



GUYANA POWER & LIGHT INCORPORATED

Technical Specifications for 500kVA Three Phase Dead Front Pad-mount Transformers

System Planning & Design Department – Projects Division

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1. SCOPE

The design, manufacture, test, supply, delivery, and warranty of three-phase dead front pad-mounted distribution transformers with separable insulated high voltage connectors, rated at 500 kVA, generally conforming to IEEE C57.12.34 except as specified otherwise herein.

This specification is intended to supplement IEEE C57.12.34, Additional or modifying statements made in this document shall override applicable sections. Where no reference is made in this specification, IEEE C57.12.34 shall apply.

Materials will be evaluated to ensure conformance with submitted manufacturer's drawings/documentation and relevant standards as listed within this specification.

2. APPLICABLE STANDARDS

Except where modified by this specification, the transformers shall be designed, manufactured and tested in accordance with the latest editions of the following standards (Table 1). The proponent may propose alternative standards, but shall demonstrate that they give a degree of quality and performance equivalent to or better than the referenced standards herein.

Acceptability of an alternative standard is at the discretion of the Purchaser.

The Proponent shall furnish a copy of the alternative standard proposed along with the bid. If the alternative standard is not written in the English Language, a certified English Language translated version of the original standard shall be submitted with the bid.

Table 1: Applicable Standards

Item No.	ANSI/IEC Standards	Title
1	IEEE C57.12.34	IEEE Standard for Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 5MVA and Smaller; High Voltage 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below"

2	IEEE C57.12.00	Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
3	IEEE C57.12.28;	“IEEE Standard for Pad-Mounted Equipment – Enclosure Integrity
4	IEEE C57.12.70	IEEE Standard Terminal Markings and Connections for Distribution and Power Transformers
5	IEEE C57.12.90	Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers Corrigendum 1:Editorial and Technical Corrections
6	IEEE C57.147	Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers
7	IEEE 386-2006	IEEE Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V
8	ASTM D3487	Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus
9	NEMA TR 1	Transformers, Regulators, and Reactors
10	IEC 60076	Power Transformers

In case of conflict, the order of precedence shall be:

- This Technical Specification
- IEEE standards
- Other Applicable and Recognised Standards for pad mounted distribution transformers.

3. INSTALLATION/SERVICE CONDITIONS

The installation conditions of the transformers shall be as follows:

1. Maximum altitude above mean sea level less than 1,000 m;
2. Maximum ambient air temperature 40°C;
3. Maximum daily average ambient air temperature 30°C;
4. Minimum ambient temperature 15°C; and

5. Maximum relative humidity 100%.

All outdoor materials, components and equipment shall be designed and protected for use in exposed, heavily polluted and salty, corrosive and humid tropical coastal atmospheric conditions.

4. ELECTRICAL SYSTEM CONDITIONS

The transformer shall be suitable to be installed in GPL’s primary distribution system, which has the following characteristics (Table 2).

Table 2: Characteristics of GPL’s Primary Distribution System

Nominal System Voltage, Frequency and Phase	High Voltage (HV) Side	13.8 kV, 60 Hz, 3φ-3-wire
	Low Voltage (LV) Side	480/240, 60 Hz, 3φ-4 wire
Voltage Class	15 kV	
Short circuit withstand Capability	As per IEEE C57.12.00, section 7.1.3	
Insulation Level		
Basic Insulation Level (BIL)	As per IEEE C57.12.00, Table 3	
Power Frequency withstand level – Dry 1 Minute	As per ANSI C57.12.00, Table 10	
Power Frequency withstand level – Wet 10 Seconds		
System Grounding		
Neutral Grounding	High Side	Primary distribution feeders from Distribution Substations are three phase delta and are grounded by a zig-zag transformer. Primary distribution feeders emanating from generator buses are wye and are grounded by the power plant neutral grounding system.
	Low Side	Solidly grounded.

5. TRANSFORMER RATING

The transformers shall be double wound, sealed type, oil immersed with natural oil and air-cooling (ONAN), three phase (3 ϕ), pad-mounted with ratings of 500 kVA.

The polarity of all transformers shall be subtractive and shall be clearly indicated on the tank of the transformers.

The transformers are required to be equipped with three (3) HV and four (4) LV bushing terminations.

