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KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

CIN No. U40109KA1999SGC025521

Corporate Office
Kaveri Bhavan, K.G Road,
Bengaluru - 560 009

No. KPTCL/B25/87066/2018-19

Date: 10 FEB 2021

CIRCULAR

Sub: Revised Standardized Quality Assurance Plan (QAP) for 110kV and 66kV Power Transformers rated upto 31.5MVA - Reg.

Ref:
1. OM No. KPTCL/B25/87066/2018-19 dtd 29.01.2019
2. Circular No. KPTCL/B25/87066/2018-19 dtd 06.11.2019.
3. Proceeding No. CEE(T&P)/SEE/EE(P)/KCO-161/AEEP-1/2020-21/12191 dtd 28.12.2020.
4. Note of CEE (T&P) approved by the Managing Director on 19.01.2021.
5. T.O.Note approved by the Director(Transmission) on 10.02.2021

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In continuation to Corporate Circular dated 06.11.2019 under ref (2), the standardized Quality Assurance Plan (QAP) for 110kV and 66kV voltage class Power Transformers rated upto 31.5MVA for all procurement of Power Transformers for the works of KPTCL including direct procurement of Power Transformers by KPTCL and for turnkey works supplied through EPC contractors is revised based on the decision of the Committee w.r.t clarifications sought by some of the Power Transformer manufacturers.

In this regard, the existing approved Standardized Quality Assurance Plan (QAP) for 110kV and 66kV voltage class Power Transformers rated upto 31.5MVA issued vide Circular dated 06.11.2019 is hereby withdrawn and the revised Standardized Quality Assurance Plan (QAP) annexed to this Circular shall be adopted henceforth.

All other contents of the Circular dated 06.11.2019 under ref (2) remains unaltered.

Further, any clarification required may be obtained from O/o CEE (T&P), KPTCL, Kaveri Bhavan, Bengaluru.

10/2/2021

General Manager (Tech)
KPTCL

Copy to:

1. All Chief Engineers (Electy), KPTCL.
2. All Superintending Engineers, El., KPTCL.
3. All Executive Engineers, El., KPTCL.
4. The Company Secretary, KPTCL, Kaveri Bhavan, Bengaluru.
5. SPS to the Managing Director / Director (Transmission) / Director (Finance), KPTCL, Kaveri Bhavan, Bengaluru.

Copy to:

The Superintending Engineer (Elect.,), IT & MIS, with a request to arrange to upload this Circular in KPTCL website.

Sl. No.	Components and Operations	Manufacturing Quality Plan for 110kV and 66kV power transformer up to 31.5MVA capacity. (Revised)					Abbreviations: S- Sub supplier ; M- Transformer manufacturer ; C- Customer (KPTCL). P - Perform ; W- Witness ; V- Verification (Review)			
		Type of check	Class of Check	Quantum of check	Reference document	Accepting norms	Agency S	Agency M	Agency C	Remarks
A	**RAW MATERIALS**									
1.1	**PAPER INSULATED COPPER CONDUCTOR (PICC)**									
1.1.1	Visual & Dimensional check of bare conductor. Thickness & Width of bare conductor, Covered width & Thickness	Measure	A	One sample for each size for each rating of Transformer	IS 1897 IS 13730 IS 7401	Bare conductor Width/thick(mm) Tolerance Up to 3.15 - 0.03 3.16 to 6.30 - 0.05 6.31 to 12.5 - 0.07 12.51 to 16 - 0.10 >16 mm - 0.10 Insulated Conductor Covering thick(mm) Tolerance 0.25 to 0.5 - -10 0.51 to 1.25 - -7.5 over 1.25 - -5	P	W	V	1) Review of sourcing of copper & kraft paper shall be done. Witnessing of thickness of Kraft paper to be carried out by power transformer manufacturer during stage inspection of PICC. Test certificate for aging of paper shall be verified by Power transformer manufacturer.
1.1.2	Check of Aging of paper	Visual	A		IS 1897 IS 13730 IS 7401 IEC 60317	Technical specification, approved drawings & GTP	P	V	V	2) One sample per lot for each size and for each rating of transformer shall be drawn by the power transformer manufacturer and send for tests at CPRI/ERDA laboratory/ NABL accredited lab and reports of the same shall be submitted during the stage inspection of winding.
	Surface Finish						P	V	V	
	Number of layers of paper covering						P	W	V	The following tests shall be conducted at CPRI/ERDA only: Sl No. 1.1.1] Dimensional check Sl No. 1.1.3] Chemical composition of Copper. Sl No. 1.1.4] Resistivity at 20deg C Sl No. 1.1.5] Tensile strength & elongation test. The balance tests can be conducted at CPRI/ERDA/NABL accredited lab.
	Arrangement of top layers						P	V	V	
1.1.3	Chemical composition of Copper	Measure	A				V	W	V	
1.1.4	Resistivity at 20deg C in ohms mm^2/m a) Soft/Annealed Copper b) Work hard copper	Measure	A		IS 13730	a) 0.01727/0.017241 ohms/mm^2/m(max) at 20 deg b) 0.017777 ohms/mm^2/m(max)	P	W	V	
1.1.5	Tensile strength and elongation test(For normal Conductor)	Measure	A		IS 13730 IS 7404	Thickness (mm) Tensile strength Nm/m2 Elongation % Up to 2.5 205-265 30min >2.5-5.6 205-255 32min	P	W	V	
1.1.6	Proof Stress for work hardened conductor (if applicable)	Measure	A		IS 7404 IS 13730	As per design requirement	P	W	V	
1.1.7	Corner radius	Measure	A		IS 13730	As per design requirement	P	W	V	
1.1.8	Insulation test for bunched conductor (if applicable) a) No. of Conductors b)Thickness & width of bare conductor, Covered width & thickness c) Voltage test between strands	Measure	A		IS 13730	As per IS 13730	P	W	V	
1.1.9	Hardness Test	Measure	A		IS 7404 IS 13730	Max hardness should be RF 65, when measured in Rockwell "F" scale	P	W	V	

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Abbreviations:
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Sl. No.	Components and Operations	Type of check	Class of Check	Quantum of check	Reference document	Accepting norms	Agency S	Agency M	Agency C	Remarks
1.2	**CONTINUOUSLY TRANSPOSED COPPER CONDUCTOR (CTC)**									
1.2.1	Visual Inspection,Check for Number of conductors, Ageing of paper	Visual	A	One sample for each size for each rating of Transformer	IEC 60317 IS 60317	As per design requirement & Technical specification	P	W	V	Review of sourcing of copper & kraft paper shall be done. Witnessing of thickness of Kraft paper to be carried out by power transformer manufacturer during stage inspection of CTC. One sample of CTC per lot shall be drawn by the power transformer manufacturer and send for tests at CPRI/ERDA and reports of the same shall be submitted during the stage inspection of winding.
	Arrangement of paper covering						P	V	V	
	Check for adherence of enamel						P	V	V	
1.2.2	Check for - Thickness, width of bare & enameled conductor - Increase in Dimension due to enamel & due to paper covering - Axial width	Measure	A		IEC 60317 IS 60317	As per design requirement & Technical specification	P	W	V	
1.2.3	Resistivity at 20deg C in ohms mm^2/m a) Soft/Annealed Copper b) Work hard copper	Measure	A		IEC 60317 IS 60317 IS 13730	a)0.01727 ohm/mm2 / m(max) at 20 deg b) 0.01777 ohm-mm2/ m (max)	P	W	V	
1.2.4	Tensile strength and elongation test (For anneled Conductor)	Measure	A		IS 7404 IS 13730	Thickness (mm) / Tensile strength Nm/m2 / Elongation % Up to 2.5 — 205-265 — 30min >2.5-5.6 — 205-255 — 32min	P	W	V	
1.2.5	Proof Stress for work hardened conductor (if applicable)	Measure	A		IS 7404 IS 13730	As per design requirement	P	W	V	
1.2.6	Breakdown Voltage test on enameled conductor	Measure	A		IEC 60317 IS 60317	As per design requirement & Technical specification	P	W	V	
1.2.7	Flexibility	Test	A		IEC 60317 IS 60317	As per design requirement & Technical specification	P	W	V	
1.2.8	Insulation test	Test	A		IEC 60317 IS 60317	As per design requirement & Technical specification	P	W	V	
1.2.9	Chemical Analysis	Test	A		IS191/SDS	As per design requirement & Technical specification	P	W	V	
1.2.10	Insulation test for bunched CTC a) No. of Conductors b)Thickness & width of bare conductor, Covered width & thickness c) Voltage test between strands (if applicable)	Measure	A		IEC 60317 IS 60317	At 250 volt AC/DC for 1 min (1 Amp Max)	P	W	V	
1.2.11	Hardness Test	Measure	A		IS 7404 IS 13730	Max hardness should be RF 65, when measured in Rockwell "F" scale	P	W	V	

