SCHEDULE D
PART I

1. - POWER TRANSFORMERS

1.1 - Auto transformers

Item No	Description		Particulars
1	Description of transformers		Transmission autotransformers
1.1	Type of transformer		Three phase, oil immersed
1.2	Shell or core		core
1.3	Auto or separate winding		Auto
1.4	Three phase or single phase unit		Three-phase
2	Indoor or outdoor installation		Outdoor
3	Site conditions:		
3.1	Altitude above sea level	m	<1000
3.2	Air temperature		
3.2.1	minimum	°C	-10
3.2.2	maximum	°C	50
3.2.3	maximum daily average	°C	35
3.2.4	Annual average temperature	°C	30
3.2.5	Average of the hottest month	°C	35.5
3.3	Design temperature	° C	50
3.4	Relative humidity variation	%	4~100
3.5	Pollution level		Heavy airborne contamination
3.6	Isokeraunic	level days/annum	15
3.7	Wind velocity	m/sec	50
3.8	Ice loading, radial thickness	mm	10
3.9	Average annual rainfall	mm	230
3.10	Solar radiation	W/m²	1150
3.11	Seismic condition Horizontal acceleration		Zone 2B accordance to Jordanian seismic code
4	Insulator creepage distance(SCD,IEC60815)	mm/kV	35
5	Type of cooling		ONAN/ONAF/OFAF
6	maximum Continuous ratings (MCR) corresponding to full power tapping position when operating under site conditions:		
6.1	HV winding	MVA	400
6.2	LV winding	MVA	400

Item No	Description		Particulars
6.3	Tertiary winding	MVA	100
7	Minimum ONAN/ONAF/OFAF ratings, irrespective of tapping position when operating under site conditions		ONAN/ONAF/OFAF
7.1	HV terminal rating		240/320/400
7.2	LV terminal rating		240/320/400
7.3	Tertiary terminal rating		60/80/100
8	Rated frequency	Hz	50
9	Rated voltage corresponding to principal tapping		
9.1	HV	kV	400
9.2	LV	kV	138.6
9.3	Tertiary	kV	33
10	System highest voltage:		
10.1	HV	kV	420
10.2	LV	kV	145
10.3	Tertiary	kV	36
11	Method of system earthing		
11.1	HV system		directly earthed (solid)
11.2	LV system		directly earthed (solid)
11.3	Tertiary system		Earthing transformer
12	Method of earthing of transformers		
12.1	HV winding		Directly earthed (solid)
12.2	LV winding		Directly earthed(solid)
12.3	Tertiary winding		Earthing transformer
13	Impedance voltage percent at 75°C. **Percent on primary winding rating of 400MVA** (as appropriate) to match the following impedances.		
13.1	HV/LV		
13.1.1	At minimum voltage ratio (400/158.4-tap1)	%	17
13.1.3	At principal tapping (400/138.6-tap10)	%	15.4
13.1.4	At maximum voltage ratio (400/118.8-tap19)	%	16
13.2	HV/tertiary at any voltage ratio	%	46.7
13.3	LV/tertiary at principal tap	%	26

Item No	**Description**		**Particulars**
14	Full Wave Lightning Impulse (LI) under site conditions		
14.1	HV	kV	1425
14.2	LV	kV	650
14.3	Tertiary	kV	170
14.4	Neutral HV/LV	kV	170, HV neutral shall be earthed during test

Item No	Description		Particulars
15	Chopped Wave Lightning Impulse (LIC) under site conditions		
15.1	HV winding	kV	1570
15.2	LV winding	kV	715
15.3	Tertiary winding	kV	187
16	Switching impulse (SI)		
16.1	HV winding	kV	1050
16.2	LV winding	kV	540
16.3	Tertiary winding	kV	N.A
17	Applied Voltage (AV)		
17.1	HV winding	kV	630
17.2	LV winding	kV	275
17.3	Tertiary winding	kV	70
18	Rated short-duration induced or separate source AC withstand voltage		
18.1	HV winding induced test voltage	kV r.m.s	630
18.2	LV winding induced test voltage	kV r.m.s	275
18.3	Neutral of HV/LV separate source applied test voltage	kV r.m.s	70
18.4	Tertiary winding separate source applied test voltage	kV r.m.s	70
19	Maximum system symmetrical rms fault current (1 phase or 3 phase) at the terminals of the transformer which the windings must be capable of withstanding		
19.1	HV terminals(1s)	kA	40
19.2	LV terminals(3s)	kA	40
19.3	Tertiary terminals(3s)	kA	31.5
19.4	Asymmetrical crest factor		2.55
20	Phase connections		
20.1	IEC vector group symbols		**YNa0d1**
20.2	Whether links are required for alternative IEC vector group		No
20.3	Alternative vector group required		-
21	Type of insulation		
21.1	Common winding		Graded

