



BHEL HEAVY ELECTRICALS LIMITED
Field Engineering Services Department, Jhansi (U.P.)

TFE
043A/2

FORMAT FOR PRE-ERECTION TEST/ INTERNAL INSPECTION/ PRE-COMMISSIONING TEST/ PRE-CHARGING CHECK LIST FOR ST, GT & ICT

I. GENERAL DETAILS

Sl. No	Description	Detail
1	E&C executed by	
2	Customer	
3	Site	
4	Equipment	
5	MVA Rating	
6	KV Class	
7	Unit & Phase (to be mentioned for 1 Ø)	
8	Serial No	
9	Work Order	
10	Sub-contractor detail	
11	Date of Receipt at site	
12	Date of Starting of Erection	
13	Date of Completion of Erection and Oil filling	
14	Date of Commissioning	

II. CHECKS AFTER RECEIPT OF TRANSFORMER AT SITE:

A) DRY AIR/ N2 PRESSURE & DEW POINT RECORD

DESCRIPTION	DATE	Dry Air PRESSURE (kg/Cm sq)	DEW POINT (° C)	REMARKS
After receipt/ placement on foundation at site				
Storage at site before erection				

Please write 'NIL' in case of No Remarks
NOTE: Log sheet record of N2 pressure to be maintain at site.

B) CORE INSULATION ISOLATION TEST

Make of testing kit :

Date of calibration & Valid upto :

(Testing date: _____)

COMBINATION	INSULATION VALUE On applying 500V
BETWEEN CC-G	
BETWEEN CL-G	
BETWEEN CC-CL	

Note: Shorting link between CC, CL & G to be removed and IR value to be taken between CC-G, CL-G & CC-CL.

C) INTERNAL INSPECTION

Date of Internal Inspection: _____

Sl.No	Description	Observation	Remarks
1.0	Precaution to be taken during inspection 1.1 Remove shoes/socks before going inside tank. 1.2 Do not carry anything in the pocket. 1.3 Do not wear any loose item like chain, wrist watch etc. which might have chances of being left in the tank. 1.4 Support of lead/TG, should not be taken while entering into tank.		
2.0	Physical observations 2.1 For any dent/scratch mark on the tank. 2.2 Damage of external fittings like air release valve, flanges and blanking plates. 2.3 Impact recorder Sl. No.- whether found fitted in position. 2.4 Removal for analysis of impact graph. 2.5 N2 pressure in Transformer. 2.6 Leakages from drain plug cover other gasket joints due to looseness and their tightening. 2.7 Measurement of isolation between core clamping, core laminations and tank with 500V meggar		
3.0	Inspection 3.1) Remove inspection cover for entering inside tank. 3.2) Inspection of leads (HV/IV/LV/TAP), for any burning / tracking / blackening marks on <ul style="list-style-type: none">• Leads• Top and bottom yoke shunts.• Earthing leads of core, end frame, tank, top and bottom yoke shunts and wall shunts.• CT leads• Outer barrier of coil assembly and aux. leg. 3.3) Connection of all earthing leads and CT leads are tightened. 3.4) Connection of all isolation leads are proper		

	3.5) There is no hanging of all earthing leads. (ie. Core, core clamp/end frame & tank leads) are properly connected to respective points on 2KV/10KV isolation board. 3.6) There is no hanging of all earthing leads. 3.7) Locking of core with tank cover is proper. ie. There is no air gap between the two. 3.8) No burning / blackening mark on insulation provided below & above cross plate. 3.9) No blackening / burning mark on the insulation provided between top end frame and core. 3.10) Removal of nuts/bolts if found loose. 3.11) Removal wdg lead metallic transport support		
4.0	Bottom tank surface to be checked for any foreign material i.e. metallic particle, loose wire block etc.		
4.0	Observation of : 4.1 All leads i.e. HV/LV/Neutral 6.2 Lead take out position where ever possible. 6.3 Yoke/wall shunts along with earthing leads. 6.4 2kV/10kV Isolation & CT terminal boards. 6.5 Overall view from HV/LV/Neutral side. 6.6 Tank Bottom/Cover surface.		
4.0	Clearance check HV – (RØ) to Tank wall or nearest grounding/ Wdg part HV – (YØ) to Tank wall or nearest grounding/ Wdg part HV – (BØ) to Tank wall or nearest grounding/ Wdg part Neutral to Tank wall or nearest grounding/ Wdg part		
5.0	Any observation other than above.		
6.0	After completion of inspection 6.1) Box up the Transformer. 6.2) N2 filling upto 2.0 psi		

