute
min.	shall mean minimum
μ (prefix)	shall mean micro
rms.	shall mean root mean square
p.u.	shall mean per unit
p/p	shall mean peak to peak
T	shall mean Tesla
kg	shall mean kilogram
N	shall mean Newton
l	shall mean litre
s or sec.	shall mean second
No.	shall mean number
dB	shall mean decibel
Amp	shall mean amperes
F	shall mean Farad
°C	shall mean centigrade
K	shall mean degree Kelvin
m ²	shall mean square metre (mm ² for millimetre, etc.)
m ³	shall mean cubic metre (mm ³ for millimetre, etc.)
m ³ /s	shall mean cubic metres per second



STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

Item	Description	Units	Requirement	Offered
1	Type/Designation		State	
2	Interrupting medium		VACUUM	
3	Insulating medium		SF6	
4	Applicable Standards		IEC 62271-200	
5	Voltage rating			
5(i)	Nominal	kV	11	
5(ii)	Maximum	kV	12.1	
5(iii)	Power frequency	Hz	28	
5 (iv)	Basic Insulation Level	kV	75	
6	Insulated busbars	Yes/No	Yes-State insulating material	
7	Current rating			
7(i)	Continuous Load Current	Amps	1400 Incomer 1400 Feeder 2800 Busbar	
7(ii)	Short time 3 seconds	Amps	At least 31.5kA	
7(iii)	Interrupting	Amps	31.5kA-3seconds	
8	Opening time (trip initiation to contact)	Ms	<=60	
9	Closing time (close initiation to contact make)	Ms	<=90	
10	Type of Operating Mechanism			
10(i)	-Trip mechanism		Spring	
10(ii)	-Closing mechanism		Spring	
11	Operating Voltage			
11(i)	DC closing voltage	V	110	
11(ii)	DC trip voltage	V	110	
12	Remote Control Unit	Yes/No	Yes	
13	Arc Protection	Yes/No	Yes	
14	Arc Pressure relief	Yes/No	Yes	
15	Earthing Provision	Yes/No	Busbar Earth -Yes	
		Yes/No	Feeder Earth -Yes	
16	Lockable shutters	Yes/No	Yes	

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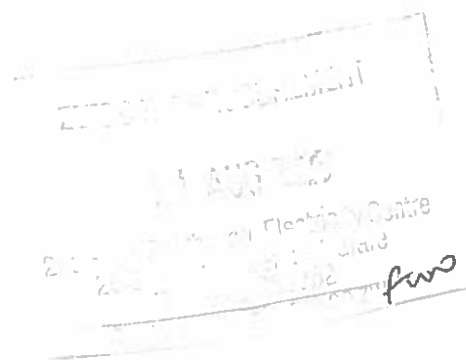
STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

17	Lockable cubicle doors	Yes/No	Yes	
18	Compliance to Environmental conditions, Clause 5	Yes/No	Yes	
19	Drawings	Yes/No	Yes	
20	Dimensions(Max)			
	- Height	Mm	1800	
	- Length	Mm	1000	
21	Weight	Kg	700	
22	Manufacturer			
23	Country of origin			
24	Guaranteed lifespan	Years	20	
25	Current Transformer ratio			
	Feeder circuit	Ratio	1400/600/400/1	
	Transformer incomer	Ratio	1400/1000/800/1	

Signed

Date.....



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STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

2.4.3 TECHNICAL GUARANTEE SCHEDULE FOR OVERCURRENT AND EARTH FAULT PROTECTION

Please complete this schedule by stating the actual tendered specification and sign as indicated.

Name of Manufacturer: _____
 Model: _____
 Type: _____

Data about offered equipment shall be filled in by the bidder in table below which must be duly signed and dated. The following compliance schedule which must be met 100% must be accompanied by technical specs/datasheets/brochures from manufacturer. Please indicate in the last column where proof of compliance can be located from the manufacturer's spec sheet. Failure to attach the necessary proof will result in automatic disqualification.

