



FOSKOR (PTY) LIMITED

**ANNEXURE
SCOPE OF REQUIREMENTS**

FOR

**SUPPLY AND DELIVERY OF DISTRIBUTION
TRANSFORMERS (CRITICAL SPARES)**

SCOPE OF WORK

Tender No.: FOSPHB-RFP-42-25/26

Description: Supply and delivery of distribution transformers (strategic spares)

1 INVITATION TO TENDER

Invitation to bid for the DESIGN, MANUFACTURE, FAT, DELIVER AND SAT OF 10 X DISTRIBUTION TRANSFORMERS FOR FOSKOR MINE AT PHALABORWA (CRITICAL SPARES).

Contents

1	INVITATION TO TENDER	1
2	SCOPE BACKGROUND	2
3	COMPANY BACKGROUND	2
4	ABBREVIATION AND STANDARDS	2
5	DESIGN REQUIREMENTS	4
6	MANUFACTURING REQUIREMENTS	4
7	FACTORY ACCEPTANCE TEST (FAT REQUIREMENTS	4
8	DELIVERY REQUIREMENTS	5
9	SITE ACCEPTANCE TEST (SAT) REQUIREMENTS	5
10	TECHNICAL SPECIFICATION REQUIREMENTS	5
11	DOCUMENTATION REQUIREMENTS	6
12	QUALITY ASSURANCE AND CONTROL REQUIREMENTS	6
13	QUALITY	10
14	CONTRACTOR DELIVERABLES	11
15	SUPERVISION REQUIRED	11
16	TENDER DELIVERABLES	11
17	LEGISLATIVE REQUIREMENTS	12
18	MINIMUM CRITERIA FOR PERMITTING CONTRACTORS ON-SITE	15
19	PARAMETERS	17
20	SPECIFICATIONS, CODES, STANDARDS AND REGULATORS	18
21	SITE GEOGRAPHY	18
22	FOSKOR GENERAL ENGINEERING SPECIFICATIONS	19
23	ELECTRICAL SPECIFICATIONS	20
24	PROJECT MANAGEMENT - CONTRACTOR	21
25	LIAISON AND CO-OPERATION WITH OTHERS	21
26	TENDER EVALUATION CRITERIA	22
27	GENERAL CONDITIONS	29
28	PRICING SCHEDULE	30
29	ENQUIRIES	34
30	ANNEXURE A: 2500 kVA, 11000/525 V DISTRIBUTION TRANSFORMER	36
31	ANNEXURE B: 2000 kVA, 11000/525 V DISTRIBUTION TRANSFORMER	52
32	ANNEXURE C: 1500 kVA, 11000/380 V DISTRIBUTION TRANSFORMER	68
33	ANNEXURE D: 1500 kVA, 11000/525 V DISTRIBUTION TRANSFORMER	84
34	ANNEXURE E: 1000 kVA, 11000/525 V DISTRIBUTION TRANSFORMER	100
35	ANNEXURE F: 50 kVA, 11000/525 V DISTRIBUTION TRANSFORMER	116

2 SCOPE BACKGROUND

This specification covers the design, manufacturing, testing, supply, delivery and performance requirements of ground-mounted three-phase distribution transformers with ratings as follows;

- i. 4 x 2500 KVA, 11000/525 V
- ii. 2 x 2000 KVA, 11000/525 V
- iii. 1 x 1500 KVA, 11000/380 V
- iv. 1 x 1500 KVA, 11000/525 V
- v. 1 x 1000 KVA, 11000/525 V
- vi. 1 x 50 KVA, 11000/525 V

These are for continuous service at 50Hz. It covers two winding oil-immersed naturally cooled transformers with off-circuit tap selectors suitable for outdoor service at the Open Cast Mine in Phalaborwa.

2.1 Pre-qualification requirements

Bid submission not meeting the pre-qualification requirement shall result in the bid being disqualified.

No	Pre-Qualification	Comments
1	Letter of warranty and guarantee with a minimum of 24 months from commissioning or 30 months from delivery, whichever occurs first.	Warranty letter from the OEM

3 COMPANY BACKGROUND

Foskor is one of the world's largest producers of phosphate rock (concentrate) and phosphoric acid. It is one of the world's few vertically integrated producers of phosphoric acid and is the second largest supplier to India, the world's largest consumer of phosphoric acid.

The Company owns and mines phosphate resources and beneficiates the mined material to produce a phosphate concentrate at Phalaborwa, in the Limpopo Province of South Africa. The phosphate concentrate is sold locally and also transported to the Richards Bay plant on the coast of Kwa-Zulu Natal to produce phosphoric acid, sulphuric acid and granular fertilisers MAP and DAP from phosphoric acid and is the leading supplier of fertilisers to South Africa. In all about 95% of the phosphoric acid is exported and the granular sales are divided between exports and local markets. Since 1951 Foskor has supplied more than 95% of South Africa's fertiliser requirements.

4 ABBREVIATION AND STANDARDS

4.1 Acronyms

- a. KV – Kilo Volts
- b. MCC – Motor Control Centre
- c. REM – Rotating Electrical Machines
- d. RWPS – Return Water Pump Station
- e. XLPE cable – Cross-linked polyethylene cable

4.2 Applicable Standards

In general work and materials shall be in accordance with the latest practice and in particular in accordance with the latest revision of the following specifications, and any amendments thereto, the SANS specification taking precedence:

Foskor Standards

- Foskor COPs.
- Foskor's Engineering Specification (GES-001) – Instrumentation General Specification and Procedures.
- Foskor's Engineering Specification (GES-002) – Instrumentation installations and commissioning.
- Foskor's Engineering Specification (GES-003) – Instrumentation General Specification.
- Foskor's Engineering Specification (GES-004) – Field Instrumentation Standard.

EC International Electrotechnical Commission:

- IEC 60071: Insulation co-ordination
- IEC 60076: Power transformers
- IEC 60137: Bushing for alternating voltages above 1,000V
- IEC 60156: Method for the determination of the electric strength of insulating oils
- IEC 60296: Specification for unused mineral insulating oils for transformer and switchgear
- IEC 60354: Loading guide for oil-immersed power transformers
- IEC 60437: Radio interference test on high-voltage insulators
- IEC 60551: Determination of transformer and reactor sound levels
- IEC 60616: Terminal and tapping markings for power transformers
- IEC 60722: Guide to the lightning impulse and switching impulse testing of power transformers and reactors

ISO International Organization for Standardization:

- ISO/IEC 17025: General requirements for the competence of testing and calibration laboratories.
- ISO 1459: Metallic coatings - Protection against Corrosion by Hot Dip Galvanising - Guiding Principles
- ISO 1460: Metallic coatings - Hot dip galvanized coatings on ferrous materials. Gravimetric determination of the mass per unit area
- ISO 2178: Non-magnetic coatings on magnetic substrates - Measurements of coating thickness - Magnetic method
- ISO 9000: Quality management and quality assurance standards - Guidelines for selection and use

5 **DESIGN REQUIREMENTS**

- a) The design of the transformers shall be such as to operate on an 11 000 V, 3 phase, 50 Hertz, impedance grounded system with an estimated fault level not exceeding 250 MVA.
- b) Detailed design of the [Equipment/System Name] in accordance with all applicable international and local standards (e.g., SANS, ISO, IEC, ASME), Foskor Mine's specific requirements, and good engineering practices.
- c) The design shall consider operational environment conditions (e.g., dust, temperature variations, humidity, vibration specific to a mining environment), maintenance accessibility, safety features, and energy efficiency.
- d) Preparation and submission of all design documentation, including but not limited to:
 - o General arrangement drawings (dimensions, clearances, terminal arrangements)
 - o Detailed fabrication drawings for tank, core, and windings
 - o Electrical schematics (winding connections, protection circuits)
 - o Component datasheets (bushings, tap changer, instruments, protective devices)
 - o Design calculations (e.g., winding design, thermal performance, impedance calculations)
 - o Loss calculation reports (no-load and load losses)
 - o Safe operating procedure
- e) Design will have to be approved by the Foskor engineer before manufacturing commences

6 **MANUFACTURING REQUIREMENTS**

The service provider shall be responsible for;

- a) Procurement of all necessary raw materials (e.g., core steel, copper/aluminium windings, insulating oil, tank steel), components, and sub-assemblies conforming to specified quality standards (virgin insulating oil certificates).
- b) Manufacturing, fabrication, assembly, and integration of the transformer in a controlled manufacturing facility, ensuring clean room conditions for winding and insulation.
- c) Adherence to stringent quality control procedures throughout the manufacturing process, including material inspection, winding tension control, core assembly, tank fabrication, and insulation drying. The quality control procedures shall be presented to the Foskor representative before manufacturing commences.
- d) All welding, surface preparation, painting (e.g., anti-corrosion, specific colour), and finishing shall meet industry best practices and specified standards for outdoor mining environments. These shall be presented to Foskor for perusal and approval before manufacturing commences

7 **FACTORY ACCEPTANCE TEST (FAT REQUIREMENTS)**

- a) Development and submission of a comprehensive FAT procedure for Foskor Mine's approval. This shall be submitted via email to Foskor at a reasonable time before FAT
- b) Conducting the FAT at the OEM's or designated manufacturing facility in the presence of Foskor Mine's representatives.

- c) The FAT shall demonstrate the full functionality, performance parameters, and compliance of the transformers with the technical specifications and design requirements.
- d) All required tests (e.g., functional tests, performance tests, safety checks, structural integrity tests, electrical tests) shall be conducted and documented.
- e) All routine tests required by the relevant standards shall be carried out even if they are not listed in this specification, and these tests shall be carried out at the manufacturer's works. The service provider / OEM shall submit full details of the proposed methods of testing, including connection diagrams to FOSKOR for approval, at least one month before testing.
- f) The service provider / OEM shall submit to FOSKOR a signed copy of the test certificates, giving results of the prescribed tests.
- g) Transformers shall not be dispatched until FOSKOR has received the test certificates and the service provider / OEM has been informed that they are acceptable. FOSKOR reserves the right to reject any item of the equipment if the test results do not comply with the values specified or with the data given in the Technical Data

8 **DELIVERY REQUIREMENTS**

The service provider shall execute the following

- a) Properly store and fasten the transformers to ensure safe transportation to FOSKOR Mine, Phalaborwa, ensuring protection against mechanical damage, moisture ingress, and theft.
- b) Arrangement of all necessary logistics and transportation shall be done by the service provider
- c) Delivery to the designated receiving point within FOSKOR Mine premises as per agreed schedule, including offloading
- d) All transport and handling shall comply with relevant safety regulations and best practices, specifically for heavy and oil-filled equipment.

9 **SITE ACCEPTANCE TEST (SAT) REQUIREMENTS**

Upon delivery, the service provider/OEM shall conduct comprehensive site testing (SAT).

- e) The site testing shall verify the successful transportation and functionality of the transformers.
- f) Development and submission of a detailed site testing procedure for FOSKOR Mine's approval. This shall be submitted via email to FOSKOR at a reasonable time before delivery
- g) Rectification of any deficiencies identified during site testing.

10 **TECHNICAL SPECIFICATION REQUIREMENTS**

See the following annexures for technical requirements

Transformer	Reference
2500 KVA, 11000/525 V	ANNEXURE A
2000 KVA, 11000/525 V	ANNEXURE B
1500 KVA, 11000/380 V	ANNEXURE C
1500 KVA, 11000/525 V	ANNEXURE D
1000 KVA, 11000/525 V	ANNEXURE E
50 KVA, 11000/525 V	ANNEXURE F

11 DOCUMENTATION REQUIREMENTS

The service provider/OEM shall provide the following documentation in both hard copy and electronic formats (e.g., PDF, native CAD files) at various project stages:

- a) Project Management Plan and Schedule
- b) Detailed Technical Proposal
- c) Design Drawings (GA, Fabrication, Electrical, P&ID)
- d) Component Datasheets and Certificates of Conformity
- e) FAT Procedures and Reports
- f) Site Testing Procedures and Reports
- g) Operation and Maintenance Manuals (including troubleshooting guides, spare parts lists, recommended lubrication schedules)
- h) As-built drawings
- i) Training Manuals (if training is part of the scope)
- j) Warranty Certificates

12 QUALITY ASSURANCE AND CONTROL REQUIREMENTS

The service provider/OEM shall:

- a) Operate a quality management system to ISO 9001 or equivalent.
- b) Provide a Quality Control Plan for the project, detailing inspection and testing points from material procurement to final delivery.
- c) Allow FOSKOR Mine's representatives access to their manufacturing facilities for progress inspections and quality audits at reasonable notice.
- d) Provide material test certificates for all critical components.

The table below must be taken into consideration for inclusions and exclusions.

WHO WILL SUPPLY THE FOLLOWING?					
N/A = NOT APPLICABLE C = CONTRACTOR FF = FOSKOR, FREE OF CHARGE FC = FOSKOR, AT COST TO CONTRACTOR					
1. Sanitary –		2. Transport		3. Electrical	
1.1 Water on-site and toilet facilities / janitorial services	C	2.1 Labour	C	3.1 Generators	C
1.2 Potable connection point	C	2.2 Materials	C	3.2 Electrical Extensions	C
1.3 Connection to construction water supply	C	2.3 Equipment	C	3.3 COC Site Establishment	C
1.4 Change rooms	C	2.4 All TMMS	C	3.4 Temporary lighting	C
				3.5 Electrical connection point	FF
				3.6 Connection to Electrical Supply	C
				3.7 Electric panel + distributing wiring	C
				3.8 Power for tools on site from existing Foscok electrical supply point (Welding plugs and 220v plugs)	C
4. Quality –		5. Security		6. Lifting and Rigging	
4.1 Plan, Management, QA, QC, etc.	C	5.1 Site Security	C	6.1 All rigging equipment (Slings, Chain blocks, turfers, etc.)	C
4.2 All quality tests Civil, Paint, Mechanical, etc.	C	5.2 Foscok ID Card	C	6.2 Rigger	C
4.3 Sampling and laboratory testing	C			6.3 Mobile cranes and any other lifting devices	C

7. Medicals -		8. Communication devices – All communication devices like laptops, computers, networks, radios, cellphones, etc.	C	9. PPE	
7.1 Entry and Exit	C			9.1 Supply, Issue, inspect and manage	C
7.2 First aid box at the place of work	C				
10 Site Surveys	C	11. Safety File - Foscok will issue a template	FF	12 Training & Authorizations	
		Ensure the file conforms/ populate to Foscok standards	C	12.1 All Required Training	C
				12.2 Authorisation - As Per Foscok COP	FF
13. Site Establishment		14 Waste management on site		15 Painting - All Equipment and tools paint, labour , etc.	C
13.1 Site office/s with suitable facilities for daily “Green Area” meetings, and lunch area	C	14.1 Transport all waste to Foscok designated waste sites	C		
13.2 Site establishment space	FF				
16 Scaffolding		17 Labour		18. Compressed air	
16.1 Scaffolding Supply & Erect	FF	17.1 All labour as per Scope of Work to execute task including management	C	18.1 Sandblasting or flash blast	C
16.2 Scaffolds be managed by the Contractor	FF			18.2 Compressor	C
16.3 Cherry Picker’s – only if and when available by pre-booking	FF			18.3 Air for power tools - If available	FF
16.4 Cherry Picker’s Driver– Trained and authorized driver	FF				
19 Fuel		20. Storage and		21 Consumables	

		inventory control			
19.1 Fuel Supply	C	20.1 Protective coverings/tarpaulins	C	21.1 Welding rods	C
19.2 Fuel storage	C	20.2 Storage area and inventory control	C	21.2 Bolts & Nuts	C
19.3 Fuel fire protection	C			21.3 Etc.	C
19.4 Refueling	C				
22 Tools & Equipment		23 Certificates -		24 Training	
22.1 All Portable Electrical Equipment	C	Supply All certificates as required	C	All required training and training manuals as required to ensure that FOSKOR can train its workforce and operate the plant/equipment safely	C
22.2 Hot Work Equip as per FOSKOR COP - Welding Machines, Gas Cutting, Grinding, Gauging, etc.	C			All manuals and related documents are to be supplied to the project Eng and FOSKOR Drawing office for safekeeping	C
22.3 Tools as required to execute the task	C				

Equipment such as the crane, scaffolding, excavator etc will be supplied by FOSKOR as may be required. The rest of the tools and materials for the installation shall be provided by the contractor unless specified to be a free issue.

FOSKOR has made provision for the supply of crane, scaffolding, and excavator free of charge depending on the size and nature of the works. It is expected that arrangements will be communicated to the appointed Scaffolding contractor at least 3 days before the requirement. Proof of request and arrangements and actual scaffolding installation for Scaffolding are to be provided to FOSKOR on request. It should be noted that FOSKOR has an existing appointed and accredited scaffolding supplier

The rest of the tools and materials for the installation shall be provided by the contractor unless specified to be a free issue.

12.1 As-Built Drawings

- The supplier shall supply FOSKOR with The Manuals and Data Packs. The Supplier shall provide 3 hardcopies and 2 electronic copies of all the operating, maintenance manuals and test certificates in English.

The Data Pack and Operation and Maintenance Manuals shall be supplied as separate documents, each bearing a unique document reference number. Manuals and Data Packs shall be well indexed and user friendly

Note! – All drawings are to be delivered in AutoCAD electronic format and PDF format.

13 QUALITY

- a. The contractor must provide the necessary quality management systems and plans to ensure that the quality of his work complies with the requirements of this scope of work
- b. The contractor shall be responsible for all the resources required for executing the Quality Management System including but not limited to, developing the Quality Assurance Plan & performing the Quality Control measures to ensure that the deliverables comply with the specifications & standards mentioned in the scope of work
- c. Any change requests / additional work resulting from an inadequate quality management system will be to the account of the contractor
- d. Foskor might appoint a third party for Quality Control Inspections
- e. The Contractor will have to provide an approved quality system for all work executed.
- f. This will include the following but is not limited to:
 - i. *Quality plan*
 - ii. *Quality compliance – Performance and reports*
 - iii. *Quantity Surveying*
 - iv. *Quality Assurance*
 - v. *Quality Authorization matrix – part of the Quality plan*
 - vi. *Quality control*
 - vii. *Quality administration. – All documents, checks, measurements, reports, variances, analysis, Corrective actions, etc. need to be properly filed and available on request at any time. The file will require an index*
 - viii. *Includes all test work, laboratories, Filing, etc.*
 - ix. *Survey and survey verifications*
 - x. *Construction versus design - Any Deviations from the approved “Construction Drawings”*
 - xi. *Quality communication – What needs to be reported to whom and at what frequency*
- g. Foskor envisage a complete quality System driven by the Contractor and this system/plan will be approved by Foskor and the appointed designer (if applicable) before construction/fabrication will be started.
- h. Compliance with this plan will be measured and failure to adhere to the quality plan will result in the stopping of construction activities until concerns have been addressed. The cost for this delay will be for the contractor's account.

- i. Foskop may appoint a third party to measure and control Foskop's interest in the terms of quality in this contract and the contractor is expected to work in conjunction with this company
- j. Hold points will be discussed and finalized with the successful contractor based on the approved Quality plan

14 **CONTRACTOR DELIVERABLES**

The deliverables for this project should include:

Documents and Manuals are to be submitted in the following formats:

Type of Document	Hard Copy	Electronic Format
Design documents	X	X
Comprehensive test reports and fault details	X	X
Quality File	X	X
A copy of all installation, operation and maintenance manuals shall be submitted with the tender. These manuals shall, preferably, be on a USB in an Adobe Acrobat format. However, hard copies are also acceptable	X	X

Hard Copy: Book or binding arch file format and must be durable and of high quality.

Soft Copy: Manuals, Reports and Data Books – Word, Excel, PDF, etc.

Storage – Compact Disk or Data Traveller.

Language: English.

The contractor shall inform Foskop in writing and the contractor must have confirmation from Foskop that it has been accepted if there is an exclusion on the tender Scope when the order is placed on the contractor. Failure to have that confirmation will mean that the full scope is still applicable.

15 **SUPERVISION REQUIRED**

Not required

16 **TENDER DELIVERABLES**

The deliverables will include: -

- a. Submit Pricing for the Project as specified.
- b. Complete Foskop pricing schedule (BOQ)
- c. Company training Matrix indicated minimum training requirement compliance or the

- d. Valid B-BBEE Certificate.
- e. Valid Company Registration documents.
- f. Valid letter of good standing.
- g. Valid tax certificate.
- h. Valid ID documents for Directors.
- i. Letter of technical operation guarantee addressing a situation in case of supply interruptions (also during operations) that exceed the duration limit declared by the manufacturer for normal operation. The letter shall guarantee that.
 - i. There shall be no false operation, false alarms or false remote signalling resulting from the interruption or reinstatement of the supply.
 - ii. The manufacturer shall state the behaviour of the device when the supply voltage gets interrupted (for example impact on internal energy storage).
 - iii. The manufacturer shall state the behaviour of the device when the supply voltage returns.
 - iv. Subsequent actions shall only be completed in response to a new valid operational command (where applicable).
- j. General arrangement drawings. These drawings shall include overall dimensions, headroom for erection and/or operation, and positions of all cable entries or connections to the transformers.
- k. If the crane is required, indicate the required crane size for off-loading of switchgear to the site.

