

**DESIGN, SUPPLY, DELIVERY INSTALLATION, AND COMMISSIONING OF 11KV  
OUTDOOR SWITCHING STATION AT BEATRICE 33/11KV SUBSTATION, HARARE  
ZETDC/DOM/55/2025**

# **Zimbabwe Electricity Transmission & Distribution Company**



## **STANDARD BIDDING DOCUMENT**

**DESIGN, SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF  
11KV OUTDOOR SWITCHING STATION AT BEATRICE 33/11KV SUBSTATION,  
HARARE**

**TENDER ZETDC/DOM/55/2025**

**Closing Date : 27 November 2025**

**Closing Time : 1000 hours**

**STANDARD BIDDING DOCUMENT FOR DESIGN, SUPPLY, DELIVERY, INSTALLATION  
AND COMMISSIONING OF  
BEATRICE SUBSTATION 11KV OUTDOOR SWITCHING STATION**

<b>Procurement Reference No:</b>	<b>ZETDC/DOM/55/2025</b>
<b>Procuring Entity:</b>	<b>ZETDC</b>
<b>Date of Issue:</b>	<b>17 October 2025</b>

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The definitions used in the Public Procurement and Disposal of Public Assets Act [Chapter 22:23] (“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 and services apply to this Standard Bidding Document. The Act and the Regulations govern the submission of Bids and should be read by all Bidders.

**Procurement Reference Number: ZETDC/DOM/55/2025 Preparation of  
Bids**

You are requested to bid for the items described in the Statement of Requirements below, by completing attached forms and submitting 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. Attach filled in and signed Declaration of Conflict/Non-Conflict of Interest and Non-Disclosure form.
5. Bidders Details form must be completed and submitted together with the bid
6. Proof of Registration with the Procurement Regulatory Authority of Zimbabwe in the relevant category;
7. A bid security of **US\$18000.00 payable in ZWG at the prevailing RBZ bank rate on the day of payment** in the format specified in this part;
8. Proof of payment for the Special Procurement Oversight Committee to be attached.
9. Valid Letter of **authorisation from manufacturer** to be provided by Agents/Non-manufacturers.
10. There shall be no change of Original Equipment Manufacturer (OEM) for this tender. Change of OEM at any stage of procurement will result in automatic cancellation of contract.
11. **Technical Brochures, drawings and diagrams and technical data sheets with detailed literature** covering the tendered items to be included in the bid.
12. **Copies of Type test certificates for similar equipment to be attached. All type tests should conform to the IEC 60255 standards**
13. At least two manufacturer’s trade references on an official letter head shall be submitted with the bid.
14. Certificate of incorporation
15. A copy of old CR 14, now new CR6; **showing names of Directors** or **equivalent** company registration documents in the country of residence for foreign companies.

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16. A copy of old CR 6, now new CR5; **showing physical place of business** or **equivalent** company registration documents in the country of residence for foreign companies. N.B. Tenders submitted by a JV of two or more firms as partners shall comply with this eligibility requirement for each partner.
17. Valid NSSA Certificate
18. Valid Tax clearance certificate;
19. Bid Validity of sixty (60) days must be clearly stated
20. Prices must be quoted in United States Dollars
21. Payment terms will be made as follows: ZETDC will pay Foreign Component to the Original Equipment Manufacturer (OEM) in USD using a confirmed irrevocable Letter of Credit (LC) with payment being released as per agreed milestones. Balance for companies bidding as local companies will be paid in Zimbabwe Gold (ZWG) currency at Reserve Bank of Zimbabwe (RBZ) interbank rate as at the date of payment within 30 days from date of delivery and Goods Received Note (GRN) issued by ZETDC. Balance for companies bidding as foreign companies will be paid through Telegraphic Transfer (TT) in United States (USD) currency within 30 days from date of delivery and Goods Received Note (GRN) issued by ZETDC.
22. Delivery period is within nine (9) months DDP Beatrice Substation
23. Minimum of three (3) trade reference letters from customers with active contact details showing bidders' direct experience in the provision of similar services.
24. Warranty letter from manufacturer for at least 3 (three) year must be provided.
25. Compliance statement to the technical specification **on a clause by clause basis** to be provided.
26. Bidder to supply manufacturer's supply history of 5 years
27. Bidder to supply his service history of 3 years
28. **Technical Guarantee schedule** to be completed in full, signed for and shall be compliant with ZETDC requirements
29. Factory acceptance test shall be carried out at the supplier's premises and witnessed by three ZETDC Engineers at ZETDC's expense
30. No deviation or exception shall be permitted without the written approval of the purchaser.

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31. All accessories, items of work, though not indicated but required to make the system complete for its safe, efficient, reliable and trouble free operation and maintenance shall also be in supplier's scope unless specifically excluded.
32. **There will be mandatory site visit on the 03 November 2025 at ZETDC Beatrice Substation, Corner Willowvale Road & Simon Mazorodze Harare at 1000hrs,**
33. **A site visit certificate will be issued and should be submitted together with the bid.**
34. **Partial bid shall not be accepted**
  
35. Bidders to submit security clearance application details with Name, Surname, National Identity Number for locals and Passport page with Photo for foreigners under cover of a company letterhead by **31 October 2025** for ZETDC to facilitate security clearance application with relevant authorities. The security clearance application documents should be submitted on email [procurement@zetdc.co.zw](mailto:procurement@zetdc.co.zw) or hand delivered to ZETDC PMU, Electricity Center, 2<sup>nd</sup> Floor, 25 Samora Machel Avenue, Harare

**NB: Failure to comply with the above requirements leads to automatic disqualification.**

### **Lots**

There are no lots.

**Contract will be awarded to the bidder with the lowest aggregate price to specification. 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 more than one Bidder owned, directly or indirectly, by the same person.

### **Clarifications**

Clarification of the bidding document may be requested through eGP at any time on or before **11 November 2025, 1600 Hours**. If a prospective Tenderer sends an inquiry after the stated date or the inquiry is received after the stated date, ZETDC shall not respond to the inquiry but ignore it.

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**BEATRICE SUBSTATION 11KV OUTDOOR SWITCHING STATION**

**Responses to Clarifications**

All responses to clarifications will be posted on the e-GP system website <https://egp.praz.org.zw>. Bidders should frequently check for updates on the websites until the closing date of the tender.

**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 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.

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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.

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.

**Submission of Bids**

**Bids must be submitted through electronic Government Procurement (e-GP) system portal <https://egp.praz.org.zw>. No bids received outside the system will be accepted.**

<b>Date of Deadline</b>	<b>27 November 2025</b>	<b>Deadline Time:</b>	<b>1000 hours Harare Time (GMT + 2 hours)</b>
<b>Submission Address:</b>	<a href="https://egp.praz.org.zw">https://egp.praz.org.zw</a>		

**Bid opening**

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

**Withdrawal, amendment or modification of Bids**

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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.

**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.

**Bid Security**

The Bidder must include a bid security of **US\$18000.00 or equivalent in ZWG at the prevailing RBZ bank rate on the day of payment** in the following form:

**First Option.** A certified bank cheque; or

**Second Option.** A bank guarantee; or

**Third Option.** A refundable cash deposit of **US\$18000.00 or equivalent in ZWG at the prevailing RBZ interbank rate on the day of payment** 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 fee of **US\$750.00**

**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.
3. Purpose of the Bank Guarantee to be clearly stated.

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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 submission of the Performance Bond as specified in the tender document.

**Third Option**

If Option 3 is chosen bidders must pay **USD\$18000.00 or equivalent** in ZWG at the RBZ prevailing Interbank rate of the day of payment. The Bid Security that shall be Refundable at the end of the bid validity period plus another **USD750.00 or equivalent** in ZWG at the RBZ prevailing Interbank rate of the day of payment 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), 9<sup>th</sup> Floor, Pearl House, 61 Samora Machel A venue, Harare or to be deposited in the following account numbers:

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**1 REFUNDABLE (USD)**

*Bid Bonds (USD) only*

BANK NAME: COMMERCIAL BANK OF ZIMBABWE  
ACCOUNT NAME: PROCUREMENT REGULATORY AUTHORITY  
OF  
ZIMBABWE  
CURRENCY: UNITED STATES DOLLARS (USD)  
ACCOUNT NUMBER: 10721064850128  
BRANCH SORT CODE: 6101  
SWIFT CODE: COBZZHAXXX

**1 REFUNDABLE (ZWG)**

*Bid Bonds (ZWG) only*

BANK NAME: COMMERCIAL BANK OF ZIMBABWE  
ACCOUNT NAME: PROCUREMENT REGULATORY AUTHORITY  
OF  
ZIMBABWE  
ACCOUNT  
NUMBER: 10721064850118  
BRANCH: KWAME NKRUMAH

**2 NON-REFUNDABLE (USD)**

*United State Dollars (USD) only Registration, Bid Establishment Fees, Admin Fees (Contract,  
SPOC and other Admin Fees) United States Dollar (USD) only*

BANK NAME: COMMERCIAL BANK OF ZIMBABWE  
ACCOUNT NAME: PROCUREMENT REGULATORY AUTHORITY OF ZIMBABWE  
ACCOUNT NUMBER: 10721064850150  
BRANCH SORT CODE: 6101  
SWIFT CODE: COBZZHAXXX

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**3 NON-REFUNDABLE (ZWG)**

*Registration, Bid Establishment Fees, Admin Fees (Contract, SPOC and other Admin Fees)  
Zimbabwean Gold (ZWG) currency only*

BANK NAME: COMMERCIAL BANK OF ZIMBABWE  
ACCOUNT NAME: PROCUREMENT REGULATORY AUTHORITY  
OF  
ZIMBABWE  
ACCOUNT NUMBER: 10721064850020  
BRANCH: KWAME NKRUMAH

If **Option 3** is chosen bidders must pay for the Bid Security that shall be Refundable at the end of the bid validity period plus another 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), 61 Samora Machel Avenue, Harare or to be deposited in the following account numbers:

**1. NON-REFUNDABLE (LOCAL)**

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

**2. REFUNDABLE (LOCAL)**

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

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**NB: The bid security shall be valid for sixty (60) 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, where this is a requirement of bidding, will be rejected by the Procuring Entity as non-responsive.**

The Bid Security of a Joint Venture (JV) must be in the name of the JV that submits the Bid. If the JV has not been legally constituted at the time of bidding, the Bid Security must be in the names of all intended partners.

### **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 a bid will be eliminated and not considered in subsequent stages.

### **Currency**

Bids should be priced in **United States Dollars**.

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### **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.

### **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.

### **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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**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.

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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:**

<p>.....</p>	<p><b>Name:</b> .....</p>
<p><b>Position:</b> .....</p>	<p><b>Date:</b> ..... (DD/MM/YY)</p>
<p><b>Authorised for and on behalf of:</b></p>	
<p><b>Company</b> .....</p>	
<p><b>Address:</b> .....</p>	

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**PART 2: STATEMENT OF REQUIREMENTS**

**Procurement Reference Number:** ZETDC/DOM/55/2025

**Bidder's Name:** \_\_\_\_\_

Currency of Quotation is United States Dollars payable in ZWG at the prevailing RBZ interbank rate on the date of payment.

Subject	Requirement
Services to be performed	<b>DESIGN, SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF BEATRICE SUBSTATION 11KV OUTDOOR SWITCHING STATION</b>
Location(s)	<b>ZETDC HARARE REGION BEATRICE 33/11KV SUBSTATION</b>
Duration of contract	1 year

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**Price Schedule**

<b>A</b>	<b>B</b>	<b>c</b>	<b>d</b>	<b>e</b>	<b>f</b>	<b>g</b>	<b>h</b>
<b>Item</b>	<b>Description</b>	<b>Quantity</b>	<b>Unit of Measure</b>	<b>Price Excl. VAT</b>	<b>Total Price Excl. Vat (c * e)</b>	<b>VAT (f *0.15)</b>	<b>Total Price Incl. VAT (f + g)</b>
<b>1</b>	DESIGN, SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF BEATRICE SUBSTATION 11KV OUTDOOR SWITCHING STATION	<b>1</b>	EACH				

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**Delivery Schedule**

**Procurement Reference Number:** ZETDC/DOM/55/2025

Bidder's Name: \_\_\_\_\_

Bidder's Reference Number: \_\_\_\_\_

Item No.	Description of Goods	Delivery Date Required by Procuring Entity, and applicable INCOTERM	Bidder's offered Delivery period & Incoterm
			<i>To be provided by the bidder</i>
1	DESIGN, SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF BEATRICE SUBSTATION 11KV OUTDOOR SWITCHING STATION	With 9 MONTHS DDP Beatrice Substation	

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

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**Bidder Details Form**

Tender Number: ZETDC/DOM/55/2025

Name of Bidder: \_\_\_\_\_

Physical Address:  
\_\_\_\_\_  
\_\_\_\_\_

Active Telephone Numbers: \_\_\_\_\_  
\_\_\_\_\_

Active email Address: \_\_\_\_\_

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**Tick the Option chosen to pay Bid Security**

**First Option.**     A certified bank cheque,

**Second Option.**     A bank guarantee; or   
Name of the Bank: \_\_\_\_\_

**Third Option.**     A refundable cash deposit of **US\$ 18000.00**

**Banking Details**

Account Name: \_\_\_\_\_

Bank: \_\_\_\_\_

Branch: \_\_\_\_\_

Account Number: \_\_\_\_\_

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**DECLARATION OF CONFLICT/NON-CONFLICT OF INTEREST AND NON-  
DISCLOSURE FORM**

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

**HARARE**

**RE: DECLARATION OF CONFLICT OF INTEREST**

1, ....., 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**

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ZETDC/DOM/55/2025**

**ZIMBABWE ELECTRICITY TRANSMISSION &  
DISTRIBUTION COMPANY**



***DISTRIBUTION SERVICES DEPARTMENT***

**ZETDC SPECIFICATION NO. DS27082025BTSS**

**SPECIFICATION FOR**

**11kV OUTDOOR SWITCHING STATION**

**FOR BEATRICE 33/11kV PRIMARY SUBSTATION**

**ABBREVIATION DEFINITION AND INTERPRETATION**

**AC** – Alternating Current

**ALF** – Accuracy Limiting Factor

**ASTM** – American Society for Testing and Materials

**BS** – British Standards

**DC** – Direct Current

**DIN** - German Institute for Standardization

**EN** - European Norm

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ZETDC/DOM/55/2025**

**Hz** – Hertz

**IEC** – International Electromechanical Commission

**ISO** - International Standards Organisation

**KV**- Kilovolt

**REF** - Restricted Earth fault

**DIFF** - Differential

**OC/EF** – Overcurrent /Earth fault

**CT** – Current transformer

**MVA** - Mega Volt Amp

**NC** – Normally Close

**NO** – Normally Open

**V** – Volt

**GPR** – Ground Potential Rise

**Cu** - copper

**AL** - Aluminium

**oC** - degree Celcius

**HV** - High Voltage

**kA** - kilo Ampere

**kg** - kilogram

**km** - kilometre

**kN** - kiloNewton

**m** - meter

**m<sup>2</sup>** - square meter

**mm** - millimetre

**MPa** - MegaPascal

**m/s**- meters per second

**Nm** - Newton-meter

**PCD** - pitch circle diameter

**OD** - outer diameter

**SANS** - South African National Standard

# STANDARD BIDDING DOCUMENT FOR DESIGN, SUPPLY, DELIVERY, INSTALLATION AND COMMISSIONING OF BEATRICE SUBSTATION 11KV OUTDOOR SWITCHING STATION ZETDC/DOM/55/2025

$V_m$  - maximum system voltage (in IEC terminology  $U_m$ )

## 1. INTRODUCTION

This specification calls for the design, supply, delivery, installation and commissioning of 11kV outdoor Switching station to replace the existing indoor board at Beatrice 33/11 kV substation.

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 fully meet the technical and commercial requirements.

Tenderers should quote for the design, supply, delivery, installation and commissioning of the switching station equipment complete with Busbars, Busbar connectors, current transformers, relays, instruments and other ancillary equipment, to ZETDC Harare Stores from which the equipment will be ferried to the substation for installation.

An equipment layout Diagram 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 ZETDC.

**The contract shall be awarded to tenderers who have at least 3 traceable references where similar work has been done and has operated efficiently for at least 5 years.**

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

**Tenderers shall include a Gantt chart for the design, supply, delivery, installation and commissioning and in any case it shall not exceed 9 (Nine) months.**

**The project implementation team shall be indicated in an organogram with the relevant experience of the three main team members clearly stated. The project team leader shall have at least 10 years relevant experience.**

**N.B. Tenderers should note that a compulsory site meeting will be held at the project site (Beatrice 33/11kV Substation) two weeks prior to the tender closing. The exact date and time can be confirmed with the Procurement Administrator, ZETDC.**

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## 2. Project Scope

Design, Supply, Delivery, Installation and commissioning of an 11kV Switching station at the Beatrice 33/11kV substation, Harare.

The actual requirements are as indicated in Appendix 1.

**NB: The equipment shall be arranged as shown on Appendix 2 and all equipment shall be in compliance with this specification.**

## 3. PARTICULARS OF ELECTRICAL SYSTEM

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

- a) Three phase overhead-line construction and underground system. The maximum earth fault factor on the network is 1.5.
- b) Operated at 50 Hz, with approximately sinusoidal wave form.
- c) The highest system voltage does not normally exceed the nominal system voltage by 10%. The nominal system voltages are 11kV, 33kV and 132kV.
- d) The system frequency variation does not exceed plus or minus 2.5% from 50 Hz. Designs should allow for these variations.
- f) Intrinsically safe to operate due to mechanical and electrical interlocks.

## 4. PARTICULARS OF THE ENVIRONMENT

- a) Altitude: The substation operates at an average altitude of 1480m above sea level at typical air pressure of 860 mbar.
- b) The station will be exposed to direct tropical sunlight.
- c) Humidity: Humidity of 13mg per cubic metre absolute and 65% relative before storms with vapour pressure of 17mmHg.
- d) Equipment 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.

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- e) Relative humidity - 80%
  
- f) Maximum wind pressure at project area on conductors and cylindrical objects - 430 N/m<sup>2</sup>
  
- h) Maximum wind pressure on steel members on 1.5 times projected area - 820 N/m<sup>2</sup>
  
- i) Rainfall conditions 800-1700 mm/year  
Maximum - 160mm in 24 hrs
  
- j) Maximum solar radiation shall be 1200W/m<sup>2</sup>

It is the manufacturers 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.

## 5. EQUIPMENT DESIGN AND CONSTRUCTION

### 5.0 General

The complete configuration is shown on the single line diagram attached in appendix 2 showing most of the equipment required and their general arrangement.

### 5.1 Circuit Breakers Specification

#### General

The three phase 11kV circuit breakers shall be of the outdoor, single pressure SF<sub>6</sub> gas types. The SF<sub>6</sub> gas shall comply with IEC 376.

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.

System for monitoring continuously the 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, the circuit breaker should be automatically blocked against operation.

A SF<sub>6</sub> pressure gauge shall be provided in the local circuit breaker cubicle.

An SF<sub>6</sub> gas refilling equipment mounted on a trolley shall be provided for use in the station.

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The circuit breakers shall be provided with means to prevent contact pumping while the closing circuit remains energised should the circuit breaker either fail to latch or be tripped during closing due to the operation of the protective relays.

A motor charged or electromagnetic spring operated mechanism is preferred. Pneumatic or hydraulic operating mechanism is not accepted.

The operating mechanism shall be provided for electrical, local and remote control. The control voltage for closing and opening commands and for the operating mechanism, unless otherwise stated in the Schedule of Requirements, shall be:

**DC voltage shall be 110V DC + 10% - 20% from unearthed battery for closing, opening and indication. Motor operated mechanism shall be supplied from 230 V AC.**

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

A local position indicator, visible with the panel door closed, shall be mounted in the front panel of the operating mechanism cubicle.

A crank, lever or other similar suitable device shall be provided to permit charging the operation 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.

It shall be possible to determine the available operating energy stored by the mechanism prior to operating the circuit breaker. An alarm shall be given in the event of the stored energy falling below a minimum rated level.

The complete operating mechanism, including the controls, shall be built-in water-tight and dust-proof lockable cubicles (min. IP 54). All parts shall be easily accessible without dismantling other parts. Openings, covered with dust filters, shall allow a good ventilation of these cubicles. In order to avoid any moisture, thermostat controlled heaters for 230 V AC shall be built-in. Push buttons for operating the breaker shall be located not more than 1.7 m above ground.

A lockable local/remote control selector switch shall be provided in the cubicle. With the selector switch set to local control, operation from any remote source including the protective relays shall be inhibited. The switch shall have spare contacts.

A sufficient number of auxiliary contacts for 110 V DC shall be provided for control and interlock purposes.

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

All wiring shall lead to terminals. 10% of the terminals shall be spare.

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**Circuit Breaker Mounting Details**

The breakers shall be mounted on steel structures.

The following minimum distances and conditions shall be observed:

<b>Description</b>	<b>Unit</b>	
<b>Nominal Voltage</b>	<b>kV</b>	
Phase to Ground	mm	230
Phase to Phase	mm	260
Busbar phase to phase	mm	260
Distance from ground to live parts	mm	2000
Distance from roads to live parts	mm	5200
Nearest part of insulators to ground level	mm	2000
Maximum Temperature rise of conductors above ambient (40 °C)	°C	40
Maximum Wind Pressure on Conductors and Cylindrical Objects	N/m <sup>2</sup>	430
Maximum wind pressure on flat surfaces	N/m <sup>2</sup>	820

**Electrical Equipment Materials**

All materials incorporated in the equipment supplied shall be new and of first class commercial quality, free from defects and imperfections.