The design of the tank, fittings, bushings, etc., shall be such that it will not be necessary to keep the transformer energised to prevent deterioration as the transformers may be held in reserve and outdoors conditions for many years.

All transformers shall be rated in accordance with ANSI C57.12.20, section 3.

All transformers, inclusive of tap changer and other current carrying components, shall accept emergency overloading as per ANSI/IEEE C57.92, section 4.

6. TAPS AND VOLTAGE REGULATION

Transformers shall have the following voltage transformation ratio and tapping range:

- Voltage ratings shall be specified on the purchase order typically:
13800 Volts delta – 480/240 Volts wye – with access to neutral of LV winding;
- tolerance on the voltage ratio shall be in accordance with IEEE C57.12.00, section 9.1;
- taps shall be provided in the high voltage winding (13.8 kV side), with steps of two (2) 2.5% taps above and below the primary voltage rating (13.8 kV); and

- The bidder shall state in the technical schedule, the percentage regulation at full load, power factor 1.0 and at full load power factor 0.8 lagging. The primary and secondary voltage variation shall be based on a winding temperature of 85°C.

7. OVERCURRENT PROTECTION

Transformers up to and including the rating of 500 kVA shall be equipped with an internally mounted low-voltage circuit breaker and high voltage protection fuse links.

The operation of the LV breaker and HV protection fuse links shall be coordinated such that any short circuit and/or overloading on the secondary side of the transformer will first trip the LV breaker before the HV protective links operate, taking the load off the transformer before the core and/or coil is/are thermally and/or mechanically damaged.

The operation of the protection devices mentioned above shall be indicated externally on the tank/cabinet, and the circuit breaker shall be made to be externally controlled.

The characteristics of the protection devices shall allow for full usage of the transformer's continuous rating and short-time overload capabilities for emergency loading condition (120% of nominal kVA rating).

The Proponent shall submit the characteristic curves of the internal protection devices with the bid. The characteristic curves shall also include the transformers' through-fault withstand capability curves or transformer damage curves.

8. BIL RATING

The transformer shall be rated minimum 95 kV BIL on the HV side and 30kV BIL on the LV side.

9. IMPEDANCE

The guaranteed minimum value of impedance measured at 65°C, on the nominal tap and at the rated voltage of the transformer shall be:

- 2.38%

While tolerance of transformers' impedances in accordance with IEEE C57.12.00, section 9.2 may be applicable, the preferred short-circuit impedance shall be 2.38%. The preferred short-circuit impedance value is to facilitate paralleling with existing 500 kVA pad-mounted transformer(s), as GSU, for the operation of small diesel generator units.

10. SHORT CIRCUIT RATINGS

Bidders must submit all short circuit test results for compliance with IEEE C57.12.00, section 7.1.3.

11. LOSSES

11.1 Transformer Losses

The Bidder shall state the guaranteed losses. However, no positive tolerance is allowable on the guaranteed values. If transformers are supplied with losses exceeding the guaranteed values, the purchaser reserves the right to reject the transformer(s).

The Bidder shall also state the value of guaranteed magnetizing current, subject to the tolerance specified in IEC 60076.

11.2 Loss Evaluation

For the purpose of evaluation, the transformer(s) shall be evaluated according to the total price plus the capitalized value of losses. The formula to be used in evaluation will be:

$$\text{Capitalized Bid Price (US\$)} = \text{Initial Bid Price (US\$)} + (\text{NLL} \times \text{US\$}12.47) + (\text{LL} \times \text{US\$}9.7)$$

Where:

NLL = No load loss in kW; and

LL = Load loss in kW at full rated load and maximum operating temperature.

The losses proposed by the Bidders shall be measured during routine tests with tolerances guided by IEC 60076. If the results from the routine tests indicate that either the copper or iron loss is more significant than the proponents' guaranteed values, the Purchaser shall have the right to reject the transformer(s).

12. FLUX DENSITY

The flux density at any point of the magnetic circuit, core, and winding, when the transformer is connected on the centre tap and operating at normal voltage and frequency, shall be stated in the bid and shall not exceed 1.7 Tesla. The transformer must be capable of operating at 10% overvoltage at 97% of rated frequency without resulting in magnetic saturation of the transformer’s core or the flux density exceeding 1.9 Tesla.

13. NOISE LEVEL

The acceptable audible sound levels for all transformers shall comply with NEMA TR1, table 0-3.

