

BALUCHISTAN ENERGY COMPANY LIMITED

DEVELOPMENT OF LPG TESTING LABORATORY AT TAFTAN

SPECIFICATION FOR DISTRIBUTION TRANSFORMER



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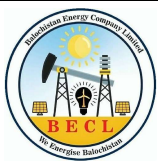
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1.0 SCOPE

This specifications covers the minimum design, manufacturing, testing and performance of oil filled distribution transformer shall comply with all currently applicable ANSI/IEEE or IEC Standards and specific Standards & Codes specified elsewhere in this specification.

TERMINOLOGY

The following terminology will be applied throughout this specification.

Plant	Taftan, Balochistan
Company	Balochistan Energy Company limited.
Company Representative	A Company designated Personnel, Party/Parties duly authorized by the company to act on behalf of the company with whom the Supplier shall consult at all reasonable times and whose instructions, request and decision shall be binding on Supplier.
Supplier	Entity with whom the Company will execute a Contract for supply of equipment/material as per this document
Project	Development of Feasibility Study of LPG Testing Laboratory at Taftan

2.0 CODES AND STANDARDS

Reference is made in this specification to the following documents. The latest issues, amendments, and supplements to these documents shall apply unless otherwise indicated in the document.

Institute of Electrical and Electronics Engineers (IEEE)

IEEE Std C57.12.00	IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
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IEEE Std C57.19.00	IEEE Standard General Requirements and Test Procedure for Outdoor Power Apparatus Bushings
IEEE Std C57.19.01	IEEE Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
IEEE Std C57.12.70	IEEE Standard Terminal Markings and Connections for Distribution and Power Transformers 230 kV and Below 833 / 958 through 8333 / 10 417 kVA, Single-Phase, and 750 / 862 through 60 000 / 80 000 / 100 000 kVA, Three-Phase Without Load Tap Changing; and 3750 / 4687 through 60 000 / 80 000 / 100 000 kVA with Load Tap Changing— Safety Requirements

International Electrotechnical Commission (IEC)

IEC 60076-1	IEC Standard Power Transformers Part 1 – General.
IEC 60076-2	Power transformers – Part 2: Temperature rise
IEC 60076-3	Power transformers – Part 3: Insulation levels and dielectric tests
IEC 60076-3-1	Power transformers – Part 3: Insulation levels and dielectric tests. External clearances in air
IEC 60076-5	Power transformers – Part 5: Ability to withstand short circuit
IEC 60137	Bushings for alternating voltages above 1 000 V
IEC 60354	Loading guide for oil-immersed power transformers
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60551	Determination of transformer and reactor sound levels

3.0 ABBREVIATIONS

ANSI	American National Standards Institute
BIL	Basic lightning Impulse Insulation Level
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical & Electronic Engineers.
kA	Kilo Ampere
kV	Kilo Volt
kVA	Kilo Volt Ampere
MVA	Mega Voltage Ampere
MCC	Motor Control Center
PCB	Polychlorinated Biphenyls



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4.0 RATING DATA

COOLING

The transformer shall be ONAN type. The tank shall be hermetically sealed type with welded/bolted cover plate as per manufacturer standard.

OPERATING FREQUENCY

Transformer shall be operating at 50 Hz.

VOLTAGE RATING

Primary	11	kV
Secondary	0.415	kV

MVA RATING

As per transformer datasheet document (Shall be finalized after detailed Engineering)

INSULATION

Insulation level shall be decided as per IEEE Std C57.12.00 sub clause 5.10 or IEC equivalent.

TAPPING

Manually operated off load tap changer shall be provided. The tap changer shall meet the following requirements:

- The tapping range shall be +/- 5 % in 2.5 % steps
- All four taps shall be full capacity
- Taps are operable from outside by means of a lockable device

CONNECTIONS

Standard connection arrangements shall be as per IEEE Std C57.12.70 or IEC equivalent.

TERMINAL MARKINGS

Terminal markings shall be in accordance with IEEE Std C57.12.70 or IEC equivalent.



