Failure report of 400/220 kV 500 MVA Power Transformer at Somanahalli Substation of PGCIL on 31.05.2026

1. M/s PGCIL vide their email dated 01.06.2026 intimated that 500 MVA, 400/220 kV ICT-1 (CGL Make) Somanahalli POWERGRID S/s failed on 31.05.2026 at 20:07 Hrs.

2. In compliance of CEA letter dated 01.06.2026, Standing Committee of Experts comprising following members carried out the site visit on 08.06.2026 in order to investigate the cause of failure of the Power Transformer.

S.No.	Name	Designation	Organization
1.	Sh. Pankaj Kumar Verma	Dy. Director (PSE&TD)	CEA
3.	Sh. B.V. Girish	Chief Engineer, Electy. RT, R&D and Hotlines	KPTCL
4.	Shri M Chandra Sekhar,	Joint Director	CPRI, Bengaluru
2.	Shri Paul Daniel,	Assistant Engineer	SRPC

3. PGCIL has submitted following information.
(a) SLD of Somanahalli POWERGRID S/s (**Annexure-I**)
(b) Post failure Test Report covering Magnetic Balance Test, Magnetisation Current Test, Voltage test, Measurement of Winding Resistance and SFRA. (**Annexure-II**)
(c) Pre Commissioning Test Report of ICT (**Annexure-III**)

4. As the 220 kV side of ICT is directly feeding to KPTCL Somanahalli Substation, therefore, information was also sought from KPTCL. KPTCL has submitted following information.
(a) SLD of KPTCL Somanahalli Substation (**Annexure-IV**)
(b) SLD Bus Configuration (**Annexure-IV**)
(c) 220 kV Line and ICT Trippings due to fault during April 2022 to May 2026 at 220 kV KPTCL Substation, Somanahalli. (**Annexure-V**)

5. Brief Introduction of Somanahalli Substation of PGCIL:

400/220 kV Somanahalli Substation of PGCIL is having seven 400 kV Line, One Bus Reactor and three 500 MVA, 400/220 kV ICTs feeding the Power to Somanahalli Substation of KPTCL. 220 kV IV Side of two Transformers are connected to Bus Section-1 Somanahalli Substation of KPTCL while third ICT is connected to Bus Section-2 of KPTCL. The Single Line Diagram of the 400 kV Somanahalli Substation of PGCIL is given below. Detailed SLD of Somanahalli Substation of PGCIL is at Annexure-I.

6. Details of the failed Power Transformer

Details of the failed Power Transformer are given below:

ICT Particulars	Details
Make	CGL
Voltage rating	400/220 kV
MVA rating	500 MVA
Serial No. of equipment	T10660/1
Year of Manufacturing	2016
Year of commissioning	13.03.2017
Date & Time of failure	31.05.2026 at 20:07

7. Historical Facts of failed ICT:

(i) Subject Transformer was manufactured by M/s CG Power and Industrial Solutions Ltd in 2016.

(ii) The transformer was commissioned on 13.03.2017 and has been in continuous commercial operation since then at Somanahalli Substation of PGCIL in March, 2017.

(iii) The transformer got faulty on 31.05.2026.

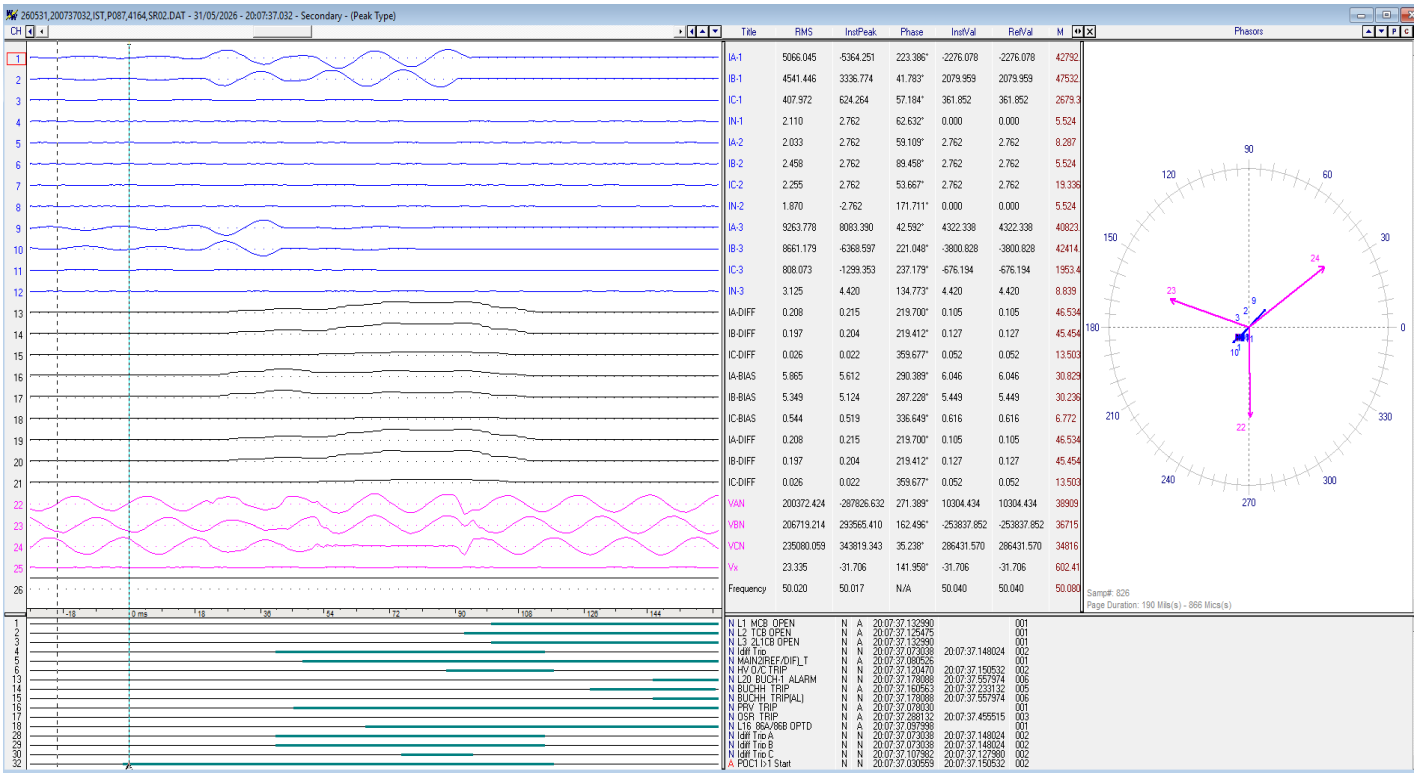
(iv) The Subject transformer was operating on load of 170 MW before the incidence of failure

8. <u>Disturbance Records:</u>

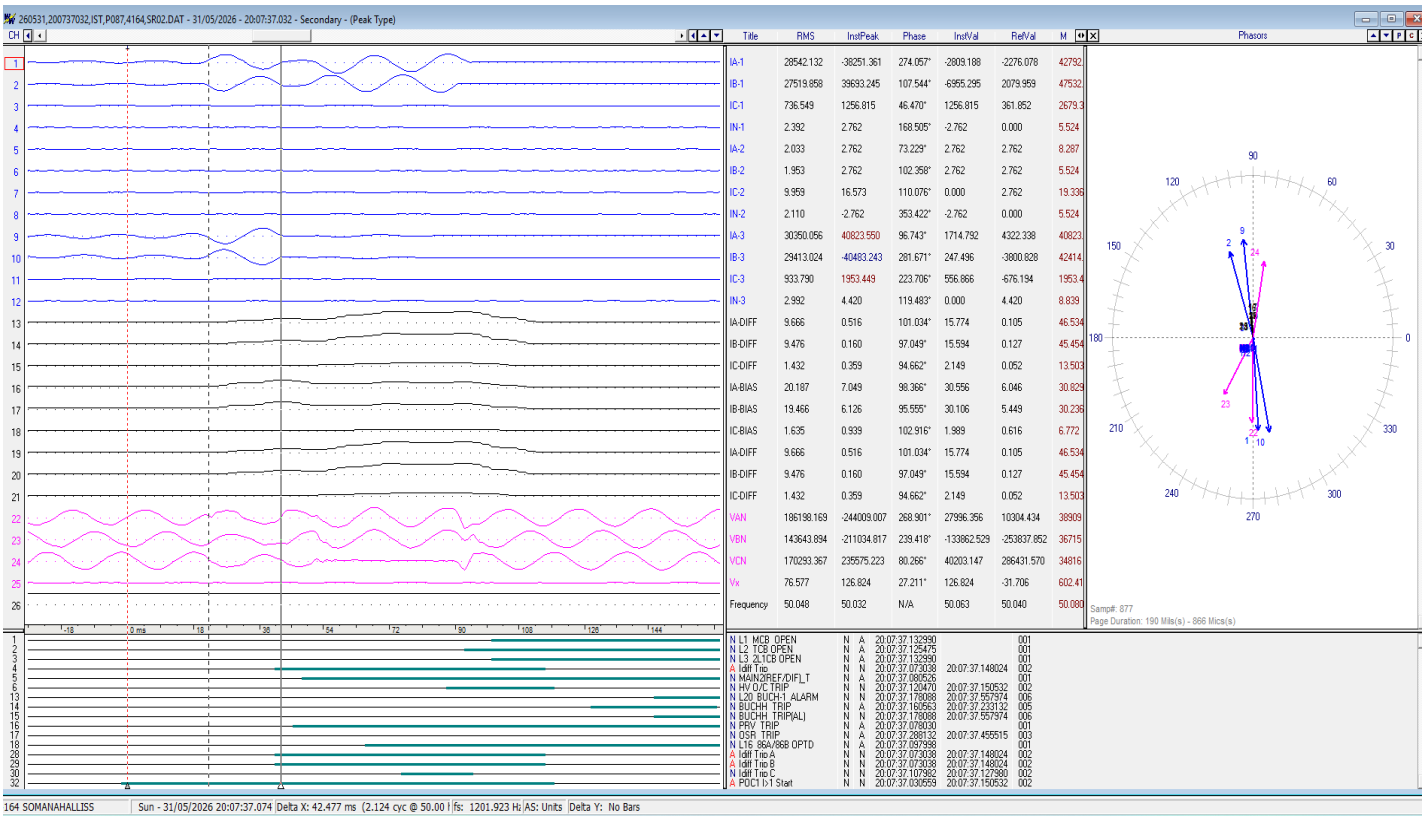
The Current fed by the ICT during incidence are as under.

