4.9 All inspection, measuring and test equipment used by manufacturer shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The manufacturer shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by purchaser. In case repair is carried out in the measuring and test equipment it should be compulsorily re-calibrated. All calibrated measuring and test equipment must be properly sealed after calibration to stop any kind of manipulation with the equipment. Wherever mutually agreed between manufacturer & Purchaser, the manufacturer shall re-calibrate the measuring/test equipment in the presence of the Inspector.

4.10 Preparation of inspection report is the concluding part of inspection. Every inspection agency has its own style of preparation of inspection report. However, since it is a quality document, we must ensure that all relevant information and enclosures are made available along with the report. The inspection report has mainly three parts:

a) The first part contains details of equipment, contract detail, quantity offered, sampling, observation noted during inspection, remark on test results etc.
b) The second part contains reports on physical verification.
c) The third part of the report contains the routine test results of the inspected transformers, temperature rise test results, if carried-out, and few demonstrative sample calculations e.g. Load Loss calculation at normal and extreme taps, Temperature rise calculation, Noise level calculation etc.

5.0 INSPECTION AND TESTING

The inspection envisaged by the purchaser is given below. However, the manufacturer shall draw up and carry out a comprehensive inspection and testing programme in the form of detailed quality plan duly approved by Purchaser for necessary implementation during manufacture of the equipment. All accessories and components of transformer shall be purchased from source, approved by the purchaser. All process tests, critical raw material tests and witness/ inspection of these testing shall be carried out as per approved Manufacturing Quality Plan (MQP) by the purchaser.

5.1 Factory Tests

5.1.1 The manufacturer shall carry out all type & routine tests specified in "**Annexure-D** and **Annexure-E".** All tests shall be done in line with latest IS: 2026/IEC 60076 or as per procedure specified in

this document**.** Complete test report shall be submitted to purchaser after proper scrutiny and signing on each page by the test engineer of the manufacturer.

5.1.2 The manufacturer shall be fully equipped to perform all the required tests as specified. He shall confirm the capabilities of the proposed manufacturing plant in this regard. Any limitations shall be clearly stated.

5.1.3 The manufacturer shall bear all additional costs related to tests which are not possible to carry out at his own works.

5.1.4 In case, any failure observed during factory testing involving winding/ winding shield/ static shield ring, then affected winding of all phases shall be replaced by new one mutually agreed between manufacturer & Purchaser.

5.1.5 Tank Tests

(A) Oil Leakage Test

All tanks and oil filled compartments shall be completely filled with air or oil of a viscosity not greater than that of insulating oil conforming to IEC 60296 at the ambient temperature and subjected to a pressure equal to normal head of oil plus 35 kN/sq.m (5 psi) measured at the base of the tank. This pressure shall be maintained for a period of not less than 12 hours for oil and 1 hour for air during which no leakage shall occur.

(B) Vacuum Test

All transformer tanks shall be subjected to the specified vacuum. The tank designed for full vacuum (760 mm of mercury at sea level) shall be tested at an internal pressure of 3.33 KN/Sq.m absolute (25 torr) for one hour. The permanent deflection of flat plate after the vacuum has been released shall not exceed the values specified below:

Horizontal Length of flat plate (in mm)	**Permanent deflection (in mm)**
Up to and including 750	5.0
751 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.5
2001 to 2250	11.0
2251 to 2500	12.5

2501 to	3000	16.0
Above	3000	19.0

(C) Pressure Test

All transformer tanks, its radiator, conservator and other fittings together or separately shall be subjected to a **pressure corresponding to twice the normal head of oil or normal oil head pressure plus 35 KN/ sq.m whichever is lower, measured at the base of the tank and maintained for eight hours**. The permanent deflection of flat plates after the excess pressure has been released shall not exceed the figure specified above for vacuum test.

5.2 Stage Inspection

5.2.1 **Stage inspection** will be carried out by the Inspector **on Core, Winding, core-coil assembly & Tank during the manufacturing stages** of the transformer. The manufacturer will have to call for the stage inspection and shall arrange the inspection at manufacturer's premises or manufacturer's sub-supplier's premises, as applicable, free of cost.