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TEMPERATURE RISE

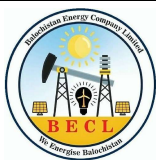
Transformer temperature rise shall not exceed 55°C. Temperature rise shall be determined in accordance to IEEE Std C57.12.00 sub clause 5.11 or IEC equivalent. Maximum hot spot winding temperature rise limit shall also be restricted to and measured in accordance with the same sub clause mentioned above. Temperature rise of other parts of transformer and insulation liquid shall also be measured and restricted as per IEEE Std C57.12.00 sub clause 5.11 or IEC equivalent.

NAME PLATE

Name plate shall be made of corrosion resistance stainless steel. Plates mounted on the outside of the equipment shall be fixed by means of durable self-threading corrosion resistance screws or pop rivets. Information on nameplate, warning plates, instruction plates etc. shall be in both English and Arabic languages if not possible then separate plate for English and Arabic shall be provided.

Following information shall be provided on the name plate:

- Serial number
- Month/year of manufacture
- Class (ONAN, ONAF, etc.)
- Number of phases
- Frequency
- kVA (or MVA) rating
- Voltage ratings (HV&LV)
- Current ratings (HV&LV)
- Tap voltages (2)
- Temperature rise, °C
- Phasor diagram
- Percent impedance
- Basic lightning impulse insulation levels (BIL) (3)
- Approximate masses in kg (pounds) (4)
- Connection diagram
- Name of manufacturer
- Installation and operating instructions reference
- The word transformer or autotransformer



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- Tank, pressure, and liquid data (5)
- Type of insulating liquid (generic name preferred) (6)
- Winding schematic representation shall be as per Table 11(b) IEEE Std C57.12.00 or IEC equivalent.

Notes:

1. The font size on name plate shall be such that it is easily visible.
2. The tap voltages of a winding shall be designated by listing the winding voltage of each tap in tabular form. The rated voltage and current of each tap shall be shown.
3. Full-wave BIL in kV of line terminals shall be designated as in the following example:

High-voltage winding	450 BIL
High-voltage winding neutral	110 BIL
High-voltage winding neutral bushing	95 BIL
Low-voltage winding	95 BIL

4. The approximate mass shall be shown as follows:
 - a. Core and coils
 - b. Tank and fittings
 - c. Liquid
 - d. Total mass
 - e. Untanking mass (heaviest piece)
5. The following tank, pressure, and liquid data for transformers shall be provided:
 - a. Maximum operating pressures of liquid preservation system _____ kPa (lb_f/in²) positive and _____ kPa (lb_f/in²) negative.
 - b. Tank designed for _____ kPa (lb_f/in²) vacuum filling.
 - c. Liquid level below top surface of the highest point of the highest manhole flange at 25°C _____ mm (in). Liquid level changes _____ mm (in) per 10°C change in liquid temperature. The volume of insulating liquid, in cubic meters (gallons), and type shall be shown for the main tank and for each liquid-filled compartment.



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6. The nameplate shall have the following note:

“Contains no detectable level of PCB (less than 2 PPM) at the time of manufacture.”

5.0 CONSTRUCTION

TANK REQUIREMENT

The tank cover shall be welded to the tank with a continuous weld or bolted to the tank as per Vendor Standard manufacturing practice to ensure the sealing requirement. The tank, cover and cooling system assembly shall have the mechanical strength to withstand without permanent distortion; the internal pressures caused by the contraction or expansion of the oil/liquid and gas air volumes (if applicable) under the specified service conditions. Tank pressure under rated conditions of sealed transformers shall not exceed two atmospheres (203 kPa, 14.74 psig) absolute pressure unless the requirements of applicable sections of the ASME Boiler and Pressure Vessel Code (BPV) are met.

A level gage with vertical face shall be mounted on the side (or top as per vendor standard practice) of the tank and shall be readable to a person standing at the level of the base. The gage shall have a White-face dial with black markings and a black-colored indicating hand. The diameter of the dial (inside bezel) shall be:

- a) 82.6 mm (3-1/4 inches) +/-6.4 mm (1/4 inch) when the 25oC liquid level is more than 2.44 m (96 inches) or less above the bottom of the base.
- b) 140 mm (5-1/2 inches) +/-12.7 mm (1/2 inch) when the 25oC liquid level is 2.44 m (96 inches) above the bottom of the base.

