

A log of the following quantities taken at a minimum of 30 minute intervals:

- time
- Voltage between phases
- Current in each phase and total power
- Power in each phase and total power
- Ambient temperature
- Top oil temperature
- Cooler inlet and outlet oil temperatures
- Hot spot temperatures (make use of probes)
- Colour photographs of the four sides and top of the transformer together with the corresponding series of thermal images (colour) during starting of the test then after every two hours till the temperature stabilised and finally during temperature stabilised for each rating (ONAN/ONAF/OFAP or (ODAF) or ONAN/ONAF1/ONAF2)

Notes:

The probes may be left in position provided the reliability and integrity of unit will not be jeopardized during its long life expectancy.

v. Winding temperature rise test

- Record the weight of conductor in each winding, and the losses in watts per kilogram, the 'cold' resistance of each winding and the simultaneous top oil and ambient air temperatures, together with the time required for the effect to disappear.
- Record the thermal time constant of the winding.
- Log the half -hourly readings of the quantities as for the top oil temperature rise test.
- Provide a table of readings, after shut-down of power, giving the following information ;
 - a) Time after shut- down:
 - b) Time increment:
 - c) Winding resistance:
 - d) Resistance increment:
 - e) X, where x is the time after shut-down divided by the thermal time constant of the winding; and
 - f) Y, where $Y = 100 (1 - e^{-x})$
- (Any graphical/computer method used to determine the temperature of a winding by extrapolation to the instant of power shut-down shall produce a linear curve.)
- Provide a record of all calculations, corrections and curves leading to the determination of the winding temperatures at the instant of shut-down of power.
- Record any action taken to remedy instability of the oil surge device during initiation of the oil circulating pumps.

Temperature measurements as per special probes or sensors (fibre optic) placed at various locations shall also be recorded.

4. Tank Tests

i. 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.

ii. Vacuum Test

All transformer tanks shall be subjected to the specified vacuum. The tank designed for full vacuum 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

iii. 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 one hour. The permanent deflection of flat plates after the excess pressure has been released shall not exceed the figure specified above for vacuum test.

5. Dynamic short circuit withstand test shall be carried out as per IEC 60076-5. Dynamic short circuit test shall be carried out in HV-IV combination at nominal & extreme tap positions. For LV winding, dynamic short circuit shall be carried out either on HV-LV or IV-LV combination, whichever draws higher short circuit current as per calculation. Type tests shall be carried out before short circuit test. Following shall also be conducted before and after Short Circuit test:

- i) Dissolved gas analysis
- ii) Frequency response analysis
- iii) All routine tests

Detail test procedure shall be submitted by contractor & shall be approved before short circuit test.

6. Routine test on bushings shall be done as per IEC 60137

Reference Drawings

The list of drawings indicated below forms a part of this specification.

Sr. No	Drawing Description	Drawing No.
i)	Standard Foundation Drawing	0000-000-T-E-A-003
ii)	Standard dimensions for RIP Condenser bushings (Lower portion)	0000-T-E-A-001 R02
iii)	Typical arrangement of transformer with regulating winding at the end of the series winding.	000S3-YE4-014
iv)	Conceptual drawing for optical fiber sensor	C/ENGG/STD/ optical fiber sensor/AT-SR, REV 0
v)	Pre-Commissioning Procedures and formats for switchyard equipment	D-2-01-03-01-04, issued on 01-04-2013 or latest.
vi)	Conceptual drawing for showing power and control cable connection for operation of 1-ph unit with spare unit	C/ENGG/TR/SPARE/STD; REV00
vii)	Conceptual drawing for showing power and control cable connection for operation of 3-ph unit	C/ENGG/STD/CABLE/TR

Design Review Document

Sr. No.	Description
1.	Core and Magnetic Design
2.	Over-fluxing characteristics upto $1.7U_m$
3.	Inrush-current characteristics while charging from HV & IV respectively.
4.	Winding and tapping design
5.	Short-circuit withstand capability including thermal stress for min. 2 Sec.
6.	Thermal design including review of localised potentially hot area.
7.	Cooling design
8.	Overload capability
9.	Eddy current losses
10.	Seismic design, as applicable
11.	Insulation co-ordination
12.	Tank and accessories
13.	Bushings
14.	Tap changers
15.	Protective devices
16.	Fans, pumps and radiators
17.	Sensors and protective devices– its location, fitment, securing and level of redundancy
18.	Oil and oil preservation system
19.	Corrosion protection
20.	Electrical and physical Interfaces with substation
21.	Earthing (Internal & External)
22.	Processing and assembly
23.	Testing capabilities
24.	Inspection and test plan
25.	Transport and storage
26.	Sensitivity of design to specified parameters
27.	Acoustic Noise
28.	Spares, inter-changeability and standardization
29.	Maintainability
30.	PRD and SPR (number & locations)
31.	Conservator capacity calculation
32.	Winding Clamping arrangement details with provisions for taking it “in or out of tank”
33.	Conductor insulation paper details
34.	Location of Optical temperature sensors
35.	The design of all current connections
36.	Location & size of the Valves

Painting Procedure

PAINTING	Surface preparation	Primer coat	Intermediate undercoat	Finish coat	Total dry film thickness (DFT)	Colour shade
Main tank, pipes, conservator tank, oil storage tank & DM Box etc. (external surfaces)	Shot Blast cleaning Sa 2 ½*	Epoxy base Zinc primer (30-40µm)	Epoxy high build Micaceous iron oxide (HB MIO) (75µm)	Aliphatic polyurethane (PU) (Minimum 50µm)	Minimum 155µm	RAL 7035
Main tank, pipes (above 80 NB), conservator tank, oil storage tank & DM Box etc. (Internal surfaces)	Shot Blast cleaning Sa 2 ½*	Hot oil proof, low viscosity varnish or Hot oil resistant, non-corrosive Paint	--	--	Minimum 30µm	Glossy white for paint
Radiator (external surfaces)	Chemical / Shot Blast cleaning Sa 2 ½*	Epoxy base Zinc primer (30-40µm)	Epoxy base Zinc primer (30-40µm)	PU paint (Minimum 50µm)	Minimum 100µm	Matching shade of tank/ different shade aesthetically matching to tank
contractor may also offer Radiators with hot dip galvanised in place of painting with minimum thickness of 40µm (min)						
Radiator and pipes up to 80 NB (Internal surfaces)	Chemical cleaning, if required	Hot oil proof, low viscosity varnish or Hot oil resistant, non-corrosive Paint	--	--	--	--
Digital RTCC Panel	Seven tank process as per IS:3618 & IS:6005	Zinc chromate primer (two coats)	--	EPOXY paint with PU top coat or POWDER coated	Minimum 80µm / for powder coated minimum 100µm	RAL 7035 shade for exterior and Glossy white for interior
Control cabinet / Marshalling Box - No painting is required.						

Note: (*) indicates Sa 2 ½ as per Swedish Standard SIS 055900 of ISO 8501 Part-1.

* reg Addendum 1 to NO 09

Annexure – G

Unused inhibited Insulating Oil Parameters

Sl. No.	Property	Test Method	Limits
A Function			
1a.	Viscosity at 100degC	ISO 3104 or ASTM D445 or ASTM D7042	(Max.) 3 mm ² /s
1b.	Viscosity at 40degC	ISO 3104 or ASTM D445 or ASTM D7042	(Max.) 12 mm ² /s
1c.	Viscosity at -30degC	ISO 3104 or ASTM D445 or ASTM D7042	(Max.) 1800 mm ² /s
2.	Appearance	A representative sample of the oil shall be examined in a 100 mm thick layer, at ambient temperature	The oil shall be clear and bright, transparent and free from suspended matter or sediment
3.	Pour point	ISO 3016 or ASTM D97	(Max.) - 40degC
4.	Water content a) for bulk supply b) for delivery in drums	IEC 60814 or ASTM D1533	(Max.) 30 mg/kg 40 mg/kg
* 5.	Electric strength (breakdown voltage)	IEC 60156 or ASTM D1298	(Min.) 50 kV (new unfiltered oil) / 70 kV (after treatment)
6.	Density at 20 deg C	ISO 3675 or ISO 12185 or ASTM D 4052	0.820 - 0.895 g/ml
7.	Dielectric dissipation factor (tan delta) at 90 deg C	IEC 60247 or IEC 61620 Or ASTM D924	(Max) 0.0025
8.	Negative impulse testing KVp @ 25 deg C	ASTM D-3300	145 (Min.)
* 9.	Carbon type composition (% of Aromatic, Paraffins and Naphthenic compounds)	IEC 60590 or ASTM D 2140	Max. Aromatic : 4 to 12 % Paraffins : <50% & balance shall be Naphthenic compounds.
B Refining/Stability			
1.	Acidity	IEC 62021-1 or ASTM D974	(Max) 0.01 mg KOH/g
2.	Interfacial tension at 27degC	ISO 6295 or ASTM D971	(Min) 0.04 N/m
* 3.	Total sulphur content	BS 2000 part 373 or ISO 14596 or ASTM D129	0.15 % (Max.)
4.	Corrosive sulphur	IEC 62535	Non-Corrosive on copper and paper
		ASTM D1275B	Non-Corrosive
5.	Presence of oxidation inhibitor	IEC 60666 or ASTM D2668 or D4768	0.08% (Min.) to 0.4% (Max.) Oil should contain no other additives. Supplier should declare presence of additives, if any.

