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		66
19.	Tank hot spot temperature		110
20.	Maximum design ambient temperature	^{o}C	50
21.	Windings		
i)	Lightning Impulse withstand Voltage		
	HV	kV_p	650 (132 kV) 550 (110 kV)
	LV	kV_p	170
	HV Neutral	kV_p	95
	LV Neutral	kV_p	170
ii)	Chopped Wave Lightning Impulse Withstand Voltage		
	HV	kV_p	715 (132 kV) 605 (110 kV)
	LV	kV_p	187
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	540 (132 kV) 460 (110 kV)
iv)	One Minute Power Frequency withstand Voltage		
	HV	kV_{rms}	275 (132 kV) 230 (110 kV)
	LV	kV_{rms}	70
	HV Neutral	kV_p	38
	LV Neutral	kV_p	70
v)	Neutral Grounding (HV and LV)		Solidly grounded
vi)	Insulation		
	HV		Graded
	LV		Uniform

vii)	Tan delta of winding	%	≤0.5%	
22.	Bushings			
i)	Rated voltage			
	HV	kV	145	
	LV, LV Neutral & HV Neutral	kV	36	
ii)	Rated current (Min.)			
	HV	A	1250	
	LV	A	3150	
	HV Neutral & LV Neutral	A	3150	
iii)	Lightning Impulse withstand Voltage			
	HV	kV_p	650	
	LV, HV Neutral and LV Neutral	kV_p	170	
iv)	One Minute Power Frequency withstand Voltage			
	HV	kV_{rms}	305	
	LV, HV Neutral and LV Neutral	kV_{rms}	77	
v)	Tan delta of bushing at ambient Temperature	%	≤ 0.5	
vi)	Minimum total creepage distances		(Specific creepage distance: 31mm/kV corresponding to the line to line highest system voltage)	
	HV	mm	4495	
	LV, HV Neutral and LV Neutral	mm	1116	
vii)	Maximum Partial discharge level at U_m on HV and LV	pC	10	
23.	Maximum Partial discharge level at 1.58*Ur/√3	pC	100	
24.	Maximum Noise level at rated voltage, at principal tap & no load and all cooling active	dB	75	
25.	Termination details		To be provided by the purchaser as per its requirement	
26.	**Maximum Permissible Losses of Transformers**		**80 MVA**	**100 MVA**
i)	Max. No Load Loss at rated voltage and frequency	kW	**35**	**44**

ii)	Max. Load Loss at rated current and frequency and at 75°C at principal tap between HV & LV	kW	**221**	**268**
iii)	Max. I^2R Loss at rated current and frequency and at 75°C at principal tap between HV & LV	kW	**189**	**228**
iv)	Max. Auxiliary Loss at rated voltage and frequency	kW	**5**	**6**

7.0

(a) 31.5 MVA and 50 MVA, 132/33 kV, 3-Phase Power Transformer

(b) 31.5 MVA and 50 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	31.5 MVA	50 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	
8.	Cooler Bank Arrangement		1 X 100%	
9.	Frequency	Hz	50	
10.	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	
11.	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	
12.	Tolerance on Impedance	%	As per IEC	
13.	Service		Outdoor	
14.	Duty		Continuous	
15.	Overload Capacity		IEC 60076-7	

16.	Temperature rise over 50°C ambient temp.		
iii)	Top oil measured by thermometer	^{o} C	50
iv)	Average winding measured by resistance method	^{o} C	55
17.	Winding hot spot rise over yearly weighted temperature of 32 °C		66
18.	Tank hot spot temperature		110
19.	Maximum design ambient temperature	^{o} C	50
20.	Windings		
i)	Lightning Impulse withstand Voltage		
	HV	kV_p	650 (132 kV) 550 (110 kV)
	LV	kV_p	170
	HV Neutral	kV_p	95
	LV Neutral	kV_p	170
ii)	Chopped Wave Lightning Impulse Withstand Voltage		
	HV	kV_p	715 (132 kV) 605 (110 kV)
	LV	kV_p	187
iii)	Switching Impulse withstand Voltage		
	HV	kV_p	540 (132 kV) 460 (110 kV)
iv)	One Minute Power Frequency withstand Voltage		
	HV	kV_{rms}	275 (132 kV) 230 (110 kV)
	LV	kV_{rms}	70
	HV Neutral	kV_p	38
	LV Neutral	kV_p	70
v)	Neutral Grounding (HV and LV)		Solidly grounded
vi)	Insulation		
	HV		Graded
	LV		Uniform