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							Agency			Remarks
		Type of check	Class of Check	Quantum of check	Reference document	Accepting norms	S	M	C	
1.3	**KRAFT INSULATING PAPER (FOR COVERING OF PICC & CTC)**									
1.3.1	Checks for paper healthiness	Visual	A	One sample per each size per lot	IEC 60554-3-1 IEC 60554-3-5 IEC 60554-2, Methods of Test IS 9335	Paper to be smooth, unglazed surface & free from dust particles/ No surface defects	P	V	V	
1.3.2	Thickness	Measure	A			Within specified value ± 10%	P	W	V	Record review by KPTCL at the time of stage inspection of winding. Test certificate of aging of paper is to be furnished during stage inspection of winding. Witnessing of thickness of Kraft paper to be carried out by power transformer manufacturer during stage inspection of PICC & CTC.
1.3.3	Apparent Density	Measure	A			min 0.75gm/ cm^3, max 0.85gm cm^3 or 0.8 ±0.05 gm/ cm^3	P	V	V	
1.3.4	Moisture Content	Measure	A			8 % max	P	V	V	
1.3.5	Tensile Index a) Machine direction (MD) min b) Cross Machine direction (CMD) Min	Measure	A			93 NM/gm (min) 35 NM/gm (min)	P	V	V	
1.3.6	Electrical strength in air	Measure	A			Min 7kV/mm	P	V	V	
1.3.7	Ash Content	Measure	A			1 % max	P	V	V	
.3.8	Conductivity of 5% aqueous water extract	Measure	A			10 mS/m (max)	P	V	V	
.3.9	PH of 5% aqueous extract	Measure	A			6 to 8	P	V	V	
1.3.10	BDV test at air Tear Index(MD/CMD), Air permeability, Water absorption, Elongation	Measure	A			5 mN m2/g (min)/ 6 mN m2/g (min) 0.5 to 1.0 µm/Pa.s 10 %	P	V	V	
1.3.11	Heat stability a) Reduction of degree of polymerization b.) Reduction of Bursting Strength c.) Increase of Conductivity of Aqueous extract.	Measure	A			According to type test report	P	V	V	
1.3.12	Substance (grammage)	Measure	A			Thick (µm) Sub (g/cm3) Tolerance 50 40 10 65 52 05 75 60 05 90 72 05	P	V	V	
1.4	**PRECOMPRESSED PRESSBOARD**									
1.4.1	Check for healthiness, Appearance	Visual	A	One sample of each size per lot	Technical specification & IS 1576 IEC 60641	No visible surface defect	P	V	V	If this inspection is offered at Manufacturer's premises, the same shall be performed by the Manufacturer. Thickness of press boards to be verified by KPTCL during stage inspection of Core & windings. Reports of all tests to be submitted during stage inspection of core and windings. Record review by KPTCL at the time of stage inspection of core & winding
1.4.2	Check for thickness of various sizes, Dimensions	measure	A			Within tolerance	P	W	V	
1.4.3	Density	Measure	A			1 to 1.3 g/cm^3	P	V	V	
1.4.4	Oil absorption	Measure	A			Min 7% to 11% (depending on the thickness)	P	V	V	
1.4.5	Moisture Content	Measure	A			Max 6%	P	V	V	
1.4.6	Shrinkage in air MD, CD & PD	Measure	A			IEC 60641/MD - 0.5 % max, CD- 0.7 % max, Thick -5 % max	P	V	V	
.4.7	Cohesion between plies	Measure	A			The split shall not show a rupture in one or more piles	P	V	V	
1.4.8	Tensile Index a) Machine direction b) Cross direction	Measure	A			a) Min 100 to 110 Mpa b) Min 75 to 85 Mpa	P	V	V	
1.4.9	Elongation a) Machine direction b) Cross direction	Measure	A			a) Min 3% b)Min 4%	P	V	V	
1.4.10	Compressibility in air a) Max compressibility b)Reversible compressibility	Measure	A			a) Max: 4 to 10% b) Min: 45 to 50%	P	V	V	
1.4.11	Dielectric strength (BDV) a) Electric strength in air b) Electric strength in oil	Measure	A			Min 30 to 40kV/mm in oil depending on thickness	P	V	V	
1.4.12	Ash Content	Measure	A			Max 1%	P	V	V	
1.4.13	PH Value of aqueous extract	Measure	A			6 to 9	P	V	V	
1.4.14	Conductivity of aqueous extract	Measure	A			Max 5 to 10 mS/m	P	V	V	
1.4.15	Ply Bond Resistance	Measure	A				P	V	V	
1.4.16	Flexural strength MD, CD (Laminated Boards)	Measure	A				P	V	V	