* 202 addendum-1 Sr 09

6.	2-Furfural content	IEC 61198 or ASTM D5837	25 Microgram/litre (Max.)
C Performance			
1	Oxidation stability -Total acidity -Sludge - Dielectric dissipation factor (tan delta) at 90degC	IEC 61125 (method c) Test duration 500 hour IEC 60247	Max 0.3 mg KOH/g Max 0.05 % Max 0.05
2.	Oxidation stability (Rotating Bomb test)	IEC : 61125(Method B) / ASTM D2112 (e)	220 Minutes (Min.)
D Health, safety and environment (HSE)			
1.	Flash point	ISO 2719	(Min.)135degC
2.	PCA content	BS 2000 Part 346	Max 3%
3.	PCB content	IEC 61619 or ASTM D4059	Not detectable (Less than 2 mg/kg)
E Oil used (inhibited) for first filling, testing and impregnation of active parts at manufacturer's works shall be same type of oil which shall be supplied at site and shall meet parameters as mentioned below:			
1	Break Down voltage (BDV)		70kV (min.)
2	Moisture content		5 ppm (max.)
3	Tan-delta at 90°C		0.005 (max)
4	Interfacial tension		0.04 N/m (min)
F Each lot of the processed oil shall be tested prior to filling in main tank at site for the following:			
1	Break Down voltage (BDV)		70 kV (min.)
2	Moisture content		5 ppm (max.)
3	Tan-delta at 90°C		0.0025 (Max)
4	Interfacial tension		More than 0.04 N/m
G After filtration & settling and prior to energisation at site oil shall be tested for following:			
1	Break Down voltage (BDV)	IS: 1866 / IEC 60422	70 kV (min.)
2	Moisture content at hot condition		5 ppm (max.)
3	Tan-delta at 90°C		0.005 (Max)
4	Interfacial tension		More than 0.04 N/m
5	*Oxidation Stability	Test method as per IEC 61125 method C, Test duration: 500hour for inhibited oil	
	a) Acidity		0.3 (mg KOH /g) (max.)
	b) Sludge		0.05 % (max.)
	c) Tan delta at 90 °C		0.05 (max.)
6	*Total PCB content		Not detectable (less than 2 mg/kg total)
* Separate oil sample shall be taken and test results shall be submitted within 45 days after commissioning for approval of POWERGRID.			

2.0 Current Transformer Parameters (On each phase) for 3-ph 500MVA and 1-ph, 167 MVA, 400/220/33 kV Transformers

Description	Current Transformer Parameters (Transformer)		
	HV Side	IV Side	Neutral Side
(a) Ratio			
CORE 1	1600/1	1600/1	1600/1
CORE 2	1000/1	1600/1	
(b) Minimum knee point voltage or burden and accuracy class			
CORE 1	1600V, TPS	1600V, TPS	1600V, TPS
CORE 2	0.2 Class 30VA ISF ≤ 5	0.2 Class 30VA ISF ≤ 5	
(c) Maximum CT Secondary Resistance			
CORE 1	4.0 Ohm	4.0 Ohm	4.0 Ohm
CORE 2	-	-	
(d) Application			
CORE 1	Restricted Earth Fault	Restricted Earth Fault	Restricted Earth Fault
CORE 2	Metering	Metering	
(e) Maximum magnetization current (at knee point voltage)			
CORE 1	25 mA	25 mA	25 mA
CORE 2	-	-	

NOTE:

- vi) Accuracy class PS as per IEC 60044.
- vii) Class (for the relevant protection and duties) as per IEC 60185.
- viii) Parameters of WTI CT for each winding shall be provided by the contractor.
- ix) For estimation of spares, one set of CTs shall mean one CT of each type used in transformer.
- x) The CT used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

1.1 KV GRADE POWER & CONTROL CABLES

- 1.1 Separate cables shall be used for AC & DC.
- 1.2 Separate cables shall be used for DC1 & DC2.
- 1.3 At least one (1) core shall be kept as spare in each copper control cable of 4C, 5C or 7C size whereas minimum no. of spare cores shall be two (2) for control cables of 10 core or higher size.
- 1.4 The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects. All aluminium used in the cables shall be of H2 grade.
- 1.5 The fillers and inner sheath shall be of non-hygrosopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable.
- 1.6 Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.
- 1.7 Strip wire armouring method (a) mentioned in Table 5, Page-6 of IS: 1554 (Part 1) – 1988 shall not be accepted for any of the cables. For control cables only round wire armouring shall be used.
- 1.8 The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.
- 1.9 All the cables shall conform to fire resistance test as per IS: 1554 (Part - I).
- 1.10 The normal current rating of all PVC insulated cables shall be as per IS: 3961.
- 1.11 Repaired cables shall not be accepted.
- 1.12 Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.
- 1.13 **PVC Power Cables**
- 1.13.1 The PVC (70°C) insulated 1100V grade power cables shall be of FR type, C1 category, conforming to IS: 1554 (Part-I) and its amendments read along with this specification and shall be suitable for a steady conductor temperature of 70°C. The conductor shall be stranded aluminium. The Insulation shall be extruded PVC to type-A of IS: 5831. A distinct inner sheath shall be provided in all multi core cables. For multi core armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-1 of IS: 5831 for all cables.
- 1.14 **PVC Control Cables**

- 1.14.1 The 1100V grade control cables shall be of FR type C1 category conforming to IS: 1554 (Part-1) and its amendments, read along with this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS: 5831. A distinct inner sheath shall be provided in all cables whether armoured or not. The over sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be grey in colour except where specifically advised by the Employer to be black.
- 1.14.2 Cores shall be identified as per IS: 1554 (Part-1) for the cables up to five (5) cores and for cables with more than five (5) cores the identification of cores shall be done by printing legible Hindu Arabic Numerals on all cores as per clause 10.3 of IS : 1554 (Part - 1).

STANDARD TECHNICAL DATA SHEET (11kV GRADE XLPE POWER CABLES)

Sr. No	Description	Parameters	
1a	Name of manufacturer	As per approved list	
b	Cable Sizes	1 C x 630	3½ C x 300
c	Manufacturer's type designation	A2XWaY	A2XWY
2	Applicable standard	IS: 7098/PT-I/1988 & its referred specifications	
3	Rated Voltage(volts)	1100 V Grade	
4	Type & Category	FR & C1	FR & C1
5	Suitable for earthed or unearthed system	for both	
6	Continuous current rating when laid in air in a ambient temp. of 50 °C and for maximum conductor temp. of 70 °C of PVC Cables[For information only]	732	410
7	Rating factors applicable to the current ratings for various conditions of installation	As per IS-3961-Pt-II-67	
8	Short circuit Capacity		
a	Guaranteed Short Circuit Amp. (rms) KA for 0.12 sec duration at rated conductor temperature of 90 degree C, with an initial peak of 105 KA	45kA	45kA
b	Maximum Conductor temp. allowed for the short circuit duty (deg C.) as stated above	250°C	
9	Conductor		
a	Material	Stranded Aluminium as per Class 2 of IS : 8130	
b	Grade	H 2 (Electrolytic grade)	
c	Cross Section area (Sq.mm.)	630	300/150
d	Number of wires(No.) minimum	53	30/15
e	Form of Conductor	Stranded and compacted circular	Stranded compacted circular/sector shaped
f	Direction of lay of stranded layers	Outermost layer shall be R.H lay & opposite in successive layers	
10	Conductor resistance (DC) at 20 °C per km-maximum	0.0469	0.1/0.206
11	Insulation		
a	Composition of insulation	Extruded XLPE as per IS-7098 Part(1)	
b	Nominal thickness of insulation(mm)	2.8	1.8/1.4
c	Minimum thickness of insulation	2.42	1.52/1.16
12	Inner Sheath		
a	Material	Extruded PVC type ST-2 as per IS-5831-84	
b	Calculated diameter over the laid up cores,(mm)	NA	52
c	Thickness of Sheath (minimum)mm	NA	0.6
d	Method of extrusion	NA	Pressure/Vacuum extrusion
13	Armour		
a	Type and material of armour	Al wire [H4 grade]	Gal. Steel wire
b	Direction of armouring	Left hand	
c	Calculated diameter of cable over inner sheath (under armour), mm	33.9	53.2
d	Nominal diameter of round armour wire (minimum)	2	2.5
e	Guaranteed Short circuit capacity of the armour for 0.12 sec at room temperature.	45kA	45kA
f	DC resistance at 20 °C (Ω/Km)	\$	0.577
14	Outer Sheath	ST-2 & FR	ST-2 & FR

