2.12 POWER TRANSFORMERS

2.12.1 63MVA, 220/33 kV Transformer

No	Item		Units	Required	Tendered
(a)	**Rating and Performance**				
1.	Manufacturer's Name & Address				
2.	Continuous maximum rating (ONAN/ONAF)		MVA	46/63	
3.	Number of phases			3	
4.	Rated Frequency		Hz	50	
5.	Number of windings			2	
6.	Applicable standards			IEC 60076: 2011	
7.	System maximum voltage for both windings (Um)	HV	kV	245	
		MV	kV	36	
8.	Insulation type	HV		Graded	
		MV		Uniform	
9.	Highest Voltage for equipment	HV	kV	245	
		MV	kV	36	
10.	Winding insulation level.	HV		LI: 1050kV, AC:460 kV	
		MV		LI:170 kV, AC:70kV	
11.	Transformer Nominal Ratio			220kV/ 33kV	
12.	Phase connections :				
	HV winding			Star	
	MV winding			Delta	
	Vector Group			YNd1	
13.	Short circuit withstand fault level at terminals of				
	245 kV busbars		kA	40	
	36 kV busbars		kA	25	
	Short Circuit withstand current		sec	3	
14.	Type of Cooling			ONAN/ONAF	
15.	External cooling medium			Air	

No	Item	Units	Required	Tendered
16.	Service conditions :			
	Altitude not exceeding	m	1000	
	Air temperature not exceeding	^{0}C	40	
	Average air temperature in any one year not exceeding			
	In any one day	^{0}C	32	
	Average in one year	^{0}C	30	
17.	On-load tap changer			
	(A) Type		M.R. (Germany)	
	(B) Category of voltage control		CFVV	
	(C) HV or LV winding		HV	
	(D) Range (+ & -)		shall be matched to the paralleling unit	
	(E) Step size	%	shall be matched to the paralleling unit	
	(F) Power frequency withstand test voltage between first and last contacts of the selector switch between any two adjacent contacts of the selector between diverter and switch contacts	(kV)		
	(G) Type test certificate reference			
	Tap position Indication		2nos BCD	
18.	Size of tapping step with position nos.		shall be matched to the paralleling unit	
19.	Approximate ONAN rating	MVA	46	
20.	Winding temperature rise at CMR	^{0}C	55	
21.	Top oil temperature rise			
	(A) CMR	^{0}C	50	
	(B) ONAN rating	^{0}C		
22.	Maximum hot spot temperature at CMR	^{0}C	98	

No	Item	Units	Required	Tendered
23.	Maximum winding hot spot temperature of transformer at a) Normal Cyclic Loading (IEC 60076-7) b) Long-time emergency loadings(IEC 60076-7) Short time emergency loading(IEC 60076-7)	^{0}C ^{0}C ^{0}C	120 140 160	
24.	Flux density in iron at normal voltage and frequency and at normal ratio - (no load).			
	(a) Core	Tesla	≤ 1.6	
25.	Magnetizing current (approx) at nominal ratio and			
	at 0.9 x nominal voltage	%		
	at 1.0 x nominal voltage	%		
	at 1.1 x nominal voltage	%		
	at 1.2 x nominal voltage	%		
26.	Guaranteed Losses at nominal ratio			
	(A) No Load losses (at rated voltage and frequency)	kW	Max. 30	
	(B) Copper losses at CMR corrected to 75^{0}C	kW	Max. 225	
	(C) Auxiliary losses at CMR corrected to 75^{0}C	kW		
27.	Regulation at 75^{0}C and normal ratio			
	(A) At unity power factor	%		
	(B) At 0.8 lagging power factor	%		
28.	Impedance voltage at 75 ^{0}C and CMR. Between			
	HV and LV Windings at Tap			
	Maximum	%	shall be matched to the paralleling unit	
	Nominal	%	shall be matched to the paralleling unit	
	Minimum	%	shall be matched to the paralleling unit	