Not submitting the required documentation or not completing the documentation (Pricing Schedule) correctly will lead to a disregard of the tender.

17 LEGISLATIVE REQUIREMENTS

- a. The successful or appointed Bidder shall comply with:
 - i. The Mines Health and Safety Act with Regulations (Latest revision)
 - ii. The National Road Traffic Act with Regulations (Latest revision)
 - iii. All applicable national and international legislative requirements and regulations.
 - iv. Foskop (Pty) Ltd. COP (Compendium Of Procedures) No. 25 for Service Provider Control (Available on request)
 - v. Foskop (Pty) Ltd. COP (Compendium Of Procedures) No. 59 for Trackless Mobile Machinery (Available on request)
 - vi. All Foskop procedures and policies applicable to the successful application of the contract. (Available on request)
- b. The successful or appointed Bidder shall comply with the following Environmental Specifications, Policies and Procedures:

- i. COP 41 Housekeeping and workplace organisation
 - ii. COP 49 Waste Management
 - iii. COP 51 Resource conservation, energy, and materials
 - iv. COP 70 Storage of petroleum products and other hazardous material
 - v. National Environmental Management Act 107 of 1998 (NEMA)
 - vi. National Environmental Management Waste Act 59 of 2008 (NEMWA) as amended.
 - vii. The successful Bidder shall include in his/her SAFETY FILE, and comply with, the following documents:
 - Environmental Aspect and Impact Register (Applicable to this contract).
 - Environmental Objectives and Targets (Applicable to this contract).
 - Waste Management Plan (Applicable to this contract).
 - FOSKOR Atmospheric Emissions License (Copy available on request)
 - FOSKOR Waste Management Licence (Copy available on request)
 - FOSKOR Water Use Licence (Copy available on request)
- c. The appointed Bidder shall, before entering and operating a vehicle on the Foskop premises:
- i. Obtain permission from the Foskop Safety & Security manager to operate his nominated service vehicle/s on the Foskop site. (Forms will be provided)
 - ii. Obtain a certificate of fitness from the Foskop Light Vehicle maintenance workshop supervisor or appointed Foskop inspector for his nominated service vehicle/s. Inspections are conducted daily between 08:00 and 08:30 and between 13:30 and 14:00 (Excl Fridays) at the Light Vehicle Maintenance workshop.
 - iii. Submit the above permission and COF at the main security office for the issue of a vehicle access disk.
 - iv. Ensure that his service vehicles have been inspected (Daily) by the Foskop standard (COP 59) to ensure that they are safe and fit for use. (Forms will be provided)
 - v. See Foskop COP 59, Trackless Mobile Machinery for details.
- d. Before entering and operating/working on the Foskop site the appointed Bidder shall ensure that his driver/workmen are:
- i. Briefed on the required task and have been informed of any abnormal conditions/situations.
 - ii. Physically, emotionally and mentally fit to perform their duty.

- iii. Issued with the necessary PPE (Personal Protective Equipment) to safely operate his service vehicles and perform the duty of maintaining, servicing, inspecting and testing earthmoving- and mobile equipment.
- e. Before entering and operating/working on the Foskop site the appointed Bidder shall ensure that his portable electrical equipment has been tested and declared safe to use by the Foskop electrical services workshop.
- f. Before accessing earthmoving- and mobile equipment whereupon work is to be conducted, the earthmoving- or mobile equipment shall be locked out at the battery power source. The lock shall be marked and tagged. The tag shall contain the Bidder's business name, the employee name responsible for the lock and contact numbers. See Foskop COP 53, Lock-out system and usage for details.
- g. Before accessing the earthmoving- or mobile equipment where working at height is required (Above 2 meter ground level) the appointed Bidder's employees shall have inspected the 1) safety lanyard (Full body harness) to be of correct standard and safe to use, 2) life-line or anchorage points and 3) that access ladders in good and safe working order. See Foskop COP 96, working at heights for details.
- h. Although every effort has been made to ensure that the information contained within this document is correct, it remains the responsibility of the bidder to verify the actual status and site conditions. (A site visit can be arranged)

18 MINIMUM CRITERIA FOR PERMITTING CONTRACTORS ON-SITE

18.1 Background

Foskor (Pty) Ltd would like to ensure that all contractors are aligned with our goals to improve our SHEQ performance whilst ensuring compliance with the legal framework in which Foskor operate.

To achieve this, Foskor would like to draw attention to some of the minimum requirements that must be in place before any order is placed with a supplier of services without limiting or distracting from the full SHEQ requirements, Engineering Standards or Codes of Practices.

The requirements (both commercial and safety) must therefore be read in harmony and implemented without conflicting or compromising each other. This document is designed to communicate to all contractors as well as Foskor departments the absolute minimum requirement that is needed to ensure compliance with the Foskor standards as well as the MHSA. The requirements for permitting suppliers on site will differ depending on several considerations such as the nature of the services, consideration for the Health and safety risk as per the scope of work, the reason for inclusion on the database and the capacity.

The guidelines apply to all contractors that perform work on the Foskor Phalaborwa site for a duration exceeding 5 days per year (either continuous or total days)

18.2 Scope of work

The scope of work determines the nature of the services that are procured and thus the absolute minimum requirement that is needed to ensure compliance with the Foskor standards as well as the MHSA. It is therefore imperative that clearly define the SHEQ requirements in enough detail at the start of the procurement process, namely in the scope of work.

18.3 SHEQ Requirements

18.3.1 PPE

Any contractor that does not provide employees with his/her protective equipment, use it incorrectly or use damaged equipment in the opinion of an authorised Foskor official, will be prevented from starting or continuing the work.

All contractors must ensure that:

- a. His workers are issued with the correct personal protective equipment free of charge.
- b. That the workers wear the PPE in accordance with the project area's requirements or as given by the Supervisor.
- c. Training is provided and records of training are kept in the correct use of PPE to workers.
- d. Daily inspections are done on PPE.
- e. The registers will be completed at least monthly on findings on PPE. (All PPE must be kept in good condition)

18.3.2 Training

Prospective service providers, who intend to tenders/quotes, must be informed that evidence must be

provided that employees received the minimum training in Safety, Health and Environmental issues and submit this with their tender or quotation.

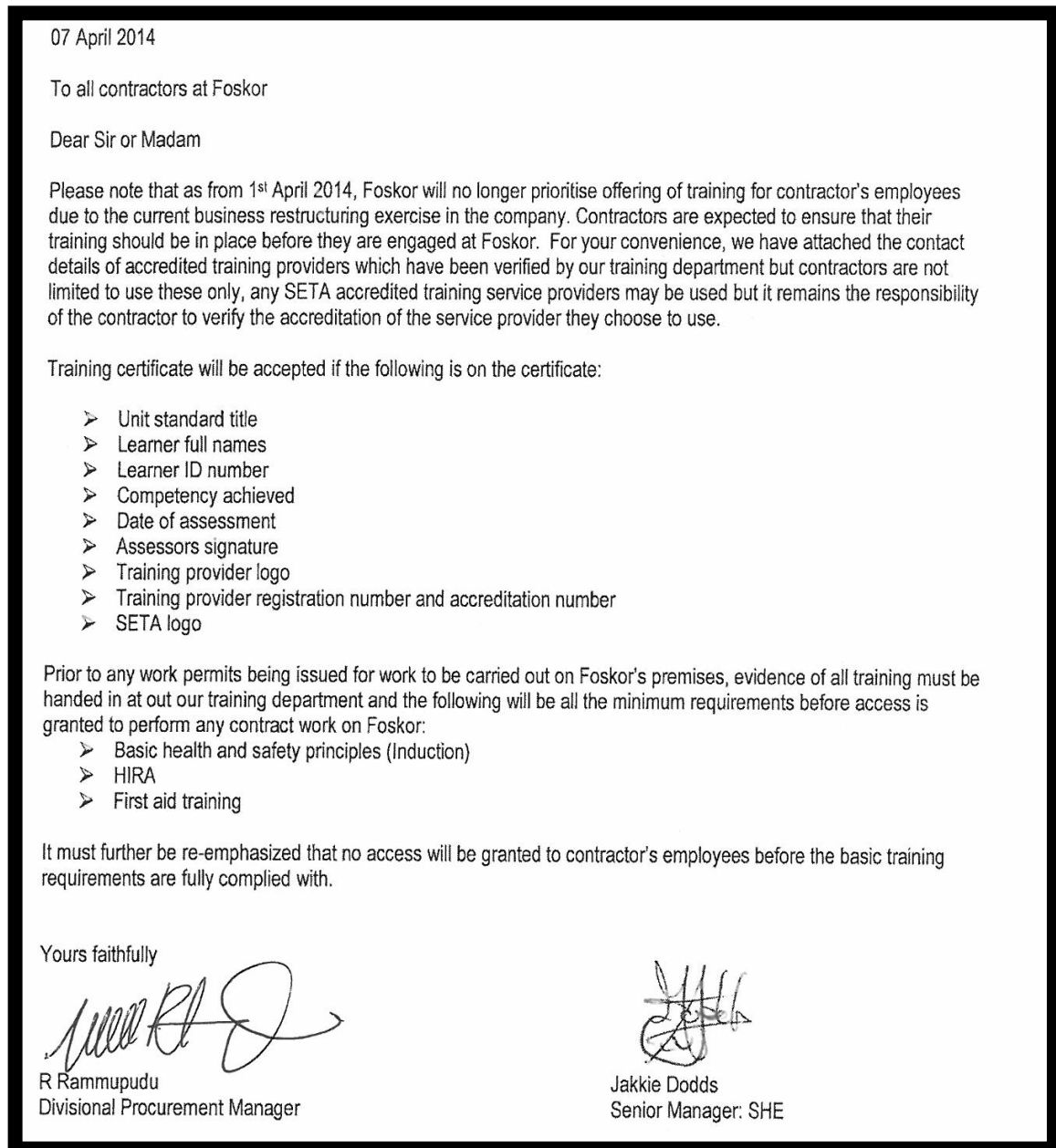
All providers of services need to be informed of the following minimum training applicable to all contractors (irrespective of the tasks or scope of work) that will enter the Foskor Phalaborwa site with effect from 1 April 2014. This training is not presented by the Foskor Training section and service providers must ensure that the training is sourced through accredited external training companies:

- Basic health and safety principles
- HIRA
- First Aid Training

All other training requirements must be aligned with the baseline risk assessment as defined in the scope of work. Risks identified in the baseline risk assessment will guide the requirements for training. As an example, if work entails working with overhead cranes, the employee/s needs to be trained in lifting equipment and lifting tackle. The Foskor COP (COP 56), however, also required that the person/s is not only trained but also authorised to perform lifting tasks.

The training matrix (see Annex 2) is a summary of the training completed as well as the status of required authorization as per Foskor COPs, except for the minimum training requirement.

EXTRACT OF LETTER ISSUED TO CONTRACTORS BY FOSKOR



19 PARAMETERS

19.1 Design parameters

All plant and equipment will be designed to:

- a. Operate satisfactorily under atmospheric, ambient and other conditions present at the site location.
- b. Ensure interchangeability of units and/or sub-parts throughout the plant to reduce spare holding requirements – take old plant equipment into account.
- c. Ensure reliability and maintainability. A minimum availability of 98% is required.

- d. Operate without undue vibration, stress (temperature and built-in) and excessive noise.
- e. Comply with legal requirements in terms of the water license and DWA

19.2 Layout Parameters of the site

The appointed will have to conduct the feasibility study of the pump station and also familiarize himself with the layout of the area and all associated parameters.

20 SPECIFICATIONS, CODES, STANDARDS AND REGULATORS

The latest addition of the South African National Standards and standard building in effect at the date of project design shall establish the minimum requirements for design, materials and construction. This should be referenced with the Foskor General Engineering specifications and requirements of the Foscok SHEQ system (COP's)

No work shall be contemplated which is in breach of any of the following regulations:

- a. Water license (04/B72K/ACGIJ/962)
- b. Occupational Health and Safety Act
- c. South African Mine Health and Safety Acts and Regulations (Act 29 of 1996)
- d. Explosive acts and regulations - South Africa
- e. DWA and the National Water Act.
- f. Foscok COP's
- g. Foscok Engineering Specifications
- h. The latest revisions of the SANS standardized specifications and Foscok Specifications as applicable at the time of quotation shall apply to this contract.

The equipment is to be capable of continuous operation 24 hrs/day, 365 days/year with operating availability equal to or exceeding 100%.

21 SITE GEOGRAPHY

The plant is located at Phalaborwa, Limpopo, South Africa

21.1 Ambient conditions

- a. Ambient temperature

Summer	35 Degrees Avg	50 Degrees Max
Winter	17 Degrees Avg	2 Degrees Min

- b. Site Altitude : 380m
- c. Prevailing wind direction: Generally South Easterly - Maximum design velocity 40m/s (144km/h)
- d. Very dusty conditions
- e. Average annual rainfall = 540 mm

22 FOSKOR GENERAL ENGINEERING SPECIFICATIONS

(should be consulted before finalization of any design or specification)

	GENERAL ENGINEERING SPECIFICATIONS INDEX			DOC NO: Index REVISION: 0 ISO 9001 REF: 7.5.1 ISO 14001 REF: 4.4.6 OHSAS18001 REF: 4.4.6
DOCUMENT NUMBER	DOCUMENT TITLE	REVISION NUMBER	DATE REVISED	LOCATION
GS001	General Design Information	0	01/11/2011	
GS002	Engineering drawings	0	01/11/2011	
GS003	Quality control procedures for general fabrications	0	01/11/2011	
GS004	Site work associated with civil construction works	Future		
GS005	Concrete and formwork	0	01/11/2011	
GS006	Masonry and building work.	Future		
GS007	Plate and workshop fabrications	0	01/11/2011	
GS008	Welding standards and procedures	0	01/11/2011	
GS009	Structural fabrication and erection.	0	01/11/2011	
GS010	General Mechanical Equipment	Future		
GS011	Piping	0	01/11/2011	
GS012	Pressure vessels	0	01/11/2011	
GS013	Painting and Protective coatings	0	01/11/2011	
GS014	Rubberlining	0	01/11/2011	
GS015	Fencing	0	01/11/2011	
GS016	Roofing and side cladding	0	01/11/2011	
GS017	Fuel for use in combustion engines	0	01/11/2011	
GS018	Lubrication	0	01/11/2011	
GS019	Bund walls for liquid containment	0	01/11/2011	
GS020	General Purpose Valves	0	01/11/2011	
GS021	Gearboxes	0	01/11/2011	
GS022	Repair of Chain blocks and Lever hoists	0	01/11/2011	
GS023	Slurry Pumps	Future		
GS024	Overhead Cranes	Future		
GS025	Conveyors	Future		

Contractor /Supplier - Please ensure that you have the latest copy of Specifications before any activity is committed

SPECIFICATION NUMBER	REVISION	TITLE
GV - 1	Latest Revision	General Engineering Specifications Mine Health & Safety Act for contractors
GV - 2	Latest Revision	Conditions for admission to and employment within the Foskor works
GM - 3	Latest Revision	Surface preparation and protection specification
GM - 2	Latest Revision	Engineering Specifications – Mechanical erection

GS - 1	Latest Revision	Engineering Specifications – Structural steelwork, platework, fabrication and installation.
GC-1	Latest Revision	Engineering Specifications – Civil, excavation and concrete work
GC-3	Latest Revision	Engineering Specifications – Packing and grouting
GQ-1	Latest Revision	Engineering Specifications – Quality control
GI-4	Latest Revision	Instrumentation specifications
GA - 2	Latest Revision	Recording of underground services & structures
GS - 2	Latest Revision	Metal roofing & cladding of structures
GM - 1	Latest Revision	Mechanical Equipment
GM - 5	Latest Revision	Pipe standards
GM - 6	Latest Revision	Engineering drawing & document requirements
Foskor Electrical Specifications	Latest Revision	Foskor Electrical Specifications
Applicable FOSKOR COPs	Latest Revision	Applicable FOSKOR COPs

23 ELECTRICAL SPECIFICATIONS		
SPECIFICATION NUMBER	REVISION	TITLE
EE-1	Latest Revision	Motor Control Centre & Switchgear
EE-2	Latest Revision	Squirrel Cage Induction & Wound Rotor Motors
EE-11	Latest Revision	Power Factor Correction Equipment
GE-1	Latest Revision	Design Criteria for Electrical Installations
GA-1	Latest Revision	Procedures for Enquiries & Tenders
GD-1	Latest Revision	General Requirements for Design, Project Management & Tenders
GD-2	Latest Revision	Engineering Change Order (E.C.O) Procedure
GM-1	Latest Revision	Mechanical Equipment
GM-5	Latest Revision	Pipe Standards
GM-6	Latest Revision	Engineering Drawing & Document Requirements
GM-8	Latest Revision	Surface Protection
GM-3	Latest Revision	Painting & Surface Protection of Steel
GS-1	Latest Revision	Structural Steelwork & Plate work Fabrication & Erection

GQ-1	Latest Revision	Quality Control
GI-1	Latest Revision	23.1.1.1 General specifications & Procedures
GI-2	Latest Revision	23.1.1.2 Installation & Commissioning
GI-3	Latest Revision	23.1.1.3 General Equipment Specification
GI-4	Latest Revision	23.1.1.4 Field Instrumentation Specification

24 **PROJECT MANAGEMENT - CONTRACTOR**

- Nominate a single window of communication to FOSKOR – Typically the appointed contractor 2.6.1
- Attend meetings as agreed during the project kick-off meeting.
- Submit Progress reports (Format & interval) as defined in the Kick-off Meeting (Invoicing, Labour, Performance against plan, Contractor purchases, Quality Management, Safety, Etc.
- Manage and participate in the “Daily Journal” as part of executing the project.
- All meetings will be held at FOSKOR offices unless otherwise stated.
- The contractor shall provide updated project management plans on progress as defined by the FOSKOR Project Engineer.

The Service provider is responsible for managing the project and this is graphically displayed below indicating where what functions lie. Graphical presentation only covers some basic aspects.

25 **LIAISON AND CO-OPERATION WITH OTHERS**

- The contractor shall be required to cooperate and liaise with FOSKOR appointed project manager / engineer.
- The contractor must note that construction is within an operational plant.
- The contractor may appoint a FOSKOR approved subcontractor.
- The contractor shall be required to work in conjunction with the FOSKOR appointed structural-, electrical-, equipment- and instrumentation installation contractor.

26 TENDER EVALUATION CRITERIA

This section contains the technical evaluation criteria specification.

The methodology adopted to perform the technical evaluation comprises of, desktop evaluation, factory assessment together with the product assessment and the final product acceptance post-contract award.

26.1 Evaluation Criteria Methodology

The evaluation criteria on technical functionality shall have a weighted score of 100 percentage points. To qualify for the second evaluation phase (commercial) your company needs to score a minimum of 70% on the technical

The evaluation methodology shall be in two (2) stages as follows:

- Desktop evaluation– Technical and Commercial evaluation - stage 1
- Factory and product assessment – stage 2

A tender will be disqualified if:

- It fails to meet the Pre-qualification requirements.
- It fails to submit the mandatory technical returnable.
- It fails to achieve the stipulated minimum threshold.

A tender is regarded as acceptable for further evaluation at stage two (2) if it achieves the clearly specified minimum threshold of 70 percentage points.

26.2 Desktop evaluation - Stage 1

The desktop evaluation is divided into two parts as mentioned below:

- 1) Technical Evaluation.
- 2) Commercial Evaluation.

The technical evaluator(s) shall check for the submission of all technical tender returnable documents.

26.3 Factory and Product Assessment (Due diligence) - Stage 2

The Foskor registered desktop evaluation report shall be compiled indicating which submissions were evaluated and those that met the minimum requirements. The tenderers that met minimum technical requirements undergo the Foskor process for OEM factory assessment to assess the capability to manufacture the required product. The final report shall be produced for both of these evaluation stages.

Foskor reserves the right to visit the OEM premises for factory and product assessment.

26.3.1 Factory Assessment

Foskor technical evaluators shall visit the factory to assess the capabilities of the factory, machinery, skills and technical processes, to ensure the factory can deliver on the requirements. The following will be included:-

- Manufacturing Methods
- Workshop Practices
- Design Practices and Application
- Testing Facility and Practices
- Raw material Procurement, Storage and Sub-contractor practices

- Site and Other Services
- Factory Performance (including the On Time Delivery (OTD) and Factory Failure Rate (FFR))

26.3.2 Product Assessment

The technical acceptable tenderer shall be subjected to the product assessment. The technical evaluator is responsible to explain to the Tenderer and factory representatives that the purpose of the visit is not a negotiation, but purely an assessment of the product, which has been offered to ensure compliance with Foskor's requirements as specified.