21.2	Series winding		Graded
22	Whether one winding is a stabilising winding only		No
23	Whether `on-load' or `off-circuit' tap changing equipment or links are required		On load
24	Tapping quantities		
24.1	Maximum voltage ratio	kV	400/118.8/33
24.2	Principal voltage ratio	kV	400/138.6/33
24.3	Minimum voltage ratio	kV	400/158.4/33
25	Tapping steps:		
25.1	Step size	kV	2.2
25.2	Number		19
26	Capability of excess voltage continuously applied over tapping voltage for any tapping when transformer is delivering tapping power	per cent	5
27	Whether tappings are preferred on any particular winding		On common winding
28	IEC category of voltage variation		CFVV
29	Whether on-load tap changing equipment shall be suitable for supervisory control and indication		Yes
29.1	Remote tap changer control panel		No
30	The MDU panel should include **5** cards step contact card and 4 BCD cards		Yes
30.1	Whether required		Yes
30.2	The AVR panel shall include The following		
	-Auto/Manual control.		Yes
	-Raise/Lower Pushbuttons.		Yes
	-Remote/Supervisory selector switch.		Yes
	-Master/Follower/Independent/Off selector switch.		Yes
30.3	Exterior finish		RAL7044
31	Automatic voltage control equipment		
31.1	Whether required		Yes

31.2	Whether to be suitable for remote adjustment of setting	Yes
32	Whether equipment shall be provided to permit automatic synchronised operation of on-load tap changing equipment in parallel with similar transformers	Yes
33	Whether gas and oil actuated relay shall be fitted to each tap selector compartment	Yes

Item No	Description	Particulars
34	Bushing insulators or cable boxes for line terminals	
34.1	HV	Oil/SF6 bushing
34.2	LV	Oil/Oil bushing
34.3	Tertiary	Oil/Air inside Cable box
34.4	Filling medium for cable boxes	Air
35	Whether disconnecting chambers are required	Yes
36	Bushing insulator or cable box for HV/LV neutral terminal	Oil /Air Bushing
37	Whether accommodation for current transformers shall be provided:	
37.1	HV terminals	Yes, (thermometer winding and TMS…etc.) *
37.2	LV terminals	Yes, (overcurrent blocking/operation by load and TMS/thermometer of winding / cooling control…etc.) *
37.3	Common winding neutral end	Yes, (2000/1000/1, class X for the transformer high impedance protection, Thermometer winding…etc.) *
37.4	Tertiary terminals	Yes, (Thermometer winding, TMS) *

38	Whether tapping shall be brought out from each capacitance graded type bushing insulator to a separate terminal for power factor testing on site, on:	
38.1	HV bushings	Yes
38.2	LV bushings	Yes
38.3	Neutral bushing	No
38.4	Tertiary bushing	No
39	RAL number for the transformers	RAL 7001

*The CT specifications will be confirmed during engineering stage, it is the contractor responsibility to coordinate and confirm compliance.

Item No	Description	Particulars
39	Whether pressure relief devices are to be fitted	Yes
40	Whether first filling of oil shall be supplied for the transformer and its associated oil filled equipment	Yes
41	Whether transformer shall be transported filled with oil or with a suitable gas	Dry gas or nitrogen is required.
42	Minimum capacity of conservator between highest and lowest visible levels, as percentage of total cold oil volume of the transformer per cent	7.5
43	Whether marshalling unit shall be provided IF SO:	Yes
43.1	Whether free-standing kiosk or transformer mounted cabinet	Transformer mounted cabinet
43.2	Whether metalclad heater to be provided	Yes
44	Type of dehydrating breather:	
44.1	Silica Gel	Yes

44.2	Automatic of the repetitive cycle type (refrigeration type)	Yes
45	Whether wheels shall be provided	No
46	Whether winding or oil temperature indicators are required	Yes
46.1	HV winding temperature indicator	Yes
46.2	LV winding temperature indicator	Yes

Item No	Description	Particulars
46.3	Tertiary winding temperature indicator	Yes
46.4	Oil temperature indicator	Yes
47	Whether winding temperature indicator remote repeaters are required	Yes
48	Whether the forced cooling equipment is to be operated automatically from contacts on the winding temperature indicator	Yes
49	Whether electrical energy will be provided on site for erection purposes	Yes (if needed)
	IF SO:	
49.1	Maximum available power kW	50
50	Supply voltage for transformer auxiliaries V	400/230
51	Whether control and instrument wiring shall conform to specified colour code	Yes
52	Impulse tests: (state whether "type" or "routine")	Routine According to IEC 60076-3 Table 1
52.1	Whether recurrent surge oscillography tests are to be carried out	Yes
52.2	Whether HV winding to be directly impulse tested	Yes
52.2.1	Whether chopped waves to be included	Yes
52.2.2	For tests of HV winding impedance to earth from:	
	Other HV terminals LV terminals Tertiary terminal	As IEC
52.3	Whether LV winding to be directly impulse tested	Yes