No	Item	Units	Required	Tendered
29.	Equivalent circuit zero sequence impedance between HV and LV windings	ohms		
30.	Maximum current density in windings at C.M.R.			
	(A) HV Winding	A/mm^2		
	(B) LV Winding	A/mm^2		
(b)	**Control Circuits**			
1.	Type of controls for on load tap changer and cooler controls		Automatic	
2.	Whether automatic control required and the		Yes	
	reference voltage (VT output line to line)	V	110 AC (50 Hz)	
3.	Whether load compensation required on the AVR.		Yes	
4.	Whether separate remote control panel required		Yes	
5.	Estimated distance between remote control point and transformer	m	<110	
6.	DC supply (control voltage) :			
	Nominal	V	220 V DC	
	Maximum float voltage	V		
7.	AC supply voltage for tap changer operating motor 3 phase.		400V AC 50Hz	
8.	Whether provision for supervisory control required, including AVR setting		No	
9.	Whether marshalling kiosk required			
10.	Whether provision for supervisory control required, including AVR setting			
11.	Number of transformers for which automatic control is to be provided		All	
12.	Transformer terminals for line and neutral			
	(i) HV line		Bushings	
	(ii) Neutral		Bushings	
	(iii) MV line		Bushings	
	(attach all technical data of all types of bushings & ducts)			
13.	Accommodation for current transformers in bushings at			
	(i) HV line			
	(ii) Neutral			

No	Item	Units	Required	Tendered
	(iii) MV line			
14.	Accommodation of tank for outdoor weatherproof HV neutral current transformers		Yes	
15.	Pollution category of bushings High-25mm/kV based on system highest voltage			
(c)	**Cooling**			
1.	Minimum number of radiators per transformer			
2.	Maximum rating of each radiator as percentage of total loss at CMR			
(d)	**General**			
1.	Type of oil preservation system		Silica Gel	
2.	Whether wheels, skid or flat bottom base required		Wheels	
3.	Whether anti-vibration pads required		No	
4.	Transformer noise acceptance level	dB	81	
(e)	**Details Of Construction**			
1.	Types of winding -			
	(A) HV			
	(B) MV			
2.	Material of Insulation			
	(A) HV windings.			
	(B) MV windings			
3.	Insulation of tapping connections			
4.	Insulation of -			
	(A) Yoke bolts.			
	(B) Side plates.			
5.	Winding connections brazed or crimped Specify material (winding material and the joint material)			
6.	Is facility provided for adjustment of axial pressure on windings.	Yes/No		
7.	Thickness of transformer tank			
	(A) Sides	mm		

No	Item	Units	Required	Tendered
	(B) Bottom	mm		
8.	Material used for gaskets for oil tight joints.			
9.	Cover flange:-			
	Level: Low/High			
	Joint: WELDED/GASKETTED			
(f)	**Radiators Valves and Fans**			
1.	Thickness of radiator plates and/or cooling tubes.	mm		
2.	Valve type/material:			
	75mm and below			
	above 75mm			
3.	Equipment for ONAN cooling state (A) or (B) -			
	(A) Radiator on main tank			
	(B) Separate cooler bank			
4.	Number of cooling air blowers per transformer			
5.	Speed of air blowers and air flow	rpm /m^3 per min		
6.	Rating of each air blower motor	kW		
7.	Starting current of each blower motor,	A		
(g)	**Oil Volumes and Weights**			
1.	Total oil required including cooler system	liters		
2.	Volume of oil to fill transformer to above the top yoke.	liters		
3.	Total volume of conservator	liters		
4.	Volume of oil in conservator between highest and lowest visible	liters		
5.	Weight of core and winding assembly	tons		
6.	Weight of each oil cooler bank complete with oil if mounted separately from transformer	tons		
7.	Total weights of complete transformers, including attached coolers, voltage regulating equipment, all fittings and oil	tons		
8.	Weight of transformer arranged for transport	tons		
(h)	**Transformer Oil**			

No	Item	Units	Required	Tendered		
1.	Manufacture, type and class of oil to IEC 60296					
(I)	**Transformer Parts Subject to Short-Circuit Test**					
1.	Demonstration of ability to withstand short circuit as per IEC 60076-5 : 2006	(Yes/No)	Yes			
(j)	**Transformer Bushing (If Applicable) (For bushings of each voltage level shall be separately provided)**			HV	MV	HV-N
1.	Manufacturer					
2.	Insulator material (solid/oil-paper)					
3.	Manufacturer's type reference and rated voltage					
4.	Rated current					
5.	Manufacturer of porcelain					
6.	Length of insulator (overall).	mm				
7.	Weight of insulator.	kg				
8.	Electrostatic capacity of complete bushings.	pF				
9.	Dry lightning impulse voltage withstand. (1.2/50 wave)	kV				
10.	50Hz dry voltage withstand voltage without arching horns	kV				
11.	50Hz wet withstand voltage without arcing horns	kV				
12.	Total creepage distance of shed (specified minimum 25mm/kV based on maximum system voltage)	mm				
(k)	**Other Information**					
1	Negative pressure tank can withstand					
2	Type test Certificate for similar category transformer	To be annexed	yes			
3	Proof of manufacturing experience of 12 years for power transformers	To be annexed	yes			
4	Customer reference list for similar category Transformers	To be annexed	yes			
5	Tests carried out at the manufacture's work as per IEC 60076-1:2011	To be annexed	yes			
(l)	**Transformer tank Fittings**					
1	Draining and filter valves		yes			
2	Valves for tank oil sampling		yes			
3	Radiator isolation valves		yes			