vii)	Tan delta of winding	%	≤0.5%	
21.	Bushings			
i)	Rated voltage			
	HV	kV	145	
	LV, LV Neutral & HV Neutral	kV	36	
ii)	Rated current (Min.)			
	HV	A	1250	
	LV	A	1250	
	HV Neutral & LV Neutral	A	1250	
iii)	Lightning Impulse withstand Voltage			
	HV	kV_p	650	
	LV, HV Neutral and LV Neutral	kV_p	170	
iv)	One Minute Power Frequency withstand Voltage			
	HV	kV_{rms}	305	
	LV, HV Neutral and LV Neutral	kV_{rms}	77	
v)	Tan delta of bushing at ambient Temperature	%	≤ 0.5	
vi)	Minimum total creepage distances		(Specific creepage distance: 31mm/kV corresponding to the line to line highest system voltage)	
	HV	mm	4495	
	LV, HV Neutral and LV Neutral	mm	1116	
	Maximum Partial discharge level at U_m on HV	pC	10	
22.	Maximum Partial discharge level at 1.58*Ur/√3	pC	100	
23.	Maximum Noise level at rated voltage, at principal tap & no load and all cooling active	dB	75	
24.	Termination details		To be provided by the purchaser as per its requirement	
25.	**Maximum Permissible Losses of Transformers**		**31.5 MVA**	**50 MVA**
i)	Max. No Load Loss at rated voltage and frequency	kW	**18**	**25**

ii)	Max. Load Loss at rated current and frequency and at 75°C at principal tap between HV & LV	kW	**110**	**151**
iii)	Max. I^2R Loss at rated current and frequency and at 75°C at principal tap between HV & LV	kW	**92**	**129**
iv)	Max. Auxiliary Loss at rated voltage and frequency	kW	**2**	**3**

Annexure-B

TECHNICAL PARAMETERS OF BUSHING CURRENT TRANSFORMERS

[These parameters are tentative and liable to change within reasonable limits. Purchaser's approval shall be obtained before proceeding with the design of bushing current transformers.]

1.0 Parameters of Current Transformer for 315MVA / 250MVA (3-Ph), 400/33-33 kV Transformers

Description	**Current Transformer Parameters**			
	HV Side	**HV Neutral Side**	**LV1 & LV2 Side**	**LV1 & LV2 Neutral Side**
Ratio				
CORE 1	1000/1	1000/1	3000/1	3000/1
CORE 2	600/1	-	-	-
Minimum knee point voltage or burden and accuracy class				
CORE 1	1000V, PX / PS	1000V, PX / PS	3000V, PX / PS	3000V, PX / PS
CORE 2	0.2S Class 20VA ISF≤5	-	-	-
Maximum CT Secondary Resistance				
CORE 1	2.5 Ohm	2.5 Ohm	7.5 Ohm	7.5 Ohm
CORE 2	-	-	-	-
Application				
CORE 1	Restricted Earth Fault (REF)	REF	REF	REF
CORE 2	Metering	-	-	-
Maximum magnetization current (at knee point voltage)				
CORE 1	60 mA	60 mA	30 mA	30 mA
CORE 2	-	-	-	-

Notes:

1. Parameters of WTI CT for each winding shall be provided by the manufacturer / contractor.
2. The CTs used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