Sl. No.	Time	HV-R (kA)	HV-Y (kA)	HV-B (kA)	IV-R (kA)	IV-Y (kA)	IV-B (kA)	Remarks
1.	20:07:37:032	5.066	4.541	0.408	9.263	8.661	0.808	Overcurrent Starts
2.	20:07:37:051	5.665	4.308	0.425	9.250	8.277	0.906	Current remains high
3.	20:07:37:074	28.542	27.519	0.736	30.350	29.413	0.933	Sudden Fault Current rise, Differential relay operates
4.	20:07:37:104	35.945	31.760	0.806	4.646	4.692	0.564	Maximum Fault Current

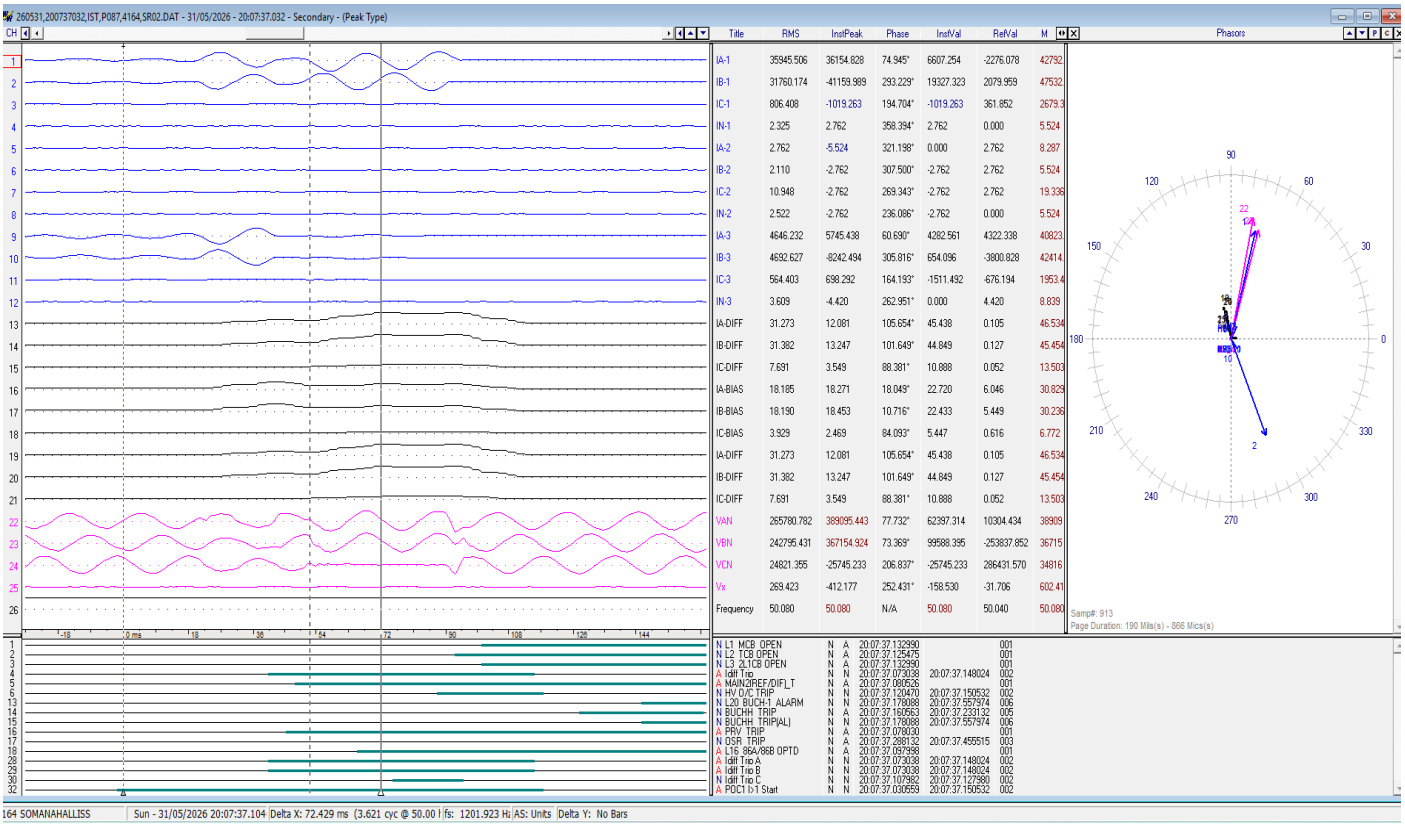
(a) DR of Somanahalli Substation of PGCIL at 20:07:37:032 i.e. When Overcurrent Starts



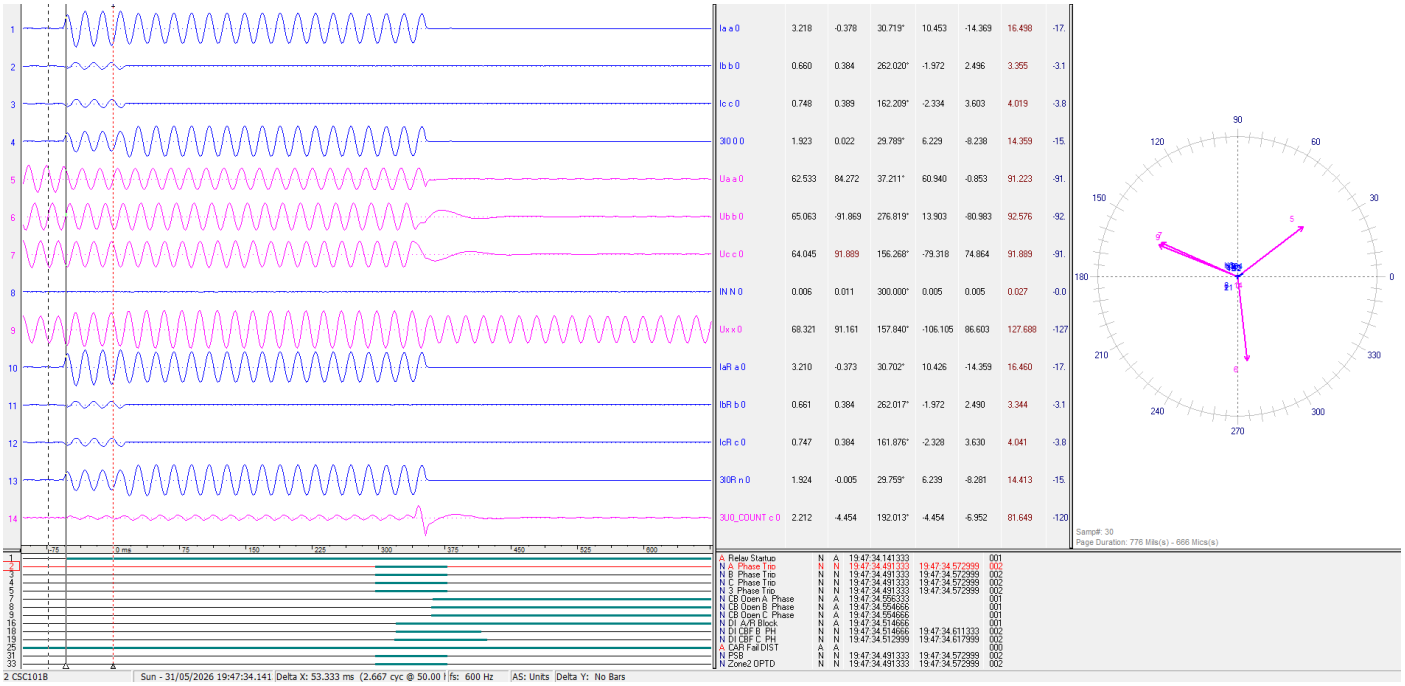
(b) DR of Somanahalli Substation of PGCIL at 20:07:37:074 i.e. When sudden Fault Current rises



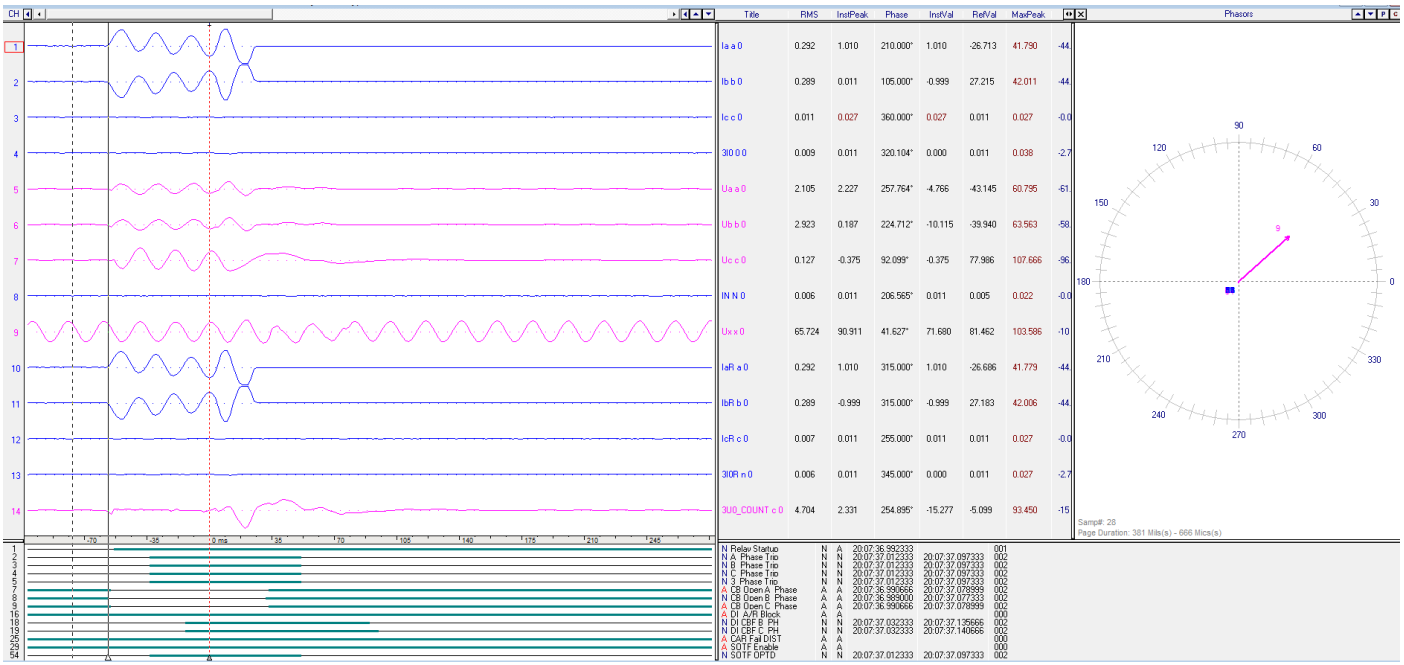
(c) DR of Somanahalli Substation of PGCIL at 20:07:37:104 i.e. When maximum Fault current reaches.



(d) DR of Somanahalli KPTCL Substation at 17:47:34:139 when R-G Fault at KPTCL Harohalli line occurred.



(e) DR of Somanahalli KPTCL Substation of PGCIL at 20:07:36:989 when R-Y Fault at KPTCL Harohalli line occurred.



9. <u>Testing of ICT:</u>

It is informed by PGCIL that various tests such as Magnetic Balance Test, Magnetisation Current Test, Voltage test, Measurement of Winding Resistance and SFRA. Following are the observations.