Nuts, bolts and washers below 16 mm shall be provided in stainless steel.

**Surface Treatment and Painting**

The control cubicle 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 two finishing coats.

Parts that cannot be readily painted shall be hot-dip galvanised.

All galvanising shall be in accordance with BS 729 or other internationally approved standards.

**Voltage and current rating**

The rated voltage and insulation levels shall be:

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<b>Description</b>	<b>Unit</b>	
Nominal Voltage	kV	11
Basic insulation level	kV	75
Power Frequency withstand Voltage	kV	28

**Surface Treatment and Painting**

Control boards, panel boards, cubicles, cabinets, etc. if applicable shall have interior surfaces painted with at least one primary, 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, and two layers of paint on zinc powder basis applied after perfect cleaning. Parts that cannot be readily painted shall be hot-dip galvanized.

**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 incomer and bus section	1600 Amps
Feeders	800 Amps
All other HV connections	800 Amps

Minimum short circuit current rating for transformer incomer, bus section and feeders shall be 25kA.

**NB: The circuit breaker shall be supplied from a company that has at least 100 units operating and the supply history for the units shall be provided. Type test results for the circuit breakers done by an independent testing institution shall be provided.**

**5.2 CURRENT TRANSFORMERS**

**General**

Outdoor post type Current Transformers with polymeric rubber bushings and shall be suitable for mounting on individual steel structures. The current transformers shall be single-phase, dry type, and shall be mounted on a steel structure. The number of cores and ratios shall be as specified in the Schedule of Requirements.

**Insulation Medium and Housing**

The supplied current transformers shall be dry type.

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## Short Time Current Rating

All current transformers shall have a maximum short-time current rating, at rated output of not less than 25 kA for three seconds.

## Terminal Box

All secondary connections shall be connected to a terminal block which shall be located in a dust-proof and watertight housing. An earth connection to the housing shall be provided.

## Continuous Current Rating

The current transformers shall be designed to carry continuously a current of 120% of the rated current. The characteristics of the current transformers shall comply with the provisions stipulated in IEC 60185.

## Creepage Distance

The combined current transformer insulator creepage distance shall not be less 276 mm for 11 kV.

## Test Certificates and Reports

The current transformers shall pass the manufacturer's standard test routine, and such test report shall be submitted with the bid. The report shall clearly indicate the tests performed and to which international standard they conform to. In addition, the bid shall be submitted with type tests certificates from independent internationally recognized test laboratories of the following tests in accordance with the latest IEC 60044-1 recommendations;

- Short time current test
- Temperature rise test
- Lightning impulse test
- Wet test for current transformers
- Determination of error.

**NB. All routine test certificates and reports attached shall be not more than two years old. Type test certificates shall not be more than 5 years old.**

## Rating Plate

Ratings and data of the current transformers shall be provided on the nameplate, which shall be weather and corrosion proof. The nameplate shall be securely riveted to the side of the (lower part) current transformers with legible print that can be easily read from the

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ground level when it is installed at a height of 2.5 m from the ground level. It shall consist of the following information:-

- (a) Number and year of the standard adopted.
- (b) Inscription of Customer name- (ZETDC)
- (c) Name of manufacturer.
- (d) A serial number and CT type designation.
- (e) The rated primary and secondary currents.
- (f) The rated Voltage kV.
- (g) The rated frequency Hz.
- (h) The rated burden (VA).
  
- (i) Accuracy Class
- (j) Class of insulation.

### **5.3 Isolators**

#### **General**

- a) The design, dimensions and materials of all parts shall be such that they will not suffer damage under the most adverse conditions nor result in deflections and vibrations, which might adversely affect the operation of the equipment. Mechanisms shall be constructed to avoid sticking due to rust or corrosion.
  
- b) The equipment and apparatus shall be designed and manufactured in the best and most substantial and workmanlike manner with materials best suited to their respective purpose and generally in accordance with up-to-date recognized standards of good practice.
  
- c) All parts which will or might have to be dismantled for the purpose of serving or replacement shall be assembled with anti-corrosive fasteners. The type, material and size of all fasteners shall be selected to safely withstand the maximum superimposed direct, alternating, kinetic and all loads induced by workmen when installing or removing the fasteners during the life of the equipment.
  
- d) The equipment shall be designed to cope with 0.15G acceleration of seismology on the centres of gravity.
  
- e) All equipment shall be designed to minimize the risk of fire and consequential damage, to prevent ingress of vermin, dust and dirt, and accidental contact with electrically energized or moving parts. The plant shall be capable of continuous operation with minimum attention and maintenance in the exceptionally severe conditions likely to be obtained in a tropical climate.

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- f) Upon request by the Employer complete information regarding the design assumptions, loading and operating conditions, deflections and unit stresses used in the design shall be provided by the supplier.
- g) The Bidderr shall be deemed to have examined the specification and drawings herewith, and unless stated specifically to the contrary in the schedule of proposed conditions and /or deviations from the specification to have concurred with the design and layout of the applicable project features as being sufficient to insure reliability and safety in operation, freedom from undue stresses, adequate drainage and other essentials for a satisfactory working plant.

**Strength and quality**

- a) All steel castings and weldings shall be stress-relieved by heat treatment before machining, and castings shall be stress-relieved again after repair by welding.
- b) Liberal factors of safety shall be used throughout, especially in the design of all parts subject to alternating stresses or shocks.

**Basic requirements for electrical equipment**

All materials supplied under this Contract shall be new and of the best quality and of the class most suitable for working under the conditions specified. They shall withstand the variations of temperature and atmospheric conditions arising under working conditions without distortion deterioration or undue stresses in any parts and also without affecting the suitability of the various parts of the Works for which they were designed. The Plant shall be designed for a lifetime of at least 40 years.

**Corona and radio interference**

- a) Isolator shall be electrically designed to avoid local corona formation and discharge likely to cause radio interference.
- b) The design of all line conductor fittings, insulator fittings, etc. shall avoid sharp corners or projections which would produce high electrical stress in normal operation.
- c) The design of adjacent metal parts and melting surfaces shall be such as to prevent corrosion of the contact surfaces and to maintain good electrical contact under service conditions.
- d) Particular care shall be taken during manufacture of conductors and fittings and during subsequent handling to insure smooth surface free from abrasion.

**Insulators and fittings**

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- a) All porcelain insulators and bushings for outdoor equipment shall be brown glazed. The resin insulators for indoor equipment may be of the inherent colour of the resin. All fittings shall be malleable iron hot-dipped galvanized alloy.
- b) All the insulators and bushings shall have impressed thereon, before firing the glaze, the name, initial or trade mark of the manufacturer, the year of manufacture and the mechanical strength.

**Materials and workmanship**

- a) Materials shall be new; the best quality of their respective kinds and such as is usual and suitable for work of like character. All materials shall comply with the latest issues of the specified standard unless otherwise specified or permitted by the Employer.
- b) Workmanship shall be of the highest class throughout to ensure reliable and vibrations free Operations. The design, dimensions and materials of all parts shall be such that the stresses to which they may be subjected shall not cause distortion, undue wear, or damage under the most severe conditions encountered in service.
- e) All parts shall conform to the dimensions shown on and shall be built in accordance with approved specifications. All joints, datum surfaces and meeting components shall be machined. All machined finished shall be shown on the drawings. All screw, bolts, studs and nuts and threads for pipe shall conform to the latest standards of the International Organization for Standardization covering these components and shall all conform to the standards for metric sizes. The supplier shall never incorporate any standards or size system by his own account, regardless of that accepted and incorporated in this Contract.
- d) All materials and works that have cracks, flaws or other defects or inferior workmanship will be rejected by the Employer. The supplier shall promptly remove all defective materials from the site.

**Standard Specifications**

The design, materials, manufacture, testing, inspection and performance shall, unless otherwise specified in the Special requirements of these Specifications, conform to the authorized standards of the International Electro technical Commission (IEC) or equivalent national standards in addition to ZETDC Operational procedures. The supplier shall include a standards, intended to be used.

**Assembly**

Necessary items of equipment shall be assembled in the factory prior to shipment and the contractor as may be required to demonstrate to the satisfaction of the Employer the adequacy of equipment and its component parts shall perform routine tests. All tests

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should simulate normal operating conditions as closely as possible. All dismantled parts shall be properly match marked and doweled to ensure correct assembly in the field.

**Casting**

- a) Casting shall be true to pattern, of workmanlike finish and of uniform quality and condition, free from blowholes, porosity, hard spots, shrinkage defects, cracks or other injurious defects, shall be satisfactorily cleaned for their intended purpose.
- b) Major defect on castings shall not be repaired, plugged, or welded without permission of the Employer. Such permission will be given only when the defects are small and do not adversely affect the Strength, use or merchantability of the castings. The Employer shall give the distinction between major and minor defects. Excessive segregation of impurities or alloys at critical points in a casting will be a cause for its rejection. The largest fillets compatible with the design shall be incorporated wherever a change in section occurs. All castings shall be stress-relieved before machining and again after repair by welding.
- c) Plates to be joined by welding shall be accurately cut to size and rolled by pressure to the proper curvature, which shall be continuous from the edges. Flattening in the curvature along the edges with correction by blows will not be allowed. The dimensions and shape of the edges to be jointed shall be such as to allow thorough fusion and complete penetration, and the edges of plates shall be properly formed to accommodate the various welding conditions.

**Forging**

- a) The ingots from which the forgings are made shall be cast in metal moulds. The workmanship shall be first-class in every respect and the forgings shall be free from all defects affecting their strength and durability, including seams, pipes, flaws, cracks, scales, fins, porosity, hard spots, excessive non-metallic inclusions and segregations.
- b) The largest fillets compatible with the design shall be incorporated wherever a change in section occurs. All finished surfaces of forgings shall be smooth and free from tool marks.
- f) The forging shall be clearly stamped with the heat number in such locations to be readily observed when the forging is assembled in a completed unit.

**Welding**

- a) Wherever welding is specified or permitted, a welding process, including stress relieve treatment as required if necessary, conforming to an appropriate and widely recognized professional standard shall be used.

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- b) Plates to be joined by welding shall be accurately cut to size and rolled by pressure to the proper curvature, which shall be continuous from the edge. Flattening in the curvature along the edges with correction by blows will not be allowed. The dimensions and shape of the edges to be jointed shall be such as to allow through fusion and complete penetration, and the edges of plates shall be properly formed to accommodate the various welding conditions.
- c) The surfaces of the plates adjacent to the edges to be welded shall be thoroughly cleaned of all rust, grease and scale to bright metal. All important welding shall be stress-relieved by heat treatment before machining.

**Galvanizing**

- a) Unless specifically mentioned to the contrary, iron and steel shall be galvanized in the factory after fabrication. The zinc coating shall be uniform, clean, smooth and as free from spangle as possible. Galvanizing shall be applied by the hot dip process for all parts other than steel wires. All steel wires shall be galvanized by a recognized trade standard.
- b) The minimum quantities of zinc coating shall be 350 gram/sq. metre for bolts and nuts and 550 gram/sq. Metre for all other parts except steel wires, unless otherwise specified in the Contract Documents. The uniformity of zinc coating, tested by dipping surface shall be exposed until the surface has been dipped four times for bolts and nuts, and six times for all parts.
- c) The preparation for galvanizing and the galvanizing itself shall not distort or adversely affect the mechanical properties of the materials.
- d) Special treatment during galvanizing to prevent the formation of “White rust” during shipment or storage is required. The Bidder shall state in his Tender the treatment to be used.

**Nameplate**

- a) To facilitate operation and maintenance it is very important that all equipment e.g., Outdoor/indoor Switchgear, valves, instruments, switches, pipeline, etc., shall be clearly identified by engraved nameplates showing the function and proper use of each item. Such identification shall be in English and must be intelligently and carefully designed to minimize errors and to avoid mal operation in operations or maintenance.
- b) The nameplates shall be permanently legible, clearly worded, weather proof when outdoors and securely mounted in conspicuous and logical locations.

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**5.4 Lightning Arrestors**

**General Description**

A surge arrester is essentially a protection device designed to protect electrical apparatus from high transient voltage surges with the following features: -

- i) Ability for repeated operation to limit high transient voltage surges.
- ii) Ability to limit the duration and amplitude of follow up current.
- iii) Ability to interrupt power frequency follow through current.
- iv) Ability not to conduct under normal power frequency voltage.
- v) Ability to withstand normal over-voltages on healthy phases could approach line-to-line nominal voltages.

**Design and Construction**

The arresters shall be the metal oxide gap-less type, and shall be connected between phase and earth. The arresters shall be suitable for outdoor installation.

- a) The arrester design should be such that when it is necessary to bolt units together to form each pole stack, the bolted surface shall be machined and aligned so that, when assembled, the stack will be vertical and no strain other than compression will be imposed on insulation portions of the arrester.
- b) When arresters are supplied for base mounting, they shall be complete with fittings for mounting them on a steel or concrete structure supplied under separate contract. Such fittings should include suitable base plate for ensuring an even distribution of the weight arrester.
- c) All arresters shall be supplied with a name plates which indicates the data specified in BS 2914:1972 engraved or embossed characters.
- d) Arresters offered shall have, incorporated in the design, an isolating device to isolate the earth lead in the event of arrester operation. The device shall operate only when the valve material of the arrester becomes damaged and the arrangements made to ensure such a condition shall be shown in the tender.
- e) The connection terminals shall be suitable for conductors with diameters ranging from 16 to 70mm.

**Electrical Equipment Materials**

All materials incorporated in the equipment supplied shall be new and of first class commercial quality, free from defects and imperfections.

The housing of the arresters shall be polymeric rubber. Arresters with porcelain housing are not acceptable

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**Surface Treatment and Painting**

Exposed metal parts shall be hot-dip galvanized.

All galvanizing shall be in accordance with BS 729 or other internationally approved standards.

**Ratings**

**Voltage Rating**

The arresters will be used on networks with nominal voltage of 11kV.

The maximum system voltages is 12kV.

The MCOV for the arrestors shall be between (80-85) percent of nominal voltage.

**Current Rating**

The nominal discharge current rating for surge arresters shall be 10kA.

**Protection Characteristics**

The protection level of the arrester shall be determined as the highest of the following values: -

- Residual voltage at nominal discharge current and 8/20 $\mu$ s, or
- Standard lightning impulse voltage, or
- Front-of-wave impulse spark over voltage divided by 1.15

The protection level shall have a margin of safety of at least 40% compared to the BIL of the equipment to be protected. The equipment to be protected will have a BIL of 75kV. Reference is made to IEC 71-2. The residual voltages for 10kA shall therefore be less than 45kV for the 11kV arresters.

**Creepage Distance (Housing)**

The specific creepage distance for any arrester shall not be less than 25-mm/kV-system voltage, corresponding to heavy pollution according to IEC.

**Tests**

**General**

- a) Lightning arresters offered or supplied to this Specification shall be capable of complying with the tests detailed in BS 2914 and IEC 99-4:1991-11 including wet tests and any additional tests specified herein or included in other acceptable specifications with

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which the equipment is claimed to comply. Tests shall include requirements set out below.

**i) Operating Duty Tests**

Arresters are required to withstand the effect of multiple lightning strokes which may consist of fifteen impulses over a period of one second. Comparatively high short circuit currents may occur at some points on the system and arresters are required to limit the follow-through power frequency current to values which will not damage the arrester. The residual voltage should not be so high that upon discharging the rated current, does not provide an adequate margin for the protection of substation equipment. Preference will be given to diverter designs which have been tested to prove their sustainability for these conditions. Details of the tests shall be provided in the tender.

**ii) Line Discharge Tests**

The line discharge capability of heavy-duty arresters shall be established by the test of which the parameters and results shall be given in the tender.

**iii) Radio Influence Voltages**

Radio influence tests shall be carried out to American N.E.M.A. standard; test details shall be supplied in the tender and the radio influence value in microvolt quoted,

Note: reseat voltages shall be recorded.

- b) Tests shall be carried out in accordance with the details set out above.
- c) Certified copies of type test reports shall be submitted with the tender and shall include calibrated oscillograms demonstrating that each type of arrester offered complied with the minimum specified requirements. The Tenderers catalogue numbers applicable to each arrester shall appear on the oscillograms.
- d) The Seller shall submit fully completed test-certificates, in duplicate showing compliance with the routine dry power frequency test, the standard lightning voltage impulse test, and the standard lightning-voltage impulse acceptance test, immediately after testing.
- e) Tenderers should state what routine tests are carried out to prove the effectiveness of the seals of the arresters.
- f) Tenderers should state what tests are carried out to prove the capabilities of the arresters to withstand the effects of a multiple lightning stroke.

**5.5 Feeder Circuits**

Each feeder circuit shall be equipped with a current transformer on each phase. The current

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transformer ratios shall be as specified in Appendix I.

## 5.6 Busbar Incomers

The 11kV Busbar incomers shall be equipped with a current transformer on each phase. The current transformer ratios shall be as specified in **Appendix 1**:

The L.V neutrals for the transformers shall be equipped with a current transformer. The current transformer ratios shall be as specified in Appendix 1:

-All the 2 cores shall have an accuracy of class 5P20 and shall be used for protection. The rated burden shall be 15VA.

## 5.7 Voltage Transformers

The voltage transformer with a ratio of  $(11/\sqrt{3})/(0.11/\sqrt{3})$  kV shall have two secondary cores for measurands and voltage regulation.

- Core 1 shall be rated 50VA Class 3P and shall be used for voltage regulation.

- Core 2 shall be rated 50VA Class 1P and shall be used for metering.

## 6.0 TUBULAR ALUMINIUM ALLOY BUSBARS

### 6.1 Introduction

Substation tubular conductors are designed to carry rated normal and fault currents. This specification is intended to ensure that substation tubular conductors supplied to ZETDC are properly specified to meet the desired performance requirements.

### 6.2 Supporting Clauses

#### 6.2.1 Scope

This technical specification covers ZETDC's requirements for the manufacture, testing, supply and delivery of substation tubular conductors for use in outdoor high-voltage substations with maximum system voltages of up to and including 400kV.

#### 6.2.2 Applicability

The specification is applicable to all distribution and transmission substations.

### 6.3 Applicable Standards

The substation tubular conductors required in this specification must comply with the minimum requirements of the relevant IEC and European (EN and BS) specifications including the following:

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ASTM B807 / B807M – Standard Practice for Extrusion Press Solution Heat Treatment for Aluminum Alloys.

ASTM B918 / B918M – Standard Practice for Heat Treatment of Wrought Aluminum Alloys.

ISO 9591: 2004: Corrosion of aluminium alloys – Determination of resistance to stress corrosion cracking.

SANS 5544:2008: Dimensions of aluminium and copper strip, sheet, rod, bar, tube, channel and angle.

EN 573-2: Aluminium and aluminium alloys – Chemical composition and form of wrought products – Part 2: Chemical symbol based designation system.

EN 573-3: Aluminium and aluminium alloys – Chemical composition and form of wrought products – Part 3: Chemical composition and form of products.

EN 755-1:2008: Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 1: Technical conditions for inspection and delivery.

EN 755-2:1997: Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 2: Mechanical properties.

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EN 755-7:2005: Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 7:

Seamless tubes, tolerances on dimensions and form.

EN 755-8:2008: Aluminium and aluminium alloys – Extruded rod/bar, tube and profiles – Part 8:

Porthole tubes, tolerances on dimensions and form.

EN 10002-1:2001: Metallic materials – Tensile testing – Part 1: Method of test at ambient temperature.

BS 2898:1970 – Specification for wrought aluminium and aluminium alloys for electrical purposes – bars, extruded round tubes and sections.

BS 159:1992 – Specification for high-voltage busbars and busbar connections.

**6.4 Service Conditions**

The tubular conductors shall be suitable for use in outdoor substations under the following service conditions:

i)Altitude (max)            1500m

ii)Ambient temperature

          maximum            40°C

          minimum            -10°C

          daily average        35°C

iii)Maximum solar radiation    1200 Watts /m<sup>2</sup>

iv)Pollution level            Very heavy

v)Seismic                      0.3g

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**6.5 Technical Requirements**

**6.5.1 General**

Aluminium or aluminium alloy tubular conductors are required for carrying continuous rated normal and short-time busbar current in substations.

**6.5.2 Material**

- a) The tubular conductor shall be made of aluminium alloy.
- b) The alloy type shall either be 6061 (EN equivalent AlMgSiCu) or 6063A (EN equivalent AlMg0.7Si(A) and German equivalent AlMgSi0.5F25) with temper of T6. The alloy shall be suitable for use as substation tubular busbar conductor and shall meet both specified electrical and mechanical requirements. The type of alloy used, temper and designation shall be specified in Schedule B.
- c) The tube shall have a smooth-finished surface.
- d) The material shall not be prone to stress corrosion, cracking or layer corrosion in accordance with ISO 9591.
- e) The electrical resistivity of the tube at 20°C shall not exceed 0.037  $\Omega \cdot \text{mm}^2$  per unit length (1 meter).
- f) The tube shall be resistant to atmospheric corrosion

**6.5.3 Chemical composition**

- a) The tube shall be free of any material defects.
- b) The aluminium alloys shall have the chemical composition limits specified in the relevant clauses of EN 573-3.
- c) ZETDC reserves the right to request the testing of samples to verify the chemical composition. Conformance shall be determined by analyzing samples taken from the ingots or analyzing samples taken from the finished or semi-finished product.
- d) The determination of chemical composition shall be made in accordance with suitable chemical or spectrochemical methods.