52.3.1	Whether chopped waves to be included	Yes
52.3.2	For tests on LV winding, impedance to earth from: Other LV terminals HV terminals Tertiary terminals	 As IEC
Item No	**Description**	**Particulars**
52.4	Whether tertiary winding to be directly impulse tested	Yes
52.4.1	Whether chopped waves to be included	Yes
52.4.2	For tests on tertiary winding, impedance to earth from: Other tertiary terminals HV terminals LV terminals	 As IEC
53	Dielectric tests on 420 kV windings, non-uniform insulation:	As IEC
53.1	Applied voltage test (AV) on common neutral and tertiary winding	Yes, according to IEC 60076-3
53.2	Induced voltage test (IVPD) on HV and LV windings	Yes, according to IEC 60076-3
53.3	Switching impulse test voltage on HV winding	Yes, according to IEC 60076-3
54	Whether zero phase sequence impedance test required	Yes
55	Vacuum test level mbar (a)	according to IEC
56 56.1	Losses: Capitalized Cost of Losses TCO = **IC + 7438.54 (P0 + Pc0) + 1880.52 (Pk + Pcs – Pc0),** (in Jordanian Dinars)Where : –IC: Transformer initial cost, in JOD; –P0: No load losses at rated tap; –Pc0: The cooling power for no load operation; –Pk: Load losses at rated tap; –Pcs: Total cooling power at rated full Power	(as describe in IEC TS 60076-20 /Annex A)
57 57.1 57.2	Heat run test (Temperature rise limits) Temperature rise of winding at C.M.R, specified design temperature not to exceed: K Temperature rise of top oil at C.M.R, specified design temperature not to exceed K	On one transformer 55 50
58 58.1	Transformer monitoring system (TMS) required Measurements shall be used to derive the following data:	Yes

	a) Hot spot temperature in accordance with IEC 60076-7. b) Aging rate in accordance with IEC 60076-7. c) Continuous overload current capacity of the Transformer. d) Overvoltage detection including a lightning Surge and overcurrent e) Variation in the capacitance of bushings. f) Refer to details in technical specifications g) Tan delta and partial discharge	Yes Yes Yes Yes Yes Yes Yes
59	The maximum acceptable Sound Level dBA.	75
60	Waveform electronic Impact recorder	Yes

1.2 - Earthing transformers

Item No	Description	Particulars
1	Rating of interconnected star winding on 30 second basis amperes	750
2	Bushing insulators or cable boxes for:	
2.1	HV terminals	Cable box
2.2	LV terminals	Cable box
2.3	HV neutral terminal	Bushing
2.4	Filling medium for cable boxes	Air
3	Secondary winding continuous rating kVA	500
4	Whether wheels are required, IF SO:	No
4.1	Whether plain or flanged	-
4.2	Whether required to swivel	-
4.3	Gauge of track	-
5	Nominal/rated higher voltage kV	33/36
6	Nominal lower voltage V	400
7	Phase connections - IEC vector group symbols	ZNyn11
8	Whether manual off circuit tap changer is required	Yes
9	Total range of voltage ratio variation from rated voltage ratio Increasing ratio per cent Decreasing ratio per cent	 5 in 2½ steps 5 in 2½ steps
10	Whether MCCB unit is required	Yes
11	Temperature rise limits	
11.1	Temperature rise of winding at C.M.R, specified design temperature not to exceed: K	55
11.2	Temperature rise of top oil at C.M.R, specified design temperature not to exceed K	50
11.3	Heat run test	On one Transformer

11.4	The LV terminals on earthing transformers (fuse box) MCB side must be suitable to be connected by three cables or more for each phase to supply 400kV, 132kV control building, etc. Note: the stabilizing winding in primary shall provide if required according to calculation. And design	Yes