Details of abnormalities notice if any:

III. PRE ERECTION TEST.

a) INSULATION RESISTANCE MEASUREMENT OF BUSHING CT'S (at 500V)

Make of testing kit :
Date of calibration & Valid upto :
(Testing date: _____)

MEASUREMENT BETWEEN	UNIT	HV			LV		
		R – Ø	Y – Ø	B – Ø	R – Ø	Y – Ø	B – Ø
Earth - Core I							
Earth - Core II							
Earth - Core III							
Earth - Core IV							

MEASUREMENT BETWEEN	UNIT	HV			LV		
		R – Ø	Y – Ø	B – Ø	R – Ø	Y – Ø	B – Ø
Core I – Core II							
Core I – Core III							
Core I – Core IV							
Core II – Core III							
Core II – Core IV							
Core III – Core IV							

b) **CONTINUITY TEST OF BUSHING CT'S**

(Testing date: _____)

Continuity, Check between Terminals OK / NOT OK

CORE	BETWEEN TERMINAL	HV			LV		
		R – Ø	Y – Ø	B – Ø	R – Ø	Y – Ø	B – Ø
Core – I	1S1–1S2						
Core – II	2S1–2S2						
Core – III	3S1–3S2						
Core – IV	4S1–4S2						

c) **SECONDARY WINDING RESISTANCE OF BUSHING CT'S (IN OHM)**

(Testing date: _____ Ambient Temperature _____)

i. **HV side**

CORE	BETWEEN TERMINAL	UNIT	R – Ø		Y – Ø		B – Ø	
			FACTORY	SITE	FACTORY	SITE	FACTORY	SITE
Core I	1S1 – 1S2	Ω						
Core II	2S1 – 2S2	Ω						
Core III	3S1 – 3S2	Ω						
Core IV	4S1 – 4S2	Ω						

ii. **LV Side**

CORE	BETWEEN TERMINAL	UNIT	R – Ø		Y – Ø		B – Ø	
			FACTORY	SITE	FACTORY	SITE	FACTORY	SITE
Core I	1S1 – 1S2	Ω						
Core II	2S1 – 2S2	Ω						
Core III	3S1 – 3S2	Ω						
Core IV	4S1 – 4S2	Ω						

iii. Neutral Side

CORE	BETWEEN TERMINAL	UNIT		
			FACTORY	SITE
Core I	1N1S1 – 1N1S2	Ω		
Core II	1N2S1 – 1N2S2	Ω		

d) POLARITY TEST OF BUSHING CT'S

With 1.5 V DC supply (Connect +ve at P1 and –ve at P2) (Testing date:)

CORE	BETWEEN		HV			LV			N
			R Ø	Y Ø	B Ø	R Ø	Y Ø	B Ø	
Core I	1S1 (+ve)	1S2 (-ve)							
Core II	2S1 (+ve)	2S2 (-ve)							
Core III	3S1 (+ve)	3S2 (-ve)							
Core IV	4S1 (+ve)	4S2 (-ve)							

e) CURRENT RATIO TEST

Make of testing kit :

Date of calibration & Valid upto :

(Testing date:)

Primary Injection through Primary Injection Kit at Primary Terminal P1 – P2

Measure current on the secondary Terminals

i. HV side (CT Ratio)— R phase

CORE S1 - S2	PRIMARY	CURRENT ACTUAL	SECONDARY CURRENT IN AMP	THEORETICAL RATIO	ACTUAL RATIO	% OF ERROR
Core I (1S1 – 1S2)	20%					
	50%					
	100%					
Core II (2S1 – 2S2)	20%					
	50%					
	100%					
Core III (3S1 – 3S2)	20%					
	50%					
	100%					
Core IV (4S1 – 4S2)	20%					
	50%					
	100%					