**6.5.4 Manufacturing**

- a. The extruded tube shall be produced by the die/mandrel method or tube porthole/bridge method.
- b. The tube shall be solution-treated in accordance with ASTM Practice B 807.
- c. The tube shall be heat-treated in accordance with ASTM Practice B 918.
- d. The tube shall have a smooth-finished surface and shall be free of any material defect.

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**6.5.5 Tube Dimensions**

- a. Tubes shall have outer diameters ranging from 80 mm to 250 mm. The required outer diameter will be specified in Technical Schedule A.
- b. The wall thickness of the tubes shall be up to a maximum of 10 mm. The required wall thickness will be specified in Technical Schedule A.
- c. The length and quantities required will be stated in Technical Schedule A.
- d. ZETDC reserves the right to verify any dimension by itself or by employing the services of an independent third party.

**6.5.6 Tolerances on Dimensions**

**6.5.6.1 Tolerance on diameter**

Tolerance on outer diameter shall be  $\pm 1\%$  of specified outer diameter.

**6.5.6.2 Tolerance on lengths**

Tolerance on lengths shall be in accordance with the requirements of EN 755-7 or EN 755-8.

**6.5.6.3 Tolerance on wall thickness**

The tolerance of the wall thickness of the tubular conductor shall not exceed  $\pm 0.4$  mm

**6.5.6.4 Tolerance on straightness**

Tolerance on straightness shall be in accordance with the requirements of EN 755-7 or EN 755-8.

**6.5.7 Electrical requirements**

**6.5.7.1 Electrical resistivity**

The electrical resistivity of the material shall not exceed  $0.037 \Omega \cdot \text{mm}^2$  per unit length (1 meter) at  $20^\circ\text{C}$ .

**6.5.7.2 Electrical ratings**

- a) The conductor shall be able to continuously carry specified rated current without exceeding a temperature rise of  $40^\circ\text{C}$  above an ambient temperature of  $40^\circ\text{C}$ . The maximum rated tubular conductor current shall be stated in Technical Schedule B.
- b) Tubes with outer diameters of 200 mm and above and wall thickness of 6mm and above shall be capable of carrying rated currents of not less than 3500 A at  $85^\circ\text{C}$ .
- c) Tubes with outer diameters of 200 mm and above shall be capable of withstanding short-circuit currents of not less than 63kArms (thermal) for 3 seconds and 160 kApeak (mechanical).

**6.5.7.3 Temperature Rise**

- a) Under normal operating conditions, the tube shall not exceed temperature rise of  $40^\circ\text{C}$  above an ambient temperature of  $40^\circ\text{C}$  under the service conditions specified in 3.1.
- b) Under short-circuit conditions, the tube temperature rise shall not exceed  $200^\circ\text{C}$ .

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**6.5.8 Mechanical Requirements**

**6.5.8.1 Tensile strength**

The tube shall have a minimum tensile strength of 140 MPa.

**6.5.8.2 Yield strength**

The tube shall have a minimum yield strength of 170MPa

**6.5.9 Test requirements**

**6.5.9.1 Electrical tests**

**6.5.9.1.1 Short-circuit Withstand Test**

**A. Thermal withstand**

- a. Short-circuit withstand tests shall be done in accordance with the requirements of BS 159:1992 and IEC 60694:2002.
- b. Tubes with outer diameters of less than 200 mm shall be able to withstand short-circuit currents of 40 kA for 3 seconds without melting.
- c. Tubes with outer diameters of 200 mm and above shall be capable of withstanding short-circuit currents of 63 kA for 3 seconds without melting.
- d. After the short-circuit withstand test, the tube shall be capable of carrying its rated normal current continuously without exceeding the temperature-rise limits specified in 3.2.7.3.

**B. Mechanical withstand**

- a) Tubes with outer diameters of less than 200 mm shall be able to withstand short-circuit currents of 102 kA peak without any mechanical damage or melting.
- b) Tubes with outer diameters of 200 mm and above shall be capable of withstanding short-circuit currents of 160 kA peak without any mechanical damage or melting.

**6.5.9.1.2 Resistance Test**

The electrical resistivity of the tube shall be determined by direct measurement.

**6.5.9.2 Mechanical tests**

**6.5.9.2.1 Tensile strength tests**

The tensile strength tests shall be undertaken in accordance with the test methods outlined in EN10002-1. The test specimen shall be able to withstand a minimum pressure of 140 MPa without any damage

**6.5.9.2.2 Yield strength tests**

The tensile strength tests shall be undertaken in accordance with the test methods outlined in EN10002-1. The test specimen shall be able to withstand a minimum pressure of 170 MPa without any damage

**6.5.9.2.3 0.2% Proof strength tests**

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The 0.2% proof strength tests shall be undertaken in accordance with the test methods outlined in EN10002-1.

The test specimen shall be able to withstand a minimum pressure of 195 MPa without any damage

**6.5.9.2.4 Elongation tests**

The A5 elongation tests shall be undertaken in accordance with the test methods outlined in EN10002-1.

The A5 percentage elongation shall not exceed the value stated by the manufacturer in Schedule B.

**6.5.9.2.5 Stress-corrosion cracking tests**

The stress corrosion cracking tests shall be undertaken in accordance with the test methods outlined in ISO 9591.

**6.5.9.3 Test Samples**

- a) Material of the same dimensions, produced in the same way and of the same composition, shall be grouped into batches of 2,000 kg, unless the heat-treatment batch is smaller in which event that shall constitute the batch. One test sample shall be cut from a bar or section selected from each batch.

**6.5.9.5 Test Certificates**

- a) Type-test certificates shall be submitted to ZETDC at the tender stage.
- b) Copies of routine test certificates shall be submitted to ZETDC at tender stage.

**6.6 Packaging and Transportation**

- a) The supplier shall be responsible for transporting and off-loading of the tubes to the site designated by ZETDC.
- b) The tubes shall be packed in such a manner that they are adequately protected to avoid damage during transport and storage.
- c) A suitable label bearing the ZETDC's order and item number, the quantity and the delivery address shall be securely attached to the lot. The marking shall not be destroyed during storage (NB: must withstand outdoor storage conditions) and transport.
- d) The tubes must be stacked in such a way that they are not damaged during off-loading or when being moved using forklifts. The onus shall be on the supplier to ensure that the tubes are not damaged during transportation to site and off-loading.

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**7. CONTROL, PROTECTION RELAYS AND INSTRUMENTATION  
REQUIREMENTS.**

**7.1 General**

The control voltage shall be 110 V DC, +10%, -20% supplied from the station battery unless otherwise specified in the Schedule of Requirements.

- ☐ Each transformer incomer feeder shall have one protection panel to house 2 protection relays.

- Relay 1.

Functions : Differential protection, over-current and earth fault protection

- Relay 2

Functions : LV R.E.F protection, over-current and earth fault protection.

- ☐ 2 transformer incomer protection panels are required for the two 33/11kV transformers.

- ☐ Each outgoing feeder shall have one protection panel to house one protection relay for over-current, earth-fault and S.E.F protection. Auto-reclose functionality must be available.

A total of 10 feeder protection panels are required.

**7.2 Relay Panels**

The winning bidder shall design, manufacture, supply and deliver to site and commission pre-wired protection panels for 2x 33/11kV Transformer Incomers as well as for 14 x11kV Outgoing feeders.

The winning bidder shall be responsible for calculating the protection settings. All designs and calculations must be submitted to the Employer for approval

The panels shall be designed and delivered as per technical specification below complete with the relevant protection relays specified in relay technical specifications.

Unless otherwise stated, reference shall be made to the following standards

IEC 60429                      Low voltage switchgear and control assemblies

IEC 60529                      Degree of protection provided by enclosures

All panels offered must have been type tested to the standards given above or equivalent

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Panels shall be freestanding floor mounting type, completely metal enclosed with front access with doors opening to the left.

The table below outlines the Protection and Control Panel Specifications.

<b>SPECIFICATION ITEM</b>	<b>DESCRIPTION</b>
<b><u>ENCLOSURE</u></b>	
Material	3mm Mild Steel Plate
Colour	Light Grey (G29)
<b><u>OVERAL DIMENSIONS</u></b>	
Length	800mm
Width	800mm
Height	2200mm
<b><u>ACCESS</u></b>	
+	Front Access
+	Doors shall be provided with integral handles for-locking
+	It shall be possible to securely fix the hinged front door in open position
<b><u>CABLE ENTRY</u></b>	
+	Type of entry Bottom centre entry with removable gland plates
<b><u>ENVIRONMENTAL CONDITIONS</u></b>	
+	Service Temperature Range -5°C to 55°C
+	Temperature influence 0.1%/°C
+	Relative humidity 0 to 95% non-condensing
+	Degree of protection (IEC 60529), IP 54
<b><u>PANEL WIRING AND TERMINAL BLOCKS</u></b>	
+	Connections Screw terminals for connection of wires using ring lug terminal lugs for all AC inputs
	4mm <sup>2</sup> connection terminals for all AC wiring and shall be suitable for ring lug termination
	2.5mm <sup>2</sup> connection terminals and screw compression type for all dc wiring
+	Outgoing Connections Provision Provision for outgoing connections from the protection cubicles shall be made for multi-core cables
+	Ferruling Standards All panel wiring shall be identified by ferrules at all terminations. No ferrule number shall appear on more than one circuit
	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

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	Colour coding for all AC wiring in the panel required for easier identification of ac wiring cables
	The format of the ferrule number shall include the cable core identity and sitting position. For example k510/ x310.28 where k510 is the cable core identity and x310 is the terminal block, 28 is the terminal number
✚ Core Sleeving	Each cable core in the tripping circuit shall have a red sleeve
✚ Trip Links	Trip links for each trip circuit shall be positioned at the bottom of the front panel.
✚ Terminal Arrangement	Terminals should be arranged so that terminations of any incoming wiring provided at site under separate contract are directly visible.
	Terminal blocks 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 blocks showing the functions of the groups
	All terminal blocks shall have a minimum of 20% spare terminals.
✚ Terminations	All incoming and outgoing connections shall be terminated at a terminal block. Direct termination on to auxiliary switches, links and fuses will not be accepted.
✚ Panel Trunking	Panel wiring shall be adequately accommodated in panel trunking.
	All panel trunking shall have covers
✚ Testing Facilities	Panels shall be provided with test terminal blocks that will isolate plant from relay circuit in order to facilitate maintenance testing (isolate all ac and dc circuits)
	The appropriate test plugs shall be provided.
✚ Anti-condensation Heaters	Low energy heaters shall be provided in each panel 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.
✚ Panel Lighting	Panels shall be provided with sufficient lighting of the energy saver type
	A door position switch to be fitted for automatically switching on panel lighting when the door is open(ed)
<b><u>VOLTAGE WITHSTAND TESTS</u></b>	
✚ Tests	All secondary and panel wiring shall withstand a test voltage of 2 kV to earth for one minute.
<b><u>PANEL LABELS</u></b>	
✚ Panel Identification	Each panel shall have a label for the protected circuit at the top
✚ Protection Function	Each relay on the panel face shall have a label indicating the main function of the relay e.g. DIFFERENTIAL PROTECTION
✚ Relay Scheme Identity	The rear of each relay or switch in the scheme shall have a label carrying its scheme identity e.g. F10, F210, etc
<b><u>DWB OPERATIONS</u></b>	
✚ Control Function	The 11kV panels shall provide for a single-line diagram (mimic) for the 11kv busbar and direct wire board (DWB) operations for circuit breakers.
	Each panel shall have control selector switch (R/L), remote control switch ( TNC), Auto/Non auto selector switch

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### 7.3 Protection Relay Details

#### 7.3.1 General

Protection relays shall be numeric type incorporating a minimum of protection functions outlined on the following schedule with specifications.

Protection relays shall be designed and applied to provide maximum discrimination between faulty and healthy circuits. The relays shall remain inoperative during transient phenomena, which may arise during switching or other disturbances to the system.

Relays shall be fully numerical microprocessor based complying with IEC Publication 60255, and shall have approved characteristics and be flush mounted. All relays shall have self-supervision and self-monitoring facilities. Test Certificates for the relays shall be made available to ZETDC.

#### 7.3.2 Incomers

The table below outlines the relay specifications.

**TRANSFORMER DIFFERENTIAL PROTECTION RELAY**

SPECIFICATION ITEM	DESCRIPTION
<b>RELAY TYPE</b>	Numeric
<b>ENCLOSURE</b>	
Material	3mm mild steel plate
<b>FREQUENCY AND ROTATION</b>	
+ Frequency	50Hz
+ Rotation	ABC
<b>POWER SUPPLY</b>	
+ Range	48...250V ac/dc
<b>AC INPUT CURRENTS</b>	
+ Nominal Current, In	1A and 5A 3 phase, ac
+ Continuous withstand	4 x In
+ Short time withstand	10 x In for 1s
+ Immunity	High Immunity to CT saturation and harmonic distortion
<b>AC INPUT VOLTAGES</b>	
+ Nominal Voltage, Vn	110V, 3 phase AC
<b>TRIP OUTPUTS</b>	
+ Rated Voltage	250Vdc,
+ Continuous Withstand Current	6A
+ Make current	30A at 250Vdc for 0.5s
+ Thermal Withstand	50 A for 1 s

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✚ Swell	At least 50ms
<b>CONTROL SIGNAL OUTPUTS</b>	
✚ Rated Voltage	250Vdc,
✚ Continuous Current Withstand	6A
✚ Make	10A at 250Vdc for 0.5s
✚ Thermal Withstand	15 A for 1 s
✚ Swell	At least 50ms
<b>TERMINAL BLOCK CONNECTIONS</b>	
✚ Type Of Connection	Screw terminals for connection of wires using ring terminal lugs for all AC inputs and control outputs.
✚ AC Inputs	Maximum 4mm <sup>2</sup> . Shall be suitable for ring lug terminals
✚ Binary I/O	Maximum 2.5mm <sup>2</sup> . Screw Compression Type
<b>ENVIRONMENTAL CONDITIONS</b>	
✚ Service Temperature Range	-5°C to 55°C
✚ Temperature influence	0.1%/°C
✚ Relative humidity	60% +55°, 6 Cycles
✚ Degree of protection	(IEC 60529) IP 54
✚ Electromagnetic Compatibility	IEC 60255-25:2000
<b>TYPE TESTS</b>	All type tests should conform to the IEC 60255 standards
<b>GENERAL</b>	
✚ HMI	<p>Display unit for Human Machine Interface (HMI) that indicates: measurement values, operating messages, and device maintenance messages</p> <p>A minimum of 4 lines for clear annunciation of alarm conditions on the display unit</p> <p>A minimum of 16 configurable LEDs</p> <p>Keypad to select the following operations: display of metering and operating data, alarm messages, clearing of alarms and resetting, acknowledgement, and access to protection and other relay settings</p>
<b>PROTECTION FUNCTIONS</b>	
✚ Differential Protection (87)	<p>Winding short circuit and interturn fault protection for two winding transformer with variable percentage.</p> <p>Two settable slopes with adjustable intersection points and minimum pick-up values</p> <p>Numerical vector group and wide amplitude matching</p> <p>Transformer over-fluxing restraint</p> <p>Transformer inrush restraint</p> <p>Through-fault stabilization</p>
✚ Restricted Earth Fault (87N)	<p>Biased restricted earth fault protection</p> <p>At least three Restricted Earth Fault elements per group are required.</p>
✚ Definite Time And Inverse Time Overcurrent Protection (50/51)	Overcurrent elements per group shall be included to provide phase, negative-sequence and residual protection.

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✚ Over/Undervoltage Protection (27/59)	At least two stage Overvoltage protection
	At least two stage Undervoltage protection
✚ Definite Time And Inverse Time Earth Fault Protection (50N/51N)	Earth Fault elements shall be included to provide neutral and residual (ground) protection
	At least three earth fault elements per parameter setting group are required
✚ Overexcitation V/f Protection (24)	Volts/hertz protection to detect and provide an output when user settable excitation thresholds are exceeded.
✚ Definite Time And Inverse Time Earth Fault Protection (50N/51N)	Overcurrent elements to provide neutral and residual protection
✚ Circuit Breaker Failure (50BF)	Circuit breaker failure protection with adjustable CBFP operate time
	Breaker failure protection shall provide subsidence current detection to minimize system coordination times.
✚ Thermal Overload Protection (49)	Thermal overload protection to give alarm and trip signal outputs
<b>OTHER FUNCTIONS/ FEATURES</b>	
✚ Disturbance Recording	Disturbance recorder capable of recording currents and digital signals
	Signals to be used for triggering must be selectable
	At least 70 Disturbance records
	At least 72 channels for binary signals
✚ Event Recording	At least 20 channels for analogue signals
	Minimum pre-fault time of 10cycles per event
	Minimum fault time of 100 cycles per event
✚ Diagnostics	At least 70 Event Records
	At least 16 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
	LEDs on HMI with LED testing facilities
	Each indicator shall be so designed that it cannot change state before the relay has completed its operation.
	All indication shall be clearly visible without opening of relay cases or relay panel doors
	Indication shall only be given by the protection(s) which causes the fault to be cleared
All LEDs shall be capable of being reset without the necessity of opening the case.	
✚ Testing Facility	Relays shall have on line testing facility
✚ Parameter Subset Selection	At least four setting groups to enable relay use under different operational configurations
✚ Password Protection	Protection mode access shall be protected by a personal customized password of at least 4 characters.
	Parameter setting mode access shall be protected by a second password of at least 4 characters.
<b>INPUT/ OUTPUT</b>	

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✚ Digital Output	At least six fast trip digital output contacts, with the above-specified capacities
	At least forty flexible and configurable output relays with the above-specified capacities for alarms and annunciations
✚ External Input	At least thirty-two programmable external control inputs intended for the processing, indication and retransmission of alarm and trip signals
<b>COMMUNICATION/ INTEGRATION</b>	
✚ Communication Protocols	IEC 61850, hard wiring to RTU, TCP IP protocols
✚ Communication Ports	One front panel Ethernet port
	One Fibre Optic Serial Port
✚ Interrogation/Settings	Windows-based PC software for settings, configuration and report retrieval
	Operating System to be WINDOWS 10 or higher
<b>METERING &amp; MEASUREMENT</b>	
✚ The following shall be measured	3 Phase Active Power
	3 Phase Reactive Power
	3 Phase Apparent Power
	Power Factor
	Phase – Phase Voltage magnitude
	Phase current magnitude
	Power System Frequency
	Harmonic Content from fundamental to the fifth for all ac current and voltage
Tap Position	Transformer tap position indication required

### 7.3.3 11kV Outgoing feeders

The table below outlines the relay specifications.