At the factory, the Foskor technical evaluator assesses the products using the Compliance clause by clause and deviations, check sheets. The Check sheets are populated as Foskor technical evaluator identifies deviations.

From the combined desktop evaluation and the factory and product assessment reports, the final technical evaluation report is compiled.

Prior to awarding of the contract

Foskor reserves the right to shortlist Suppliers/ Tenderers based on the compliance of all other evaluations, after the factory and product assessment. The technical evaluator shall meet with those shortlisted Suppliers/ Tenderers prior to awarding of the contract. The following shall be discussed in detail with those shortlisted Suppliers/ Tenderers:

- Closing of the technical deviations
- Training
- Final acceptance of drawings e.g. general arrangement and wiring

26.4 Test for Responsiveness

Determine, after opening and before detailed evaluation, whether each tender offer properly

- a. complies with the requirements of these Conditions of Tender, (scope work, pricing, proposed amendments and qualifications, and cover letters must be considered)
- b. has been properly and fully completed and signed, and
- c. is responsive to the other requirements of the tender documents. (Check certificates if attached, e.g., Qualifications, etc. allow bidder reasonable time to submit.)

A responsive tender conforms to all the terms, conditions, and specifications of the tender documents without material deviation or qualification. A material deviation or qualification is one which, in the Employer's opinion, would:

- a) detrimentally affect the scope, quality, or performance of the works, services or supply identified in the Scope of Work,
- b) significantly change the Employer's or the tenderer's risks and responsibilities under the contract, or
- c) affect the competitive position of other tenderers presenting responsive tenders if it were to be rectified.

Foskor reserves the right to reject a non-responsive tender offer, and not allow it to be subsequently made responsive by correction or withdrawal of the non-conforming deviation or reservation.

26.5 Arithmetical errors, omissions, and discrepancies.

Foskor shall check responsive tenders for discrepancies between amounts in words and amounts in figures. Where there is a discrepancy between the amounts in figures and the amount in words, the amount in words shall govern.

Foskor shall check the highest ranked tender or tenderer with the highest number of tender evaluation points after the evaluation of tender offers in accordance with BOQ for:

- a. the gross misplacement of the decimal point in any unit rate.
- b. omissions made in completing the pricing schedule or bills of quantities; or
- c. arithmetic errors in:
 - i. line-item totals resulting from the product of a unit rate and a quantity in bills of quantities or schedules of prices; or
 - ii. the summation of the prices.

Foskor shall notify the tenderer of all errors or omissions that are identified in the tender offer and either confirm the tender offer as tendered or accept the corrected total of prices.

Where the tenderer elects to confirm the tender offer as tendered, correct the errors as follows:

a) If bills of quantities or pricing schedules apply and there is an error in the line item total resulting from the product of the unit rate and the quantity, the line item total shall govern, and the rate shall be corrected. Where there is a gross misplacement of the decimal point in the unit rate, the line item total as quoted shall govern, and the unit rate shall be corrected.

b) Where there is an error in the total of the prices either as a result of other corrections required by this checking process or in the tenderer's addition of prices, the total of the prices shall govern, and the tenderer will be asked to revise selected item prices (and their rates if bills of quantities apply) to achieve the tendered total of the prices.

26.6 Pre-qualification requirements

Bid submission not meeting the pre-qualification requirement shall result in the bid being disqualified.

No	Pre-Qualification	Comments
1	Letter of warranty and guarantee with a minimum of 24 months from commissioning or 30 months from delivery, whichever occurs first.	Warranty letter from the OEM

26.7 Mandatory Requirements

The following documents are mandatory for this submission. These may lead to disqualification if not provided.

No	Mandatory Requirements	Comments
1	- Valid B-BBEE Certificate - Valid Company Registration documents - Valid letter of good standing - Valid tax certificate - Valid ID documents for Directors	This is a mandatory requirement. It is required before appointment and may lead to disqualification when not supplied
2	General arrangement drawings. These drawings shall include overall dimensions, headroom for erection and/or operation, and positions of cable entries or connection points.	This is a mandatory requirement. It is required before appointment and may lead to disqualification when not supplied
3	A copy of all installation, operation and maintenance manuals shall be submitted with the tender. These manuals shall, preferably, be on a USB in an Adobe Acrobat format. However, hard copies are also acceptable.	This is a mandatory requirement. It is required before appointment and may lead to disqualification when not supplied

26.8 Technical Evaluation Criteria

The minimum score for Technical Evaluation is 70 out of a maximum possible score of 100. Bidders that fail to achieve the minimum score for functionality will NOT be evaluated further.

	Technical Criteria Description	Wght (%)	Evaluation Method
1	Technical and operational (82%)		
1.1	Previous Experience (Project Management) (Contactable references with letterhead and signed by the company) • ≥Five (5) references in the last five years = 10 points • ≥Four (4) references in the last five years = 8 points • Three(3) reference in the last five years =6 points • Two(2) refence in the last five years =4 points • Two (2) references in the last five years = 0 point	10	Previous Experience/ Proven track record references must include client names, contact details, project values, and completion dates. Contactable references are essential.
1.2	All Technical Schedule completed (ANNEXURE A to F) in full by the service provider / OEM. • ANNEXURE A Technica Schedule =3 points • ANNEXURE B Technica Schedule =3 points • ANNEXURE C Technica Schedule =3 points • ANNEXURE D Technica Schedule =3 points • ANNEXURE E Technica Schedule =3 points • ANNEXURE F Technica Schedule =3 points Partially completed or not complete = 0 points	18	Completed Technical Schedule.
1.3	Type Tests certificate: The appointed OEM or service provider shall provide evidence of the below mentioned type tests on similar transformers • temperature rise test = 6 points • lightning impulse withstand test = 6 points • short-circuit withstand test = 6 points • Acoustic Sound Level Measurement = 6 points 1 point per class/size of transformer specified for all type tests	24	Provide Type test report for each type of transformer

1.4 Energy efficiency for 11kV Transformers

Rating (kVA)	Output Volt (V)	No-Load Loss (kW)	Load Loss (kW)	Efficiency at 75% Load (PF 0.8)	Tier	Score	Evaluation Method
2500	525	≤ 1.50	≤ 16.00	≥ 99.30%	Excellent	5	submit type test reports for similar transformer designs that demonstrate you have previously achieved such high efficiencies and low loss values.
		≤ 1.70	≤ 18.00	≥ 99.20%	Good	3	
		≤ 1.90	≤ 20.00	≥ 99.00%	Acceptable	2	
2000	525	≤ 1.20	≤ 14.50	≥ 99.25%	Excellent	5	
		≤ 1.40	≤ 16.50	≥ 99.15%	Good	3	
		≤ 1.60	≤ 18.50	≥ 99.00%	Acceptable	2	
1500	380	≤ 1.00	≤ 10.50	≥ 99.20%	Excellent	5	
		≤ 1.20	≤ 12.00	≥ 99.10%	Good	3	
		≤ 1.40	≤ 13.50	≥ 99.00%	Acceptable	2	
1500	525	≤ 1.00	≤ 10.50	≥ 99.20%	Excellent	5	
		≤ 1.20	≤ 12.00	≥ 99.10%	Good	3	
		≤ 1.40	≤ 13.50	≥ 99.00%	Acceptable	2	
1000	525	≤ 0.80	≤ 7.50	≥ 99.15%	Excellent	5	
		≤ 1.00	≤ 9.00	≥ 99.05%	Good	3	
		≤ 1.20	≤ 10.50	≥ 98.90%	Acceptable	2	
50	525	≤ 0.15	≤ 0.90	≥ 98.50%	Excellent	5	
		≤ 0.20	≤ 1.10	≥ 98.30%	Good	3	
		≤ 0.25	≤ 1.30	≥ 98.00%	Acceptable	2	

2	Lead time (5%)		
2.1	Work breakdown structure indicating the lead time in weeks • ≤ 24 weeks = 5 points • >24 weeks ≤ 26 weeks = 3 points • >26 weeks = 0 points	5	Work breakdown structure indicating the lead time in weeks in Gantt chart
3	Quality and Execution (13%)		
3.1	c) Quality Planning, Quality assurance plan, Quality Control • Quality control for 2 completed projects = 7 points • Quality Assurance on 2 completed projects = 6 points • No Plan = 0 points	13	Quality Control Plan for the project, detailing inspection and testing points from material procurement to final delivery

26.9 Commercial Evaluation Criteria

Commercial Evaluation Criteria			
Criteria Section	Commercial Criteria Description	% Contribution	Proof/documents to be submitted
Price (per PPPFA formula)	1. Price		
	a) Lowest obtains maximum points, above the lowest rated per PPPFA scale. Minimum tolerance for above 10% premium per Foskor policy	80%	Tender price
BBBEE	2. BEE / Social involvement		BBBEE Accreditation certificate to be provided
	a) BEE Accreditation (BBBEE)		
	(Level 1 = 10, Level 2 = 8, Level 3 = 6, Level 4 = 4, Level 5 = 2; > 5 = 0)	10%	
	b) BEE ownership commitment (Mining charter)		
	(51%+ to 100% = 5, 30-50% = 3; 26% - 29% = 1; < 26% = 0)	5%	
	c) Black Women's ownership		
Admin requirements	51%+ = 5, 30-49% = 3; 20-29% = 1, <19 = 0	5%	
	3. Documentary proof		Documentation to be provided
	a) Company registration		
	b) BBBEE Certification		
	c) Tax Clearance		
	d) Letter of Good Standing (COID)		
	e) Valid ID documents for Directors		
Total Commercial Score		100%	

27 GENERAL CONDITIONS

- Extension on the promise completion or Milestone date may be requested but needs to be approved by Foskop. The service provider should have a formal document issued via Foskop Procurement indicating that this request was approved.
- Any additional works not defined in the order need to be approved by Foskop in writing before any work commences.
- Valid SARS Pin

Description	Condition	Duration
Penalties	2 % per Week (to a maximum of 8% of project value)	Late Delivery after the promised completion date
Retention	10% of Contract value	Release after 4 months after final report submission
Type of Contract	Foskop's standard terms and conditions of service	7 months
Tender price validity	180 days	
Escalation	N/A	N/A

28 PRICING SCHEDULE

Tender No.: T _ _ _ / _ _

Description: DESIGN, MANUFACTURE, FAT, DELIVER AND SAT OF 10 X DISTRIBUTION TRANSFORMERS FOR FOSKOR MINE AT PHALABORWA, AS A ONCE OFF (STRATEGIC SPARES)

Pricing conditions

- a. Quotation prices to be valid for at least the duration of the contract period.
- b. Attached to the official quotation the Bidder is to submit a detailed description of intended rate increases if any. (As an example, increases based CPI adjustments)
- c. If any minimum requirements may alter or added for whatever reason, they will be brought to the attention of the bidder before the closing date for the submission of tenders or be added and highlighted on the tender
- d. Any other optional support or guarantee not mentioned in this scope may be noted on the official tender.
- e. Any additions to the scope (based on the knowledge and experience) should be conspicuously indicated and quoted accordingly
- f. Contractor is fully liable for the compliance of the entire project
- g. Amendments, corrections or alternatives necessary for legal and/or technical compliance should be clearly stipulated in a company cover letter
- h. Please only make use of this pricing schedule for pricing
- i. Failure to submit your company's bid on this pricing structure will result in the immediate disqualification
- j. Daily progress meetings with the Foskor team and the engineer will be communicated and conducted by the engineer.
- k. The actual number of all quantities on the BOQ, are to be re-measurable upon awarding of tender and shall be invoiced accordingly**
- l. It is the responsibility of the BIDDER to evaluate the Foskor site and actual working conditions. A site visit can be arranged.

28.1 Bill of Quantities (BOQ)

Item No.	Description	Unit	Qty	Unit Rate (R)	Total Amount (R)
1	TRANSFORMER UNIT COSTS (PER KVA RATING)				
1.1	2500 kVA, 11000/525 V Transformer				
1.1.1	Design & Engineering (Drawings, Calculations, Specs)	Lot	4		
1.1.2	Manufacturing & Assembly (Materials, Fabrication, QC)	Lot	4		
1.1.3	Factory Acceptance Testing (Routine & Type Tests)	Lot	4		
1.1.4	Delivery to FOSKOR Mine, Phalaborwa (incl. Logistics & Offloading)	Lot	4		
1.1.5	Site Acceptance Testing (SAT)	Lot	4		
1.2	2000 kVA, 11000/525 V Transformer				
1.2.1	Design & Engineering (Drawings, Calculations, Specs)	Lot	2		
1.2.2	Manufacturing & Assembly (Materials, Fabrication, QC)	Lot	2		
1.2.3	Factory Acceptance Testing (Routine & Type Tests)	Lot	2		
1.2.4	Delivery to FOSKOR Mine, Phalaborwa (incl. Logistics & Offloading)	Lot	2		
1.2.5	Site Acceptance Testing (SAT)	Lot	2		
1.3	1500 kVA, 11000/380 V Transformer				
1.3.1	Design & Engineering (Drawings, Calculations, Specs)	Lot	1		
1.3.2	Manufacturing & Assembly (Materials, Fabrication, QC)	Lot	1		
1.3.3	Factory Acceptance Testing (Routine & Type Tests)	Lot	1		
1.3.4	Delivery to FOSKOR Mine, Phalaborwa (incl. Logistics & Offloading)	Lot	1		
1.3.5	Site Acceptance Testing (SAT)	Lot	1		
1.4	1500 kVA, 11000/525 V Transformer				
1.4.1	Design & Engineering (Drawings, Calculations, Specs)	Lot	1		
1.4.2	Manufacturing & Assembly (Materials, Fabrication, QC)	Lot	1		
1.4.3	Factory Acceptance Testing (Routine & Type Tests)	Lot	1		
1.4.4	Delivery to FOSKOR Mine, Phalaborwa (incl. Logistics & Offloading)	Lot	1		
1.4.5	Site Acceptance Testing (SAT)	Lot	1		
1.5	1000 kVA, 11000/525 V Transformer				
1.5.1	Design & Engineering (Drawings, Calculations, Specs)	Lot	1		

1.5.2	Manufacturing & Assembly (Materials, Fabrication, QC)	Lot	1		
1.5.3	Factory Acceptance Testing (Routine & Type Tests)	Lot	1		
1.5.4	Delivery to FOSKOR Mine, Phalaborwa (incl. Logistics & Offloading)	Lot	1		
1.5.5	Site Acceptance Testing (SAT)	Lot	1		
1.6	50 kVA, 11000/525 V Transformer				
1.6.1	Design & Engineering (Drawings, Calculations, Specs)	Lot	1		
1.6.2	Manufacturing & Assembly (Materials, Fabrication, QC)	Lot	1		
1.6.3	Factory Acceptance Testing (Routine & Type Tests)	Lot	1		
1.6.4	Delivery to FOSKOR Mine, Phalaborwa (incl. Logistics & Offloading)	Lot	1		
1.6.5	Site Acceptance Testing (SAT)	Lot	1		
2	SPARES				
2.1	Spare PRV for 2500 KVA, 11000/525 V transformer	Each	1		
2.2	Spare PRV for 2000kVA, 11000/525 V transformer	Each	1		
2.3	Spare PRV for 1500 KVA, 11000/380 V transformer	Each	1		
2.4	Spare PRV for 1500 KVA, 11000/525 V transformer	Each	1		
2.5	Spare PRV for 1000 KVA, 11000/525 V transformer	Each	1		
2.6	Spare Buchholz for 2500 KVA, 11000/525 V transformer	Each	1		
2.7	Spare Buchholz for 2000kVA, 11000/525 V transformer	Each	1		
2.8	Spare Buchholz for 1500 KVA, 11000/380 V transformer	Each	1		
2.9	Spare Buchholz for 1500 KVA, 11000/525 V transformer	Each	1		
2.10	Spare Buchholz for 1000 KVA, 11000/525 V transformer	Each	1		
2.11	Spare Temperature Gauge for 2500 KVA, 11000/525 V transformer	Each	1		
2.12	Spare Temperature Gauge for 2000kVA, 11000/525 V transformer	Each	1		
2.13	Spare Temperature Gauge for 1500 KVA, 11000/380 V transformer	Each	1		
2.14	Spare Temperature Gauge for 1500 KVA, 11000/525 V transformer	Each	1		
2.15	Spare Temperature Gauge for 1000 KVA, 11000/525 V transformer	Each	1		

3	TRAVEL AND ACCOMODATION				
3.1	Travel and Accommodation for the full duration of the project including the labour cost during travel and all sundries	Task	1		
	SUB-TOTAL (Excl. VAT)				
	VAT (15%)				
	TOTAL PROJECT COST (Incl. VAT)				

BBBEE Level		Black Ownership	%	Black Woman Ownership	%
Tender Validity	Days	Completion Period	Days	Delivery Basis	
Guarantee	Months	Commencement days after receipt of official purchase order			

Price Basis for the duration of the contract/till supply of goods (Please tick):

Fixed	☐	Variable	☐
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If variable provide price variation factors, base date, percentages, and formula in cover letter. (Please specify indices to be used)

Where prices include a foreign currency rate please provide:

% of price subject R O E	%	ROE	= ZAR
ROE Base Date			

Note: If the above fields are not completed, it is confirmed that the quoted price/s are valid for the entire contract period mentioned and no escalation in the price is allowed under any circumstances.

I, _____ in my capacity as _____ for and on behalf of _____ hereby acknowledge that I have read and understand the Instruction to Tender and the Scope of Work as detailed in this document and accept all the Terms and Conditions of Tender T _____.

Signed at _____ on this the _____ day of _____ 2025

Signature: _____

Witness:

1. Name: _____ Signature: _____
2. Name: _____ Signature: _____

28.2 For and on behalf of Foskor (Pty) Limited

Name: _____ Signature: _____

Designation: _____ Date: _____

Tender Evaluation Criteria

See attached schedule

Note: It is imperative to complete this schedule and include all the documentation requested with the tender document. Tender documentation without supporting documentation requested for the tender evaluation criteria will not be considered.

29 ENQUIRIES

Further enquiries can be directed in writing to the below-named official:

Clayton Losper at claytonl@foskor.co.za

ANNEXURE A

Technical Specifications for 2500 kVA, 11000/525V Distribution Transformer

30 ANNEXURE A: 2500 kVA, 11000/525 V DISTRIBUTION TRANSFORMER

Technical Specification: 2500 kVA, 11000/525 V Distribution Transformer

30.1 General:

- a. Rated Power: 2500 kVA
- b. Rated Primary Voltage (HV): 11000 V (11 kV)
- c. Rated Secondary Voltage (LV): 525 V
- d. Frequency: 50 Hz
- e. Number of Phases: Three-phase
- f. Type of Transformer: Separate winding, Oil-immersed, hermetically sealed (bolted type)
- g. Application: Step-down power transformer for industrial power distribution at Foskor Mine, Phalaborwa. Suitable for continuous operation under heavy industrial loads.
- h. Location: Outdoor, within the open-cast mine environment.
- i. Cooling: Naturally cooled (ONAN)
- j. Tap Winding: HV

30.2 Operating and Environmental Conditions

(Critical for Phalaborwa - Hot, Dusty, Inland):

a. Ambient Temperature:

Season	Average Temperature	Maximum/Minimum Temp.
Summer	35 Degrees Avg	50 Degrees Max
Winter	17 Degrees Avg	2 Degrees Min

- b. Altitude: Not exceeding 380 m above sea level
- c. Wind: Prevailing wind direction: Generally South Easterly - Maximum design velocity 40m/s (144km/h)
- d. Average annual rainfall: 540 mm
- e. Atmospheric Pollution:

- High Dust Content: Transformer design must account for significant airborne dust, requiring appropriate sealing of control cabinets and robust bushing design to prevent flashovers due to dust accumulation.
 - Industrial Pollution: Moderate industrial pollution (e.g., mine dust, particulate matter, potentially mild acidic or alkaline compounds depending on specific mine processes. The supplier should confirm suitability for such environments).
- f. Corrosion: Moderate corrosion risk from general industrial atmosphere. Paint system should be robust for outdoor industrial use.
- g. Seismic Zone: To be determined based on local seismic data for Phalaborwa
- h. Electrical Characteristics:

Vector Group	Dyn11
Impedance Voltage (U_k):	Target range 4% to 6% at rated kVA. Manufacturer to confirm actual value. and to the latest SANS 60076 series specification. Guaranteed value to be indicated in the diagram plate
No-Load Losses (P₀):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable and to the latest SANS 60076 series specification. Manufacturer to provide guaranteed values.
Load Losses (P_k):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable. Manufacturer to provide guaranteed values.
Temperature Rise Limits:	• Winding Temperature Rise: Max 65 K over ambient (oil-immersed). • Top Oil Temperature Rise: Max 60 K over ambient (oil-immersed). <i>Note: Given the high ambient temp, ensure the transformer can operate continuously at rated load without exceeding insulation limits.</i>

Highest Voltage for equipment winding Um kV	• HV Side: 12kV • LV Side: <1.1
Insulation Levels (BIL - Basic Impulse Level):	• HV Side: 95 kV • LV Side: 10 kV BIL.
Applied voltage or line terminal AC withstand	28kV
Voltage Regulation:	Max. allowable voltage drop at full load and rated power factor.
Winding Material	Copper (Cu) only
HV Taps	• Type: Off-circuit tap changer (OCTC). • Range: $\pm 2 \times 2.5\%$ (e.g., 11550V, 11275V, 11000V, 10725V, 10450V). • Operation: Manual (lever type) operation when transformer is de-energized. • Provision shall be made for locking the tap switch handle with a padlock having a 6 mm diameter hasp. • Tap changer handles shall be fitted with gasketed covers, so that sealing of the transformer under normal conditions is independent of the switch shaft gland.
Earthing:	LV neutral shall be solidly earthed
Load Rejection	Due to load curtailment from Eskom, the mine has generators that are interconnected to the grid supply. The transformer shall be designed to withstand load rejection conditions at 1,4 times rated voltage for 5 s at the transformer terminals on the HV side.