CONTROL, OPERATION, INDICATION AND ALARM CIRCUITS

Device	**Function**	**Operating supply voltage**	**If Required**
Main Transformer Buchholz relay	a. Alarm b. Trip	110 V dc 110 V dc	Yes Yes
Winding temperature indicator	a. Alarm b. Trip c. Cooler Control	110 V dc 110 V dc 240 V ac	HV LV Tertiary
Winding temperature indicator remote repeater	Indication	110V dc	HV LV Tertiary
Oil temperature indicator	a. Alarm b. Trip	110 V dc 110 V dc	Yes Yes
Tap-changing equipment Fan failure/pumps	a. Control b. Indication Alarm	110 V dc 110 V dc 110 V dc	Yes Yes Yes
Oil Pump running	Alarm	110 V dc	Yes
Fans running	Alarm	110 V dc	Yes

Device	**Function**	**Operating supply voltage**	**If Required**
Oil flow failure	Alarm	110 V dc	Yes
Main Transformer Min. oil level	Alarm	110V dc	Yes
Main Transformer max. oil level	Alarm	110V dc	Yes
Remote electrical indicator to show if units of a group of transformers are in parallel on different tappings	a. Indication b. Alarm	110 V dc 110 V dc	Yes

Device	**Function**	**Operating supply voltage**	**If Required**
Transformer "tap change in progress" remote electrical indication	a. Indication,	110 V dc	Yes
Tap Changer incomplete	Alarm	110 V dc	Yes
OLTC Buchholz	Alarm Trip	 110V dc	 Yes
OLTC on local OLTC oil level	Alarm Alarm	110V dc 110V dc	Yes
Earthing Transformer Buchholz	Trip	110V dc	Yes
AC Power Supply Failure	Alarm	110V dc	Yes
DC Power Supply Failure	Alarm	110Vdc	Yes

Device	**Function**	**Operating supply voltage**	**If Required**
Earthing Winding Temperature	a. Alarm b. Trip	110 V dc 110 V dc	Yes Yes
Transformer remote electrical indication "voltage ratio" "Auto/Manual" "Remote/Supervisory" "Master/Follower/Independent/Off" "Transformer AC supply" "Transformer DC supply" "Transformer Fans/pumps On/Off and alarm"	Indication	110 V dc	Yes
Main transformer pressure relief	Trip	110 Vdc	Yes
Earthing transformer pressure Relief	Trip	110 Vdc	Yes
Earthing transformer Oil temp	Alarm Trip	110 Vdc 110 Vdc	Yes Yes
Earthing transformer Oil level	Alarm Trip	110 Vdc	Yes
Earthing transformer Buchholz relay	Alarm Trip	110 Vdc	Yes
Reactor Buchholz relay	Alarm Trip	110Vdc	Yes
Reactor Pressure relief device	Trip	110Vdc	Yes
Reactor oil level indicator	Alarm Trip	110Vdc	Yes

Reactor Winding Temperature Indicator	Alarm Trip	110Vdc	Yes

Note: The above-mentioned control, operation, indication and alarm circuits are the minimum requirement and not final, the final will be determined during engineering stage.

- **BUSHINGS**

Item No	Description	Particulars			
1	Nominal voltage (U_N) kV	400	132	33	Neutral
2	Site altitude above sea level for which bushings are to be suitable where this exceeds 1000 m m	<1000			
3	Minimum nominal specific creepage distance in mm per unit of system highest voltage mm/kV	35			
4	Impulse withstand level (full wave 1.2/50 microsecond) under site conditions kVp	1425	650	170	170 (TR)
5	Switching surge withstand level kVp	1050	540		
6	Radio influence voltage measured at 110 per cent of the maximum line to ground operating voltage and at 1000 kHz, shall be less than µV	2500			
7	Maximum symmetrical fault current kA	40 kA and 31kA (33kV)			
8	All outdoor equipment must be suitable for live washing	Yes			

INHIBITED INSULATING OIL DATA SHEET (SUPER GRADE MINERAL, SYNTHETIC INHIBITED OIL)

The following table summarizes the characteristics of insulating oil.

Item No	Property	Test Method	Limits	
1 Functional Properties				
1.1	Appearance	IEC 60296	Clear, free from sediment	
1.2	Viscosity at 40° C	ISO 3104	**<11 mm^2/s**	
1.3	Viscosity at -30° C	ISO 3104	**<1400 mm^2/s**	
1.4	Pour point	ISO 3016	**Max -45°C**	
1.5	Density at 20°C	ISO 12185	Max 0.895 Kg/dm^3	
1.6	Water content	IEC 60814	<30 mg/kg	
1.7	Dielectric strength (breakdown voltage)	IEC 60156	>30 kV (after treatment > 70 kV)	
1.8	Dielectric Dissipation Factor (DDF) at 90° C	IEC 60247	<0.005	
2 Refining and Stability				
2.1	Acidity	IEC 62021	<0.01 mgKOH/g	
2.2	Interfacial Tension	EN 14210	>40 mN/m	
2.3	Potentially corrosive sulphur	IEC 62535	non-corrosive	
2.4	Corrosive sulphur	DIN 51353 or ASTM D 1275b	non-corrosive	
2.5	DBDS (in mg/kg)	IEC 62697-1	non-detectable	