2.0 Parameters of Current Transformer for 160MVA, 400/33-33 kV Transformers

Description	Current Transformer Parameters			
	HV Side	**HV Neutral Side**	**LV1 & LV2 Side**	**LV1 & LV2 Neutral Side**
Ratio				
CORE 1	1000/1	1000/1	1600/1	1600/1
CORE 2	300/1	-	-	-
Minimum knee point voltage or burden and accuracy class				
CORE 1	1000V, PX / PS	1000V, PX / PS	1600V, PX / PS	1600V, PX / PS
CORE 2	0.2S Class 20VA ISF≤5	-	-	-
Maximum CT Secondary Resistance				
CORE 1	2.5 Ohm	2.5 Ohm	4 Ohm	4 Ohm
CORE 2	-	-	-	-
Application				
CORE 1	Restricted Earth Fault (REF)	REF	REF	REF
CORE 2	Metering	-	-	-
Maximum magnetization current (at knee point voltage)				
CORE 1	60 mA	60 mA	30 mA	30 mA
CORE 2	-	-	-	-

Notes:

1. Parameters of WTI CT for each winding shall be provided by the manufacturer / contractor.
2. The CTs used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

3.0 Parameters of Current Transformer for 125MVA (3-Ph), 400/33 kV Transformers

Description	Current Transformer Parameters			
	HV Side	**HV Neutral Side**	**LV Side**	**LV Neutral Side**
Ratio				
CORE 1	1000/1	1000/1	3000/1	3000/1
CORE 2	300/1	-	-	-
Minimum knee point voltage or burden and accuracy class				
CORE 1	1000V, PX / PS	1000V, PX / PS	3000V, PX / PS	3000V, PX / PS
CORE 2	0.2S Class 20VA ISF≤5	-	-	-
Maximum CT Secondary Resistance				
CORE 1	2.5 Ohm	2.5 Ohm	7.5 Ohm	7.5 Ohm
CORE 2	-	-	-	-
Application				
CORE 1	Restricted Earth Fault (REF)	REF	REF	REF
CORE 2	Metering	-	-	-
Maximum magnetization current (at knee point voltage)				
CORE 1	60 mA	60 mA	30 mA	30 mA
CORE 2	-	-	-	-

Notes:

1. Parameters of WTI CT for each winding shall be provided by the manufacturer / contractor.
2. The CTs used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

4.0 Parameters of Current Transformer for 160MVA, 220 (or 230)/33-33 kV Transformers

Description	Current Transformer Parameters			
	HV Side	**HV Neutral Side**	**LV1 & LV2 Side**	**LV1 & LV2 Neutral Side**
Ratio				
CORE 1	800/1	800/1	1600/1	1600/1
CORE 2	600/1	-	-	-
Minimum knee point voltage or burden and accuracy class				
CORE 1	800V, PX / PS	800V, PX / PS	1600V, PX / PS	1600V, PX / PS
CORE 2	0.2S Class 20VA ISF≤5	-	-	-
Maximum CT Secondary Resistance				
CORE 1	2.0 Ohm	2.0 Ohm	4 Ohm	4 Ohm
CORE 2	-	-	-	-
Application				
CORE 1	Restricted Earth Fault (REF)	REF	REF	REF
CORE 2	Metering	-	-	-
Maximum magnetization current (at knee point voltage)				
CORE 1	100 mA	100 mA	30 mA	30 mA
CORE 2	-	-	-	-

Notes:

1. Parameters of WTI CT for each winding shall be provided by the manufacturer / contractor.
2. The CTs used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

5.0 Parameters of Current Transformer for 125MVA (3-Ph), 220 (or 230)/33 kV Transformers

Description	Current Transformer Parameters			
	HV Side	**HV Neutral Side**	**LV Side**	**LV Neutral Side**
Ratio				
CORE 1	800/1	800/1	3000/1	3000/1
CORE 2	600/1	-	-	-
Minimum knee point voltage or burden and accuracy class				
CORE 1	800V, PX / PS	800V, PX / PS	3000V, PX / PS	3000V, PX / PS
CORE 2	0.2S Class 20VA ISF≤5	-	-	-
Maximum CT Secondary Resistance				
CORE 1	2 Ohm	2 Ohm	7.5 Ohm	7.5 Ohm
CORE 2	-	-	-	-
Application				
CORE 1	Restricted Earth Fault (REF)	REF	REF	REF
CORE 2	Metering	-	-	-
Maximum magnetization current (at knee point voltage)				
CORE 1	100 mA	100 mA	30 mA	30 mA
CORE 2	-	-	-	-