Overload Capacity	- The transformer shall be capable of operating in accordance with the loading guidelines of IEC 60354 without exceeding the normal daily use of life and without the transformer winding hot spot temperature exceeding 140 °C. - The service provider / OEM shall submit calculations demonstrating that above requirements are met. These calculations shall disregard the effect of winding thermal capacity.
Short Circuit Performance	- The transformer shall be capable of withstanding the thermal and dynamic effects of short circuits. - The ability to withstand the thermal and dynamic effects of a short circuit shall be demonstrated in accordance with IEC 60076 and IEC 60354. Calculations / test certificates shall be submitted for approval
Flux Density	The flux density at any point of the magnetic circuit when the transformer is connected on the centre tap and operating at normal voltage and frequency shall not exceed 1.65 Tesla. Saturation must not occur at 10 % over voltage.
Noise Level	The average noise level of the transformers shall not exceed the values given in IEC 60551. The measurements shall be carried out in accordance with the above standard at a distance of 300 mm from the envelope of the transformer

30.3 Construction Details:

a. Tank Type:

- Conservator type: must include a robust moisture and dust filter (e.g., an advanced breather system beyond standard silica gel) and enhanced sealing

b. Bushings:

- HV Bushings: Outdoor type, porcelain, suitable for 11 kV system. Increased creepage distance recommended (e.g., 25-31 mm/kV) due to potential dust accumulation leading to flashovers.
- LV Bushings: Outdoor type, composite, suitable for 525 V system.
- Specify connection type: Cable box (for direct cable connection, preferred for industrial protection) or outdoor bare terminals. If cable boxes, specify appropriate IP rating (e.g., IP54 or higher) for dust protection.
- The manufacturer shall submit detailed design drawings of the HV and LV cable boxes for approval prior to fabrication. These drawings shall include:
 - Overall dimensions and mounting details.
 - Material specifications and coating details.
 - Internal clearances and phase barrier arrangements.
 - Cable entry gland plate details (size, quantity, proposed gland types).
 - Locking mechanisms and security features.
- The HV bushings shall be labeled in accordance with IEC 60076. Letters shall be at least 12 mm high. The means of marking shall be either:
 - Engraved metal plate or etched anodized aluminium. Identification by adhesive stickers is not acceptable.
 - If labeling is to be carried out on the tank, it is preferred that one plate be used rather than individual markings for each phase, in order to prevent incorrect phase markings.

c. **Radiators:**

- Detachable fin-type radiators.
- To be evenly distributed on opposite sides of the tank
- To have the same colour as the tank (RAL 7033 (Cement Grey))

d. **Protective Coating:**

- Paint system: Durable, **high-temperature resistant**, and robust anti-corrosion paint system suitable for industrial and dusty environments (e.g., hot-dip galvanized tank or

multi-coat epoxy paint system, minimum dry film thickness as per SANS 780, with consideration for UV stability).

- Colour: RAL 7033 (Cement Grey) or as specified by Foskor for the main tank and radiators and White for the conservator
 - The transformer tank and its steel attachments shall be hot dip galvanized or metallized, followed by painting. The painting system used should be proven and documented.
 - All surfaces shall be thoroughly cleaned of rust, scale, grease and dirt and other foreign matter and all imperfections shall be removed by means of approved methods.
 - The inside of the tank shall be painted with an approved oil resisting varnish so that the oil cannot come into contact with the tank metal at any time
- e. **Lifting Lugs:** Provided for total mass.
- f. **Rollers/Wheels:** Removable bi-directional rollers for movement on rails and floor.
- g. **Tank Earthing Terminals:**
- At least two substantial earthing pads.
 - Earthing terminal shall be of stainless steel welded to the tank and be fitted with a stainless steel M12 bolt, nut, spring washer and a lock washer.
- h. **Core – Tank earthing:** to be brought out for external earthing
- i. **Rating Plate:** Stainless steel, engraved with all relevant transformer data, highly resistant to corrosion and fading.
- j. **Height:**
- The preferred height from tank base to tank top cover < 1.8m
 - The preferred height from tank base to top of the conservator < 2.7m (0.9m from tank main cover to the conservator top)
 - (This is due to height restriction is most of the Foskor transformer bays)
- k. **Tank fittings and attachments**

- Tap changer (off-circuit with pad lockable switch)
- HV bushing assembly
- LV bushings assembly
- Oil filling and drain valves
- Main earthing terminal
- Lifting and pulling eyes and jacking pads
- Stainless steel engraved rating and connection plate in English
- Pressure relief valve
- Bucholz relay
- Oil level indicator
- Terminal marking

l. Transformer Assembly

- The core and winding shall be dried in a vacuum drying oven.
- The heating and vacuum drying cycle shall be approved by the Foskor.
- The tank, complete with core and windings, shall be filled with oil under a vacuum.

m. Transformer Oil

- The transformers shall be supplied filled with class 1 mineral oil (Virgin Oil) conforming to IEC 60296.
- Foskor shall submit a detailed specification for the type of oil proposed.
- The oil shall not contain polychlorinated biphenyls (PCB).
- Foskor may require evidence that the oil is not contaminated by PCB. If an antioxidant is recommended, its use shall be subject to Foskor's approval.

30.4 Main Rating & Diagram plate (Connection & Vector Group Diagram)

30.4.1 General Requirements:

- a. **Material:** Non-corrosive, weather-resistant, and UV-stable stainless steel material. It must withstand the harsh mining environment at Foskor (dust, high temperatures, potential industrial fumes, sunlight).

- b. **Mounting:** Permanently affixed to the transformer tank in a clearly visible and easily accessible location. It should be securely attached using corrosion-resistant fasteners (e.g., stainless steel rivets or screws).
- c. **Legibility:** All text, symbols, and lines shall be clearly engraved, etched, or printed with indelible ink, ensuring excellent legibility for the lifetime of the transformer, even under adverse lighting or dusty conditions.
- d. **Size:** Of sufficient size to clearly display all required information without clutter, while remaining proportionate to the transformer's overall dimensions.

30.4.2 Content Requirements:

- Type of transformer
- Specification to which standard it was manufactured
- Manufacturer's name
- Serial number
- Year of manufacturer
- Number of phases
- Rated power
- Rated frequency
- Rated voltage
- Rated currents
- Vector group
- Percentage impedance voltage at rated current
- Type of cooling
- Continuous ambient temperature at which ratings apply
- Top oil temperature rise at rated load
- Total weight
- Volume of oil
- Weight of core and windings
- Table of primary voltages at the 5 tapping positions
- Connection diagram
- Employer's name

30.4.3 Compliance:

The design and content of the diagram plate shall comply with the requirements of **SANS 60076-1 (IEC 60076-1)**, specifically regarding information required on the rating plate and supplementary plates.

30.5 Protection and Accessories (Standard and Optional):

- a. **Oil Level Indicator:** Magnetic type, with minimum and maximum levels.
- b. Temperature **Indicators:**
 - Oil Temperature Indicator (OTI): Dial type, with maximum reading pointer and alarm/trip contacts.
 - Winding Temperature Indicator (WTI): Dial type, with maximum reading pointer and alarm/trip contacts (simulated by OTI with heating element).
- c. **Pressure Relief Device:** Spring-loaded pressure relief valve.
- d. **Drain Valve:** With oil sampling device.
- e. **Filter/Filling Valve:** For oil filtration/filling.
- f. **Breather:** advanced silica gel breather with oil seal or similar robust dust filter system to minimize ingress of dust and moisture.
- g. **Buchholz Relay:** to be provided for gas and oil surge detection
- h. **Terminal Box:** Weatherproof terminal box for external wiring of alarm/trip contacts, with **IP55 or higher rating** for dust protection.
- i. **Surge Arresters:** to be supplied with the transformer manufacturer, and mounted on the HV side.

30.6 Standards Compliance:

- a. **International Standards:** IEC 60076 series (Power Transformers).
- b. **National Standards:**
 - SANS 60076 series (Power Transformers).
 - SANS 780 (South African National Standard for Distribution Transformers), and
 - NRS 049 (National Rationalised Standard)
- c. All materials and components to comply with relevant South African national standards.

30.7 Factory Acceptance Testing (FAT) and Documentation:

- a. **Routine Tests:** All routine tests as per IEC 60076 must be performed and certified test reports provided
 - Measurement of winding resistance
 - Measurement of voltage ratio and check of polarity and vector group
 - Measurement of impedance voltages
 - Measurement of load losses
 - Measurement of no-load losses and no-load current,
 - Induced overvoltage withstand test (IVW)
 - Applied voltage test (AV)
 - Sweep Frequency Response Analysis
 - Auxiliary wiring insulation test (AuxW)
 - Dielectric strength of oil,
 - Relief Device (PRV) test
 - Dielectric Routine Tests
 - Galvanizing tests.
 - Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)

- b. **Type Tests:** The appointed OEM or service provider shall provide evidence of type tests on similar transformer (e.g., temperature rise test, lightning impulse withstand test, short-circuit withstand test). If these test have never been done on the similar transformer, the service provider /OEM shall conduct these tests. These shall be at the expense of the service provider /OEM

The following shall be regarded as type tests:

- Temperature Rise Test. This test shall be carried out on the tap having maximum losses
- Short Circuit Withstand test
- Impulse Voltage Test and Power Frequency Test

- Acoustic Sound Level Measurement
- Tank Vacuum Test
- Measurement of Harmonic Level in no load condition

c. **Documentation:**

The following documents shall be submitted during with the delivery of the transformer

- Certified test reports.
- Outline dimension drawings.
- Connection diagrams.
- Rating plate drawing.
- Comprehensive Instruction Manuals for operation and maintenance.
- Oil test results.
- Tan Delta

30.8 Site Acceptance Testing (SAT) and documentation

All site acceptance testing shall be performed as per IEC 60076 and certified test reports provided

a. **Tests**

- Sweep Frequency Response Analysis
- Insulation Resistance (IR) Test (Megger Test)
- Winding DC Resistance Test
- Transformer Turns Ratio (TTR) Test / Voltage Ratio Test
- Vector Group and Polarity Check
- Exciting Current Test (380V)
- Short-Circuit Impedance
- Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)
- Auxiliary equipment testing and wiring

b. **Documentation:**

A comprehensive SAT report must be generated, detailing all tests performed,

measured values, comparison with FAT results, and conclusions on the transformer's readiness for service

30.9 Transportation, Handling, and After-Sales:

- a. The transformer shall be suitably packed for transportation to Phalaborwa, protecting against dust, heat, and mechanical damage.
- b. Clear marking of lifting points and handling instructions on the packaging.
- c. **Delivery Point:** Delivered to Foskor Mine in Phalaborwa. The Transformer shall be offloaded at TSS Electrical workshop
- d. **Warranty:** Minimum 24 months from commissioning or 30 months from delivery, whichever occurs first.
- e. **After-Sales Support:** Manufacturer must demonstrate capability for local service, spare parts availability, and technical support in South Africa.
- f. **Site Support:** Ability to provide technical supervision for offloading, positioning, and cold-commissioning

30.10 TECHNICAL SCHEDULE

(TO BE COMPLETED BY THE BIDDER)

2500 kVA, 11000/525 V Distribution Transformer

The following Technical Schedule shall be filled out for the transformer rating.

#	Description	Unit	Data
1	International standards transformer complies with	-	
2	Nominal frequency	Hz	
3	Rated Power	kVA	
4	Nominal primary voltage	kV	
5	Nominal secondary voltage	V	
6	Rated primary voltage	kV	
7	Rated secondary voltage	V	
8	Type of cooling	-	
9	Vector group	-	
10	Tap changing		
	Number of steps	± steps	
	Tapping range	± %	
11	Rated short circuit current and withstanding duration		
	Current	kA	
	Duration	s	
12	Impedance measured at 75 °C and center tap	%	
13	X/R ratio	-	
14	Duration of overload		
	25 % overload	°C	
	50 % overload	°C	
15	Design maximum outdoor temperature	°C	
16	Design continuous ambient temperature	°C	
17	Thermal Characteristics		
	Average winding temperature rise	°C	

	Maximum average temperature rise	°C	
	Maximum hot spot temperature rise	°C	
	Hot-spot to top-oil temperature gradient	°C	
18	Magnetic flux density	Tesla	
19	Core Losses	W	
20	Winding losses	W	
21	No load current	A	
22	Regulation: full load, PF=1	%	
23	Regulation: full load, PF=1	%	
	Regulation: full load, PF=0.85	%	
24	Silicon steel		
	Manufacturer		
	Type and grade		
	Operating flux density	Tesla	
	Guaranteed maximum operating flux density	kA/m	
	Manufacturer's data sheet supplied	Yes/No	
25	Conductor for HV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
26	Conductor for LV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
27	HV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
28	LV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
29	Bushing basic impulse withstand voltage		
	HV Bushing	kV	

	LV Bushing	kV	
30	Bushing power frequency withstand voltage		
	HV Bushing	kV	
	LV Bushing	kV	
31	Terminals		
	Type and metal used in HV terminal		
	Type and metal used in LV terminal		
	Type of metal used in Earth terminal		
32	Minimum phase to phase clearance	mm	
33	Minimum phase to earth clearance	mm	
34	Spring and lock washers included	Yes/No	
35	Tap changer		
	Manufacturer/Supplier		
	Type		
	Catalogue details attached	Yes/No	
	Manufacturers data sheet attached	Yes/No	
36	Can tap changer switch be locked	Yes/No	
37	Tank Fabrication		
	Tank material		
	Thickness of the metal sheet		
	Painting method details attached	Yes/No	
38	Tank Dimensions		
	Width	mm	
39	Transformer weights		
	Height	mm	
	Depth	mm	
	Weight of core and windings	kg	
	Weight of tank	kg	
	Weight of oil at 20 °C	kg	
	Total weight of transformer, ready for shipping	kg	
	Shipping weight of transformer	kg	

ANNEXURE B

Technical Specifications for 2000 kVA, 11000/525V Distribution Transformer

31 ANNEXURE B: 2000 kVA, 11000/525 V DISTRIBUTION TRANSFORMER

Technical Specification: 2000 kVA, 11000/525 V Distribution Transformer

31.1 General:

- a) Rated Power: 2000 KVA
- b) Rated Primary Voltage (HV): 11000 V (11 kV)
- c) Rated Secondary Voltage (LV): 525 V
- d) Frequency: 50 Hz
- e) Number of Phases: Three-phase
- f) Type of Transformer: Separate winding, Oil-immersed.
- g) Application: Step-down power transformer for industrial power distribution at Foskor Mine, Phalaborwa. Suitable for continuous operation under heavy industrial loads.
- h) Location: Outdoor, within the open-cast mine environment.
- i) Cooling: Naturally cooled (ONAN)
- j) Tap Winding: HV

31.2 Operating and Environmental Conditions

(Critical for Phalaborwa - Hot, Dusty, Inland):

a) Ambient Temperature:

Season	Average Temperature	Maximum/Minimum Temp.
Summer	35 Degrees Avg	50 Degrees Max
Winter	17 Degrees Avg	2 Degrees Min

- b) Altitude: Not exceeding 380 m above sea level
- c) Wind: Prevailing wind direction: Generally South Easterly - Maximum design velocity 40m/s (144km/h)
- d) Average annual rainfall: 540 mm
- e) Atmospheric Pollution:

- High Dust Content: Transformer design must account for significant airborne dust, requiring appropriate sealing of control cabinets and robust bushing design to prevent flashovers due to dust accumulation.
 - Industrial Pollution: Moderate industrial pollution (e.g., mine dust, particulate matter, potentially mild acidic or alkaline compounds depending on specific mine processes. The supplier should confirm suitability for such environments).
- f) Corrosion: Moderate corrosion risk from general industrial atmosphere. Paint system should be robust for outdoor industrial use.
- g) Seismic Zone: To be determined based on local seismic data for Phalaborwa if any specific requirements apply.

31.3 Electrical Characteristics:

Vector Group	Dyn11
Impedance Voltage (U_k):	Target range 4% to 6% at rated kVA. Manufacturer to confirm actual value. and to the latest SANS 60076 series specification. Guaranteed value to be indicated in the diagram plate
No-Load Losses (P₀):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable and to the latest SANS 60076 series specification. Manufacturer to provide guaranteed values.
Load Losses (P_k):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable. Manufacturer to provide guaranteed values.
Temperature Rise Limits:	• Winding Temperature Rise: Max 65 K over ambient (oil-immersed). • Top Oil Temperature Rise: Max 60 K over ambient (oil-immersed). <i>Note: Given the high ambient temp, ensure the transformer can operate continuously at rated load without exceeding insulation limits.</i>

Highest Voltage for equipment winding Um kV	• HV Side: 12kV • LV Side: <1.1
Insulation Levels (BIL - Basic Impulse Level):	• HV Side: 95 kV • LV Side: 10 kV BIL.
Applied voltage or line terminal AC withstand	28kV
Voltage Regulation:	Max. allowable voltage drop at full load and rated power factor.
Winding Material	Copper (Cu) only
HV Taps	• Type: Off-circuit tap changer (OCTC). • Range: $\pm 2 \times 2.5\%$ (e.g., 11550V, 11275V, 11000V, 10725V, 10450V). • Operation: Manual (lever type) operation when transformer is de-energized. • Provision shall be made for locking the tap switch handle with a padlock having a 6 mm diameter hasp. • Tap changer handles shall be fitted with gasketed covers, so that sealing of the transformer under normal conditions is independent of the switch shaft gland.
Earthing:	LV neutral shall be solidly earthed
Load Rejection	Due to load curtailment from Eskom, the mine has generators that are interconnected to the grid supply. The transformer shall be designed to withstand load rejection conditions at 1,4 times rated voltage for 5 s at the transformer terminals on the HV side.

Overload Capacity	- The transformer shall be capable of operating in accordance with the loading guidelines of IEC 60354 without exceeding the normal daily use of life and without the transformer winding hot spot temperature exceeding 140 °C. - The service provider / OEM shall submit calculations demonstrating that above requirements are met. These calculations shall disregard the effect of winding thermal capacity.
Short Circuit Performance	- The transformer shall be capable of withstanding the thermal and dynamic effects of short circuits. - The ability to withstand the thermal and dynamic effects of a short circuit shall be demonstrated in accordance with IEC 60076 and IEC 60354. Calculations / test certificates shall be submitted for approval
Flux Density	The flux density at any point of the magnetic circuit when the transformer is connected on the centre tap and operating at normal voltage and frequency shall not exceed 1.65 Tesla. Saturation must not occur at 10 % over voltage.
Noise Level	The average noise level of the transformers shall not exceed the values given in IEC 60551. The measurements shall be carried out in accordance with the above standard at a distance of 300 mm from the envelope of the transformer

31.4 Construction Details:

- a. **Tank Type:** Conservator type: must include a robust moisture and dust filter (e.g., an advanced breather system beyond standard silica gel) and enhanced sealing.
- b. **Bushings:**

- HV Bushings: Outdoor type, porcelain, suitable for 11 kV system. Increased creepage distance recommended (e.g., 25-31 mm/kV) due to potential dust accumulation leading to flashovers.
- LV Bushings: Outdoor type, composite, suitable for 525 V system.
- Specify connection type: Cable box (for direct cable connection, preferred for industrial protection) or outdoor bare terminals. If cable boxes, specify appropriate IP rating (e.g., IP54 or higher) for dust protection.
- The manufacturer shall submit detailed design drawings of the HV and LV cable boxes for approval prior to fabrication. These drawings shall include:
 - Overall dimensions and mounting details.
 - Material specifications and coating details.
 - Internal clearances and phase barrier arrangements.
 - Cable entry gland plate details (size, quantity, proposed gland types).
 - Locking mechanisms and security features.
- The HV bushings shall be labeled in accordance with IEC 60076. Letters shall be at least 12 mm high. The means of marking shall be either:
 - Engraved metal plate or etched anodized aluminium. Identification by adhesive stickers is not acceptable.
 - If labeling is to be carried out on the tank, it is preferred that one plate be used rather than individual markings for each phase, in order to prevent incorrect phase markings.

c. Radiators:

- Detachable fin-type radiators.
- To be evenly distributed on opposite sides of the tank.
- To have the same colour as the tank (RAL 7033 (Cement Grey)).

d. Protective Coating:

- Paint system: Durable, **high-temperature resistant**, and robust anti-corrosion paint system suitable for industrial and dusty environments (e.g., hot-dip galvanized tank or multi-coat epoxy paint system, minimum dry film thickness as per SANS 780, with consideration for UV stability).