Bidders shall confirm procedure for noise level measurement according to IEEE C57.12.90 and submit audible sound levels test results with the bid document.

14. RADIO INFLUENCE VOLTAGE

Radio influence voltage of all transformers, contained herein, shall comply with NEMA TRI, section 0.03.1.

15. TAP CHANGING CHARACTERISTICS

Tap positions shall be numbered as shown in Table 3.

Table 3: Transformer tap positions

Tap 1	+5%
Tap 2	+ 2.5%
Tap 3	0% (Principal Tap)
Tap 4	-2.5%
Tap 5	- 5.0 %

The operating handle shall have provision for padlocking and shall give a visual indication of the tap position without unlocking.

Each tap-changer position and the tap voltage or percentage associated with voltage shall be identifiable by reference to nameplate information. All positions of the tap changer shall be operative positions.

Tap changer handles shall be fitted with covers having gaskets, so that sealing of the transformer under normal conditions is independent of the switch shaft gland.

16. CORE AND WINDINGS

The core and windings shall be vacuum processed to ensure maximum penetration of insulating fluid into the coil insulation system. While under vacuum, the windings will be energized to heat the coils and drive out moisture, and the transformer will be filled with preheated filtered degassed insulating fluid.

The core and winding shall be capable of withstanding mechanical shocks during transport, installation, and servicing.

16.1 CORE

The core shall be manufactured from high grade, non-aging, burr-free, grain-oriented silicon steel laminations, or superior material and shall be precisely stacked to eliminate gaps in the corner joints.

Transformers shall be constructed with either a 5-legged core or a triplex core to mitigate ferro-resonant tank heating.

Provision to the design and construction of the transformer shall be made to prevent movement of the core and windings, relative to the tank, during transport, installation and short-circuits.

The design shall avoid the presence of pockets, which can prevent complete emptying of the oil in the tank through its drain plug.

16.2 WINDINGS

The winding conductor shall be of electrolytic copper or aluminium, to give the optimum economic and technical results of the transformers.

The windings shall be insulated with B-stage, epoxy coated, diamond pattern, insulating paper, which shall be thermally cured under pressure to ensure proper bonding of conductor and paper, and shall be free from any other insulating compounds that are liable to soften, ooze out, shrink, or collapse, and non-catalytic and chemically inert in the transformer oil during normal servicing. The windings shall be uniformly insulated, and the LV neutral points shall be insulated for full line-to-line voltage.

The stacks of windings shall receive adequate shrinkage treatment, and the windings and connections are to be braced to withstand mechanical shocks during transport, switching, short-circuit or other transient conditions.

17. BUSHINGS AND TERMINATIONS

17.1 BUSHINGS

Bushings shall be of the outdoor type and easily replaceable. Cemented types will **not** be acceptable. The bushings shall be sufficiently robust (mechanically) to withstand normal transport and erection hazards.

All bushings shall have a minimum creepage distance of 25 mm/kV for maximum phase-to-phase system voltage and shall have a continuous rating of 200 % of the transformer capacity rating.

For currents below 200 Amps: The high voltage bushings shall be 15/25 kV 200A bushing wells with bushing well inserts installed. The bushings shall be externally removable and be supplied with a removable stud.

For currents above 200 Amps: The high voltage bushing shall be a 600A Dead break Primary One-Piece Bushing externally removable, 3Ø rated, integral design.

17.2 BUSHING LABELS

HV bushings shall be labelled H₁, H₂ and H₃.

LV bushings shall be labelled X₁ to X₄ in accordance with IEEE C57.12.70 standards.

Marking letters shall be at least 12 mm (or 1/2 inch) high. The means of marking shall conform to the requirements of the section on Labels in this specification.

17.3 HIGH VOLTAGE BUSHING WELLS

High voltage bushing wells and bushing well inserts shall be provided.

18. EARTHING TERMINALS

All transformers shall be provided with two earthing/grounding terminals comprising an M12 isometric bolt and nut, which shall be non-ferrous material. It shall include a spring washer and a lock washer.

External connecting strip(s) between earthing/grounding terminal and neutral bushing(s) **is/are** required.

19. HIGH AND LOW VOLTAGE TERMINAL CONFIGURATION

The transformer shall be provided with bushings in a staggered arrangement in accordance with Figure 12a dimensions for a larger termination compartment for greater working space is desired of IEEE C57.12.34.