No	Item	Units	Required	Tendered
4	Pulling eyes for complete transformer		yes	
5	Supports for hydraulic jacks		yes	
6	Lifting lugs		yes	
7	Tank earth terminals		yes	
8	Core earth terminal box		yes	
9	Inspection manholes		yes	
10	Ladder		yes	
11	Skids or wheels adjustable in two directions		yes	
(m)	**Transformer accessories**			
1	Oil preservation system with or without rubber bag		Yes	
2	Dehydrating breather (maintenance free Type)		Yes	
3	Oil level indicator of magnetic type		Yes	
4	Contact thermometer for the oil temperature		Yes	
5	Winding temperature indicator		Yes	
6	Direct winding temperature measurement using fibre optic sensors		Yes	
7	Pressure relief device		Yes	
8	Rapid pressure relay		Yes	
9	Buchholz relay		Yes	
10	Buchholz relay gas sampling		Yes	
11	On-line gas monitor		Yes	
12	On-line monitoring system		Yes	
13	Fire protection system		Yes	
(n)	**Quality Assurance**			
1	Manufacturer quality assurance acc. to ISO 9001		Yes	

No	Item	Units	Required	Tendered
2	Manufacturer Quality Manual is submitted with offer		Yes	
3	Manufacturer a sample of Quality Inspection and Test Plan is submitted with offer		Yes	
(o)	**Routine tests at manufacturers works (IEC 60076-1:2011)**			
1	Measurement of winding resistance (11.2).		Yes	
2	Measurement of voltage ratio and check of phase displacement (11.3).		Yes	
3	Measurement of short-circuit impedance and load loss (11.4).		Yes	
4	Measurement of no-load loss and current (11.5).		Yes	
5	Dielectric routine tests (IEC60076-3).		Yes	
6	Tests on on-load tap-changers (11.7).		Yes	
7	Leak testing with pressure for liquid-immersed transformers (tightness test) (11.8).		Yes	
8	Check of the ratio and polarity of built-in current transformers.		Yes	
9	Check of core and frame insulation for liquid immersed transformers with core or frame insulation (11.12).		Yes	
10	Insulation of Auxiliary wiring (IEC 60076 , part 3)		Yes	
11	Partial discharge measurement (IEC 60076 , part 3		Yes	
12	Determination of capacitances windings-to-earth and between windings		Yes	
13	Measurement of d.c. insulation resistance between each winding to earth and between windings.		Yes	
14	Measurement of dissipation factor (tan δ) of the insulation system capacitances.		Yes	

No	Item	Units	Required	Tendered
16	Measurement of no-load loss and current at 90 % and 110 % of rated voltage (11.5).		Yes	
(p)	**Type tests**			
1	Temperature-rise type test (IEC60076-2).		Yes	
2	Dielectric type tests (IEC60076-3).		Yes	
3	Determination of sound level (IEC60076-10) for each method of cooling		Yes	
4	Measurement of the power taken by the fan and liquid pump motors.		Yes	
5	Measurement of no-load loss and current at 90% and 110% of rated voltage		Yes	
(q)	**Special tests**			
1	Dielectric special tests (IEC60076-3).		Yes	
2	Winding hot-spot temperature-rise measurements.		Yes	
3	Determination of capacitances windings-to-earth, and between windings.		Yes	
4	Measurement of dissipation factor (tan δ) of the insulation system capacitances.		Yes	
5	Determination of transient voltage transfer characteristics (Annex B of IEC60076-3:2000).		Yes	
6	Measurement of zero-sequence impedance(s) on three-phase transformers (11.6).		Yes	
7	Short-circuit withstand test on similar transformer as per (IEC60076-5) at an internationally recognized test laboratory such as KEMA or CESI. (if theoretical evaluation is unsuccessful)		Yes. (At an independent test lab)	
8	Measurement of d.c. insulation resistance each winding to earth and between windings.		Yes	
9	Vacuum deflection test on liquid immersed transformers (11.9).		Yes	
10	Pressure deflection test on liquid immersed transformers (11.10).		Yes	