- Colour: RAL 7033 (Cement Grey) or as specified by Foskor for the main tank and radiators and White for the conservator
 - The transformer tank and its steel attachments shall be hot dip galvanized or metallized, followed by painting. The painting system used should be proven and documented.
 - All surfaces shall be thoroughly cleaned of rust, scale, grease and dirt and other foreign matter and all imperfections shall be removed by means of approved methods.
 - The inside of the tank shall be painted with an approved oil resisting varnish so that the oil cannot come into contact with the tank metal at any time
- e. **Lifting Lugs:** Provided for total mass.
- f. **Rollers/Wheels:** Removable bi-directional rollers for movement on rails.
- g. **Tank Earthing Terminals:**
- At least two substantial earthing pads.
 - At least two substantial earthing pads.
 - Earthing terminal shall be of stainless steel welded to the tank and be fitted with a stainless steel M12 bolt, nut, spring washer and a lock washer.
- h. **Core-Tank earthing:** to be brought out for external earthing.
- i. **Rating Plate:** Stainless steel, engraved with all relevant transformer data, highly resistant to corrosion and fading.
- j. **Height:**
- The preferred height from tank base to tank top cover <1.8m
 - The preferred height from tank base to top of the conservator < 2.7m (0.9m from tank main cover to the conservator top)
- (This is due to height restriction in most of the Foskor transformer bays.
- k. **Tank fittings and attachments**
- Tap changer (off-circuit with pad lockable switch)
 - HV bushing assembly

- LV bushings assembly
- Oil filling and drain valves
- Main earthing terminal
- Lifting eyes pulling eyes and jacking pads
- Stainless steel engraved rating and connection plate in English
- Pressure relief valve
- Bucholz relay
- Oil level indicator
- Terminal marking

l. Transformer Assembly

- The core and winding shall be dried in a vacuum drying oven.
- The heating and vacuum drying cycle shall be approved by the Foskor.
- The tank, complete with core and windings, shall be filled with oil under a vacuum.

m. Transformer Oil

- The transformers shall be supplied filled with class 1 mineral oil (Virgin Oil) conforming to IEC 60296.
- Foskor shall submit a detailed specification for the type of oil proposed.
- The oil shall not contain polychlorinated biphenyls (PCB).
- Foskor may require evidence that the oil is not contaminated by PCB. If an antioxidant is recommended, its use shall be subject to Foskor's approval.

31.5 Main Rating & Diagram plate (Connection & Vector Group Diagram)

31.5.1 General Requirements:

- a) **Material:** Non-corrosive, weather-resistant, and UV-stable stainless steel material. It must withstand the harsh mining environment at Foskor (dust, high temperatures, potential industrial fumes, sunlight).
- b) **Mounting:** Permanently affixed to the transformer tank in a clearly visible and easily accessible location. It should be securely attached using corrosion-resistant fasteners (e.g., stainless steel rivets or screws).

- c) **Legibility:** All text, symbols, and lines shall be clearly engraved, etched, or printed with indelible ink, ensuring excellent legibility for the lifetime of the transformer, even under adverse lighting or dusty conditions.
- d) **Size:** Of sufficient size to clearly display all required information without clutter, while remaining proportionate to the transformer's overall dimensions.

31.5.2 Content Requirements:

The diagram plate shall include the following but not be limited to the below information:

- Type of transformer
- Specification to which standard it was manufactured
- Manufacturer's name
- Serial number
- Year of manufacturer
- Number of phases
- Rated power
- Rated frequency
- Rated voltage
- Rated currents
- Vector group
- Percentage impedance voltage at rated current
- Type of cooling
- Continuous ambient temperature at which ratings apply
- Top oil temperature rise at rated load
- Total weight
- Volume of oil
- Weight of core and windings
- Table of primary voltages at the 5 tapping positions
- Connection diagram
- Employer's name

31.5.3 Compliance:

The design and content of the diagram plate shall comply with the requirements of SANS 60076-1 (IEC 60076-1), specifically regarding information required on the rating plate and supplementary plates.

31.6 Protection and Accessories (Standard and Optional):

- a) Oil Level Indicator: Magnetic type, with minimum and maximum levels.
- b) Temperature Indicators:
 - Oil Temperature Indicator (OTI): Dial type, with maximum reading pointer and alarm/trip contacts.
 - Winding Temperature Indicator (WTI): Dial type, with maximum reading pointer and alarm/trip contacts (simulated by OTI with heating element).
- c) Pressure Relief Device: Spring-loaded pressure relief valve.
- d) Drain Valve: With oil sampling device.
- e) Filter/Filling Valve: For oil filtration/filling.
- f) Breather: advanced silica gel breather with oil seal or similar robust dust filter system to minimize ingress of dust and moisture.
- g) Buchholz Relay: to be provided for gas and oil surge detection.
- h) Terminal Box: Weatherproof terminal box for external wiring of alarm/trip contacts, with IP55 or higher rating for dust protection.
- i) Surge Arresters: to be supplied with the transformer manufacturer, and mounted on the HV side.

31.7 Standards Compliance:

- a) **International Standards:** IEC 60076 series (Power Transformers).
- b) **National Standards:**
 - SANS 60076 series (Power Transformers).
 - SANS 780 (South African National Standard for Distribution Transformers), and
 - NRS 049 (National Rationalised Standard).
- c) All materials and components to comply with relevant South African national standards.

31.8 Factory Acceptance Testing (FAT) and Documentation:

- a. **Routine Tests:** All routine tests as per IEC 60076 must be performed and certified test reports provided
 - Measurement of winding resistance
 - Measurement of voltage ratio and check of polarity and vector group
 - Tan delta and Capacitance
 - Measurement of impedance voltages
 - Measurement of load losses
 - Measurement of no load losses and no load current,
 - Induced overvoltage withstand test (IVW)
 - Applied voltage test (AV)
 - Bushing routine tests
 - Sweep Frequency Response Analysis
 - Auxiliary wiring insulation test (AuxW)
 - Dielectric strength of oil,
 - Relief Device test
 - Dielectric Routine Tests
 - Galvanizing tests.
 - Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)

- b. **Type Tests:** The appointed OEM or service provider shall provide evidence of type tests on similar transformer (e.g., temperature rise test, lightning impulse withstand test, short-circuit withstand test). If these tests have never been done on the similar transformer, the service provider /OEM shall conduct these tests. These shall be at the expense of the service provider /OEM

The following shall be regarded as type tests:

- Temperature Rise Test. This test shall be carried out on the tap having maximum losses
- Short Circuit Withstand test

- Impulse Voltage Test and Power Frequency Test
- Acoustic Sound Level Measurement
- Tank Vacuum Test
- Measurement of Harmonic Level in no load condition
- Oil Analysis

c. **Documentation:**

The following documents shall be submitted during with the delivery of the transformer:

- Certified test reports.
- Outline dimension drawings.
- Connection diagrams.
- Rating plate drawing.
- Comprehensive Instruction Manuals for operation and maintenance.
- Oil test results.
- Tan Delta.

31.9 Site Acceptance Testing (SAT) and documentation

All site acceptance testing shall be performed as per IEC 60076 and certified test reports provided.

a) **Tests:**

- Sweep Frequency Response Analysis
- Insulation Resistance (IR) Test (Megger Test)
- Winding DC Resistance Test
- Transformer Turns Ratio (TTR) Test / Voltage Ratio Test
- Vector Group and Polarity Check
- Exciting Current Test
- Short-Circuit Impedance
- Dissolved Gas Analysis (DGA) of Transformer Oil
- Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)
- Auxiliary equipment testing and wiring

b) **Documentation:**

A comprehensive SAT report must be generated, detailing all tests performed, measured values, comparison with FAT results, and conclusions on the transformer's readiness for service.

31.10 Transportation, Handling, and After-Sales:

- a) The transformer shall be suitably packed for transportation to Phalaborwa, protecting against dust, heat, and mechanical damage.
- b) Clear marking of lifting points and handling instructions on the packaging.
- c) **Delivery Point:** Delivered to Foskor Mine in Phalaborwa. The Transformer shall be offloaded at TSS Electrical workshop.
- d) **Warranty:** Minimum 24 months from commissioning or 30 months from delivery, whichever occurs first.
- e) **After-Sales Support:** Manufacturer must demonstrate capability for local service, spare parts availability, and technical support in South Africa.
- f) **Site Support:** Ability to provide technical supervision for offloading, positioning, and cold-commissioning.

31.11 TECHNICAL SCHEDULE TO BE COMPLETED BY THE BIDDER

2000 kVA, 11000/525 V Distribution Transformer

The following Technical Schedule shall be filled out for the transformer rating.

#	Description	Unit	Data
1	International standards transformer complies with	-	
2	Nominal frequency	Hz	
3	Rated Power	kVA	
4	Nominal primary voltage	kV	
5	Nominal secondary voltage	V	
6	Rated primary voltage	kV	
7	Rated secondary voltage	V	
8	Type of cooling	-	
9	Vector group	-	
10	Tap changing		
	Number of steps	± steps	
	Tapping range	± %	
11	Rated short circuit current and withstanding duration		
	Current	kA	
	Duration	s	
12	Impedance measured at 75 °C and center tap	%	
13	X/R ratio	-	
14	Duration of overload		
	25 % overload	°C	
	50 % overload	°C	
15	Design maximum outdoor temperature	°C	
16	Design continuous ambient temperature	°C	
17	Thermal Characteristics		
	Average winding temperature rise	°C	
	Maximum average temperature rise	°C	

	Maximum hot spot temperature rise	°C	
	Hot-spot to top-oil temperature gradient	°C	
18	Magnetic flux density	Tesla	
19	Core Losses	W	
20	Winding losses	W	
21	No load current	A	
22	Regulation: full load, PF=1	%	
23	Regulation: full load, PF=1	%	
	Regulation: full load, PF=0.85	%	
24	Silicon steel		
	Manufacturer		
	Type and grade		
	Operating flux density	Tesla	
	Guaranteed maximum operating flux density	kA/m	
	Manufacturer's data sheet supplied	Yes/No	
25	Conductor for HV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
26	Conductor for LV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
27	HV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
28	LV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
29	Bushing basic impulse withstand voltage		
	HV Bushing	kV	
	LV Bushing	kV	

30	Bushing power frequency withstand voltage		
	HV Bushing	kV	
	LV Bushing	kV	
31	Terminals		
	Type and metal used in HV terminal		
	Type and metal used in LV terminal		
	Type of metal used in Earth terminal		
32	Minimum phase to phase clearance	mm	
33	Minimum phase to earth clearance	mm	
34	Spring and lock washers included	Yes/No	
35	Tap changer		
	Manufacturer/Supplier		
	Type		
	Catalogue details attached	Yes/No	
	Manufacturers data sheet attached	Yes/No	
36	Can tap changer switch be locked	Yes/No	
37	Tank Fabrication		
	Tank material		
	Thickness of the metal sheet		
	Painting method details attached	Yes/No	
38	Tank Dimensions		
	Width	mm	
39	Transformer weights		
	Height	mm	
	Depth	mm	
	Weight of core and windings	kg	
	Weight of tank	kg	
	Weight of oil at 20 °C	kg	
	Total weight of transformer, ready for shipping	kg	
	Shipping weight of transformer	kg	

ANNEXURE C

Technical Specifications for 1500 kVA, 11000/380V Distribution Transformer

32 ANNEXURE C: 1500 kVA, 11000/380 V DISTRIBUTION TRANSFORMER

Technical Specification: 1500 kVA, 11000/380 V Distribution Transformer

32.1 General:

- a. Rated Power: 1500 kVA
- b. Rated Primary Voltage (HV): 11000 V (11 kV)
- c. Rated Secondary Voltage (LV): 380 V
- d. Frequency: 50 Hz
- e. Number of Phases: Three-phase
- f. Type of Transformer: Separate winding, Oil-immersed, hermetically sealed (bolted type)
- g. Application: Step-down power transformer for industrial power distribution at Foskor Mine, Phalaborwa. Suitable for continuous operation under heavy industrial loads.
- h. Location: Outdoor, within the open-cast mine environment.
- i. Cooling: Naturally cooled (ONAN)
- j. Tap Winding: HV

32.2 Operating and Environmental Conditions

(Critical for Phalaborwa - Hot, Dusty, Inland):

a. Ambient Temperature:

Season	Average Temperature	Maximum/Minimum Temp.
Summer	35 Degrees Avg	50 Degrees Max
Winter	17 Degrees Avg	2 Degrees Min

- b. Altitude: Not exceeding 380 m above sea level
- c. Wind: Prevailing wind direction: Generally South Easterly - Maximum design velocity 40m/s (144km/h)
- d. Average annual rainfall: 540 mm
- e. Atmospheric Pollution:

- High Dust Content: Transformer design must account for significant airborne dust, requiring appropriate sealing of control cabinets and robust bushing design to prevent flashovers due to dust accumulation.
 - Industrial Pollution: Moderate industrial pollution (e.g., mine dust, particulate matter, potentially mild acidic or alkaline compounds depending on specific mine processes. The supplier should confirm suitability for such environments).
- f. Corrosion: Moderate corrosion risk from general industrial atmosphere. Paint system should be robust for outdoor industrial use.
- g. Seismic Zone: To be determined based on local seismic data for Phalaborwa if any specific requirements apply.

32.3 Electrical Characteristics:

Vector Group	Dyn11
Impedance Voltage (U_k):	Target range 4% to 6% at rated kVA. Manufacturer to confirm actual value. and to the latest SANS 60076 series specification. Guaranteed value to be indicated in the diagram plate
No-Load Losses (P₀):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable and to the latest SANS 60076 series specification. The manufacturer to provide guaranteed values.
Load Losses (P_k):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable. Manufacturer to provide guaranteed values.
Temperature Rise Limits:	• Winding Temperature Rise: Max 65 K over ambient (oil-immersed). • Top Oil Temperature Rise: Max 60 K over ambient (oil-immersed). <i>Note: Given the high ambient temp, ensure the transformer can operate continuously at rated load without exceeding insulation limits.</i>

Highest Voltage for equipment winding Um kV	• HV Side: 12kV • LV Side: <1.1
Insulation Levels (BIL - Basic Impulse Level):	• HV Side: 95 kV • LV Side: 10 kV BIL.
Applied voltage or line terminal AC withstand	28kV
Voltage Regulation:	Max. allowable voltage drop at full load and rated power factor.
Winding Material	Copper (Cu) only
HV Taps	• Type: Off-circuit tap changer (OCTC). • Range: $\pm 2 \times 2.5\%$ (e.g., 11550V, 11275V, 11000V, 10725V, 10450V). • Operation: Manual (lever type) operation when transformer is de-energized. • Provision shall be made for locking the tap switch handle with a padlock having a 6 mm diameter hasp. • Tap changer handles shall be fitted with gasketed covers, so that sealing of the transformer under normal conditions is independent of the switch shaft gland.
Earthing:	LV neutral shall be solidly earthed
Load Rejection	Due to load curtailment from Eskom, the mine has generators that are interconnected to the grid supply. The transformer shall be designed to withstand load rejection conditions at 1,4 times rated voltage for 5 s at the transformer terminals on the HV side.

Overload Capacity	- The transformer shall be capable of operating in accordance with the loading guidelines of IEC 60354 without exceeding the normal daily use of life and without the transformer winding hot spot temperature exceeding 140 °C. - The service provider / OEM shall submit calculations demonstrating that above requirements are met. These calculations shall disregard the effect of winding thermal capacity.
Short Circuit Performance	- The transformer shall be capable of withstanding the thermal and dynamic effects of short circuits. - The ability to withstand the thermal and dynamic effects of a short circuit shall be demonstrated in accordance with IEC 60076 and IEC 60354. Calculations / test certificates shall be submitted for approval
Flux Density	The flux density at any point of the magnetic circuit when the transformer is connected on the centre tap and operating at normal voltage and frequency shall not exceed 1.65 Tesla. Saturation must not occur at 10 % over voltage.
Noise Level	The average noise level of the transformers shall not exceed the values given in IEC 60551. The measurements shall be carried out in accordance with the above standard at a distance of 300 mm from the envelope of the transformer

32.4 Construction Details:

a. Tank Type:

- Conservator type: must include a robust moisture and dust filter (e.g., an advanced breather system beyond standard silica gel) and enhanced sealing

b. Bushings:

- HV Bushings: Outdoor type, porcelain, suitable for 11 kV system. Increased creepage distance recommended (e.g., 25-31 mm/kV) due to potential dust accumulation leading to flashovers.
- LV Bushings: Outdoor type, composite, suitable for 380 V system.
- Specify connection type: Cable box (for direct cable connection, preferred for industrial protection) or outdoor bare terminals. If cable boxes, specify appropriate IP rating (e.g., IP54 or higher) for dust protection.
- The manufacturer shall submit detailed design drawings of the HV and LV cable boxes for approval prior to fabrication. These drawings shall include:
 - Overall dimensions and mounting details.
 - Material specifications and coating details.
 - Internal clearances and phase barrier arrangements.
 - Cable entry gland plate details (size, quantity, proposed gland types).
 - Locking mechanisms and security features.
- The HV bushings shall be labeled in accordance with IEC 60076. Letters shall be at least 12 mm high. The means of marking shall be either:
 - Engraved metal plate or etched anodized aluminium. Identification by adhesive stickers is not acceptable.
 - If labeling is to be carried out on the tank, it is preferred that one plate be used rather than individual markings for each phase, in order to prevent incorrect phase markings.

c. **Radiators:**

- Detachable fin-type radiators.
- To be evenly distributed on opposite sides of the tank
- To have the same colour as the tank (RAL 7033 (Cement Grey))

d. **Protective Coating:**

- Paint system: Durable, **high-temperature resistant**, and robust anti-corrosion paint system suitable for industrial and dusty environments (e.g., hot-dip galvanized tank or

multi-coat epoxy paint system, minimum dry film thickness as per SANS 780, with consideration for UV stability).

- Colour: RAL 7033 (Cement Grey) or as specified by Foskor for the main tank and radiators and White for the conservator
 - The transformer tank and its steel attachments shall be hot dip galvanized or metallized, followed by painting. The painting system used should be proven and documented.
 - All surfaces shall be thoroughly cleaned of rust, scale, grease and dirt and other foreign matter and all imperfections shall be removed by means of approved methods.
 - The inside of the tank shall be painted with an approved oil resisting varnish so that the oil cannot come into contact with the tank metal at any time
- e. **Lifting Lugs:** Provided for total mass.
- f. **Rollers/Wheels:** Removable bi-directional rollers for movement on rails.
- g. **Tank Earthing Terminals:**
- At least two substantial earthing pads.
 - Earthing terminal shall be of stainless steel welded to the tank and be fitted with a stainless steel M12 bolt, nut, spring washer and a lock washer.
- h. **Core – Tank earthing:** to be brought out for external earthing
- i. **Rating Plate:** Stainless steel, engraved with all relevant transformer data, highly resistant to corrosion and fading.
- j. **Height:**
- The preferred height from tank base to tank top cover < 1.8m
 - The preferred height from tank base to top of the conservator < 2.7m (0.9m from tank main cover to the conservator top)
 - (This is due to height restriction is most of the Foskor transformer bays)
- k. **Tank fittings and attachments**

- Tap changer (off-circuit with pad lockable switch)
- HV bushing assembly
- LV bushings assembly
- Oil filling and drain valves
- Main earthing terminal
- Lifting eyes pulling eyes and jacking pads
- Stainless steel engraved rating and connection plate in English
- Pressure relief valve
- Bucholz relay
- Oil level indicator
- Terminal marking

l. Transformer Assembly

- The core and winding shall be dried in a vacuum drying oven.
- The heating and vacuum drying cycle shall be approved by the Foskor.
- The tank, complete with core and windings, shall be filled with oil under a vacuum.

m. Transformer Oil

- The transformers shall be supplied filled with class 1 mineral oil (Virgin Oil) conforming to IEC 60296.
- Foskor shall submit a detailed specification for the type of oil proposed.
- The oil shall not contain polychlorinated biphenyls (PCB).
- Foskor may require evidence that the oil is not contaminated by PCB. If an antioxidant is recommended, its use shall be subject to Foskor's approval.