2.6	Metal Passivator additives (in mg/kg)	IEC 60666	non-detectable	
2.7	2-Furfural and related compounds content	IEC 61198	≤0.05 mg/kg	
2.8	Inhibitor content	IEC 60666	<0.4%	
2.9	Aromatic content	IEC 60590	>3% and <9%	
3 Performances				
3.1	Oxidation stability (164h/120°C)	IEC 61125, test duration 500 hours		
	- total acidity		<0.3 mgKoH/g	
	- Sludge content		<0.05 wt%	
	- Dielectric Dissipation Factor (DDF) at 90° C		<0.05	
4 Healt and Safety				
4.1	Flash point	ISO 2719	Min 135° C	
4.2	Polycyclo Aromatic Content (PCA)	IP 346	Max 3%	
4.3	Polychlorinated Biphenyl Content (PBC)	IEC 61619	non-detectable	
Note: if passivator is detected, supplied oil shall be rejected.				

- **The oil for transformer shall be provided with <u>certification of origin</u> and <u>test certificate from independent third party</u>** *with all above characteristics*

- MINIMUM CLEARANCES IN AIR FOR TRANSFORMERS

The clearance to earth shall be adequate for the impulse level and where applicable, the switching surge withstand level specified in the Schedules and as per IEC 60071

The clearance between phases shall be 15 per cent greater than the clearance to earth (or to suit the spacing of the isolated busbars, whichever is the greater).

The minimum clearance between live metal and oil pipework, including the conservator and oil pressure relief device shall be as stated in the table below:

The safety clearances to conductors (Section clearance) and to insulation (Ground clearance) shall also be as stated below:-

Rated System Voltage	kV	420	145	36
BIL SIL	kVp kVp	1425 1050	650	170
Minimum Clearance Live metal to earth – Oil pipework	m	3.4	1.3	0.32
Minimum Clearance between Live metal of Different Phases	m	3.9	1.5	0.43
Horizontal safety Clearance	m	5.4	3.2	2.3
Vertical safety clearance	m	6.4	3.7	2.9
Minimum Height to base of insulation (Ground clearance)	m	2.7	2.4	2.4

Notes: 1 For every 100 m of altitude in excess of 1000 m above sea level, the above clearances shall be increased by 1.25 per cent.

2 Due regard must be paid to the risks from vermin.

- COLOR CODE FOR CUBICLE WIRING

COLOR OF WIRE	CIRCUIT PARTICULARS
Grey	Connections in dc circuits
Red/Yellow/Blue	Phase connections in CT and VT circuits
Black	Connections in ac neutral circuits, and Connections in ac circuits other than above
Green/Yellow	Connections to earth

- GAS AND OIL ACTUATED RELAYS

The surge float contacts shall close at a rate of steady oil flow between the following limits. As far as possible the limits shall also be met when the relay is subjected to oil surge conditions produced by rapid opening of a lever operated gate valve.

Oil pipe connection internal diameter **mm**	**Operational limits for relay rising angles of 1° to 9°** **Steady oil flow (mm/s)**
25	700 - 1300
50	750 - 1400
75	900 - 1600

The gas collection contacts shall operate within the angle test limits detailed in Schedule F.

- MINIMUM THICKNESS OF TANK BASE PLATE

Length of tank base (mm)	**Minimum thickness (mm)**	
	Base plate	**Side plate**
With flat base		
Not exceeding 2500	19	6
Exceeding 2500 not exceeding 7500	25	9
Exceeding 7500	32	16
With fabricated underbase		
Not exceeding 2500	9	6
Exceeding 2500	12	9

- NEPCO PROPERTY PLATES DETAILS (SHALL BE ON THE SEPARATE PLATE)

PLANT	**DETAILS**
POWER TRANSFORMER **EARTHING AND AUXILIARY TRANSFORMER** **Shunt Reactor**	**400KV AQABA MAIN S/S**

SCHEDULE D PART II
(Information to be supplied with Financial Bid)