(i) Low Voltage Test:

(a) **Magnetizing Current Test-HV side at Tap-6**:

Applied Voltage (V)	**Current Measured (mA)**
1R-1N : 229	Ir : 610

1Y-1N:227.8	Iy : 1770
1B-1N:231.4	Ib : 1

(b) **Magnetic Balance Test**

(i) **IV side at Tap-6:**

Applied Voltage (V)	**Current Measured (mA)**
2R-1N : 229.9	Ir : 1600
2Y-1N:227.8	Iy : 5400
2B-1N:231.4	Ib : 810

(ii) **HV side at Tap-6:**

1R-1N	**1Y-1N**	**1B-1N**
229 V	0.5 V	248.8 V
1.38 V	229 V	111.6 V
0.144 V	0.746 V	230.4 V

(c) **Voltage Ratio Measurement-at Tap 6:**

Applied Voltage			**Voltage Measured**		
1R-1N	**1Y-1N**	**1B-1N**	**2R-1N**	**2Y-1N**	**2B-1N**
231.7	230.5	231.8	138.5	117.2	0.921
Ratio			**Deviation**		
1R-1N	**1Y-1N**	**1B-1N**	**2R-1N**	**2Y-1N**	**2B-1N**
1.672	1.966	251.68	-11.31	4.26 %	13242

(d) **Winding Resistance Test:**

(i) HV winding resistance at Tap-6 (Ambient Temperature 29 °C)

	1R-2R	**1Y-2Y**	**1B-2B**
Measured Resistance (mΩ)	160.41	135.46	Not injected
Resistance at 75 °C (mΩ)	189.79	160.27	NA
Factor Values at 75 °C (mΩ)	148.87	147.63	148.38
% Error	-21.5	-8.5	NA

(ii) IV winding Resistance Test at Tap-6 (Ambient Temperature 29 °C)

	2R-1N	**2Y-1N**	**2B-1N**
Measured Resistance (mΩ)	168.57	168	168.82
Resistance at 75 °C (mΩ)	197.92	197.27	198.23
Factor Values at 75 °C (mΩ)	194	192.8	193
% Error	-2.06	-2.29	-2.74

(e) **DGA**

Sample Date	**H2**	**CH4**	**C2H2**	**C2H4**	**C2H6**	**CO**	**CO2**
11.04.2025	16	12	0.1	3	4	520	1459
17.10.2025	13	8	0	1.10	1.2	410	632
05.01.2026	16	12	0.1	3	4	520	1459

18.05.2026	11	07	0	0.7	0.8	410	759
02.06.2026#	639	611	952	1075	108	494	1265

 # Post Failure

(f) **SFRA:** SFRA test carried out post Failure is mentioned at **Annexure-II**.

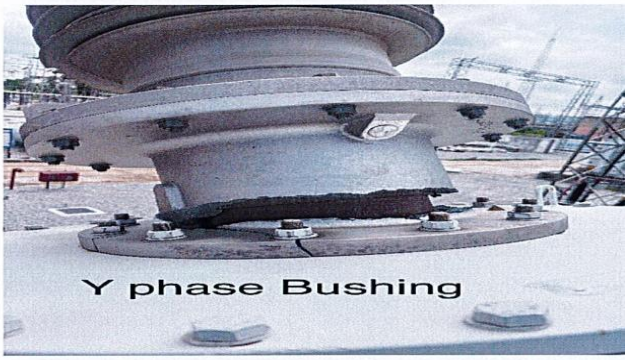
10. Sequence of Events

Sl No.	Time	Event
1.	20:07:37:031	Over Current Start
2.	20:07:37:074	Differential Trip
3.	20:07:37:079	PRV Trip
4.	20:07:37:098	REF Trip
5.	20:07:37:161	Buchholz Trip

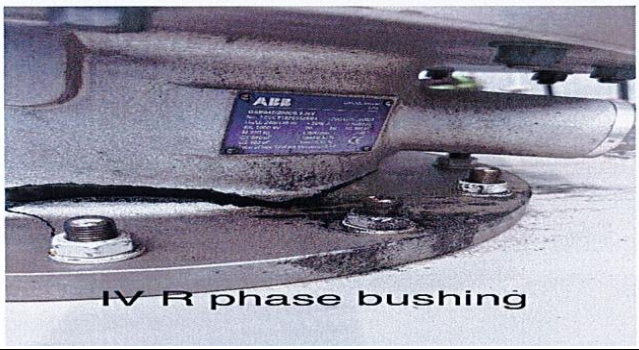
11. <u>Photographs of Power Transformer:</u>

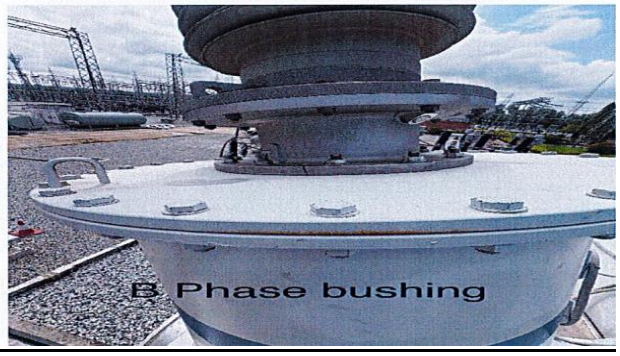
Main tank box stiffener damaged at multiple location

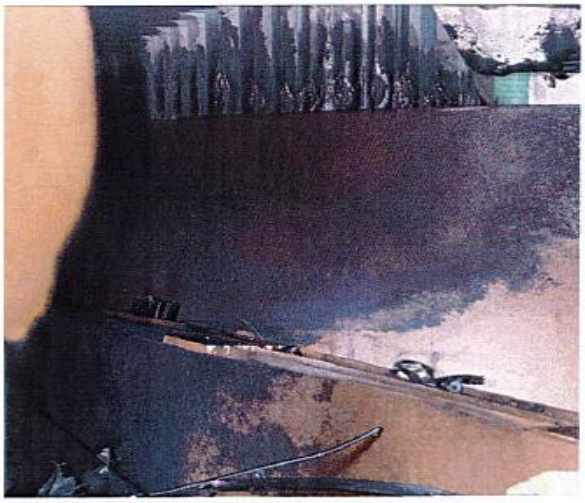
B phase OLTC found damaged



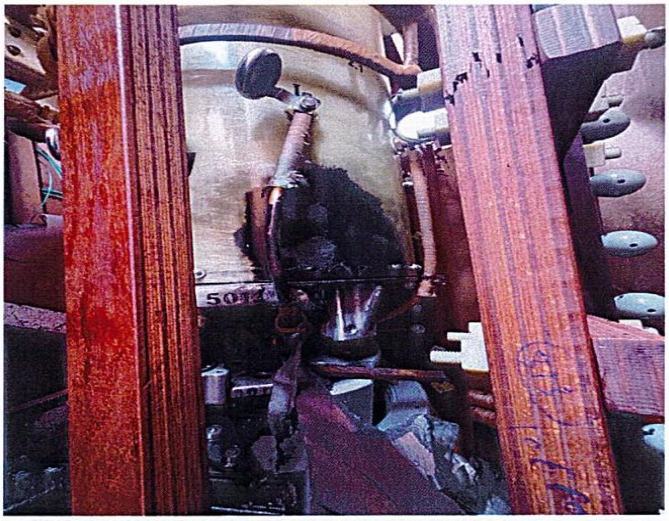
Y phase IV bushing found damaged

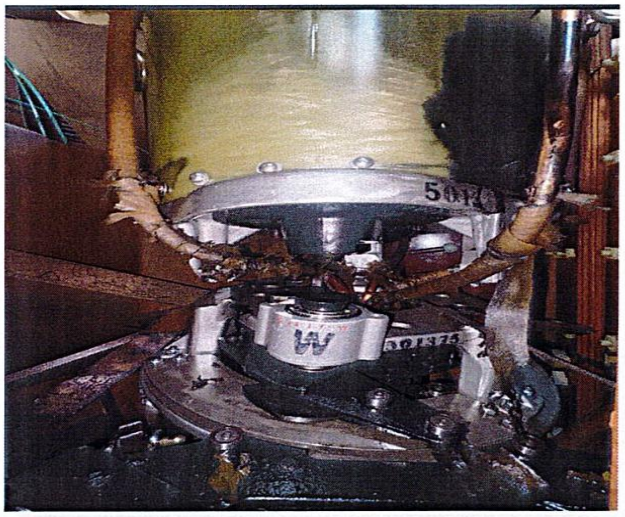




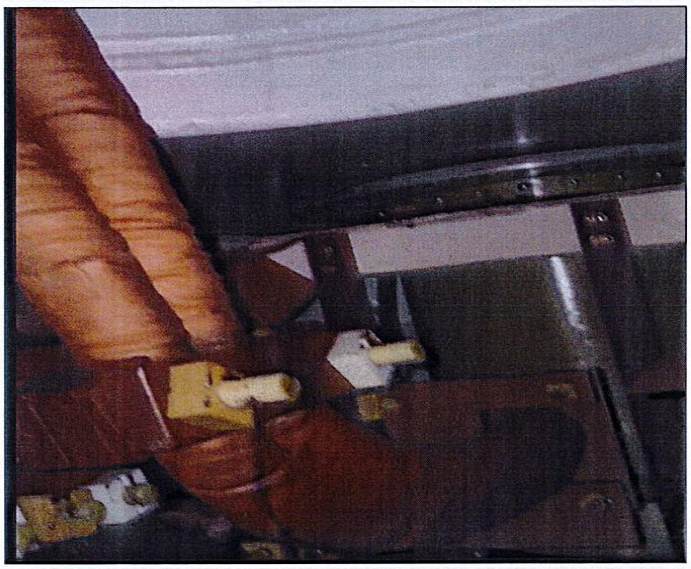


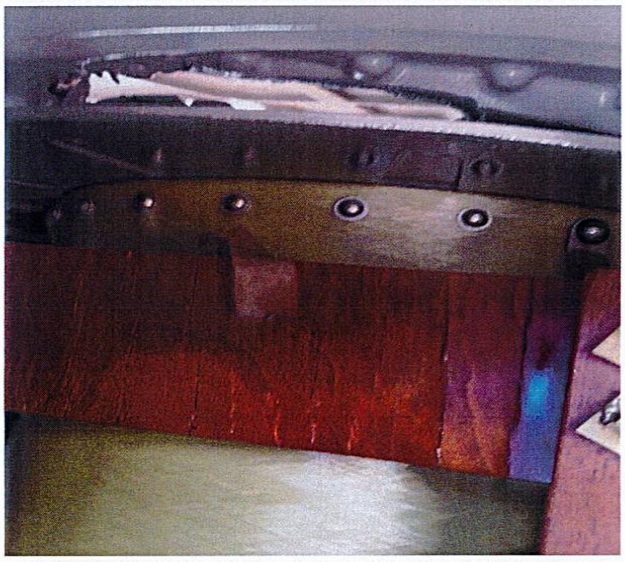
Y phase core limb top IV side (lamination burned) R phase side limb top IV side (lamination burned)