A	Material (PVC Type)	38.3	59.50
B	Calculated diameter under the sheath	1.72	2.36
C	Min. thickness of sheath(mm)	Min 29.0	Min 29.0
D	Guaranteed value of minimum oxygen index of outer sheath at 27 °C	Min 250	Min 250
E	Guaranteed value of minimum temperature index at 21 oxygen index	Black	Black
f	colour of sheath	\$	\$
15a	Nominal Overall diameter of cable	+2/-2 mm	
b	Tolerance on overall diameter (mm)	shall conform to IS 10418 and technical specification	
16	Cable Drums	1000/500	1000/500
a	Max./ Standard length per drum for each size of cable (single length) with $\pm 5\%$ Tolerance (mtrs)		
b	Non-standard drum lengths	Maximum one(1) non-standard lengths of each cable size may be supplied in drums only over & above the standard lengths as specified above.(if required for completion of project)	
17	Whether progressive sequential marking on outer sheath provided at 1 meter interval 18	Yes	
18	Identification of cores		
a	colour of cores	As per IS 7098 Part(1)	
b	Numbering	NA	
19	Whether Cables offered are ISI marked	Yes	
20	Whether Cables offered are suitable for laying as per IS 1255	Yes	

\$'- As per manufacturer design data

STANDARD TECHNICAL DATA SHEET - 1.1kV kV GRADE PVC POWER CABLES

Name of manufacturer: As per approved list

SN	Description	Parameters					
		1 c x 150	3.5 cx 70	3.5 cx 35	4 c x 16	4c x 6	2 c x 6
1a	Cable Sizes						
1b	Manufacturer's type designation	AYWaY	AYFY	AYFY	AYFY	AYWY	AYWY
2	Applicable standard	IS: 1554/PT-I/1988 & its referred standards					
3	Rated Voltage(volts)	1100 V grade					
4	Type & Category	FR & C1	FR & C1	FR & C1	FR & C1	FR & C1	FR & C1
5	Suitable for earthed or unearthed system	for both					
6	Continuous current rating when laid in air in a ambient temp. of 50oC and for maximum conductor temp. of 70 oC of PVC Cables[For information only]	202	105	70	41	24	28
7	Rating factors applicable to the current ratings for various conditions of installation:	As per IS-3961-Pt-II-67					
8	Short circuit Capacity						
a)	Short Circuit Amp. (rms)KA for 1 sec duration	11.2	5.22	2.61	1.19	0.448	0.448
b)	Conductor temp. allowed for the short circuit duty (deg C.)	160 ^o C					
9	Conductor						
a)	Material	STRANDED ALUMINIUM					
b)	Grade	H 2 (Electrolytic grade)					
c)	Cross Section area (Sq.mm.)	150	M-70 N-35	M-35 N-16	16	6	6
d)	Number of wires(No.)	as per Table 2 of IS 8130					
e)	Form of Conductor	Non- compacted Stranded circular	shaped conductor	shaped conductor	shaped conductor	Non- compacted Stranded circular	Non- compacted Stranded circular
f)	Direction of lay of stranded layers	Outermost layer shall be R.H lay & opposite in successive layer					
10	Conductor resistance (DC) at 20 oC per km-maximum	0.206	0.443/0 .868	0.868/ 1.91	1.91	4.61	4.61
11	Insulation						
a)	Composition of insulation	Extruded PVC type A as per IS-5831-84					
b)	Nominal thickness of insulation(mm)	2.1	1.4/1.2	1.2/1.0	1.0	1.0	1.0
c)	Minimum thickness of insulation	1.79	1.16/0.9 8	0.98/0. 8	0.8	0.8	0.8
12	Inner Sheath						
a)	Material	Extruded PVC type ST-I as per IS-5831-84					
b)	Calculated diameter over the laid up cores,(mm)	N.A	27.6	20.4	15.7	11.6	9.6
c)	Thickness of Sheath (minimum) mm	N.A	0.4	0.3	0.3	0.3	0.3
13	Armour	as per IS 3975/88					
a)	a) Type and material of armour	Al. Wire[H4 grade]	Gal.steel strip	Gal.steel strip	Gal.steel strip	Gal.steel wire	Gal.steel wire

b)	b) Direction of armouring	left hand					
c)	c) Calculated diameter of cable over inner sheath (under armour), mm	18	28.4	21	16.3	12.2	10.2
d)	d) Nominal diameter of round armour wire/strip	1.6 4	0.8 4	0.8 4	0.8	1.4	1.4
e)	e) Number of armour wires/strips	Armouring shall be as close as practicable					
f)	f) Short circuit capacity of the armour along for 1 sec-for info only	$K \times A \sqrt{t}$ (K Amp)(where A = total area of armour in mm^2 & t = time in seconds), K=0.091 for Al & 0.05 for steel					
g)	g) DC resistance at 20 oC (Ω/Km)	0.44	2.57	3.38 4	3.99	3.76	4.4
14	Outer Sheath						
a)	a) Material (PVC Type)	ST-1& FR	ST-1& FR	ST-1& FR	ST-1& FR	ST-1& FR	ST-1& FR
b)	b) Calculated diameter under the sheath	21.2	30.1	22.6	17.9	15	13
c)	c) Min. thickness of sheath(mm)	1.4	1.56	1.4	1.4	1.4	1.24
d)	d) Guaranteed value of minimum oxygen index of outer sheath at 27oC	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0
e)	e) Guaranteed value of minimum temperature index at 21 oxygen index	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250
f)	f) colour of sheath	Black	Black	Black	Black	Black	Black
15a)	a) Overall diameter of cable	\$					
b)	b) Tolerance on overall diameter (mm)	+2/-2 mm					
16	Cable Drums	shall conform to IS 10418 and technical specification					
a)	a) Max./ Standard length per drum for each size of cable (single length) with $\pm 5\%$ Tolerance (mtrs)	1000/50 0	1000/50 0	1000/5 00	1000/50 0	1000/50 0	1000/50 0
b)	b) Non standard drum lengths	Maximum one(1) non standard lengths of each cable size may be supplied in drums only over & above the standard lengths as specified above.(if required for completion of project)					
17	Whether progressive sequential marking on outer sheath provided	Yes					
18	Identification of cores						
a)	a) colour of cores	Red	R,Y,BI & Bk	R,Y,B l& Bk	R,Y,BI & Bk	R,Y,BI & Bk	Red & Bk
b)	b) Numbering	N.A	N.A	N.A	N.A	N.A	N.A
19	Whether Cables offered are ISI marked	YES					
20	Whether Cables offered are suitable for laying as per IS 1255	YES					

S'- As per manufacturer design data

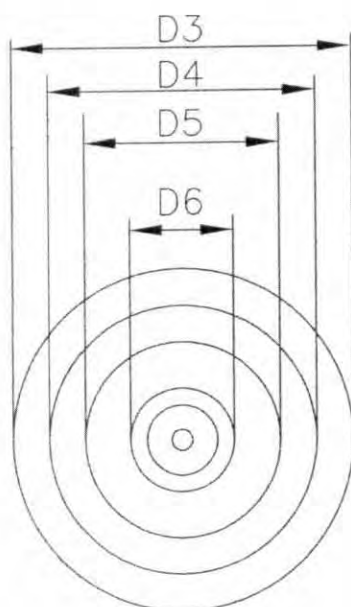
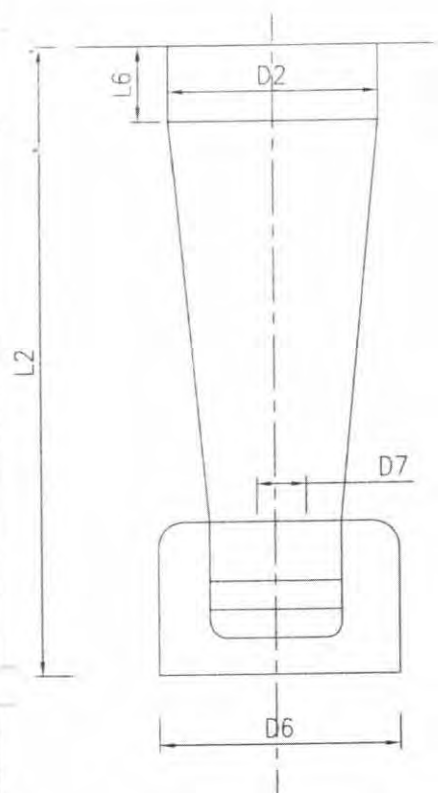
STANDARD TECHNICAL DATA SHEET - 1.1kV kV GRADE PVC CONTROL CABLES
Name of manufacturer: As per approved list