No	Item	Units	Required	Tendered
11	Vacuum tightness test on site on liquid immersed transformers (11.11).		Yes	
12	Measurement of frequency response (Frequency Response Analysis or FRA). The test procedure shall be agreed between manufacturer and purchaser.		Yes	
13	Check of external coating (ISO 2178 and ISO 2409 or as specified).		Yes	
14	Measurement of dissolved gasses in dielectric liquid.		Yes	
15	Mechanical test or assessment of tank for suitability for transport (to customer specification).		Yes	
16	Determination of weight with transformer arranged for transport. For transformers up to 1,6 MVA by measurement. For larger transformers by measurement or calculation as agreed between manufacturer and purchaser.		Yes	
17	Measurement of the harmonics of the on-load current		Yes	
18	Insulation test of oil and Measurement of dielectric strength of oil		Yes	
(r)	**Site tests**			
1	insulation resistance measurement of core and frame insulation, winding insulation to earth and between windings		Yes	
2	frequency response analysis		Yes	
3	interrogation of shock recorders fitted for transport		Yes	
4	Voltage ratio		Yes	
5	Vector group		Yes	
6	Insulation resistance measurement		Yes	
7	Check of protective earthing connections		Yes	
8	Current transformer polarity check		Yes	
9	Control equipment circuit check		Yes	
10	Oil tests		Yes	

No	Item	Units	Required	Tendered
11	Operation test of supervisory equipment		Yes	
12	Operation test of cooling equipment		Yes	
13	Operation test of on load tap changer		Yes	
14	Visual Inspections and adjustments as per clause 10.24 of technical specifications		Yes	
15	Fingerprint tests (Um>72 kV)		Yes	

2.12.2 31.5MVA, 132/33 kV Transformer

The Guaranteed Technical Particulars shall be completed without any alterations to its format. All blank spaces shall be filled with the information required. The provided particulars under this form shall be taken as the particulars guaranteed by the bidder/manufacturer for the offered item/s under this contract, and shall prevail over catalogues or any other document submitted with the bid.

No	Item	Units	Required	Tendered
(A)	**Rating and Performance**			
1.	Manufacturer's name and address			
2.	Continuous maximum rating (ONAN/ONAF)	MVA	23/31.5	
3.	Number of phases		3	
4.	Rated Frequency	Hz	50	
5.	Number of Windings		2	
6.	Applicable standards		IEC 60076:2011	
7.	System maximum voltages			
	- HV	kV	145	
	- MV	kV	36	
8.	Winding Insulation			
	- HV		Graded	
	- MV		Uniform	
9.	Highest voltage for equipment			
	- HV	kV	145	
	- MV	kV	36	
10.	Winding insulation levels			
	- HV	kV	LI: 650, AC: 275	
	- MV	kV	LI: 170, AC: 70	
11.	Transformer nominal ratio	kV	132/33	
12.	Phase connections			
	- HV winding		Star	
	- MV winding		Delta	

No	Item	Units	Required	Tendered
	- Vector group		YNd1	
13.	Short circuit withstand fault level at terminals of			
	- 145 kV Busbars	kA	31.5	
	- 36 kV Busbars - Short circuit current duration	kA sec	25 3	
14.	Type of cooling		ONAN/ONAF	
15.	External cooling medium		Air	
16.	Service conditions			
	• Altitude not exceeding	m	1000	
	• Air temperature not exceeding	^{0}C	40	
	• Average air temperature in any one year not exceeding - In any one day - Average in one year	 ^{0}C ^{0}C	 32 30	
17.	On load tap changer			
	(a) Type		M.R. Germany	
	(b) Category of voltage control		CFVV	
	(c) HV or LV winding		HV	
	(d) Range (+ & -)		shall be matched to the paralleling unit	
	(e) Interrupter		Vacuum Type	
	(f) Step size	%	shall be matched to the paralleling unit	
	(g) Power frequency withstand test voltage between first and last contacts of the selector switch between any two adjacent contacts of the selector between diverter and switch contacts	kV		
	(h) Type test certificate reference			
	(i) Tap position indication		2nos BCD	
18.	Size of tapping step with position nos.		shall be matched to the paralleling unit	
19.	Approximate ONAN rating	MVA	23	