B phase OLTC



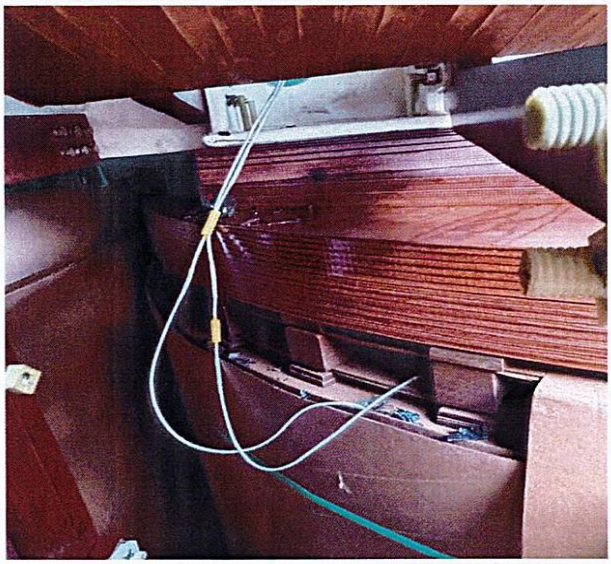


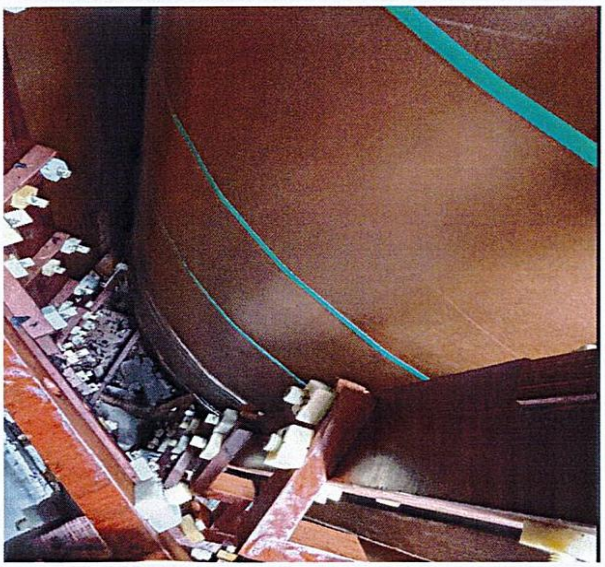
R phase OLTC

Y phase OLTC

Y phase winding view from IV side

R phase winding view from IV side





B Phase winding view from IV side

12. Committee observations:

Based on the Disturbance recorder, physical inspection of the Power transformer and the data provided by the substation officials (Both PGCIL and KPTCL), following are the observations:

(a) The Subject transformer was operating on load of 170 MW before the incidence of failure.

(b) The Subject Transformer (ICT-1) is connected to 220 kV Bus Section-1 while ICT-2 and ICT-3 are connected with Bus Section-2.

(c) On 31.05.2026 at 20:07:37.074 Hrs, 500 MVA 400/220 kV ICT-1 got failed. ICT-2 and ICT-3 remained in service.

(d) The Subject Transformer design is not a Dynamic short circuit withstand tested. The Subject Transformer does not qualify for similarity with any other Transformer as per criteria for Selection of Similar reference Transformer for Dynamic Short Circuit Withstand Test.

(e) it has been observed that as per the faults history data, the ICT-1 has seen adequate number of faults over a period of time and served its operation after the fault. Some of the faults are terminal faults, fault occurred few meters away from the ICT. As per IEC 60076-5, total nine number of short circuits are to be carried out on the Transformer during the DSC test, however, the transformer has seen around 131 of total number of Fault occurred on 220 kV Side of KPTCL Somanahalli Substation in last Four year (From April 2022 to May 2026). It includes variety of faults (LG, LL).

(f) ICT-1 tripped on mechanical protection (PRV & Buchholz) along with Differential & REF protection. The transformer got bulged and Oil spiled out of the transformer.

(g) During the Inspection, it was found that the main tank exhibited bulging at the bell-tank joint on the HV and IV, and the tank stiffeners were found cracked on both IV and HV sides. Further, IV side bushings sustained severe damage.

(h) As per information furnished by PGCIL, during internal inspection following were observed.

   (i) R-phase winding geometry was found disturbed. The top clamping ring was dislocated. Winding clamping sectors were displaced outward, and the winding outer cylinder was found broken.

   (ii) Y-phase winding geometry was found disturbed. The top clamping ring was dislocated. Winding clamping sectors were displaced outward, and the winding outer cylinder was found broken.

   (iii) Burnt marks were observed on B phase OLTC diverter switch chamber.

   (iv) Evidence of localized heating was observed at multiple locations in the vicinity of the R and Y phase cores.

   (v) At multiple locations, the tank wall shunts were found to be damaged and dislocated.

   (vi) Heating and burning marks were observed on the CFT terminal board.

   (vii) No visible signs of damage were observed in the R and B phases during inspection from the HV side.

   (viii) Carbon particles were observed at various locations.

   (ix) The pressboard cylinders associated with the Y phase were observed to be displaced from their original position during inspection from the HV side.

   (x) R & Y phase windings were found dislocated from their position towards the LV side.

(i) Prior to the Fault, on 31.05.2026 at 19:47:34 hrs, KPTCL Harohalli line tripped due to R–G fault. The fault Current was 10 kA for 410 ms. The Fault was not cleared in Zone-1 Protection and Zone-2 Protection operated which led to Bus Sectionalizer open at KPTCL Somanhalli Substation.

(j) While recharging the KPTCL Harohalli line at 20:07:36 hrs on 31.05.2026, the KPTCL Harohalli line tripped due to R–Y ground fault in SOTF. During recharging the Bus Sectionlizer was in open condition.

(k) The Disturbance Recorder data indicates that initially (at 20:07:37:032) the fault current was 9.263 kA in R Phase and 8.661 in Y Phase of 220 kV Side (IV side) while 5.066 kA in R

Phase and 4.541 kA in B Phase of 400 kV side (HV side). After 42 ms, the Current suddenly increased to 30.350 kA in R Phase & 29.413 kA in Y phase on IV side and 28.542 kA in R Phase & 27.519 kA in Y phase of HV side, leading to operation of Differential Relay. The Current further increased to 35.945 kA in R Phase and 31.760 kA in B phase at 20:07:37:104.

(l) It was observed that there are frequent fault occurring on 220 kV side of KPTCL Somanahalli Substation. Total number of Fault occurred on 220 kV Side of KPTCL Somanahalli Substation are around 131 in last Four year (From April 2022 to May 2026) (Details is attached at Annexure-V).

(m) Out of above 131 faults, there are four incidences where the Subject Transformer was tripped. These are as follows.

(i) In November, 2022: The 220 kV side of the Transformer tripped on backup OCR relay at 400/220 kV PGCIL Somanahalli due to 220 kV Somanahalli-Harohally line bay R phase CT flash over at 220 kV KPTCL Somanahalli Substation.

(ii) On 03.10.2024 at 00:58, the Transformer tripped due to fault on 220 kV Somanahalli-Harohalli line. During this Fault, it was observed that all the three ICTs i.e. ICT-1, ICT-2 and ICT-3 were in service and Bus Sectionalizer was close. During this event ICT-1 and ICT-2 tripped while ICT-3 remain in service.

(iii) Again on 03.10.2024 at 14:21, the Transformer tripped due to fault on 220 kV Somanahalli-Harohalli line.

(iv) On 03.10.2025 at 15:55 the Transformer tripped at PGCL due to cross bus insulator flashover of 220 kV Harohalli bay at 220 kV KPTCL Somanahalli Substation.

13. <u>Failure analysis:</u>

On 31.05.2026 at 20:07 hrs, ICT-1 connected with Bus Section-1 was only the Transformer feeding all the line connected to Bus Section-1 as the Bus Sectionlizer was open. The Bus Sectionalizer generally remain in close condition, however, because of the fault occurred at 19:47:34 hrs on 31.05.2026 on KPTCL Harohalli line, Zone-2 Protection operated during which Bus Sectionalizer breaker also tripped at KPTCL Somanhalli Substation. At 31.05.2026 at 20:07 Hrs, when the Harohalli line was test charged, the line tripped on SOTF operation sensing R-Y fault. It was observed by KPTCL that during the fault at 19:47:34, the fault was cleared after 400 ms in Zone-2, since this line is operated in radial mode from Somanahalli Substation end. This might have led to cutting of jumper of 'R' phase close to Somnahalli Substation and cut jumper got shorted to Y Phase conductor. On test charging of Harohalli line at 20:07 hrs, the line immediately tripped on SOTF indication and the fault was cleared within 65 msec. Only ICT-1 fed this fault in Downstream Harohalli feeder as the Bus sectionlizer was in open condition. The Fault Current fed by the ICT-1 was recorded as 9.2 kA on IV side. This HV side winding could not sustain the fault current and the fault converted into internal arcing. The fault current in IV side increased upto 30 kA. This led to operation of 87T (Differential) and REF protections. Buchholz and PRV operated immediately along with Diff/REF operation, indicating rapid gas generation and internal pressure rise due to high-energy fault. The HV & IV side R&Y-phase current magnitude was beyond the Transformer max fault current, confirming a high-energy R& Y phase fault inside the transformer. The fault initially started as a R&Y through fault, and within ~60 ms evolved into a R–Y phase fault in transformer, indicating cause of insulation breakdow .

From the post failure test carried out, following were observed

(a) The observed disturbance in magnetic balance, magnetizing current indicates the presence of turn to turn insulation failure in the R and Y phase winding. Further, a significant deviation in the voltage ratio of R&Y phases was observed when compared with the previous test results. This deviation is indication of turn to turn insulation failure within the respective winding.

(b) In the Winding resistance, increase in HV winding resistance was observed. The increase in winding resistance on HV side is indicative of thermal stress and heating of the winding

conductors caused by the short-circuit current. The measured values of Resistance on IV side are within acceptable limits, which clearly indicate that no turn-to-turn fault has developed within the IV winding.

(c) In SFRA analysis, variation was found between superimposed graphs taken during commissioning and post failure. Variation in the phase to phase superimposed graphs indicate that a fault developed within the winding and that the winding geometry has changed. The variation observed in the core zone suggest that fault current passed through the core, which may have resulted in core saturation and localising heating.

(d) In the Dissolved Gas Analysis (DGA) it was observed that before the incident, all combustible gas levels were well within acceptable limits, which clearly indicated that no abnormality existed inside the transformer. However, after the incident, the levels of all combustible gases increased abruptly, which clearly indicates that arcing took place inside the transformer.

It has been observed that there have been multiple faults occurring on the downstream in the KPTCL 220 kV side. There have been 131 faults in last Four year. Out of these 131 faults, there are four incidences where the Subject Transformer was tripped. Such frequent faults have led to weakning of the Transformer. Further the duration of fault sustained has remained longer(**Annexure-VI**). However, PGCIL did not carry out the SFRA post commissioning. SFRA could have given the clue regarding weakening of the Transformer. Further, it has been observed that the Subject Transformer design is not a Dynamic short circuit withstand tested. The Subject Transformer also does not qualify for similarity with any other Transformer as per criteria for Selection of Similar reference Transformer for Dynamic Short Circuit Withstand Test. Therefore, the robustness of the Transformer to sustain the severe fault is not tested. However, it has been observed that as per the faults history data, the ICT-1 has seen adequate number of faults over a period of time and served its operation after the fault. Some of the faults are terminal faults, fault occurred few meters away from the ICT. As per IEC 60076-5, total nine number of short circuits are to be carried out on the Transformer during the DSC test, however, the transformer has seen around 131 of total number of Fault occurred on 220 kV Side of KPTCL Somanahalli Substation in last Four year (From April 2022 to May 2026). It includes variety of faults (LG, LL).