5.2.2 **Stage inspection will be carried out on at least one Transformer** against an offer of minimum 50% of the ordered quantity as mentioned in delivery schedule. On the basis of satisfactory stage inspection, manufacturer will proceed further.

5.2.3 The manufacturer will offer the core for stage inspection and get approval from purchaser during manufacturing stage. **The BIS certified prime core materials are only to be used.** The manufacturer has to produce following documents at the time of stage inspection for confirmation of use of prime core materials.

a) Invoice of supplier
b) Mills' approved test certificates
c) Packing list
d) Bill of lading
e) Bill of entry certificate by custom.
f) Description of material, electrical analysis, physical inspection, certificate for surface defects, chemical composition certificate, thickness and width of the materials
g) Place of cutting of core materials

To avoid any possibility of mixing of 'Prime material' with any other second grade/ defective material, **the imported packed slit coils of CRGO materials shall be opened in the presence of the Inspector. Only after the inspection and approval from**

purchaser, the core material will be cut in-house or sent to external agency for cutting individual laminations. In case the core is sent to external agency for cutting, the Inspector will have full access to visit such agency for the inspection of the cutting of core. Core material shall be directly procured either from the manufacturer or through their accredited marketing organisation of repute and not through any agent.

5.2.4 Typical example for calculation of flux density, core quantity, no-load loss and weight of copper during stage inspection is given in the **Annexure-F.**

5.3 Type Tests on fittings

Following fittings shall conform to type tests and the type test reports shall be furnished along with drawing of the equipment/fittings.

a) Bushing (Type test as per IS/IEC:60137) (Seismic withstand test for 400 kV and above voltage class)
b) OLTC (Test as per IS 8468/IEC:60214 and degree of protection test for IP-55 on Driving mechanism box)
c) Buchholz relay
d) OTI and WTI
e) Pressure Relief Device (including degree of protection test for IP 55 in terminal box)
f) Sudden Pressure Relay (including degree of protection test for IP 55 in terminal box)
g) Magnetic Oil Level gauge & Terminal Box degree of protection test for IP-55.
h) Air Cell (Flexible air separator) - Oil side coating, Air side under Coating, Air side outer coating and coated fabric as per IS: 3400/ BS: 903/ IS: 7016
i) Marshalling & common marshalling box and other outdoor cubicle (IP-55 test)
j) Bus post Insulators
k) Oil pump
l) Cooling fan & motor assembly
m) RTCC Panel (IP-43 test)

6.0 Pre-Shipment Checks at Manufacturer's Works

The following pre-shipment checks shall be done at manufacturer's works:

6.1 Check for inter-changeability of components of similar transformers for mounting dimensions.

6.2 **Check for proper packing and preservation of accessories** like radiators, bushings, dehydrating breather, rollers, Buchholz relay, fans, control cubicle, connecting pipes, conservator etc.

6.3 Ensure following setting of impact recorder at the time of installation with transformer unit before despatch from factory:

1g: Start recording
2g: Warning
3g: Alarm

Further, drop-out setting shall be 1g and threshold setting shall be in the range of 5g to 10g.

6.4 Check for proper provision for bracing to arrest the movement of core and winding assembly inside the tank.

6.5 Gas tightness test to confirm tightness and record of dew point of dry air inside the tank. Derivation of leakage rate and ensure the adequate reserve dry air capacity.

6.6 Due security arrangements to be ensured during transportation to avoid pilferage and tempering with the valves and other accessories used while dry air filling.