The transformer shall be provided with three (3) high voltage bushings in accordance with Figure 4a dimensions for a larger termination compartment for greater working space is desired from IEEE C57.12.34 for radial feed configurations. The bushing heights shall be in accordance with Figure 6 dimensions for greater bushing height of IEEE C57.12.34.

20. LOW-VOLTAGE TERMINALS

Terminals shall be constructed per IEEE C57.12.34, Section 8.7.3 with an additional ground pad near the low voltage.

21. PRESSURE RELIEF VALVE

The pressure relief valve provided as per C57.12.34, 8.9.2, shall include an orange or red indicator that becomes visible only after the valve has vented. The valve shall be covered by a cap with a pull ring which will separate from the assembly during venting, revealing the orange or red indicator.

22. TRANSFORMER OIL

The transformers shall be supplied filled with class 1 mineral oil conforming to ASTM D3487. The complete first filling shall be of new oil free from inhibitors and additives. The dielectric strength of the oil shall not be less than 40kV. If an antioxidant inhibitor is recommended, its use shall be subject to the Purchaser's approval.

23. TANK COVER

The bidder shall state if other than bolted construction is used.

24. TRANSFORMER ANCHOR TABS

Four tabs shall be provided on the tank for mounting the transformer to the pad.

25. HANDHOLE

The tank shall include a handhole to access internal components for testing. The handhole shall have a cover that can be unbolted from within the terminal compartments to prevent unauthorized access.

26. FITTINGS

The following standard fittings shall be provided:

- rating, diagram, and terminal marking plate;
- tank grounding terminal;

- lifting lugs;
- oil level indicator;
- manual pressure relief device; and
- drain/sampling valve with plug.

The fittings and accessories listed above are only indicative and any other fittings and accessories according to the applicable standards herein shall be provided for the transformers.

27. RATING AND CONNECTION PLATE

Each transformer shall be provided with anodized aluminium laser engraved nameplate, in accordance with IEEE C57.12 - Nameplate A and C, as necessary. Additionally, Proponents shall ensure that the following attributes are indicated on the aforementioned nameplate and conform to the requirements of the section on Labels in this specification:

- standard to which it is manufactured and tested;
- identification of internal short-circuit and overload protection devices;
- type of cooling (ONAN);
- rated currents in A;
- chopped wave (short time) impulse voltage withstand level in kV;
- power frequency withstand voltage in kV;
- percentage impedance at 85°C;
- load loss in kW at rated current;
- no-load loss in kW at rated voltage and frequency;
- continuous ambient temperature at which ratings apply in °C (40);

- top oil and winding temperature rise at rated load in °C;
- winding connection diagram;
- total mass (core, windings, and oil) in kg;
- mass of core and windings in kg;
- volume of oil in litres;
- Oil with less than 2ppm of PCB; and
- name of the purchaser (Property of Guyana Power & Light Inc.)

28. SURFACE TREATMENT

The transformer tank and all accessories shall be treated in accordance with IEEE C57.31 to ensure enclosure and equipment integrity.

29. SUPPRESSION OF HARMONICS

Each transformer's core shall be designed with attention to the suppression of harmonic voltages and currents, as per IEEE Std 519-2014 in Table 1 for bus voltage between 1 kV and 69 kV and Table 2 for current distortion limits for systems rated 120 V through 69 kV.

Bidders shall submit results for harmonic suppression tests for voltage and current distortions.

30. TESTS

In addition to the routine tests required in IEEE C57.12.00, as per section 8 and Table 18, the following additional tests shall be carried out on all transformers. The following routine measurements and tests shall be carried out and results shall be submitted to the Purchaser upon delivery:

- a) Measurement of winding resistance at the nominal and extreme tap positions for each transformer provided;

- b) Measurement of impedance;
- c) Measurement of no-load loss and no-load currents at full, 90% and 110% voltages;
- d) Induced overvoltage withstand test;
- e) Separate source voltage withstand tests on HV and LV windings;
- f) Magnetic balance test;
- g) Polarization Index Test. The index shall be not less than 1.5;
- h) Oil leakage test: The criterion of leakage shall be discolouration by oil of whitewash applied externally to suspected parts at an oil temperature of 90⁰C or other method approved by the Purchaser;
- i) Bushings and oil shall be subject to the following routine tests.
 - a. bushing routine tests
 - b. oil dielectric and moisture content test.