In the incident at 20:07, all the fault current of R-Y phase fault of KPTCL Harohalli line was fed by the ICT-1. ICT-1 could not sustain the Fault Current and failed. From the PSSE software, a rough analysis was carried out and it has been observed that had all the ICTs i.e. ICT-1, ICT-2 and ICT-3 fed the fault current, the fault current in ICT-1 could have reduced by 2 kA. Therefore, it appears that if Bus sectionizer was in closed condition, Transformer could have handled this fault but might have failed few faults later. During the incidence of October-2024 event when all the ICTs fed the fault current (Bus Sectionlizer was closed), tripping of both ICT-1 & ICT-2 occurred. The fault was fed in parallel by all the three ICTs, reducing stress on individual transformers.

14. Recommendations:

(i) The Transformer should be Dynamic short Circuit (DSC) tested as per the Central Electricity Authority (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations, 2022.

(ii) KPTCL should ensure that frequent fault does not occur on 220 kV side of the KPTCL Substation.

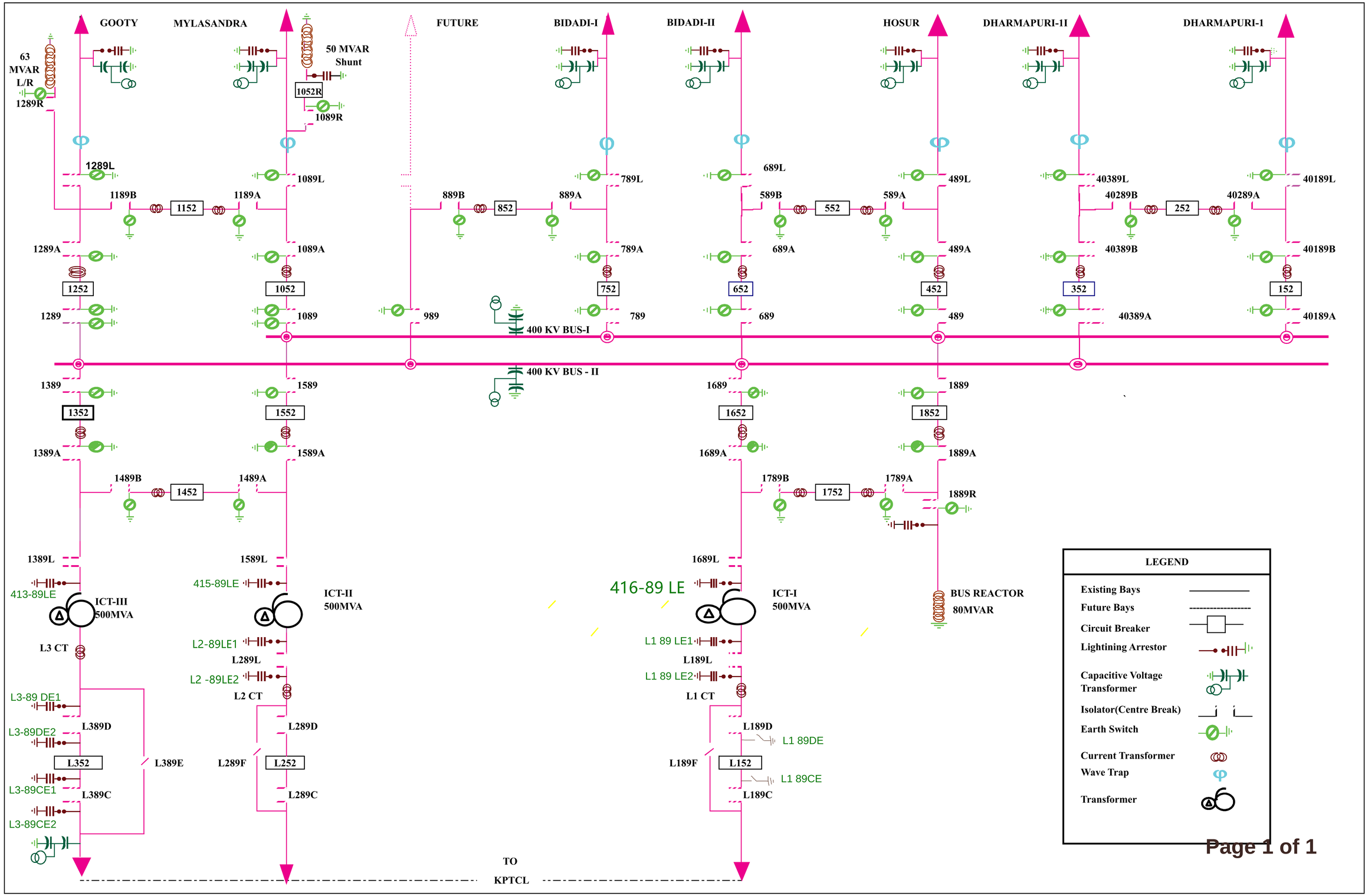
(iii) KPTCL should ensure that Bus sectionlizer remain close so that all the all the ICTs operate in parallel.

(iv) PGCIL shall measure short circuit inductance and SFRA of the transformer after the occurrence of fault, to check the mechanical integrity of the active part.

*****

पावर ग्रिड कारपोरेशन ऑफ इंडिया लिमिटेड

400 के. वी. उपकेंद्र, बेंगलूरु



1. **Test Results**:

i. ***Magnetic Balance Test (Not Applicable For Single Phase Units)***

Applied single phase 230 V across one phase of HV winding terminal and neutral then measure voltage in other two HV terminals across neutral. Repeat the test for each of the three phases.

Apply 1-Ph 230v Ac Across (1)	Voltage Measured In Volts		Remarks
	Between (2)	Between (3)	
1R1 – N: 229V	1Y1 – N: 0.5V	1B1 – N: 248.8V	
1Y1 – N:229V	1R1 – N: 1.38V	1B1 – N: 111.6V	
1B1 – N: 230.4V	1Y1 – N: 0.746	1R1 – N:0.144	

ii. Magnetization Current Test

a) Apply 1 Phase, AC supply on HV Terminals and keep IV and LV open

Tap Position	Voltage Applied (Volts)		Current Measured (Amps)		Remarks
6	R – N	229	R – PH	0.61 A	
	Y – N	231.7	Y – PH	1.77 A	
	B – N	225.5	B – PH	0.001A	

b) Apply 1 phase, 240 V AC supply on IV Terminal and keep HV & LV open

Tap Position	Voltage Applied (Volts)		Current Measured (Amp)	
6	2R – N	229.9	R – PH	1.60
	2Y – N	227.8	Y – PH	5.4
	2B –N	231.4	B – PH	0.81

iii. Voltage Ratio Test @ tap No:6

Turn Ratio: HV / IV

Voltage Applied (Volt)		Voltage Measured (Volt)		Ratio	Theoretical	% Deviation
1R-N	231.7	**2R-N**	138.5	1.673	1.8864	-11.31
1Y-N	230.5	**2Y-N**	117.2	1.967	1.8864	4.26
1B-N	231.8	**2B-N**	0.921	251.683	1.8864	13242.22

iv. Measurement Of Winding Resistance (In mΩ)

Ambient temperature in 27 ° C, OTI Reading 27 ° C , WTI reading 27 ° C

A) High voltage side (in case OLTC is on line side)

Tap Position	Winding Resistance (HV-N) / HV-IV			Resistance At 75° C			Factory Value At 75° C			% Deviation		
	1R1–2R1	1Y1–2Y1	1B1–2B1	1R1–2R1	1Y1–2Y1	1B1–2B1	1R1–2R1	1Y1–2Y1	1B1–2B1	1R1–2R1	1Y1–2Y1	1B1–2B1
6	160.41	135.46	Open circuited	189.79	160.27	Open circuited	148.87	147.63	148.38	-21.5	-8.5	NA