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1.5	**UNIMPREGNATED DENSIFIED LAMINATED WOOD (PERMAWOOD)**									
1.5.1	Visual inspections - Surface finish & Dimensional Check for thickness, width & length, shrinkage in oil.	Visual/ Measure	A	One sample of each size per lot	Technical specification, IEC 61061	Dimension within tolerance	P	W	V	If this inspection is offered at Manufacturer's premises, th same shall be performed by the Manufacturer. Reports of a tests to be submitted during stage inspection of core an windings. Record review by KPTCL at the time of stag inspection of core & winding
1.5.2	Density	Measure	A			0.9 to 1.25 g/cm^3	P	V	V	
1.5.3	Moisture Content	Measure	A			Max 7%	P	V	V	
1.5.4	Oil absorption at 90 °C	Measure	A			Min 6%	P	V	V	
1.5.5	Electrical proof strength in oil at 90 0C a) Along grain b) Edge wise	Measure	A			a) Min 4 kV/mm b) Min 60kV per 25mm	P	V	V	
1.5.6	Tensile strength	Measure	A			Min: 96 Mpa	P	V	V	
1.5.7	Cross breaking strength along grain & across grain	Measure	A			a) Min: 110 Mpa(Along grain) b) Min: 85 Mpa(Across grain)	P	V	V	
1.5.8	Compress perp to laminate	Measure	A			Max: 2.5 to 5% as per grade	P	V	V	
1.5.9	Shear strength age-wise	Measure	A			Min for LD - 450 KV /cm^2	P	V	V	
1.5.10	Compressive strength test	Measure	A			Min for LD - 1400 KV /cm^2	P	V	V	
1.6	**CRGO STEEL (MOTHER COIL)**									
1.6.1	Inspection of CRGO coil - Visual inspection for external damages, waviness, dimensions and thickness, - Manufacturer's identification slip/unique numbering of CRGO coil - Mills test certificates, surface finish, burr level/bow check, bend test. Inspection of prime CRGO coil check for coil width and thickness from name plate	Visual	A	One sample per lot	Technical specification, IEC 60404 IS 3024	Technical specification, approved drawings, GTP IEC 60404 IS 3024	-	W	V	One sample per CRGO lot shall be drawn by the power transformer manufacturer and to be sent to CPRI/ERDA Laboratory for all tests. The report of the same shall furnished to KPTCL officers at the time of core building stage inspection
1.6.2	Specific core loss , Magnetic characteristics.	Measure	A	One sample per lot		GTP/specific grade	P	W	V	
1.6.3	Stacking Factor	Measure	A			Min 95%	P	W	V	
1.6.4	Surface Insulation Resistivity (ohms-cm^2)	Measure	A			Avg value min 10 Ω cm^2 Individual value min 5Ω cm^2	P	W	V	
1.6.5	Minimum polarisation in Tesla at field strength of 800 A/m	Measure	A			Min: 1.78 for CGO Min 1.85 for HPGO	P	W	V	
1.6.6	Accelerated ageing test	Measure	A			Max 4% increase in specific total losses	P	W	V	
1.6.7	Check of core insulation	Measure	A			As per GTP IEC 60404 IS 3024	P	W	V	
1.7	**CONDENSER BUSHING**									
1.7.1	Visual check of fittings and all accessories,Surface Condition and Scaling	Visual	A	100%	Technical specification, approved drawing, GTP IS 2099 IS 12676 IEC 60137		P	W	V	All tests shall be witnessed by Power transformer manufactur Any variation in the test values or discrepancies observed, su bushings shall be rejected by the Power Transformer manufacturer. KPTCL shall verify test reports during final inspection.
1.7.2	Creepage distance and dimension check	Measure	A			As per approved GTP	P	W	V	
1.7.3	Routine Test: a) Measure of Capacitance & Tan delta at room temperature at 2KV, 5KV and 10KV and voltage dependency factor b) Dry PF voltage withstand test c) Measure of PD quantity d) Lightening impulse withstand e) Test tap insulation test f) sealing g) Tightness test	Measure	A			a) Tan Delta - 66 kV - 0.7% Above 66 kV - 0.4% b)As per approved GTP c)As per IEC - No flash-over/ puncture d) As per IS/IEC e) As per IS/IEC f) No leakage g) As per approved drawing h) No leakage	P	W	V	

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1.8	**PORCELAIN BUSHING**									
1.8.1	Visual Check	Visual	B	100%	Tech spec Approved drawings GTP IS 3347 IS 2099 IS 5621 IEC 60137	Tech spec Approved drawings GTP As per IS 3347 IS 2099 IS 5621 IEC 60137	P	V	V	Record review at the time of final inspection. LV bushing has to be replaced free of cost to KPTCL, if it is found punctured at site or if found that the LV bushing is not as per KPTCL requirement
1.8.2	Creepage distance check	Measure	B				P	V	V	
1.8.3	Dimension Check	Measure	B				P	V	V	
1.8.4	Routine test including PF volt withstand	Measure	B				P	V	V	
1.8.5	Test Certificate a) Insulation resistance measurement with 2kV Megger b) Dry Power Frequency voltage withstand test to be furnished at the time of final inspection	Measure	B				P	V	V	
1.9	**CURRENT TRANSFORMER (Bushing CT)**									
1.9.1	Visual check of healthiness	Visual	B	100%	IEC 60044-1:2003 IS 2705	Technical spec, Approved drawings, GTP, IEC 60044-1:2003 IS 2705	P	V	V	Record review at the time of final testing CT ratio to be witnessed by KPTCL during final inspection
1.9.2	Check for dimension (ID/OD, thickness)	Measure	B				P	V	V	
1.9.3	Test/ Check of a) Accuracy, Ratio b) Dry PF Withstand test on secondary c) Over voltage inter turn test d) Verification of terminal marking e) Polarity f) Knee point voltage g) Exciting current test for PS class h) Sec winding resistance for PS class	Measure	B				P	V	V	
1.10	**NITRILE GASKET**									
1.10.1	Dimension Check, Thickness	Measure	A	10% at random	Technical spec, ISO 7619-1 ISO 815 ISO 37 ISO 3865 IS 11149 IS 2751 IS 4253	Within tolerance	P	V	V	Physical verification and record review at the time tanking stage inspection
1.10.2	Shore Hardness check	Measure	A	One sample per lot per size		70 ± 5 IRHD	P	V	V	
1.10.3	Tensile strength	Measure	A			12.5 N/mm^2 min	P	V	V	
1.10.4	Elongation at break	Measure	A			250% min	P	V	V	
1.10.5	Compression Set test	Measure	A			20% max	P	V	V	
1.10.6	Accelerated aging in air&oil at 100±2 ^{0}C for 72 Hrs.	Measure	A			Max change in harness - 10 IRHD/Change in weight - 5 to 8.5% Change in thickness - 4% max Change in width & length - 0.2% max	P	V	V	
1.10.7	Resistance to insulating oil	Measure	A			As per IS 4253	P	V	V	
1.11	**TERMINAL CONNECTOR**									
1.11.1	Visual Check	Visual	B	100%	Technical spec, Approved drawings, GTP, IS 5561	No surface defects	P	V	V	Record review at the time of final testing
1.11.2	Check for dimension	Measure	B	100%		Dimension within tolerance	P	V	V	
1.11.3	Routine Test a) Tensile test b) Resistance test c) Galvanising test (if required)	Measure	B	One sample of each size per lot		as per IS 5561	P	V	V	

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1.12	**MARSHELLING BOX/COOLER CONTROL CABINET**									
1.12.1	Check workmanship of inside, ferruling, labeling, paint shade, internal arrangement, Check of BOM etc.	Visual	B	100%	Technical spec, Approved drawings, GTP	As per approved drawing	P	V	V	Record review at the time of final testing. **Type test report from any NABL lab not older than 5 years for Degree of Protection (IP 55) shall be verified during Final isnpection.** Performance to be checked during final inspection
1.12.2	Dimension, paint thickness, adhesion test, paint shade etc. check of dry film thickness.	Measure	B			As per approved drawing	P	V	V	
1.12.3	Routine Test a) HV test at 2kV for 1 min between live terminal/earth b)IR at 500V for 60 sec c) Functional test & verify wiring d) Accuracy of indication	Measure	B			a)1 min withstand c)Firm and aesthetic other all as per approved drawing	P	V	V	
1.12.4	Degree of Protection (IP 55) for Marshalling Box						P	V	V	
1.13	**a) RTCC** **b) Digital RTCC relay if applicable:-**									
1.13.1	Surface cleaning before painting	Visual	B	100%	Technical spec, Approved drawings & GTP	No surface defects	P	V	V	Record review at the time of final testing. Record review of transformer monitoring device (ITCS) at the time of final inspection.
1.13.2	Verification of BoQ&Dimension check	Visual	B			As per approved BoQ & dimensions within tolerance	P	V	V	
1.13.3	Check of paint shade, paint film thickness and paint film adhesion	Measure	B			Shade as per approved drawing and GTP	P	V	V	
1.13.4	Functional check- manual and electrical operation as per scheme	Visual	B			Operation satisfactory	P	V	V	
1.13.5	Checking for wiring routing	Visual	B			As per approved drawing	P	V	V	
1.13.6	Make/type of instrument/component	Visual	B			As per approved drawing	P	V	V	
1.13.7	Dielectric test: Live terminal & E(Ground) at 2kV	Measure	B			Withstand 2kV for 1 min	P	V	V	
1.13.8	Measurement of IR by 500 Volt IR test	Measure	B			More than 100 Kilo ohm	P	V	V	
1.13.9	**Check on Digital RTCC Relay/automatic voltage regulating relay (VAR) if applicable**									
1.13.9.1	Voltage and current measurement	Measure	B	100%	Technical spec, Approved drawings & GTP	Technical spec, Approved drawings & GTP	P	V	V	Record review at the time of final testing
1.13.9.2	Check of panel switches	Measure	B				P	V	V	
1.13.9.3	Check for function of communication interface	Measure	B				P	V	V	
1.13.9.4	Test of complete function including tap, position indicator & raise and lower command and all other functionality check.	Measure	B				P	V	V	
1.14	**AIR CELL - if applicable**									
1.14.1	Check of make & surface finish of complete air cell	Visual	B	100%	Technical spec, Approved drawings & GTP IS 3400 BS 903 IS 7016	No surface defects	P	V	V	Record review at the time of final testing
1.14.2	Check of dimension & leakages	Measure	B			Dimension within tolerance	P	V	V	
1.14.3	a) 10 times Inflation and deflation @ 10kpa. b) Pressure test @ 10kpa for 24 hrs.	Measure	B			No leak, no opening of joints	P	V	V	
1.14.4	Routine tests on basic fabric a) Oil side coating compound b) Air side inner/outer coating c) Rubber coating inner/outer d) Coated fabric	Measure	B	One sample per lot of raw material			P	V	V	