SPECIFICATION ITEM	DESCRIPTION
<b>RELAY TYPE</b>	Numeric
<b>ENCLOSURE</b>	
Material	3mm mild steel plate
<b>FREQUENCY AND ROTATION</b>	
✚ Frequency	50Hz
✚ Rotation	ABC
<b>POWER SUPPLY</b>	
✚ Range	48.....250Vdc
<b>AC INPUT CURRENTS</b>	
✚ Nominal Current, In	1A and 5A, 3 phase, ac
✚ Continuous withstand	4 x In continuous,
✚ Short time withstand	10 x In for 1s
✚ Immunity	High Immunity to CT saturation and harmonic distortion
<b>TRIP OUTPUTS</b>	
✚ Rated Voltage	250Vdc,

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✚ Continuous Current Withstand	6A
✚ Make current	30A at 250Vdc for 0.5s
✚ Thermal Withstand	50 A for 1 s
✚ Swell	At least 50ms
<b><u>CONTROL SIGNAL OUTPUTS</u></b>	
✚ Rated Voltage	250Vdc,
✚ Continuous Current Withstand	6A
✚ Make	10A at 250Vdc for 0.5s
✚ Thermal Withstand	15 A for 1 s
✚ Swell	At least 50ms
<b><u>TERMINAL BLOCK CONNECTIONS</u></b>	
✚ Type Of Connection	Screw terminals for connection of wires using ring terminal lugs for all AC inputs and control outputs.
✚ AC Inputs	Maximum 4mm <sup>2</sup> . Shall be suitable for ring lug terminals
✚ Binary I/O	Maximum 2.5mm <sup>2</sup> . Screw Compression Type
<b><u>ENVIRONMENTAL CONDITIONS</u></b>	
✚ Service Temperature Range	-5°C to 55°C
✚ Temperature influence	0.1%/°C
✚ Relative humidity	60% +55°, 6 Cycles
✚ Degree of protection	(IEC 60529) IP 54
✚ Electromagnetic Compatibility	IEC 60255-25:2000
<b><u>TYPE TESTS</u></b>	
All type tests should conform to the IEC 60255 standards or equivalent	
<b><u>GENERAL</u></b>	
✚ HMI	Display unit for Human Machine Interface (HMI) that 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: display of metering and operating data, alarm messages, clearing of alarms and resetting, acknowledgement, and access to protection and other relay settings
<b><u>PROTECTION FUNCTIONS</u></b>	
✚ Definite Time And Inverse Time Overcurrent Protection (50/51)	Overcurrent elements shall be included to provide phase and negative sequence overcurrent protection.
	At least three overcurrent elements per parameter setting group are required
✚ Definite Time And Inverse Time Earth Fault Protection (50N/51N)	Earth Fault elements shall be included to provide neutral and residual (ground) protection
	At least three earth fault elements per parameter setting group are required

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<p>✚ Circuit Breaker Failure (50BF)</p>	<p>Circuit breaker failure protection with adjustable CBFP operate time Breaker failure protection shall provide subsidence current detection to minimize system coordination times.</p>
<p>✚ Thermal Overload Protection (49)</p>	<p>Thermal overload protection to give alarm and trip signal outputs</p>
<p>✚ Auto Reclosing (79)</p>	<p>The overcurrent &amp; 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 reclaim time The relays to have adjustable reclosing times (range : 0.1 to 120s)</p>
<p><b><u>OTHER FUNCTIONS/ FEATURES</u></b></p>	
<p>✚ Disturbance Recording</p>	<p>Disturbance recorder capable of recording currents and digital signals Signals to be used for triggering must be selectable At least 30 Disturbance records At least 16 channels for binary signals At least 8 channels for analogue signals</p>
<p>✚ Event Recording</p>	<p>Minimum pre-fault time of 10 cycles per event Minimum fault time of 50 cycles per event At least 15 Event Records</p>
<p>✚ Diagnostics</p>	<p>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 LEDs on HMI with LED testing facilities Each indicator shall be so designed that it cannot change state before the relay has completed its operation. All indication shall be clearly visible without opening of relay cases or relay panel doors Indication shall only be given by the protection(s) which causes the fault to be cleared All LEDs shall be capable of being reset without the necessity of opening the case.</p>
<p>✚ Testing Facility</p>	<p>Relays shall have on line testing facility</p>
<p>✚ Parameter Subset Selection</p>	<p>At least four setting groups to enable relay use under different operational configurations</p>
<p>✚ Password Protection</p>	<p>Protection mode access shall be protected by a personal customized password of at least 4 characters. Parameter setting mode access shall be protected by a second password of at least 4 characters.</p>
<p><b><u>INPUT/ OUTPUT</u></b></p>	
<p>✚ Digital Output</p>	<p>At least six fast trip digital output contacts, with the above-specified capacities At least ten flexible and configurable output relays with the above-specified capacities for alarms and annunciations</p>
<p>✚ External Input</p>	<p>At least ten programmable external control inputs intended for the processing, indication and retransmission of alarm and trip signals</p>

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<b>COMMUNICATION/ INTEGRATION</b>	
+ Communication Protocols	IEC 61850, hard wiring to RTU, TCP/ IP protocols
+ Communication Ports	One Ethernet port
	One Fibre Optic Serial Port
+ Interrogation/Settings	Windows-based PC software for settings, configuration and report retrieval
	Operating System to be WINDOWS 10 or higher
<b>METERING &amp; MEASUREMENT</b>	
+ The following shall be measured	Phase current magnitude
	Residual current magnitude

### 7.4 Transformer Tap Changer Control Panel

The winning bidder shall supply and deliver to site pre-wired Remote Tap Changer Control Panel control panels

The table below outlines the panel specifications.

<b>SPECIFICATION ITEM</b>	<b>DESCRIPTION</b>
<b><u>ENCLOSURE</u></b>	
Material	3mm Mild Steel Plate
Colour	Light Grey (G29)
<b><u>OVERAL DIMENSIONS</u></b>	
Length	800mm
Width	800mm
Height	2200mm
<b><u>ACCESS</u></b>	
+	Front Access
+	Doors shall be provided with integral handles for-locking
+	It shall be possible to securely fix the hinged front door in open position
<b><u>CABLE ENTRY</u></b>	
+ Type of entry	Bottom centre entry with removable gland plates
<b><u>ENVIRONMENTAL CONDITIONS</u></b>	
+ Service Temperature Range	-5°C to 55°C
+ Temperature influence	0.1%/°C
+ Relative humidity	0 to 95% non condensing
+ Degree of protection	(IEC 60529), IP 54
<b><u>PANEL WIRING AND TERMINAL BLOCKS</u></b>	

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✚ Connections	Screw terminals for connection of wires using ring lug terminal lugs for all AC inputs
	4mm <sup>2</sup> connection terminals for all AC wiring and shall be suitable for ring lug termination
	2.5mm <sup>2</sup> connection terminals and screw compression type for all dc wiring
✚ Outgoing Connections Provision	Provision for outgoing connections from the protection cubicles shall be made for multi-core cables
✚ Ferruling Standards	All panel wiring shall be identified by ferrules at all terminations. No ferrule number shall appear on more than one circuit
	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
	Colour coding for all AC wiring in the panel required for easier identification of ac wiring cables
	The format of the ferrule number shall include the cable core identity and sitting position. For example k510/ x310.28 where k510 is the cable core identity and x310 is the terminal block, 28 is the terminal number
✚ Core Slewing	Each cable core in the tripping circuit shall have a red sleeve
✚ Trip Links	Trip links for each trip circuit shall be positioned at the bottom of the front panel.
✚ Terminal Arrangement	Terminals should be arranged so that terminations of any incoming wiring provided at site under separate contract are directly visible.
	Terminal blocks 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 blocks showing the functions of the groups
	All terminal blocks shall have a minimum of 20% spare terminals.
✚ Terminations	All incoming and outgoing connections shall be terminated at a terminal block. Direct termination on to auxiliary switches, links and fuses will not be accepted.
✚ Panel Trunking	Panel wiring shall be adequately accommodated in panel trunking.
	All panel trunking shall have covers
✚ Testing Facilities	Panels shall be provided with test terminal blocks that will isolate plant from relay circuit in order to facilitate maintenance testing (isolate all ac and dc circuits)
	The appropriate test plugs shall be provided.
✚ Anti-condensation Heaters	Low energy heaters shall be provided in each panel 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.
✚ Panel Lighting	Panels shall be provided with sufficient lighting of the energy saver type
	A door position switch to be fitted for automatically switching on panel lighting when the door is open(ed)

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✚ Tests	All secondary and panel wiring shall withstand a test voltage of 2 kV to earth for one minute.
<b><u>PANEL LABELS</u></b>	
✚ Panel Identification	Each panel shall have a label for the protected circuit at the top e.g TRANSFORMER T5
<b><u>PANEL CONTROL FUNCTIONS</u></b>	Automatic or manual local control switch, raise/lower switch, Independent, Master / Follower switch Position indicator, operation counter, numeric voltage regulating relay, remote/local controls with position indicator, SCADA interfaces for supervisory control

**TRANSFORMER AVR RELAY**

Item	Description	Unit	Description
1.	Relay Type	-	Numeric
2.	Enclosure Material		Metallic plate
3.	Frequency	Hz	50
4.	Rotation	-	ABC
	<b>ENVIRONMENTAL CONDITIONS</b>		
5.	Operating temperature range	°C	-5 to +55
6.	Degree of protection by enclosure when panel-mounted	-	At least IP 30
	<b>POWER SUPPLY</b>		
7.	Range	V	48-250VDC
8.	Short time withstand	A	$\geq 10 \times I_N$ for 1s
	<b>AC INPUT VOLTAGES</b>		
9.	Nominal Voltage, $U_N$	V	110VAC phase to phase
	<b>CONTROL SIGNAL OUTPUTS</b>		
10.	Rated Voltage	V DC	110V dc
	<b>CONTROL SIGNAL INPUTS</b>		

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11.	Rated Voltage	V DC	110
	<b>TERMINAL BLOCK CONNECTIONS</b>		
12.	AC Inputs	-	Shall be suitable for 4 mm <sup>2</sup> compression/ ring lug
13.	Binary I/O	-	Shall be 1.5-2.5 mm <sup>2</sup> and compression/ ring lug
14.	<b>TYPE TESTS</b>	-	Type tests to conform to IEC 60255 or applicable standard
	<b>GENERAL</b>		
15.	Human Machine Interface (HMI)	-	(HMI) indicates: measurement values, operating messages, and device maintenance messages
16.		-	A minimum of 4 lines for clear annunciation of alarm conditions on the display unit
17.	Functional control keys		At least the following: Manual / automatic control mode, Raise / lower, Menu keys
18.	LEDs		At least 10 LEDs for Alarming and Indications
	<b>ENGINEERING FUNCTIONS</b>		
	<b>Voltage regulation</b>		Effective and continual automatic voltage regulation.
	<b>Transformer Parallel Operation techniques</b>		At least the following: 1(a). Master-Follower principle (synchronism control of tap-changer) 1(b). Master-Follower principle (automatic synchronism) 2. Circulating reactive current principle
	<b>Protection functions</b>		At least the following: Undervoltage blocking, Overcurrent/overload blocking, overvoltage detection.  1.
	<b>COMMUNICATION/ INTERGRATION</b>		

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19.	Standard and Protocol	-	IEC 61850, TCP/ IP protocols
20.	Relay Interrogation	-	Windows-based PC software for settings, configuration and report retrieval
		-	Operating System to be WINDOWS 10 or higher
	<b>METERING &amp; MEASUREMENT</b>		
21.	The following shall be measured	MW	3 Phase Active Power
		MVar	3 Phase Reactive Power
		MVA	3 Phase Apparent Power
		-	Power Factor
		V	Phase – Phase Voltage magnitude
		-	On load tapchanger positions
		A	Active current
A	Reactive current		

Tenderers must provide accessories and maintenance tools and equipment for the protection and control panels and relays.

**8. SCADA – RTU SPECIFICATIONS**

**8.1.0 RTU**

The Beatrice 33/11 kV switching station will be a completely automated substation conforming to IEC 61850. Interlocking complying with generally accepted best practice in terms of human, plant and power system safety shall be designed and provided. Full interoperability of IEDs will be ensured by clear allocation of responsibility for software and hardware interfacing. The substation automation and control system will provide as a minimum;

- Interlocking,
- Local control,
- Remote control via the RTU
- HMI via the RTU for local control and monitoring
- Statistical Metering connected to the RTU
- Diagnostic information and an engineering interface to IEDs.

**NB:** The Project scope will upgrade the Transformers and the new 11KV circuits which are to be integrated with new relays which support IEC61850 protocol. However the existing 33KV circuits which include Circuit Breakers CB17,27,57,67,87 and the 33KV Bus Section are not included in this upgrade as they will maintain the existing hardwiring philosophy. Integration of these circuit will require hardwiring which will be done by ZETDC. This specification therefore calls for RTU560 for Beatrice 33/11KV as the Engineers are competent in the RTU design, installation and commissioning.

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8.1.1 It shall be possible to completely check the proper functioning of an RTU by means of tests carried out locally, with the communication link to the Control Centre disconnected. The tenderer shall provide / supply suitable test sets for this purpose including means to listen in to the communication channels.

8.1.2 The proposed RTUs shall have the following main processing features:

- Time tagged events with 1 ms time resolution (Sequence Of Event)
- Monitoring and acquisition of single and double point indications
- Monitoring and acquisition of measured values
- Acquisition of pulse counters for integrated totals
- Command handling of single pole, double and set points, tap change control
- Select before operate sequence and immediate execute sequence
- Time synchronization with the master system via IEC60-870-5-101 and IEC60-870-5-104, local GPS and NTP protocols.
- Operate in a multi drop configuration towards Central Computer (NCC) also being able to relay telegrams between other substations and NCC.

8.1.3 The RTU will be installed in control buildings without temperature or humidity control. The RTU shall be capable  
of operating in ambient temperatures from  $-5$  to  $+55^{\circ}\text{C}$  and relative humidity from 5 to 95%, non-condensing with  
rate of temperature change of  $20^{\circ}\text{C}/\text{hour}$ .

8.1.4 The RTU shall simultaneously respond to independent scans and commands from master stations, and local user  
maintenance interface using a simulated master centralized controller and database. The RTU shall support the  
use of a different communication data exchange rate (bits per second) to each master station. For serial  
communication these communication speeds between RTU and NCC shall be freely configurable from 100bps up  
to 38400bps inclusive of the speeds 100bps, 200bps, 400bps, 600bps, 1200bps, 2400bps, 4800bps, 9600bps,  
19200bps and 38400bps.

8.1.5 The RTU shall perform as a slave on the communication channel to NCC Central systems. The SCADA system  
master stations shall initiate all communication. Where the RTU must notify the master stations of an unusual  
condition at the RTU (such as a power fail/restoration or RTU malfunction) or must initiate the transfer of changed  
data, the notification shall be accomplished within the framework of the periodic data acquisition exchanges and  
the protocol used.

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8.1.6 The RTU communication protocol shall report changes by exception. The communication protocol shall also

support an update demand scan of all status data by master stations regardless of the lack of any change in data.

The reply to an exception scan request for status points shall consist of an indication of the presence or absence

of a change of the status indication points in the RTU. A master station will then request the input of the changed

points. The RTU shall continue to indicate exception changes until the master station acknowledges successful

receipt of the changed data.

8.1.7 It shall be possible to remotely login to the RTU and manage it via an IP based link and a web browser.

8.1.8 Scope of work to include supply, configuration (IEC61850), installation and commissioning

8.1.9 Tenderer to provide 19-inch prewired cabinet for RTU, GPS server and switches mounting

8.1.10 Tenderer must provide detailed designs for approval by ZETDC before manufacturing.

8.1.11 Tenderer to provide detailed product specific documentation.

## **8.2. POWER SUPPLY**

The input voltage to the RTU power supply will be provided through the 50V DC Battery bank and charger (which the tenderer shall supply). The Power supply unit to the RTU must be dual for improved operational redundancy. The tenderer shall therefore provide / supply power supplies to chop/ adapt the voltage if necessary to the required 50V DC

## **8.3 COMMUNICATION PORTS**

The RTU shall have programmable Fast Ethernet/Gigabit Ethernet ports (at least 2), RJ45 serial ports

(at least 2) and RS485 ports, an SFP module for fibre communication.

## **8.4 COMMUNICATION PROTOCOLS**

The RTU shall support (and be licensed for) the following protocols/standards

- IEC61850 for substation automation
- IEC60870-5-101 and IEC60870-5-104 for NCC communication
- MODBUS serial over RS485 and MODBUS TCP/IP for communicating with measuring instruments

*Note: The RTU shall initially be configured to use IEC60870-5-101 protocol to communicate with*

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NCC

**8.5 TIME SYNCHRONISATION**

8.5.1 The tenderer shall provide a local GPS Time server to be used for time synchronization. The time

server shall provide time sync to the RTU and relays using SNTP over the substation LAN.

8.5.2 The time server shall come complete with the GPS antennae and lightning protection.

**8.6 RTU CARDS**

To facilitate the monitoring of the existing 33KV circuits, battery chargers, battery banks, etc the tenderer shall provide the following cards with the RTU

- 8\* 16 channel Digital Input Cards
- 3 \* 8 channel Analog Input Cards
- 4 \* 16 channel Digital Output Cards/Modules
- 3 \* 16 channel terminal blocks with isolating links din rail mounted ( for analogue input)
- 6 \* 18 channel terminal blocks with isolating links din rail mounted ( for digital input)
- 3 \* 32 channel terminal blocks with isolating links din rail mounted (for digital outputs)
- 1 \* 18 core assorted colour drum cable and accessories (for digital and analogue input wiring)
- 1 \* 1 set digital input cable crimping & extraction
- 4 \* 32 core assorted colour 3m cable( for digital output wiring)

**8.7 LICENSING**

8.7.1 The RTU shall come with perpetual Engineering License to allow ZETDC engineers to add and modify

the RTU configuration as the need arises. The tenderer shall provide the engineering and diagnostics software.

8.7.2 The RTU license shall enable ZETDC to configure and monitor at least 5000 signals in the RTU. The RTU to have local archive license for all these local events storage using FIFO

**8.8 WARRANTY and OTHER REQUIREMENTS**

8.8.1 The warranty period shall be for at least 36 months from date of commissioning on site. Extended duration would

be required for RTU with unsatisfactory or inadequately proven performance in the field

8.8.2 **Valid ISO Certificates for the manufacturer must be submitted with the bid. ISO9001, ISO14001 and OHSAS18001**

8.8.3 Equipment offered must be supported by technical data sheets, technical specifications, catalogues and brochures in English.

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**8.9 MAINTENANCE**

The Tenderer shall provide a Maintenance Terminal (1 Laptop), with appropriate equipment and windows based software to enable configuration, testing and maintenance of the RTU to be carried out. It is anticipated that this will take the form of a Laptop together with additional equipment such as modems, communications leads, etc. plus appropriate software. The laptops shall come fully loaded with IEC 61850 configuration software (with perpetual licenses) and IEC60-870-5-101 and 104 monitoring and simulation software (master and client) also with perpetual licenses and necessary dongles. The laptops shall have capability to support the portable RTU substation operator human machine interface.

**8.10 GATEWAY - FIREWALL**

1 x IP Firewall/Gateway with at least 2 GBE ports and support for VLAN for secure remote access of RTU for remote management and Energy meter-AMR server communication.

**8.11 CYBERSECURITY**

8.11.1 Cyber security for the RTU is now cause for concern after the introduction of TCP/IP based communication protocols. Therefore, cyber security has become mandatory to the RTU and should be considered to assure integrity, reliability/availability of the RTU, maintain and meet compliance regulatory requirements. Cyber security should be an integral part of the design of the RTU keeping it protected from unwanted intrusion.

8.11.2 The Cyber security requirements should fulfil the security standards such as, NERC CIP, IEEE, etc.

8.11.3 The Cyber security requirements shall include but not limited to the following:

- (i) **Robust User access control** – a proven user account management that defines specific users that can access the RTU to avoid un-authorized access. Different access levels, which are configurable to each user, enable to restrict the right to modify configuration, to upload new files, and to reset data. The user accounts, are enforced by password policies. The user should access the system via a web interface. There RTU shall have login timeouts, inactivity timeouts and be able to restrict concurrent login sessions.
- (i) **Audit Trail** to maintain traceability on Detailed security event logs - security relevant user activities like log in, log out, change of parameters/ configuration and updates to software/firmware to be logged. The audit trail should also include file transfers.
- (ii) **Syslog** security events, alarms, and intrusion notifications can be sent to an external syslog server at the dispatch centre. The security events should be configurable between a minimum of 1000 and maximum 10 000.
- (iii) **System hardening** - Unused communications ports should be closed to inhibit anyone or any server to log on a local or remote communication port. Only ports and services required for normal operation to be enabled by default.

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Documentation of all running ports and services should be provided. All open communication sessions should be monitored for activities. If there is no activity on the communication port after a certain delay, the open session should be terminated automatically.

- (iv) **Security Updates** - The contractor shall provide security updates for the RTU throughout the entire, contractually agreed warranty period.

The strategy to implement security shall be to act on protection both for internal and external attacks

## 8.12 HMI

The RTU shall have capability for user Interface that shall be implemented with a Laptop computer. The laptop shall be connected via the Ethernet connection port or switch on the same network with the RTU. Once the Laptop is connected to the RTU, the user shall select the displays of interest and the display shall become live and the user made aware of the current state of the station.

This gives the user at the substation the opportunity to carry out switching operations using the laptop connected to the RTU instead of carrying out the switching operations in the switchyard.

The usage of the user interface shall be possible by connection of a standard laptop with no special software requirements.

## 8.13 INDUSTRIAL SWITCHES

8.13.1 The tenderer must provide enough industrial Ethernet switches for the substation LAN.

8.13.2 The switches must be:

- 19 inch rack mount switches. Din rail mount also acceptable.
- 50VDC powered.
- Have at least 8 Fast Ethernet ports
- Have at least 2 gigabit Ethernet Fibre optic ports
- Support RSTP protocol

## 8.14 TESTS

Site Acceptance testing of the RTU shall be done during project implementation.

## 8.15 STRATEGIC SPARES

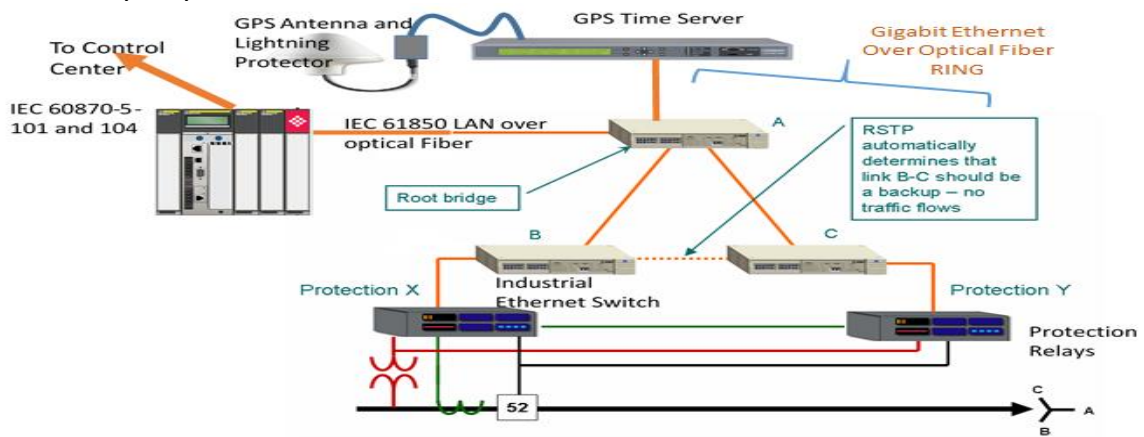
- 1 x RTU unit equipped with two processors and two power supply modules.
- 1 x Digital Input Card

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- 1 x Analogue Input Card
- 1 x Digital Output Card
- 2 x Industrial Ethernet Switches
- 1 x GPS Antenna with Lightning Protector
- 1 x GPS Time server
- 1 x CAT7 Ethernet Cable Roll(500metres) and must be shielded for substation installation.
- 1 x IP Firewall/Gateway

**8.16 DIAGRAM**

The following diagram shows the envisioned arrangement of equipment. It does not in any way show the Bill Of Quantities.