Notes:

1. Parameters of WTI CT for each winding shall be provided by the manufacturer / contractor.
2. The CTs used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

6.0 Parameters of Current Transformer for 100MVA (3-ph), 220 (or 230)/33 kV Transformers

Description	Current Transformer Parameters			
	HV Side	**HV Neutral Side**	**LV Side**	**LV Neutral Side**
Ratio				
CORE 1	800/1	800/1	2000/1	2000/1
CORE 2	400/1	-	-	-
Minimum knee point voltage or burden and accuracy class				
CORE 1	800V, PX / PS	800V, PX / PS	2000V, PX / PS	2000V, PX / PS
CORE 2	0.2S Class 15VA ISF ≤ 5	-	-	-
Maximum CT Secondary Resistance				
CORE 1	2 Ohm	2 Ohm	5 Ohm	5 Ohm
CORE 2	-	-	-	-
Application				
CORE 1	Restricted Earth Fault (REF)	REF	REF	REF
CORE 2	Metering	-	-	-
Maximum magnetization current (at knee point voltage)				
CORE 1	100 mA	100 mA	30 mA	30 mA
CORE 2	-	-	-	-

Notes:

1. Parameters of WTI CT for each winding shall be provided by the manufacturer / contractor.
2. The CTs used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

7.0 Parameters of Current Transformer for 80MVA/100 MVA (3-ph), 132 (or 110)/33kV Transformers

Description	Current Transformer Parameters			
	HV Side	**HV Neutral Side**	**LV Side**	**LV Neutral Side**
Ratio				
CORE 1	800/1	800/1	2000/1	2000/1
CORE 2	600/1	-	-	-
Minimum knee point voltage or burden and accuracy class				
CORE 1	800V, PX / PS	800V, PX / PS	3000V, PX / PS	3000V, PX / PS
CORE 2	0.2S Class 15VA ISF ≤ 5	-	-	
Maximum CT Secondary Resistance				
CORE 1	2 Ohm	2 Ohm	5 Ohm	5 Ohm
CORE 2	-	-	-	-
Application				
CORE 1	Restricted Earth Fault (REF)	REF	REF	REF
CORE 2	Metering	-	-	-
Maximum magnetization current (at knee point voltage)				
CORE 1	100 mA	100 mA	30 mA	30 mA
CORE 2	-	-	-	-

Notes:

1. Parameters of WTI CT for each winding shall be provided by the manufacturer / contractor.
2. The CTs used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

8.0 Parameters of Current Transformer for 31.5MVA/ 50MVA MVA (3-ph) 132 (or110)/33kV Transformers

Description	Current Transformer Parameters			
	HV Side	**HV Neutral Side**	**LV Side**	**LV Neutral Side**
Ratio				
CORE 1	600/1	600/1	1000/1	1000/1
CORE 2	400/1	-	-	-
Minimum knee point voltage or burden and accuracy class				
CORE 1	600V, PX / PS	600V, PX / PS	1000V, PX / PS	1000V, PX / PS
CORE 2	0.2S Class 15VA ISF ≤ 5	-	-	
Maximum CT Secondary Resistance				
CORE 1	1.5 Ohm	1.5 Ohm	2.5 Ohm	2.5 Ohm
CORE 2	-	-	-	-
Application				
CORE 1	Restricted Earth Fault (REF)	REF	REF	REF
CORE 2	Metering	-	-	-
Maximum magnetization current (at knee point voltage)				
CORE 1	100 mA	100 mA	30 mA	30 mA
CORE 2	-	-	-	-

Notes:

1. Parameters of WTI CT for each winding shall be provided by the manufacturer / contractor.
2. The CTs used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

Annexure-C

GUARANTEED AND OTHER TECHNICAL PARTICULARS
(To be filled in by the manufacturer)