HV side (CT Ratio) — Y phase

CORE S1 - S2	PRIMARY	CURRENT ACTUAL	SECONDARY CURRENT IN AMP	THEORETICAL RATIO	ACTUAL RATIO	% OF ERROR
Core I (1S1 – 1S2)	20%					
	50%					
	100%					
Core II (2S1 – 2S2)	20%					
	50%					
	100%					
Core III (3S1 – 3S2)	20%					
	50%					
	100%					
Core IV (4S1 – 4S2)	20%					
	50%					
	100%					

HV side (CT Ratio) — B phase

CORE S1 - S2	PRIMARY	CURRENT ACTUAL	SECONDARY CURRENT IN AMP	THEORETICAL RATIO	ACTUAL RATIO	% OF ERROR
Core I (1S1 – 1S2)	20%					
	50%					
	100%					
Core II (2S1 – 2S2)	20%					
	50%					
	100%					
Core III (3S1 – 3S2)	20%					
	50%					
	100%					
Core IV (4S1 – 4S2)	20%					
	50%					
	100%					

ii. LV Side (CT Ratio) – R phase

CORE S1 - S2	PRIMARY	CURRENT ACTUAL	SECONDARY CURRENT IN AMP	THEORETICAL RATIO	ACTUAL RATIO	% OF ERROR
Core I (1S1 – 1S2)	20%					
	50%					
	100%					
Core II (2S1 – 2S2)	20%					
	50%					
	100%					

Core III (3S1 – 3S2)	20%					
	50%					
	100%					
Core IV (4S1 – 4S2)	20%					
	50%					
	100%					

LV side (CT Ratio) — Y phase

CORE S1 - S2	PRIMARY	CURRENT ACTUAL	SECONDARY CURRENT IN AMP	THEORETICAL RATIO	ACTUAL RATIO	% OF ERROR
Core I (1S1 – 1S2)	20%					
	50%					
	100%					
Core II (2S1 – 2S2)	20%					
	50%					
	100%					
Core III (3S1 – 3S2)	20%					
	50%					
	100%					
Core IV (4S1 – 4S2)	20%					
	50%					
	100%					

LV side (CT Ratio) — Y phase

CORE S1 - S2	PRIMARY	CURRENT ACTUAL	SECONDARY CURRENT IN AMP	THEORETICAL RATIO	ACTUAL RATIO	% OF ERROR
Core I (1S1 – 1S2)	20%					
	50%					
	100%					
Core II (2S1 – 2S2)	20%					
	50%					
	100%					
Core III (3S1 – 3S2)	20%					
	50%					
	100%					
Core IV (4S1 – 4S2)	20%					
	50%					
	100%					

iii) Neutral Bushing CT

CORE S1 - S2	PRIMARY		CURRENT ACTUAL	SECONDARY CURRENT IN amp	THEORETICAL RATIO	ACTUAL RATIO	% OF ERR
Core I (1S1 – 1S2)	20%						
	50%						
	100%						
Core I (1S1 – 1S3)	20%						
	50%						
	100%						
Core I (1S1 – 1S4)	20%						
	50%						
	100%						
Core II (2S1 – 2S2)	20%						
	50%						
	100%						
Core II (2S1 – 2S3)	20%						
	50%						
	100%						
Core II (2S1 – 2S4)	20%						
	50%						
	100%						
Core III (3S1 – 3S2)	20%						
	50%						
	100%						
Core IV (1S1 – 1S2)	20%						
	50%						
	100%						

f) TAN DELTA AND CAPACITANCE MEASUREMENT OF BUSHING

Make of testing kit :

Date of calibration & Valid upto :

Ambient temperature : °C (Testing date: _____)

i. Capacitance of HV Bushing (pF)

I. Capacitance of HV Bushing (pF)							
VOLTAGE APPLIED	R-PHASE		Y-PHASE		B-PHASE		REMARKS
	SITE (pF)	FACTORY (pF)	SITE (pF)	FACTORY (pF)	SITE (pF)	FACTORY (pF)	
Measurement of C1							
2 kV							
5 kV							
10 kV							
Measurement of C2(PF)							
1KV							

ii. Tan δ of HV Bushings

Part C - 11 kV Bushings							
VOLTAGE APPLIED	R-PHASE		Y-PHASE		B-PHASE		REMARKS
	SITE	FACTORY	SITE	FACTORY	SITE	FACTORY	
Measurement of C1 Tan δ							
2 kV							
5 kV							