32.5 Main Rating & Diagram plate (Connection & Vector Group Diagram)

32.5.1 General Requirements:

- a. **Material:** Non-corrosive, weather-resistant, and UV-stable stainless steel material. It must withstand the harsh mining environment at Foskor (dust, high temperatures, potential industrial fumes, sunlight).

- b. **Mounting:** Permanently affixed to the transformer tank in a clearly visible and easily accessible location. It should be securely attached using corrosion-resistant fasteners (e.g., stainless steel rivets or screws).
- c. **Legibility:** All text, symbols, and lines shall be clearly engraved, etched, or printed with indelible ink, ensuring excellent legibility for the lifetime of the transformer, even under adverse lighting or dusty conditions.
- d. **Size:** Of sufficient size to clearly display all required information without clutter, while remaining proportionate to the transformer's overall dimensions.

32.5.2 Content Requirements:

- Type of transformer
- Specification to which standard it was manufactured
- Manufacturer's name
- Serial number
- Year of manufacturer
- Number of phases
- Rated power
- Rated frequency
- Rated voltage
- Rated currents
- Vector group
- Percentage impedance voltage at rated current
- Type of cooling
- Continuous ambient temperature at which ratings apply
- Top oil temperature rise at rated load
- Total weight
- Volume of oil
- Weight of core and windings
- Table of primary voltages at the 5 tapping positions
- Connection diagram
- Employer's name

32.5.3 Compliance:

The design and content of the diagram plate shall comply with the requirements of **SANS 60076-1 (IEC 60076-1)**, specifically regarding information required on the rating plate and supplementary plates.

32.6 Protection and Accessories (Standard and Optional):

- j. **Oil Level Indicator:** Magnetic type, with minimum and maximum levels.
- k. **Temperature Indicators:**
 - Oil Temperature Indicator (OTI): Dial type, with maximum reading pointer and alarm/trip contacts.
 - Winding Temperature Indicator (WTI): Dial type, with maximum reading pointer and alarm/trip contacts (simulated by OTI with heating element).
- l. **Pressure Relief Device:** Spring-loaded pressure relief valve.
- m. **Drain Valve:** With oil sampling device.
- n. **Filter/Filling Valve:** For oil filtration/filling.
- o. **Breather:** advanced silica gel breather with oil seal or similar robust dust filter system to minimize ingress of dust and moisture.
- p. **Buchholz Relay:** to be provided for gas and oil surge detection
- q. **Terminal Box:** Weatherproof terminal box for external wiring of alarm/trip contacts, with **IP55 or higher rating** for dust protection.
- r. **Surge Arresters:** to be supplied with the transformer manufacturer, and mounted on the HV side.

32.7 Standards Compliance:

- a. **International Standards:** IEC 60076 series (Power Transformers).
- b. **National Standards:**
 - SANS 60076 series (Power Transformers).
 - SANS 780 (South African National Standard for Distribution Transformers), and
 - NRS 049 (National Rationalised Standard)
- c. All materials and components to comply with relevant South African national standards.

32.8 Factory Acceptance Testing (FAT) and Documentation:

- a. **Routine Tests:** All routine tests as per IEC 60076 must be performed and certified test reports provided
 - Measurement of winding resistance
 - Measurement of voltage ratio and check of polarity and vector group
 - Tan delta and Capacitance
 - Measurement of impedance voltages
 - Measurement of load losses
 - Measurement of no load losses and no load current,
 - Induced overvoltage withstand test (IVW)
 - Applied voltage test (AV)
 - Bushing routine tests
 - Sweep Frequency Response Analysis
 - Auxiliary wiring insulation test (AuxW)
 - Dielectric strength of oil,
 - Relief Device test
 - Dielectric Routine Tests
 - Galvanizing tests.
 - Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)

- b. **Type Tests:** The appointed OEM or service provider shall provide evidence of type tests on similar transformer (e.g., temperature rise test, lightning impulse withstand test, short-circuit withstand test). If these tests have never been done on the similar transformer, the service provider /OEM shall conduct these tests. These shall be at the expense of the service provider /OEM

The following shall be regarded as type tests:

- Temperature Rise Test. This test shall be carried out on the tap having maximum losses

- Short Circuit Withstand test
- Impulse Voltage Test and Power Frequency Test
- Acoustic Sound Level Measurement
- Tank Vacuum Test
- Measurement of Harmonic Level in no load condition
- Oil Analysis

c. **Documentation:**

The following documents shall be submitted during with the delivery of the transformer

- Certified test reports.
- Outline dimension drawings.
- Connection diagrams.
- Rating plate drawing.
- Comprehensive Instruction Manuals for operation and maintenance.
- Oil test results.
- Tan Delta

32.9 Site Acceptance Testing (SAT) and documentation

All site acceptance testing shall be performed as per IEC 60076 and certified test reports provided

a. **Tests**

- Sweep Frequency Response Analysis
- Insulation Resistance (IR) Test (Megger Test)
- Winding DC Resistance Test
- Transformer Turns Ratio (TTR) Test / Voltage Ratio Test
- Vector Group and Polarity Check
- Exciting Current Test
- Short-Circuit Impedance
- Dissolved Gas Analysis (DGA) of Transformer Oil
- Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)

- Auxiliary equipment testing and wiring

b. Documentation:

A comprehensive SAT report must be generated, detailing all tests performed, measured values, comparison with FAT results, and conclusions on the transformer's readiness for service

32.10 Transportation, Handling, and After-Sales:

- The transformer shall be suitably packed for transportation to Phalaborwa, protecting against dust, heat, and mechanical damage.
- Clear marking of lifting points and handling instructions on the packaging.
- Delivery Point:** Delivered to Foskor Mine in Phalaborwa. The Transformer shall be offloaded at TSS Electrical workshop
- Warranty:** Minimum 24 months from commissioning or 30 months from delivery, whichever occurs first.
- After-Sales Support:** Manufacturer must demonstrate capability for local service, spare parts availability, and technical support in South Africa.
- Site Support:** Ability to provide technical supervision for offloading, positioning, and cold-commissioning

32.11 TECHNICAL SCHEDULE TO BE COMPLETED BY THE BIDDER

1500 kVA, 11000/380 V Distribution Transformer

The following Technical Schedule shall be filled out for the transformer rating.

#	Description	Unit	Data
1	International standards transformer complies with	-	
2	Nominal frequency	Hz	
3	Rated Power	kVA	
4	Nominal primary voltage	kV	
5	Nominal secondary voltage	V	
6	Rated primary voltage	kV	
7	Rated secondary voltage	V	
8	Type of cooling	-	
9	Vector group	-	
10	Tap changing		
	Number of steps	± steps	
	Tapping range	± %	
11	Rated short circuit current and withstanding duration		
	Current	kA	
	Duration	s	
12	Impedance measured at 75 °C and center tap	%	
13	X/R ratio	-	
14	Duration of overload		
	25 % overload	°C	
	50 % overload	°C	
15	Design maximum outdoor temperature	°C	
16	Design continuous ambient temperature	°C	
17	Thermal Characteristics		
	Average winding temperature rise	°C	
	Maximum average temperature rise	°C	
	Maximum hot spot temperature rise	°C	
	Hot-spot to top-oil temperature gradient	°C	
18	Magnetic flux density	Tesla	
19	Core Losses	W	
20	Winding losses	W	
21	No load current	A	
22	Regulation: full load, PF=1	%	
23	Regulation: full load, PF=1	%	

	Regulation: full load, PF=0.85	%	
24	Silicon steel		
	Manufacturer		
	Type and grade		
	Operating flux density	Tesla	
	Guaranteed maximum operating flux density	kA/m	
	Manufacturer's data sheet supplied	Yes/No	
25	Conductor for HV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
26	Conductor for LV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
27	HV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
28	LV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
29	Bushing basic impulse withstand voltage		
	HV Bushing	kV	
	LV Bushing	kV	
30	Bushing power frequency withstand voltage		
	HV Bushing	kV	
	LV Bushing	kV	
31	Terminals		
	Type and metal used in HV terminal		
	Type and metal used in LV terminal		
	Type of metal used in Earth terminal		
32	Minimum phase to phase clearance	mm	
33	Minimum phase to earth clearance	mm	
34	Spring and lock washers included	Yes/No	
35	Tap changer		
	Manufacturer/Supplier		
	Type		
	Catalogue details attached	Yes/No	
	Manufacturers data sheet attached	Yes/No	

36	Can tap changer switch be locked	Yes/No	
37	Tank Fabrication		
	Tank material		
	Thickness of the metal sheet		
	Painting method details attached	Yes/No	
38	Tank Dimensions		
	Width	mm	
39	Transformer weights		
	Height	mm	
	Depth	mm	
	Weight of core and windings	kg	
	Weight of tank	kg	
	Weight of oil at 20 °C	kg	
	Total weight of transformer, ready for shipping	kg	
	Shipping weight of transformer	kg	

ANNEXURE D

Technical Specifications for 1500 kVA, 11000/525V Distribution Transformer

33 ANNEXURE D: 1500 kVA, 11000/525 V DISTRIBUTION TRANSFORMER

Technical Specification: 1500 kVA, 11000/525 V Distribution Transformer

33.1 General:

- a. Rated Power: 1500 kVA
- b. Rated Primary Voltage (HV): 11000 V (11 kV)
- c. Rated Secondary Voltage (LV): 525 V
- d. Frequency: 50 Hz
- e. Number of Phases: Three-phase
- f. Type of Transformer: Separate winding, Oil-immersed, hermetically sealed (bolted type)
- g. Application: Step-down power transformer for industrial power distribution at Foskor Mine, Phalaborwa. Suitable for continuous operation under heavy industrial loads.
- h. Location: Outdoor, within the open-cast mine environment.
- i. Cooling: Naturally cooled (ONAN)
- j. Tap Winding: HV

33.2 Operating and Environmental Conditions

(Critical for Phalaborwa - Hot, Dusty, Inland):

a. Ambient Temperature:

Season	Average Temperature	Maximum/Minimum Temp.
Summer	35 Degrees Avg	50 Degrees Max
Winter	17 Degrees Avg	2 Degrees Min

- b. Altitude: Not exceeding 380 m above sea level
- c. Wind: Prevailing wind direction: Generally South Easterly - Maximum design velocity 40m/s (144km/h)
- d. Average annual rainfall: 540 mm
- e. Atmospheric Pollution:

- High Dust Content: Transformer design must account for significant airborne dust, requiring appropriate sealing of control cabinets and robust bushing design to prevent flashovers due to dust accumulation.
 - Industrial Pollution: Moderate industrial pollution (e.g., mine dust, particulate matter, potentially mild acidic or alkaline compounds depending on specific mine processes. The supplier should confirm suitability for such environments).
- f. Corrosion: Moderate corrosion risk from general industrial atmosphere. Paint system should be robust for outdoor industrial use.
- g. Seismic Zone: To be determined based on local seismic data for Phalaborwa if any specific requirements apply.

33.3 Electrical Characteristics:

Vector Group	Dyn11
Impedance Voltage (U_k):	Target range 4% to 6% at rated kVA. Manufacturer to confirm actual value. and to the latest SANS 60076 series specification. Guaranteed value to be indicated in the diagram plate
No-Load Losses (P₀):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable and to the latest SANS 60076 series specification. Manufacturer to provide guaranteed values.
Load Losses (P_k):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable. Manufacturer to provide guaranteed values.
Temperature Rise Limits:	• Winding Temperature Rise: Max 65 K over ambient (oil-immersed). • Top Oil Temperature Rise: Max 60 K over ambient (oil-immersed). <i>Note: Given the high ambient temp, ensure the transformer can operate continuously at rated load without exceeding insulation limits.</i>

Highest Voltage for equipment winding Um kV	• HV Side: 12kV • LV Side: <1.1
Insulation Levels (BIL - Basic Impulse Level):	• HV Side: 95 kV • LV Side: 10 kV BIL.
Applied voltage or line terminal AC withstand	28kV
Voltage Regulation:	Max. allowable voltage drop at full load and rated power factor.
Winding Material	Copper (Cu) only
HV Taps	• Type: Off-circuit tap changer (OCTC). • Range: $\pm 2 \times 2.5\%$ (e.g., 11550V, 11275V, 11000V, 10725V, 10450V). • Operation: Manual (lever type) operation when transformer is de-energized. • Provision shall be made for locking the tap switch handle with a padlock having a 6 mm diameter hasp. • Tap changer handles shall be fitted with gasketed covers, so that sealing of the transformer under normal conditions is independent of the switch shaft gland.
Earthing:	LV neutral shall be solidly earthed
Load Rejection	Due to load curtailment from Eskom, the mine has generators that are interconnected to the grid supply. The transformer shall be designed to withstand load rejection conditions at 1,4 times rated voltage for 5 s at the transformer terminals on the HV side.

Overload Capacity	- The transformer shall be capable of operating in accordance with the loading guidelines of IEC 60354 without exceeding the normal daily use of life and without the transformer winding hot spot temperature exceeding 140 °C. - The service provider / OEM shall submit calculations demonstrating that above requirements are met. These calculations shall disregard the effect of winding thermal capacity.
Short Circuit Performance	- The transformer shall be capable of withstanding the thermal and dynamic effects of short circuits. - The ability to withstand the thermal and dynamic effects of a short circuit shall be demonstrated in accordance with IEC 60076 and IEC 60354. Calculations / test certificates shall be submitted for approval
Flux Density	The flux density at any point of the magnetic circuit when the transformer is connected on the centre tap and operating at normal voltage and frequency shall not exceed 1.65 Tesla. Saturation must not occur at 10 % over voltage.
Noise Level	The average noise level of the transformers shall not exceed the values given in IEC 60551. The measurements shall be carried out in accordance with the above standard at a distance of 300 mm from the envelope of the transformer

33.4 Construction Details:

a. Tank Type:

- Conservator type: must include a robust moisture and dust filter (e.g., an advanced breather system beyond standard silica gel) and enhanced sealing

b. Bushings:

- HV Bushings: Outdoor type, porcelain, suitable for 11 kV system. Increased creepage distance recommended (e.g., 25-31 mm/kV) due to potential dust accumulation leading to flashovers.
- LV Bushings: Outdoor type, composite, suitable for 525 V system.
- Specify connection type: Cable box (for direct cable connection, preferred for industrial protection) or outdoor bare terminals. If cable boxes, specify appropriate IP rating (e.g., IP54 or higher) for dust protection.
- The manufacturer shall submit detailed design drawings of the HV and LV cable boxes for approval prior to fabrication. These drawings shall include:
 - Overall dimensions and mounting details.
 - Material specifications and coating details.
 - Internal clearances and phase barrier arrangements.
 - Cable entry gland plate details (size, quantity, proposed gland types).
 - Locking mechanisms and security features.
- The HV bushings shall be labeled in accordance with IEC 60076. Letters shall be at least 12 mm high. The means of marking shall be either:
 - Engraved metal plate or etched anodized aluminium. Identification by adhesive stickers is not acceptable.
 - If labeling is to be carried out on the tank, it is preferred that one plate be used rather than individual markings for each phase, in order to prevent incorrect phase markings.

c. **Radiators:**

- Detachable fin-type radiators.
- To be evenly distributed on opposite sides of the tank
- To have the same colour as the tank (RAL 7033 (Cement Grey))

d. **Protective Coating:**

- Paint system: Durable, **high-temperature resistant**, and robust anti-corrosion paint system suitable for industrial and dusty environments (e.g., hot-dip galvanized tank or

multi-coat epoxy paint system, minimum dry film thickness as per SANS 780, with consideration for UV stability).

- Colour: RAL 7033 (Cement Grey) or as specified by Foskor for the main tank and radiators and White for the conservator.
 - The transformer tank and its steel attachments shall be hot dip galvanized or metallized, followed by painting. The painting system used should be proven and documented.
 - All surfaces shall be thoroughly cleaned of rust, scale, grease and dirt and other foreign matter and all imperfections shall be removed by means of approved methods.
 - The inside of the tank shall be painted with an approved oil resisting varnish so that the oil cannot come into contact with the tank metal at any time
- e. **Lifting Lugs:** Provided for total mass.
- f. **Rollers/Wheels:** Removable bi-directional rollers for movement on rails.
- g. **Tank Earthing Terminals:**
- At least two substantial earthing pads.
 - Earthing terminal shall be of stainless steel welded to the tank and be fitted with a stainless steel M12 bolt, nut, spring washer and a lock washer.
- h. **Core – Tank earthing:** to be brought out for external earthing
- i. **Rating Plate:** Stainless steel, engraved with all relevant transformer data, highly resistant to corrosion and fading.
- j. **Height:**
- The preferred height from tank base to tank top cover < 1.8m
 - The preferred height from tank base to top of the conservator < 2.7m (0.9m from tank main cover to the conservator top)
 - (This is due to height restriction is most of the Foskor transformer bays)
- k. **Tank fittings and attachments**

- Tap changer (off-circuit with pad lockable switch)
- HV bushing assembly
- LV bushings assembly
- Oil filling and drain valves
- Main earthing terminal
- Lifting eyes pulling eyes and jacking pads
- Stainless steel engraved rating and connection plate in English
- Pressure relief valve
- Bucholz relay
- Oil level indicator
- Terminal marking

l. Transformer Assembly

- The core and winding shall be dried in a vacuum drying oven.
- The heating and vacuum drying cycle shall be approved by the Foskor.
- The tank, complete with core and windings, shall be filled with oil under a vacuum.

m. Transformer Oil

- The transformers shall be supplied filled with class 1 mineral oil (Virgin Oil) conforming to IEC 60296.
- Foskor shall submit a detailed specification for the type of oil proposed.
- The oil shall not contain polychlorinated biphenyls (PCB).
- Foskor may require evidence that the oil is not contaminated by PCB. If an antioxidant is recommended, its use shall be subject to Foskor's approval.

33.5 Main Rating & Diagram plate (Connection & Vector Group Diagram)

33.5.1 General Requirements:

- a. **Material:** Non-corrosive, weather-resistant, and UV-stable stainless steel material. It must withstand the harsh mining environment at Foskor (dust, high temperatures, potential industrial fumes, sunlight).

- b. **Mounting:** Permanently affixed to the transformer tank in a clearly visible and easily accessible location. It should be securely attached using corrosion-resistant fasteners (e.g., stainless steel rivets or screws).
- c. **Legibility:** All text, symbols, and lines shall be clearly engraved, etched, or printed with indelible ink, ensuring excellent legibility for the lifetime of the transformer, even under adverse lighting or dusty conditions.
- d. **Size:** Of sufficient size to clearly display all required information without clutter, while remaining proportionate to the transformer's overall dimensions.

33.5.2 Content Requirements:

- Type of transformer
- Specification to which standard it was manufactured
- Manufacturer's name
- Serial number
- Year of manufacturer
- Number of phases
- Rated power
- Rated frequency
- Rated voltage
- Rated currents
- Vector group
- Percentage impedance voltage at rated current
- Type of cooling
- Continuous ambient temperature at which ratings apply
- Top oil temperature rise at rated load
- Total weight
- Volume of oil
- Weight of core and windings
- Table of primary voltages at the 5 tapping positions
- Connection diagram
- Employer's name

33.5.3 Compliance:

The design and content of the diagram plate shall comply with the requirements of **SANS 60076-1 (IEC 60076-1)**, specifically regarding information required on the rating plate and supplementary plates.

33.6 Protection and Accessories (Standard and Optional):

- a. **Oil Level Indicator:** Magnetic type, with minimum and maximum levels.
- b. **Temperature Indicators:**
 - Oil Temperature Indicator (OTI): Dial type, with maximum reading pointer and alarm/trip contacts.
 - Winding Temperature Indicator (WTI): Dial type, with maximum reading pointer and alarm/trip contacts (simulated by OTI with heating element).
- c. **Pressure Relief Device:** Spring-loaded pressure relief valve.
- d. **Drain Valve:** With oil sampling device.
- e. **Filter/Filling Valve:** For oil filtration/filling.
- f. **Breather:** advanced silica gel breather with oil seal or similar robust dust filter system to minimize ingress of dust and moisture.
- g. **Buchholz Relay:** to be provided for gas and oil surge detection
- h. **Terminal Box:** Weatherproof terminal box for external wiring of alarm/trip contacts, with **IP55 or higher rating** for dust protection.
- i. **Surge Arresters:** to be supplied with the transformer manufacturer, and mounted on the HV side.

33.7 Standards Compliance:

- a. **International Standards:** IEC 60076 series (Power Transformers).
- b. **National Standards:**
 - SANS 60076 series (Power Transformers).
 - SANS 780 (South African National Standard for Distribution Transformers), and
 - NRS 049 (National Rationalised Standard)
- c. All materials and components to comply with relevant South African national standards.