A. GENERAL

Sl. No.	Description	Unit	Specified by Buyer	Offered by manufa-cturer
1.	General Information i) Supplier ii) Name of Manufacturer iii) Place of Manufacture (Country & City) iv) Type of transformer (Core/Shell)			
2.	Applications i) Indoor/Outdoor ii) 2wdg/3wdg iii)			
3.	Corrosion Level at Site i) Light ii) Medium iii) Heavy iv) Very Heavy			
4.	Site altitude above mean sea level	M		--
5.	Seismic zone and ground acceleration at site (both in horizontal & vertical direction)			--
6.	Maximum and minimum ambient temperature at site			
7.	Applicable Standards i) IEC: 60076 ii) IS : 2026 iii) Any other, please specify			
8.	Rated Capcity / Full load rating (HV/LV (or LV1/LV2)	MVA		
9.	3-Phase			
10.	Rated No Load Voltages (HV/LV (or LV1/LV2)/ Tertiary	kV		
11.	Currents at normal tap (HV/LV(or LV1/LV2)/ tertiary	Amp		
12.	Rated Frequency	Hz		
13.	Connections and phase displacement symbols (Vector Group)			
14.	Weight Schedules (Minimum with no negative tolerance)			

	i) Active part (Core + coil)	Kg		
	ii) Insulating Oil (excluding mass of extra oil)	Kg		
	iii) Tank and Fittings	Kg		
	iii) Total weight	Kg		
	iv) Transportaion Weight	Kg		
	v) Overall dimensions L x B x H	mm		
	vi) Size of heaviest package L x B x H	mm		
	vii) Weight of heaviest package	Kg		
	viii) Weight of 5% extra oil	Kg		
	ix) Weight of core	Kg		
	x) Weight of copper (HV/Tertiary/LV(or LV1/LV2/ Regulating)	Kg		
	xi) Insulating Oil volume (excluding 5% extra oil)	Ltrs		
	xii) Quantity of oil in OLTC	Ltrs		
15.	Transport limitation			
16.	LV Winding i) Stabilizing tertiary (Yes/No) ii)			
17.	Tappings i)Type (OLTC/OCTC) and make of tap changer ii)Position of Tapping on the winding iii)Variation on iv)Range of variation v)No. of Steps vi) Whether control suitable for : • Remote/local operation • Auto/manual operation vi)Parallel Operation Requirements	 % 		
18.	Impedance and Losses			
	i) Guaranteed No load loss at rated voltage and frequency	kW		
	Tolerance (to be considered for loss evaluation)	%		
	ii) Guranteed I^2R Loss at rated current & frequency (at 75^0C) at principal tap	kW		
	iii) Eddy current and stray loss at rated current & frequency (at 75^0C) at principal tap	kW		
	iv) Load Loss(I^2R+Eddy and Stray) at rated current & frequency (at 75^0C) at principal tap	kW		
	Tolerance (to be considered for loss evaluation)	%		
	v) Guaranteed Auxiliary loss at rated voltage and frequency	kW		

	Tolerance (to be considered for loss evaluation)	%		
	vi) Calculated Fan Loss	kW		
	vii) Air core reactance of HV winding	%		
	viii)Guaranteed Impedance (at Highest MVA base)	%		
	(a) HV-Tertairy (at Pricipal tap) (b) HV-LV (or LV1/LV2) (at Pricipal tap) (c) Tertairy -LV(at Pricipal tap)			
	Tolerance			
	ix) Impedance at extreme tappings at Highest MVA base [for HV-LV for two winding transformer] a) Max. Voltage tap b) Min. Voltage tap	%		
	Tolerance	%		
	x) Zero sequence impedance at principal tap (for 3-phase transformers)			
19.	Capacitance to earth for HV/Tertiary/LV (or LV1/LV2)	pF		
20.	Regulation at full load at 75 ^{0}C winding temperature at: a) upf b) 0.8 pf			
21.	Guaranteed maximum Magnetizing Current at rated Voltage	%		
22.	Efficiency : At 100% load upf 0.8 lead 0.8 lag At 75% load upf 0.8 lead 0.8 lag At 50% load upf 0.8 lead 0.8 lag	%		
23.	Load at Maximum efficiency	%		
24.	Any limitations in carrying out the required test? If Yes, State limitations			
25.	Fault level of system (in kA) and its duration (in sec)	kA (sec)		
26.	Calculated short Circuit current (in kA) withstand capability for 2 seconds without exceeding temperature limit (i.e. Thermal ability to withstand SC current)	kA		
27.	Test current (in kA) and duration (in ms) for short Circuit current test (i.e. Dynamic ability to withstand SC)	kA & msec		
28.	Over fluxing withstand time (due to combined voltage & frequency fluctuations): 110% 125% 140%	msec		