10 kV							
Measurement of C2 Tan δ							
1kV							

iii. Capacitance of LV Bushing (pF)

VOLTAGE APPLIED	R-PHASE		Y-PHASE		B-PHASE		REMARKS
	SITE (pF)	FACTORY (pF)	SITE (pF)	FACTORY (pF)	SITE (pF)	FACTORY (pF)	
Measurement of C1							
2 kV							
5 kV							
10 kV							
Measurement of C2(PF)							
1KV							

iv. Tan δ of LV Bushings

VOLTAGE APPLIED	R-PHASE		Y-PHASE		B-PHASE		REMARKS
	SITE	FACTORY	SITE	FACTORY	SITE	FACTORY	
Measurement of C1 Tan δ							
2 kV							
5 kV							
10 kV							
Measurement of C2 Tan δ							
1kV							

v. Capacitance of Neutral Bushing

VOLTAGE APPLIED	SITE (pF)	FACTORY (pF)
2 kV		
5 kV		
10 kV		
1kV (C2)		

vi. Tan δ of Neutral Bushings

VOLTAGE APPLIED	SITE	FACTORY
2 kV		
5 kV		
10 kV		
1kV (C2)		

C2 values shall be only for record purpose.

IV) CHECKS /PRECAUTIONS DURING ERECTION:

- Active part of Transformer should be minimum exposed to atmosphere
- Use of dry air generator / dry air cylinders, during exposure of active part of Transformer to atmosphere.
- Assembly of Turret & Bushing:

Yes	No	Remarks

Description	Assembly Date	Remarks
HV Turret		
LV & Neutral Turret		
HV Bushings		
LV Bushings		
Neutral Bushing		

- d. Transformer kept sealed with Dry air in between different erection activities

Yes	No	Remarks

- e. Pressure Test & Oil flushing in each Radiator/ Coolers

Sl.no	Description	Observation	Date
1.0	Physical observations		
1.1	For any dent/scratch mark on each Radiator / Coolers.		
1.2	Damage of external fittings like air release valve, blanking plates of each Radiator/ Coolers.		
2.0	Pressure Test on each Radiator/ Coolers @ 1.0 kg/cm ² & hold for 30 min.		
	Radiator/ Coolers-01		
	Radiator-02		
	Radiator-03		
	Radiator-04		
	Radiator-05		
	Radiator-06		
	Radiator-07		
	Radiator-08		
	Radiator-09		
	Radiator-10		
3.0	Oil Flushing for each Radiator Bank / Coolers Bank for 15 Minutes		
	Radiator Bank-01		
	Radiator Bank-02		

Note: Used oil should not be mixed with fresh oil.

f. Pressure test of Air Cell & Conservator Tank

Physical inspection has to be done for Air Cell, MOG Rod & Float inside conservator tank.

DESCRIPTION	Applied Dry Air PRESSURE (kg/Cm sq)	START DATE	END DATE	REMARKS
Leakage test on Air Cell	0.07			
Pressure test on Conservator Tank (Air Cell should not be in pressurized condition)	0.5			

Details of abnormalities notice if any:

V) EVACUATING AND OIL FILLING

- a) Before filling oil, each drum has been physically checked for free moisture and appearance

Yes	No

- b) **Details of oil filter machine**

Make:

Capacity: _____ KL

SL.NO	DESCRIPTION OF WORKS	REMARKS / READING
1	Changing of Lubricating oil of vacuum pump	
2	Cleaning of Filter packs	
3	Flushing of whole filter machine with fresh oil	
4	Vacuum obtained without load (milli bar)	_____ milli bar

c) Vacuum pump for evacuation of Transformer

SL.NO	DESCRIPTION OF WORKS	REMARKS / READING
1	Changing of Lubricating oil of vacuum pump	
2	Vacuum obtained without load (milli bar)	_____ milli bar
3	Diameter of vacuum hose (50 mm)	

d) Oil storage tank

Capacity:kL

Quantity: _____no.