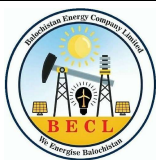
Dial markings shall show the 25oC level and the minimum and maximum operating levels.

The words “Liquid Level” shall be on the dial or on a suitable nameplate adjacent thereto.

The 25°C liquid level shall also be shown by suitable permanent markings on the tank or by an indication on the nameplate of the distance from the liquid level to the highest point of the hand hole or manhole flange surface.

A dial-type thermometer shall be mounted on the side of the tank. For mounting heights 2.44m (96 inches) or less from the bottom of the base, the face of the thermometer shall be mounted in a vertical plane; for mounting heights greater than 2.44 m (96 inches), the face shall be at an angle of 30 degrees from the vertical.

The thermal element shall be mounted in a closed well at a suitable level to indicate the top-liquid temperature. For dimensions of the well, see IEEE Std C57.12.00.



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The thermometer shall have a white-face dial with black markings, a black-colored indicating hand, and a red-colored maximum indicating hand, with provision for resetting. The diameter of the dial (inside bezel) shall be 114 mm (4-1/2 inches) +/- 25.4 mm (1 inch). The dial markings shall cover a range of 0°C to 120°C. The words “Liquid Temperature” shall be on the dial or on a suitable nameplate mounted adjacent to the indicator.

A combination drain and lower filter valve shall be located on the side of the transformer tank. This valve shall provide for drainage of the liquid to within 25.4 mm (1 inch) of the bottom of the tank.

The drain valve shall have a built-in 9.5 mm (3/8-inch) sampling device, which shall be located in the side of the valve between the main valve seat and the pipe plug.

The sampling device shall be supplied with a 7.9 mm (5/16-inch) - 32 male thread for the user's connection and shall be equipped with a cap.

The size of the drain valve shall be 25.4 mm (1 inch), and shall have tapered pipe threads (National Pipe Thread), in accordance with ANSI/ASME B1.20.1-1983, with a pipe plug in the open end.

Transformers shall have a 25.4-mm (1-inch) upper filter plug, or cap, located above the maximum liquid level.

Lifting moving and jacking facility shall be provided with transformer.

All accessories with specifications as per manufacturer standard practice but with same functionality as mentioned above are also acceptable.

BUSHINGS

Transformers shall be equipped with bushings with an insulation level not less than that of the winding terminal to which they are connected.

Bushings dimension, impulse, low-frequency insulation levels and other characteristics shall be as per IEEE Std C57.12.00, IEEE Std C57.19.00-1991, IEEE Std C57.19.01-1991 or IEC equivalent.

WINDING

The winding connection shall be delta on primary and star on secondary with neutral grounded by means of a bare copper cable. The angular displacement shall be 30°, with the low voltage lagging the high voltage. Primary and secondary windings shall be made of electrical grade copper with a minimum conductivity of 98 percent for copper used in electrical conductors. The conductors shall be machine spirally wound with several overlapping layers of insulation paper. This process shall detect and eliminate conductor burrs that might affect the dielectric integrity of the winding. All metal parts of the transformer, except those connected electrically to the windings, shall be maintained at ground potential.



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IMPEDANCE

Impedance shall be maintained at 5.75% as per ANSI/IEEE Std C57.12.10 table 10 or IEC equivalent.

EXTERNAL CLEARANCE

Minimum clearance shall be as per IEEE Std C57.12.00 sub clause 6.8 or IEC equivalent. Manufacturer shall ensure that the distance he specifies would suffice.

SHORT CIRCUIT WITHSTAND CAPABILITY

The short circuit fault levels shall be as specified in the datasheets document. The transformer winding shall be capable of withstanding, on any tapping, without damage, the electro-dynamic and thermal effects of a full external short circuit on the secondary side, with the primary side connected to an infinite system fault level.

CORE CONSTRUCTION

Three-limb cores shall be used. The core stamping shall be of Cold Rolled Grain Oriented silicon steel. The transformer core shall be grounded for electrostatic purposes to the transformer tank.