SN	Description	Parameters							
1a	Cable Sizes	2 c x 2.5	3c cx 2.5	5c x 2.5	7 c x 2.5	10 c x 2.5	14 c x 2.5	19 c x 2.5	27 c x 2.5
1b	Manufacturer's type designation	YWY	YWY	YWY	YWY	YWY	YWY	YWY	YWY
2	Applicable standard	IS: 1554/PT-I/1988 & its referred standards							
3	Rated Voltage(volts)	1100 V grade							
4	Type & Category	FR & C1							
5	Suitable for earthed or unearthed system	for both							
6	Continuous current rating when laid in air in a ambient temp. of 50oC and for maximum conductor temp. of 70 oC of PVC Cables[For information only]	22	19	19	14	12	10.5	9.7	8
7	Rating factors applicable to the current ratings for various conditions of installation:	As per IS-3961-Pt-II-67							
8	Short circuit Capacity								
a)	Short Circuit Amp. (rms)KA for 1 sec duration	0.285	0.285	0.285	0.285	0.285	0.285	0.285	0.285
b)	Conductor temp. allowed for the short circuit duty (deg C.)	160 ⁰ C							
9	Conductor								
a)	Material	Plain annealed High Conductivity stranded Copper (as per IS 8130/84)							
b)	Grade	Electrolytic							
c)	Cross Section area (Sq.mm.)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
d)	Number of wires(No.)	as per Table 2 of IS 8130							
e)	Form of Conductor	Non-compacted Stranded circular shaped conductor							
f)	Direction of lay of stranded layers	Outermost layer shall be R.H lay							
10	Conductor resistance (DC) at 20 oC per km-maximum	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41
11	Insulation								
a)	Composition of insulation	Extruded PVC type A as per IS-5831-84							
b)	Nominal thickness of	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

	insulation(mm)								
c)	Minimum thickness of insulation	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
12	Inner Sheath								
a)	Material	Extruded PVC type ST-I as per IS-5831-84							
b)	Calculated diameter over the laid up cores,(mm)	7.2	7.8	9.7	10.8	14.4	15.9	18	22.1
c)	Thickness of Sheath (minimum)mm	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
13	Armour	as per IS 3975/99							
a)	Type and material of armour	Gal. Steel Wire							
b)	Direction of armouring	left hand							
c)	Calculated diameter of cable over inner sheath (under armour), mm	7.8	8.4	10.3	11.4	15	6.5	18.6	22.7
d)	Nominal diameter of round armour wire/strip	1.4	1.4	1.4	1.4	1.6	1.6	1.6	1.6
e)	Number of armour wires/strips	Armouring shall be as close as practicable							
f)	Short circuit capacity of the armour along for 1 sec-for info only	$0.05 \times A \sqrt{t}$ (K Amp)(where A = total area of armour in mm ² & t = time in seconds)							
g)	DC resistance at 20 oC (Ω /Km) & Resistivity	As per IS 1554 Part (1), wherever applicable and IS 3975-1999							
14	Outer Sheath								
a)	Material (PVC Type)	ST-1& FR							
b)	Calculated diameter under the sheath	10.6	11.2	13.1	14.2	18.2	19.7	21.8	25.9
c)	Min.thickness of sheath(mm)	1.24	1.24	1.24	1.24	1.4	1.4	1.4	1.56
d)	Guaranteed value of minimum oxygen index of outer sheath at 27oC	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0
e)	Guaranteed value of minimum temperature index at 21 oxygen index	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250
f)	colour of sheath	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey
15a)	Overall diameter of cable	\$							
b)	Tolerance on overall diameter (mm)	+2/-2 mm							
16	Cable Drums	shall conform to IS 10418 and technical specification							
a)	Max./ Standard length per drum for each size of cable (single length) with $\pm 5\%$ Tolerance (mtrs)	1000/500							

b)	Non standard drum lengths	Maximum one(1) non standard lengths of each cable size may be supplied in drums only over & above the standard lengths as specified above.(if required for completion of project)							
17	Whether progressive sequential marking on outer sheath provided								
18	Identification of cores	Yes							
a)	colour of cores	R & Bk	R, Y & Bl	Red R,Y,Bl	Grey	Grey	Grey	Grey	Grey
b)	Numbering	N.A	N.A	N.A	Numerals in black ink				
19	Whether Cables offered are ISI marked	YES							
20	Whether Cables offered are suitable for laying as per IS 1255	YES							

\$'- As per manufacturer design data



VOLTAGE RATING KV	420		245		145	72.5	52
BIL (kV _p)	1425		1050		650	325	250
CREEPAGE (MM) (Min.)	10500		6125		3625	1810	1300
CURRENT RATING (A) (Min.)	800	1250	1250	2000	800	800	3150
L2±5 (FOR DIFF. VALUES OF L6)	1640		1130	1230	600 [#] /800	695	475
L6 (MIN.)	400		300		100 [#] /300	300	100
D2 (Max.)	350		270		165	115	165
D3±2	720		450		335	225	335
D4±1	660		400		290	185	290
D5xN	24x12		20x12		15x12	15x6	15x12
D6 (MAX)	350		270		165	115	115
D7 (Min)	60		48	—	38	—	—

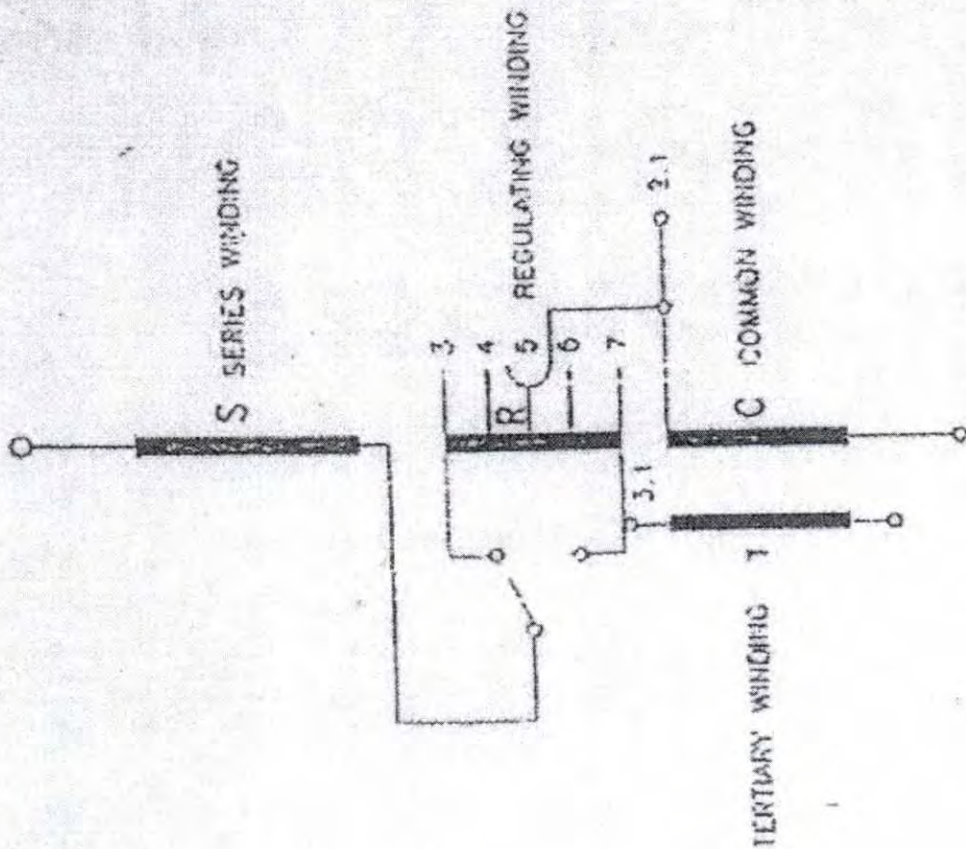
NOTE:

1. ALL DIMENSIONS ARE IN MM
2. NO POSITIVE TOL. WHERE MAX. DIMENSION SPECIFIED AND NO NEG. TOL. WHERE MIN. DIMENSION IS SPECIFIED

APPLICABLE FOR SHUNT REACTOR

71

PREPARED BY	CHECKED BY	APPROVED BY	TITLE	DRG NO
<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>	STD. DIMN. FOR RIP CONDENSER BUSHINGS (LOWER PORTION)	000-T-E-A-001-R02



T R C S

CORE

- A TYPICAL MARKINGS FOR ONE PHASE OF AUTO TRANSFORMER WITH TAPPED WINDING AT THE END OF SERIES WINDING (COMMON FOR ALL TYPE OF AUTO TRANSFORMER)
- B POSITIONING OF REGULATING WINDING WITH RESPECT TO OTHER WINDINGS.
APPLICABLE FOR CONSTANT OHMIC (IMPED) TYPE AUTO TRANSFORMERS ONLY.

