

3.0 AC SYSTEM

3.1 STATION TRANSFORMER

3.1.1 Transformer and its accessories shall comply with IS 2026 including those referred to therein:

3.1.2 Transformers shall be oil-immersed type, hermetically sealed with corrugated tank. The technical parameters of transformer shall be as below:

Sr. No.	Description	Unit	Particulars
1	Type	-	Oil-filled
2	Transformer Installation		Outdoor
3	Rated output	kVA	63
5	No load voltage ratio	kV	11/0.400
6	Number of phases	Ph	3
7	Rated Frequency	Hz	50
8	Impedance at principal tap	%	As per IS recommendation
9	Material of conductor	-	Electrical Grade Copper
10	Type of cooling	-	ONAN
11	Vector group	-	Dyn11
12	Design ambient temperature	⁰ C	40
13	Winding temperature rise measured over designed ambient temperature by resistance method	⁰ C	55
14	Type of tap changer link	-	Off circuit links
15	Tap range	%	± 7.5%
16	Tap step	%	± 2.5%
17	Type of terminal connection		
a)	HV side	-	Cable Box
b)	LV side	-	Cable Box – open-able
18	Cable sizes:		

	- Primary		1 x 3 C x 300 sq.mm 11 kV, (E) Aluminum, XLPE armored cable	
	- Secondary		2 x 4 C x 95 sq.mm, 1.1 kV, Aluminum XLPE armored cable.	
c)	Secondary neutral end		One bushing each inside and outside cable box	
19	Windings		HV	LV
a)	One minute power frequency withstand voltage (dry & wet)	kV (rms)	28	3
b)	1.2/50 micro second full wave impulse withstand voltage	kV (peak)	75	-
20	Bushings			
	Rated voltage – Primary	kV	11	
	– Secondary	kV	0.400	
	One minute power frequency withstand voltage (dry and wet) - Primary	kV (rms)	28	
	- Secondary (Line and Neutral)	kV (rms)	3	
	Rated lightning impulse withstand voltage	kV (peak)	75	
21	Painting		Powder coated	
22	Colour		RAL 7032	

** Note: Transformer selection will be based on loss evaluation formula by CBIP, India

The transformer shall be designed taking into consideration the altitude correction factor and the power frequency & rated values shall be corrected accordingly.

3.1.3 Accessories and fittings

3.1.3.1 The transformer shall have the following fittings and accessories including, but not limited to:

- a) Oil temperature indicator
- b) Winding temperature indicator.
- c) Explosion vent diaphragm / pressure relief valve

- d) Sampling and drainage valves
- e) A plug or blank flange at the top for connecting valve for filtration
- f) Two earthing terminals
- g) Rating plate (Nameplate and diagram plate)
- h) Lifting lugs
- i) Removable plain rollers
- j) Adequate number of air vents for relieving trapped air during oil filling and during maintenance.
- k) Accessories for clamping the wheel to the foundation channel in order to withstand earthquake forces.

3.1.4 **Windings**

3.1.4.1 Windings shall be of electrical grade copper.

3.1.5 **Core**

3.1.5.1 The magnetic circuit shall be constructed from high grade, cold rolled, non-aging, grain oriented silicon steel laminations. Each sheet shall have an insulating coating resistant to the action of hot oil. Each lamination shall be coated with insulation which is unaffected by the temperature attained by the transformer during service.

3.1.5.2 The insulation structure for the core to bolts and core to clamp plates shall be such as to withstand appropriate dielectric test. All steel sections used for supporting the core shall be thoroughly shot or sand blasted after cutting, drilling and welding. Core laminations shall be annealed and burrs removed after cutting. Cut edges shall be insulated. The framework and clamping arrangements of core and coil shall be securely earthed inside the tank by a copper strap connected to the tank. The core clamping structure shall be designed to minimize eddy current loss. The core shall be provided with lugs suitable for lifting the complete core and coil assembly. The framework and clamping arrangements shall be securely earthed.

3.1.5.3 The core and coil assembly shall be dried out and impregnated under vacuum.

3.1.6 **Tank**

3.1.6.1 The transformer tank shall be perforated and be made from high-grade sheet steel, suitably reinforced by stiffeners made of structural steel sections. All seams, flanges, lifting lugs, braces, and other parts attached to the tank shall be welded. The interior of the tank shall

be cleaned by shot blasting and painted with two coats of heat resistant, oil insoluble paint. Adequately sized manholes shall be provided for ease of inspection and maintenance. Steel bolts and nuts exposed to atmosphere, shall be galvanised.

3.1.6.2 Tank together with radiators, bushings and other fittings shall be designed to withstand without permanent distortion the following conditions:

- a) Full vacuum of 760 mm of Hg for filling with oil under vacuum
- b) Internal gas pressure of 0.35 kg/cm² with oil at operating level

3.1.6.3 Tank shall be provided with a pressure release device, which shall operate at a pressure below the test pressure for the tank and radiators. The device shall be provided with a device visible from ground to indicate operation. The device shall be provided with potential free contacts for alarm and tripping. Alternatively, a separate pressure relay shall be provided for this purpose.