**8.17 BILL OF QUANTITIES FOR BEATRICE SCADA COMPONENTS \_HITACHI RTU560**

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Item	Description	Qty	Unit	Supplier's Model	Clarification
1	RTU Panel (2200mm X 800mm X 600mm)	1	pcs	Prewired panel	With accessories and wiring of the following equipment from Item 2 to 14. Including associated MCBs, Panel lighting, AC Sockets and heater
2	ABB RTU560 19" Rack 5605FR02A	2	pcs	1KGT022200R0001 5605FR02 R0001 19" swing frame rack for optional redundant power supply	One rack is for IEC61850 Engineering and the second rack is for existing and new hardwired circuits
3	RTU560 Power Supply Modules (560PSR00)	4	pcs	1KGT026500R0001 560PSR00 R0001 Power supply unit for RTU560, 24 . 60 VDC, 44.3W	
4	ABB 560CMR02 (5000 Data Points; PLC Licence; IEC101, IEC61850, Modbus Protocol supported)	2	pcs	1KGT036300R0002 560CMR02 R0002 Communication unit (CMU) for RTU560, 6 serial ports, 2 Ethernet ports, Crypto Chip	
		2	pcs	1KGT201643R0013 Rel. 13 PLC/Archives license open and 5000 data points	
5	Bus Connection Units 560BCU04	1	pcs	1KGT022300R0001 560BCU04 R0001 Bus connection unit for 560MPR03 (Basic)	
		1	pcs	1KGT022300R1002 560BCU04 R1002 Bus connection unit for 560MPR03 (Extension)	
6	Analogue Input Cards (560AIR01)	3	pcs	1KGT036500R0001 560AIR01 R0001 Analog input module (mA, V), 8 channels	For existing hardwired measurements
7	Digital Input Cards (560BIR01)	10	pcs	1KGT034000R0101 560BIR01 R0101 Binary input, 16 channels, LED's	
8	Digital Output Modules (23BA40)	4	pcs	1KGT011200R0011 23BA40 R0011 Command output module 110 . 220 VDC	
9	RTU560 Power Supply Modules (560PSU41)	4	pcs	1KGT017700R0001	Power supply module for the 23BA40 Command modules and multimeter measuring units
10	Multimeter modules ABB 500CVD21	2	pcs	500CVD21 multimeter with display, LO, 1A, 3U3I	One for the HV side measurands and the second for the LV side measurands
11	Blanking front plates (560FPR01 R1002)	30	pcs	1KGT007700R1002 560FPR01 R1002 Blanking	
12	Manageable Industrial Ethernet Switches –Each switch with 24 ports (Gigabit Fibre and Ethernet) (50VDC or 110VDC Powered)	2	pcs	Any model that meet the specifications	
13	Router/Firewall for Cybersecurity enhanced system protection (50VDC or 110VDC Powered)	1	pcs	SEL3220 Model	Being implemented in ZETDC network. The Server already based at the NCC.
14	GPS Time Server for IEDs and RTU Time synchronisation (50VDC or 110VDC Powered)(including GPS Antenna, GPS Coaxial 30meters cable, 2 x GPS In-Line Lightning Arrestor, GPS Coaxial 5meter cable)	1	pcs	Any model that meet the specifications	
15	Enough Fibre Patch Leads and ethernet pre-terminated cables for connecting IEDs	1	set	As Specification Required as supported by RTU, Switch and Protection relays communication ports	
16	Spare Fibre patch leads	5	pcs	As Specification Required as supported by RTU, Switch and Protection relays communication ports	
17	Spare ethernet pre-terminated cables	10	pcs	As Specification Required as supported by RTU, Switch and Protection relays communication ports	
18	Project Laptop for configurations, commissioning and maintenance works (Intel 4GHz Core i7, 10th Generation, 16GB RAM, 1TB HDD)- with all configuring softwares.	1	pcs	Software configuration tools to include IEC61850 tools i.e. IET, ITT, IEC101 and IEDSCOUT	
19	Cat7 Ethernet Cable for networking	200	m	As Specification Required	
20	RJ45(Cat7) Connectors and RJ45 Boots	50	pair	As Specification Required	
21	RJ45 Crimping Tool	2	pcs	As Specification Required	

## 9. Technical Specification for Earthing and Lightning Protection

### 9.1 Introduction

This specification covers the technical requirements of the design, supply at site and installation of an earthing and lightning protection system complete with all accessories for an efficient and trouble free operation.

### 9.2 Standards

The Earthing System covered in this specification shall unless otherwise stated be designed, installed and tested in accordance with the following standards.

Table 11: Standards applicable for Earthing and Lightning Protection.

Document	Title
IEEE Standard 80-2000	Guide for safety in alternating current substation grounding
IEC 60071	Insulation Coordination
IEC 60137	Insulated bushings for alternating voltages above 1 000 V
IEC 60364	Electrical installations in buildings
IEC 60664	Insulation coordination for equipment within low-voltage systems
IEC 60950	Safety of information technology equipment, including electrical business equipment
BS 7354	Design of high-voltage open-terminal stations

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BS EN 50522

Earthing of power installations exceeding 1kV AC

In case of any conflict between the standards and this specification, this specification shall govern. Any discrepancy between the various specifications/standards shall be discussed with the Project Manager. The earthing and lightning protection supplied shall satisfy all applicable statutes, regulations and safety codes of Local Statutory authorities.

### **9.3 Design Overview**

The station earthing system shall be designed principally according to IEEE 80 "Guide to safety in substation grounding".

The system design shall be based on the maximum earth fault current that is expected to occur during the design life of the station including transmission system contributions.

The earthing system shall provide for:

1. Adequate protection for personnel and equipment against dangerous voltages, currents and lightning surges.
2. Safe step and touch voltages for the entire plant, whereby for outer fences special care shall be taken to avoid danger for personnel standing outside and inside these fences.
3. A low earthing impedance for the lightning arresters
4. A low earthing impedance for the transformer neutrals, and a sufficiently low neutral conductor impedance
5. Limitation of the induced, or capacitively transformed, voltages on low-voltage, low-current and electronic cables, circuits, panels and other equipment.
6. Flow of short-circuit and earth-fault currents through the earthing systems, and not through other conducting parts or building elements, to a degree not hazardous to people or equipment.

The earthing system shall have the following main technical characteristics:

7. All connections between equipment and the earthing network shall be exposed (not embedded) and easily accessible for checking of the transition points. Bare conductors, as part of the open earthing system, embedded directly in the concrete will not be accepted. Similarly, bolted connections of metallic constructions do not form an acceptable earthing connection.
8. For all areas, the earthing system shall extend to all metal parts, even if these do not constitute a conducting part of an electric system of the works, such as machinery, operating panels, cat-walks, piping, sewers, rails, metal tanks, lighting fixtures, cable racks, etc.
9. All earth conductors shall be of copper.
10. The earthing resistance shall be as low as possible and not more than 0.5 ohm.

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11. The earth conductors shall be designed for carrying the earth-fault currents of the various parts of the plant for at least 3 seconds without exceeding a surface temperature of 250°C.
12. Risers or earth conductors are not allowed to touch cables.
13. Connections shall be made by compressed clamps or by approved welding process. No bolted clamps may be used on sub surface connections. Welding shall be by the thermoweld method.
14. Connections to steel structures (riser connections) shall be made by compressed lugs with provision for two holes in the contact pad.
15. All connection points shall be protected against all types of corrosion.
16. Buried connections shall be welded, connections above earth shall as a main rule be clamped and shall be easily accessible for inspection.
17. All designs and calculations must be submitted to the Employer for approval.
18. Facility for temporary earthing points must be provided.

## **9.4 Technical Details**

### **9.4.1 Earth grid**

The earth mat and associated conductors must be installed at an optimal depth and spacing to achieve the safe step and touch values as set-out in the relevant international standards. This must however be approved by ZETDC.

Main earthmat conductors shall be designed for the maximum fault current that might be achieved. In addition, the combined resistance of earthmat in the substation shall not exceed 0.5  $\Omega$  (maximum) to the general body of earth, with the provision that under the worst case substation fault condition, the GPR does not exceed 5 kV. To reach the desired earth resistance, additional grounding rods shall be installed as necessary. The rods shall be connected to the earth mat.

All the equipment, structures and towers shall be earthed by running main and duplicate earthing conductors from the equipment base along the structure to the main earthmat. The earthmat shall be formed by compressed joints or approved welding of the copper earthing conductors at all crossing points.

Once all joints below ground level are completed, the Contractor will observe a "Hold Point" and no further related work will be permitted until the relevant joints have been inspected by the Project Manager and approved accordingly. Ductor resistance across all connection points will be measured by the contractor. A revised earthing layout drawing together with a spreadsheet specifying test points of the newly installed system will be presented to the Project Manager for inspection and approval prior to energisation of the system. Once approval is given

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to proceed, the relevant joints/connections shall be treated with bitumen paint, allowed to dry before backfilling the excavation.

Whenever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, railway tracks, etc, the earth conductor shall be laid at a minimum depth of 500 mm below existing services and shall be rerouted in the event that the earth conductor is in conflict with any foundation.

Earthing conductors running along cableways inside cable trenches, columns, beams, walls, etc. shall be supported and secured by suitable cleats or brackets at intervals of 800mm. Wherever the earth conductor passes through a wall, floor, etc, a suitably sized PVC pipe shall be provided for the passage of the conductor. After installation of the conductor, both ends of the piping shall be sealed with an approved hydrophobic material to prevent water ingress.

Where the earth conductor is to be buried in concrete, a layer of at least 100 mm of concrete shall be cast over the earth conductor.

#### **9.4.2 Equipment and Structure Earthing**

The following equipment shall be connected directly to the earth electrodes or the risers:

1. All power transformer neutrals and transformer tanks. Main transformer tanks shall be earthed in two points, by different risers.
2. All steel structures in the outdoor switchyard.
3. All lightning arresters. The earth conductor from the arrester to the counter, as well as the in-terminal of the counter, shall be suitably insulated or screen-protected against accidental touching and shall be of minimum 2 x 95sqmm.

Each item shall be directly connected to an earthing conductor and not with a series connection through other metallic parts. For the current and voltage transformers, an earth connection to the housing shall be provided. Earthing of the cores and neutrals shall be done on the transformers and not on the terminal boxes.

The fence of the switchyard and other fences for transformer cells, etc. shall be earthed to the earthing system at intervals of not more than 20 m and to the earthing electrode system at all corners and gates. Gates shall be connected to earthed gate posts by a flexible copper braid or equivalent. Flexible copper braids of minimum 35 mm<sup>2</sup> shall also be used for connecting all sections of pipes, metal trays, conduits, rails, cable racks, etc., unless these are welded together or each section is separately earthed.

Earthing conductors for telecommunication equipment and electronic systems shall be insulated and shall be run separately from the systems, panels, etc., directly to a main earthing bus close to a connection to the earthing electrode system. These earthing conductors shall be of minimum 50 mm<sup>2</sup> and shall not be branch-off from the earthing of the high-power systems.

The below concrete template shall be manufactured from a suitable steel capable of

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maintaining the required bolt formation and bending stresses imposed by the concrete casting and the heat absorption when the two copper earth straps are welded to the template.

The holding down-bolts are to be fixed to the template by means of a hot dipped galvanised steel washer and nut either side of the template and torqued to the required value which shall be dependent on the bolt size. Special care must be given to achieving and maintaining a good contact surface between the washers and template thus avoiding a high resistive contact joint.

The Project Manager or his representative is to be notified by the Contractor at least 72 hours prior to the casting of the concrete foundation to enable an inspection to take place on each holding down bolt earthing arrangement. In the event that the Project Manager or his representative reject the earthing arrangement as constructed the Contractor shall re-work the template and earth connection to the satisfaction of the Project Manager.

The earth connections between earthing points on the equipment and the main earthing grid shall be made by short and direct earth conductor leads free of kinks, sharp bends and splices. In the case where earth pads have not been provided on the equipment to be earthed, earth connection points shall be added in consultation with the Project Manager.

Whether specifically shown on the detailed drawings or not, steel reinforced concrete columns, metallic stairs etc. shall be connected to the nearest earth point by two earth leads. Earth continuity shall be ensured by bonding the different sections of hand-rails and metallic stairs.

Metallic pipes, conduits, and cable tray sections for cable installation shall be bonded to the main earth every 5 metres or at intervals as agreed to by the Project Manager to ensure electrical continuity.

Metallic conduits and water pipes shall not be used as earth continuity conductors under any circumstances.

A separate copper earth conductor shall be provided for earthing lighting fixtures, receptacles, switches, junction boxes, lighting conduits, switch boxes, sockets etc.

Wherever an earthing conductor crosses or runs along a metallic structure or pipes of gas, water, steam or conduit or steel reinforcement in concrete, it shall be bonded to the same.

The substation earth mat shall be buried at a minimum depth of 600 mm below finished ground level. Should previously unknown rock outcrops or similar obstacles be encountered whilst excavating earth mat conductor trenches, the Project Manager may authorise the Contractor to reduce the burial depth.

Lighting poles, junction boxes on the poles, cable boxes/glands, lockout switches etc. shall be connected to the earthing conductor running along the supply cable, which in turn, shall be connected to the earthing grid conductor at a minimum of two points.

Flexible earthing conductors shall be used wherever earthing of moving parts (handles) are to be connected to the earthmat.

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For transformer neutral earthing, 2 sections of flat 50 x 3mm flat copper straps, secured together in parallel formation (one on top of the other) shall be used. The connection from the HV and MV neutral shall be directly connected to the substation earth mat by the shortest route possible via a CT. These must be separate connections.

All equipment support structures shall be connected to the main substation earth grid with two individual earth straps of at least 50 x 3mm flat copper; these shall be connected at opposite diagonal corners.

Auxiliary earthmat shall be provided for each disconnector operating box location, where a person would normally stand to operate the disconnector. Design must be confirmed with the Project Manager.

### **9.4.3 Cable Earthing**

Metallic sheaths and armour of all multi-core power cables shall be earthed at both equipment and cubicle ends. Sheath and armour of single core power cables (if applicable) shall be earthed at the switchgear end only.

### **9.4.4 Jointing**

Above ground earth connections to equipment earth points shall be bolted. The surface of the contact area shall be free from scale, paint, enamel, grease, rust or dirt. A minimum of two bolts shall be used for making each connection.

All equipment bolted connections, after being checked and tested shall be painted with anti-corrosive paint/compound.

Connections between the equipment earth lead and the main earth conductors shall be by a welding process which is subject to approval by the Project Manager.

The ohmic resistance of a unit length of conductor with a joint shall not be greater than the resistance of an equivalent unit length of conductor without a joint.

### **9.4.5 Earthing Inside Switch Room and Control Room**

An earthing conductor of sufficient area shall be provided extending the whole lengths of the switchboards and control cabinets.

All panels inside the Control/Relay room shall be earthed by connecting two copper earth leads of suitable size from the main earth point within each panel, to the main earthing conductor of suitable size running horizontally the length of the Control/Relay room cable trench wall. This earth conductor shall in turn be connected to the switchyard earth mat by duplicate connections.

All loose cable gland plates shall be separately hard earthed to the main earth connection within the cubicle, kiosk, etc; reliance on the cable gland plate fixing bolts will not be accepted.

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## 9.4.6 Earthing of Other Types of Equipment

Earth terminals of low-voltage equipment shall be earthed by wires designed for the actual earth fault current.

Connection and marshalling cubicles etc. for low-voltage or control equipment shall be connected to the earthing system irrespective of whether they are mounted on otherwise grounded structures or not.

Cubicle doors, where electrical apparatus or instruments are installed, shall be earthed by a flexible earthing cord.

## 9.4.7 Lightning Protection System

The lightning protection system shall be carried out with earthwire (100/18 'HARE' SCA conductor) secured in suitable clamps on gantry tower peaks in the 33 kV switchyard.

Conductors in the lightning protection system shall not be connected to the conductor of the safety earthing system above ground level.

Lightning conductors shall not pass through or be run inside G.I conduits.

Down conductors shall be clamped at 750mm intervals to the gantry tower steelwork with clamps purposely manufactured for the securing of conductor.

For the medium voltage switchyard, where applicable, lightning protection shall be by 4m lightning spikes mounted on lightning masts, busbar gantries or support steel as approved by the Project Manager.

All equipment support structures and gantry verticals are to be fitted with earth ball studs, suitable for securing portable working earths.

Lightning masts or gantry mounted spikes shall be positioned and installed in the switchyard to provide total and complete earth screen coverage for all primary electrical equipment in the substation area.

## 10. CIVIL WORKS

### 10.1.1 Location

The site is located inside Beatrice 33/11kV substation

#### 1.1 Works to be executed

Site clearance and levelling, tarred access road, reinforced and mass concrete foundations and concrete cable ducts

#### 1.2 Programme

Contractors when tendering shall submit a detailed construction programme in the form of a bar chart subdivided into periods of no more than one week and showing the duration of the main activities necessary to carry out and complete the works and the times required for delivery to site of the main construction materials.

The construction programme submitted by the successful Bidder will, subject to amplification in detail in terms of the **General Conditions of Contract** be held to be the programme referred to in that clause and shall be adhered to.

Time shall be the essence of the contract and the attention to the Contractor is drawn to the [clause](#) of the **General Conditions of Contract** which covers liquidated damages payable for default in completion of parts or the whole of the works.

#### 1.3 Contract Drawings and units

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The drawings referred to in the **General Conditions of Contract** are listed in annexure 6 to this specification but these drawings are subject to modifications and additions as described in the general conditions of contract.

Drawings have been fully dimensioned in the S.I. system of metric units. The S.I. metric system of units shall be used at all times in connection with this contract.

1.4 Setting out

The contractor shall supply all the necessary instruments and equipment and shall be responsible for the accurate setting out of the works.

The contractor's authorised representatives or agent shall be capable of setting out the works satisfactorily.

A beacon and bench mark to define the positions and levels of the various structures included in the works will be provided by the Engineer, and these shall be the sole points of reference for setting out of the works by the Contractor.

1.5 Supply of materials

The Contractor shall supply all materials necessary for the completion of the works.

1.6 Electricity and water supply

The Employer shall make available from a fixed point on site or immediately adjacent to the site, electrical energy of capacity not more than 200kVA for supplying power to plant, welding and other tools. The cost of providing the power supply will be met by The Employer but power consumed by the contractor will be charged to Contractor at applicable tariff rates.

All wiring for tackle and lighting from the point of supply shall be provided by the Contractor and all such installations shall comply in full with all appropriate statutory regulations to which the Employer is subject.

Wiring shall be of the best quality tough rubber sheathed or other approved type suitably to fixed, protected and maintained. All necessary precautions shall be taken by the Contractor to ensure the safety of every person employed or working on the site.

The Contractor shall be responsible for providing all water required by him for domestic and constructional purposes.

1.7 Transport and Accommodation of workmen

The Contractor shall be responsible for and bear the cost of all transport of staff and workmen to and from the site.

The Contractor shall provide, maintain and clear away on completion all quarters and camps for staff and labour necessary for the execution of the works, and shall be responsible for the provision of adequate sanitary accommodation and for disposal of refuse from such quarters and camps.

The Contractor must make due allowance for any restrictions imposed by the local or governmental authorities on the establishment of such temporary labour camps.

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With regard to provision of accommodation, camps, toilet facilities, etc for his staff and labour, the Contractor shall be responsible for meeting the requirements of Labour Officer and other Government and Local Authorities and shall exercise proper control over his workmen, especially with a view to maintaining good relations with adjacent landowners.

The Contractor shall take special care to prevent injury, damage or trespass on lands fences and other properties near and adjacent to the works.

**1.8 Communications**

The Contractor must provide whatever communication services he requires.

**1.9 Attendance to Engineer**

The Contractor shall provide one labourer as required for attendance on the Engineer and his stall in any setting out, measuring, levelling or testing work.

**1.10 Measurement**

Further to the clause in the General Conditions of Contract on measurement , as each portion of works is completed the Contractor shall within two weeks thereafter render to the Engineer a statement of the final measurement and quantities of such portion.

The whole of the works shall be measured after completion and shall take into account and include all final measurements of such work or sections which have been made at various times during the progress of the contract and which have been agreed to between the Engineer and the Contractor.

In the case of foundation or other work to be hidden underground, the Contractor shall timeously call upon the Engineer to note the levels and measurements of work to be so covered up or hidden failing which the Contractor may be required subsequently to open and restore the same at own cost.

For the purposes of recording measured work, the Engineer's representative will prepare records month by month and the Contractor as and when called upon to do so, shall within fourteen days attend to examine and agree such records with the Engineer's representative and shall sign the same when so agreed. If the Contractor does not so attend to examine and agree any such records, they shall be taken to be correct. If after examination of such records, agreement cannot be reached between the Contractor and the Engineer's representative, they shall nevertheless be taken to be correct unless the Contractor shall within fourteen days of such examination lodge with the Engineer's representative for final decision by the Engineer notice in writing of the respects in which such records are claimed to be incorrect.

**1.11 Standard Specification and Code of practice**

The latest issue of the standard specifications codes of practice, regulations or other publications referred to in these documents shall apply to the works unless otherwise agreed in writing with the Engineer. The Contractor shall provide himself with one copy of each of these publications to be held in his site office.