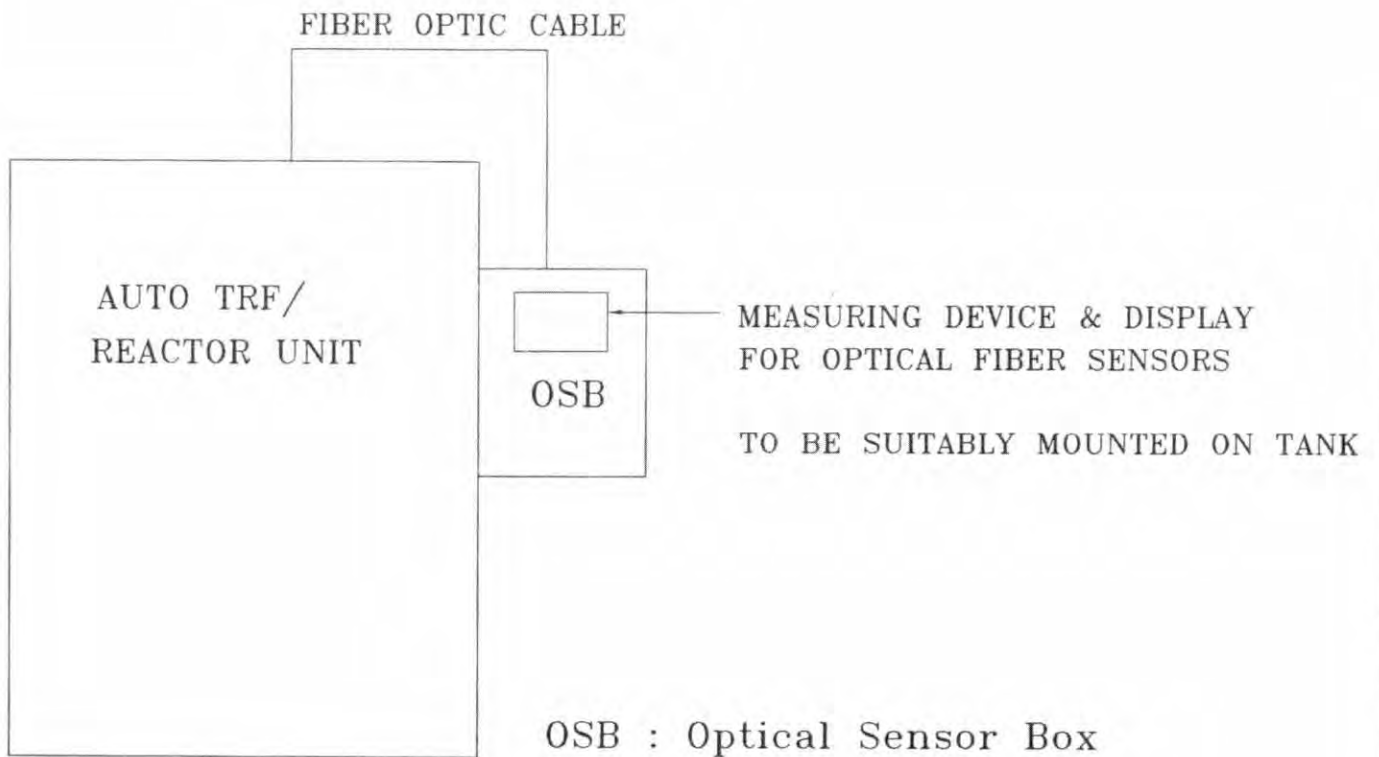


PROJECT
STANDARDISATION

DRO. NO.
0033-TEA-D14

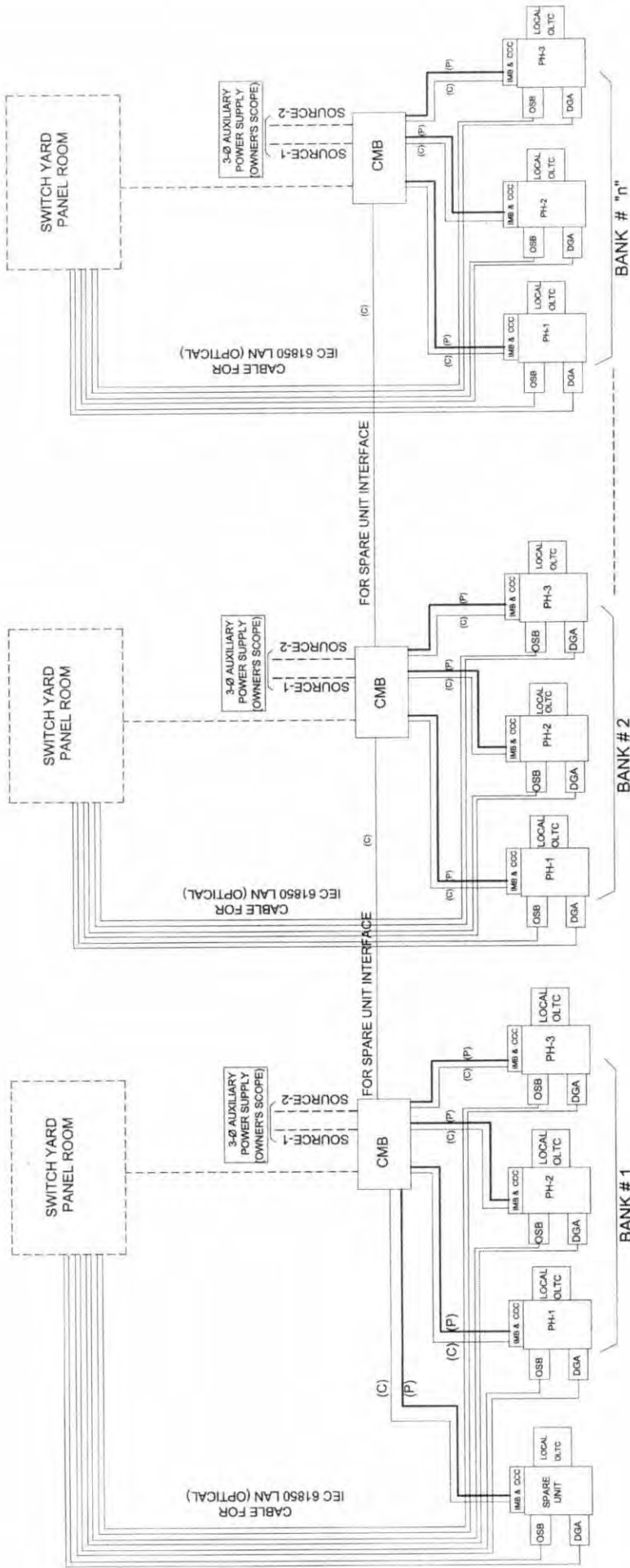
TYPICAL ARRANGEMENT FOR ONE
PHASE OF AUTO TRANSFORMER WITH REGULATING
WINDING AT THE END OF SERIES WINDING

REV	DATE	QPH	CHKD	APPD	TITLE
0	25.1.79	Advisory	1 of 1	physocin	



73

PREPARED BY	CHECKED BY	APPROVED BY	TITLE	DRG NO	REV.
			CONCEPTUAL DRG FOR OPTICAL FIBER SENSOR	C/ENGG/STD/OPICAL FIBER SENSOR/AT-SR	0



FOR TENDER PURPOSE ONLY



POWER GRID CORPORATION
OF INDIA LIMITED
(A Government of India Enterprise)