Annexures

Annexure-A

SPECIFIC TECHNICAL REQUIREMENT

1.0 250 MVA & 315 MVA, 400/33-33 kV 3-Phase Power Transformer

S. No	Description	Unit	Technical Parameters	
1.	Voltage ratio (Line-to-Line)	kV	400/33	
2.	Rated Capacity			
	HV	MVA	250	315
	LV1	MVA	125	157.5
	LV2	MVA	125	157.5
	Tertiary	MVA	Tertiary winding may be provided if transformer is of 5 limbs construction.	
3.	No of phases		3-phase	
4.	No of Secondary windings		Two windings	
5.	Vector Group		YNynyn0 (without tertiary) YNyn0yn0+d11 (with tertiary)	
6.	Type of transformer		Power transformer	
7.	Applicable Standard		IEC 60076/ IS 2026	
8.	Cooling type		ONAN / ONAF / ODAF (or OFAF) Or ONAN/ONAF1/ONAF2	
9.	Rating at different cooling	%	60 / 80 / 100	
10.	Cooler Bank Arrangement		2 X 50%	
11.	Frequency	Hz	50	
12.	Tap Changer (OLTC)		-10% to +10% in steps of 1.25% for HV variation	
13.	Location of tap changer		On HV neutral end	

14.	Impedance at 75°C, at 157.5 MVA base (for 315 MVA transformer) at 125 MVA base (for 250 MVA transformer)		
i)	HV-LV1 & HV-LV2:		
	Max. Voltage tap	%	16.2
	Principal tap	%	15
	Min. Voltage tap	%	14
ii)	LV1-LV2	%	20 (min.)
iii)	Tolerance on Impedance	%	As per IEC, unless specified otherwise
15.	Service		Outdoor
16.	Duty		Cyclic
17.	Overload Capacity		IEC-60076-7
18.	Temperature rise over 50°C ambient temp.		
i)	Top oil measured by thermometer	^{o}C	50
ii)	Average winding measured by resistance method	^{o}C	55
19.	Winding hot spot rise over yearly weighted temperature of 32 °C	^{o}C	66
20.	Tank Hotspot Temperature	^{o}C	110
21.	Maximum design ambient temperature	^{o}C	50
22.	Windings		
i)	Lightning Impulse withstand Voltage		

	HV	kV_p	1300
	LV1 & LV2	kV_p	250
	HV Neutral	kV_p	95
	LV Neutrals	kV_p	250
	Tertiary (if provided)	kV_p	250
ii)	Chopped Wave Lightning Impulse Withstand Voltage		
	HV	kV_p	1430
	LV1 & LV2	kV_p	275
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
iv)	One Minute Power Frequency withstand Voltage		
	HV	kV_{rms}	570
	LV1 & LV2	kV_{rms}	95
	HV Neutral	kV_{rms}	38
	LV Neutrals	kV_{rms}	95
	Tertiary (if provided)	kV_{rms}	95
v)	Neutral Grounding (HV & LV)		Solidly grounded
vi)	Insulation		
	HV		Graded
	LV1 & LV2		Uniform
vii)	Tertiary Connection (if provided)		Ungrounded Delta
viii)	Tan delta of winding	%	≤ 0.5
23.	Bushing		
i)	Rated voltage		
	HV	kV	420
	LV1 & LV2	kV	52
	HV Neutral	kV	36

	LV Neutrals	kV	52
	Tertiary (if provided)	kV	52
ii)	Rated current		
	HV	A	1250
	LV1 & LV2	A	3150
	HV Neutral	A	2000
	LV Neutrals	A	2000
	Tertiary (if provided)	A	1250
iii)	Lightning Impulse withstand Voltage		
	HV	kV_p	1425
	LV1 & LV2	kV_p	250
	HV Neutral	kV_p	170
	LV Neutrals	kV_p	250
	Tertiary (if provided)	kV_p	250
iv)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
v)	One Minute Power Frequency withstand Voltage		
	HV	kV_{rms}	695
	LV1 & LV2	kV_{rms}	105
	HV Neutral	kV_{rms}	77
	LV Neutrals	kV_{rms}	105
	Tertiary (if provided)	kV_{rms}	105
vi)	Tan delta of bushing at ambient Temperature	%	≤ 0.5
vii)	Minimum total creepage distances		(Specific creepage distance: 31mm/kV corresponding to the line to line highest system voltage)