1. - 400 MVA POWER AUTOTRANSFORMERS

1. Guaranteed values

Item No	Description	Unit	Particulars (to be supplied with Bid)
1	No load losses at rated frequency		
1.1	At rated voltage (not higher than 110 kW) "guaranteed"	kW	
1.3	At 105% rated voltage	kW	
1.2	At 110% rated voltage	kW	
2	Load losses at 75°C:		
2.1	HV/LV winding at 400 MVA "guaranteed"		
2.1.1	At central tap (not higher than 850kW)	kW	
2.1.2	At maximum tap	kW	
2.1.3	At minimum tap	kW	
2.2	HV/Tertiary winding at 100 MVA	kW	
2.3	LV/Tertiary winding at 100 MVA	kW	
2.4	HV/LV at ONAN rating	kW	
3	Cooling system losses (pumps and fans in service full load)	kW	
4	Total losses at 75°C and rated voltage ratio and with all windings loaded at:-	kW	
4.1	At IEC rating	kW	
4.2	At ONAN rating	kW	
5	Proportion of sum of fixed and load losses at rated power which will be supplied during the temperature rise test	%	
6	Tap position on which maximum losses occur at MCR		
6.1	Load losses at MCR on tap position with maximum losses	kW	
7.1	Regulation at 75 °C and MCR at unity P.F.	%	

Item No	Description	Unit	Particulars (to be supplied with Bid)
7.2	Regulation at 75 °C and MCR at 0.8 P.F lagging	%	

NOTE 1: Guaranteed maximum values of no load losses, load losses and auxiliary losses in no case shall be higher than the values prescribed in the Data Sheet of transformers in Chapter 5 of Transformer Technical Specification.

NOTE 2: For the purposes of Bid evaluation these losses are capitalized in accordance with the following formula:
Capitalized Cost of Losses TCO = IC + 7438.54 (P0 + Pc0) + 1880.52 (Pk + Pcs – Pc0) (in Jordanian Dinars)

Where: (as describe in IEC TS 60076-20 /Annex A)

- IC: Transformer initial cost, in JOD;
- P0: No load losses at rated tap;
- Pc0: The cooling power for no load operation;
- Pk: Load losses at rated tap;
- Pcs: Total cooling power at rated full Power.

EARTHING TRANSFORMER

Item No	Description	Unit
No load losses	kW	
Load losses (at CMR of lower voltage winding) at 75°C	kW	

SCHEDULE D
PART II
(Information to be supplied with Technical Tender)

2 Informative values

Item No	Description	Unit	Particulars (to be supplied with Bid)
1	Description of transformers		
2	Type of transformers:		
2.1	Shell or core		
2.2	Auto or separate windings		
2.3	Three phase or single phase units		
2.4	Cooling (IEC letter symbols)		
3	IEC ratio power at terminals of:		
3.1	HV winding	MVA	
3.2	LV winding	MVA	
3.3	Tertiary winding	MVA	
4	Continuous maximum ratings at winding terminals according to tapping position when operating under site conditions:		
4.1	HV winding	MVA	
4.2	LV winding	MVA	
4.3	Tertiary winding	MVA	
5	Maximum ONAN and ONAF ratings of winding terminals irrespective of tapping position, when operating under site conditions		
5.1	ONAN rating:		

Item No	Description	Unit	Particulars (to be supplied with Bid)
5.1.1	HV winding	MVA	
5.1.2	LV winding	MVA	
5.1.3	Tertiary winding	MVA	
5.2	ONAF ratings:		
5.2.1	HV winding	MVA	
5.2.2	LV winding	MVA	
5.2.3	Tertiary winding	MVA	
6	IEC rated lighting impulse withstand level:		
6.1	HV winding	kVp	
6.2	LV winding	kVp	
6.3	Tertiary winding	kVp	
6.4	Common Neutral winding	kVp	
7	Maximum temperature rise above ambient at CMR when operating under site conditions		
7.1	Windings hot spot	°C	
7.2	Windings average (by resistance)	°C	
7.3	Top of oil	°C	
7.4	Oil at inlet to cooler	°C	
7.5	Oil at outlet from cooler	°C	
8	Maximum flux density in iron at rated voltage and power frequency and at rated voltage ratio:		
8.1	Wound limbs	T	
8.2	Unwound limbs	T	
8.3	Yokes	T	

Item No	Description	Unit	Particulars (to be supplied with Bid)
8.4	Shields	T	
9	Maximum flux density in iron under the most onerous voltage conditions stated in Technical Specification Data Sheet and at power frequency:		
9.1	Wound limbs	T	
9.2	Unwound limbs	T	
9.3	Yokes	T	
9.4	Shields	T	
10	Maximum current density in windings at IEC rated power:		
10.1	HV winding	A/mm²	
10.2	LV winding	A/mm²	
10.3	Tertiary winding	A/mm²	
10.4	Tapping	A/mm²	
11	Magnetizing current (HV winding)		
12	At 90% rated voltage	A	
13	At 100% rated voltage	A	
14	At 110% rated voltage	A	
14.1	At the maximum voltage equivalent to the value quoted in Schedule D1	A	
15	Impedance voltage at 75°C.referred to primary winding rating of 400 MVA (including all tolerances):		MAX/MIN
15.1	Between HV and LV windings	%	
15.2	Between HV and tertiary windings	%	
15.3	Between LV and tertiary windings	%	
16	Impedance voltage at 75°C at each end of tapping range - per cent on primary winding rating i.e 400 MVA (including all tolerances):		MAX/MIN