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							Agency			
		Type of check	Class of Check	Quantum of check	Reference document	Accepting norms	S	M	C	Remarks
1.15	**ROLLER ASSEMBLY**									
1.15.1	Visual & paint check	Visual	B	One sample per lot	Technical spec, Approved drawings & GTP IS 5517/IS 2004 IS 28 IS 8500	Free from surface defect	P	V	V	Record review at the time of final testing
1.15.2	Dimensional check	Measure	B			Within tolerance	P	V	V	
1.15.3	Mechanical properties and chemical composition of raw material used for shaft and roller forging	Measure	B	1 sample /heat treatment batch		For shaft as per MS EN8, BS 970-1 For roller wheel of cast iron IS 210 For roller wheel of Cast steel IS 1030	P	V	V	
..16	**OIL & WINDING TEMPERATURE INDICATOR (LOCAL & REMOTE)**									
1.16.1	Check of Type, Make & healthiness	Visual	B	100%	Technical spec, Approved drawings & GTP	No visible surface defect	P	V	V	Record review at the time of final testing
1.16.2	Dimensional check	Measure	B			within tolerance as per approved drawing	P	V	V	
1.16.3	Calibration check & verify accuracy ^{0}C	Measure	B			Accuracy better than ±3/ ± 1.5% of FSD (ieema)	P	V	V	
1.16.4	2kV HV test @ 1 min for terminals & earth	Measure	B			Should withstand for 1 min	P	V	V	
1.16.5	Switch operation check Continuity of contacts for Alarm & Trip and all other contacts.	Measure	B			Should be ±2.5 ^{0}C of switch setting	P	V	V	
1.17	**RTD TYPE REMOTE AND WINDING TEMPERATURE INDICATOR**									
1.17.1	Check of healthiness	Visual	B	100%	Technical spec, Approved drawings & GTP	No visible damage	P	V	V	Record review at the time of final testing
1.17.2	Dimensional check	Measure	B			Dimension within tolerance	P	V	V	
1.17.3	a) Calibration check b) HV Test (2000 V for one minute) c) Insulation resistance at 500V for 60 sec d) Sensor resistance/switch contact operation	Measure	B			a) 2. ± 1.5% of FSD b). Withstand for 1 min c) withstand for 1 min. d)operation within ± 2° C of setting	P	V	V	
1.18	**PRESSURE RELIEF VALVE**									
1.18.1	Type & Make	Visual	B	100%	Technical spec, Approved drawings & GTP IS 2500	As per approved drawing & GTP	P	V	V	Power Transformer manufacturer has to witness the air pressure test, switch contact operation test and Dielectric Test. Record review by KPTCL at the time of final testing Configuration of contacts for alarm & trip to be carried out during final inspection
1.18.2	Dimensional check	Measure	B			within tolerance as per approved drawing	P	V	V	
1.18.3	Operation check- Air pressure and Liquid pressure test	Measure	B			Operate at specified pressure ±0.07 kg/cm^2	P	W	V	
1.18.4	Leakage test 75% operating pressure	Measure	B			No leak for 24 Hrs.	P	V	V	
1.18.5	Switch contact operation test	Measure	B			To be checked after operation	P	W	V	
1.18.6	Dielectric test between each terminals & body of PRV	Measure	B			Withstand 2kV for 1 min	P	W	V	
1.19	**MAGNETIC OIL LEVEL GAUGE**									
1.19.1	Type & make	Visual	B	100%	Technical spec, Approved drawings & GTP	As per approved drawing & free from defect	P	V	V	Record review at the time of final testing
1.19.2	Dimension check, check for pointer movement	Measure	B			within tolerance as per approved drawing	P	V	V	
1.19.3	Functional Check- Calibration check by empty and full contact	Measure	B			Check pointer position for Max, Min and center level	P	V	V	
1.19.4	2kV HV test for 1 min (terminals & body)	Measure	B			Withstand for 1 minute	P	V	V	
1.19.5	Switch/contact operation test	Measure	B			Operate at Min level indication	P	V	V	