No	Item	Units	Required	Tendered
20.	Winding temperature rise at CMR	^{0}C	55	
21.	Top oil temperature rise			
	(a) CMR	^{0}C	50	
	(b) ONAN rating	^{0}C	50	
22.	Maximum hot spot temperature at CMR	^{0}C	98	
23.	Maximum winding hot spot temperature of transformer at			
	(a) Normal Cyclic Loading (IEC 60076-7)	^{0}C	120	
	(b) Long time emergency loadings (IEC 60076-7)	^{0}C	140	
	(c) Short time emergency loading (IEC 60076-7)	^{0}C	160	
24.	Flux density in iron at nominal voltage and frequency and at nominal ratio – (no load)			
	(a) Core	Tesla	≤ 1.6	
25.	Magnetizing current (approx) at nominal ratio and			
	- At 0.9 x nominal voltage	%		
	- At 1.0 x nominal voltage (I_0)	%		
	- At 1.1 x normal voltage	%		
	- At 1.2 x normal voltage	%		
26.	Guaranteed losses at 75 ^{0}C			
	- No load losses at rated voltage, frequency and at nominal tap position	kW	Maximum 22.5	
	- Load losses at maximum tap position at ONAN base	kW		
	- Load losses at nominal tap position at ONAN base	kW		
	- Load loss at minimum tap position at ONAN base	kW		
	- Load losses at maximum tap position at ONAF base	kW		
	- Load losses at nominal tap position at ONAF base	kW	Maximum 120	
	- Load loss at minimum tap position at ONAF base	kW		
	- Auxiliary losses at CMR corrected to 75^{0}C	kW	Maximum 3	
	- Total losses at nominal tap position at ONAN base	kW		

No	Item	Units	Required	Tendered
	- Total losses at nominal tap position at ONAF base	kW		
27.	Efficiency referred to 75 ^{0}C and nominal ratio			
	(a) 100 % CMR at unity power factor	%		
	(b) 75 % CMR at unity power factor	%		
	(c) 50 % CMR at unity power factor	%		
	(d) 25 % CMR at unity power factor	%		
	(e) 100 % CMR at 0.8 power factor	%		
	(f) 75 % CMR at 0.8 power factor	%		
	(g) 50 % CMR at 0.8 power factor	%		
	(h) 25 % CMR at 0.8 power factor	%		
28.	Voltage regulation referred to 75 ^{0}C and nominal ratio			
	(a) 100 % CMR at unity power factor	%		
	(b) 75 % CMR at unity power factor	%		
	(c) 50 % CMR at unity power factor	%		
	(d) 25 % CMR at unity power factor	%		
	(e) 100 % CMR at 0.8 power factor	%		
	(f) 75 % CMR at 0.8 power factor	%		
	(g) 50 % CMR at 0.8 power factor	%		
	(h) 25 % CMR at 0.8 power factor	%		
29.	Impedance voltage at 75 ^{0}C			
	(a) For nominal tap position between HV and MV windings at ONAN rating	%		
	(b) For nominal tap position between HV and MV windings at ONAF rating	%	shall be matched to the paralleling unit	
	(c) For maximum tap position between HV and MV windings at ONAN rating	%		
	(d) For maximum tap position between HV and MV windings at ONAF rating	%	shall be matched to the paralleling unit	

No	Item	Units	Required	Tendered
	(e) For minimum tap position between HV and MV windings at ONAN rating	%		
	(f) For minimum tap position between HV and MV windings at ONAF rating	%	shall be matched to the paralleling unit	
30.	Equivalent zero sequence impedance between HV and LV windings			
31.	Maximum current density in windings at CMR			
	(a) HV winding	A/mm^2		
	(b) MV winding	A/mm^2		
32	Transformer warranty period	Years		
(B)	**Control Circuits**			
1.	Type of controls for on load tap changer and cooler controls		Automatic	
2.	Whether automatic control required		Yes	
	Reference voltage (VT output line to line)	V	110 AC (50 Hz)	
3.	Whether load compensation required on the AVR		Yes	
4.	Whether separate remote control panel required		Yes	
5.	Estimated distance between remote control point and transformer	m	<110	
6.	DC Supply (Control voltage)			
	- Nominal	V DC	110	
	- Maximum float voltage	V DC		
7.	AC supply voltage for tap changer operating motor 3 phase		400 V AC 50 Hz	
8.	Whether provision for supervisory control required, including AVR setting		Yes	
9.	Whether marshalling kiosk required		Yes/No	
10.	Transformer terminals for line and neutral			
	(a) HV line		Outdoor Bushings	
	(b) MV line		Outdoor Bushings	
	(c) Neutral		Outdoor Bushings	