Routine test certificates shall include in addition to the test results, the Purchaser's order number, the transformers' serial numbers, outline drawing number and transformer kVA rating.

Upon acceptance of Tender, the Manufacturer/Bidder shall provide results of standard design type tests required in Table 18 of IEEE C57.12.00.

31. COMPLIANCE WITH SPECIFICATION

The transformers shall comply in all respects with the requirements of this specification. However, any minor departure from the provisions of the specification shall be disclosed at the time of tendering in the Non-Compliance Schedule in this document.

32. COMPLIANCE WITH REGULATIONS

All the transformers/equipment shall comply in all respects with the Laws of Guyana Governing the Importation of Commercial Items and/or Goods.

The equipment and connections shall be designed and arranged to minimize the risk of fire and any damage that might be caused in the event of a fire.

33. QUALITY ASSURANCE, INSPECTION AND TESTING

33.1 GENERAL

To ensure that the supply and services are in accordance with the Specification herein, with the regulations of Guyana and with relevant authorized international standards, the Proponent shall have in place suitable Quality Assurance Programmes and Procedures to ensure that all activities are being controlled and documented, as necessary.

The quality assurance arrangements shall conform to the relevant requirements of ISO 9001 or ISO 9002, as deemed appropriate by the Purchaser and the Proponent.

The systems and procedures that the Proponent will use to ensure that the supply complies with the specified requirements, shall be defined in the Proponent's Quality Plan.

The Proponent shall operate systems that implement the following:

Hold Point "A stage in the material procurement or workmanship process beyond which work shall not proceed without the documented approval of designated individuals or organisations."

The Purchaser's written approval is required to authorise work to progress beyond the Hold Points indicated in approved Quality Plans.

Notification Point "A stage in material procurement or workmanship process for which advance notice of the activity is required to facilitate witness."

If the Purchaser's representative does not attend after receiving documented notification in accordance with the agreed procedures and with the correct period of notice, then work may proceed.

33.2 QUALITY ASSURANCE SYSTEM

Unless the Proponent's Quality Assurance System has been audited and approved by the Purchaser, a Quality Assurance System shall be submitted to the Purchaser for approval within a minimum of One (1) month from the placement of order, or such other period as shall be agreed with the Purchaser. The Quality Assurance System shall provide a description of the Quality Control System for the supply and shall, unless advised otherwise, shall include, but not limited to the following details:

1. The structure of the organisation;
2. The duties and responsibilities assigned to staff to ensure quality of work;
3. The system for purchasing, taking delivery and verification of the specifications of raw materials;
4. The system for ensuring the quality of workmanship
5. The system for control of documentation;
6. The system for the retention of records; and
7. The arrangement for the Proponent's internal auditing.

33.3 QUALITY PLANS

The Quality Plans shall set out the activities in a logical sequence and, unless advised otherwise, shall include, but limited to the following:

1. An outline of the proposed programme sequence;
2. The duties and responsibilities assigned to staff ensuring the quality of work;
3. Hold and notification points;
4. Submission of engineering documents required by the specification;

5. The inspection of materials and components on receipt;
6. Reference to the Supplier's procedures appropriate to each activity;
7. Inspection during fabrication and assembly; and
8. Final inspection and test.

33.4 INSPECTION AND TESTING

The Purchaser shall have free entry at all times, while work on the order is being performed, to all parts of the manufacturer's working area which are in relation to the processing of the transformers ordered. The Manufacturer/Proponent shall afford the Purchaser without charge, all reasonable facilities to assure that the transformers being furnished are in accordance with the specifications herein.

The equipment shall have successfully passed all tests as described in Section 30.

The Purchaser reserves the right to reject an item of the transformer if the test results do not comply with the values specified herein.

Tests, including any retests required, shall be carried out by the Supplier at no extra charge, at the manufacturer's works.

Full details of the proposed methods of testing, including connection diagrams, shall be submitted to the Purchaser by the Supplier for approval, at least one month before testing.

All costs in connection with the testing, including any necessary re-testing, shall be borne by the Manufacturer/Proponent.