	HV	mm	13020	
	LV1 & LV2	mm	1612	
	HV Neutral	mm	1116	
	LV Neutrals	mm	1612	
viii)	Maximum Partial discharge level at U_m			
	HV	pC	10	
	LV1 & LV2	pC	10	
24.	Maximum Partial discharge level at 1.58 * U_r / √3	pC	100	
25.	Maximum Noise level at rated voltage, at principal tap & no load and all cooling active	dB	80	
26.	Termination details		To be provided by the purchaser as per its requirement	
27.	**Maximum Permissible Losses of Transformers**		**250 MVA**	**315 MVA**
i)	Max. No Load Loss at rated voltage and frequency	kW	**111**	**128**
ii)	Max. Load Loss at rated current and at 75°C for HV and LV (LV1+ LV2) windings, at principal tap position	kW	**608**	**698**
iii)	Max. I^2R Loss at rated current and at 75°C for HV and LV (LV1+ LV2) windings , at principal tap position	kW	**497**	**571**
iv)	Max. Auxiliary Loss at rated voltage and frequency	kW	**14**	**16**

2.0 160 MVA, 400/33-33 kV 3-Phase Power Transformer

S. No.	Description	Unit	Technical Parameters
1.	Voltage ratio (Line-to-Line)	kV	400/33
2.	Rated Capacity		
	HV	MVA	160
	LV1	MVA	80
	LV2	MVA	80
3.	No of phases		3-phase
4.	No of secondary windings		Two windings
5.	Vector Group		YNynyn0
6.	Type of Transformer		Power Transformer
7.	Applicable Standard		IEC 60076 / IS 2026
8.	Cooling		ONAN / ONAF
9.	Rating at different cooling	%	70 / 100
10.	Cooler Bank Arrangement		2 X 50%
11.	Frequency	Hz	50
12.	Tap Changer (OLTC)/OCTC		-10% to +10% in steps of 1.25% for HV variation
13.	Location of tap change		On HV neutral end
14.	Impedance at 75°C at 80 MVA base		
i)	HV-LV1 & HV-LV2:		
	Max. Voltage tap	%	16.2
	Principal tap	%	15
	Min. Voltage tap	%	14
ii)	LV1-LV2	%	20 (min.)
iii)	Tolerance on Impedance	%	As per IEC, unless specified otherwise
15.	Service		Outdoor
16.	Duty		Cyclic
17.	Overload Capacity		IEC-60076-7

18.	Temperature rise over 50°C ambient temp		
i)	Top oil measured by thermometer	^{o}C	50
ii)	Average winding measured by resistance method	^{o}C	55
19.	Winding hot spot rise over yearly weighted temperature of 32°C	^{o}C	66
20.	Tank Hotspot Temperature	^{o}C	110
21.	Maximum design ambient temperature	^{o}C	50
22.	Windings		
i)	Lightning Impulse withstand Voltage		
	HV	kV_p	1300
	LV1 & LV2	kV_p	250
	HV Neutral	kV_p	95
	LV Neutrals	kV_p	250
ii)	Chopped Wave Lightning Impulse Withstand Voltage		
	HV	kV_p	1430
	LV1 & LV2	kV_p	275
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
iv)	One Minute Power Frequency withstand Voltage		
	HV	kV_{rms}	570
	LV1 & LV2	kV_{rms}	95
	HV Neutral	kV_{rms}	38
	LV Neutrals	kV_{rms}	95
v)	Neutral Grounding (HV & LV)		Solidly grounded
vi)	Insulation		
	HV		Graded
	LV1 & LV2		Uniform
vii)	Tan delta of winding	%	≤0.5
23.	Bushing		
i)	Rated voltage		
	HV	kV	420
	LV1 & LV2	kV	52
	HV Neutral	kV	36
	LV Neutrals	kV	52
ii)	Rated current		
	HV	A	1250
	LV1 & LV2	A	2000