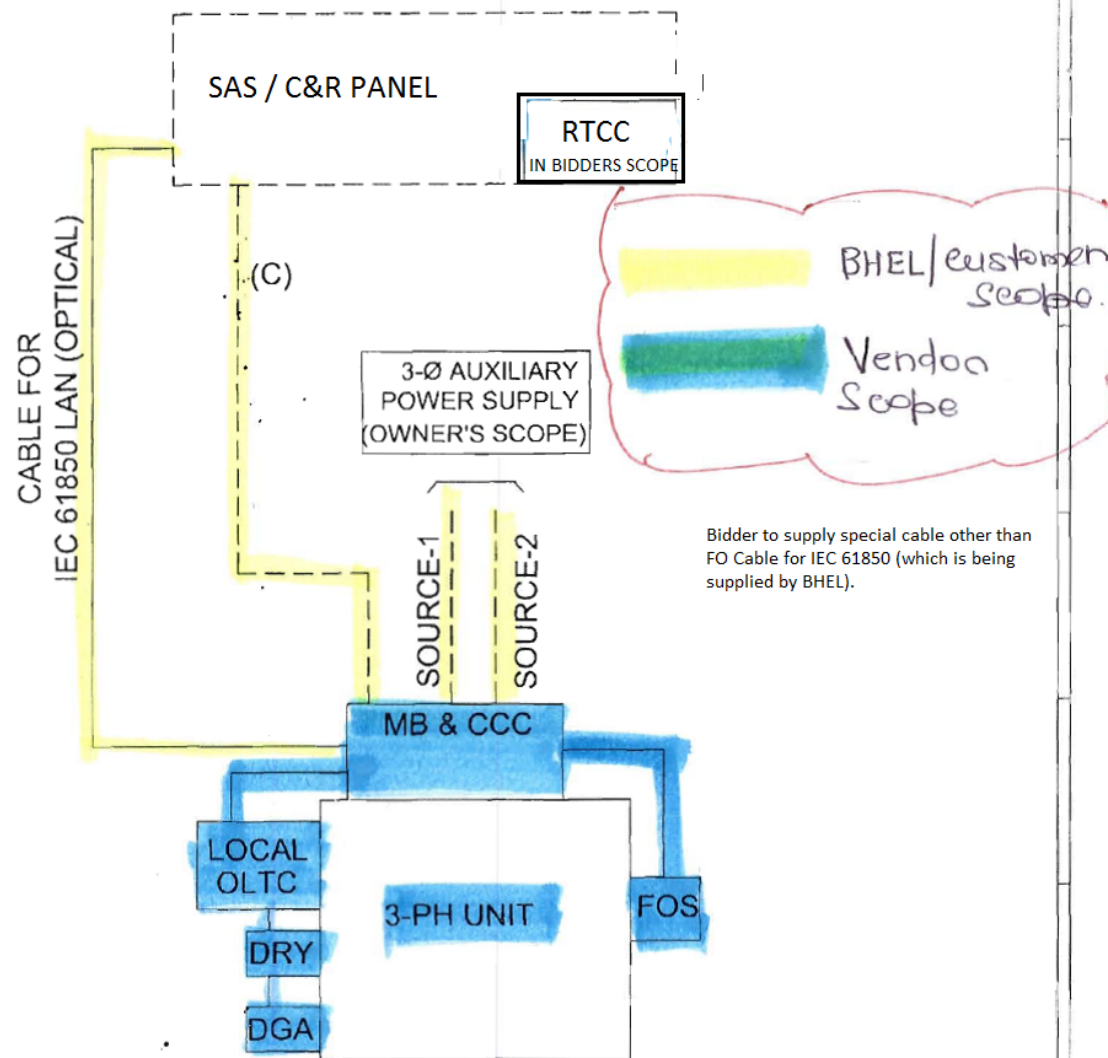
PROJECT : 765KV & 400KV 1-PH TRANSFORMER

TITLE :
CONCEPTUAL DRG. FOR SHOWING POWER AND CONTROL
CABLE CONNECTION FOR OPERATION WITH SPARE UNIT

REV.	CHKD.	APPROVED BY	DRAWING NO.
01			

LEGEND-

- OWNER'S SCOPE (HOWEVER, ALL SPECIAL CABLE ARE IN BIDDER'S SCOPE)
- (C) CONTROL CABLE & SPACAL CABLE AS APPLICABLE (BIDDER'S SCOPE)
- (P) POWER CABLE (BIDDER'S SCOPE)



LEGEND-

ee. Managed Ethernet switch, LIU patch cords etc. shall be provided in CMB/MB.
All IEC 61850 compliant signals from various monitoring equipment/accessories shall be wired upto the Ethernet switch.

NOTE

1. MANAGED ETHERNET SWITCH, LIU PATCH CORDS ETC. SHALL BE PROVIDED IN MB (BIDDER SCOPE OF SUPPLY).

Project: 765/400/220kV Bhuj Pool (New) S/S and Extension of 765kV Banaskantha S/S under Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part C; [Part-II]
Customer: Power Grid Corporation of India (POWERGRID)

Technical Specification for 500MVA Auto Transformer
Section-5: Technical Check List

Doc No. TB-392-316-001
Rev. No. 01

SECTION-4 GUARANTEED TECHNICAL PARTICULARS

1. Technical Particulars/ Parameters for 500MVA, 400/220/33kV 3-Phase Auto Transformer

Sr. No.	Description	Unit	Data to be furnished by Bidder
1.1	Rated Capacity		
	(i) HV	MVA	
	(ii) IV	MVA	
	(iii) LV (Tertiary): Active + Reactive loading	MVA	
1.2	Voltage ratio (Line to Line)		
1.3	Single / Three Phase Design		
1.4	Applicable Standard		
1.5	Frequency	Hz	
1.6	Cooling & Percentage Rating at different cooling		
1.7	Type of Transformer		
1.8	Impedance at 75 °C		
	(i) HV-IV		
	Max. Voltage tap	%	
	Principal tap	%	
	Min Voltage tap	%	
	(ii)HV-LV		
	Principal tap (minimum)	%	
	(ii)IV-LV		
	Principal tap (minimum)	%	
1.9	Tolerance on Impedance (HV-IV)	%	
1.10	Service		
1.11	Duty		
1.12	Overall Capacity		
1.13	Temperature rise over 50deg C ambient Temp		
	(i) Top oil measured by thermometer	°C	
	(ii) Average winding measured by resistance method	°C	
1.14	Windings		
	(i) System Fault level		
	HV	kA	
	IV	kA	
	LV	kA	

Project: 765/400/220kV Bhuj Pool (New) S/S and Extension of 765kV Banaskantha S/S under Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part C; [Part-II]
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Technical Specification for 500MVA Auto Transformer
Section-5: Technical Check List

Doc No. TB-392-316-001
Rev. No. 01

	(ii) Lightning Impulse withstand Voltage		
	HV	KVp	
	IV	KVp	
	LV	KVp	
	Neutral	KVp	
	(iii) Switching Impulse withstand Voltage		
	HV	KVp	
	(iv) One Minute Power Frequency Withstand Voltage		
	HV	KVrms	
	IV	KVrms	
	LV	KVrms	
	Neutral	KVrms	
	(v) Neutral Grounding		
	(vi) Insulation		
	HV		
	IV		
	LV		
	(vii) Tertiary Connection		
	(viii) Tan delta of winding	%	
1.15	Vector Group (3-ph) (unless specified differently elsewhere)		
1.16	Tap Changer		
	(i) Tap Range & No. of steps		
	(ii) Location of Tap changer		
	(iii) Design		
	(iv) Tap control		
1.17	Bushing		
	(i) Rated voltage		
	HV	kV	
	IV	kV	
	LV	kV	
	Neutral	kV	
	(ii) Rated current (Min.)		
	HV	A	
	IV	A	
	LV	A	
	Neutral	A	
	(iii) Lightning Impulse withstand Voltage		
	HV	KVp	
	IV	KVp	

Project: 765/400/220kV Bhuj Pool (New) S/S and Extension of 765kV Banaskantha S/S under Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part C; [Part-II]
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Technical Specification for 500MVA Auto Transformer

Doc No. TB-392-316-001

Section-5: Technical Check List

Rev. No. 01

	LV	KVp	
	Neutral	KVp	
	(iv) Switching Impulse withstand Voltage		
	HV	KVp	
	IV	KVp	
	(v) One Minute Power Frequency withstand Voltage		
	HV	KVrms	
	IV	KVrms	
	LV	KVrms	
	Neutral	KVrms	
	(vi) Minimum total creepage distances		
	HV	mm	
	IV	mm	
	LV	mm	
	Neutral	mm	
	(vii) Tan delta of bushings		
	HV	%	
	IV	%	
	LV	%	
	Neutral		
	(viii) Max Partial discharge level at Um		
	HV	pC	
	IV	pC	
	LV	pC	
	Neutral		
1.18	Max Partial discharge level at $1.58 * U_r / \sqrt{3}$	pC	
1.19	Max Noise level at rated voltage and at principal tap on full load and all cooling active	dB	
1.20	Maximum Permissible Losses for Auto Transformer		
	(i) Max. No Load Loss/ Iron Loss at rated voltage and frequency	kW	
	(ii) Max. Load Loss/ Copper Loss at rated current and at 75°C	kW	
	(iii) Max. Auxiliary Loss/ Cooler Loss at rated voltage and frequency	kW	

Project: 765/400/220kV **Bhuj Pool (New)** S/S and Extension of 765kV Banaskantha S/S under Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part C; [Part-II]

Customer: Power Grid Corporation of India (POWERGRID)

Technical Specification for 500MVA Auto Transformer

Doc No. TB-392-316-001

Section-5: Technical Check List

Rev. No. 01

Notes:

1. For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.
2. No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.
3. Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.
4. The criteria for Transformer losses shall be **“Copper Loss (Load Loss) > Iron Loss (No Load Loss) > Cooler Loss (Auxiliary Loss)”**.