SL.NO	DESCRIPTION OF WORKS	REMARKS / READING
1	Silica gel breather provided in the tank	
2	Any opening left uncovered	
3	Inside painted or not	
4	Cleanliness of inside of pipes/ hoses to the storage tank	

e) Sample testing of oil from drums

Sl.No	Oil Properties	Measured Value	Testing Date
1	BDV		

2	Moisture content		
3	Tan Delta		
4	Resistivity		

f) Exposure during erection

SL.NO	DESCRIPTION OF WORKS	REMARKS / READING
1	First day exposure (in hrs)	
2	Second day exposure (in hrs)	
3	Third Day exposure (in hrs)	
4	Dry Air pressure applied after each days erection work	
5	Ambient Temperature (in °C)	°C
6	Average Relative Humidity	
7	Weather Condition	Rainy/ Stormy/ Cloudy/ Sunny

g) N2/Dry Air sealing in case of delay in oil filling

SL.NO	DESCRIPTION OF WORKS	REMARKS / READING
1	No. of Cylinders used for displacing N2 inside the tank	
2	N2 admitted from bottom valve	
3	No. of Cylinders used for building up 3 PSI	

h) Pressure withstand test of Transformer

SL.N O	DESCRIPTION OF WORKS	Applied Dry Air PRESSURE (kg/Cm sq)	START DATE	END DATE	REMARKS
1	Pressure test on main unit of Transformer	0.35			

Note: If any pressure drop has been observed, leakage point to be rectified.

i) Dry out process of Transformer

Sl.No	DESCRIPTION OF WORKS	Date	Time	Vacuum / N2 Pressure in Transformer Tank	Ambient Temp	Dew point of N2 (Filled in Trafo)
1.0	1st Dry Out Cycle					
1.1	Start of Vacuum until the vacuum pressure reaches below 1 torr. And hold for 3-4 hrs for leakage test					
1.2	After getting 1 Torr vacuum ,continue of vacuum for 48 hrs					

1.3	Break of vacuum by using UHP grade N2 Gas having dew point of -60°C till pressure of 0.30 kg/cm ² is achieved .					
1.4	Maintain N2 pressure for minimum period of 24 Hrs., measure the DEW point.					
2.0	2nd Dry Out Cycle					
2.1	Start of Vacuum until the vacuum pressure reaches 1 torr and continue till 24 hrs.					
2.2	Break of vacuum by using UHP grade N2 Gas having dew point of -60°C till pressure of 0.30 kg/cm ² is achieved &					
2.3	Maintain N2 pressure for minimum period of 24 Hrs. after 24 hrs ,measure the DEW point.					
3.0	3rd/ 4th Dry Out Cycle	As per test results of 2 nd Dry out cycle if DEW point is beyond limit.				
3.1	Repeat activities as detailed in 2.1 & 2.2					
3.2	Repeat activities as detailed in 2.3					

Note: Minimum 2 dry out cycles or till the desired value of dry out/ dew point of Main tank is achieved then proceed for oil filling in Transformer under vacuum.

j) Record of drying out process (if carried out) : Refer note

Drying out started on date:

Time:

Ambient temp:

Hourly reading to be taken

DATE	TIME	VACUUM READING IN FILTRATION MACHINE	VACUUM READING IN TRANSFORMER TANK	OTI OF TANK	CONDENSATE COLLECTED TOTAL / RATE	REMARKS & SIGN OF ENGINEER
NA	NA	NA	NA	NA	NA	NA

Note: Record of filtration and Dry out shall be kept in a register and shall be made a part of the Pre-commissioning document.

k) Oil test report prior to oil filling in Transformer

After completion of oil filtration in storage tank, oil testing for BDV & Moisture to be carried out before filling in main tank.

Sr.No	Oil Properties	Measured Value	Testing Date
1	BDV in KV		
2	Moisture content in PPM		

1) Schedule for Oil filling in Transformer

Sl.No	INSPECTION ACTIONS	DATE	TIME	REMARKS / READING
1	Evacuate the Transformer at 1 Torr vacuum for 24 Hrs & then start pushing the oil in Transformer under vacuum & maintain the max. oil flow rate at 4-5 KL/Hrs.			
2	Oil Filling in Main Tank			
3	Oil filling in Conservator tank			

m) Schedule for HOC (Hot Oil Circulation)

Subsequent to oil filling HOC to be carried out.