	HV Neutral	A	2000
	LV Neutral	A	2000
iii)	Lightning Impulse withstand Voltage		
	HV	kV_p	1425
	LV1 & LV2	kV_p	250
	HV Neutral	kV_p	170
	LV Neutrals	kV_p	250
iv)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
v)	One Minute Power Frequency withstand Voltage		
	HV	kV_{rms}	695
	LV1 & LV2	kV_{rms}	105
	HV Neutral	kV_{rms}	77
	LV Neutrals	kV_{rms}	105
vi)	Tan delta of bushing at ambient Temperature	%	≤ 0.5
vii)	Minimum total creepage distances		(Specific creepage distance: 31mm/kV corresponding to the line to line highest system voltage)
	HV	mm	13020
	LV1 & LV2	mm	1612
	HV Neutral	mm	1116
	LV Neutrals	mm	1612
viii)	Maximum Partial discharge level at U_m		
	HV	pC	10
	LV1 & LV2	pC	10
24.	Maximum Partial discharge level at 1.58 * U_r / √3	pC	100
25.	Maximum Noise level at rated voltage, at principal tap & no load and all cooling active	dB	80
26.	Termination details		To be provided by the purchaser as per its requirement
27.	**Maximum Permissible Losses of Transformers**		
i)	Max. No Load Loss at rated voltage and frequency	kW	**73**

ii)	Max. Load Loss at rated current and at 75°C for HV and LV (LV1+ LV2) windings, at principal tap position	kW	**408**
iii)	Max. I^2R Loss at rated current and at 75°C for HV and LV (LV1+ LV2) windings, at principal tap position	kW	**334**
iv)	Max. Auxiliary Loss at rated voltage and frequency	kW	**10**

3.0 125 MVA, 400/33 kV 3-Phase Power Transformer

S. No.	Description	Unit	Technical Parameters
1.	Voltage ratio (Line-to-Line)	kV	400/33
2.	Rated Capacity (HV & LV)	MVA	125
3.	No of phases		3-phase
4.	No of secondary windings		One winding
5.	Vector Group		YNyn0
6.	Type of Transformer		Power Transformer
7.	Applicable Standard		IEC 60076 / IS 2026
8.	Cooling		ONAN / ONAF
9.	Rating at different cooling	%	70 / 100
10.	Cooler Bank Arrangement		2 X 50%
11.	Frequency	Hz	50
12.	Tap Changer (OLTC)/OCTC		-10% to +10% in steps of 1.25% for HV variation
13.	Location of tap change		On HV neutral end
14.	Impedance at 75°C at highest MVA base		
	Max. Voltage tap	%	16.2
	Principal tap	%	15
	Min. Voltage tap	%	14
15.	Tolerance on Impedance	%	As per IEC, unless specified otherwise
16.	Service		Outdoor
17.	Duty		Cyclic
18.	Overload Capacity		IEC-60076-7
19.	Temperature rise over 50°C ambient temp		
i)	Top oil measured by thermometer	^{o}C	50
ii)	Average winding measured by resistance method	^{o}C	55
20.	Winding hot spot rise over yearly weighted temperature of 32°C	^{o}C	66
21.	Tank Hotspot Temperature	^{o}C	110
22.	Maximum design ambient temperature	^{o}C	50
23.	Windings		
i)	Lightning Impulse withstand Voltage		
	HV	kV_p	1300
	LV	kV_p	250
	HV Neutral	kV_p	95

	LV Neutral	kV_p	250
ii)	Chopped Wave Lightning Impulse Withstand Voltage		
	HV	kV_p	1430
	LV	kV_p	275
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
iv)	One Minute Power Frequency withstand Voltage		
	HV	kV_{rms}	570
	LV	kV_{rms}	95
	HV Neutral	kV_{rms}	38
	LV Neutral	kV_{rms}	95
v)	Neutral Grounding (HV & LV)		Solidly grounded
vi)	Insulation		
	HV		Graded
	LV		Uniform
vii)	Tan delta of winding	%	≤0.5
24.	Bushing		
i)	Rated voltage		
	HV	kV	420
	LV	kV	52
	HV Neutral	kV	36
	LV Neutral	kV	52
ii)	Rated current		
	HV	A	1250
	LV	A	3150
	HV Neutral	A	2000
	LV Neutral	A	2000
iii)	Lightning Impulse withstand Voltage		
	HV	kV_p	1425
	LV	kV_p	250
	HV Neutral	kV_p	170
	LV Neutral	kV_p	250
iv)	Switching Impulse withstand Voltage		
	HV	kV_p	1050
v)	One Minute Power Frequency withstand Voltage		
	HV	kV_{rms}	695
	LV	kV_{rms}	105
	HV Neutral	kV_{rms}	77