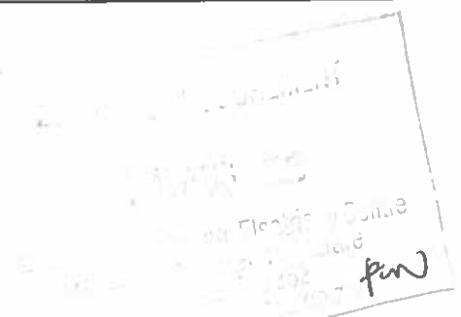
Item	Description	Unit	ZETDC Requirement	Tendered	Remarks	Corresponding reference page in spec sheet
						(e.g. found on page 3, section 3.2 paragraph/line e.t.c)
1.	Relay Type	-	Numeric			
2.	Enclosure Material		Metallic plate			
3.	Frequency	Hz	50			
4.	Rotation	-	ABC			
	ENVIRONMENTAL CONDITIONS					
5.	Operating temperature range	°C	-5 to +55			
6.	Degree of protection by enclosure when panel-mounted	-	At least IP 30			
	POWER SUPPLY					
7.	Range	V	48.....130 for 110 Nominal voltages			
	AC INPUT CURRENTS					
8.	Nominal current, I_N	A	1A, 3phase			
9.	Continuous withstand	A	$\geq 3 \times I_N$			
10.	Short time withstand	A	$\geq 10 \times I_N$ for 1s			
	AC INPUT VOLTAGES					
11.	Nominal Voltage, U_N	V	110VAC phase to phase			
12.	Continuous withstand	V	$\geq 1.5 \times U_N$			

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STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

13.	Short time withstand	V	$\geq 2 \times U_N$ for 1s			
	TRIP OUTPUTS					
14.	Rated Voltage	V	250			
15.	Continuous current withstand	A	≥ 6			
16.	Make current	A	$\geq 30A$ at 250V dc			
17.	Thermal withstand	A	$\geq 30A$ for 1 s			
	CONTROL SIGNAL OUTPUTS					
18.	Rated Voltage	V	250V dc			
19.	Continuous current withstand	A	≥ 6			
20.	Make current	A	$\geq 10A$ at 250V DC			
21.	Thermal Withstand	A	$\geq 15A$ for 1 s			
	CONTROL SIGNAL INPUTS					
22.	Rated Voltage	V	110			
	TERMINAL BLOCK CONNECTIONS					
23.	AC Inputs	-	Shall be suitable for min 2.5mm ² compression/ ring lug			
24.	Binary I/O	-	Shall be 1.5-2.5 mm ² and compression/ ring lug			
25.	TYPE TESTS	-	Type tests to conform to IEC 60255			
	GENERAL					
26.	Human Machine Interface (HMI)	-	(HMI) indicates: measurement values, operating messages, and device maintenance messages			



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STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

		-	A minimum of 4 lines for clear annunciation of alarm conditions on the display unit			
		-	A minimum of 8 configurable LEDs			
		-	Keypad to select the following operations: display of metering and operating data, alarm messages, clearing of alarms and resetting, acknowledgment, and access to protection and other relay settings			
	PROTECTION FUNCTIONS					
27.	Definite Time And Inverse Time Overcurrent Protection (50/51)	-	At least three overcurrent elements per group shall be included to provide phase, negative-sequence and residual protection.			
28.	Auto Reclosing (79)		The overcurrent & earth fault protection shall be able to initiate three phase reclosing after a fault of any type			
			The relays shall have a minimum of three auto reclosing shots within a specified			

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STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

			reclaim time			
			It shall be possible to initiate Auto reclose from external signals			
	ANCILLARY FEATURES					
29.	Disturbance/ Event Recording	-	Disturbance Recorder capable of recording analogue and digital signals			
		-	At least 20 Disturbance/ Event records			
		-	At least 10 channels for binary signals			
		-	At least 8 channels for analogue signals			
		-	Minimum pre-fault time of 5 cycles per event			
		-	Minimum fault time of 10 cycles per event			

30	Diagnostics	-	At least 8 LEDs to facilitate post fault analysis including identification of the faulted			
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STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

			phase and type of fault			
		-	Long term storage of the indication is not dependent upon an auxiliary supply			
		-	All indication shall be clearly visible without opening of relay cases.			
		-	All LEDs shall be capable of being reset without the necessity of opening the case.			
31	Parameter Subset Selection	-	At least two setting groups to enable relay use under different operational configurations			
32	Password Protection	-	Provision for level access control by password			
	INPUT/ OUTPUT					
33	Digital Output	-	At least three fast trip, heavy-duty digital output contacts, as specified in 14, 15, 16 and 17.			
		-	At least six flexible and configurable output relays as specified in 18, 19, 20 and 21			
34	External Input		At least four configurable external control inputs.			
	COMMUNICATION/INTERGRATION					
35.	Standard and Protocol	-	IEC 61850, TCP/ IP protocols			
36.	Communication Ports	-	One front communicatio			