Project: 765/400/220kV Bhuj Pool (New) S/S and Extension of 765kV Banaskantha S/S under Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part C; [Part-II]

Customer: Power Grid Corporation of India (POWERGRID)

Technical Specification for 500MVA Auto Transformer

Doc No. TB-392-316-001

Section-5: Technical Check List

Rev. No. 01

1. Technical Particulars/ Parameters for Current Transformer (On each phase) for 3-ph 500MVA, 400/220/33 kV Transformers

Description	Current Transformer Parameters (Transformer)		
	HV Side	IV Side	Neutral Side
(a) Ratio			
Core 1			
Core 2			
(b) Minimum knee point voltage or burden and accuracy class			
Core 1			
Core 2			
(c) Maximum CT Secondary Resistance			
Core 1			
Core 2			
(d) Application			
Core 1			
Core 2			
(e) Maximum magnetization current (at knee point voltage)			
Core 1			
Core 2			

NOTE:

- For TPS class CT's, Dimensioning parameter "K", Secondary VA shall be considered 1.5 and 20 respectively. Class (for the relevant protection and duties) as per IEC 60185.
- Rated continuous thermal current rating shall be 200% of rated primary current.
- Parameters of WTI CT for each winding shall be provided by the contractor.
- For estimation of spares, one set of CTs shall mean one CT of each type used in transformer.
- The CT used for REF protection must have the identical parameters in order to limit the circulating current under normal condition for stability of protection.

SECTION-5
TECHNICAL CHECK LIST

Technical Checklist for information to be furnished with technical offer. Return this technical checklist as a part of technical offer duly signed

BHEL ENQUIRY. NO.:
BIDDER OFFER REF.:

It is to be noted that,

- a) The technical offer shall not be considered if this technical checklist duly filled, and signed are not enclosed with this technical offer.
- b) Bidder shall ensure the completeness of their technical offer in this regard.

regard.			
Sr. No.	Description	Reply by Bidder	
1	Technical Qualifying Requirements		
1.1	Documents for meeting qualifying criteria submitted with the technical offer. *The evaluation of bidder against qualifying criteria specified under clause 1.5 of Section-1 of technical specification shall be based on the documentary proof submitted by bidder along with the technical offer.	Confirmed	Yes/ No
1.2	The bid shall be submitted by the Supplier/ Manufacturer only. The bidder's scope includes supply and services i.e. unloading , supervision of installation, testing and commissioning etc.	Confirmed	Yes/ No
1.3	All the documents shall be submitted in English. Translated pages should be attested by the bidder. All the dimensions shall be in SI units.	Confirmed	Yes/ No
2	Un-priced Bill of Quantities		
2.1	Confirm that all items have been quoted. *Confirmation shall be done by writing "Quoted" against each item. In case, if	Confirmed	Yes/ No

	any item has not been quoted, the same shall be confirmed by writing "Not quoted" and reasons for the same is specifically brought out in Schedule of Technical Deviation		
2.2	The Specification envisages design, type testing, engineering, manufacture, testing, delivery & unloading at site including all materials, accessories, spares, supervision of unloading, erection, testing and commissioning of the equipment specified/ 500MVA, 400/220/33kV Auto Transformer to the satisfaction of BHEL/POWERGRID.	Confirmed	Yes/ No
2.3	Any other item/ service required for the execution for the complete work is deemed to be included in the offer, whether specifically mentioned in the specification or not. List of items required for completeness of work is to be attached, if required and prices for same deemed to be included in prices of main items.	Additional Supply(s)/ Service(s) required	Yes/ No
3	Technical Requirements		
3.1	Guaranteed Losses for Auto Transformer – at rated parameters i.e. voltage etc.		
3.1.1	Guaranteed Iron Loss (kW)	95 kW	Yes/ No
3.1.2	Guaranteed Copper Loss (kW)	500 kW	Yes/ No
3.1.3	Guaranteed Cooler Loss (kW)	7 kW	Yes/ No
3.1.4	Bidder to ensure the Autotransformer with above specified losses.	Confirmed	Yes/ No
3.5	In the event the actual losses attained in guarantee tests are higher than the guaranteed losses at rated voltage, specified in para 1.2.2 Section-1, but	Confirmed	Yes/ No

	the actual losses are not more than the limit specified in para 1.2.4 Section-1, and the Bidder elects to pay liquidated damages to the BHEL in lieu of making changes, modifications and/or additions to the Facilities then the Bidder shall pay (deducted from the contract price) liquidated damages as per rates given under: 1. Rs.1, 67,715/kW differential Copper Loss 2. Rs.3, 69,950/KW differential Iron Loss 3. Rs.2, 46,640/KW differential Cooler Loss		
3.6		Confirmed	Yes/ No
4	Technical Particulars		
4.1	Rated Capacity		
	(i) HV	500MVA	Yes/ No
	(ii) IV	500MVA	Yes/ No
	(iii) LV (Tertiary): Active + Reactive loading	1/3 rd of rated capacity of HV winding	Yes/ No
4.2	Voltage ratio (Line to Line)	400/220/33kV	Yes/ No
4.3	Single / Three Phase Design	3 (Three)	Yes/ No
4.4	Applicable Standard	IEC 60076	Yes/ No
4.5	Frequency	50Hz	Yes/ No
4.6	Cooling & Percentage Rating at different cooling	ONAN/ONAF/(OFAF or ODAF) : 60% / 80%/100% OR ONAN/ONAF1/ ONAF2: 60% / 80%/100% OR OFAF (with 5 x 25% unit cooler)	Yes/ No
4.7	Type of Transformer	Constant	Yes/ No

		Ohmic impedancety pe	
4.8	Impedance at 75 Deg C		
	(i) HV-IV		
	Max. Voltage tap	10.3%	Yes/ No
	Principal tap	12.5%	Yes/ No
	Min Voltage tap	15.4%	Yes/ No
	(ii)HV-LV		
	Principal tap (minimum)	60.0%	Yes/ No
	(ii)IV-LV		
	Principal tap (minimum)	45.0%	Yes/ No
4.9	Tolerance on Impedance (HV-IV)	As per IEC	Yes/ No
4.10	Service	Outdoor	Yes/ No
4.11	Duty	Continuous	Yes/ No
4.12	Overall Capacity	IEC-60076-7	Yes/ No
4.13	Temperature rise over 50deg C ambient Temp		
	(i) Top oil measured by thermometer	50 °C	Yes/ No
	(ii) Average winding measured by resistance method	55 °C	Yes/ No
4.14	Windings		
	(i) System Fault level for 1 Sec		
	HV	63kA	Yes/ No
	IV	40kA	Yes/ No
	LV	25kA	Yes/ No
	(ii) Lightning Impulse withstand Voltage		
	HV	1300KVp	Yes/ No
	IV	950KVp	Yes/ No
	LV	250KVp	Yes/ No
	Neutral	95KVp	Yes/ No
	(iii) Switching Impulse withstand Voltage		
	HV	1050KVp	Yes/ No
	(iv) One Minute Power Frequency Withstand Voltage		
	HV	570KVrms	Yes/ No
	IV	395KVrms	Yes/ No

	LV	95KVrms	Yes/ No
	Neutral	38KVrms	Yes/ No
	(v) Neutral Grounding	Solidly grounded	Yes/ No
	(vi) Insulation		
	HV	Graded	Yes/ No
	IV	Graded	Yes/ No
	LV	Uniform	Yes/ No
	(vii) Tertiary Connection	Ungrounded Delta	Yes/ No
	(viii) Tan delta of winding	<0.5%	Yes/ No
4.15	Vector Group (3-ph) (unless specified differently elsewhere)	YNad11	Yes/ No
4.16	Tap Changer	OLTC	Yes/ No
	(i) Tap Range & No. of steps	$\pm 10\%$ of HV variation in the step of 1.25%, 16 steps	Yes/ No
	(ii) Location of Tap changer	On the 220 kV side of the series winding	Yes/ No
	(iii) Design	Constant flux voltage variation type as per cl. 6.2 of IEC 60076 part-I	Yes/ No
	(iv) Tap control	Full capacity - on load tap changer suitable for group / independent, remote /local electrical and local manual operation and bi-directional power flow	Yes/ No
4.17	Bushing		
	(i) Rated voltage		