	LV Neutral	kV_{rms}	105
vi)	Tan delta of bushing at ambient Temperature	%	≤ 0.5
vii)	Minimum total creepage distances		(Specific creepage distance: 31mm/kV corresponding to the line to line highest system voltage)
	HV	mm	13020
	LV	mm	1612
	HV Neutral	mm	1116
	LV Neutral	mm	1612
viii)	Maximum Partial discharge level at U_m		
	HV	pC	10
	LV	pC	10
25.	Maximum Partial discharge level at 1.58 * U_r / √3	pC	100
26.	Maximum Noise level at rated voltage, at principal tap & no load and all cooling active	dB	80
27.	Termination details		To be provided by the purchaser as per its requirement
28.	**Maximum Permissible Losses of Transformers**		
i)	Max. No Load Loss at rated voltage and frequency	kW	**63**
ii)	Max. Load Loss at rated current and at 75°C for HV and LV windings, at principal tap position	kW	**344**
iii)	Max. I^2R Loss at rated current and at 75°C for HV and LV windings, at principal tap position	kW	**286**
iv)	Max. Auxiliary Loss at rated voltage and frequency	kW	**8**

4.0 (a) 160 MVA, 220/33-33 kV 3-ph Power Transformer
(b) 160 MVA, 230/33-33 kV 3-ph Power Transformer

Cl. No.	Description	Unit	Technical Parameters
1.	Voltage ratio (Line-to-Line)	kV	(a) 220/33 (b) 230/33
2.	Rated Capacity		
3.	HV	MVA	160
4.	LV1	MVA	80
5.	LV2	MVA	80
6.	No of phases		3 (Three)
7.	No of secondary windings		Two windings
8.	Vector Group		YNynyn0
9.	Type of transformer		Power transformer
10.	Applicable Standard		IEC 60076 / IS 2026
11.	Cooling type		ONAN / ONAF
12.	Rating at different cooling	%	70 / 100
13.	Frequency	Hz	50
14.	Cooler Bank Arrangement		2 X 50%
15.	Tap Changer		
i)	Type		On-load tap changer /OCTC
ii)	Tap range and steps		-10% to +10% in steps of 1.25% for HV variation
iii)	Location of tap changer		On HV neutral end
16.	Impedance at 75°C, at 80 MVA base		
i)	HV-LV1 & HV-LV2:		
	Max. Voltage tap	%	16.2
	Principal tap	%	15
	Min. Voltage tap	%	14
ii)	LV1-LV2	%	20 (min.)
iii)	Tolerance on Impedance	%	As per IEC, unless specified otherwise
17.	Service		Outdoor
18.	Duty		Cyclic
19.	Overload Capacity		IEC-60076-7
20.	Temperature rise over 50°C ambient Temp		
i)	Top oil measured by thermometer	^{O}C	50

ii)	Average winding measured by resistance method	^{o}C	55
21.	Winding hot spot rise over yearly weighted temperature of 32°C	^{o}C	66
22.	Tank Hotspot Temperature	^{o}C	110
23.	Maximum design ambient temperature	^{o}C	50
24.	Windings		
i)	Lightning Impulse withstand Voltage		
	HV	kV_p	950
	s	kV_p	170
	HV Neutral	kV_p	95
	LV neutrals	kV_p	170
ii)	Chopped Wave Lightning Impulse Withstand Voltage		
	HV	kV_p	1045
	LV1 & LV2	kV_p	187
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	750
iv)	One Minute Power Frequency withstand Voltage		
	HV	kV_{rms}	395
	LV1 & LV2	kV_{rms}	70
	HV Neutral	kV_{rms}	38
	LV neutrals	kV_{rms}	70
v)	Neutral Grounding (HV & LV)		Solidly grounded
vi)	Insulation		
	HV		Graded
	LV1 & LV2		Uniform
vii)	Tan delta of winding	%	≤ 0.5
25.	Bushing		
i)	Rated voltage		
	HV	kV	245
	LV1 & LV2	kV	36
	HV Neutral	kV	36
	LV Neutrals	kV	36
ii)	Rated current		
	HV	A	1250
	LV1 & LV2	A	3150
	HV Neutral	A	3150
	LV neutrals	A	3150
iii)	Lightning Impulse withstand Voltage		
	HV	kV_p	1050