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1.20	**BUCHHOLZ RELAY & OIL SURGE RELAY**									
1.20.1	Type & make	Visual	B			As per approved drawing & free from defect	P	V	V	Record review at the time of final inspection. Continuity for alarm and trip test to be carried out during final inspection.
1.20.2	Dimension check	Measure	B			within tolerance as per approved drawing	P	V	V	
1.20.3	2kV HV test for 1 min (terminals & body)	Measure	B			Withstand for 1 minute	P	V	V	
1.20.4	Switch/contact operation test	Measure	B				P	V	V	
1.20.5	Routine Test a) Porosity & element test b) High voltage c)Insulation resistance d)Gas volume test at 5° ascending towards conservator e)Loss of oil & surge test/float operation f)Continuity of contacts for alarm & trip	Measure	B	100%	Technical spec, GTP, IS 3637-1966 (Re affirmed 2007)	a) No leakage b) 2 KV for 1 min. withstand c) Min 10 MΩ by 500 V DC megger d) GOR - 1: 90 to 165 CC GOR - 2: 175 to 225 CC GOR - 3: 200 to 300 CC e) GOR - 1: 70 to 130 CC GOR - 2: 75 to 140 CC GOR - 3: 90 to 160 CC	P	V	V	
1.21	**GAS COLLECTING DEVICE**									
1.21.1	Dimension Check	Measure	B	100%	Technical spec, Approved drawings & GTP	within tolerance as per approved drawing	P	V	V	Record review at the time of final testing
1.21.2	Pressure test/leak test	Measure	B			No leak at 0.75 kg/cm^2	P	V	V	
1.22	**GATE VALVE**									
1.22.1	Dimension Check	Measure	B	1 sample of one size per lot	CBIP manual/ Technical spec, Approved drawings & GTP	within tolerance as per approved drawing	P	V	V	Record review at the time of final testing
1.22.2	Check for raw material for valve body, gate wedge, spindle & gland	Visual	B			as per CBIP manual/Approved drawings & GTP	P	V	V	
1.22.3	a) Body test at 1.5 Mpa for 2 min b) Seat test at 1.0 Mpa for 2 min c) Seepage at 2 kg/cm^2 for 12 Hr	Measure by using water	B	a) 100% b) 100% c) 1%		There should be no leaks	P	V	V	
1.22.4	Pressure test	Measure	A	100%		As per CBIP manual & IS 778	P	V	V	
1.23	**BUTTERFLY VALVE**									
1.23.1	Dimensional Check	Measure	B	1 sample per lot	AS per CBIP manual, Technical spec, Approved drawings & GTP	Within tolerance	P	V	V	Record review at the time of final testing
1.23.2	Visual inspection	Visual	B	100%		No visible defects	P	V	V	
1.23.3	Pressure test through body and spindle	Measure	B			No leak at 5kg/cm^2 for 30 min	P	V	V	
1.23.4	Pressure test diaphragm	Measure	B			Max 6 drops/min 1.5 kg/cm^2	P	V	V	
1.23.5	Oil seepage test (oil at 105 ±5 ^{0}C & pressure of 2kg/cm^2 (for 24 hrs)	Measure	B	1 sample per lot		No leak from body & spindle Max 6 drops /min from disc	P	V	V	
1.23.6	Material composition (Disc/Housing)	Measure	B			As per approved drawing	P	V	V	
1.24	**SILICAGEL BREATHER**									
1.24.1	Dimension, Type and model check, Silica gel capacity and Quality	Visual	B	100%	Technical spec, Approved drawings & GTP	Within tolerance	P	V	V	Record review at the time of final testing
1.24.2	Check of health/colour of silicagel	Measure	B			No visible defect SilicaGel is blue	P	V	V	
1.24.3	Pressure test by blanking oil cup, operational check	Measure	B			No leak for 30min at 0.35 kg/cm^2	P	V	V	
1.25	**RADIATOR**									
1.25.1	Properties of material as per technical specifications	Visual	B	1 sample per lot	Technical spec, Approved drawings & GTP					Record review at the time of final testing
1.25.2	DP test on lifting lug welds	Visual	B	100%		No welding defect	P	V	V	
1.25.3	Dimensional check after final welding flange centre & overall	Measure	B			As per approved drawing	P	V	V	
1.25.4	Air pressure test on elements & Radiator assembly	Measure	B			As per relevant standards /CBIP	P	V	V	
1.25.5	Surface cleaning of header support & bracing details by shot blasting	Visual	B			Free from surface defect	P	V	V	
1.25.6	Number of elements and size (Fins)	Visual	B				P	V	V	
1.25.7	Visual check of finish of weld and paint - Paint shade, Paint thickness, DFT & Outside film adhesion test	Visual	B			As per tech spec, coating thickness more than 70 micron	P	V	V	
1.25.8	Leakage Test	Visual	B			No leakage	P	V	V	

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1.26	**INSULATING OIL**									
1.26.1	Appearance	Visual	A	Sample per lot IEC:60296 IS 6855 & IS 6858 for barrel	Technical spec & GTP IEC 60296	Clear & transparent	P	V	W	Long duration tests shall be conducted and completed by Transformer manufacturer/ oil supplier where stage inspection will be offered in such a way that Long duration test results will be available to the inspecting KPTCL officials as on the date of stage inspection of oil. All other tests shall be witnessed by KPTCL at Transformer manufacturer /Sub vendor premises Record review by KPTCL at the time of final testing
1.26.2	Viscosity at 100 ^{0}C	Measure	A			Parameters as per IEC 60296	P	V	W	
1.26.3	Viscosity at 40 ^{0}C	Measure	A				P	V	W	
1.26.4	Viscosity at -20 ^{0}C	Measure	A				P	V	W	
1.26.5	Pour Point ^{0}C and Flash point deg C	Measure	A				P	V	W	
1.26.6	Water Content a) For bulk supply b) For delivery in Drums	Measure	A				P	V	W	
1.26.7	Electric Strength (Break down voltage) a) Unfiltered After Filtration	Measure	A				P	V	W	
1.26.8	Density at 20 ^{0}C	Measure	A				P	V	W	
1.26.9	Dielectric dissipation factor (Tan Delta)at 90 deg C	Measure	A				P	V	W	
1.26.10	Resistivity at 90 ^{0}C ohm-cm and 27 degC	Measure	A				P	V	W	
1.26.11	Total Acidity (Neutralisation value)	Measure	A				P	V	W	
1.26.12	Interfacial tension at 27 ^{0}C	Measure	A				P	V	W	
1.26.13	Total Sulphur content	Measure	A				P	V	W	
1.26.14	Corrosive Sulphur (IEC 62535)	Measure	A				P	V	W	
1.26.15	Oxidation stability test and presence of oxidation inhibitor	Measure	A				P	W	V	
1.27	**STEEL FOR FABRICATED PARTS (RAW MATERIAL)**									
1.27.1	Check for finish	Visual	A	One sample per lot	Technical spec	Technical spec, Approved drawings & GTP	P	V	V	Record review at the time of tank stage inspection
1.27.2	Check for dimension	Measure	A				P	V	V	
1.27.3	Chemical composition	Measure	A				P	V	V	
1.27.4	Mechanical properties	Measure	A				P	V	V	
1.28	**FABRICATION OF TANK AND ACCESSORIES**									
1.28.1	Welding procedure Spec (WPS) & welder qualification (for fabrication)	Visual	A	For all jobs	Technical spec, Approved drawings & GTP	ASME Sec IX	P	V	V	To be done during tank stage inspection and **Customer Inspection Point (CIP). It is required to offer tank and core coil assembly for inspection at the same time in order to save time and hence plan accordingly. All the check points and checking for proper finish of tank inside surface and checking for non existence of particles shall be compulsorily checked.** Record review at the time of final testing During **tank inspection** test at Sl No 4,7, 9,10 &11 to be witnessed and results of the other tests needs to be verified
1.28.2	Visual check for welding electrode (for all steel fabricated items)	Visual	A	1 sample of each type		No defect as per report	P	V	V	
1.28.3	Check for fit up for butt welds on tank walls, base & cover	Visual	A	100%		Check for proper welding	P	V	V	
1.28.4	DP test on load bearing welds / members.	Visual	A	Each Tank		Check for proper welding	P	V	W	
1.28.5	Visual check of welding joint	Visual	A	5%		No visual defects	P	V	V	
1.28.6	Dimension check after final welding including rim flatness, position of guides & earth connection, matching of tank & cover	Measure	A	100%		As per approved GTP and drawings & CBIP standards	P	V	W	
1.28.7	Air Leakage test on assembled tank with turrets and on conservator separately	Measure	A	100%	Technical spec, Approved drawings & GTP	No leakage	P	V	W	
1.28.8	Air pressure test and Vacuum test (AV/VT) on tank only with deflection measurement	Measure	A	Each Tank		As per approved GTP and drawings & CBIP standards	P	V	W	
1.28.9	Check for nitrogen injection points (if applicable)	Visual	A	Each Tank			P	V	W	
1.28.10	Dimension of roller mounting pad with std. fixture of roller by turning by 90 ^{0}C	Measure	A	100%			P	V	V	
1.28.11	Surface clearing by shot blasting	Visual	A	100%			P	V	V	
1.28.12	Check of a) Paint shade b) Paint film thickness (inside & outside) c) Film adhesion test	Visual	A	100%		As per approved GTP and drawings & CBIP standards	P	V	V	