Project: 765/400/220kV Bhuj Pool (New) S/S PART-2**Technical Specification for 500MVA Auto Transformer
Section-5: Technical Check List**Doc No. TB-392-316-001
Rev. No. 01

	HV	420kV	Yes/ No
	IV	245kV	Yes/ No
	LV	52kV	Yes/ No
	Neutral	36kV	Yes/ No
	(ii) Rated current (Min.)		
	HV	1250A	Yes/ No
	IV	2000A	Yes/ No
	LV	3150A	Yes/ No
	Neutral	2000A	Yes/ No
	(iii) Lightening Impulse withstand Voltage		
	HV	1425KVp	Yes/ No
	IV	1050KVp	Yes/ No
	LV	250KVp	Yes/ No
	Neutral	170KVp	Yes/ No
	(iv) Switching Impulse withstand Voltage		
	HV	1050KVp	Yes/ No
	IV	850KVp	Yes/ No
	(v) One Minute Power Frequency withstand Voltage		
	HV	695KVrms	Yes/ No
	IV	505KVrms	Yes/ No
	LV	105KVrms	Yes/ No
	Neutral	77KVrms	Yes/ No
	(vi) Minimum total creepage distances		
	HV	10500mm	Yes/ No
	IV	6125mm	Yes/ No
	LV	1300mm	Yes/ No
	Neutral	900mm	Yes/ No
	(vii) Tan delta of bushings		
	HV	<0.4%	Yes/ No
	IV	<0.4%	Yes/ No
	LV	<0.4%	Yes/ No
	Neutral	--	Yes/ No
	(viii) Max Partial discharge level at Um		
	HV	10pC	Yes/ No
	IV	10pC	Yes/ No

	LV	10pC	Yes/ No
	Neutral	--	Yes/ No
4.18	Max Partial discharge level at $1.58 * U_r / \sqrt{3}$	100pC	Yes/ No
4.19	Max Noise level at rated voltage and at principal tap on full load and all cooling active	80dB	Yes/ No
4.20	For parallel operation with existing transformer, the impedance, OLTC connection & range and the winding configuration (if necessary) is to be matched.	Confirmed	Yes/ No
4.21	No external or internal Transformers / Reactors are to be used to achieve the specified HV/IV, HV/LV and IV/LV impedances.	Confirmed	Yes/ No
4.22	Tan delta of Winding & Bushing shall be measured at ambient temperature. No temperature correction factor shall be applied.	Confirmed	Yes/ No
5	Technical Deviations		
5.1	Confirm that the Complete systems have been offered as per the requirements of Technical Specification and Technical Deviation sheet has been submitted. Deviations mentioned elsewhere in the bid will not be considered.	Confirmed	Yes/ No
5.2	Schedule of Technical Deviation is enclosed.	Confirmed	Yes/ No
6	General Requirements		
6.1	Paint System and Procedure: Bidder to follow paint system and procedure as per Clause 7.0 and Annexure-F of Section-2B.	Confirmed	Yes/ No
6.2	Grounding: Supply of grounding/ earthing material (except 40mm Dia MS rod and/or GI Flat) and supervision of erection/fixing of grounding/ earthing of Auto Transformer and its accessories shall be under bidder's scope, based on their design philosophy.	Confirmed	Yes/ No
6.3	Cabling: Cabling from Marshalling Box to Auto Transformer and its Cooling	Confirmed	Yes/ No

	Bank is under scope of supply including glands, lugs, tags and ferruling etc. Termination schedule shall be submitted along with drawings.		
6.4	Auxiliary Supply: Terminals in marshalling box for external power supply coming into marshalling box shall be suitable to requirement.	Confirmed	Yes/ No
7	Type Testing		
7.1	The validity of Type Tests (except dynamic short circuit test) of Transformer shall be 5 years as on the originally scheduled date of bid opening i.e. dated 07 April 2015 , provided that offered transformer design is identical to the type tested transformer and same active materials (CRGO, Conductor and Insulation) of same grade & from the same sub-vendors are used. In case of any change of either active materials or sub-vendors, the type tests shall be carried out by the Bidder at no extra cost to BHEL. Transformer type test report from the same manufacturing plant shall only be acceptable. With regards to validity of dynamic short circuit test once conducted shall be applicable.	Confirmed	Yes/ No
7.2	A. Bidder should have successfully carried out Dynamic Short Circuit test on 315MVA, 400/220/33kV Auto Transformer as on the originally scheduled date of bid opening i.e. 07.04.2015 . This shall be applicable for 400kV class 500MVA Auto Transformer specified in Technical Specification. Further, for 400kV class 500MVA Auto Transformer design review shall be carried out based on the design of short circuit tested 315MVA Auto Transformer. B. The 500MVA 400kV Auto	Confirmed	Yes/ No

	Transformer being offered are from manufacturer(s) who should have designed, manufactured, type tested and supplied, installed & commissioned (or supervised Installation & Commissioning) 345kV or above class transformers of at least 200MVA (or equivalent capacity in banks of single phase units). Transformers should have been in satisfactory operation# for at least two (2) years as on the originally scheduled date of bid opening i.e. 07.04.2015.		
7.3	Type Tests on Transformer fittings: The test reports submitted, shall be of the tests conducted within last 10 (ten) years prior to the originally scheduled date of bid opening i.e. 07 April 2015. In case the test reports are of the test conducted earlier than 10 (ten) years prior to the originally scheduled date of bid opening i.e. 07 April 2015. , the Bidder shall repeat these test(s) at no extra cost to the BHEL/POWERGRID.	Confirmed	Yes/ No
7.4	In case type test reports are found to be technically unacceptable to BHEL/POWERGRID, the type test shall be conducted without cost and delivery implication to BHEL/POWERGRID.	Confirmed	Yes/ No
8	Inspection and Testing at Works		
8.1	The Bidder shall carry out a comprehensive inspection and testing programme during manufacture of the equipment as detailed in section-2B and section3.	Confirmed	Yes/ No
9	Quality Plan		
9.1	The Bidder to follow valid and approved POWERGRD Quality Plan as per POWERGRID procedure. In case the bidder does not have POWERGRID approved Quality Plan, it will be the bidder's responsibility to get its Quality	Confirmed	Yes/ No

	plan approved directly from POWERGRID.		
10	Erection, Testing and Commissioning at Site		
10.1	The Bidder shall supervise a comprehensive erection, testing and commissioning programme at site duly POWERGRID approved as detailed in section-2B and section3 .	Confirmed	Yes/ No
11	Information to be furnished by the Bidder		
11.1	Information/ documents to be furnished at the TENDER STAGE shall be as per Section-2B and Section-3 .	Confirmed	Yes/ No
12	Drawings/ Data Sheets		
	Bidder shall submit POWERGRID approved/Standard drawings wherever available for extension of approval.	Confirmed	Yes/ No
13.	Standards		
	The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the originally scheduled date of bid opening i.e. 07 April 2015) of standard specified under Section-2A , unless specifically mentioned in the specification.	Confirmed	Yes/ No
14	Documents to be submitted with Technical Offer		
14.1	All documents as mentioned in Technical Specification are enclosed.	Confirmed	Yes/ No
14.2	OGA drawings are enclosed	Confirmed	Yes/ No
14.3	Documents for meeting Qualifying Requirements are enclosed.	Confirmed	Yes/ No
14.4	Bidder will submit detailed bar chart/ activity schedule indicating all the milestones from Engineering till manufacturing/ testing, dispatch to site and commissioning.	Confirmed	Yes/ No

Project: 765/400/220kV Bhuj Pool (New) S/S and Extension of 765kV Banaskantha S/S under Green Energy Corridors: Inter-State Transmission Scheme (ISTS) – Part C; [Part-II]
Customer: Power Grid Corporation of India (POWERGRID)

Technical Specification for 500MVA Auto Transformer Doc No. TB-392-316-001
Section-6: Schedule of Technical Deviations Rev. No. 01

SECTION-6
SCHEDULE OF TECHNICAL DEVIATIONS

Bidder shall list all the technical deviation/(s), clause wise with respect to technical specifications

Sr. No.	Page No.	Clause No.	Description	Deviations Sought	Reasons/ Justifications

Any deviation/(s) not specifically brought out in this section shall not be admissible for any commercial/ technical implication at later stage. Except the technical deviation/(s) listed in this schedule, Bidder's offer shall be considered in full compliance to technical specifications, irrespective of any such deviations indicated/ taken elsewhere in the submitted technical offer.

Date:

Bidder's Stamp and Signature