CABLE CONNECTION BOX

Cable connecting box shall be made of corrosion resistant stainless steel and shall be dimensioned to allow termination of the cables specified on the Datasheet document. Dimensions, creepage distances and clearances shall be suitable for air-insulated connections. The enclosures shall offer a minimum degree of IP 54. Cable termination boxes shall be used for HV side, LV side and auxiliary circuits' cables. Cable box for auxiliary circuits' shall be located on transformer in such position that is easily accessible. The cover of cable box shall be secured by means of captive bolts or screws and it shall not be removable without the use of tools.

The size of cable box for power cable shall be such that minimum clearances between HV phase to phase, phase to ground, phase to neutral and on lower voltage winding as per IEEE Std C57.19.01 or IEC equivalent. All cables boxes shall be designed to cater for cable minimum bending radius. All connections shall be sized to carry the maximum continuous current, (including overloads, where relevant), and also the prospective through-fault currents.

Facilities shall be provided for the grounding of each cable protective screen and/or armour inside each cable connecting box, including those for secondary or auxiliary circuits. For grounding the screens and/or armour of single-core cables, a copper



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grounding bar shall be provided complete with a grounding bolt, nuts and washers for each cable. Grounding bolts, nuts and washers shall be provided in each box.

Power Terminals (and lugs where appropriate) shall be suitable for the cable conductors, specified in the datasheets document.

The terminals shall be logically arranged, circuit-by-circuit, with adequate barrier shields and spacers in between them. Terminals shall be clearly and indelibly marked.

Suitable cable supports and clamps for the main cables shall be provided. The internal winding ends shall always remain under the oil level.

Auxiliary circuit conductors shall be stranded copper and shall have a cross section of at least 2.5mm², XLPE insulation 600/1000V. All auxiliary wiring and cabling shall be ferruled in accordance with the Manufacturer's wiring diagram. All external auxiliary cabling shall either be wire braided or wire armored.

FRAME GROUNDING

Transformers shall be provided with two ground terminals on the outside of the transformer mainframe or tank wall, for connection to an external grounding grid. The terminal shall be located on opposite sides of the transformer

Each ground connection shall consist stainless with nuts and washers. All metallic components, such as cable boxes and their internal grounding bars or studs, shall be bonded to the transformer mainframe or tank.

MOUNTING AND HANDLING FACILITIES

The transformers shall be skid-mounted. The transformer skids shall have rounded off beam-ends and be provided with pulling holes to enable site movements. The transformer shall be provided with rollers with locking facilities. The transformer base shall be strong enough to allow rolling into its installed position.

NOISE LIMITS

Audible sound level pressure shall not exceed 75 db.

INSULATION LIQUID

See datasheet document for details.

PAINTING

The treatment and protection of metalwork shall be in accordance with the painting specification attached to the Material Requisition, and shall include cleaning,



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degreasing, rust resisting primers and paint finishes that provide effective protection against corrosion under the functional and climatic conditions.

Painting / finish shall be RAL 7033 Cement Grey.

6.0 TESTING AND INSPECTION

Prior to dispatch, the Manufacturer shall verify by test that the operation of the assembled unit complies with the requirements specified on the purchase order documents, and shall submit a report incorporating measurements and results of all tests performed. Acceptance criteria for each test shall be stated on the test form.

Contractor / CLIENT / CONSULTANT will witness the functional tests and will carry out an inspection of the assembled unit and related documents to verify compliance with the requirements of the purchase order and this specification. All routine testing of components and the complete apparatus shall be carried out in accordance with IEEE Std C57.12.00 clause 8 or IEC equivalent.

Transformer to be tested on site by running motors unloaded for two hours to check for excessive vibrations, noise or overheating.

TEST EQUIPMENT

All test equipment shall have calibration records traceable to the National Bureau of Standards. Calibration labels shall be visible on all test equipment. Calibrations over six months old shall not be acceptable on field test instruments. The accuracy of all test equipment shall be at least twice that of the accuracy of the equipment. Serial and model numbers of the instruments used shall be recorded on the test forms.