3.1.6.4 The tank cover shall be bolted type and not welded, sealed type. The tank cover shall be removable and shall be suitably sloped so that it does not retain rainwater.

3.1.7 **Marshalling box**

3.1.7.1 The marshalling box shall be tank mounted, weather proof, vermin proof, dust proof, sheet steel (2 mm thick), enclosed and with hinged door having padlock. Door and gland plate shall be fitted with neoprene gaskets. Bottom shall be at least 600 mm from grade level. Top surface shall be sloped. The degree of protection shall be IP65.

3.1.7.2 Contacts / terminals of devices etc. mounted on the transformer shall be wired to the marshalling box. Interconnecting wires between the marshalling box and the accessories / devices shall be either PVC insulated wires in GI conduits or PVC insulated, armoured cables together with provision of double compression type, brass cable glands at the marshalling box. The above mentioned cables as well as terminating the cables shall be the Contractor's responsibility.

3.1.8 **Cable Terminations**

3.1.8.1 Primary and secondary side cable boxes shall have sufficient space for segregating the cable cores and for adequate clearance in air between bare conductors at the terminals. Cable boxes shall be complete with necessary glands, lugs and armour grips.

3.1.8.2 Air filled cable boxes shall be of adequate dimensions and designed in such a manner that they can be opened for inspection without disturbing the gland plate or incoming cable. Disconnecting chamber shall be provided for disconnecting and moving away the main transformer, without removing the cables or the cable box.

3.1.8.3 Provision shall be made for earthing the body of each cable box.

3.1.9 **Tests**

3.1.9.1 All routine and acceptance tests as specified in the applicable standards shall be carried out on the transformer. Test reports for all the bought out items shall be review/acceptance during testing.

3.1.9.2 **Earthing**

All internal metal parts of the transformers shall be earthed at one point only. The magnetic circuit shall be connected to the clamping structure at one point only. The frame work and clamping arrangements of core and coil shall be securely earthed by copper strip connection to the main frame and enclosure.

Two earthing terminals shall be provided on the frame for external earthing. The terminals shall be suitable for the earthing conductor.

3.1.10 **Miscellaneous**

3.1.10.1 The following items shall also be included in the Contractor's scope for each transformer:

- a) Supply, installation and commissioning of interconnecting cables between transformer mounted accessories, marshalling box, remote panel in the electrical room along with associated compression type brass cable glands, lugs, etc.
- b) Ten percent extra oil, in addition to that required for first filling of complete transformer, in non-returnable drums
- c) Adequate paint for touching up the external surface after erection, and
- d) Terminal clamps/connectors suitable for connecting to specified sizes of conductor/tube /cable.

3.2 LV INDOOR SWITCHBOARD

3.2.1 LV indoor switchboard and its components shall comply with the following International Standards, including those referred to therein.

Air break switches, Air break switch disconnectors and fuse combination units, MCCBs for voltage not exceeding 1000 V AC or 1200 V DC	IS 13947
Control Switches	IS 6875 / IEC 60947
Low voltage Fuse	IS 13703 / IEC 60269
Specification for low voltage switchgear and control gear	IS 13947 / IEC 60947
Degree of protection provided by enclosures for low voltage switchgear and control gear	IS 13947 / IEC 60947
Marking and arrangement for switchgear, busbars, main connections and auxiliary wiring	IS 5578 / IS 11353
Code of practice for selection, installation and maintenance of switchgear and control gear	IS 10118

3.2.2 The technical parameters/Data sheet of LV switchboard shall be as given below :

Sr. No.	Description	Unit	Particulars
A	General		
1	Type of Mounting		Floor mounting
2	Rated voltage, Phases and Frequency	V, Ph, Hz	415V, 3 Phase (4 wire), 50 Hz
	Type of switchboard (Brief Description)	-	Indoor, Cubicle, compartmentalized, Single front and open-able both sides type , Fixed type
4	One minute Power Frequency withstand voltage		
a)	Power circuit	kV(rms)	3.0
b)	Control Circuit	kV(rms)	2.5
5	Continuous current rating of busbars under design ambient of 30°C	Amp	300
6	Short circuit withstand for busbars and droppers (1 sec.)	kA	10

7	Maximum temperature of busbars, dropper and contacts at continuous current rating over design ambient temperature of 40°C	°C	60
8	Thickness of sheet steel in mm Cold rolled (Frame/Enclosure/Covers)	mm	3 / 2/ 2
9	Degree of protection of enclosure	-	IP-4X
10	Type of paint		Powder Coating mat finish
11	Finish Colour Shade		
a)	Interior & Exterior	-	White and RAL 7032
12	Earthing bus		
a)	Material	-	copper
b)	Size	mm	25 X 3
13	Cable entry	-	Bottom