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1.29	**RESIN COATED GLASS TAPE**									
1.29.1	Visual and Dimension check	Visual	B	100%	Technical specifications, IS 15208	Free from visual defect	P	V	V	Record review at the time of core building/Core Coil Assembly stage inspection
1.29.2	Elongation	Measure	B	One sample per lot			P	V	V	
1.29.3	Tensile strength , Cross Breaking strength	Measure	B			Min 200 N/mm	P	V	V	
1.29.4	Curing Test	Measure	B			12 months	P	V	V	
1.29.5	Resin Content	Measure	B			27 (± 3%)	P	V	V	
1.29.6	Softening point of resin	Measure	B			Max 200 °C	P	V	V	
1.30	**COOLING FAN & MOTOR ASSEMBLY**									
1.30.1	Type & Make	Visual	B	100%	Technical specifications, approved GTP and drawings IS2312/IS6272	As per approved GTP and drawing	P	V	V	Record review at the time of final testing
1.30.2	Check of healthiness	Visual	B				P	V	V	
1.30.3	Dimensional check	Measure	B				P	V	V	
1.30.4	Routine and acceptance test	Measure	B				P	V	V	
1.30.5	Power consumption, rating test	Measure	B				P	V	V	
1.30.6	HV test	Measure	B			1.3 kV for 1 min or 1.8 kV for 5 sec	P	V	V	
1.30.7	Insulation resistance value	Measure	B			10 MΩ min with 500 V DC megger	P	V	V	
1.31	**CONSERVATOR**									
1.31.1	Properties of Material	Measure	B	1 Sample per lot	Technical specifications, approved GTP and drawings		P	V	V	Record review at the time of final testing
1.31.2	Dimensions	Measure	B				P	V	V	
1.31.3	Leakage Test	Test	B				P	V	V	
1.31.4	Air Pressure Test	Test	B				P	V	V	
1.31.5	Check for finish of weld and paint, paint thickness	Visual	B				P	V	V	
1.32	**FIBER OPTIC SENSOR (If provided) (applicable to 66kV, 31.5MVA class power transformers)**									
1.32.1	Visual check, check of range & dimension	Visual	B	100%	KPTCL tech spec	As per manufacturers certificate	P	V	V	Record review at the time of inspection of core coil assembly.
1.32.2	Negative full wave LI test (type test) without breakdown or flashover	Measure	B	One sample	Prepare: ASMD 2413	500kVp, gap of 25mm	P	V	V	
1.32.3	Impulse creep test (type test) without breakdown or flashover	Measure	B		ASTM D149	360 kVp gap of 25mm	P	V	V	
1.32.4	a) PD measurement less than electric field strength of 4.7 kV/mm b) AC withstand test	Measure	B		ASTM D 2413	a) less than 10pC b) 70kV on 15 mm gap 140kV on 30 mm gap	P	V	V	
1.33	**ON LOAD TAP CHANGER***									
1.33.1	Mechanical operation test of diverter switch (Endurance Test)	Measure	A	Each OLTC	Tech spec Approved drawings GTP IEC 60214 IS:8468 IS:8478		P	V	W	* Customer Inspection Point (CIP) 1) Type test reports not older than 5 years for having conducte tests @ CPRI/ERDA as per relevant IEC/IS shall be submitted at the time of inspection 2) If type test reports are older than 5 years or there is change in design it is to be repeated at no extra cost to KPTCL @ CPRI/ERDA without affecting delivery schedule. 3) All routine tests and type tests shall be carried out as per KPTCL specifications
1.33.2	Transition time & Sequence test	Measure	A			Switching time within permissible limit	P	V	W	
1.33.3	Pressure leak test, vacuum test and gas tightness test of diverter switch compartment	Measure	A			No leakage	P	V	W	
1.33.4	Mechanical test of tap selector with motor drive	Measure	A			Satisfactory operation for 1 complete cycle	P	V	W	
1.33.5	Contact Resistance Test	Measure	A				P	V	W	
1.33.6	Operation test and Endurance test of complete OLTC including functional check of driving mechanism.	Measure	A			Satisfactory working as per drawing Approved Satisfactory working of trip & reset	P	V	W	
1.33.7	HV test on auxiliary circuit	Measure	A			Withstand 2kV for 1 min	P	V	W	
1.33.8	Physical & Dimension Check as per drawing	Measure	A	Each OLTC		Free from defects	P	V	W	
1.33.9	Visual check of paint shade & thickness and adhesion on motor drive panel	Visual	A			As per approved drawing & GTP	P	V	W	

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1.34	**Nitrogen Injection Fire Protection Systems (applicable for 10MVA and above rating power transformers)**									Witness by KPTCL at sub vendor premises.
1.34.1	All functional test	Measure	A	Each unit	-	As per Technical specification, approved drawing & GTP	P	V	W	
B	**IN PROCESS INSPECTION**									
2.1	**WINDING (Built up)**									
2.1.1	Measure of conductor Size	Measure	A	Each Winding	Technical spec, Approved drawing & GTP	Technical specification & GTP	-	P	W	Witness during Winding stage inspection and Record review at the time of final testing. **During stage inspection of winding, the following records need to be reviewed by KPTCL:** 1) Test reports of CPRI/ERDA pertaining to samples of PICC/CTC drawn by power transformer manufacturer and sent to CPRI/ERDA for all tests. 2) Test certificate of ageing of paper. 3) Thickness of press boards & permawood to be verified by KPTCL and review of test reports on press boards & permawood. 4) The inspecting officers of KPTCL shall make dimensional checks physically on each and every transformer on its winding during stage inspection at manufacturer's place and the values shall be recorded by the inspecting officers as per Annexure -1 attached to this standardized MQP **V* - Customer Inspection Point (CIP):- -** PICC/CTC Samples for each transformer shall be taken in presence of customer during winding stage inspection and sent to CPRI/ERDA for all tests including chemical composition, Tensile strength, elongation & Resistivity . Manufacturer has to submit test reports to KPTCL for verification during final inspection. Any excuses from the manufacturer refraining from submission of test reports during final inspection will not be entertained. Assessment of I^2R loss at 75°C is to be carried out during this stage inspection. Winding resistance of all the windings shall be measured and I^2R loss to be assessed by calculation, for all transformers
2.1.2	Check inside & Outside Diameter, unshrunk height & radial thickness	Measure	A				-	P	W	
2.1.3	Calculate current density of each coil	Calculate					-	P	W	
2.1.4	Weight of the windings	Weigh/ Measure					-	P	W	
2.1.5	Check of insulation arrangement, winding direction and Transposition	Visual	A				-	P	W	
2.1.6	Check arrangement of Fibre Optic Sensor (FOS)	Visual	B				-	P	W	
2.1.7	Testing of winding: Continuity tests on winding	Visual	A				-	P	W	
2.1.8	Brazing procedure & Brazer qualification	Verification	B	All Brazers			-	P	W	
2.1.9	Check brazing of tap leads, if finished (Else same shall be witnessed during core coil assembly stage)	Visual	A				-	P	W	
2.1.10	Check on the finished coil a) Chemical composition of copper b) Tensile strength c) elongation d) Resistivity	Measure	A	Each Winding	Technical spec & GTP		-	P	V*	
2.1.11	Resistance of the winding	Measure	A	Each Winding			-	P	W	
2.1.12	Visual inspection of brazed joints & transposition	Visual	A				-	P	W	
2.1.13	Lead & coil identification & marking	Measure	A				-	P	W	
2.1.14	I^2R loss assessment	Calculate	A				-	P	W	