33.8 Factory Acceptance Testing (FAT) and Documentation:

- a. **Routine Tests:** All routine tests as per IEC 60076 must be performed and certified test reports provided
 - Measurement of winding resistance
 - Measurement of voltage ratio and check of polarity and vector group
 - Tan delta and Capacitance
 - Measurement of impedance voltages
 - Measurement of load losses
 - Measurement of no load losses and no load current,
 - Induced overvoltage withstand test (IVW)
 - Applied voltage test (AV)
 - Bushing routine tests
 - Sweep Frequency Response Analysis
 - Auxiliary wiring insulation test (AuxW)
 - Dielectric strength of oil,
 - Relief Device test
 - Dielectric Routine Tests
 - Galvanizing tests.
 - Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)

- b. **Type Tests:** The appointed OEM or service provider shall provide evidence of type tests on similar transformer (e.g., temperature rise test, lightning impulse withstand test, short-circuit withstand test). If these tests have never been done on the similar transformer, the service provider /OEM shall conduct these tests. These shall be at the expense of the service provider /OEM

The following shall be regarded as type tests:

- Temperature Rise Test. This test shall be carried out on the tap having maximum losses

- Short Circuit Withstand test
- Impulse Voltage Test and Power Frequency Test
- Acoustic Sound Level Measurement
- Tank Vacuum Test
- Measurement of Harmonic Level in no load condition
- Oil Analysis

c. **Documentation:**

The following documents shall be submitted during with the delivery of the transformer

- Certified test reports.
- Outline dimension drawings.
- Connection diagrams.
- Rating plate drawing.
- Comprehensive Instruction Manuals for operation and maintenance.
- Oil test results.
- Tan Delta

33.9 Site Acceptance Testing (SAT) and documentation

All site acceptance testing shall be performed as per IEC 60076 and certified test reports provided

a. **Tests**

- Sweep Frequency Response Analysis
- Insulation Resistance (IR) Test (Megger Test)
- Winding DC Resistance Test
- Transformer Turns Ratio (TTR) Test / Voltage Ratio Test
- Vector Group and Polarity Check
- Exciting Current Test
- Short-Circuit Impedance
- Dissolved Gas Analysis (DGA) of Transformer Oil
- Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)

- Auxiliary equipment testing and wiring

b. Documentation:

A comprehensive SAT report must be generated, detailing all tests performed, measured values, comparison with FAT results, and conclusions on the transformer's readiness for service

33.10 Transportation, Handling, and After-Sales:

- a. The transformer shall be suitably packed for transportation to Phalaborwa, protecting against dust, heat, and mechanical damage.
- b. Clear marking of lifting points and handling instructions on the packaging.
- c. **Delivery Point:** Delivered to Foskor Mine in Phalaborwa. The Transformer shall be offloaded at TSS Electrical workshop
- d. **Warranty:** Minimum 24 months from commissioning or 30 months from delivery, whichever occurs first.
- e. **After-Sales Support:** Manufacturer must demonstrate capability for local service, spare parts availability, and technical support in South Africa.
- f. **Site Support:** Ability to provide technical supervision for offloading, positioning, and cold-commissioning

33.11 TECHNICAL SCHEDULE TO BE COMPLETED BY THE BIDDER

1500 kVA, 11000/525 V Distribution Transformer

The following Technical Schedule shall be filled out for the transformer rating.

#	Description	Unit	Data
1	International standards transformer complies with	-	
2	Nominal frequency	Hz	
3	Rated Power	kVA	
4	Nominal primary voltage	kV	
5	Nominal secondary voltage	V	
6	Rated primary voltage	kV	
7	Rated secondary voltage	V	
8	Type of cooling	-	
9	Vector group	-	
10	Tap changing		
	Number of steps	± steps	
	Tapping range	± %	
11	Rated short circuit current and withstanding duration		
	Current	kA	
	Duration	s	
12	Impedance measured at 75 °C and center tap	%	
13	X/R ratio	-	
14	Duration of overload		
	25 % overload	°C	
	50 % overload	°C	
15	Design maximum outdoor temperature	°C	
16	Design continuous ambient temperature	°C	
17	Thermal Characteristics		
	Average winding temperature rise	°C	
	Maximum average temperature rise	°C	
	Maximum hot spot temperature rise	°C	
	Hot-spot to top-oil temperature gradient	°C	
18	Magnetic flux density	Tesla	
19	Core Losses	W	
20	Winding losses	W	
21	No load current	A	
22	Regulation: full load, PF=1	%	
23	Regulation: full load, PF=1	%	

	Regulation: full load, PF=0.85	%	
24	Silicon steel		
	Manufacturer		
	Type and grade		
	Operating flux density	Tesla	
	Guaranteed maximum operating flux density	kA/m	
	Manufacturer's data sheet supplied	Yes/No	
25	Conductor for HV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
26	Conductor for LV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
27	HV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
28	LV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
29	Bushing basic impulse withstand voltage		
	HV Bushing	kV	
	LV Bushing	kV	
30	Bushing power frequency withstand voltage		
	HV Bushing	kV	
	LV Bushing	kV	
31	Terminals		
	Type and metal used in HV terminal		
	Type and metal used in LV terminal		
	Type of metal used in Earth terminal		
32	Minimum phase to phase clearance	mm	
33	Minimum phase to earth clearance	mm	
34	Spring and lock washers included	Yes/No	
35	Tap changer		
	Manufacturer/Supplier		
	Type		
	Catalogue details attached	Yes/No	
	Manufacturers data sheet attached	Yes/No	

36	Can tap changer switch be locked	Yes/No	
37	Tank Fabrication		
	Tank material		
	Thickness of the metal sheet		
	Painting method details attached	Yes/No	
38	Tank Dimensions		
	Width	mm	
39	Transformer weights		
	Height	mm	
	Depth	mm	
	Weight of core and windings	kg	
	Weight of tank	kg	
	Weight of oil at 20 °C	kg	
	Total weight of transformer, ready for shipping	kg	
	Shipping weight of transformer	kg	

ANNEXURE E

Technical Specifications for 1000 kVA, 11000/525V Distribution Transformer

34 ANNEXURE E: 1000 kVA, 11000/525 V DISTRIBUTION TRANSFORMER

Technical Specification: 1000 kVA, 11000/525 V Distribution Transformer

34.1 General:

- a. Rated Power: 1000 kVA
- b. Rated Primary Voltage (HV): 11000 V (11 kV)
- c. Rated Secondary Voltage (LV): 525 V
- d. Frequency: 50 Hz
- e. Number of Phases: Three-phase
- f. Type of Transformer: Separate winding, Oil-immersed, hermetically sealed (bolted type)
- g. Application: Step-down power transformer for industrial power distribution at Foskor Mine, Phalaborwa. Suitable for continuous operation under heavy industrial loads.
- h. Location: Outdoor, within the open-cast mine environment.
- i. Cooling: Naturally cooled (ONAN)
- j. Tap Winding: HV

34.2 Operating and Environmental Conditions

(Critical for Phalaborwa - Hot, Dusty, Inland):

a. Ambient Temperature:

Season	Average Temperature	Maximum/Minimum Temp.
Summer	35 Degrees Avg	50 Degrees Max
Winter	17 Degrees Avg	2 Degrees Min

- b. Altitude: Not exceeding 380 m above sea level
- c. Wind: Prevailing wind direction: Generally South Easterly - Maximum design velocity 40m/s (144km/h)
- d. Average annual rainfall: 540 mm
- e. Atmospheric Pollution:

- High Dust Content: Transformer design must account for significant airborne dust, requiring appropriate sealing of control cabinets and robust bushing design to prevent flashovers due to dust accumulation.
 - Industrial Pollution: Moderate industrial pollution (e.g., mine dust, particulate matter, potentially mild acidic or alkaline compounds depending on specific mine processes. The supplier should confirm suitability for such environments).
- f. Corrosion: Moderate corrosion risk from general industrial atmosphere. Paint system should be robust for outdoor industrial use.
- g. Seismic Zone: To be determined based on local seismic data for Phalaborwa if any specific requirements apply.

34.3 Electrical Characteristics:

Vector Group	Dyn11
Impedance Voltage (U_k):	Target range 4% to 6% at rated kVA. Manufacturer to confirm actual value. and to the latest SANS 60076 series specification. Guaranteed value to be indicated in the diagram plate
No-Load Losses (P₀):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable and to the latest SANS 60076 series specification. Manufacturer to provide guaranteed values.
Load Losses (P_k):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable. Manufacturer to provide guaranteed values.
Temperature Rise Limits:	• Winding Temperature Rise: Max 65 K over ambient (oil-immersed). • Top Oil Temperature Rise: Max 60 K over ambient (oil-immersed). <i>Note: Given the high ambient temp, ensure the transformer can operate continuously at rated load without exceeding insulation limits.</i>

Highest Voltage for equipment winding Um kV	• HV Side: 12kV • LV Side: <1.1
Insulation Levels (BIL - Basic Impulse Level):	• HV Side: 95 kV • LV Side: 10 kV BIL.
Applied voltage or line terminal AC withstand	28kV
Voltage Regulation:	Max. allowable voltage drop at full load and rated power factor.
Winding Material	Copper (Cu) only
HV Taps	• Type: Off-circuit tap changer (OCTC). • Range: $\pm 2 \times 2.5\%$ (e.g., 11550V, 11275V, 11000V, 10725V, 10450V). • Operation: Manual (lever type) operation when transformer is de-energized. • Provision shall be made for locking the tap switch handle with a padlock having a 6 mm diameter hasp. • Tap changer handles shall be fitted with gasketed covers, so that sealing of the transformer under normal conditions is independent of the switch shaft gland.
Earthing:	LV neutral shall be solidly earthed
Load Rejection	Due to load curtailment from Eskom, the mine has generators that are interconnected to the grid supply. The transformer shall be designed to withstand load rejection conditions at 1,4 times rated voltage for 5 s at the transformer terminals on the HV side.

Overload Capacity	- The transformer shall be capable of operating in accordance with the loading guidelines of IEC 60354 without exceeding the normal daily use of life and without the transformer winding hot spot temperature exceeding 140 °C. - The service provider / OEM shall submit calculations demonstrating that above requirements are met. These calculations shall disregard the effect of winding thermal capacity.
Short Circuit Performance	- The transformer shall be capable of withstanding the thermal and dynamic effects of short circuits. - The ability to withstand the thermal and dynamic effects of a short circuit shall be demonstrated in accordance with IEC 60076 and IEC 60354. Calculations / test certificates shall be submitted for approval
Flux Density	The flux density at any point of the magnetic circuit when the transformer is connected on the centre tap and operating at normal voltage and frequency shall not exceed 1.65 Tesla. Saturation must not occur at 10 % over voltage.
Noise Level	The average noise level of the transformers shall not exceed the values given in IEC 60551. The measurements shall be carried out in accordance with the above standard at a distance of 300 mm from the envelope of the transformer

34.4 Construction Details:

a. Tank Type:

- Conservator type: must include a robust moisture and dust filter (e.g., an advanced breather system beyond standard silica gel) and enhanced sealing

b. Bushings:

- HV Bushings: Outdoor type, porcelain, suitable for 11 kV system. Increased creepage distance recommended (e.g., 25-31 mm/kV) due to potential dust accumulation leading to flashovers.
- LV Bushings: Outdoor type, composite, suitable for 525 V system.
- Specify connection type: Cable box (for direct cable connection, preferred for industrial protection) or outdoor bare terminals. If cable boxes, specify appropriate IP rating (e.g., IP54 or higher) for dust protection.
- The manufacturer shall submit detailed design drawings of the HV and LV cable boxes for approval prior to fabrication. These drawings shall include:
 - Overall dimensions and mounting details.
 - Material specifications and coating details.
 - Internal clearances and phase barrier arrangements.
 - Cable entry gland plate details (size, quantity, proposed gland types).
 - Locking mechanisms and security features.
- The HV bushings shall be labeled in accordance with IEC 60076. Letters shall be at least 12 mm high. The means of marking shall be either:
 - Engraved metal plate or etched anodized aluminium. Identification by adhesive stickers is not acceptable.
 - If labeling is to be carried out on the tank, it is preferred that one plate be used rather than individual markings for each phase, in order to prevent incorrect phase markings.

c. **Radiators:**

- Detachable fin-type radiators.
- To be evenly distributed on opposite sides of the tank
- To have the same colour as the tank (RAL 7033 (Cement Grey))

d. **Protective Coating:**

- Paint system: Durable, **high-temperature resistant**, and robust anti-corrosion paint system suitable for industrial and dusty environments (e.g., hot-dip galvanized tank or

multi-coat epoxy paint system, minimum dry film thickness as per SANS 780, with consideration for UV stability).

- Colour: RAL 7033 (Cement Grey) or as specified by Foskor for the main tank and radiators and White for the conservator
 - The transformer tank and its steel attachments shall be hot dip galvanized or metallized, followed by painting. The painting system used should be proven and documented.
 - All surfaces shall be thoroughly cleaned of rust, scale, grease and dirt and other foreign matter and all imperfections shall be removed by means of approved methods.
 - The inside of the tank shall be painted with an approved oil resisting varnish so that the oil cannot come into contact with the tank metal at any time
- e. **Lifting Lugs:** Provided for total mass.
- f. **Rollers/Wheels:** Removable bi-directional rollers for movement on rails.
- g. **Tank Earthing Terminals:**
- At least two substantial earthing pads.
 - Earthing terminal shall be of stainless steel welded to the tank and be fitted with a stainless steel M12 bolt, nut, spring washer and a lock washer.
- h. **Core – Tank earthing:** to be brought out for external earthing
- i. **Rating Plate:** Stainless steel, engraved with all relevant transformer data, highly resistant to corrosion and fading.
- j. **Height:**
- The preferred height from tank base to tank top cover < 1.8m
 - The preferred height from tank base to top of the conservator < 2.7m (0.9m from tank main cover to the conservator top)
 - (This is due to height restriction is most of the Foskor transformer bays)
- k. **Tank fittings and attachments**

- Tap changer (off-circuit with pad lockable switch)
- HV bushing assembly
- LV bushings assembly
- Oil filling and drain valves
- Main earthing terminal
- Lifting eyes pulling eyes and jacking pads
- Stainless steel engraved rating and connection plate in English
- Pressure relief valve
- Bucholz relay
- Oil level indicator
- Terminal marking

l. Transformer Assembly

- The core and winding shall be dried in a vacuum drying oven.
- The heating and vacuum drying cycle shall be approved by the Foskor.
- The tank, complete with core and windings, shall be filled with oil under a vacuum.

m. Transformer Oil

- The transformers shall be supplied filled with class 1 mineral oil (Virgin Oil) conforming to IEC 60296.
- Foskor shall submit a detailed specification for the type of oil proposed.
- The oil shall not contain polychlorinated biphenyls (PCB).
- Foskor may require evidence that the oil is not contaminated by PCB. If an antioxidant is recommended, its use shall be subject to Foskor's approval.

34.5 Main Rating & Diagram plate (Connection & Vector Group Diagram)

34.5.1 General Requirements:

- a. **Material:** Non-corrosive, weather-resistant, and UV-stable stainless steel material. It must withstand the harsh mining environment at Foskor (dust, high temperatures, potential industrial fumes, sunlight).

- b. **Mounting:** Permanently affixed to the transformer tank in a clearly visible and easily accessible location. It should be securely attached using corrosion-resistant fasteners (e.g., stainless steel rivets or screws).
- c. **Legibility:** All text, symbols, and lines shall be clearly engraved, etched, or printed with indelible ink, ensuring excellent legibility for the lifetime of the transformer, even under adverse lighting or dusty conditions.
- d. **Size:** Of sufficient size to clearly display all required information without clutter, while remaining proportionate to the transformer's overall dimensions.

34.5.2 Content Requirements:

- Type of transformer
- Specification to which standard it was manufactured
- Manufacturer's name
- Serial number
- Year of manufacturer
- Number of phases
- Rated power
- Rated frequency
- Rated voltage
- Rated currents
- Vector group
- Percentage impedance voltage at rated current
- Type of cooling
- Continuous ambient temperature at which ratings apply
- Top oil temperature rise at rated load
- Total weight
- Volume of oil
- Weight of core and windings
- Table of primary voltages at the 5 tapping positions
- Connection diagram
- Employer's name

34.5.3 Compliance:

The design and content of the diagram plate shall comply with the requirements of **SANS 60076-1 (IEC 60076-1)**, specifically regarding information required on the rating plate and supplementary plates.

34.6 Protection and Accessories (Standard and Optional):

- a. **Oil Level Indicator:** Magnetic type, with minimum and maximum levels.
- b. **Temperature Indicators:**
 - Oil Temperature Indicator (OTI): Dial type, with maximum reading pointer and alarm/trip contacts.
 - Winding Temperature Indicator (WTI): Dial type, with maximum reading pointer and alarm/trip contacts (simulated by OTI with heating element).
- c. **Pressure Relief Device:** Spring-loaded pressure relief valve.
- d. **Drain Valve:** With oil sampling device.
- e. **Filter/Filling Valve:** For oil filtration/filling.
- f. **Breather:** advanced silica gel breather with oil seal or similar robust dust filter system to minimize ingress of dust and moisture.
- g. **Buchholz Relay:** to be provided for gas and oil surge detection
- h. **Terminal Box:** Weatherproof terminal box for external wiring of alarm/trip contacts, with **IP55 or higher rating** for dust protection.
- i. **Surge Arresters:** to be supplied with the transformer manufacturer, and mounted on the HV side.

34.7 Standards Compliance:

- a. **International Standards:** IEC 60076 series (Power Transformers).
- b. **National Standards:**
 - SANS 60076 series (Power Transformers).
 - SANS 780 (South African National Standard for Distribution Transformers), and
 - NRS 049 (National Rationalised Standard)
- c. All materials and components to comply with relevant South African national standards.

34.8 Factory Acceptance Testing (FAT) and Documentation:

- a. **Routine Tests:** All routine tests as per IEC 60076 must be performed and certified test reports provided
 - Measurement of winding resistance
 - Measurement of voltage ratio and check of polarity and vector group
 - Tan delta and Capacitance
 - Measurement of impedance voltages
 - Measurement of load losses
 - Measurement of no load losses and no load current,
 - Induced overvoltage withstand test (IVW)
 - Applied voltage test (AV)
 - Bushing routine tests
 - Sweep Frequency Response Analysis
 - Auxiliary wiring insulation test (AuxW)
 - Dielectric strength of oil,
 - Relief Device test
 - Dielectric Routine Tests
 - Galvanizing tests.
 - Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)

- b. **Type Tests:** The appointed OEM or service provider shall provide evidence of type tests on similar transformers (e.g., temperature rise test, lightning impulse withstand test, short-circuit withstand test, Acoustic Sound Level Measurement). If these test have never been done on the similar transformer, the service provider /OEM shall conduct these tests. These shall be at the expense of the service provider /OEM
 The following shall be regarded as type tests:
 - Temperature Rise Test. This test shall be carried out on the tap having maximum losses
 - Short Circuit Withstand test
 - Impulse Voltage Test and Power Frequency Test

- Acoustic Sound Level Measurement
- Tank Vacuum Test
- Measurement of Harmonic Level in no load condition

c. **Documentation:**

The following documents shall be submitted with the delivery of the transformer

- Certified test reports.
- Outline dimension drawings.
- Connection diagrams.
- Rating plate drawing.
- Comprehensive Instruction Manuals for operation and maintenance.
- Oil test results.
- Tan Delta

34.9 Site Acceptance Testing (SAT) and documentation

All site acceptance testing shall be performed as per IEC 60076 and certified test reports provided

a. **Tests**

- Sweep Frequency Response Analysis
- Insulation Resistance (IR) Test (Megger Test)
- Winding DC Resistance Test
- Transformer Turns Ratio (TTR) Test / Voltage Ratio Test
- Vector Group and Polarity Check
- Exciting Current Test
- Short-Circuit Impedance
- Dissolved Gas Analysis (DGA) of Transformer Oil
- Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)
- Auxiliary equipment testing and wiring

b. **Documentation:**

A comprehensive SAT report must be generated, detailing all tests performed,

measured values, comparison with FAT results, and conclusions on the transformer's readiness for service

34.10 Transportation, Handling, and After-Sales:

- a. The transformer shall be suitably packed for transportation to Phalaborwa, protecting against dust, heat, and mechanical damage.
- b. Clear marking of lifting points and handling instructions on the packaging.
- c. **Delivery Point:** Delivered to Foskor Mine in Phalaborwa. The Transformer shall be offloaded at TSS Electrical workshop
- d. **Warranty:** Minimum 24 months from commissioning or 30 months from delivery, whichever occurs first.
- e. **After-Sales Support:** Manufacturer must demonstrate capability for local service, spare parts availability, and technical support in South Africa.
- f. **Site Support:** Ability to provide technical supervision for offloading, positioning, and cold-commissioning

34.11 TECHNICAL SCHEDULE TO BE COMPLETED BY THE BIDDER

1000 kVA, 11000/525 V Distribution Transformer

The following Technical Schedule shall be filled out for the transformer rating.