Note: Separate format may be attached

[illegible]

➤ **PRE-COMMISSING TESTS**

VI) CORE INSULATION ISOLATION TEST

Make of testing kit :
Date of calibration & Valid upto :
(Testing date: _____)

COMBINATION	INSULATION VALUE On applying 500 V
BETWEEN CC-G	
BETWEEN CL-G	
BETWEEN CC-CL	

Note: Shorting link between CC, CL & G to be removed and IR value to be taken between CC-G, CL-G & CC-CL.

VII) INSULATION RESISTANCE MEASUREMENT

a. Insulation Resistance Measurement in MΩ (Using 500 V Megger)

Make & Sl. No of testing kit :
Date of last calibration of the kit :
Ambient temp in ° C : ____ ° C
(Testing date: _____)

SL. NO.	DESCRIPTION	STATUS		REMARKS, IF ANY
		YES	NO	
A	Control wiring			
B	Main wiring			

b. Insulation Resistance Measurement in MΩ (Using 5000 V Megger)

Make & Sl No. of testing kit :
Date of calibration & Valid upto :
Ambient temp in ° C : ____ ° C
Testing date: _____

MAIN WINDING	IR VALUE (GΩ)			DIELECTRIC ABSORPTION COEFFICIENT DAI= 60 Sec / 15 Sec	POLARISATION INDEX PI= 600 Sec / 60 Sec	REMARKS
	15 sec	60 sec	600 sec			
HV / LV + Tank +E						
LV / HV + Tank +E						
HV/LV						

VIII) MAGNETIZATION CURRENT TEST

Make & Sl No. of testing kit :
Date of calibration & Valid upto :
Ambient temperature ____ °C Temperature of oil: ____ °C
(Testing date: _____)

VOLTAGE APPLIED IN VOLTS		CURRENT MEASURED IN m AMPS		REMARK
HV				
R- N		R-N		
Y-N		Y-N		

XI) MAGNETIC BALANCE TEST AT NORMAL TAP

Make & SI No. of testing kit :
Date of calibration & Valid upto :
Ambient temp in ° C : ____ ° C
Testing date: _____

a. HV Side

1U-N	1V-N	1W-N

b. LV Side

2U-2V	2V-2W	2W-2U

XII) SHORT CIRCUIT IMPEDENCE:

Make & SI No. of testing kit :
Date of calibration & Valid upto :
Ambient temp in ° C : ____ ° C
Testing date: _____

a. Applied 1 phase Voltage on HV Side and Measured Current in HV Side, While LV kept shorted.**HV/LV**

TAP POS.	HV Side (Applied Volts)			HV Side (Current in Amp)			Isc (Amp)
	1U-1V	1V-1W	1W-1U	1U	1V	1W	

b. Applied 1 phase Voltage on LV Side and Measured Current in LV Side, While HV kept shorted.**LV/HV**

TAP POS.	LV Side (Applied Volts)			LV Side (Current in Amp)			Isc (Amp)
	2U-2V	2V-2W	2W-2U	2U	2V	2W	

XIII) FLOATING NEUTRAL MEASUREMENT

Applied 3Ø phase Voltage n HV Side and Measured Voltage on LV Side & N-E

TAP POS.	HV Terminals	Applied Voltage (Volts)	LV Terminals	Measured Voltage (Volts)
Normal Tap	1U-1V		2U-N	
	1V-1W		2V-N	
	1W-1U		2W-N	
			N-E	

XIV) VECTOR GROUP TEST

Vector Group:

Apply 3Ø, 415 Volts in ____ Terminal

Connections	Measured Voltage	Remark / Condition

XV) TAN DELTA AND CAPACITANCE MEASUREMENT OF BUSHING

Make & SI No. of testing kit :

Date of calibration & Valid upto :

Ambient temp in ° C : ____ ° C

Testing date: _____

i) Capacitance of HV Bushing (pF)

VOLTAGE APPLIED	R-PHASE		Y-PHASE		B-PHASE		REMARKS
	SITE (pF)	FACTORY (pF)	SITE (pF)	FACTORY (pF)	SITE (pF)	FACTORY (pF)	
2 kV							
5 kV							
10 kV							
Measurement of C2 Tan δ							
1KV							

ii) Tan δ of HV Bushings

VOLTAGE APPLIED	R-PHASE		Y-PHASE		B-PHASE		REMARKS
	SITE	FACTORY	SITE	FACTORY	SITE	FACTORY	
Measurement of C1 Tan δ							
2 kV							
5 kV							
10 kV							
Measurement of C2 Tan δ							
1kV							

iii) Capacitance of LV Bushing (pF)