No	Item	Units	Required	Tendered
	(Attach all technical data of all types of bushings & ducts)			
11.	Accommodation for current transformers bushings at			
	(a) HV line			
	(b) MV line			
	(c) Neutral			
12.	Accommodation of tank for outdoor weatherproof HV neutral current transformers			
13.	Pollution category of bushings Creepage distance based on system highest voltage		43.3mm/kV (USCD)	
(C)	**Cooling**			
1.	Minimum number of radiators per transformer			
2.	Maximum rating of each radiator as percentage of total loss at CMR	%		
3.	Cooling capacity 100% with one fan out of order		Yes	
(D)	**General**			
1.	Type of oil preservation system		Conservator with silica gel breather	
2.	Whether wheels, skid or flat base required		Wheels	
3.	Whether anti-vibration pads required		No	
4.	Transformer Sound Pressure Level	dB(A)	76	
(E)	**Details of Construction**			
1.	Types of winding			
	(a) HV			
	(b) MV			
2.	Material of Insulation			
	(a) HV			
	(b) MV			
3.	Insulation of tapping connections			
4.	Insulation of			
	(a) Yoke bolts			

No	Item	Units	Required	Tendered
	(b) Side plates			
5.	Winding connection brazed or crimped (specify winding and joint material)			
6.	Is facility for adjustment of axial pressure on windings	Yes/ No		
7	Thickness of transformer tank			
	(a) Sides	mm		
	(b) Bottom	mm		
	(c) Cover	mm		
8.	Material used for gaskets for oil tight joints			
9.	Cover Flange			
	- Level		Low/high	
	- Joint		Welded	
10.	Maximum vacuum pressure safely withstand by tank	Pa		
(F)	**Radiators and Fans**			
1.	Thickness of radiator plates and/ or cooling tubes			
2.	Equipment for ONAN cooling state (a) or (b) (a) Radiator on main tank (b) Separate cooler bank			
3.	Number of cooling air blowers per transformer			
4.	Speed of air blowers and air flow	rpm/m^3 per min		
5.	Rating of each air blower motor	kW		
6.	Starting current of each air blower motor	A		
(G)	**Oil volumes, weights and dimensions**			
1.	Total oil required including cooler system	Liters		
2.	Volume of oil to fill transformer above the top yoke	Liters		
3.	Capacity of conservator	Liters		
4.	Volume of oil in conservator between highest and lowest visible points	Liters		
5.	Weight of core and winding assembly	Tons		

No	Item	Units	Required	Tendered
6.	Weight of each oil cooler bank complete with oil if mounted separately from transformer	Tons		
7.	Total weight of complete transformer, including attached coolers, voltage regulating equipment, all fittings and oil	Tons		
8.	Weight of transformer arranged for transport	Tons		
9.	Overall dimensions including bushings			
	- Height	mm		
	- Depth	mm		
	- Width	mm		
10.	Shipping dimensions			
	- Height	mm		
	- Depth	mm		
	- Width	mm		
11.	Minimum space required for transformer bay			
	- Depth	mm		
	- Width	mm		
(H)	**Transformer oil**			
1.	Manufacturer			
2.	Type		Uninhibited	
3.	Class		1	
4.	Standard		IEC60296	
(I)	**Transformer parts subject to Short circuit test**			
1.	Demonstration of ability to withstand short circuit as per IEC 60076-5: 2006	(Yes / No)	Yes	
(J)	**Transformer bushing**			
1.	132 kV Bushings			
	- Manufacturer			
	- Insulator material (Solid/oil-paper)			
	- Manufacturer's type reference and rated voltage			