	150% 170%			
29.	Free space required above the tank top for removal of core			
30.	Maximum Partial discharge level at 1.58 Ur/√3	pC		

B. MAGNETIC SYSTEM

Sl. No.	Description	Unit	Specified by Buyer	Offered by manufacturer
1.	Core Type: i) 3 Phase 3 Limb (3 wound limbs) ii) 3 Phase 5 Limb (3 wound limbs)			
2.	Type of Core Joint: i) Mitred ii) Step Lap			
3.	CRGO : i) Make & Country of Origin ii) Thickness, mm iii) Max. Specific loss at 1.7 T, 50Hz, in Watts/kg iv) Grade of core as per BIS v) Insulation between core lamination vi) BIS certified (Yes/No)			
4.	Minimum Gross & Net Area of: i) Core ii) Limb iii) Yoke iv) Unwound limb (May be verified during manufacturing stage – at the discretion of buyer)	cm^2		
5.	Stacking Factor	%		
6.	Voltage per turn	V		
7.	Apparent Core Density for Weight Calculation			
8.	Minimum Net Weight of Silicon Steel Lamination CRGO (may be verified during manufacturing stage by calculation)	kg		
9.	Maximum Flux density at 90%, 100% and 110% voltage and frequency (may be verified during manufacturing stage by calculation)	T		
10.	W/kg at working flux density			
11.	Building Factor Considered			
12.	Calculated No Load Loss at rated voltage and Frequency (Net Weight x W/kg x Building factor)	kW		
13.	Magnetizing inrush current	Amp		
14.	No load current at normal ratio and frequency for : 85% of rated voltage	Amp		

	100% of rated voltage 105% of rated voltage			
15.	Core Isolation test	kV		
16.	Core bolt in limb / yoke	Yes/ No		
17.	Core bolt insulation withstand voltage for one minute	kV		
18.	Maximum temperature rise of any part of core or its support structure in contact with oil	^{0}C		

C. CONDUCTING SYSTEM

Sl. No.	**Description**	**Unit**	**Offered by manufacturer**			
			HV	**LV**	**Tertiary**	**Regulating**
1.	Type of Winding Helical/Disc/Layer/inter wound					
2.	Type of Conductor PICC/CTC/CTCE/CTCEN/BPICC					
3.	Minimum Yield Strength of Conductor for 0.2% elongation	N/mm^2				
4.	Maximum Current density at CMR and conductor area at any tap: i) HV ii) Tertiary iii) LV (or LV1/LV2)	A/mm^2 & sq. mm				
5.	Maximum current density under short circuit: i) HV ii) Tertiary iii)LV (or LV1/LV2)	A/mm^2				
6.	Bare Weight of copper without paper insulation and lead (Minimum)	Kg				
7.	Per Phase Maximum resistance of winding at rated tap at 75 ^{O}C	ohm				
8.	Number of Turns/Phase					
9.	Insulating material used for HV/LV/Tertiary winding					
10.	Insulating material used between : i) HV and LV winding ii) LV and Tertiary winding iii) Tertiary winding and core iv) Regulating winding and adjacent winding/core					

11.	Details of special arrangement provided to improve surge voltage distribution in the winding					
12.	Dielectric Shielding used: i) Interleaved winding ii) Wound in Shield iii) Others					
13.	Magnetic Shielding used: i) Yoke Shunt on core clamp ii) Magnetic shunt on tank iii) Electromagnetic (Copper/Aluminum) shield on tank iv) Others					
14.	Noise level when energized at normal voltage and frequency without load	dB				