VOLTAGE APPLIED	R-PHASE		Y-PHASE		B-PHASE		REMARKS
	SITE (pF)	FACTORY (pF)	SITE (pF)	FACTORY (pF)	SITE (pF)	FACTORY (pF)	
2 kV							
5 kV							
10 kV							
Measurement of C2 Tan δ							
1KV							

iv) Tan δ of LV Bushings

VOLTAGE APPLIED	R-PHASE		Y-PHASE		B-PHASE		REMARKS
	SITE (pF)	FACTORY (pF)	SITE (pF)	FACTORY (pF)	SITE (pF)	FACTORY (pF)	
2 kV							
5 kV							
10 kV							
Measurement of C2 Tan δ							
1KV							

v) Capacitance of Neutral Bushing

VOLTAGE APPLIED	SITE (pF)	FACTORY (pF)
2 kV (C1)		
5 kV (C1)		
10 kV (C1)		
1kV (C2)		

vi) Tan δ of Neutral Bushings

VOLTAGE APPLIED	SITE	FACTORY
2 kV (C1)		
5 kV (C1)		
10 kV (C1)		
1kV (C2)		

C2 values shall be only for record purpose.

XVI) TAN DELTA AND CAPACITANCE MEASUREMENT OF WINDING

Make & SI No. of testing kit :
 Date of calibration & Valid upto :
 Ambient temp in ° C : ____ ° C
 Testing date: _____

VOLTAGE	WINDING COMBINATION	TEST MODE	CAPACITANCE(pF)		TAN DELTA		REMARK
			SITE	FACTORY	SITE	FACTORY	
2 kV	HV/LV	UST					
5 kV							
10 kV							
2 kV	HV/ ground with LV Guard	GST-g					
5 kV							
10 kV							

2 kV	HV/ LV + Ground	GST					
5 kV							
10 kV							
2 kV	LV/HV	UST					
5 kV							
10 kV							
2 kV	LV/ HV+Ground	GST-g					
5 kV							
10 kV							
2 kV	LV/ ground with HV Guard	GST					
5 kV							
10 kV							

XVII) FREQUENCY RESPONSE ANALYSIS (FRA)

Make & SI No. of testing kit :
Date of calibration & Valid upto :
Ambient temp in ° C : ____ ° C
Testing date: _____

- i. Carried out after completion of all commissioning activities

Yes	No	Remarks

- ii. Interpretation of test results carried out

Yes	No	Remarks

- iii. Test results matching with the factory results

Yes	No	Remarks

- iv. Factory & site FRA test report available at site

Yes	No	Remarks

XVIII) MEASUREMENT OF WINDING RESISTANCE (IN OHM)

Make & SI No. of testing kit :
Date of calibration & Valid upto :
Ambient temperature: ____ °C Temperature of oil: °C
WTI reading: °C
(Testing date: _____)

i. WINDING RESISTANCE OF TRANSFORMER WINDING

a. HV Side

[illegible]

b. LV Side

[illegible]

* Formula for calculating the resistance at 75°C: $R_{75} = R_T (235+75) / (235+T)$, where R_T = Resistance Measured at Winding Temperature T.

XIX) OIL CHARACTERISTICS

(Sample to be taken after completion of HOC / prior to charging to Transformer and testing shall be done at reputed NABL accredited lab acceptable to BHEL/ customer.)

DATE OF OIL SAMPLING	B.D.V.	MOISTURE	TAN DELTA	RESISTIVITY	INTERFACIAL TENSION
Measured value					

XX) DISSOLVE GAS ANALYSIS

Testing of oil samples for DGA testing before final charging & DGA 24 Hrs after charging shall be done at reputed NABL accredited lab acceptable to BHEL/customer.