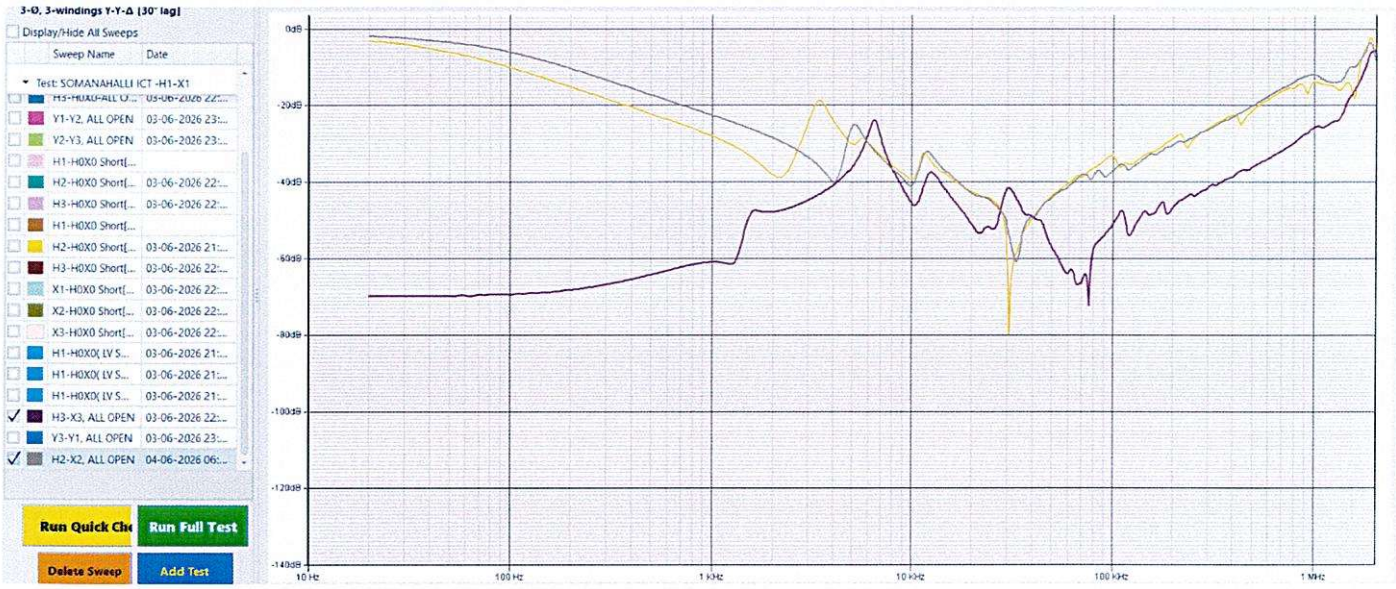
v. *SFRA Test :*

Set-1

1U-2U(H1-X1)—All open

1V-2V(H2-X2)—All open

1W-2W(H3-X3)—All open

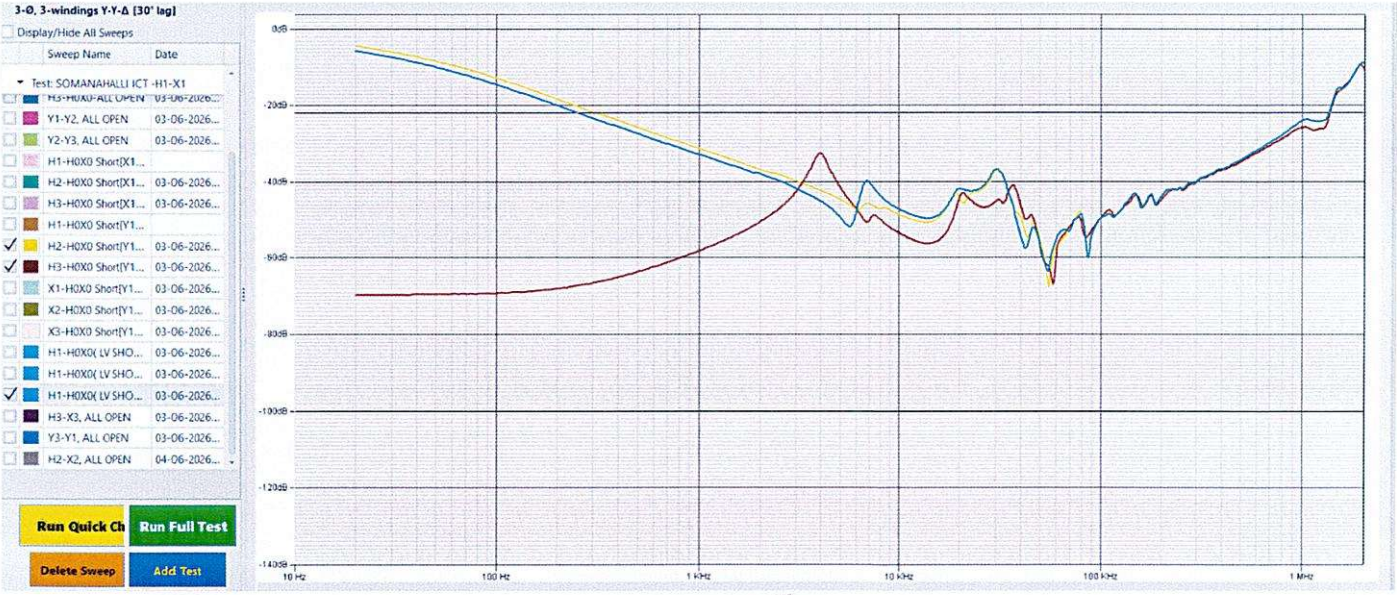


Set-2

1U-N(H1-H0X0)-- LV SHORT

1V-N(H2-H0X0) -- LV SHORT

1W-N(H3-H0X0)-- LV SHORT

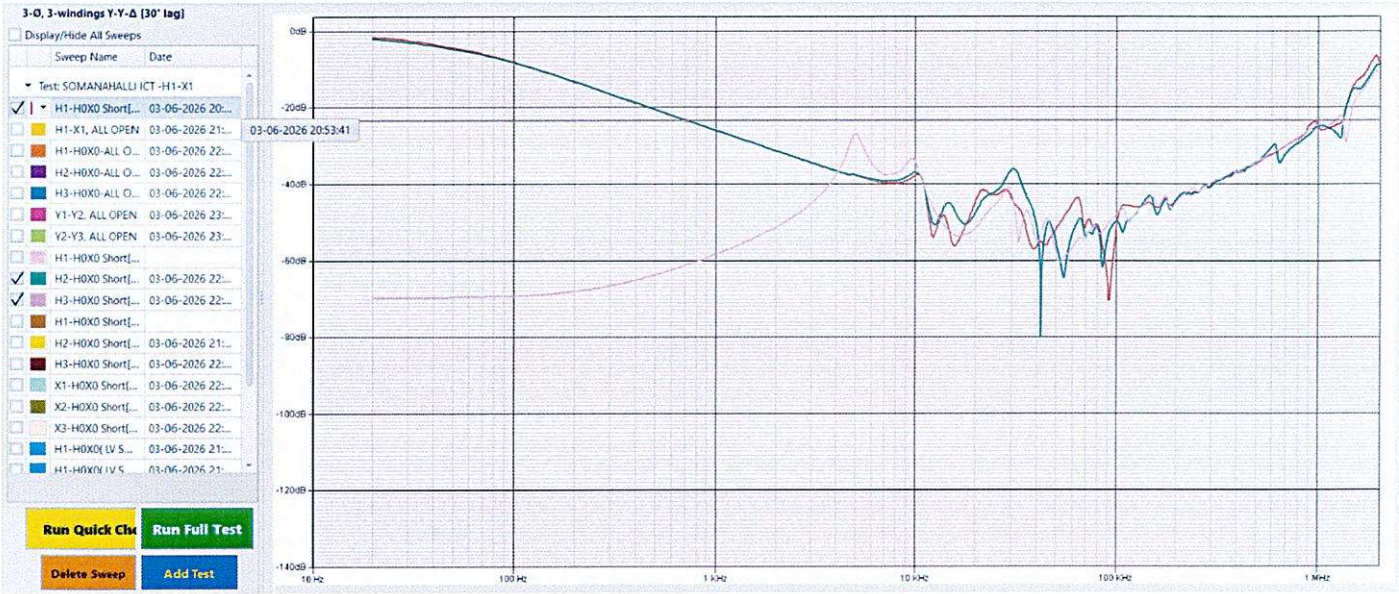


Set-3

1U-N(H1-H0X0)-- IV SHORT

1V-N(H2-H0X0) -- IV SHORT

1W-N(H3-H0X0)-- IV SHORT

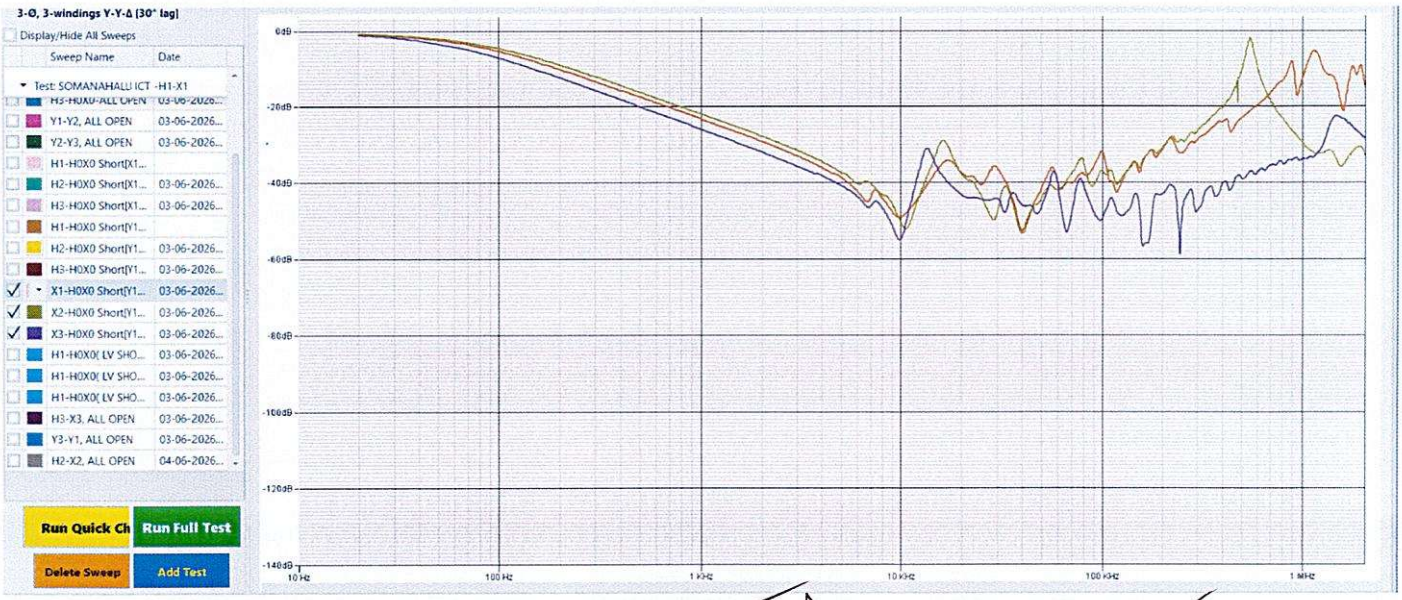


Set-4

2U-N(X1-H0X0)—LV short

2V-N(X2-H0X0)—LV short

2W-N(X3-H0X0)—LV short

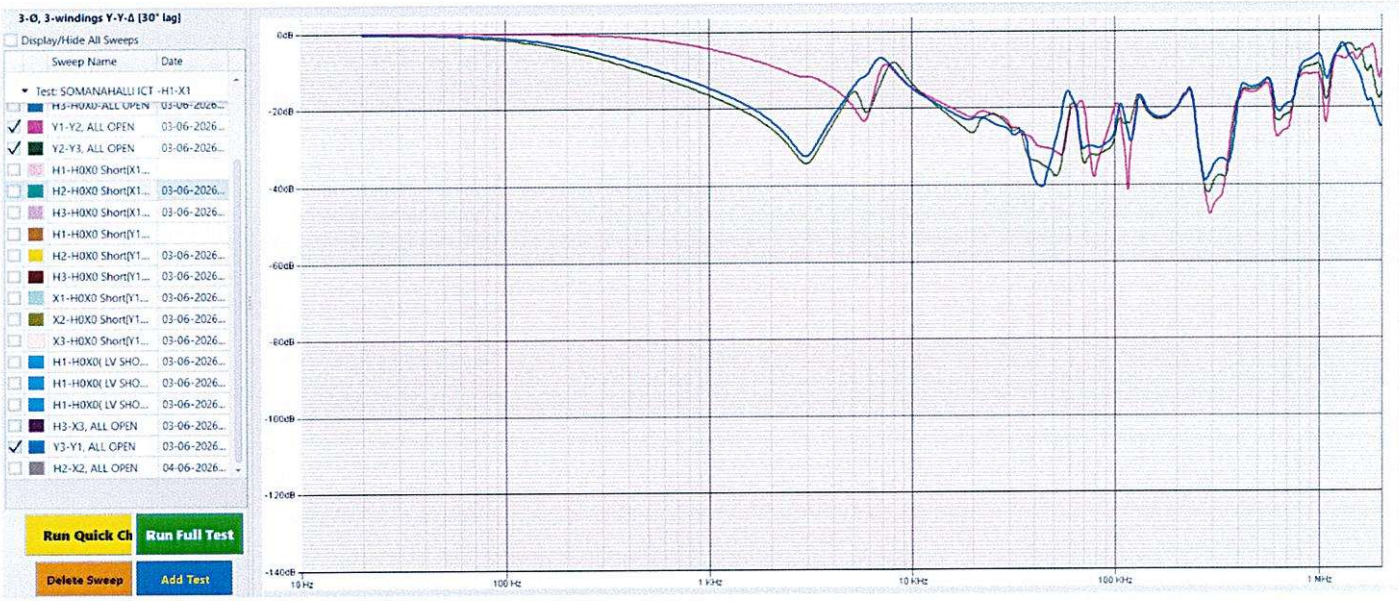


Set-5

3U-3V(Y1-Y2)—All open

3V-3W(Y2-Y3)-- All open

3W-3U(Y3-Y1)-- All open

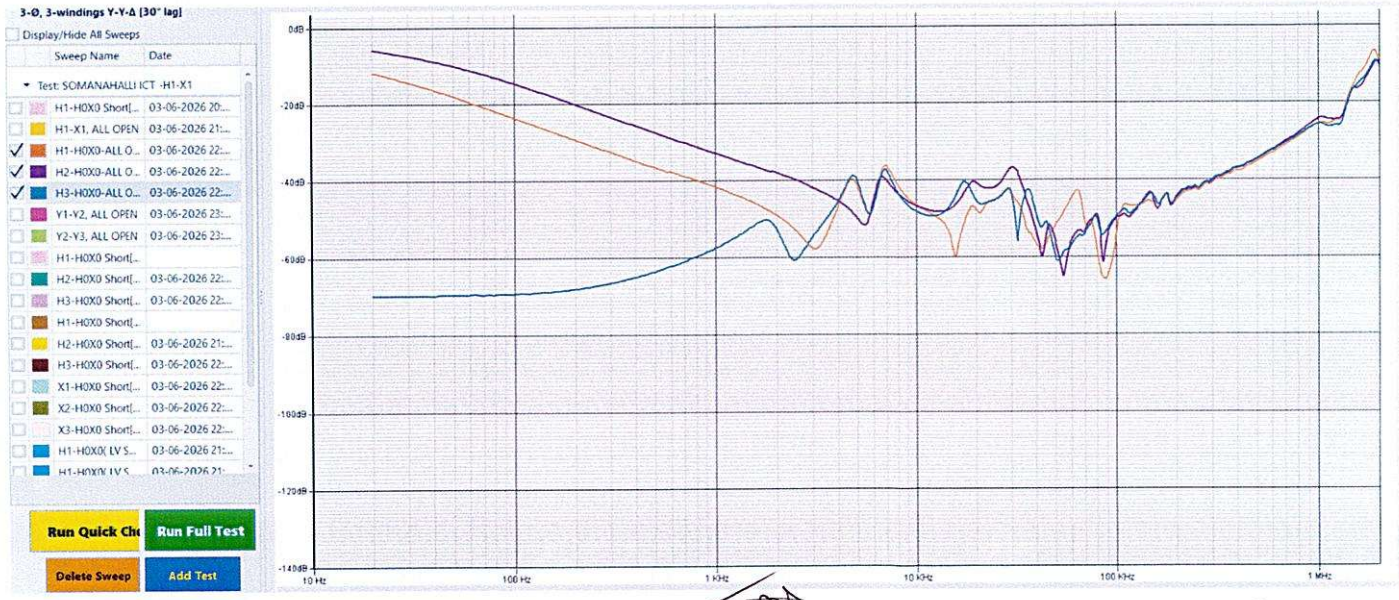


Set-6

1U-N(H1-H0X0)—All Open

1V-N(H2-H0X0) -- All Open

1W-N(H3-H0X0)-- All Open



CGL/T1/TTR/T10660/1

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Transformer (T1) Division

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Report No :	CGL/T1/TTR/T10660/1	Date :	16/05/2016

CUSTOMER NAME	PGCIL			
Type	Three Phase, Three Winding Auto Trafo Transformer			
W.O.NO.	T10660			
SR.NO.	T10660/1			
PRODUCT DETAILS	COOLING NAME	ONAN/ONAF/ODAF	ONAN/ONAF/ODAF	ONAN/ONAF/ODAF
	MVA	300/400/500	300/400/500	100/133/167
	WINDING TEMP. RISE	55 °C	55 °C	55 °C
	OIL TEMP. RISE	50 °C	50 °C	50 °C
	WINDING NAME	HV	IV	LV
	RATED VOLTAGE (kV)	400	220	33
	RATED CURRENT (A)	721.71	1312.2	2921.83
	BIL (kVp)	1300	950	250
	SIL (kVp)	1050	NA	NA
	CONNECTION TYPE	STAR	AUTO-STAR	OPEN DELTA
	VECTOR GROUP	YNa0d11		
	NO. OF PHASES	Three		
	FREQUENCY	50 Hz		
	TAPPING	TAP FROM 10 % TO -10 % IN STEPS OF 1.25 % ON HV TO VARY HV		
DATE OF RECEIPT OF TEST OBJECT	10/05/2016			
DATE OF TESTING	10/05/2016	TO	16/05/2016	
METHOD OF TEST	AS PER IEC:60076			
REMARK	ALL TEST PASSED SATISFACTORILLY (RESULT ENCLOSED)			

WITNESSED BY :

Mr. SUJOY SAHA, PGCIL

CHECKED BY :

F/ Pravin Zagade

Sr.Manager
Transformer (T1) Division
CG Power Systems

NOTE :-

1) This report can not be reproduced in part under any circumstances.
2) This report relates to the particular test object received for testing at CGL Transformer Test Laboratory
3) Any Correction in the report invalidates the report

CGL/T1/TTR/T10660/1

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Report No :	CGL/T1/TTR/T10660/1	Date :	16/05/2016
W.O.NO :	T10660	SR.NO :	T10660/1
Customer :	PGCIL		

Measurement of No Load Loss and No Load Current at 500 MVA

	NO LOAD LOSS(kW)		
	90 %	100 %	110 %
Guaranteed		78 (MAX)	
Measured	55.671	74.459	106.933
	% No Load Current		
	90	100	110
Guaranteed	--	1.0 % (IEC TOL)	--
Measured	0.023	0.036	0.15

Measurement of Load Loss & Impedance Voltage

IV/HV at 500 MVA

Tap	At @ 35.15 °C			Load Loss(kW) at 75 °C at 500 MVA		Impedance (%) at 75 °C at 500 MVA	
Pos	Voltage (V)	Current (Amp)	Power (kW)	Guaranteed	Measured	Guaranteed	Measured
1	23190.7	1,314.20	466.08	-	518.95	10.3 (± 15% TOL)	10.52
9	28248.5	1,311.00	452.16	510 (MAX)	493.18	12.5 (± 7.5% TOL)	12.85
17	37019.5	1,312.90	578.64	-	620.81	15.4 (± 15% TOL)	16.82

HV/LV at 167 MVA

Tap	At @ 37.85 °C			Load Loss(kW) at 75 °C at 167 MVA		Impedance (%) at 75 °C at 500 MVA	
Pos	Voltage (V)	Current (Amp)	Power (kW)	Guaranteed	Measured	Guaranteed	Measured
1	70274.9	188.22	276	-	390.20	-	55.63
9	73083.9	208.56	294.6	-	408.45	60 % (MIN)	63.23