No	Item	Units	Required	Tendered
	- Rated current	A		
	- Manufacturer of porcelain			
	- Length of insulator (Overall)	mm		
	- Weight of insulator	kg		
	- Electrostatic capacity of complete bushings.	pF		
	- Dry lightning impulse voltage (1.2/50 wave) test voltage	kV		
	- 50 Hz dry voltage withstand test voltage without arching horns	kV		
	- 50 Hz wet voltage withstand test voltage without arching horns	kV		
	- Total creepage distance of shed (USCD minimum 43.3mm/kV based on maximum system voltage)	mm		
	- Capacitive voltage tap available for testing purposes		Yes	
2.	33 kV Bushings			
	- Manufacturer			
	- Insulator material (Solid/oil-paper)			
	- Manufacturer's type reference and rated voltage			
	- Rated current	A		
	- Manufacturer of porcelain			
	- Length of insulator (Overall)	mm		
	- Weight of insulator	kg		
	- Electrostatic capacity of complete bushings.	pF		
	- Dry lightning impulse voltage (1.2/50 wave) test voltage	kV		
	- 50 Hz dry voltage withstand test voltage without arching horns	kV		
	- 50 Hz wet voltage withstand test voltage without arching horns	kV		
	- Total creepage distance of shed (USCD minimum 43.3mm/kV based on maximum system voltage)	mm		
	- Capacitive voltage tap available for testing purposes		Yes/No	

No	Item	Units	Required	Tendered
3.	132 Neutral Bushings			
	- Manufacturer			
	- Insulator material (Solid/oil-paper)			
	- Manufacturer's type reference and rated voltage			
	- Rated current	A		
	- Manufacturer of porcelain			
	- Length of insulator (Overall)	mm		
	- Weight of insulator	kg		
	- Electrostatic capacity of complete bushings.	pF		
	- Dry lightning impulse voltage (1.2/50 wave) test voltage	kV		
	- 50 Hz dry voltage withstand test voltage without arching horns	kV		
	- 50 Hz wet voltage withstand test voltage without arching horns	kV		
	- Total creepage distance of shed (USCD minimum 43.3mm/kV based on maximum system voltage)	mm		
	- Capacitive voltage tap available for testing purposes		Yes/No	
(K)	**Transformer tank Fittings**			
1	Draining and filter valves (a) Type (b) Material for 75 mm and below (c) Material for above 75 mm		Yes Gate/ Ball Gunmetal	
2	Valves for tank oil sampling (a) Type (b) Material		Yes Gunmetal	
3	Radiator isolation valves (a) Type (b) Material for 75 mm and below (c) Material for above 75 mm		Yes Gunmetal	
4	Pulling eyes for complete transformer		yes	
5	Supports for hydraulic jacks		yes	
6	Lifting lugs		yes	
7	Tank earth terminals		yes	

No	Item	Units	Required	Tendered
8	Core earth terminal box		yes	
9	Inspection manholes		yes	
10	Ladder		yes	
11	Skids or wheels adjustable in two directions		yes	
(L)	**Transformer accessories**			
1	Oil preservation system with or without rubber bag		Yes	
2	Dehydrating breather		Yes	
3	Oil level indicator of magnetic type		Yes	
4	Contact thermometer for the oil temperature		Yes	
5	Winding temperature indicator		Yes	
6	Direct winding temperature measurement using fibre optic sensors		Yes	
7	Pressure relief device		Yes	
8	Rapid pressure relay		Yes	
9	Buchholz relay		Yes	
10	Buchholz relay gas sampling		Yes	
11	On-line gas monitor		No	
12	On-line monitoring system		No	
13	Fire protection system		Not required	
(M)	**Quality Assurance**			
1	Manufacturer quality assurance acc. to ISO 9001 and 14001		Yes	
2	Manufacturer Quality Manual is submitted with offer		Yes	
3	Manufacturer a sample of Quality Inspection and Test Plan is submitted with offer		Yes	
(N)	**Other Information**			
1.	Negative pressure tank can withstand			
2.	Type & Special test Certificate for similar category transformer	To be annexed	Yes	
3.	Customer reference list for similar category Transformers	To be annexed	Yes	
4.	Tests carried out at the manufacture's work as per IEC	To be annexed	Yes	

No	Item	Units	Required	Tendered
	60076-1:2011			
(O)	**Routine tests at manufacturers works (IEC 60076-1:2011)**			
1	Measurement of winding resistance (11.2).		Yes	
2	Measurement of voltage ratio and check of phase displacement (11.3).		Yes	
3	Measurement of short-circuit impedance and load loss (11.4).		Yes	
4	Measurement of no-load loss and current (11.5).		Yes	
5	Dielectric routine tests (IEC60076-3).		Yes	
6	Tests on on-load tap-changers (11.7).		Yes	
7	Leak testing with pressure for liquid- immersed transformers (tightness test) (11.8).		Yes	
8	Check of the ratio and polarity of built-in current transformers.		Yes	
9	Check of core and frame insulation for liquid immersed transformers with core or frame insulation (11.12).		Yes	
10	Insulation of Auxiliary wiring (IEC 60076 , part 3)		Yes	
11	Partial discharge measurement (IEC 60076 , part 3		Yes	
12	Determination of capacitances windings- to-earth and between windings		Yes	
13	Measurement of d.c. insulation resistance between each winding to earth and between windings.		Yes	
14	Measurement of dissipation factor (tan δ) of the insulation system capacitances.		Yes	
15	Measurement of no-load loss and current at 90 % and 110 % of rated voltage (11.5).		Yes	
(P)	**Type tests**			
1	Temperature-rise type test (IEC60076-2).		Yes	
2	Dielectric type tests (IEC60076-3).		Yes	
3	Determination of sound level (IEC60076-		Yes	