**1.12 Security**

The Contractor shall be responsible for his own security arrangements but shall comply with the security instructions which the Engineer may issue from time to time. No information, drawings or details of the contract may be passed to third parties without the

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approval of the Engineer, excepting information which is deemed in the course of business necessary to obtain quotations.

**1.13 Sales Tax**

The schedules of rates and prices shall include for any sales tax which would be levied. The Contractor shall each month for the duration of the contract, submit to the Engineer copies of all invoices with sales tax shown as separate items to enable the Employer to claim refunds from the Statutory Authority.

**1.14 Import permits, custom duty, taxes etc**

The contractor shall be responsible for all import permits, custom duties, taxes, fees and foreign exchange arrangements etc required in respect of all materials supplied by contractor.

**1.15 Safety precautions**

The contractor shall at all times undertake the work in such a manner as to ensure safety of his workmen, staff and the safety of the works

**1.16 Sunday working**

The contractor shall make every endeavour to avoid working on Sundays except for necessary maintenance repairs and emergencies and where necessary for the safety of the works.

**1.17 Clearance of site on completion**

On completion the contractor shall clear away and remove from site all construction plant, rubbish and temporary works of every kind and leave the site clean and in a workmanlike condition to the satisfaction of the Engineer

**1.18 Holding down bolts**

The contractor shall supply and fit all angle iron anchors. The employer shall supply all holding down bolts to be fitted by the contractor.

Setting of bolts in position shall be to a high standard of accuracy and the contractor must allow for templates, equipment and instruments necessary for setting out this work in his pricing.

**1.19 Access to site**

Access to site is by tarred road.

**10.1 Materials**

**10.2.1 Quality of materials**

All materials used in the construction of the works shall be new and of good quality and to the approval of the Engineer. Any materials rejected by the Engineer shall be immediately removed from site at Contractor's cost.

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**10.2.2 Samples and Tests**

Samples of materials may be require before or during progress of the works by the Engineer for test purposes. The cost of such tests shall be borne by the contractor and shall be included in the rates.

***10.3 Setting Out***

Before any excavation or filling work begins, the contractor shall set out accurately all excavation and filling lines in accordance with approved drawings and shall satisfy himself as to the correctness of all site levels shown on the drawings.

During the work the Contractor shall ensure that the excavation and filling follow the said lines, and the Contractor shall set out as necessary as the work proceeds, profiles and other markers for levelling purposes and he shall be in agreement with the Employer about the levels of the said profiles and markers.

***10.4 Excavation***

The contractor shall excavate the ground to the lengths and widths and exact depths as indicated on the drawings provided for the construction of the works. In cases where the bearing capacity of the sub-soil under foundations or roads is insufficient, the excavation shall be continued to such greater depth as may be necessary.

The Contractor shall report all cases of unsuitable or weak ground to the Employer and shall follow the instruction given by the Employer during the excavation works.

All excavation may be carried out mechanically, but the final shaping and trimming of the substratum below foundations etc. shall be done by hand.

If due to negligence or mistakes on the part of the Contractor any excavations be taken to a level lower than that shown on the drawings or stated in the specification or required for the works, the Contractor shall at his own cost fill in the void so formed to the proper level with approved fill material well compacted or, if necessary under foundations and the like with approved blinding concrete.

The Contractor shall handle and remove as necessary all water from whatsoever source which may come into the excavations and he shall provide, maintain and remove on completion all planking, strutting, shoring or piling required to support the sides of the excavation.

***10.5 Backfilling and Compaction***

Filling of areas and around foundations and backfilling of trenches shall be executed in such a way and to such extra depths as will ensure that final surfaces after settlement and compaction conforms to the specified levels. All filling material shall be free from cinders, ashes, refuse vegetation or organic material, boulders and other unsuitable material.

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All fill material shall be well compacted by mechanical means until a high degree of compaction is obtained. The filling material shall be placed in even layers of a depth not greater than 0.4 m and each layer shall be thoroughly compacted. A suitable power-driven roller of at least 5 tons weight making at least 10 passes for each layer shall be used.

For backfilling of narrow and steep sections the thickness of each layer shall be maximum 15 cm, each layer being compacted to the required density by using a vibrating plate compactor.

The Employer's instructions with regard to the addition of water to improve compaction of fill must be adhered to. For fill under roads and foundations, every effort shall be made to compact the fill material at its optimum moisture content for compaction. In any case the dry density of the compacted soil shall not be less than 95 per cent of the maximum density according to ASSHTO T180.

Backfilling and compaction around any pipes, cables or ducts shall be done by hand using selected materials for a depth of at least 0.5 m above such pipes, cables or ducts.

## **10.6 Concrete**

### **10.6.1 Materials**

#### **Cement**

Shall be Portland cement suitable for concrete works. It shall comply with the requirements of BS.12:1958 and CAS A46. The cement shall be fresh and shall be stored under dry conditions to the approval of the Engineer.

#### **Fine aggregates**

For concrete, grouting and topping shall be clean river or pit sand of quality approved by the engineer. It shall comply with the requirements of Class A fine aggregate in BS.882:1944 and CAS 233:1978.

#### **Course aggregates**

Shall be hard clean crushed natural aggregate to the approval of the engineer. It shall comply with CAS 233:1978 and in the interpretation of test results relating to this specification, particular attention will be paid to ensuring the absence of mineral sulphides.

#### **Water**

Used for concrete manufacture shall be clean and free from injurious amounts of acids, alkalis, organic matter or other substances which may impair the strength and durability of the concrete.

#### **Admixtures**

Admixtures shall not be used without the written approval of the Engineer. Where permitted, they shall be used in accordance with BS CP 110 Part I.

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**10.6.2 Storage of materials**

Cement shall be store in a waterproof shelter to the approval of the Engineer. Cement shall be used in the order in which it is received.

Each size of aggregate shall be stored separately in stockpiles capable of draining freely.

**10.6 3 Grading of aggregates**

Course aggregate

Shall be of normal 19mm size for troughs, beams, suspended slabs, lintels and pre-cast work. It shall be of nominal 38mm size for wall foundations, pier foundations, mass foundations (plain and reinforced), floors and filling and hunching concrete.

Coarse aggregate shall have the following grading:-

PERCENTAGE BY WEIGHT PASSING B.S. SIEVE							
Nominal Size	51mm	38mm	25mm	19mm	13mm	10mm	6mm
38mm	100	85-100	0-50	0-25	0-5	-	-
19mm	-	-	100	85-100	0-50	0-25	0-5

The percentage of voids as determined per SABS.718: 1962 shall not exceed 48 percent.

Fine aggregate shall be graded such that not more than 10% shall be retained on a 5mm sieve and at least 85% shall be retained on the BS. No. 100 sieve. The percentage of sand passing a BS. No. 200 sieve shall not exceed 5%. The fineness modulus of the sand shall fall within the range of 2,0 to 3,5. The percentage of voids as determined by SABS. 718:1962 shall not exceed 48%.

**10.6.4 Quality of concrete**

It is the intent of these specifications to secure for every part of the structures homogenous concrete which will have the required strength and durability. The contractor shall be responsible for ensuring that the quality and strength of the concrete is as specified.

Concrete grades

All grades of concrete are specified as “design mixes” as defined in BS.:5328. “design mixes” are concrete mixes for which cube strength at 28 days are specified and are classified according to the characteristic strength required and the maximum size of the coarse aggregate used. Thus, concrete of “grade 25/38” means concrete having a characteristic 28-day cube strength of 25N/mm and a maximum size coarse aggregate of 38mm. Characteristic strength is defined as the 28-day cube crushing strength used by the designer for structural calculations. The contractor shall design the mixes to give average strength higher than characteristic strength as tabulated below when tested and interpreted in accordance with clauses 4.6 and 4.7.

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Concrete grade	25/38	25/19	15/39	
Maximum cement/water ratio by mass	1.7	1.7	1.3	
Minimum cement content kg/h of compacted concrete	300	325	22	
Characteristic strength in N/mm	25	25	15	
Average 28-day cube strength	33.5	33.5	20	
Maximum aggregate size in mm	37.5	19	37.5	
Slump limits in mm	25-50	25-50	25-50	75-125
Manner of compaction	Vibrated	Vibrated	Vibrated	Vibrated

Cement content and cement/water ratio shall in all cases have the minimum tabulated values irrespective of the requirements to produce the specified characteristic strengths.

The contractor shall be responsible for determining the proportion of the constituent materials necessary to produce each design mix to comply with the tabulated requirements of the clause.

The proportion of fine aggregate, measured by mass as a percentage of the total aggregate mass shall normally not be less than 33% nor more than 45%.the Engineer may however relax this requirement to suit special circumstances.

#### **10.6.5 Trial mixes and preliminary testing**

Before commencement of concreting in the works, the Contractor shall make trial mixes, with the materials and plant which he proposes to use and submit his proposal for design mixes to the Engineer.

The Engineer shall have the right to order tests as in clause 4.7 or such changes in materials or proportions or both as he may consider necessary in order to meet the requirements of this specification. Likewise, during progress of the work, the Engineer may order such changes as he considers necessary to meet the requirements of this specifications. No extra payment shall be made to the Contractor by reason of such changes. The Contractor shall not make any change in materials and/or proportions of the mix as originally approved by the Engineer without obtaining the Engineer's approval.

#### **10.6.6 Testing of concrete**

During the progress of the construction, the Engineer shall have the right to have samples taken and tests made to ensure the concrete complies with this specification.

The minimum frequency of sampling shall be one sample for each grade of design mix for every 40m of concrete placed, with at least one sample of each grade of design mix being taken each week. The Engineer may vary this frequency at his discretion. The procedures for sampling and testing shall comply with SABS standard methods 861, 862 and 863.

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A sample taken from any batch of concrete shall be deemed to be representative of the whole of the concrete of which that batch formed a part. Records shall be kept to ensure that the concrete from which each sample was taken can be identified.

Six test cubes, 150mm nominal size, shall be prepared from each sample. Three of each set of six test cubes shall be tested at 7 days after making and the remaining three cubes at 28 days after making. The average of the results for three cubes shall be taken as the test result.

The Contractor shall supply sufficient moulds suitable for testing.

The costs incurred in the testing of concrete as specified above shall be deemed to be included in the rates for concrete.

Concrete from which test cubes have been taken shall be considered as having failed to meet this specification when the strength determined from any 28 day test result is less than:

22N/mm for grade 25  
12n/mm for grade 15

Each test result shall be the average strength calculated from cubes from a single sample of concrete.

If the tests disclose a consistent relationship between the 7-day and 28-day strengths of the concrete, the 7-day strength may be used as basis for the assessment of the 28-day strength. As both 7-day and 28-day strength tests will be carried out consistently and continually throughout the contract, these will provide a record of any seasonal variation in relation between the 7-day and 28-day strength. The assessment of the 28-day strength from 7-day strength will therefore be consistent with any such variation.

Until such a relationship has been established on site, the 7-day strength shall be taken to be not less than 60% in the case of ordinary Portland cement, the 28-day strength as defined in clause 4.5.

**10.6.7 Measuring materials**

Cement shall be measured by weight only. Water shall be measured by weight or volume. Aggregate shall be measured by weight unless, approval is given by the Engineer for measuring by volume.

Quantities shall be measured to an accuracy of +/-3%.

**10.6.8 Mixing**

Mixing shall be carried out in a mechanical mixer of approved type and capacity to B.S. 1305 or B.S. 4251, which is capable of producing a uniform distribution of the ingredients throughout the mass. The period of mixing shall be measured from time when all materials are in the drum until commencement of discharge and shall not be less than one and half minutes.

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A reversible sand glass or other approved timing device shall be used to measure the timing of mixing

The use of air entrainment agents will only be permitted where specifically agreed by the Engineer in advance.

**10.6.9 Transportation**

Concrete shall be transported in such a manner that segregation or loss of any of the ingredients is prevented.

**10.6.10 Placing Concrete**

Concrete shall be placed in its final position before setting occurs and in no case more than one hour after discharge from the mixer. In no circumstances shall partially hardened concrete be deposited in the work or re-tempered by the addition of water or other materials.

Placing shall be carried out in such a manner that segregation of the materials is prevented. Wherever possible, the concrete shall be deposited vertically into its final position. Once concreting of a structure has commenced it shall be carried out on a continuous operation upto final level. Before concrete is deposited, all debris shall removed from the space to be occupied by the concrete. Premature drying out of the concrete to be placed shall be prevented by thoroughly damping down ground or other absorbent surfaces upon or against which the fresh concrete is to be placed. At the time of concreting, however, there shall be no free water upon such surface.

**10.6.11 Compaction**

The concrete shall be fully compacted to produce a dense homogenous mass to the full extent of each layer, and successive layers shall be thoroughly worked together without any visible joint. Unless otherwise directed by the Engineer, approved power driven vibrators shall be inserted or otherwise applied to ensure that the concrete is fully compacted throughout. Over vibration causing segregation, surface laitance, or leakage through formwork shall be avoided.

Vibrators shall not be used to move concrete along the forms or in such a way as to displace reinforcement or other embedded items or to damage formwork or concrete already set in position.

When the concrete is compacted by hand, it shall be thoroughly rammed and spaded into place and around reinforcement and embedded parts and against shattering by an adequate number of properly trained men so as to give a homogenous mass and a surface finish free from defects.

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**10.6.12 Curing**

All exposed surface of all plinths shall be protected by a polythene curing membrane adequately fixed round the edges and covering the concrete to ground level. This membrane shall be left in position until removal for erection of steelworks, or until its removal is approved by the Engineer. The Engineer may additionally require that a layer of moist sand is placed over the polythene and maintained in a moist condition for a minimum of seven days.

**10.6.13 Building paper in foundations**

Side of excavations for equipment foundations, plinths and troughs shall be lined with good quality building paper, adequately fixed in position before concrete placing commences.

**10.6.14 Mortar grouting**

All mortar for grouting and dressing of steel base plates shall be one part cement to three parts aggregate.

**10.6.15 Construction joints**

Whenever concrete is to be bonded to other concrete which has taken its initial set, the surface of contact between the sections shall be treated as construction joint. Such joints shall only be located where shown on the drawings approved by the Engineer. All laitance will be from the face of the concrete and clean sound aggregate exposed. If necessary a scabbling tool will be used to suitably remove surface laitance. The surface will be thoroughly washed down and a thin layer of cement rich grout applied to the surface before further concrete is placed against it.

**10.6.16 Adverse conditions**

In hot weather the Contractor shall take suitable steps to shield aggregates, water supply, mixer and fresh concrete from direct rays of the sun to ensure that the temperature of the concrete discharged from the mixer is not higher than 32°C. He shall also ensure that the reinforcement that is about to be covered by new concrete is cooled sufficiently to ensure local cracking of concrete along the bars does not occur.

When the air temperature is 35°C or higher, the contractor shall protect the part of the structure where concrete is being placed from direct rays of the sun.

Concrete shall not be placed during rain unless the fresh concrete is protected from the rain. Before ceasing work the concrete shall be finished at a temporary construction joint as directed.

The contractor shall ensure that ground water does not rise over any concrete work within twelve hours after it has been placed.

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After being placed and compacted the concrete shall not be disturbed in any way until it has thoroughly hardened. Newly placed concrete shall be protected to the satisfaction of the engineer against excessively low or high temperatures, rain, sun, wind or any other adverse influences or from damage occasioned by other works in progress until it has hardened.

No plant, workmen or materials shall be permitted on newly placed concrete until the engineer considers the concrete to be sufficiently strong and hard not to be damaged thereby.

**10.6.17 Failure to meet specifications**

If a concrete test result fails to comply with clause 4.7, the volume of concrete represented by the sample maybe removed from the works at the discretion of the engineer, the cost of this removal and reconstruction to be at contractor's expense. The engineer may require cores to be cut from the concrete involved, the cost to be borne by the contractor.

If the concrete shows any defect, the contractor shall immediately report any such defect to the engineer and shall not carry out any patching or remedial work until authorised by the engineer.

The engineer will either specify the extent and method of repair or order the demolition and reconstruction of the whole of the defective work to the extent considered necessary.

The cost of all such investigation, repair and remedial work and of any demolition and reconstruction of defective work shall be borne by the contractor and shall be executed to the satisfaction of the engineer.

**10.6.18 Measurement**

The scheduled rates for concrete are to include for all the provisions of this section of the specification and the cost of building in all reinforcement, holding down bolts, anchors, pipes and the like. Separate items will be scheduled for each grade of concrete. The rates shall be for concrete made with ordinary Portland cement unless otherwise stated.

Concrete, weather placed against excavations, sub-foundation carpets or formwork, will be measured to the exact dimensions shown on the drawings.

For un-reinforced concrete the contractor shall supply;

- a. A rate per square metre for formwork, where applicable to include the supply and fixing and removal of the formwork
- b. A rate per cubic metre for each concrete grade specified, to include the supply, placing, compaction, surface finishing, fixing holding down bolts, curing and testing.

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For reinforced concrete the contractor shall supply rates as in 4.19.2 plus a rate per tonne or part thereof for the reinforcing steel specified, to include supply, bending, cutting, fixing and wastage.

**10.7 Formworks**

Forms shall be designed and so constructed that the concrete can be properly placed and thoroughly compacted and that the hardened concrete while still supported by the forms shall conform accurately to the required shape, position and level subject to the tolerances specified in clause 5.7.

Special care shall be taken to maintain the stability of the formwork and the tightness of the joints particularly during vibrating operations.

Plastering of defective concrete as a means of making good will not be permitted.

**10.7.1 Formwork – Classes and finish**

- a. Rough  
This finish is for work which will be permanently concealed from view. Formwork shall consist of sawn timber, sheet metal or other material which will prevent the loss of fines when the concrete is vibrated.
- b. Wrought  
This finish is for surfaces exposed to view where good appearance and alignment are of special importance. To achieve this finish the formwork shall be faced with plywood, hardwood, steel shutters or equivalent material in large sheets. The sheets shall be arranged in an approved uniform pattern. All joints between panels shall be vertical and horizontal unless otherwise directed. Standard steel panels will only be permitted where their condition and use is approved by the engineer.

**10.7.2 Concrete Work formed by ground excavation**

All external faces of footings, equipment foundations and troughing will be formed wherever possible by neat and accurate excavation of the ground and payment for rough or wrought shuttering will only be made where the engineer has specifically approved it use. Should any slips occur in the excavation during execution of the works, from any cause whatsoever, the contractor shall execute the necessary remedial work in such a manner and form and with such materials as the engineer shall direct and, if in the opinion of the engineer, slips have occurred from causes within the contractor's control the remedial works shall be executed at the cost of the contractor, but if it is shown that the slips have occurred from causes beyond the contractor's control, the remedial works be valued on the basis of the contract prices. Back shuttering of the concrete in the excavations shall only be paid for when prior approval of the engineer has been obtained.

**10.7.3 Formwork for pockets**

Where required, pockets for holding down bolts shall be form with polystyrene sleeves.

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The rate for this formwork shall include for removing the polystyrene, rough hacking and wire brushing the faces of the pockets and damping immediately before grouting.

**10.7.4 Removal of formwork**

Forms shall be removed without damage to the concrete. Unless otherwise directed by the engineer, the following times shall elapse between completion of placing concrete and removal of forms, but this shall not relieve the contractor of his responsibility for ensuring the concrete has set sufficiently to permit the removal of the forms without damage to the concrete or injury or damage due to premature removal of the forms.

Formwork position	Minimum striking period
Vertical faces	24 hours
Soffits of beams of slabs (prop left under)	6 days
Props to beams and slabs	14 days

**10.7.5 Classes of concrete surface finish**

- a. Screeded  
This is a screeded finish for surfaces of footing concrete, beds, basement slabs and structural members to be covered by backfill or further concrete topping where a superior finish is not required.
  
- b. Trowelled  
This is hard smooth steel trowelled finish for exposed surfaces of equipment foundations, troughing etc. exposed to weathering. Trowelling shall not commence until the moisture film has disappeared and the concrete hardened sufficiently to prevent excessive laitance from being worked to the surface. The surface shall be trowelled under firm pressure and left free from trowel marks.

This finish shall also apply to cement mortar toppings to floor slabs where a smooth hard finish is required.

**10.7.6 Tolerance**

Concrete surfaces shall not be more than +10mm or –5mm from specified lines and levels. Deviation from a 2m template shall not be more than +20mm or –10mm from those specified.

**10.8 Reinforcement**

Reinforcement shall be plain round mild steel bars to B.S. 4449, cold twisted steel bars to B.S. 4461, steel fabric to SABS 1024 and SABS CKS 158. Lengths of bars and bending dimensions shall be to B.S. 4466 as shown on the drawings and free from grease and excessive mill scale or rust.

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Reinforcement shall be secured against displacement by tying with approved wire and supported by concrete or mortar chairs and spacers. Cover to reinforcement shall be not less than specified, nor exceed the specified cover by more than 10mm. Placed and fixed reinforcement shall be checked against the relevant drawings by the engineer before concrete is poured

## 11. FACTORY ACCEPTANCE TESTS

The bidder shall make provision for 3 (Three) ZETDC Engineers to witness Factory Acceptance Tests (FATs) for switchgear, protection & Control and Supervisory equipment at Original Equipment Manufacturer factory(ies).