17	72034.3	217.78	288.9	-	451.58	-	73.68

IV/LV at 167 MVA

Tap	At @ 37.85 °C			Load Loss(kW) at 75 °C at 167 MVA		Impedance (%) at 75 °C at 500 MVA	
Pos	Voltage (V)	Current (Amp)	Power (kW)	Guaranteed	Measured	Guaranteed	Measured
-	35374.8	439.72	377.73	-	404.50	45 % (MIN)	47.96

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INDEX

W. O. No. T10660 | Sr. No. : T10660/1

MVA : 500 | kV : 400/220/33

Freq. : 50 Hz. | COOLING : ONAN/ONAF/ODAF

Customer : PGCIL

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Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF VOLTAGE RATIO

HV/IV

TAP NO.	VOLTAGES (kV)		CAL. RATIO	MEASURED RATIO					
	HV	IV		1U-N / 2U-N	% Error	1V-N / 2V-N	% Error	1W-N / 2W-N	% Error
1	440.0000	220.0000	2.0000	2.0000	0.000	2.0000	0.000	2.0010	0.050
2	435.0000	220.0000	1.9773	1.9770	-0.015	1.9780	0.035	1.9790	0.086
3	430.0000	220.0000	1.9545	1.9560	0.077	1.9550	0.026	1.9560	0.077
4	425.0000	220.0000	1.9318	1.9320	0.010	1.9330	0.062	1.9340	0.114
5	420.0000	220.0000	1.9091	1.9090	-0.005	1.9090	-0.005	1.9110	0.100
6	415.0000	220.0000	1.8864	1.8870	0.032	1.8860	-0.021	1.8880	0.085
7	410.0000	220.0000	1.8636	1.8640	0.021	1.8640	0.021	1.8650	0.075
8	405.0000	220.0000	1.8409	1.8410	0.005	1.8410	0.005	1.8420	0.060
9(Nor)	400.0000	220.0000	1.8182	1.8190	0.044	1.8180	-0.011	1.8190	0.044
10	395.0000	220.0000	1.7955	1.7960	0.028	1.7940	-0.084	1.7950	-0.028
11	390.0000	220.0000	1.7727	1.7720	-0.039	1.7700	-0.152	1.7730	0.017
12	385.0000	220.0000	1.7500	1.7470	-0.171	1.7470	-0.171	1.7480	-0.114
13	380.0000	220.0000	1.7273	1.7250	-0.133	1.7240	-0.191	1.7260	-0.075
14	375.0000	220.0000	1.7045	1.7000	-0.264	1.7020	-0.147	1.7020	-0.147
15	370.0000	220.0000	1.6818	1.6780	-0.226	1.6780	-0.226	1.6790	-0.166
16	365.0000	220.0000	1.6591	1.6550	-0.247	1.6550	-0.247	1.6570	-0.127
17	360.0000	220.0000	1.6364	1.6320	-0.269	1.6320	-0.269	1.6330	-0.208

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Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF VOLTAGE RATIO

HV/LV

TAP NO.	VOLTAGES (kV)		CAL. RATIO	MEASURED RATIO					
	HV	LV		1U-N / 3U-3W	% Error	1V-N / 3V-3U	% Error	1W-N / 3W-3V	% Error
1	440.0000	33.0000	7.6982	7.7030	0.062	7.7020	0.049	7.7110	0.166
2	435.0000	33.0000	7.6107	7.6150	0.056	7.6090	-0.022	7.6200	0.122
3	430.0000	33.0000	7.5233	7.5290	0.076	7.5210	-0.031	7.5280	0.062
4	425.0000	33.0000	7.4358	7.4390	0.043	7.4360	0.003	7.4440	0.110
5	420.0000	33.0000	7.3483	7.3520	0.050	7.3460	-0.031	7.3530	0.064
6	415.0000	33.0000	7.2608	7.2630	0.030	7.2610	0.003	7.2680	0.099
7	410.0000	33.0000	7.1734	7.1760	0.036	7.1720	-0.020	7.1800	0.092
8	405.0000	33.0000	7.0859	7.0890	0.044	7.0850	-0.013	7.0930	0.100
9(Nor)	400.0000	33.0000	6.9984	6.9920	-0.091	6.9890	-0.134	6.9990	0.009
10	395.0000	33.0000	6.9109	6.9030	-0.114	6.9000	-0.158	6.9100	-0.013
11	390.0000	33.0000	6.8234	6.8180	-0.079	6.8200	-0.050	6.8280	0.067
12	385.0000	33.0000	6.7360	6.7310	-0.074	6.7280	-0.119	6.7370	0.015
13	380.0000	33.0000	6.6485	6.6460	-0.038	6.6420	-0.098	6.6500	0.023
14	375.0000	33.0000	6.5610	6.5550	-0.091	6.5500	-0.168	6.5580	-0.046
15	370.0000	33.0000	6.4735	6.4660	-0.116	6.4640	-0.147	6.4660	-0.116
16	365.0000	33.0000	6.3860	6.3760	-0.157	6.3760	-0.157	6.3870	0.016
17	360.0000	33.0000	6.2986	6.2880	-0.168	6.2850	-0.216	6.2930	-0.089