Any cost incurred by the Purchaser in connection with inspection and re-testing as a result of the failure of the transformer or any of its components under test or damage during transport or offloading shall be to the account of the Proponent.

The Proponent shall submit to the Purchaser three signed copies of the test certificates, giving the results of the tests as required. No materials shall be dispatched until the test certificates have been received by the Purchaser and the Proponent has been informed that they are acceptable.

The test certificates must show the actual values obtained from the tests, in the units used in this specification, and **not** merely confirm that the requirements have been met.

No inspection or lack of inspection or approval by the Purchaser's Representative of equipment or materials whether supplied by the Proponent or a Sub-Proponent, shall relieve the Proponent from his/her liability to complete the contracted works in accordance with the contract would exonerate him/her from any of his/her guarantees.

33.5 GUARANTEE

The Proponent shall guarantee the following:

- Quality and strength of materials used;
- Satisfactory operation during the guarantee period of one (1) year from the date of commissioning, or 18 months from the date of acceptance of the equipment by the Purchaser following delivery, whichever is the earlier. The Purchaser shall advise the Proponent of the date of commissioning;
- Performance figures as supplied by the Proponent in the Technical Data Schedule, the guaranteed copper and iron losses and other particulars;
- The offered surface treatment shall protect the treated metal from corrosion for a period of not less than ten (10) years from the date of delivery.

34. SPARE PARTS AND SPECIAL TOOLS

The Proponent shall provide a list of recommended spare parts and their individual prices and shall include HV and LV bushings and bi-metallic connectors for HV and LV bushings. This list

shall identify all essential spares and consumable items for any recommended maintenance for a period of five (5) years after commissioning.

The Purchaser may order all or any of the spares parts listed at the time of placement of order.

A spare parts catalogue with price list shall be provided and this shall form part of the drawings and literature to be supplied with the bid.

The Proponent shall give an assurance that spare parts and consumables will continue to be available through the life span of the equipment/transformers, which shall be 25 years minimum. However, the Proponent shall give a minimum of 12 months' notice to the Purchaser, in the event that the Proponent or any Sub-supplier, plan to discontinue manufacturing of any component used in the transformers.

Any spare apparatus, parts or tools shall be subjected to the same specification herein, tests and conditions as similar main material supplied. They shall be strictly interchangeable and suitable for use in place of the corresponding parts supplied with the transformer and must be suitably marked and numbered for identification.

Spare parts shall be delivered suitably packaged and treated for long periods in storage. Each package shall be clearly and indelibly marked with its contents, including a designation number corresponding to the spare parts lists in the operation and maintenance instructions.

35. LABELS

All apparatus shall be clearly labelled indicating, where necessary, its purpose and service positions.

The material of all labels and plates, their dimensions, legend, and the method of printing shall be subject to the approval of the Purchaser.

Colours shall be permanent and free from fading. All labels and plates for outdoor use shall be of non-corrosive material.

They shall be engraved in English. Nameplates shall carry all the applicable information specified in the applicable items of the Standards and other details as required in this specification. No scratching, corrections or changes will be allowed on nameplates.

Wherever possible the equipment shall carry the markings "**THIS EQUIPMENT IS PROPERTY OF GPL Inc.**".

36. DECALS

"Danger do not open" decal on exterior transformer doors

"Danger do not touch" decal on interior transformer doors

Typical decals shown in Appendix A.

37. SUBMITTALS REQUIRED WITH THE BID

The following shall be required in duplicate of three (3) copies:

1. completed technical data schedule for each type and rating of the transformer;
2. descriptive literature giving full technical details of equipment offered;
3. Outline dimension drawings for each major component, general arrangement drawing showing component layout and general schematic diagrams;
4. type test certificates, where available, and sample routine test reports for each type and rating of the transformer;
5. summary reference list of customers already using equipment offered during the last 5 years with particular emphasis on units of similar design and rating;
6. details of manufacturer's quality assurance standards and programme and ISO 9000 series or equivalent national certification;
7. deviations from this specification. Only deviations approved in writing before placement of order shall be accepted; and

8. list of recommended spare parts and consumable items for five years of operation with prices and spare parts catalogue with price list for future requirements.

38. NON-COMPLIANCE SCHEDULE

On this schedule, the Proponent shall provide a list of non-compliance with this specification, documenting the effects that such non-compliance is likely to have on the transformer/equipment/component life span and operating characteristics. Each non-compliance shall be referred to the relevant specification clause.