	LV1 & LV2	kV_p	170
	HV Neutral	kV_p	170
	LV neutrals	kV_p	170
iv)	Switching Impulse withstand Voltage		
	HV	kV_p	850
v)	One Minute Power Frequency withstand Voltage		
	HV	kV_{rms}	505
	LV1 & LV2	kV_{rms}	77
	HV Neutral	kV_{rms}	77
	LV Neutrals	kV_{rms}	77
vi)	Tan delta of bushing at ambient Temperature	%	≤ 0.5
vii)	Minimum total creepage distances		(Specific creepage distance: 31mm/kV corresponding to the line to line highest system voltage)
	HV bushing	mm	7595
	LV bushing	mm	1116
	HV neutral / LV neutrals	mm	1116
viii)	Maximum Partial discharge level at U_m		
	HV	pC	10
26.	Maximum Partial discharge level at 1.58 * U_r / √3	pC	100
27.	Maximum Noise level at rated voltage, at principal tap & no load and all cooling active	dB	80
28.	Termination details		To be provided by the purchaser as per its requirement
29.	**Maximum Permissible Losses of Transformers**		
i)	Max. No Load Loss at rated voltage and frequency	kW	**65**
ii)	Max. Load Loss at rated current and at 75°C for HV and LV (LV1+LV2) windings at principal tap position	kW	**390**
iii)	Max. I^2R Loss at rated current and at 75°C for HV and LV (LV1+LV2) windings at principal tap position	kW	**319**

iv)	Max. Auxiliary Loss at rated voltage and frequency	kW	**8**

5.0 (a) 100 MVA & 125 MVA , 220/33 kV 3-ph Power Transformer
(b) 100 MVA & 125 MVA, 230/33 kV 3-ph Power Transformer

Cl. No.	Description	Unit	Technical Parameters
1.	Voltage ratio (Line-to-Line)	kV	(a) 220/33 (b) 230/33
2.	Rated Capacity (HV & LV)	MVA	100 | 125
3.	No of phases		3 (Three)
4.	No of secondary windings		One winding
5.	Vector Group		YNyn0
6.	Type of transformer		Power transformer
7.	Applicable Standard		IEC 60076 / IS 2026
8.	Cooling type		ONAN / ONAF
9.	Rating at different cooling	%	70 / 100
10.	Frequency	Hz	50
11.	Cooler Bank Arrangement		2 X 50%
12.	Tap Changer		
i)	Type		On-load tap changer /OCTC
ii)	Tap range and steps		-10% to +10% in steps of 1.25% for HV variation
iii)	Location of tap changer		On HV neutral end
13.	Impedance at 75°C, at highest MVA base		
i)	Max. Voltage tap	%	16.2
ii)	Principal tap	%	15.0
iii)	Min. Voltage tap	%	14.0
iv)	Tolerance on Impedance		As per IEC
14.	Service		Outdoor
15.	Duty		Cyclic
16.	Overload Capacity		IEC-60076-7
17.	Temperature rise over 50°C ambient Temp		
i)	Top oil measured by thermometer	^{o}C	50
ii)	Average winding measured by resistance method	^{o}C	55
18.	Winding hot spot rise over yearly weighted temperature of 32°C	^{o}C	66
19.	Tank Hotspot Temperature	^{o}C	110
20.	Maximum design ambient temperature	^{o}C	50
21.	Windings		