D. COOLING SYSTEM

Sl. No.	Description	Unit	Specified by Buyer	Offered by manufac-turer
1.	Type of Cooling [ONAN/ONAF (or) ONAN / ONAF / OFAF (or ODAF)]			
2.	Percentage Rating Corresponding to Cooling Stages (HV/Tertiary/LV (or LV1/LV2)			
3.	No. of Cooler banks (2x50% / 1x100% etc.)			
4.	Temperature gradient between windings and oil			
5.	Time in minutes for which the transformer can run at full load without exceeding maximum permissible temperature at reference ambient temperature when supply to fans is cut off	min		
6.	Guaranteed Maximum Temperature rise at 1000 mts. altitude and at actual altitude at site at ambient temperature at cooling specified at sl. No. 1: i) Top Oil by thermometer ii) Average Winding by resistance iii) Winding hot spot	^{0}C		
7.	Type of Cooler: i) Radiator Bank ii) Tank Mounted iii) Header Mounted iv) Separately Mounted v) Degree of Protection of terminal box			

8.	Cooling Fans: i) Type ii) Size iii) Rating (kW) iv) Supply voltage v) Quantity (Running + Standby) per cooler bank vi) Whether fans are suitable for continuous operation at 85% of their rated voltage calculated time constant: • natural cooling • forced air cooling vii) Degree of Protection of terminal box			
9.	Oil Pumps: i) Type ii) Size iii) Rating (lpm and kW) iv) Supply voltage v) Quantity (Running + Standby) per cooler bank vi) Efficiency of motor at full load vii) Temperature rise of motor at full load viii) BHP of driven equipment			
10.	Coolers (Oil to Air): i) Quantity (Running + Standby) ii) Type and Rating			
11.	Coolers (Oil to Water): i) Quantity (Running + Standby) ii) Type and Rating iii) Oil flow rate (lpm) iv) Water flow rate (lpm) v) Nominal Cooling rate (kW) vi) Material of tube			
12.	Radiators: i) Width of elements (mm) ii) Thickness (mm) iii) Length (mm) iv) Numbers			
13.	Cooler loss at rated output, normal ratio, rated voltage, rated frequency at ambient temperature of 50°C	kW		

E. DIELECTRIC SYSTEM

Sl. No.	Description	Unit	Offered by manufacturer
1.	Geometric Arrangement of winding with respect to core e.g: Core-Tertiary-LV-HV-Reg Coarse-Reg Fine		

2.	Regulating Winding: i) Body Tap ii) Separate						
3.	HV Line Exit point in winding: i) Top ii) Center						
4.	Varistors used across Windings If yes, Details	Yes/ No					
5.	Insulation Levels of windings		HV	Tertiary	LV (or LV 1/ LV 2)	HV -N	LV-N
	i) Lightning Impulse withstand voltage (1.2/50μs)	kV_p					
	ii) Chopped wave Lightning Impulse withstand voltage	kV_p					
	iii) Switching Impulse withstand voltage (250/2500μs)	kV_p					
	iv) Power frequency withstand voltage (one minute / 5 minutes)	kV_{rms}					
6.	Tan delta of windings at ambient temperature	%					

F. ACCESSORIES

Sl. No.	Description	Unit	Offered by manufacturer	Specified by Buyer
1.	Tap Changers			
	i) Control a-Manual b-Automatic c-Remote d-Local			
	ii) Voltage Class and Current Rating of Tap Changers			
	iii) Make and Model			
	iv) Make and Type of Automatic Voltage Regulator (AVR)			
	v) Tie-in resistor requirement (to limit the recovery voltage to a safe value) and its value			
	vi) OLTC control and monitoring to be carried out through Substation Automation System	Y/N		
	vii) Power Supply for control motor (No. of Phases/Voltage/Frequency)			