B	Bus Bars		
1	Material	-	Aluminum
2	Continuous current rating under design ambient temperature	Amps	300
E	MCCB /MCB		
1	Type	-	Electronic/ Microprocessor based for rating more than 200A. Thermal magnetic-for rating less than 200A. With overload, ground fault and short circuit protection.
2	Rated Voltage	V	415
3	No. of poles		Triple pole
4	Short circuit breaking capacity	kA	10

F	Auxiliary Contactors		
1	Rated voltage of coil	V	240
2	Utilization category	-	AC3
G	Number of Incomer		
1	MCCB 125 A TP 35 kA with over current ad earth fault protection		1 nos
G	Number of Outgoing MCB, 10 kA		
	4 pole		
	63 A		3 nos
	32 A		4 nos
	2 pole		
	32 A		2 nos
	16 A		5 nos

The adequacy of the outgoing feeders shall be checked during detail engineering.

3.2.3 Accessories and fittings

- a) Digital Multi function meter
- b) CT and PT with fuse
- c) Under Voltage relay
- d) Indication lamp
- e) Terminal block with 20% spare
- f) Ammeter & Voltmeter with selector switch (96 mm x 96 mm)

3.2.4 The switchboard manufacturing shall be CNC based type and panel shall be of floor / wall mounting type. Entry for incoming and outgoing cables shall be from bottom. Busbars shall be of Aluminium. Degree of protection of the panel shall be IP 4X.

3.2.5 MCCB outgoing feeders of rating 200A and above shall be protected with over current, short circuit and earth fault protection (Electronic or Microprocessor based) and below 200A shall be protected with over current, short-circuit protection of Thermo magnetic type and electromagnetic earth fault protection releases.

3.2.6 Busbars

- 3.2.6.1 The phase and neutral busbars shall be of rating indicated in the corresponding single line diagram. Busbars shall be of Aluminium and shall be provided with minimum clearances as per standards.
- 3.2.6.2 Bus bars shall be colour coded with coloured PVC tape at suitable intervals.
- 3.2.6.3 Busbar joints, if any, shall be of the bolted type with minimum 4 bolts. Spring washers shall be provided to ensure good contact at the joints. Busbars shall be thoroughly cleaned at the joints and suitable contact grease shall be applied just before making a joint.
- 3.2.6.4 Direct access to, or accidental contact with busbars and primary connections shall not be possible. All apertures and slots shall be protected by baffles to prevent accidental shorting of busbars due to insertion of maintenance tools.
- 3.2.6.5 Sequence of red, yellow and blue phases and neutral for four-pole equipment shall be left to right and top to bottom, for horizontal and vertical layouts respectively.

3.2.7 Moulded Case Circuit Breaker (MCCB)

- 3.2.7.1 MCCBs shall be of the air break, quick make, quick break and trip free type and shall be totally enclosed in a heat resistant, moulded, insulating material housing.
- 3.2.7.2 MCCBs shall have a service short circuit breaking capacity equal to the ultimate short-circuit capacity.
- 3.2.7.3 Each pole of MCCB shall have overload, short circuit and earth fault protection. Such a protection system shall be fully self-contained, needing no separate power supply. The elements shall be adjustable. Adjustments shall be made simultaneously on all poles from a common facility.
- 3.2.7.4 MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.
- 3.2.7.5 MCCBs should be current limiting type with trip time of less than 10 msec under short circuit conditions.
- 3.2.7.6 The MCCBs should be either 3 pole fixed type.
- 3.2.7.7 MCCB shall have contact inspection facility with opening the front cover.

3.2.8 Miniature Circuit Breaker (MCB)

- 3.2.8.1 Miniature circuit breakers shall be of the thermal and magnetic tripping type, and comply with IEC 60898 and IEC 60947-2.
- 3.2.8.2 MCB shall be hand operated, air break, quick make, quick break type.

3.2.8.3 Operating mechanisms shall be mechanically trip-free from the operating knob to prevent the contacts being held closed under overload or short-circuit conditions.

3.2.8.4 Each pole shall be fitted with a bi-metallic element for overload protection and a magnetic element for short-circuit protection. Multiple pole MCBs shall be mechanically linked such that tripping of one pole simultaneously trips all the other poles. For motor feeders, MCB shall have type C characteristics.

3.2.8.5 The short circuit rating shall be not less than that of the system to which they are connected with a minimum of 10 kA.

3.2.9 Tests

3.2.9.1 All routine and acceptance tests as specified in the applicable standards shall be carried out on the LVDB. Test reports for all the bought out items shall be reviewed during testing.

3.2.10 Miscellaneous

3.2.10.1 The following items shall also be included in the Contractor's scope:

- a) Supply, installation and commissioning of interconnecting cables between ACDB and various equipment in the electrical room along with associated compression type brass cable glands, lugs etc. required to complete the works in full.
- d) Terminal clamps / connectors suitable for connecting to specified sizes of conductor / tube / cable.