## APPENDIX 1: TECHNICAL GUARANTEE SCHEDULES

### Preamble

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

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

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

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

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CIRCUIT BREAKERS	Description	Units	Requirement	Offered
1	Type/Designation		State	
2	Interrupting medium		SF6 Gas	
3	Insulating medium		SF6 Gas	
3.1	Applicable Standards		IEC And BS	
4	Voltage rating			
4(i)	Nominal	kV	11	
4(ii)	Maximum	kV	12	
4(iii)	Power frequency	Hz	50	
4 (iv)	Basic Insulation Level	kV	75kV	
5	Current rating(A)			
	Bus Incomer and bus section	Amps	1600	
	Feeders	Amps	800	
5(i)	Continuous Load Current	Amps	800	
5(ii)	Short time 3 seconds	Amps	At least 25kA	
5(iii)	Interrupting	Amps	25kA-3seconds	
7	Opening time (trip initiation to contact separation)	ms	<=60	
8	Closing time (close initiation to contact make)	ms	<=90	
9	Type of Operating Mechanism			
	-Trip mechanism		Spring	
	-Closing mechanism		Spring	
10	DC closing voltage		110V	
	DC trip voltage		110V	
11	Accessories			
	- Bushing CT's	Yes/no	No	
	- Metering amps	Yes/no	No	
	- Remote trip	Yes/no	Yes	
	- Remote close	Yes/no	Yes	
12	Dimensions			
	- Height	mm	State	
	- Width	mm	State	
	- Depth	mm	State	
13	Max Weight	kg	700	
14	Manufacturer		State	
15	Country of origin		State	

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**BUSBAR INCOMER CURRENT TRANSFORMERS**

Particulars	Unit	Requirement	Actual
Make	-	state	
Type	-	state	
Rated Frequency	Hz	50	
Accuracy Class Metering Core	-	0.2s	
Rated Burden Metering Core	VA	15	
Rated Primary Current Metering Core	A	1600/800	
Rated Secondary Current Metering Core	A	1	
Accuracy Class Protection Core	-	5P20	
Rated Burden Protection Core	VA	15	
Rated Primary Current Protection Core	A	1600/800	
Rated Secondary Current Protection Core	A	1	
Number of protection cores	-	3	
Number of metering cores	-	1	
Rated Voltage, Nominal	kV	11	
Maximum	kV	12	
Power Frequency Withstand Voltage	kV	28 rms	
Lightning Impulse Withstand Voltage	kV	75 peak	
Secondary Winding Resistance at 75°C	Ω	-	
Knee point E.M.F.	V	-	
Rated Accuracy Limit Factor	-	-	
Rated Dynamic Peak Current	kA	-	
Rated Short Time Thermal Current	kA	25 per 3 seconds	
Creepage distance of the insulator	Mm	275 minimum	

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**11KV FEEDER CURRENT TRANSFORMERS**

Particulars	Unit	Requirement	Actual
Make	-		
Type	-		
Rated Frequency	Hz	50	
Accuracy Class Metering Core	-	0.2s	
Rated Burden Metering Core	VA	15	
Rated Primary Current Metering Core	A	400/200	
Rated Secondary Current Metering Core	A	1	
Accuracy Class Protection Core	-	5P20	
Rated Burden Protection Core	VA	20	
Rated Primary Current Protection Core	A	400/200	
Rated Secondary Current Protection Core	A	1	
Number of protection cores	-	3	
Number of metering cores	-	1	
Rated Voltage, Nominal	kV	11	
Maximum	kV	12	
Power Frequency Withstand Voltage	kV	28 rms	
Lightning Impulse Withstand Voltage	kV	75 peak	
Secondary Winding Resistance at 75°C	Ω	-	
Knee point E.M.F.	V	-	
Rated Accuracy Limit Factor	-	-	
Rated Dynamic Peak Current	kA	-	
Rated Short Time Thermal Current	kA	25 per 3 seconds	
Creepage distance of the insulator	Mm	275 minimum	

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**11kV ISOLATORS**

Ite	Description	Units	Required	Actual
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m				
1	Type		Double Break Centre Rotating and Ganged	
2	Nominal voltage rating	kV	11	
3	Maximum voltage rating	kV	12	
4	Power Frequency	Hz	50	
5	One minute power frequency withstand voltage	kV	28	
6	Basic Insulation level	kVp	75	
7	<b>Fittings and Accessories</b> -Fasteners for stacking units along with clamp & terminal connectors.		Yes	
8	Insulator a) Type of Insulator b) Rated voltage for Insulator c) Min.Creepage distance	mm/kV	Polymeric 11 25	
9	Earth switch interlock: Yes/No		Yes	
10	Reference standard		IEC 62271-102	
11	Neutral Point Earthing		Solidly Earthed	
12	Thermal short circuit current, 1 second not less than	kA	31.5	
13	Dynamic Peak current not less than	kA	80	
14	Continuously rated currents of :			
	Bus Incomer and Bus section	A	1600	

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	isolators			
	LV isolators	A	800	
15	Isolating Switches: Opening time	sec	12	
16	Closing time	sec	12	
17	Bending moment at base of support insulator	kN	6	
18	Bending moment at base of support structure	kN	15	
19	Min. shear force of insulator	kN	6	
20	Min. torsional force of rotating insulator	kN	6	
21	Material of main contact system		Silver plated copper	
22	<b><i>Net weight of one single pole isolating switch</i></b>			
23	-Isolating switch without earthing switch	Kg	Specify	
24	-Isolating switch with earthing switch	Kg	Specify	
25	-Earthing switch	Kg	Specify	
26	Net weight of one separately mounted operating cabinet (if any)	Kg	Specify	

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**11kV LIGHTNING ARRESTERS**

**a) Station Type**

Item	Description	Units	11kV	
			Required	Guaranteed Value
1	Type		Metal	

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			Oxide,gapless	
2	Class		Station Type	
3	Material		Polymeric	
4	Nominal voltage rating	kV	11	
5	Maximum voltage rating	kV	12	
6	Power Frequency	Hz	50	
7	One minute power frequency withstand voltage	kV	28	
8	Basic Insulation level	kVp	75	
9	Specific creepage distance	mm/ kV	25	
10	Nominal Discharge Current with 8/20 microsec wave	kA	10	
11	<b>Fittings and Accessories</b> -Fasteners for stacking units along with clamp & terminal connectors.		Yes	
12	<b>Quantity Required</b>	Each	6	

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**b) Line Type**

Item	Description	Units	11kV	
			Required	Guaranteed Value
1	Type		Metal Oxide,gapless	
2	Class		Line Type	
3	Material		Polymeric	
4	Nominal voltage rating	kV	11	

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5	Maximum voltage rating	kV	12	
6	Power Frequency	Hz	50	
7	One minute power frequency withstand voltage	kV	28	
8	Basic Insulation level	kVp	75	
9	Specific creepage distance	mm/ kV	25	
10	Nominal Discharge Current with 8/20 microsec wave	kA	5	
11	<b>Fittings and Accessories</b> -Fasteners for stacking units along with clamp & terminal connectors.		Yes	
12	<b>Quantity Required</b>	Each	30	

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**11/0.11KV VOLTAGE TRANSFORMER**

Item	Description	Unit	Required Value	Guaranteed Value
1	Rated Voltage (Un)	KV	11	
2	Maximum service volatge(Um)	kV	12	
3	Rated frequency	Hz	50	
4	One-minute power frequency test voltage of			
	-primary winding	kV rms	28	
	-secondary winding	kV rms	3	
5	Lightning impulse withstand voltage	kV peak	95	
6	Switching impulse withstand voltage	kV	N/A	
7	Temperature rise for continuous full load operation			
	-capacitor	°C	NA	

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	-secondary windings	°C	60K	
	-oil	°C	NA	
8	Burden and accuracy class of			
	-burden	VA	50VA	
	-accuracy class	class	0.2/3P/3P	
9	Secondary Voltage	kV	0.11	
10	Permitted static load (primary terminals)	kN	1	
11	Permitted dynamic load (primary terminals)	kN	1	
12	Specific creepage distance across insulator	mm/kV	31	
13	Arcing distance across insulator	mm	Specify	
14	Reference standard		IEC 61869	
15	Type reference		Specify	
16	Overall dimensions			
	-Length	mm	Specify	
	-Width	mm	Specify	
	-Height	mm	Specify	
17	Total weight of one potential transformer	kg	Specify	
18	Weight of oil of one potential transformer	kg	Specify	
19	Commercial name of oil used		Specify	
20	Creepage distance of insulator	mm	Specify	
23	Type of insulator		Silicon rubber condenser type	
24	Ferroresonance damping function		Yes	

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**TRANSFORMER DIFFERENTIAL PROTECTION RELAY**

SPECIFICATION ITEM	REQUIRED	BIDDER'S GUARANTEED OFFER
<b>RELAY TYPE</b>	Numeric	
<b>ENCLOSURE</b>		
Material	3mm mild steel plate	
<b>FREQUENCY AND ROTATION</b>		
Frequency	50Hz	
Rotation	ABC	
<b>POWER SUPPLY</b>		
Range	48...250V ac/dc	

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<b><u>AC INPUT CURRENTS</u></b>		
✚ Nominal Current, In	1A and 5A 3 phase, ac	
✚ Continuous withstand	4 x In	
✚ Short time withstand	10 x In for 1s	
✚ Immunity	High Immunity to CT saturation and harmonic distortion	
<b><u>AC INPUT VOLTAGES</u></b>		
✚ Nominal Voltage, Vn	110V, 3 phase AC	
<b><u>TRIP OUTPUTS</u></b>		
✚ Rated Voltage	250Vdc,	
✚ Continuous Current Withstand	6A	
✚ Make current	30A at 250Vdc for 0.5s	
✚ Thermal Withstand	50 A for 1 s	
✚ Swell	At least 50ms	
<b><u>CONTROL SIGNAL OUTPUTS</u></b>		
✚ Rated Voltage	250Vdc,	
✚ Continuous Current Withstand	6A	
✚ Make	10A at 250Vdc for 0.5s	
✚ Thermal Withstand	15 A for 1 s	
✚ Swell	At least 50ms	
<b><u>TERMINAL BLOCK CONNECTIONS</u></b>		
✚ Type Of Connection	Screw terminals for connection of wires using ring terminal lugs for all AC inputs and control outputs.	
✚ AC Inputs	Maximum 4mm <sup>2</sup> . Shall be suitable for ring lug terminals	
✚ Binary I/O	Maximum 2.5mm <sup>2</sup> . Screw Compression Type	
<b><u>ENVIRONMENTAL CONDITIONS</u></b>		
✚ Service Temperature Range	-5°C to 55°C	
✚ Temperature influence	0.1%/°C	
✚ Relative humidity	60% +55°, 6 Cycles	
✚ Degree of protection	(IEC 60529) IP 54	
✚ Electromagnetic Compatibility	IEC 60255-25:2000	
<b><u>TYPE TESTS</u></b>		
	All type tests should conform to the IEC 60255 standards	
<b><u>GENERAL</u></b>		
✚ HMI	Display unit for Human Machine Interface (HMI) that indicates: measurement values, operating messages,	

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	and device maintenance messages	
	A minimum of 4 lines for clear annunciation of alarm conditions on the display unit	
	A minimum of 16 configurable LEDs	
	Keypad to select the following operations: display of metering and operating data, alarm messages, clearing of alarms and resetting, acknowledgement, and access to protection and other relay settings	
<b>PROTECTION FUNCTIONS</b>		
✚ Differential Protection (87)	Winding short circuit and interturn fault protection for two winding transformer with variable percentage.	
	Two settable slopes with adjustable intersection points and minimum pick-up values	
	Numerical vector group and wide amplitude matching	
	Transformer over-fluxing restraint	
	Transformer inrush restraint	
	Through-fault stabilization	
✚ Restricted Earth Fault (87N)	Biased restricted earth fault protection	
	At least three Restricted Earth Fault elements per group are required.	
✚ Definite Time And Inverse Time Overcurrent Protection (50/51)	Overcurrent elements per group shall be included to provide phase, negative-sequence and residual protection.	
✚ Over/Undervoltage Protection (27/59)	At least two stage Overvoltage protection	
	At least two stage Undervoltage protection	
✚ Definite Time And Inverse Time Earth Fault Protection (50N/51N)	Earth Fault elements shall be included to provide neutral and residual (ground) protection	

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		At least three earth fault elements per parameter setting group are required	
✚ Overexcitation Protection (24)	V/f	Volts/hertz protection to detect and provide an output when user settable excitation thresholds are exceeded.	
✚ Definite Time And Inverse Time Earth Fault Protection (50N/51N)		Overcurrent elements to provide neutral and residual protection	
✚ Circuit Breaker Failure (50BF)		Circuit breaker failure protection with adjustable CBFP operate time	
		Breaker failure protection shall provide subsidence current detection to minimize system coordination times.	
✚ Thermal Overload Protection (49)		Thermal overload protection to give alarm and trip signal outputs	
<b><u>OTHER FUNCTIONS/ FEATURES</u></b>			
✚ Disturbance Recording		Disturbance recorder capable of recording currents and digital signals	
		Signals to be used for triggering must be selectable	
		At least 70 Disturbance records	
		At least 72 channels for binary signals	
		At least 20 channels for analogue signals	
✚ Event Recording		Minimum pre-fault time of 10cycles per event	
		Minimum fault time of 100 cycles per event	
		At least 70 Event Records	
✚ Diagnostics		At least 16 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	
		LEDs on HMI with LED testing facilities	
		Each indicator shall be so designed that it cannot change	

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	state before the relay has completed its operation.	
	All indication shall be clearly visible without opening of relay cases or relay panel doors	
	Indication shall only be given by the protection(s) which causes the fault to be cleared	
	All LEDs shall be capable of being reset without the necessity of opening the case.	
+ Testing Facility	Relays shall have on line testing facility	
+ Parameter Subset Selection	At least four setting groups to enable relay use under different operational configurations	
+ Password Protection	Protection mode access shall be protected by a personal customized password of at least 4 characters.	
	Parameter setting mode access shall be protected by a second password of at least 4 characters.	
<b><u>INPUT/ OUTPUT</u></b>		
+ Digital Output	At least six fast trip digital output contacts, with the above-specified capacities	
	At least forty flexible and configurable output relays with the above-specified capacities for alarms and annunciations	
+ External Input	At least thirty-two programmable external control inputs intended for the processing, indication and retransmission of alarm and trip signals	
<b><u>COMMUNICATION/ INTEGRATION</u></b>		
+ Communication Protocols	IEC 61850, hard wiring to RTU, TCP IP protocols	
+ Communication Ports	One front panel Ethernet port	
	One Fibre Optic Serial Port	

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✚ Interrogation/Settings	Windows-based PC software for settings, configuration and report retrieval	
	Operating System to be WINDOWS 10 or higher	
<b>METERING &amp; MEASUREMENT</b>		
✚ The following shall be measured	3 Phase Active Power	
	3 Phase Reactive Power	
	3 Phase Apparent Power	
	Power Factor	
	Phase – Phase Voltage magnitude	
	Phase current magnitude	
	Power System Frequency	
	Harmonic Content from fundamental to the fifth for all ac current and voltage	
Tap Position	Transformer tap position indication required	

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**FEEDER OVERCURRENT & EARTH FAULT PROTECTION RELAY**

SPECIFICATION ITEM	REQUIRED	BIDDER'S GUARANTEED VALUE
<b>RELAY TYPE</b>	Numeric	
<b>ENCLOSURE</b>		
Material	3mm mild steel plate	
<b>FREQUENCY AND ROTATION</b>		
✚ Frequency	50Hz	
✚ Rotation	ABC	
<b>POWER SUPPLY</b>		
✚ Range	48.....125Vdc	
<b>AC INPUT CURRENTS</b>		
✚ Nominal Current, In	1A and 5A , 3 phase, ac	
✚ Continuous withstand	4 x In continuous,	
✚ Short time withstand	10 x In for 1s	
✚ Immunity	High Immunity to CT saturation and harmonic distortion	
<b>TRIP OUTPUTS</b>		
✚ Rated Voltage	250Vdc,	
✚ Continuous Current Withstand	6A	

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✚ Make current	30A at 250Vdc for 0.5s	
✚ Thermal Withstand	50 A for 1 s	
✚ Swell	At least 50ms	
<b><u>CONTROL SIGNAL OUTPUTS</u></b>		
✚ Rated Voltage	250Vdc,	
✚ Continuous Current Withstand	6A	
✚ Make	10A at 250Vdc for 0.5s	
✚ Thermal Withstand	15 A for 1 s	
✚ Swell	At least 50ms	
<b><u>TERMINAL BLOCK CONNECTIONS</u></b>		
✚ Type Of Connection	Screw terminals for connection of wires using ring terminal lugs for all AC inputs and control outputs.	
✚ AC Inputs	Maximum 4mm <sup>2</sup> . Shall be suitable for ring lug terminals	
✚ Binary I/O	Maximum 2.5mm <sup>2</sup> . Screw Compression Type	
<b><u>ENVIRONMENTAL CONDITIONS</u></b>		
✚ Service Temperature Range	-5°C to 55°C	
✚ Temperature influence	0.1%/°C	
✚ Relative humidity	60% +55°, 6 Cycles	
✚ Degree of protection	(IEC 60529) IP 54	
✚ Electromagnetic Compatibility	IEC 60255-25:2000	
<b><u>TYPE TESTS</u></b>		
	All type tests should conform to the IEC 60255 standards or equivalent	
<b><u>GENERAL</u></b>		
✚ HMI	Display unit for Human Machine Interface (HMI) that 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: display of metering and operating data, alarm messages, clearing of alarms and	

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	resetting, acknowledgement, and access to protection and other relay settings	
<b>PROTECTION FUNCTIONS</b>		
✚ Definite Time And Inverse Time Overcurrent Protection (50/51)	Overcurrent elements shall be included to provide phase and negative sequence overcurrent protection.	
	At least three overcurrent elements per parameter setting group are required	
✚ Definite Time And Inverse Time Earth Fault Protection (50N/51N)	Earth Fault elements shall be included to provide neutral and residual (ground) protection	
	At least three earth fault elements per parameter setting group are required	
✚ Circuit Breaker Failure (50BF)	Circuit breaker failure protection with adjustable CBFP operate time	
	Breaker failure protection shall provide subsidence current detection to minimize system coordination times.	
✚ Thermal Overload Protection (49)	Thermal overload protection to give alarm and trip signal outputs	
✚ 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 reclaim time	
	The relays to have adjustable reclosing times (range : 0.1 to 120s)	
<b>OTHER FUNCTIONS/ FEATURES</b>		
✚ Disturbance Recording	Disturbance recorder capable of recording currents and digital signals	
	Signals to be used for triggering must be selectable	
	At least 30 Disturbance records	

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		At least 16 channels for binary signals	
		At least 8 channels for analogue signals	
✚ Event Recording		Minimum pre-fault time of 10 cycles per event	
		Minimum fault time of 50 cycles per event	
		At least 15 Event Records	
✚ 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	
		LEDs on HMI with LED testing facilities	
		Each indicator shall be so designed that it cannot change state before the relay has completed its operation.	
		All indication shall be clearly visible without opening of relay cases or relay panel doors	
		Indication shall only be given by the protection(s) which causes the fault to be cleared	
		All LEDs shall be capable of being reset without the necessity of opening the case.	
✚ Testing Facility		Relays shall have on line testing facility	
✚ Parameter Selection	Subset	At least four setting groups to enable relay use under different operational configurations	
✚ Password Protection		Protection mode access shall be protected by a personal customized password of at least 4 characters.	
		Parameter setting mode access shall be protected by a second password of at least 4 characters.	
<b>INPUT/ OUTPUT</b>			

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✚ Digital Output	At least six fast trip digital output contacts, with the above-specified capacities	
	At least ten flexible and configurable output relays with the above-specified capacities for alarms and annunciations	
✚ External Input	At least ten programmable external control inputs intended for the processing, indication and retransmission of alarm and trip signals	
<b>COMMUNICATION/ INTEGRATION</b>		
✚ Communication Protocols	IEC 61850, hard wiring to RTU, TCP/ IP protocols	
✚ Communication Ports	One Ethernet port	
	One Fibre Optic Serial Port	
✚ Interrogation/Settings	Windows-based PC software for settings, configuration and report retrieval	
	Operating System to be WINDOWS 10 or higher	
<b>METERING &amp; MEASUREMENT</b>		
✚ The following shall be measured	Phase current magnitude	
	Residual current magnitude	

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**TRANSFORMER AVR RELAY**

ITEM NO.	DESCRIPTION	Unit	REQUIRED	BIDDER'S GUARANTEED VALUE
1.	Relay Type	-	Numeric	
2.	Enclosure Material		Metallic plate	
3.	Frequency	Hz	50	
4.	Rotation	-	ABC	
	<b>ENVIRONMENTAL CONDITIONS</b>			

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5.	Operating temperature range	°C	-5 to +55	
6.	Degree of protection by enclosure when panel-mounted	-	At least IP 30	
	<b>POWER SUPPLY</b>			
7.	Range	V	48-250VDC	
8.	Short time withstand	A	$\geq 10 \times I_N$ for 1s	
	<b>AC INPUT VOLTAGES</b>			
9.	Nominal Voltage, $U_N$	V	110VAC phase to phase	
	<b>CONTROL SIGNAL OUTPUTS</b>			
10.	Rated Voltage	V DC	110V dc	
	<b>CONTROL SIGNAL INPUTS</b>			
11.	Rated Voltage	V DC	110	
	<b>TERMINAL BLOCK CONNECTIONS</b>			
12.	AC Inputs	-	Shall be suitable for 4 mm <sup>2</sup> compression/ ring lug	
13.	Binary I/O	-	Shall be 1.5-2.5 mm <sup>2</sup> and compression/ ring lug	
14.	<b>TYPE TESTS</b>	-	Type tests to conform to IEC 60255 or applicable standard	
	<b>GENERAL</b>			
15.	Human Machine Interface (HMI)	-	(HMI) indicates: measurement values, operating messages, and device maintenance	

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			messages	
16.		-	A minimum of 4 lines for clear annunciation of alarm conditions on the display unit	
17.	Functional control keys		At least the following: Manual / automatic control mode, Raise / lower, Menu keys	
18.	LEDs		At least 10 LEDs for Alarming and Indications	
	<b>ENGINEERING FUNCTIONS</b>			
	<b>Voltage regulation</b>		Effective and continual automatic voltage regulation.	
	<b>Transformer Parallel Operation techniques</b>		At least the following: 1(a). Master-Follower principle (synchronism control of tap-changer) 1(b). Master-Follower principle (automatic synchronism) 2. Circulating reactive current principle	
	<b>Protection functions</b>		At least the following: Undervoltage blocking, Overcurrent/overload blocking, overvoltage detection.	