No	Item	Units	Required	Tendered
	10) for each method of cooling			
4	Measurement of the power taken by the fan and liquid pump motors.		Yes	
5	Measurement of no-load loss and current at 90% and 110% of rated voltage		Yes	
(Q)	**Special tests**			
1	Dielectric special tests (IEC60076-3).		Yes	
2	Winding hot-spot temperature-rise measurements.		Yes	
3	Determination of capacitances windings- to-earth, and between windings.		Yes	
4	Measurement of dissipation factor (tan δ) of the insulation system capacitances.		Yes	
5	Determination of transient voltage transfer characteristics (Annex B of IEC60076-3:2000).		Yes	
6	Measurement of zero-sequence impedance(s) on three-phase transformers (11.6).		Yes	
7	Short-circuit withstand test (IEC60076-5) (If theoretical evaluation is unsuccessful)		Yes (At an independent test lab such as KEMA or CESI)	
8	Measurement of DC insulation resistance each winding to earth and between windings.		Yes	
9	Vacuum deflection test on liquid immersed transformers (11.9).		Yes	
10	Pressure deflection test on liquid immersed transformers (11.10).		Yes	
11	Vacuum tightness test on site on liquid immersed transformers (11.11).		Yes	
12	Measurement of frequency response (Frequency Response Analysis or FRA). The test procedure shall be agreed between manufacturer and purchaser.		Yes	
13	Check of external coating (ISO 2178 and ISO 2409 or as specified).		Yes	
14	Measurement of dissolved gasses in dielectric liquid.		Yes	

No	Item	Units	Required	Tendered
15	Mechanical test or assessment of tank for suitability for transport (to customer specification).		Yes	
16	Determination of weight with transformer arranged for transport. For transformers up to 1,6 MVA by measurement. For larger transformers by measurement or calculation as agreed between manufacturer and purchaser.		Yes	
17	Measurement of the harmonics of the no- load current		Yes	
18	Insulation test of oil and Measurement of dielectric strength of oil		Yes	
(R)	**Site tests**			
1	insulation resistance measurement of core and frame insulation, winding insulation to earth and between windings		Yes	
2	frequency response analysis		Yes	
3	interrogation of shock recorders fitted for transport		Yes	
4	Voltage ratio		Yes	
5	Vector group		Yes	
6	Dielectric tests on transformer oil		Yes	
7	Temperature rise test with rated load for 6 hrs		Yes	
8	Thermograph imaging from all possible views		Yes	
9	Measurement of Moisture in oil & DGA after temperature rise test		Yes	
10	Any other oil tests (Please specify)		Yes/No	
11	Winding resistance on each tap		Yes	
12	Insulation resistance measurement		Yes	
13	Check of protective earthing connections		Yes	
14	Current transformer polarity check		Yes	
15	Control equipment circuit check		Yes	
16	Operation test of supervisory equipment		Yes	

No	Item	Units	Required	Tendered
17	Operation test of cooling equipment		Yes	
18	Operation test of on load tap changer		Yes	
19	Visual Inspections and adjustments as per clause 10.24 of technical specifications		Yes	
20	fingerprint tests (Um>72 kV)		Yes	
(S)	**Type test reports submitted with the bid**			
1	Temperature-rise type test (IEC60076-2).		Yes	
2	Dielectric type tests (IEC60076-3).		Yes	
3	Determination of sound level (IEC60076-10) for each method of cooling		Yes	
4	Measurement of the power taken by the fan and liquid pump motors.		Yes	
5	Measurement of no-load loss and current at 90% and 110% of rated voltage		Yes	
(T)	**Special test reports submitted with the bid**			
1	Short circuit withstand test on similar transformer as per IEC 60076-5 at an internationally recognized test laboratory such as KEMA or CESI		Yes	