#	Description	Unit	Data
1	International standards transformer complies with	-	
2	Nominal frequency	Hz	
3	Rated Power	kVA	
4	Nominal primary voltage	kV	
5	Nominal secondary voltage	V	
6	Rated primary voltage	kV	
7	Rated secondary voltage	V	
8	Type of cooling	-	
9	Vector group	-	
10	Tap changing		
	Number of steps	± steps	
	Tapping range	± %	
11	Rated short circuit current and withstanding duration		
	Current	kA	
	Duration	s	
12	Impedance measured at 75 °C and center tap	%	
13	X/R ratio	-	
14	Duration of overload		
	25 % overload	°C	
	50 % overload	°C	
15	Design maximum outdoor temperature	°C	
16	Design continuous ambient temperature	°C	
17	Thermal Characteristics		
	Average winding temperature rise	°C	
	Maximum average temperature rise	°C	
	Maximum hot spot temperature rise	°C	
	Hot-spot to top-oil temperature gradient	°C	
18	Magnetic flux density	Tesla	
19	Core Losses	W	
20	Winding losses	W	
21	No load current	A	
22	Regulation: full load, PF=1	%	
23	Regulation: full load, PF=1	%	

	Regulation: full load, PF=0.85	%	
24	Silicon steel		
	Manufacturer		
	Type and grade		
	Operating flux density	Tesla	
	Guaranteed maximum operating flux density	kA/m	
	Manufacturer's data sheet supplied	Yes/No	
25	Conductor for HV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
26	Conductor for LV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
27	HV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
28	LV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
29	Bushing basic impulse withstand voltage		
	HV Bushing	kV	
	LV Bushing	kV	
30	Bushing power frequency withstand voltage		
	HV Bushing	kV	
	LV Bushing	kV	
31	Terminals		
	Type and metal used in HV terminal		
	Type and metal used in LV terminal		
	Type of metal used in Earth terminal		
32	Minimum phase to phase clearance	mm	
33	Minimum phase to earth clearance	mm	
34	Spring and lock washers included	Yes/No	
35	Tap changer		
	Manufacturer/Supplier		
	Type		
	Catalogue details attached	Yes/No	
	Manufacturers data sheet attached	Yes/No	

36	Can tap changer switch be locked	Yes/No	
37	Tank Fabrication		
	Tank material		
	Thickness of the metal sheet		
	Painting method details attached	Yes/No	
38	Tank Dimensions		
	Width	mm	
39	Transformer weights		
	Height	mm	
	Depth	mm	
	Weight of core and windings	kg	
	Weight of tank	kg	
	Weight of oil at 20 °C	kg	
	Total weight of transformer, ready for shipping	kg	
	Shipping weight of transformer	kg	

ANNEXURE F

Technical Specifications for 50 kVA, 11000/525V Distribution Transformer

35 ANNEXURE F: 50 kVA, 11000/525 V DISTRIBUTION TRANSFORMER

Technical Specification: 50 kVA, 11000/525 V Distribution Transformer

35.1 General:

- a. Rated Power: 50 kVA
- b. Rated Primary Voltage (HV): 11000 V (11 kV)
- c. Rated Secondary Voltage (LV): 525 V
- d. Frequency: 50 Hz
- e. Number of Phases: Three-phase
- f. Type of Transformer: Separate winding, Oil-immersed, hermetically sealed (bolted type)
- g. Application: Step-down power transformer for industrial power distribution at Foskor Mine, Phalaborwa. Suitable for continuous operation under heavy industrial loads.
- h. Location: Outdoor, within the open-cast mine environment.
- i. Cooling: Naturally cooled (ONAN)
- j. Tap Winding: HV

35.2 Operating and Environmental Conditions

(Critical for Phalaborwa - Hot, Dusty, Inland):

a. Ambient Temperature:

Season	Average Temperature	Maximum/Minimum Temp.
Summer	35 Degrees Avg	50 Degrees Max
Winter	17 Degrees Avg	2 Degrees Min

- b. Altitude: Not exceeding 380 m above sea level
- c. Wind: Prevailing wind direction: Generally South Easterly - Maximum design velocity 40m/s (144km/h)
- d. Average annual rainfall: 540 mm
- e. Atmospheric Pollution:

- High Dust Content: Transformer design must account for significant airborne dust, requiring appropriate sealing of control cabinets and robust bushing design to prevent flashovers due to dust accumulation.
 - Industrial Pollution: Moderate industrial pollution (e.g., mine dust, particulate matter, potentially mild acidic or alkaline compounds depending on specific mine processes. The supplier should confirm suitability for such environments).
- f. Corrosion: Moderate corrosion risk from general industrial atmosphere. Paint system should be robust for outdoor industrial use.
- g. Seismic Zone: To be determined based on local seismic data for Phalaborwa if any specific requirements apply.

35.3 Electrical Characteristics:

Vector Group	Dyn11
Impedance Voltage (U_k):	Target range 4% to 6% at rated kVA. Manufacturer to confirm actual value. and to the latest SANS 60076 series specification. Guaranteed value to be indicated in the diagram plate
No-Load Losses (P₀):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable and to the latest SANS 60076 series specification. Manufacturer to provide guaranteed values.
Load Losses (P_k):	To conform to latest SANS 780 energy efficiency levels or lowest losses achievable. Manufacturer to provide guaranteed values.
Temperature Rise Limits:	• Winding Temperature Rise: Max 65 K over ambient (oil-immersed). • Top Oil Temperature Rise: Max 60 K over ambient (oil-immersed). <i>Note: Given the high ambient temp, ensure the transformer can operate continuously at rated load without exceeding insulation limits.</i>

Highest Voltage for equipment winding Um kV	• HV Side: 12kV • LV Side: <1.1
Insulation Levels (BIL - Basic Impulse Level):	• HV Side: 95 kV • LV Side: 10 kV BIL.
Applied voltage or line terminal AC withstand	28kV
Voltage Regulation:	Max. allowable voltage drop at full load and rated power factor.
Winding Material	Copper (Cu) only
HV Taps	• Type: Off-circuit tap changer (OCTC). • Range: $\pm 2 \times 2.5\%$ (e.g., 11550V, 11275V, 11000V, 10725V, 10450V). • Operation: Manual (lever type) operation when transformer is de-energized. • Provision shall be made for locking the tap switch handle with a padlock having a 6 mm diameter hasp. • Tap changer handles shall be fitted with gasketed covers, so that sealing of the transformer under normal conditions is independent of the switch shaft gland.
Earthing:	LV neutral shall be solidly earthed
Load Rejection	Due to load curtailment from Eskom, the mine has generators that are interconnected to the grid supply. The transformer shall be designed to withstand load rejection conditions at 1,4 times rated voltage for 5 s at the transformer terminals on the HV side.

Overload Capacity	- The transformer shall be capable of operating in accordance with the loading guidelines of IEC 60354 without exceeding the normal daily use of life and without the transformer winding hot spot temperature exceeding 140 °C. - The service provider / OEM shall submit calculations demonstrating that above requirements are met. These calculations shall disregard the effect of winding thermal capacity.
Short Circuit Performance	- The transformer shall be capable of withstanding the thermal and dynamic effects of short circuits. - The ability to withstand the thermal and dynamic effects of a short circuit shall be demonstrated in accordance with IEC 60076 and IEC 60354. Calculations / test certificates shall be submitted for approval
Flux Density	The flux density at any point of the magnetic circuit when the transformer is connected on the centre tap and operating at normal voltage and frequency shall not exceed 1.65 Tesla. Saturation must not occur at 10 % over voltage.
Noise Level	The average noise level of the transformers shall not exceed the values given in IEC 60551. The measurements shall be carried out in accordance with the above standard at a distance of 300 mm from the envelope of the transformer

35.4 Construction Details:

a. Tank Type:

- Welded steel tank, robust design to withstand transportation and operational stresses.
- Conservator type: must include a robust moisture and dust filter (e.g., an advanced breather system beyond standard silica gel) and enhanced sealing

b. Bushings:

- HV Bushings: Outdoor type, porcelain, suitable for 11 kV system. Increased creepage distance recommended (e.g., 25-31 mm/kV) due to potential dust accumulation leading to flashovers.
 - LV Bushings: Outdoor type.
 - Specify connection type: outdoor bare terminals.
 - The manufacturer shall submit detailed design drawings of the HV and LV cable boxes for approval prior to fabrication. These drawings shall include:
 - Overall dimensions and mounting details.
 - Material specifications and coating details.
 - Internal clearances and phase barrier arrangements.
 - Cable entry gland plate details (size, quantity, proposed gland types).
 - Locking mechanisms and security features.
 - The HV bushings shall be labelled in accordance with IEC 60076. Letters shall be at least 12 mm high. The means of marking shall be either:
 - Engraved metal plate or etched anodized aluminium. Identification by adhesive stickers is not acceptable.
 - If labelling is to be carried out on the tank, it is preferred that one plate be used rather than individual markings for each phase, in order to prevent incorrect phase markings.
- c. **Radiators (if required):**
- Detachable fin-type radiators.
 - To be evenly distributed on opposite sides of the tank
 - To have the same colour as the tank (RAL 7033 (Cement Grey))
- d. **Protective Coating:**
- Paint system: Durable, **high-temperature resistant**, and robust anti-corrosion paint system suitable for industrial and dusty environments (e.g., hot-dip galvanized tank or multi-coat epoxy paint system, minimum dry film thickness as per SANS 780, with consideration for UV stability).

- Colour: RAL 7033 (Cement Grey) or as specified by Foskor for the main tank and radiators and White for the conservator
 - The transformer tank and its steel attachments shall be hot dip galvanized or metallized, followed by painting. The painting system used should be proven and documented.
 - All surfaces shall be thoroughly cleaned of rust, scale, grease and dirt and other foreign matter and all imperfections shall be removed by means of approved methods.
 - The inside of the tank shall be painted with an approved oil resisting varnish so that the oil cannot come into contact with the tank metal at any time
- e. **Lifting Lugs:** Provided for total mass.
- f. **Rollers/Wheels:** Removable bi-directional rollers for movement on rails.
- g. **Tank Earthing Terminals:**
- Earthing terminal shall be of stainless steel welded to the tank and be fitted with a stainless steel M12 bolt, nut, spring washer and a lock washer.
- h. **Core – Tank earthing:** to be brought out for external earthing
- i. **Rating Plate:** Stainless steel, engraved with all relevant transformer data, highly resistant to corrosion and fading.
- j. **Height:**
- The preferred height from tank base to tank top cover < 1.8m
 - The preferred height from tank base to top of the conservator < 2.7m (0.9m from tank main cover to the conservator top)
 - (This is due to height restriction is most of the Foskor transformer bays)
- k. **Tank fittings and attachments**
- Tap changer (off-circuit with pad lockable switch)
 - HV bushing assembly
 - LV bushings assembly

- Oil filling and drain valves
- Main earthing terminal
- Lifting eyes pulling eyes and jacking pads
- Stainless steel engraved rating and connection plate in English
- Pressure relief valve
- Bucholz relay
- Oil level indicator
- Terminal marking

l. Transformer Assembly

- The core and winding shall be dried in a vacuum drying oven.
- The heating and vacuum drying cycle shall be approved by the Foskop.
- The tank, complete with core and windings, shall be filled with oil under a vacuum.

m. Transformer Oil

- The transformers shall be supplied filled with class 1 mineral oil (Virgin Oil) conforming to IEC 60296.
- Foskop shall submit a detailed specification for the type of oil proposed.
- The oil shall not contain polychlorinated biphenyls (PCB).
- Foskop may require evidence that the oil is not contaminated by PCB. If an antioxidant is recommended, its use shall be subject to Foskop's approval.

35.5 Main Rating & Diagram plate (Connection & Vector Group Diagram)

35.5.1 General Requirements:

- a. **Material:** Non-corrosive, weather-resistant, and UV-stable stainless steel material. It must withstand the harsh mining environment at Foskop (dust, high temperatures, potential industrial fumes, sunlight).
- b. **Mounting:** Permanently affixed to the transformer tank in a clearly visible and easily accessible location. It should be securely attached using corrosion-resistant fasteners (e.g., stainless steel rivets or screws).

- c. **Legibility:** All text, symbols, and lines shall be clearly engraved, etched, or printed with indelible ink, ensuring excellent legibility for the lifetime of the transformer, even under adverse lighting or dusty conditions.
- d. **Size:** Of sufficient size to clearly display all required information without clutter, while remaining proportionate to the transformer's overall dimensions.

35.5.2 Content Requirements:

- Type of transformer
- Specification to which standard it was manufactured
- Manufacturer's name
- Serial number
- Year of manufacturer
- Number of phases
- Rated power
- Rated frequency
- Rated voltage
- Rated currents
- Vector group
- Percentage impedance voltage at rated current
- Type of cooling
- Continuous ambient temperature at which ratings apply
- Top oil temperature rise at rated load
- Total weight
- Volume of oil
- Weight of core and windings
- Table of primary voltages at the 5 tapping positions
- Connection diagram
- Employer's name

35.5.3 Compliance:

The design and content of the diagram plate shall comply with the requirements of **SANS**

60076-1 (IEC 60076-1), specifically regarding information required on the rating plate and supplementary plates.

35.6 Protection and Accessories (Standard and Optional):

- a. **Oil Level Indicator:** Magnetic type, with minimum and maximum levels.
- b. **Temperature Indicators:**
 - Oil Temperature Indicator (OTI): Dial type, with maximum reading pointer and alarm/trip contacts.
 - Winding Temperature Indicator (WTI): Dial type, with maximum reading pointer and alarm/trip contacts (simulated by OTI with heating element).
- c. **Pressure Relief Device:** Spring-loaded pressure relief valve.
- d. **Drain Valve:** With oil sampling device.
- e. **Filter/Filling Valve:** For oil filtration/filling.
- f. **Breather:** advanced silica gel breather with oil seal or similar robust dust filter system to minimize ingress of dust and moisture.
- g. **Buchholz Relay:** to be provided for gas and oil surge detection
- h. **Terminal Box:** Weatherproof terminal box for external wiring of alarm/trip contacts, with **IP55 or higher rating** for dust protection.
- i. **Surge Arresters:** to be supplied with the transformer manufacturer, and mounted on the HV side.

35.7 Standards Compliance:

- a. **International Standards:** IEC 60076 series (Power Transformers).
- b. **National Standards:**
 - SANS 60076 series (Power Transformers).
 - SANS 780 (South African National Standard for Distribution Transformers), and
 - NRS 049 (National Rationalised Standard)
- c. All materials and components to comply with relevant South African national standards.

35.8 Factory Acceptance Testing (FAT) and Documentation:

- a. **Routine Tests:** All routine tests as per IEC 60076 must be performed and certified test reports provided

- Measurement of winding resistance
 - Measurement of voltage ratio and check of polarity and vector group
 - Tan delta and Capacitance
 - Measurement of impedance voltages
 - Measurement of load losses
 - Measurement of no load losses and no load current,
 - Induced overvoltage withstand test (IVW)
 - Applied voltage test (AV)
 - Auxiliary wiring insulation test (AuxW)
 - Dielectric strength of oil,
 - Dielectric Routine Tests
 - Galvanizing tests.
 - Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)
- b. **Type Tests:** The appointed OEM or service provider shall provide evidence of type tests on similar transformer (e.g., temperature rise test, lightning impulse withstand test, short-circuit withstand test). If these tests have never been done on the similar transformer, the service provider /OEM shall conduct these tests. These shall be at the expense of the service provider /OEM

The following shall be regarded as type tests:

- Temperature Rise Test. This test shall be carried out on the tap having maximum losses
- Short Circuit Withstand test
- Impulse Voltage Test and Power Frequency Test
- Acoustic Sound Level Measurement
- Tank Vacuum Test
- Measurement of Harmonic Level in no load condition
- Oil Analysis

c. Documentation:

The following documents shall be submitted during with the delivery of the transformer

- Certified test reports.
- Outline dimension drawings.
- Connection diagrams.
- Rating plate drawing.
- Comprehensive Instruction Manuals for operation and maintenance.
- Oil test results.
- Tan Delta

35.9 Site Acceptance Testing (SAT) and documentation

All site acceptance testing shall be performed as per IEC 60076 and certified test reports provided

a. Tests

- Insulation Resistance (IR) Test (Megger Test)
- Winding DC Resistance Test
- Transformer Turns Ratio (TTR) Test / Voltage Ratio Test
- Vector Group and Polarity Check
- Exciting Current Test
- Short-Circuit Impedance
- Dissolved Gas Analysis (DGA) of Transformer Oil
- Capacitance and Dissipation Factor (Tan Delta/Power Factor) Test of Windings and Bushings (if bushings allow)
- Auxiliary equipment testing and wiring

b. Documentation:

A comprehensive SAT report must be generated, detailing all tests performed, measured values, comparison with FAT results, and conclusions on the transformer's readiness for service

35.10 Transportation, Handling, and After-Sales:

- a. The transformer shall be suitably packed for transportation to Phalaborwa, protecting against dust, heat, and mechanical damage.
- b. Clear marking of lifting points and handling instructions on the packaging.
- c. **Delivery Point:** Delivered to Foskor Mine in Phalaborwa. The Transformer shall be offloaded at TSS Electrical workshop
- a. **Warranty:** Minimum 24 months from commissioning or 30 months from delivery, whichever occurs first.
- b. **After-Sales Support:** Manufacturer must demonstrate capability for local service, spare parts availability, and technical support in South Africa.
- c. **Site Support:** Ability to provide technical supervision for offloading, positioning, and cold-commissioning

35.11 TECHNICAL SCHEDULE TO BE COMPLETED BY THE BIDDER

50 kVA, 11000/525 V Distribution Transformer

The following Technical Schedule shall be filled out for the transformer rating.

#	Description	Unit	Data
1	International standards transformer complies with	-	
2	Nominal frequency	Hz	
3	Rated Power	kVA	
4	Nominal primary voltage	kV	
5	Nominal secondary voltage	V	
6	Rated primary voltage	kV	
7	Rated secondary voltage	V	
8	Type of cooling	-	
9	Vector group	-	
10	Tap changing		
	Number of steps	± steps	
	Tapping range	± %	
11	Rated short circuit current and withstanding duration		
	Current	kA	
	Duration	s	
12	Impedance measured at 75 °C and center tap	%	
13	X/R ratio	-	
14	Duration of overload		
	25 % overload	°C	
	50 % overload	°C	
15	Design maximum outdoor temperature	°C	
16	Design continuous ambient temperature	°C	
17	Thermal Characteristics		
	Average winding temperature rise	°C	
	Maximum average temperature rise	°C	
	Maximum hot spot temperature rise	°C	
	Hot-spot to top-oil temperature gradient	°C	
18	Magnetic flux density	Tesla	
19	Core Losses	W	
20	Winding losses	W	
21	No load current	A	
22	Regulation: full load, PF=1	%	
23	Regulation: full load, PF=1	%	

	Regulation: full load, PF=0.85	%	
24	Silicon steel		
	Manufacturer		
	Type and grade		
	Operating flux density	Tesla	
	Guaranteed maximum operating flux density	kA/m	
	Manufacturer's data sheet supplied	Yes/No	
25	Conductor for HV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
26	Conductor for LV winding		
	Manufacturer/Supplier and type		
	Conductor Material		
	Shape and cross sectional area		
27	HV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
28	LV Bushing		
	Type and grade		
	Bushing catalogue number		
	Manufacturer/Supplier		
29	Bushing basic impulse withstand voltage		
	HV Bushing	kV	
	LV Bushing	kV	
30	Bushing power frequency withstand voltage		
	HV Bushing	kV	
	LV Bushing	kV	
31	Terminals		
	Type and metal used in HV terminal		
	Type and metal used in LV terminal		
	Type of metal used in Earth terminal		
32	Minimum phase to phase clearance	mm	
33	Minimum phase to earth clearance	mm	
34	Spring and lock washers included	Yes/No	
35	Tap changer		
	Manufacturer/Supplier		
	Type		
	Catalogue details attached	Yes/No	
	Manufacturers data sheet attached	Yes/No	

36	Can tap changer switch be locked	Yes/No	
37	Tank Fabrication		
	Tank material		
	Thickness of the metal sheet		
	Painting method details attached	Yes/No	
38	Tank Dimensions		
	Width	mm	
39	Transformer weights		
	Height	mm	
	Depth	mm	
	Weight of core and windings	kg	
	Weight of tank	kg	
	Weight of oil at 20 °C	kg	
	Total weight of transformer, ready for shipping	kg	
	Shipping weight of transformer	kg	