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	<b>COMMUNICATION/ INTERGRATION</b>			
19.	Standard and Protocol	-	IEC 61850, TCP/ IP protocols	
20.	Relay Interrogation	-	Windows-based PC software for settings, configuration and report retrieval	
		-	Operating System to be WINDOWS 10 or higher	
	<b>METERING &amp; MEASUREMENT</b>			
21.	The following shall be measured	MW	3 Phase Active Power	
		MVar	3 Phase Reactive Power	
		MVA	3 Phase Apparent Power	
		-	Power Factor	
		V	Phase – Phase Voltage magnitude	
		-	On load tapchanger positions	
		A	Active current	
A	Reactive current			

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**BUSBAR TUBULAR CONDUCTOR**

1	2	3	4
Item No.	Description	ZETDC's minimum requirements	Bidder's Equipment guarantees
<b>1</b>	<b>Manufacturer's Details</b>		
1.1	Manufacturer		Bidder to specify
1.2	Manufacturer's Type		Bidder to specify

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	Reference		
<b>2</b>	<b>Operating environment</b>		
2.1	Nominal system voltage (kV)	11	
2.2	Maximum system voltage (kV)	12	
2.3	Altitude (m) (Max)	1 800 m	
2.4	Ambient Temperature		
	a) Minimum (°C)	-10	
	b) Maximum (°C)	40	
	c) Yearly average (°C)	25	
2.5	Solar radiation (W/m <sup>2</sup> )	2300	
2.6	Pollution level (IEC 60071-2)	Very high	
2.7	Seismic	0.3g	
<b>3</b>	<b>Tubular Conductor Properties</b>		
3.1	Material	Aluminium Alloy	
3.2	Type of Alloy	6101-BT6	Bidder to specify
3.3	Temper		Bidder to specify
3.4	Designation (in accordance with EN 573-2)		Bidder to specify
3.5	Chemical composition limits of alloy (%) in accordance with EN 573-3 – attach proof		
	- Silicon		Bidder to specify
	- Iron		Bidder to specify
	- Copper		Bidder to specify
	- Manganese		Bidder to specify
	- Magnesium		Bidder to specify
	- Chromium		Bidder to specify
	- Zinc		Bidder to specify
	- Titanium		Bidder to specify
	- Other elements		Bidder to specify
	- Aluminium		Bidder to specify
4.1	Tensile strength (MPa)	140	
4.2	0.2% Proof stress (MPa)	195	
4.3	Yield strength(MPA)	160	
<b>5</b>	<b>Electrical Requirements of Tube</b>		
5.1	Electrical resistivity @ 20°C (Ω mm <sup>2</sup> /m)	0.0333	
5.2	Rated nominal current (A)	1600	
5.3	Rated short-circuit withstand current (kA)	31.5	
5.4	Duration of short-circuit current (sec)	3	
<b>6</b>	<b>Dimensions and Shape of</b>		

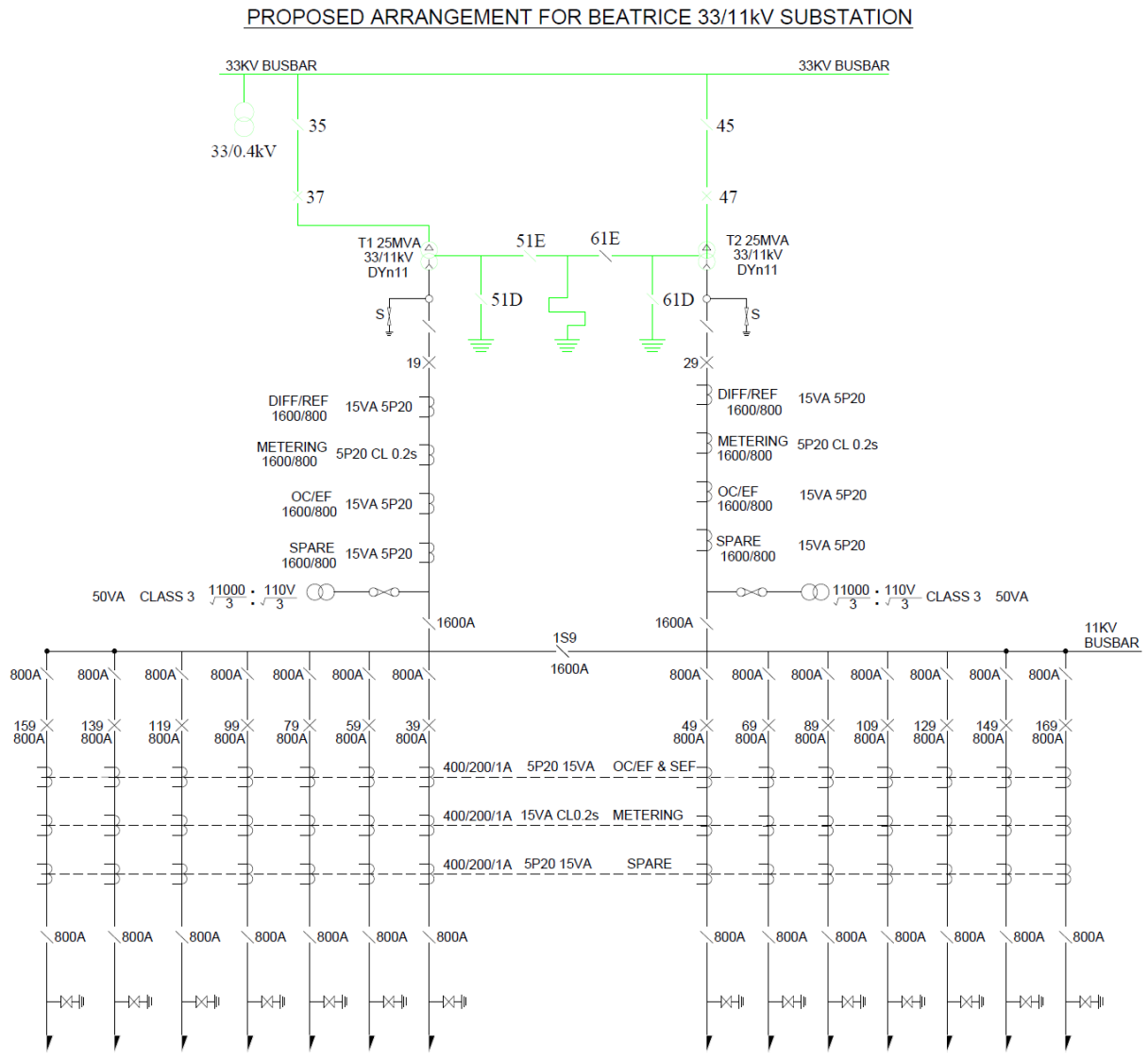
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	<b>Tube</b>		
6.1	Shape	Round tube	
6.2	Outer diameter (mm)	80	
6.3	Wall thickness (mm)		Bidder to specify
6.4	Length (mm)		Bidder to specify
6.5	Weight (kg/m)		Bidder to specify
6.6	Quantity		
<b>7</b>	<b>Dimensional Tolerances of Tube</b>		
7.1	Tolerance of outer diameter (% of diameter)	±1	
7.2	Tolerance of wall thickness (mm)	±0.4	
7.3	Tolerance of length (mm)		
	☐ 5m<L≤10m (L is specified length)	11	
	☐ 10m<L ≤15m	12	
	☐ 15m<L ≤25m	18	
7.4	Tolerance of straightness (mm/m)	2	
<b>8</b>	<b>Type Test Reports</b>		
8.1	Electrical Tests		
	Short Circuit Withstand Test	Yes	
	Resistance	Yes	
	Mechanical		
8.3	Tensile Strength Test	Yes	
8.4	0.2% Proof Strength Test	Yes	
	Elongation Test	Yes	
	Stress-Corrosion Cracking Test	Yes	

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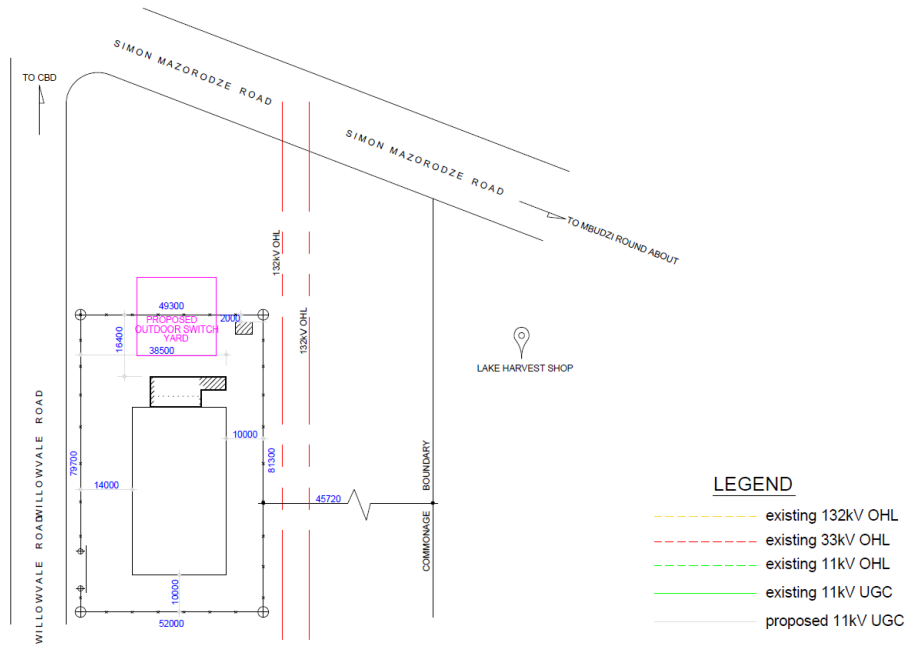
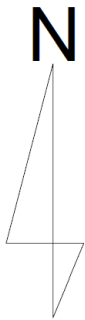
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**APPENDIX 2: BEATRICE 11KV OUTDOOR SWITCHING STATION SLD**



**APPENDIX 3: BEATRICE 33/11KV SUBSTATION SITE PLAN**

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**APPENDIX 4: BEATRICE 11KV OUTDOOR SWITCHING STATION PRICING  
SCHEDULE**

Item	Description	Quantity	Unit	Unit price (USD)	Total price(USD)
<b>1</b>	<b>Transformer LV bay</b>				
1.1	Circuit breaker Complete with support structure	2	ea		
1.2	Current Transformer complete with support structure	2	set		
1.3	Voltage Transformer complete with support structure	2	set		
1.4	LV Isolators and Bus Section isolator complete with support structure	3	ea		
1.6	Protection & Control panel	2	ea		
1.7	Lightning Arresters, Station type	2	set		
<b>2</b>	<b>11kV feeder bays</b>				
2.1	Current Transformer complete with support structure	14	set		
2.2	Isolator complete with support structure	28	set		
2.3	Circuit breaker complete with support structure	14	set		
2.4	Lightning Arrester, Line type	14	set		
2.5	Protection & Control panel	14	ea		
<b>3</b>	<b>SCADA</b>				
3.1	RTU Pre-wired Panel(2200x800x600mm)	1	pcs		
3.2	ABB RTU 560,19" rack 560SFRO2A	2	pcs		
3.3	RTU560 Power Supply Module,560PSR00	4	pcs		
3.4	ABB560CMR02(5000 Data Point;PLC License;IEC101,IEC61850, Modbus Protocol Supported),1KGT036300R0002 560CMR02 R0002 Communication Unit (CMU) for RTU560,6 Serial ports,2 Ethernet ports,Crypto Chip	2	pcs		

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3.5	ABB560CMR02(5000 Data Point;PLC License;IEC101,IEC61850, Modbus Protocol Supported), 1KGT201643R0013 Rel.13 PLC/Archives License open and 5000 data points	2	pcs		
3.6	Bus Connection Units 560BCU04, 1KGT022300R0001 560BCU04 R0001 Bus Connection Unit for 560MPR03(Basic)	1	pcs		
3.7	Bus Connection Units 560BCU04, 1KGT022300R1002 560BCU04 R1002 Bus Connection Unit for 560MPR03(Extension)	1	pcs		
3.8	Analog Input Cards,560AIR01	3	pcs		
3.9	Digital Input Cards,560BIR01	8	pcs		
3.10	Digital Output Module,23BA40	3	pcs		
3.11	16 channel terminal blocks with isolating links din rail mounted ( for analogue input)	3	pcs		
3.12	18 channel terminal blocks with isolating links din rail mounted ( for digital input)	6	pcs		
3.13	32 channel terminal blocks with isolating links din rail mounted (for digital outputs)	3	pcs		
3.14	18 core assorted colour drum cable and accessories (for digital and analogue input wiring)	1	set		
3.15	1 set digital input cable crimping & extraction	1	set		
3.16	32 core assorted colour 3m cable( for digital output wiring)	4	pcs		
3.17	RTU560 Power Supply Module,560PSU41	4	pcs		
3.18	Multimeter Module ABB 500CVD21	2	pcs		
3.19	Blanking Front Plates(560FPR01 R1002)	30	pcs		

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3.20	Manageable Industrial Ethernet Switches - Each switch with 24 ports)Gigabit Fibre and Ethernet)(50VDC or 110VDC powered)	2	pcs		
3.21	Router/Firewall for Cyber Security enhanced system protection(50VDC or 110VDC powered)	1	pcs		
3.22	GPS Time Server For IEDs and RTU Time Synchronisation(50VDC or 110VDC powered) including GPS Anntena, GPS Coaxial 30m cable, 2xGPS In - line Lightning Arrester, GPS Coaxial 5m cable	1	pcs		
3.23	Enough Fibre Patch Leads and Ethernet Pre-terminated cables for connecting IEDs	1	lot		
3.24	Spare Fibre Patch leads	5	pcs		
3.25	Spare Ethernet Pre-terminated cables	10	pcs		
3.26	Project Laptop for configurations, commissioning and maintenance works(13inch Intel 4GHz Core I7,12th Generation,32GB RAM, 1TB HDD_ - with all configuring software.	1	pcs		
3.27	Cat 7 Ethernet cable for networking	200	m		
3.28	RJ45(Cat 7) Connectors and RJ45 Boots	50	pair		
3.29	RJ45 Crimping Tool	2	pc		
<b>4</b>	<b>Cables and earthing accessories</b>				
4.1	Protection & Control cables	1	lot		
4.2	185mm <sup>2</sup> ,3C, AL,XLPE,11kV cable	1000	m		
4.3	300mm <sup>2</sup> ,1C, AL,XLPE,33kV cable	1,800	m		
4.4	Cable joints and termination kits and accessories	1	lot		
4.5	Earthing conductor and accessories	1	lot		
<b>5</b>	<b>11kV Busbar</b>				

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5.1	Busbar support structure	1	lot		
5.2	80mm Aluminium Alloy Tubular busbar & Accessories	1	lot		
<b>6</b>	<b>Earth Grid</b>				
6.1	Earthing Conductor and accessories	1	lot		
<b>7</b>	<b>110V DC Supply</b>	1	set		
7.1	110V Battery bank and charger	1	ea		
7.2	DC supply cables	1	lot		
<b>8</b>	<b>Civil Works</b>				
8.1	Switch yard earth works	1	lot		
8.2	Equipment plinths	1	lot		
8.3	Perimeter fence	1	lot		
8.4	Substation stone	1	lot		
<b>9</b>	<b>Spares</b>				
9.1	SF6 gas along with gas cylinder together with manufacturer's certificate for quality of SF6 gas (If SF6 circuit breaker)	10	kg		
9.2	Gas filling kit for 11kV circuit breaker(If SF6 Type)	1	ea		
9.3	Trip coil for 11kV circuit breaker	2	ea		
9.4	Closing coil for 11kV circuit breaker	2	ea		
9.5	Spring charging motor for 11kV circuit breaker	2	ea		
9.6	Isolator contacts Incomer feeder	1 2	Set set		
9.7	Transformer Differential Protection Relay	1	ea		
9.8	OC & EF relay	3	ea		
9.9	RTU560 processors	1	ea		
9.10	Digital input card	1	ea		
9.11	Analog input card	1	ea		
9.12	Digital output card	1	ea		
9.13	Industrial Ethernet switch	2	ea		
9.16	1 x CAT7 Ethernet Cable Roll(500metres) and must be shielded for substation installation	500	m		
9.17	IP Firewall/Gateway	1	ea		
<b>Total</b>					

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**NB.**

**Bidders must ensure that the total on the above pricing schedule is captured correctly on the eG.P price bid**

**Where the total on the pricing schedule differs with the price bid, the above pricing schedule takes precedence**

## **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***

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**Declaration by the Accounting Officer**

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

Eng. A. Gurupira  ..... 17/10/2025

<b>Name</b>	<b>Signed</b>	<b>Date</b>
-------------	---------------	-------------

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**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 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

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referred to below.

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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;
  - (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: .....

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Name:
In the capacity of: <span style="float: right;"><i>[Title or other appropriate designation]</i></span>

**For and on behalf of the Contractor**

Signed: .....
Name:
In the capacity of: <span style="float: right;"><i>[Title or other appropriate designation]</i></span>

**General Conditions of Contract**

Any resulting contract is subject to the Zimbabwe General Conditions of Contract (GCC) for the Procurement of Non-Consulting Services (copy available on the Authority’s website) except were modified by the Special Conditions below.

**Special Conditions of Contract**

Procurement Reference Number:ZETDC/DOM/55/2025 The clause numbers given in the first column correspond with the relevant clause number of the General Conditions of Contract.

<b>GCC reference</b>	<b>Special Conditions</b>
<b>GCC 3.6 and 8.1</b>	<p><b>Authorised representatives:</b></p> <ol style="list-style-type: none"> <li>1. The authorised representative of the Procuring Entity is <i>[names and contact details, including address for delivery of notices]</i>.</li> <li>2. The authorised representative of the Contractor is <i>{names and contact details, including address for delivery of notices}</i>.</li> </ol>

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<b>GCC reference</b>	<b>Special Conditions</b>
<b>GCC 7.4</b>	<b>Ineligible countries:</b> Nationals of the following countries are ineligible to be a Contractor or Sub-Contractor under this Contract. None
<b>GCC 18.1</b>	<b>Liquidated damages:</b> The rate of liquidated damages shall be <i>[State amount as a rate per day or delete if liquidated damages do not apply].</i>
<b>GCC 19.1</b>	<b>Commencement of Services:</b> The date or period of time for commencement of services is after signing of the contract and receipt of the order.
<b>GCC 20.1</b>	<b>Completion of Services:</b> The date for completion of Services or the period within which the Services are required to be performed is ..... after receipt of order.
<b>GCC 22.2</b>	<b>Contract price:</b> Costs specifically excluded from the Contract price are <i>[list excluded cost items].</i>
<b>GCC 22.3</b>	<b>Payment schedule:</b> The terms of payment shall be <i>[State:</i> <ul style="list-style-type: none"> <li><i>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;</i></li> <li><i>ii. For single or occasional services: the time after completion (usually 60 days) within which payment will be made.]</i></li> </ul>
<b>GCC 23.1</b>	<b>Price adjustment:</b> <i>[State whether prices will be fixed for the Contract Period or any adjustment factor that shall apply.]</i>
<b>GCC 24.2</b>	<b>Payment procedure:</b> <i>[State any other documentation that must accompany the Contractor's invoice.]</i>
<b>GCC 28.1</b>	<b>Insurance to be taken out by the Contractor:</b> <i>[The risks and the coverage shall be as follows:</i>

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<b>GCC reference</b>	<b>Special Conditions</b>
	<p>(a) <i>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];</i></p> <p>(b) <i>Third Party liability insurance, with a minimum coverage of [insert amount and currency];</i></p> <p>(c) <i>professional liability insurance, with a minimum coverage of [insert amount and currency];</i></p> <p>(d) <i>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</i></p> <p>(e) <i>insurance against loss of or damage to equipment purchased in whole or in part with funds provided under this Contract.</i></p> <p style="text-align: right;"><b>[Note: Delete what is not applicable].</b></p>
<b>GCC 30.1</b>	<b>Contract Administration Fee:</b> 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 \$ <i>[State applicable Fee or delete].</i>
<b>GCC 35.1</b>	<b>Performance Security:</b> <i>[State whether a Performance Security is required and, if so, the amount and form of such security, which must not exceed ten (10) percent of the Contract value.]</i>

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