	viii) Rated Voltage for control circuit (No. of Phases/Voltage/Frequency)	V					
2.	Tank						
	i) Tank Cover: Conventional/Bell/Bottom Plate						
	ii) Material of plate for tank						
	iii) Plate thickness : side, bottom, cover	Mm					
	iv) Rail Gauge	Mm					
	v) Minimum Clearance height from rail for lifting Active Part	Mm					
	vi) Wheels : Numbers/Plane/Flanged/Uni-Directional/Bi-Directional/Locking Details						
	vii) Vacuum withstand Capability (a) Tank (b) Radiators/Conservator/Accessories	mm of Hg					
	viii) High Pressure withstand Capability (a) Tank (b) Radiators/Conservator/Accessories	mm of Hg					
	ix) Radiator fins / conservator plate thickness	Mm					
	x) Tank Hot spot temperature	^{O} C					
3.	Bushings:		HV	LV	Tertiary	HV-N LV-N	
	i) Termination Type a-Outdoor b-Cable Box (oil/Air/SF_6) c-Plug in Type						
	ii) Type of Bushing: OIP/RIP/RIS/oil communicating						
	iii) Bushing housing - Porcelain / polymer						
	iv) Rated Voltage Class	kV					
	v) Rated Current	A					
	vi) Lightning Impulse withstand voltage (1.2/50μs)	kV_p					
	vii) Switching Impulse withstand voltage (250/2500μs)	kV_p					
	v) One minute Power frequency withstand voltage (dry & wet)	kV_{rms}					
	viii) Minimum Creepage Distance	Mm					
	ix) Quantity of oil in bushing and specification of oil used						
	x) Make and Model						

	xi) Tan delta of bushings	%					
	xii) Max Partial discharge level at U_m	pC					
	xiii) Terminal Pad details						
	xiv) Weight of assembled bushings	Kg					
	xv) Whether terminal connector for all bushings included in the scope of supply						
4.	Minimum clearances between bushings (for HV, Tertiary and LV) (a) Phase to phase (b) Phase to ground						
5.	Indicator / Relay						
	i) Winding temperature thermometer/ indicator: Range Accuracy						
	ii) Oil temperature thermometer/ indicator: Range Accuracy						
	iii) Temperature sensors by fiber optic (if provided)						
	iv) Oil actuated/gas operated relay						
	v) Oil level Indicators: Main Conservator OLTC Conservator						
	vi) Oil Sight Window: Main Tank Main Conservator OLTC Conservator						
6.	Conservator: i) Total volume ii) Volume between highest and lowest visible oil levels						
7.	Conservator Bag (air cell) i) Material of air cell ii) Continuous temperature withstand capacity of air cell						
8.	Air cell rupture relay provided	Yes / No					
9.	Pressure Relief Device: i) Number of PRDs provided ii) Location on the tank iii) Operating pressure of relief device						
10.	Sudden Pressure Relay / Rapid Pressure rise relay provided; if yes, i) Location on the tank	Y/N					

	ii) Operating pressure			
11.	Dehydrating Breathers(Type & No. of breathers) (a) For main Conservator tank (b) For OLTC conservator			
12.	Flow sensitive Conservator Isolation Vlave Provided	Y/N		
13.	Tap Changer protective device			
14.	Type and material of gaskets used at gasketed joints			
15.	Bushing CTs: (HV side and /LV side) i) Voltage class ii) No. of cores iii) Ratio iv) Accuracy class v) Burden vi) Accuracy limit factor vii) Maximum resistance of secondary winding viii) Knee point voltage ix) Current rating of secondaries	 kV VA Ω V A		
16.	Neutral CTs: i) Voltage class ii) No. of cores iii) Ratio iv) Accuracy class v) Burden vi) Accuracy limit factor vii) Maximum resistance of secondary winding viii) Knee point voltage ix) Current rating of secondaries	 kV VA Ω V A		
17.	Transformer Oil i) IS 335 / IEC60296 / as per specification ii) Inhibited/ un-inhibited iii) Mineral / Natural Ester / Synthetic Ester iv) Spare oil as percentage of first filling v) Manufacturer vi) Quantity of oil (before filling and before commissioning) vii) Moisture content (mg/L or ppm) viii) Tan delta (Dielectric Dissipation Factor) at 90°C ix) Resistivity (Ω-cm)) x) Breakdown Voltage (before and after treatment) (kV) xi) Interfacial tension at 20 °C (N/m) xi) Pour point (°C) xii) Flash point(°C) xiii) Acidity (mg KOH/gm) xiv) Inhibitors (for inhibited oil) (%)			