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STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

			n port			
		-	Rear Port. At least One Fibre Optic Serial Port/ one Ethernet port			
37.	Relay Interrogation	-	Windows-based PC software for settings and report retrieval			
		-	Operating System to be WINDOWS 7 or higher			
METERING & MEASUREMENT						
38.	The following shall be measured	A	Phase current magnitude			
		A	Residual current magnitude			

Tenderer's Signature: _____

Date: _____



 ZETDC/INTER/06/2023
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STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

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2.4.4 TECHNICAL GUARANTEE SCHEDULE FOR TRANSFORMER DIFFERENTIAL PROTECTION RELAY

Please complete this schedule by stating the actual tendered specification and sign as indicated.

Name of Manufacturer: _____

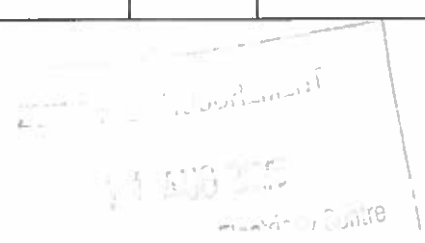
Model: _____

Type: _____

Data about offered equipment shall be filled in by the bidder in table below which must be duly signed and dated. The following compliance schedule must be completed and supported by technical specs/datasheets/brochures from manufacturer. Please indicate in the last column where proof of compliance can be located from the manufacturer's spec sheet. Failure to attach the necessary proof will result in automatic disqualification.

TECHNICAL GUARANTEE SCHEDULE FOR TRANSFORMER PROTECTION RELAYS

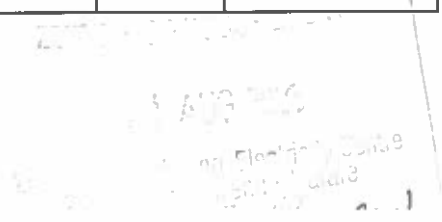
Item	Description	Unit	ZETDC Requirement	Tendered	Remarks	Corresponding reference page in spec sheet (e.g. found on page 3, section 3.2 paragraph/line e.t.c)
1.	Relay Type	-	Numeric			
2.	Enclosure Material		Metallic plate			
3.	Frequency	Hz	50			
4.	Rotation	-	ABC			
	ENVIRONMENTAL CONDITIONS					
5.	Operating temperature range	°C	-5 to +55			
6.	Degree of protection by enclosure when panel-mounted	-	At least IP 30			
	POWER SUPPLY					
7.	Range	V	48.....130 DC			
	AC INPUT CURRENTS					
8.	Nominal current, I_N	A	1A, 3phase,			
9.	Continuous withstand	A	$\geq 3 \times I_N$			
10.	Short time withstand	A	$\geq 10 \times I_N$ for 1s			
	AC INPUT VOLTAGES					
11.	Nominal Voltage, U_N	V	110VAC phase to phase			
12.	Continuous withstand	V	$\geq 1.5 \times U_N$			
13.	Short time withstand	V	$\geq 2 \times U_N$ for 1s			
	TRIP OUTPUTS					



STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

14.	Rated Voltage	V DC	250			
15.	Continuous current withstand	A	≥ 6			
16.	Make current	A	≥ 30A at 250V dc			
17.	Thermal withstand	A	≥ 30A for 1 s			
	CONTROL SIGNAL OUTPUTS					
18.	Rated Voltage	V DC	250V dc			
19.	Continuous current withstand	A	≥ 6			
20.	Make current	A	≥ 10A at 250V DC			
21.	Thermal Withstand	A	≥ 15A for 1 s			
	CONTROL SIGNAL INPUTS					
22.	Rated Voltage	V DC	110V			
	TERMINAL BLOCK CONNECTIONS					
23.	Ac Inputs	-	Shall be suitable for 4 mm ² compression/ ring lug			
24.	Binary I/O	-	Shall be 1.5-2.5 mm ² and compression/ ring lug			
25.	TYPE TESTS	-	Type tests to conform to IEC 60255			
	GENERAL					
26.	Human Machine Interface (HMI)	-	(HMI) indicates: measurement values, operating messages, and device maintenance messages			
		-	A minimum of 4 lines for clear annunciation of alarm conditions on the display unit			
		-	A minimum of 8 configurable LEDs			
		-	Keypad to select the following operations:			