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2.2	**CORE BUILDING AND FRAME ASSEMBLY**									
2.2.1	Check of frame assembly/core assembly, straightness	Visual	B	Each Transformer	As per approved design, Technical specification & GTP	As per approved design, Technical specification& GTP	-	P	W	**During stage inspection of core assembly, the following records need to be reviewed by KPTCL:** 1) Test reports of CPRI/ERDA pertaining to samples of CRGO drawn by power transformer manufacturer and sent to CPRI/ERDA for all tests. 2) Thickness of press boards & permawood to be verified by KPTCL and review of test reports on press boards & permawood. 3) Record review of resin coated glass tapes 4) The inspecting officers of KPTCL shall make dimensional checks physically on each and every transformer on its core during stage inspection at manufacturer's place and the v[illegible] shall be recorded by inspecting officers as per Annexure -1 attached to this standardized MQP
2.2.2	Check arrangement of Insulation	Visual	B				-	P	W	
2.2.3	Check window width and window height and diagonal of frame and position of oil ducts	Measure	B				-	P	W	
2.2.4	Check core stacking operation, Individual step stack dimensions, Number of steps	Measure	A				-	P	W	
2.2.5	Check of compressed stack height/ thickness	Measure	B				-	P	W	
2.2.6	Check assembly of tensile bolt	Visual	B				-	P	W	
2.2.7	Check binding of adhesive tape	Visual	B				-	P	W	
2.2.8	Check of waviness of core yoke, burr	Measure	B				-	P	W	
2.2.9	Visual Check of overall dimension of built up core	Measure	B				-	P	W	**V* - Customer Inspection Point (CIP) -** CRGO Samples for each transformer shall be taken in presence of customer during core assembly stage inspection and sent to CPRI/ERDA for all tests. Any excuses from the manufacturer refraining from submission of test reports during final inspection will not be entertained.
2.2.10	Check of insulation resistance of core & frame by 2kV IR Tester/core bolt insulation test/HV test between core and clamps	Measure	A				-	P	W	
2.2.11	No load loss/ core loss assessment	Calculate	A				-	P	W	Assessment of core loss shall be carried out.
2.2.12	Calculation of Flux density.	Calculate	A				-	P	W	
2.2.13	Assessment of preliminary core loss by calculation.	Measure	A				-	P	V*	shall be carried out during the Sample test at CPRI/ERDA for the samples drawn by KPTCL inspecting officers.
2.2.14	a) Check of damages to core b) Specific core loss c) Stacking factor d) Surface IR e) Minimum Polarisation in Tesla @ field strength Accelerated aging test	Measure	A				-	P	W	
2.2.15	Assembly of limb Insulation & plates	Visual	A				-	P	W	
2.2.16	Rectangularity of Core Assembly	Visual	A				-	P	W	
2.2.17	Check for Overlaps & air gap at joints	Visual	A				-	P	W	
2.2.18	Leaning of Core	Visual	A				-	P	W	
2.2.19	Earthing of Core	Visual	A				-	P	W	
2.2.20	Limb Clamping & Binding	Visual	A				-	P	W	
2.3	**CORE & COIL ASSEMBLY**									
2.3.1	Check of level of bottom yoke, coil dimension, bottom insulation, top insulation	Visual	B	Each Transformer	As per approved design	As per approved design	-	P	W	**Customer Inspection Point (CIP) -** **To be witnessed by KPTCL and Record review of resin coated glass tapes.** **It is required to offer tank and core coil assembly for inspection at the same time in order to save time and**
2.3.2	Check Auxiliary limb support assembly (if applicable)	Visual	B				-	P	W	
2.3.3	Check winding assembly	Visual	B				-	P	W	
2.3.4	Check assembly of the top yoke and core joints	Visual	B				-	P	W	
2.3.5	Check assembly of the magnetic shields (if applicable)	Visual	B				-	P	W	
2.3.6	Check insulation parts, lead cable and copper tube	Visual	B				-	P	W	
2.3.7	Check insulation resistance between core and frame by 2kV IR tester, insulation between coil, coil to earth insualtion, core and frame to yoke bolts (if applicable), yoke insulation test	Measure	A				-	P	W	
2.3.8	Overall Dimensions, clearance between the coils, Lead termination, Lead placements & clearances, Lead lengths, coil dimensions.	Measure	A		As per approved design	As per approved design	-	P	W	

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Manufacturing Quality Plan for 110kV and 66kV power transformer up to 31.5MVA capacity. (Revised)

Abbreviations:
S- Sub supplier ; M- Transformer manufacturer ; C- Customer (KPTCL).
P - Perform ; W- Witness ; V- Verification (Review)

Sl. No.	Components and Operations	Type of check	Class of Check	Quantum of check	Reference document	Accepting norms	Agency S	Agency M	Agency C	Remarks
2.3.9	Final inspection of core & coil assembly - Check for completeness - Check for cleanliness - Check for absence of sharp edges - Check placement of lead support assembly - Check of insulating distance between low voltage connections and other parts to earth - Final locking	Visual	A	Each Transformer			-	P	W	**Customer Inspection Point (CIP) To be witnessed by KPTCL**
2.3.10	Visual check for intercoil insulation	Visual	A				-	P	W	
2.3.11	Lead & coil identification & marking.	Visual	A				-	P	W	
2.3.12	Brazing / Crimping of Joints/coil support	Visual	A		As per brazing procedure	Shall be smooth and no sharped age	-	P	W	
2.3.13	Ratio test with tap switch	Measure	A		As per IS 2026 / IEC 60076	Tolerance as per standards	-	P	W	
2.3.14	Magnetic balance test	Measure	A				-	P	W	
2.3.15	Magnetizing current test	Measure	A				-	P	W	
2.3.16	Alignment of Spacers/Blocks & Tightness	Visual	A			Aligned	-	P	W	
2.4	**DRYING OF ACTIVE PARTS AND TANKING**									
2.4.1	Verification of vacuum achieved	Measure	B	Each Transformer	As per approved design & drawings		-	P	V	Record review at the time of pre-Tanking and assembly
2.4.2	Verification of temperature achieved/oven temp, vapour temp	Measure	B				-	P	V	
2.4.3	Check for intermediate pressure reduction	Measure	B				-	P	V	
2.4.4	Check degree and duration of fine vacuum	Measure	B				-	P	V	
2.4.5	Moisture extraction rate / amount of water extracted	Measure	B				-	P	V	
2.4.6	Check VPD final parameter	Measure	B				-	P	V	
2.4.7	Cleanliness of the Tank	Visual	B			-	P	V	V	
2.4.8	Electrical clearances	Measure	B			-	P	V	V	
2.4.9	Height of outer coil after pressing	Measure	B			-	P	V	V	
2.4.10	Clamping of coils	Measure	B			-	P	V	V	
2.4.11	Core Coil Assembly locking	Measure	B			-	P	V	V	
2.4.12	Clearances with Tank, dimensions	Measure	B			-	P	V	V	
2.4.13	Quantity of oil	Measure	B			-	P	V	V	
2.4.14	Earthing connections	Measure	B			-	P	V	V	
2.5	**SETTLING TIME & OIL LEAK TEST**									
2.5.1	Before start of high voltage test	Visual	B	Each Transformer	As per approved design & drawings & GTP	As per approved design & drawings & GTP	-	P	V	Record review at the time of final testing

