

# **SPECIFICATION FOR STEP – UP TRANSFORMER 0.415/11Kv and 0.415/33kV (630KVA & 1000KVA)**

## **DESIGN AND CONSTRUCTION**

### **General**

1. The transformer shall be three phase, oil immersed type, air cooled, core type, outdoor and shall be designed, manufactured and tested as per IEC 60076 and this specification.
2. The transformer shall be free breathing type provided with a conservator and a dehydrating breather (cobalt free). The conservator shall be in such a position as not to obstruct the electrical connections to the transformer and shall have oil gauge at one end marked with oil levels. The conservator shall have a feed valve.
3. The complete transformer shall be painted and protected against corrosion, and the final colour of the exterior surface shall be Dark Admiralty Grey colour No. 632 as per BS 381C. The inside of the tank shall be coated with oil resisting varnish or paint so that oil cannot come into contact with tank or metal at any point.
4. Each transformer shall be suitable for ground mounting (on a plinth).
5. Drawings and documentation for the transformer offered shall be given, clearly detailing important dimensions, clearances, accessories, fittings, internal assembly, material details and any special features of the offered design.

### **Tank**

1. The transformer tank shall be constructed of mild steel plates. Tank thickness shall be stated in the Technical Particulars (Annex A & B).
2. The transformer tank shall be sealed by means of suitable gasket and be fitted with earthing terminals. Eight (8No.) non-standard shearing bolts to deter unauthorized opening shall be used on bolted corners and centres of sides of the top cover. All bolts, nuts and washers shall be hot dip galvanized to BS729.

### **Core**

1. The cores shall be constructed of high quality low loss grain oriented electrical steel laminations. The design shall ensure no hot sections due to over fluxing or circulating currents across the laminations. The flux density at any point shall not exceed 1.65 Tesla.

2. The cores shall be clamped effectively with metal cross-arms and be fitted with core lifting lugs. The manufacturer shall demonstrate experimentally or via a previous test report, that the whole structural frame-work supporting the transformer windings and the core can definitely withstand repeated transformer short-circuits.

### **Windings**

1. The windings shall be of electrolytic copper capable of sustaining short circuit forces on the transformer.
2. The primary windings shall be of electrolytic copper coils or copper foils and the secondary windings shall be full coil copper wires as opposed to segmented winding.
3. The HV and LV windings shall be separated so as to allow for cooling and ease of repair. Insulating sleeves for the transformer tapping's shall be in crepe paper or better.

### **Tapping**

1. The secondary windings (11kV & 33kV) shall have tapping's at  $\pm 2 \times 2.5\%$  operated by an off-circuit self-positioning tapping switch with marked position indicators. Tapping details shall be included on the transformer name plate.
2. Switch position No. 1 shall correspond to maximum plus tapping. The make contacts of the tap changer shall be robust and of sufficient surface area.

### **Vector Group**

1. The three-phase transformer shall be wound to IEC vector reference dYN.
2. The star point of the secondary winding shall be brought out to a neutral bushing.

### **Cable Boxes, Bushings and Clearances**

1. The transformer shall be fitted with cable box on the primary side (LV) and have open bushings on the secondary side (11kV and 33kV).
2. The LV cable box shall be suitable for terminating up to 7No. Single core PVC cables of 600 mm<sup>2</sup> on a clamp pad, cables entry from bottom.

3. The 11 kV and 33kV bushings shall be open and shall have outdoor brown glazed weatherproof bushings provided with external stud for conductor sizes from 7.8 mm to 18.2 mm diameter mounted on the tank top cover.
  - a) Clamp connector shall be provided on each bushing.
  - b) The bushings shall be constructed, arranged and fitted in such a manner as to be changed without opening the transformer.
  - c) Each bushing shall be fitted with adjustable double-gap arcing horns set at 2 X 25mm gaps for 11kV and 2 X 55mm gaps for 33kV.
  - d) The minimum external electrical clearances and minimum creep age distances of the 11kV bushings and 33kV bushings shall be as indicated below:

Nominal System Voltage between Phases		11kV	33kV
Minimum clearances between phase to earth	mm	300	480
Minimum Clearances between phases	mm	250	435
Creep age distance	mm	350	900

### **Oil and Cooling**

1. Cooling of the transformer shall be by natural circulation of oil and natural circulation of air (ONAN). Loading will be as per IEC 60354.
2. Each transformer shall be dispatched filled with oil to the correct level and ready for service. The oil shall be new (unused), uninhibited mineral insulating oil class I as per IEC 296.

### **Fittings and Accessories**

1. No drain valve shall be fitted.
2. Oil gauge shall be provided on each transformer and shall be of dial or floater type. The oil gauge shall be clearly readable by an operator standing at a distance of 5 meters away from the transformer. The maximum and minimum oil level marks shall fall within 50% of the full range of the gauge with the nominal oil level being at the centre of the range.
3. Each transformer shall be complete with an oil temperature thermometer in a visible and secure position.

- Each transformer shall be complete with a pressure relief device fitted in a visible and secure position. No part of the pressure relief device shall extend to a height greater than the HV bushings.

### **Rating**

- The transformer shall be capable of carrying its full normal rated current continuously under the tropical conditions stated (maximum ambient temperature of 40°C) and at any tapping's without the temperature rise in the hottest region exceeding 55°C and 60°C in oil and winding respectively. Documents to support this shall accompany the tender.
- The transformer shall be capable of sustaining a three-phase symmetrical short circuit on the secondary side with power maintained on the primary side without damage or distress for 2 seconds.
- The transformers shall be in the following sizes:
  - 0.415/11kV: 630 kVA and 1000kVA
  - 0.415/33kV: 630 kVA and 1000kVA
- The rated withstand voltages for the transformers shall be as follows:

	Rated short duration power frequency withstand voltage (r.m.s.)	Rated lightning impulse withstand voltage (peak)
0.415/11kV Transformers	38kV	95kV
0.415/33kV	95kV	200kV

### **Impedance Voltage**

- The impedance voltage measured at the principal tap shall not exceed 5.0%.

### **Losses and Capitalization**

- The guaranteed transformer losses, measured at full load operation, unity power factor and rated voltage shall be submitted with the tender. The loss measurements (no-load and full-load) shall be adjusted to 75 degree Celsius and submitted for evaluation.
- Evaluation will be carried out to establish the capitalized values of no-load losses and load losses at nominal rating of a transformer. This cost will be added to the bid price (landed cost) of the tender.

Transformer losses shall be capitalized at the following rates:

Full load (winding) Losses	US\$ 1902 per kW for 15 years
No load (core) Losses	US\$ 4504 per kW for 15 years

Where tenders are being compared, losses will be capitalized at the above rate and added to the bid price according to the formula below:

$Gep = Gbp + G (\$)$ ,  $Gep =$  Bid evaluation price,  $Gbp =$  Bid price

$G (\$)$  = Adjustment for the cost of the operation and maintenance for 15 years

And is obtained by using the following formula

$G (\$) = 1902 \times \text{full load winding losses (kW)} + 4504 \times \text{no load losses (kW)}$