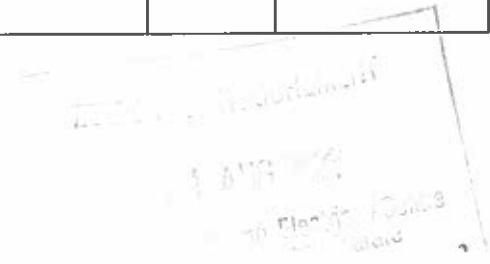


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STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

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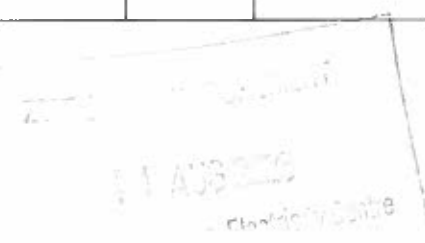
			display of metering and operating data, alarm messages, clearing of alarms and resetting, acknowledgement, and access to protection and other relay settings			
	PROTECTION FUNCTIONS					
27.	Differential Protection (function 87)	-	Winding short circuit and inter turn fault protection for three winding transformer.			
		-	Two settable slopes with adjustable intersection points and minimum pick-up values			
		-	Numerical vector group and ratio matching			
		-	Transformer over-fluxing restraint			
		-	Transformer inrush restraint			
		-	Through-fault stabilization			
28.	Restricted Earth Fault (function 87N)	-	Biased restricted earth fault protection			
		-	At least two Restricted Earth Fault elements per parameter setting group			
29.	Definite Time And Inverse Time Overcurrent Protection (functions 50/51)	-	At least three overcurrent elements per group shall be included to provide phase, negative-sequence and residual protection.			
30.	Over/Under voltage Protection (functions 27/59)	-	At least two stage Overvoltage protection			
		-	At least two stage Under voltage protection			



STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

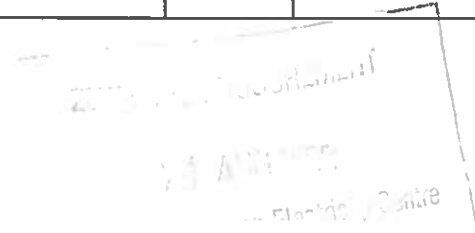
ANCILLARY FEATURES			
31.	Disturbance/ Event Recording	-	Disturbance recorder capable of recording analogue and digital signals
		-	Signals to be used for triggering must be selectable
		-	At least 20 Disturbance/ Event records
		-	At least 20 channels for binary signals
		-	At least 16 channels for analogue signals
		-	Minimum pre-fault time of 5 cycles per event
		-	Minimum fault time of 25 cycles per event
32.	Diagnostics	-	At least 8 LEDs to facilitate post fault analysis including identification of the faulted phase and type of fault
		-	Long term storage of the indication is not dependent upon an auxiliary supply
		-	All indication shall be clearly visible without opening of relay cases.
		-	All LEDs shall be capable of being reset without the necessity of opening the case.
33.	Parameter Subset Selection	-	At least two setting groups to



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			enable relay use under different operational configurations			
34.	Password Protection	-	Provision for level access control by password			
	INPUT/ OUTPUT					
35.	Digital Output	-	At least three fast trip, heavy-duty digital output contacts, as specified in 14, 15, 16 and 17.			
		-	At least sixteen flexible and configurable output relays as specified in 18, 19, 20 and 21			
36.	External Input		At least sixteen configurable external control inputs.			
	COMMUNICATION/INTEGRATION					
37.	Standard and Protocol	-	IEC 61850, TCP/ IP protocols			
38.	Communication Ports	-	One front communication port			
		-	Rear Port. At least One Fibre Optic Serial Port/ one Ethernet port			
39.	Relay Interrogation	-	Windows-based PC software for settings and report retrieval			
		-	Operating System to be WINDOWS 10 or higher			
	METERING & MEASUREMENT					
40.	The following shall be measured	MW	3 Phase Active Power			
		MVar	3 Phase Reactive			



 21/11/2023
 Electrical Centre

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Procurement Reference Number: ZETDC/INTER/06/2023