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C	**FINAL INSPECTION TESTING**	Measure	A				-	P	W	**Customer Inspection Point (CIP) :**
3.1	**ROUTINE TESTS**									**1) All routine tests and acceptance tests shall be conducte as per relevant IS/IEC/Technical specification of KPTCL.**
3.1.1	Dimension check as per the approved assembly drawing, Minimum clearance between phase bushings and each bushing to earth.	Measure	A				-	P	W	
3.1.2	Measure of winding resistance all windings	Measure	A				-	P	W	
3.1.3	Measure of PI and IR values	Measure	A				-	P	W	
3.1.4	Measure of voltage ratio of all taps, Polarity	Measure	A				-	P	W	
3.1.5	Vector Group verification for 3 phase Transformers	Measure	A				-	P	W	
3.1.6	Magnetic balance test at 415 Volta (for 3 ph transformers only)	Measure	A				-	P	W	**2) The inspecting officers of KPTCL after satisfying abou the dimensional check may take up the final acceptanc test wherein the measured values of electrical parameter on each of the subsequent transformer should be v with that of the type tested transformer as per Annexure - attached to this standardized MQP.**
3.1.7	Measure of insulation power factor (Tan delta) and capacitance of winding	Measure	A				-	P	W	
3.1.8	Measure of insulation power factor (Tan delta) and capacitance of bushing	Measure	A					P	W	
3.1.9	Measure of no load current with 415V, 50Hz AC supply	Measure	B				-	P	W	**3) Test reports of CPRI/ERDA for testing samples c PICC/CTC & CRGO drawn by KPTCL officers during In process stage shall be furnished compulsorily to th inspecting officers for verification and any excuses fro the manufacturer refraining from submission of test report during final inspection will not be entertained.**
3.1.10	No load loss & current measure at 90, 100, 110% excitation	Measure	A				-	P	W	
3.1.11	Measure of Load loass and impedance voltage at normal and extreme taps and Positive phase sequences impedance measurement on three phase transformers.	Measure	A				-	P	W	
3.1.12	Tests on OLTC	Measure	A				-	P	W	**4) The following is to be verified:-**
3.1.13	Separate source voltage withstand test	Measure	A				-	P	W	a) Bushing CT ratio is to be witnessed.
3.1.14	Lightening impulse test on line terminals (applicable for power transformers above 72.5kV voltage class)	Measure	A				-	P	W	b) Marshalling box performance and IP 55 test report and wirir of marshalling box is to be checked.
3.1.15	Induced over voltage withstand test.	Measure	A				-	P	W	c) Configuration of contacts for alarm and trip of pressure reli valve is to be carried out.
3.1.16	Repeat no load loss test, IR value, Tan delta test after HV test	Measure	A				-	P	W	d) Record review of air pressure test and switch conta operation test of Pressure Relief valve
3.1.17	Tests on transformer oil including DGA on selected sample as per IS:9434/IEC:567, before and after temp rise test and at final stage before dispatch.	Measure	A	Each Transformer	IS 2026/ IEC 60076		-	P	W	e) Record review of test reports in respect of the following:-
3.1.18	Isolation test of core to frame, core and tank, frame to tank at 2kV AC for 1 min	Measure	A							i) Condenser bushing.
3.1.19	Sweep Frequency response Test (SFRA) - Intially SFRA test to be conducted at power transformer manufacturer's premises during final inspection. Manufacturer shall arrange to repeat SFRA test at site at his cost after arrival of power transformer. Soft copy of the signatures of both of the SFRA tests also to be collected for future comparison and handed over to the concerned SEE(RT) of respective Transmission Zone.	Measure	A				-	P	W	ii) Porcelain bushing. iii) Bushing CT iv) Buchholz relay & Oil surge relay. v) Terminal connector vi) Marshalling box/ Cooler control cabinet vii) RTCC and digital RTCC relay. viii) Air cell. ix) Roller assembly. x) oil and winding temperature indicator (Local and remote) xi) RTD type oil and winding tempearture indicator xii) pressure relief valve xiii) Magnetic oil level guage xiv) Gas collecting device. xv) Gate, Globe and butterfly valves xvi) Silicagel breather xvii) Radiator xviii) Insulating oil. xix) cooling fans and motor assembly. xx) oil circulating pump xxi) oil flow indicator xxii) Fiber optic sensor(if provided) xxiii) Settling time and oil leak test. xxiv) Test certificate received from supplier for tests on air cell xxv) Test reports for corrosive sulphur detection test as p ASTM D 1275 subjecting oil for 150 deg C for 48 hrs.
3.1.20	HV withstand test on auxiliary equipment wiring after assembly by applying 2kV	Measure	B				-	P	W	
3.1.21	Oil leakage test on main tank as per CBIP (Tank leak test at 5 psi (35 kN/m2) for 12 hrs with oil.)	Visual	A				-	P	W	
3.1.22	Calculation of regulation at rated and at unity, 0.9 and 0.8 lagging pf.	Measure	A				-	P	W	
3.1.23	Auxiliary losses (fans)	Measure	A				-	P	W	
3.1.24	Zero Sequence impedance test	Measure	A				-	P	W	

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Sl. No.	Components and Operations	Manufacturing Quality Plan for 110kV and 66kV power transformer up to 31.5MVA capacity. (Revised)					Abbreviations: S- Sub supplier ; M- Transformer manufacturer ; C- Customer (KPTCL). P - Perform ; W- Witness ; V- Verification (Review)			
							Agency			Remarks
		Type of check	Class of Check	Quantum of check	Reference document	Accepting norms	S	M	C	
3.2	**TYPE TESTS AND SPECIAL TESTS**									
3.2.1	Temperature rise test at min tap (DGA before and after test)	Measure	A	100% to be conducted at manufacturer's premises and witnessed by KPTCL authorities.	IS 2026/ IEC 60076		-	P	W	(*) Customer Inspection Point (CIP) :- Type test and Special test:- 1) Dynamic short circuit test 2) Temperature rise test 3) Lightning impluse voltage withstand test (for power transformers upto 72.5kV)
3.2.2	Measure of harmonics of no load current	Measure	A	100% to be conducted at manufacturer's premises and witnessed by KPTCL authorities.			-	P	W	The above mentioned Type test reports and Special test report (Dynamic Short circuit test) of the power transformers of the same rating and voltage class as that of the offered transformer and not older than 5 years issued by CPRI/ERDA laboratory shall be furnished at the time of Final inspection.
3.2.3	Measure of Noise level	Measure	A	100% to be conducted at manufacturer's premises and witnessed by KPTCL authorities.			-	P	W	The design similarity of offered transformers and the tested transformer whose Tests reports are furnished has to be proved by the power transformer manufacturer. In case, the design similarity of offered transformers and the tested transformer whose Test reports are furnished could not be proved by power transformer manufacturer, then manufacturer has to conduct the Type Tests and special test on 1st Unit of offered Transformers at KEMA/CPRI/ERDA Laboratory without affecting the Delivery Schedule and at no extra cost to KPTCL.
3.2.4	Dynamic short circuit withstand test	Measure	A	One no. on each rating*			-	P	W	In case the facility for conducting temperature rise test at CPRI/ERDA laboratory is not available, the temperature rise test reports witnessed by Authorities of CPRI/ ERDA/State or central utilities at the manufacturer's facility will be accepted
3.2.5	Lightening impulse voltage withstand test (with chopped wave) (applicable for power transformers upto 72.5kV voltage class)	Measure	A	One no. on each rating*			-	P	W	In case type test reports / Dynamic short circuit test are older than five years, type tests and dynamic short circuit test shall be conducted on the first unit at CPRI/ERDA without affecting the delivery schedule and at no extra cost to KPTCL.
3.3	**SPECIAL TESTS (OPTIONAL)**									
3.3.1	Degree of Protection (IP 55) for control cabinets and RTCC panels, OLTC driving mechanism, terminal boxes of PRV, MOG, Buchholtz relay, pump motors, fans etc.						-	P	V	Further, Temperature rise test shall be carried out on all the transformers at manufacturer's premises and witnessed by KPTCL authorities without affecting the delivery schedule and at no extra cost to KPTCL.
D	**PACKING AND DESPATCH**									
4.1	Pre shipment check- oil tightness, proper blanking of all opening.						-	P	-	
4.2	Installation and checking of electronic impact recorder						-	P	-	
4.3	Verification of completeness of all accessories and check for soundness of packing of all accessories and fittings						-	P	-	
4.4	Level of insulating oil along with recording temperature						-	P	-	

15/11/2024

Chief Engineer (Electy)
RT & R&D, KPTCL and
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