DISSOLVE GASES	BEFORE CHARGING	24 HRS AFTER CHARGING
	Sample Date:	Sample Date:
H ₂		
CH ₄		
CO		
CO ₂		
C ₂ H ₄		

C ₂ H ₆		
C ₂ H ₂		
O ₂		
N ₂		
TDGC		
Remarks		

XXI) PRE-COMMISSIONING CHECKS:

(Date: _____)

SL. NO.	DESCRIPTION OF ACTIVITY	STATUS		REMARK/ DEFICIENCIES, IF ANY
		YES	NO	
1	Transformer and its Auxiliaries are free from visible defects on physical Inspection			
2	All fittings as per out line General Arrangement Drawing			
3	Check Main Tank has been provided with double earthing			
4	Check neutral is grounded through separate connections. Ensure metallic requirements as per specification (e.g. Cu) in earthing strips used			
5	Check that Marshalling Box, Radiator Bank has been earthed			
6	All nuts and bolts are tightened correctly as per specified torque (as per manufacturers recommendation)			
7	Check tightness of Terminal Connectors			
8	Check leveling of Transformer and its accessories			
9	Erection Completion Certificate along with list of outstanding activities reviewed			
10	Any Paint removed / scratched in transit has been touched up			
11	Bushings are clean and free from physical damages			
12	Oil level is correct on all Bushings			
13	Check Hermitically sealing is intact in all Bushings			
14	Check oil leakage through any Joints / Valves etc.			
15	Check oil drain valves are properly closed and locked			
16	Check oil level in Main and Conservator tank			
17	Check OTI and WTI pockets and replenish the oil, if required			
18	Check all valves for their opening & closing sequence			
19	Check the colour of the breather silica gel (blue when dry)			

20	Check availability of oil in the breather cup			
21	Check all rollers are locked and tack welded with rails (wherever applicable)			
22	Check busing test tap is grounded			
23	Check no debris, loose T & P and oil strains on and around the Transformer			
24	Check door seals of Marshalling Box is intact and all cable gland plates unused holes are sealed			
25	Check that pressure relief valve is correctly mounted			
26	Ensure unused secondary cores of Bushing CT's, if any, has been shorted			
27	Check CT star point has been formed properly and grounded at one end only as per scheme			
28	Check that permanent and adequate lighting arrangements are ready			
29	Check that labeling and identification is permanent and satisfactory			
30	Check that Buchholz Relay is correctly mounted with arrow pointing towards conservator			
31	Check cables are properly fixed and ensure cable entry at the bottom			
32	Ensure all Power and Control cable Terminals are tightened			
33	Check all cables and Ferrules are provided with Number as per Cable Schedule (Cross Ferruling to be checked)			
34	Check that all cables are correctly glanded			
35	Check external cabling from Junction Box to Relay / Control Panel completed			
36	Check that air has been released from the Radiators and their headers/Main tank/Bushing etc			
37	Check Fire Protection System & Emulsifier systems is adequate & ready			
38	Check that CC-CL & G are shorted			
39	Check that all radiator bank valves on top and bottom headers are open			
40	Change over operation of ac supply from source- I to source-II checked			
41	Check the flanges of bushing for any crack after fixing			
42	Calibration of OTI & WTI performed as per procedure			

XXII) PROTECTION AND ALARMS

(Testing date: _____)

SL NO	DEVICE	SET FOR		PROVED	
		ALARM	TRIP	ALARM	TRIP
1	EXCESSIVE WINDING TEMPERATURE.				
2	EXCESSIVE OIL TEMPERATURE.				
3	PRESSURE RELIEF VALVE (MAIN TANK)				
4	MAIN TANK BUCHHOLZ RELAY				
5	LOW OIL LEVEL (MAIN TANK)				
6	HIGH OIL LEVEL (MAIN TANK)				
7	OTI (MAIN TANK)				
8	WTI (MAIN TANK)				
9	DIFFERENTIAL				
10	BACKUP IMPEDENCE RELAY				
11	EARTH FAULT RELAY (REF)				
12	INTER TRIP , IF ANY				
13	TRIP FREE CHECK				
14	TEED PROTECTION				

**BHEL HEAVY ELECTRICALS LIMITED****Field Engineering Services Department, Jhansi (U.P.)****TFE
043A/2****FORMAT FOR PRE-ERECTION TEST/ INTERNAL INSPECTION/ PRE-COMMISSIONING TEST/ PRE-CHARGING CHECK LIST FOR ST, GT & ICT**

Signature:

Signature:

Name:

Name:

Designation:

Designation:

(Erection /Customer Agency)

(BHEL, Jhansi)