			Power			
		MVA	3 Phase Apparent Power			
		-	Power Factor			
		V	Phase – Phase Voltage magnitude			
		A	Phase current magnitude			

Tenderer's Signature: _____ Date: _____

DELIVERABLES AND ACCESSORIES FOR PROTECTION RELAYS

- Engineering tools including but not limited to, application software, laptop and accessories for installation, commissioning and maintenance of the relays.
- Engineering manuals for installation, commissioning and maintenance.
- Training for at least 10 Protection Engineers and Technicians

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STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

2.4.5 TECHNICAL GUARANTEE SCHEDULE FOR MULTI-FUNCTION CONFIGURABLE ELECTRICAL TRANSDUCERS

Please complete this schedule by stating the actual tendered specification and sign as indicated.

Name of Manufacturer: _____
 Model: _____
 Type: _____

Data about offered equipment shall be filled in by the bidder in table below which must be duly signed and dated. The following compliance schedule must be completed and supported by technical specs/datasheets/brochures from manufacturer. Please indicate in the last column where proof of compliance can be located from the manufacturer's spec sheet. Failure to attach the necessary proof will result in automatic disqualification.

Item	Description	Units	ZETDC Requirement	Tendered	Remarks	Reference document page (e.g. Found on page 3, section 3.1 of brochure/data sheet/manual/drawing etc.)
1.	Transducer type	-	Multifunction and Configurable			
2.	Inputs					
	Current Input Nominal Range values	A	0 - 10			
	Nominal current Input (I_N)	A	1 and 5			
	Nominal Voltage	V	63.5 _{LN} , 110 _{LL}			
	Voltage range values (U_N)	V	0 - 200V			
	Nominal Frequency	Hz	50			
	Frequency Measuring range	Hz	40.....60			
3.	MEASURAND					
	Current rms	-	Accuracy +/- 0.3			
	Voltage rms L-N and L-L	-	Accuracy +/- 0.3			
	Power (P, Q, S)	%	Accuracy +/- 0.5			
	Power factor (PF)	%	Accuracy +/- 0.5			
4.	AUXILLIARY SUPPLY					
	Voltage AC range	V	110 - 220			
	Nominal frequency	Hz	50			
	Voltage DC range	V	50-220			
	Consumption	VA	Max 10			
5.	MEASURAND					



STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENNVILLE 88/11KV SUBSTATION

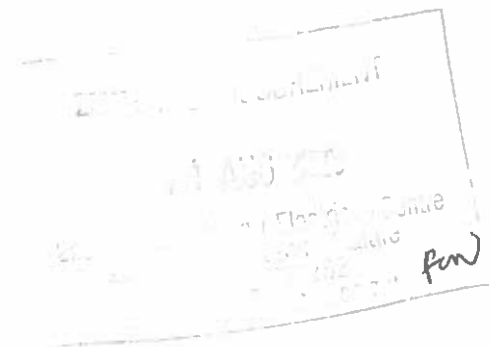
Procurement Reference Number: ZETDC/INTER/06/2023

	OUTPUT				
	Number of Analogue channels	-	At least 4		
	Range	mA	-20...0...+20		
6.	ENVIRONMENTAL CONDITIONS				
	Operating temperature range	°C	-5 to +55		
7.	COMMUNICATION				
	Standard/Protocol	-	MODBUSSLAVE(either over TCP/IP or over RS485 bus using shielded twisted pair cable).		
	Configuration	-	Must have a configuration and diagnostics port plus software.		
8.	MOUNTING	-	DIN Rail mounting		

Tenderer's Signature: _____ Date: _____

DELIVERABLES AND ACCESSORIES FOR TRANSDUCERS

- Configuration software and all relevant Application software and licenses.
- Full documentation of Modbus implementation showing the data types and register mapping for all measurements.
- Engineering manuals and User manuals in both hard and soft copy for installation, commissioning and maintenance.
- Communication cables for LAN connection, RTU and PC interface,



 [Faint stamp and handwritten text, including a signature 'pen']

STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

2.5 Declaration Of Conflict/Non Conflict Of Interest And Non-Disclosure Form

To: The Managing Director (A)
Zimbabwe Electricity Transmission & Distribution Company (Private) Limited
2nd Floor, Electricity Centre
25 Samora Machel Avenue
HARARE

RE: DECLARATION OF CONFLICT OF INTEREST

I, being the Supplier participating in
the tender for the procurement
of..... do
hereby declare as follows:

I declare that to the best of my knowledge, I DO HAVE/DO NOT HAVE conflict(s) of interest that prevent my full and impartial participation of tender number..... The nature of this conflict is described below:-

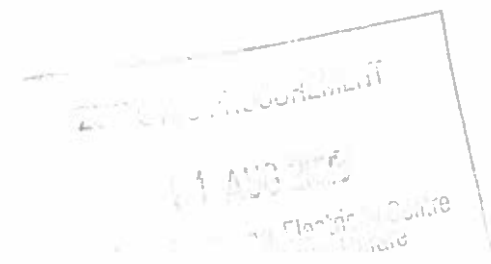
.....
.....
.....
.....

.....
Signature Date

NOTES
Conflict of interest refers to situations in which personal interests (which may include but not limited to financial interests) may compromise, or have the appearance of, or potential for, compromising professional judgment and integrity and, in doing so, the best interests of the company.

- Examples of conflict of interest**
- Having a financial interest in a potential tenderer, supplier, business partner, vendor or any other company or organization which does business or intends to do business with Zimbabwe Electricity Transmission & Distribution Company.
 - Being employed by (as staff member or volunteer) or providing service to any potential tenderer or existing supplier, vendor or business partner
 - Being a member of a potential tenderer or existing supplier's or vendor's management executive or Board member.
 - Receiving any kind of monetary payment or non-monetary gift or incentive (including hospitality) from any tenderer, existing supplier or its representative.
 - Canvassing or negotiating with any person with a view to enter into any of the arrangements stated above.
 - Having a close member of your family (which term includes unmarried partners) or personal friends who fall into any of the categories outlined above

NB: The above is a non-exhaustive list of examples, and it is the responsibility of each Director to ensure that any and all potential conflicts, whether or not of the type listed above, are disclosed.



STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

2.6 Declaration by the Accounting Officer

I declare that the procurement is based on neutral and fair technical requirements and bidder qualifications.

Eng. H. Choga

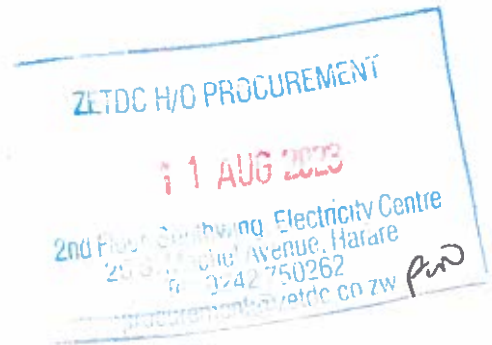


.....

Signed

..11..1..8..1/2023

Date



STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

Part 3: CONTRACT

CONTRACT AGREEMENT

{For completion with the authorised representative of the Procuring Entity following Notification of Contract Award.}

Procurement Reference:

THIS CONTRACT AGREEMENT is made the [insert: date] day of [insert: month], [insert: year].

BETWEEN

- (1) [insert complete name of Procuring Entity], a [insert description of type of legal entity, for example, an agency of the Ministry of the Government of Zimbabwe, or corporation incorporated under the laws of Zimbabwe] and having its principal place of business at [insert full postal address of Procuring Entity] (hereinafter called "the Procuring Entity"), and
- (2) [insert name of Contractor], a corporation incorporated under the laws of [insert: country of Contractor] and having its principal place of business at [insert full postal address of Contractor] (hereinafter called "the Contractor").

WHEREAS the Procuring Entity invited Bids for certain Services, viz., [insert brief description of Services] and has accepted a Bid by the Contractor for the performance of those Services in the sum of [insert Contract Price in words and figures, expressed in the Contract currency] (hereinafter called "the Contract Price").