i)	Lightning Impulse withstand Voltage		
	HV	kV_p	950
	LV	kV_p	170
	HV Neutral	kV_p	95
	LV neutral	kV_p	170
ii)	Chopped Wave Lightning Impulse Withstand Voltage		
	HV	kV_p	1045
	LV	kV_p	187
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	750
iv)	One Minute Power Frequency withstand Voltage		
	HV	kV_{rms}	395
	LV	kV_{rms}	70
	HV Neutral	kV_{rms}	38
	LV neutral	kV_{rms}	70
v)	Neutral Grounding (HV & LV)		Solidly grounded
vi)	Insulation		
	HV		Graded
	LV		Uniform
vii)	Tan delta of winding	%	≤ 0.5
22.	Bushing		
i)	Rated voltage		
	HV	kV	245
	LV	kV	36
	HV Neutral	kV	36
	LV Neutral	kV	36
ii)	Rated current		
	HV	A	1250
	LV	A	3150
	HV Neutral	A	3150
	LV neutral	A	3150
iii)	Lightning Impulse withstand Voltage		
	HV	kV_p	1050
	LV	kV_p	170
	HV Neutral	kV_p	170
	LV neutral	kV_p	170
iv)	Switching Impulse withstand Voltage		
	HV	kV_p	850
v)	One Minute Power Frequency withstand Voltage		

	HV	kV_{rms}	505	
	LV	kV_{rms}	77	
	HV Neutral	kV_{rms}	77	
	LV Neutral	kV_{rms}	77	
vi)	Tan delta of bushing at ambient Temperature	%	≤ 0.5	
vii)	Minimum total creepage distances		(Specific creepage distance: 31mm/kV corresponding to the line to line highest system voltage)	
	HV bushing	mm	7595	
	LV bushing	mm	1116	
	HV neutral / LV neutral	mm	1116	
viii)	Maximum Partial discharge level at U_m			
	HV	pC	10	
23.	Maximum Partial discharge level at 1.58 * U_r / √3	pC	100	
24.	Maximum Noise level at rated voltage, at principal tap & no load and all cooling active	dB	80	
25.	Termination details		To be provided by the purchaser as per its requirement	
26.	**Maximum Permissible Losses of Transformers**		**100 MVA**	**125 MVA**
i)	Max. No Load Loss at rated voltage and frequency	kW	**50**	**52**
ii)	Max. Load Loss at rated current and at 75°C for HV and LV windings at principal tap position	kW	**299**	**326**
iii)	Max. I^2R Loss at rated current and at 75°C for HV and LV windings at principal tap position	kW	**248**	**269**
iv)	Max. Auxiliary Loss at rated voltage and frequency	kW	**6**	**7**

6.0

(a) 80 MVA & 100 MVA, 132/33 kV, 3-Phase Power Transformer
(b) 80 MVA & 100 MVA, 110/33 kV, 3-Phase Power Transformer

S. No.	Description	Unit	TECHNICAL PARAMETERS	
1.	Voltage ratio (Line-to-Line)	kV	(a) 132/33 (b) 110/33	
2.	Rated capacity (HV and LV)	MVA	80 MVA	100 MVA
3.	No of phases		3 (Three)	
4.	Vector Group		YNyn0 [Dyn11 (for 110 kV, where delta connection is specified by utility)]	
5.	Type of transformer		Power Transformer	
6.	Applicable Standard		IEC 60076 / IS 2026	
7.	Cooling type		ONAN/ONAF	
8.	Rating at different cooling	%	70 / 100	
9.	Cooler Bank Arrangement		1 X 100%	
10.	Frequency	Hz	50	
11.	Tap changer			
i)	Type		On-load tap changer (CFVV)	
ii)	Tapping range and steps		-10% to +10% in steps of 1.25% for HV variation	
iii)	Location of tap changer		On HV neutral end	
12.	HV-LV Impedance at 75 °C, at highest MVA base			
i)	Max. Voltage tap	%	13.2	
ii)	Principal tap	%	12.5	
iii)	Min. Voltage tap	%	11.8	
13.	Tolerance on Impedance	%	As per IEC	
14.	Service		Outdoor	
15.	Duty		Cyclic	
16.	Overload Capacity		IEC 60076-7	