Clause No.	Non-Compliance

39. TEST CERTIFICATE SCHEDULE

On this schedule, a list of the test certificates shall be included with the bid. This list shall include the certificates for the type tests and sample routine test reports. Each certificate listed shall be referred to the relevant specification clause.

Clause No.	Type Test Certificate or Routine Test Report

40. SHIPPING

The Manufacturer/Proponent shall prepare the transformers for shipping in such a manner as to protect them from damage or deterioration during shipping and storage, and shall be responsible for, and make good, any and all damage due to improper preparation for loading, shipment, and storage.

All transformers shall be shipped on open sided trucks or trailers, in such a manner as to facilitate off-loading, handling and storage.

The transformers shall be shipped securely banded with a steel strap or approved synthetic strap to a pallet. The pallet shall be constructed to accept two fixed 195 mm forks spaced either 65mm or 320 mm apart. At least 90 mm clearance shall be provided under each transformer pallet and the bottom of the pallet must not be fully covered in order to facilitate the use of pallet jacks.

41. TECHNICAL SCHEDULE

Description	Unit	Data
Rated Power	kVA	
Rated Frequency	Hz	
Rated Primary Voltage	kV	
Rated Secondary Voltage	V	
No. of Tap Positions/Steps	No.	
Max Tap Position	%	
Min Tap Position	%	
Magnetic Flux Density	Tesla	
No Load Current	A	
No-load Loss at Nominal Tap Position and Rated Primary Voltage	kW	
Load Loss at Nominal Tap Position and Rated Load Current	kW	
Voltage Regulation at Full Load and Power Factor of 1	%	
Voltage Regulation at Full Load and Power Factor of 85%	%	
Rated Short-circuit Current	kA	
Rated Short-circuit Current withstand duration	s	
Impedance measured at 65 °C and nominal tap position	%	
X/R Ratio	%	
Overloading		
Duration of 25% Overload	minutes	
Duration of 50% Overload	minutes	
Temperature Rise		
Design maximum outdoor temperature	°C	
Design continuous ambient temperature	°C	
Average Winding Temperature Rise	°C	
Maximum Winding Temperature Rise	°C	
Maximum Hot Spot Temperature Rise	°C	
Hot Spot to Top oil Temperature Gradient	°C	
General Transformer Data		
Manufacturer	...	
Type and Grade	...	
Operating flux density	Tesla	
Losses kW/kg at operating flux density	kW/kg	
Manufacturer's data sheet supplied	YES/NO	
Windings/Coils		
Conductor for HV Winding - Manufacturer/Supplier and Type		
Conductor Material for HV Winding		

Conductor for LV Winding - Manufacturer/Supplier and Type		
Conductor Material for LV Winding		
Bushings & Terminals		
HV Bushing Manufacturer/Supplier		
HV Busing Type and Grade		
HV Bushing Catalogue Number		
LV Bushing Manufacturer/Supplier		
HV Bushing BIL	kV	
HV Busing Power Frequency withstand Voltage	kV	
Type and Mental used in HV Terminal		
LV Busing Type and Grade		
LV Bushing Catalogue Number		
LV Busing Power Frequency withstand Voltage	kV	
Type and Mental used in LV Terminal		
Type and Mental used in Earth Terminal		
Bushing Clearance		
Minimum phase to phase clearance	mm	
Minimum earth to phase clearance	mm	
Spring and lock washer included	YES/NO	
Tap Changer		
Tap Changer Manufacturer/Supplier		
Tap Changer Type		
Tap Changer Catalogue Details Attached	YES/NO	
Can the Tap Changer switch be Locked	YES/NO	
Tank		
Tank material		
Thickness of the metal sheet		
Painting method details attached	YES/NO	
Tank Width	mm	
Tank Height	mm	
Tank Dept	mm	
Weight of Core and Windings	kg	
Weight of Tank	kg	
Weight of Oil at 20 °C	kg	
Total weight of Transformer without oil	kg	
Shipping weight of Transformer	kg	

Affix Company Seal
Below

Name:.....

Signature:.....

Date:.....

APPENDIX A

Danger, Do Not Open Decal



Danger, Do Not Touch Decal

End of Technical Specification