THE PROCURING ENTITY AND THE CONTRACTOR AGREE AS FOLLOWS:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the General and Special Conditions of Contract referred to below.
2. The following documents shall constitute the Contract between the Procuring Entity and the Contractor, and each shall be read and construed as an integral part of the Contract:
 - (a) This Contract Agreement;
 - (b) Special Conditions of Contract;
 - (c) General Conditions of Contract;
 - (d) Schedule of Requirements;



STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

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- (e) The Contractor's Bid Submission Sheet, List of Services and Price Schedule and Statement of Methodology, Work Plan and Schedule;
 - (f) The Procuring Entity's Notification of Contract Award;
 - (g) [Add here any other document(s)].
3. This Contract Agreement shall prevail over all other Contract documents. In the event of any discrepancy or inconsistency within the Contract Documents, then the documents shall prevail in the order listed above.
4. In consideration for the payments to be made by the Procuring Entity to the Contractor as mentioned below, the Contractor hereby agrees with the Procuring Entity to provide the Services and to remedy any defects in them in conformity with the Contract.
5. The Procuring Entity hereby agrees to pay the Contractor, in consideration for the performance of the Services and the remedying of any defects in them, the Contract Price or such other sum as may become payable under the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS WHEREOF the parties hereto have caused this Agreement to be executed in accordance with the laws of Zimbabwe on the day, month and year indicated above.

For and on behalf of the Procuring Entity

Signed:
Name:	
In the capacity of:	[Title or other appropriate designation]

For and on behalf of the Contractor

Signed:
Name:	
In the capacity of:	[Title or other appropriate designation]

[Faint stamp and handwritten notes, including the word "Electric"]

STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

General Conditions of Contract

Any resulting contract is subject to the Zimbabwe General Conditions of Contract (GCC) for the Procurement of goods (copy available on the Authority's website) except where modified by the Special Conditions below.

Special Conditions of Contract

Procurement Reference Number: ZETDC/INTER/06/2023

The clause numbers given in the first column correspond with the relevant clause number of the General Conditions of Contract.

GCC reference	Special Conditions
GCC 3.6 and 8.1	Authorised representatives: <ol style="list-style-type: none"> 1. The authorised representative of the Procuring Entity is [names and contact details, including address for delivery of notices]. 2. The authorised representative of the Contractor is {names and contact details, including address for delivery of notices}.
GCC 7.4	Ineligible countries: Nationals of the following countries are ineligible to be a Contractor or Sub-Contractor under this Contract. None
GCC 18.1	Liquidated damages: Liquidated Damages in terms of section 88 of the Act shall/ apply at a rate of one percent (1%) of the total cost of the order/job card per hour up to a maximum of 120 hours after which the contract may be cancelled.
GCC 19.1	Commencement of Services: The date or period of time for commencement of services is after signing of the contract and receipt of the order.
GCC 20.1	Completion of Services: The date for completion of Services or the period within which the Services are required to be performed is 10 hours on an underground cable whose spans length is up to 10km, after receipt of order.
GCC 22.2	Contract price: Costs specifically excluded from the Contract price are [list excluded cost items].
GCC 22.3	Payment schedule: The terms of payment shall be [State:

[Handwritten signatures and stamps, including "ZETDC" and "Procurement"]

STANDARD BIDDING DOCUMENT FOR SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF 20MVA, 132/88/11KV POWER TRANSFORMER AT GLENVILLE 88/11KV SUBSTATION

Procurement Reference Number: ZETDC/INTER/06/2023

GCC reference	Special Conditions
	i. For regularly performed services: the specified period (usually one calendar month) for which payment will be made for the total amount of Services performed during that period;
GCC 23.1	Price adjustment: [State whether prices will be fixed for the Contract Period or any adjustment factor that shall apply.]
GCC 24.2	Payment procedure: [State any other documentation that must accompany the Contractor's invoice.]
GCC 28.1	Insurance to be taken out by the Contractor: [The risks and the coverage shall be as follows: (a) Third Party motor vehicle liability insurance in respect of motor vehicles operated in Zimbabwe by the Contractor or its Personnel or any Sub-Contractor or their Personnel, with a minimum coverage of [insert amount and currency]; (b) Third Party liability insurance, with a minimum coverage of [insert amount and currency]; (c) professional liability insurance, with a minimum coverage of [insert amount and currency]; (d) employer's liability and workers' compensation insurance in respect of the Personnel of the Contractor and of any Sub-Contractor, in accordance with the relevant provisions of laws of Zimbabwe, as well as, with respect to such Personnel, any such life, health, accident, travel or other insurance as may be appropriate; and (e) insurance against loss of or damage to equipment purchased in whole or in part with funds provided under this Contract. [Note: Delete what is not applicable].
GCC 30.1	Contract Administration Fee: The Contract Administration Fee set out in Part V of the Fifth Schedule of the Regulations is due upon the signing of the Contract and the applicable Fee is \$ [State applicable Fee or delete].