Item No	Description	Unit	Particulars (to be supplied with Bid)
16.1	Between HV and LV windings At maximum voltage ratio At minimum voltage ratio At principal tap	%	
16.2	Between HV and Tertiary windings	%	
17	Resistance of windings at 75°C on principal tapping:		
17.1	HV winding	Ω/ph.	
17.2	LV winding	Ω/ph.	
17.3	Tertiary winding	Ω/ph.	
18	Types and arrangement of windings:		
18.1	HV winding		
18.2	LV winding		
18.3	Tertiary winding		
18.4	Tapping		
18.5	Winding arrangement i.e. Core/TV/LV/HV/Taps		
19	Conductor material (i.e. copper, work hardened copper etc):		
19.1	HV windings		
19.2	LV windings		
19.3	Tapping windings		
19.4	Tertiary windings		
20	Conductor insulation:		
20.1	HV windings		
20.2	LV windings		

Item No	Description	Unit	Particulars (to be supplied with Bid)
20.3	Tapping windings		
20.4	Connecting leads from winding to tap changer		
20.5	Tertiary windings		
21	Calculated thermal time constant:		
21.1	Natural cooling	s	
21.2	Forced cooling	s	
22	Oil circulation (i.e. natural/partially directed/directed)		
22.1	To the windings:		
22.1.1	HV windings		
22.1.2	LV windings		
22.1.3	Tapping windings		
22.1.4	Tertiary windings		
22.2	Through the windings:		
22.2.1	HV windings		
22.2.2	LV windings		
22.2.3	Tapping windings		
22.2.4	Tertiary windings		
23	Core construction:		
23.1	Taped/banded/bolted limbs		
23.2	Taped/banded/bolted yokes		
23.3	Taping/banding material		

Item No	Description	Unit	Particulars (to be supplied with Bid)
23.4	Number of limbs		
23.5	Number of limbs wound		
24	Type of joint in magnetic core (90% butt, overlap, mitre etc)		
24.1	Whether tank or other flux shields are incorporated		
24.2	Type of core steel		
24.3	Specific loss of core steel at 1.7 T	W/kg	
25	Voltage rating of neutral bushing		
25.1	Common neutral	kV kV	
25.2	Tertiary neutral	kV	
26	Type of on-load voltage control equipment:		
26.1	Single or double compartment type etc		
26.2	Manufacturer's type designation		
27	Tappings:		
27.1	Arrangement of tappings (Linear, Coarse/fine, **Reversing**) Reversing is required		
27.2	Which winding is tapped and where (e.g. neutral end)		
27.3	Size of step as percentage of winding rated voltage		
27.4	Number of steps		
28	Thickness of transformer tank:		
28.1	Sides	mm	
28.2	Bottom	mm	
28.3	Top	mm	
29	Material of transformer tank		

Item No	Description	Unit	Particulars (to be supplied with Bid)
30	Thickness of radiator plates and/or cooling tubes	mm	
31	Number of coolers or cooler banks per transformers		
32	Rating of each cooler or cooler bank	kW	
33	Total oil required (including cooling system)	litres	
34	Filling medium of transformer tank for shipment		
35	Total volume of conservator	litres	
36	Volume of oil in conservator between the highest and lowest visible levels:	litres	
36.1	Manufacturer and designation of Dehydrating Breather		
36.2	Material of oil encapsulating membrane		
37	Mass of core and windings	kg	
38	Mass of copper required in the complete transformer	kg	
39	Mass of core laminations	kg	
40	Total mass of complete transformer including cooling gear, voltage regulating equipment, all fittings and oil	kg	
41	Mass of transformer as arranged for transport (heaviest part)	kg	
42	Maximum noise level (`A' weighting) Sound Power Level	dB	
43	Dimensions of transformer arranged for transport:		
43.1	Height	m	
43.2	Width	m	
43.3	Length	m	
44	Manufacture and type designation of condition monitoring system		
45	Time for which transformer can safely withstand 30 per cent over-voltage	s	

Item No	Description	Unit	Particulars (to be supplied with Bid)
46	Whether any reactors, capacitors, linear or non-linear resistors are immersed in the oil of the transformer or tap changer tank		
47	Transformer magnetising characteristics (on nominal tapping)		Annex curve
48	Flux-current (B-H curve for the transformers):		Annex curve
49	Confirm that the life of the transformer will not be significantly reduced if subjected to the overvoltages specified in Transformer Schedule D1		Yes/No (Delete as applicable)
50	**Bushing details 400 MVA 400/132/33 KV**		
50.1	Maker		
50.2	Type		
50.3	Current rating	A	
50.4	Voltage rating	kV	
50.5	Insulator material and color		
50.6	Insulator type		
50.7	Pitch circle diameter drilling flange		
50.8	Overall length of bushing insulator	mm	
50.9	Weight of bushing insulator	kg	
50.10	Material of fitting		
50.11	Dry withstand power frequency voltage	kV	
50.12	Wet withstand power frequency voltage	kV	
50.13	Routine power frequency test voltage (1 minute)	kV	
50.14	Voltage at which corona is not visible	kV	
50.15	Total creepage distance		
50.16	Projected creepage distance of shedding		
50.17	Maximum diameter of bushing passing through current transformer chamber	mm	
50.18	Penetration of bushing into tank measured from bottom of fixing flange	m	
51	Transformer monitoring system (TMS):		
51.1	Manufacturer		

Item No	**Description**	**Unit**	**Particulars (to be supplied with Bid)**
51.2	Place of manufacture		
51.3	Hot spot temperature in accordance with IEC 60076-7		Yes
51.4	Ageing rate in accordance with IEC 60076-7		Yes
51.5	Continuous overload current capacity of the transformer		Yes
51.6	Overvoltage detection including a lightning surge and overcurrent		Yes
51.7	Variation in the capacitance of bushings		Yes
51.8	Tan delta and partial discharge		Yes
52	Critical impact Acceleration		
53	Critical Impact Frequency		

3 Insulating oil characteristics

Item No	Description	Unit	Particulars (to be supplied with Bid)
1	Manufacturer name		
2	Country of manufacturing		
3	Type of oil		
4	Oil shall comply with the requirement of latest issue of IEC 60296		
5	Type designation		
6	Appearance		
7	Density at 20°C	Kg/m²	
8	Kinematic viscosity at 20 °C		
9	Dielectric strength		
10	Flash point	°C	
11	Pour point	°C	
12	Neutralization value	mgKoH/g	
13	Corrosive sulphur (confirm not corrosive)		
14	Water content	Ppm	
15	Dielectric dissipation factor at 90 °C		
16	Oxidation stability (164h/120°C) - Neutralization value - Sludge content	 mgKoH/g %m	

1.2 - Earthing transformers

Item No	Description	Particulars
1	Current density in the interconnected star winding (with the earth fault current specified) A/mm^2	
2	Current density in the interconnected star winding at 3 second rating A/mm^2	
3	Maximum flux density in the core iron at normal voltage and frequency T	
4	Load required by main transformer auxiliaries kVA	
5	Continuous maximum rating of star lower voltage winding kVA	
6	No load losses kW	Fill in Guaranteed values in losses table
7	Load losses (at CMR of lower voltage winding) at 75°C kW	Fill in Guaranteed values in losses table
8	Impedance voltage (at cmr of lower voltage winding) between HV and LV windings at 75°C per cent	
9	Resistance of higher voltage winding at 75°C ohms per phase	
10	Zero phase sequence impedance of inter-star winding at (LV windings open-circuited) ohms per phase	
11	Zero phase sequence impedance of lv windings at 75°C (Inter-star windings open-circuit) ohms per phase	
12	Thickness of transformer tank mm	
13	Total oil required litres	
14	Mass of complete transformer (including oil) tonnes	
15	Tappings	
15.1	Size of steps as percentage of winding rated voltage	

Item No	Description	Particulars
15.2	Number of steps	
16	Continuous rating of interconnected start winding A	

5. BUSHING:

Item No	Description	Particulars
		Transformer **400 132 33 N***
1	Rated voltage (U_N) kV	
2	Site altitude above sea level for which bushings are to be suitable where this exceeds 1000 m m	
3	Minimum nominal specific creepage distance in mm per unit of system highest voltage mm/kV	
4	Impulse withstand level (full wave 1.2/50 microsecond) under site conditions kVp	
5	Switching surge withstand level kVp	
6	Arcing horns or rings	
6.1	Whether required	
6.2	Minimum gap setting mm	-
7	Radio influence voltage measured at 110 per cent of the maximum line to ground operating voltage and at 1000 kHz, shall be less than µV	
8	Maximum symmetrical fault current kA	
9	All outdoor equipment must be suitable for live washing	