IV/LV

TAP NO.	VOLTAGES (kV)		CAL. RATIO	MEASURED RATIO					
	IV	LV		2U-N / 3U-3W	% Error	2V-N / 3V-3U	% Error	2W-N / 3W-3V	% Error
9(Nor)	220.0000	33.0000	3.8491	3.8520	0.075	3.8480	-0.029	3.8500	0.023

Results : All measured values are within ± 0.5 % tolerance of the specified values

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Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MAGNETIC BALANCE AND EXCITATION CURRENT

Magnetic Balance & Excitation Current for Tap 9 From HV Side.				
Applied Voltage ↓	1U - N [V]	1V - N [V]	1W - N [V]	Current (mA)
1U - N	**236**	225	17	1.49
1V - N	128	**236**	108	1.06
1W - N	16	228	**236**	1.53

Magnetic Balance & Excitation Current From IV Side.				
Applied Voltage ↓	2U - N [V]	2V - N [V]	2W - N [V]	Current (mA)
2U - N	**238**	225	15	3.90
2V - N	117	**237**	116	2.94
2W - N	13	223	**238**	3.78

Magnetic Balance & Excitation Current From LV Side.				
Applied Voltage ↓	3U - 3W [V]	3V - 3U [V]	3W - 3V [V]	Current (mA)
3U - 3W	**237**	206	30	27.50
3V - 3U	115	**238**	116	18.27
3W - 3V	27	211	**236**	26.90

Magnetising Current Measurement for Tap 9 From TV Side	
3-Phase	
Applied Voltage (V)	Current
3U - 3W = 409.00	24.59
3V - 3U = 412.00	40.70
3W - 3V = 409.00	50.60

WITNESSED BY	TESTED BY	CHECKED BY

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

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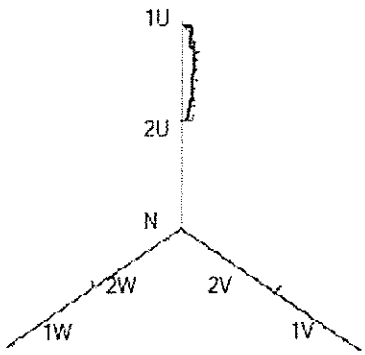
Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

VECTOR GROUP VERIFICATION

Shorted : 1U-2U

3-Phase Supply : 1U-1V-1W



Measured		
1U-1V	413	Volts
1V-1W	407	Volts
1W-1U	407	Volts
1V-2V	149	Volts
1W-2W	146	Volts
1V-2W	338	Volts
1W-2V	334	Volts

(1V-2V) ≈ (1W-2W)	149 ≈ 146
(1V-2W) ≈ (1W-2V)	338 ≈ 334

Hence, Vector Group YNa0 is confirmed.

WITNESSED BY	TESTED BY	CHECKED BY

ISO/IEC 17025 NABL NO.T1620	CGL/T1/TTR/T10660/1 **TEST CERTIFICATE** **CG Power Systems** **Transformer (T1) Division**	Smart solutions. Strong relationships

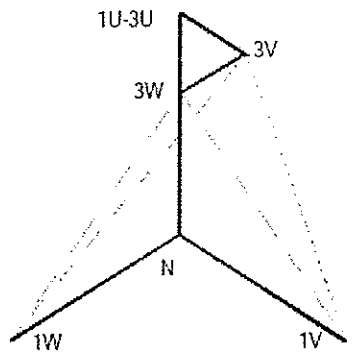
Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

VECTOR GROUP VERIFICATION

Shorted : 1U-3U

3-Phase Supply : 1U-1V-1W



Measured		
1U-1V	410	Volts
1V-1W	407	Volts
1W-1U	405	Volts
1V-3V	382	Volts
1V-3W	381	Volts
1W-3V	409	Volts
1W-3W	378	Volts

(1V-3V) ≈(1V-3W)	382 ≈ 381
(1W-3V) >(1W-3W)	409 > 378

Hence, Vector Group <u>YNd11</u> is confirmed.

WITNESSED BY	TESTED BY	CHECKED BY

TEST RESULT

MEASUREMENT OF IMPEDANCE @ LOW VOLTAGE

DATE : 10/05/2016 W.O.NO. : T10660 SERIAL NO. : T10660/1

MVA : 500 CUSTOMER : PGCIL.

Combination : HV/IV

Supplied Winding: HV Tesed MVA : 500 MVA

Shorted Winding: IV Impedance MVA : 500 MVA

Tap No	Rated Voltage (kV)	Rated Current (Amps)	Test Current (Amps)	Voltmeter Reading (Volts)	Test Frequency (Hz)	% Imp. 500 MVA & Rated Freq 50 Hz.
1	440.000	656.1	5.86	415	50.0	10.57
9	400.000	721.7	5.79	417	49.9	13.03
17	360.000	801.9	5.47	414	50.0	16.88

Combination : HV/LV

Supplied Winding: HV Tesed MVA : 167 MVA

Shorted Winding: LV Impedance MVA : 500 MVA

Tap No	Rated Voltage (kV)	Rated Current (Amps)	Test Current (Amps)	Voltmeter Reading (Volts)	Test Frequency (Hz)	% Imp. 500 MVA & Rated Freq 50 Hz.
1	440.000	219.1	1.04	417	50.0	60.03
9	400.000	241.0	1.14	414	50.1	65.25
17	360.000	267.8	1.19	417	50.1	77.74

Combination : IV/LV

Supplied Winding: IV Tesed MVA : 167 MVA

Shorted Winding: LV Impedance MVA : 500 MVA

Tap No	Rated Voltage (kV)	Rated Current (Amps)	Test Current (Amps)	Voltmeter Reading (Volts)	Test Frequency (Hz)	% Imp. 500 MVA & Rated Freq 50 Hz.
-	220.000	438.3	4.98	419	50.0	50.19

Witnessed By: Checked By: Tested By:

CGL/T1/TTR/T10660/1

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Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF WINDING RESISTANCE

Series (400 kV) Winding Resistance in milliOhms

Top Oil Temp. : 44.2°C Bottom Oil Temp. : 39.9°C Avg. Oil Temp. : 42.05°C					
TAP NO.	1U-2U	1V-2V	1W-2W	Avg. Resistance @ 42.05°C	Total Resistance @ 75 °C
1	156.040000	154.930000	155.620000	155.530000	522.082242
2	151.470000	150.360000	151.050000	150.960000	506.741766
3	146.860000	145.750000	146.430000	146.346700	491.255721
4	142.240000	141.140000	141.800000	141.726700	475.747347
5	137.640000	136.530000	137.200000	137.123300	460.294905
6	133.050000	131.950000	132.610000	132.536700	444.898395
7	128.480000	127.380000	128.040000	127.966700	429.557793
8	123.930000	122.890000	123.460000	123.426700	414.317991
9(Nor)	119.100000	118.020000	118.660000	118.593300	398.093475
10	124.040000	122.970000	123.610000	123.540000	414.698433
11	128.650000	127.560000	128.220000	128.143300	430.150851
12	133.220000	132.130000	132.810000	132.720000	445.513809
13	137.800000	136.700000	137.370000	137.290000	460.854336
14	142.350000	141.260000	141.940000	141.850000	476.161314
15	146.900000	145.800000	146.480000	146.393300	491.412357
16	151.450000	150.440000	151.050000	150.980000	506.808867
17	155.990000	154.890000	155.590000	155.490000	521.948040

Common (220 kV) Winding Resistance in milliOhms

Top Oil Temp. : 44.2°C Bottom Oil Temp. : 39.9°C Avg. Oil Temp. : 42.05°C					
TAP NO.	2U-N	2V-N	2W-N	Avg. Resistance @ 42.05°C	Total Resistance @ 75 °C
-	173.320000	172.350000	172.440000	172.703300	579.729618

LV (33 kV) Winding Resistance in milliOhms (OPEN DELTA CONDITION)

Top Oil Temp. : 44.2°C Bottom Oil Temp. : 39.9°C Avg. Oil Temp. : 42.05°C					
TAP NO.	3U- 3W	3V1-3V2	3W-3V	Avg. Resistance @ 42.05°C	Total Resistance @ 75 °C
-	22.936000	22.818000	22.718000	22.824000	76.615482

WITNESSED BY	TESTED BY	CHECKED BY

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

Smart solutions.
Strong relationships

Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF INSULATION RESISTANCE OF WINDING

Top Oil Temp. : 44.2°C Bottom Oil Temp. : 39.9°C Avg. Oil Temp. : 42.05°C			
Insulation Resistance in GigaOhms			
Measured Between	HV+IV / LV+E	LV / HV+IV+E	HV+IV / LV
Test Voltage[Volts]	5000	5000	5000
15 Seconds	0.738	0.535	0.879
60 Seconds	1.09	1.10	1.74
600 Seconds	2.14	3.34	5.17
Polarisation Index (600/ 60)	1.96	3.04	2.97

WITNESSED BY	TESTED BY	CHECKED BY

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

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Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

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Date :10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MAGNETIC CIRCUIT TEST

2 kV AC VOLTAGE WITHSTAND TEST

Terminals Under Test	Test Voltage [kV]	Test Duration [Seconds]	Result
Core / Frame	2	60	WITHSTOOD OK
Core / Tank	2	60	WITHSTOOD OK
Frame / Tank	2	60	WITHSTOOD OK

WITNESSED BY	TESTED BY	CHECKED BY
		510043

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

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Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

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Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA :500 **Customer :** PGCIL

MEASUREMENT OF CAPACITANCE AND DISSIPATION FACTOR

For Winding

Top Oil Temp. : 44.2°C	Bottom Oil Temp. : 39.9°C	Avg. Oil Temp. : 42.05°C		
Measured Between	Test Voltage [kV]	Capacitance pF	Tan Delta in % @ 42.05 °C	Tan Delta in % @ 20 °C
HV+IV+N/LV+E	10.00	15644.210	0.282	0.173
LV/HV+IV+N+E	10.00	26653.430	0.265	0.162
HV+IV+N/LV+g	10.00	8536.160	0.340	0.208
LV/HV+IV+N+g	10.00	19537.190	0.283	0.173
HV+IV+N/LV	10.00	7124.170	0.225	0.138

tan delta @ 20°C= Tan Delta @ Test Temp./ K, where K =0.6428 X e (0.0222x Avg. Temp.)

For Bushing

Top Oil Temp. : 44.2°C | Bottom Oil Temp. : 39.9°C | Avg. Oil Temp. : 42.05°C				
Terminal Connected	Make / Sr. No.	Test voltage [kV]	Capacitance [pF]	Tan Delta in % @ 42.05 °C
1U	CGL/S-73169	10.00	545.240	0.268
1V	CGL/S-73201	10.00	565.310	0.318
1W	CGL/S-73202	10.00	552.940	0.262
2U	CGL/S-2453005668	10.00	387.270	0.236
2V	CGL/S-2453005663	10.00	385.900	0.269
2W	CGL/S-2453005664	10.00	390.390	0.291
3U	TRENCH/1601146	10.00	552.840	0.289
3V	TRENCH/1601147	10.00	549.450	0.287
3W	TRENCH/1601145	10.00	555.700	0.282

NOTE : HV & IV BUSHINGS USED ARE ONLY FOR TESTING PURPOSE

WITNESSED BY	TESTED BY	CHECKED BY

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

ISO/IEC 17025 NABL NO.T1620	CGL/T1/TTR/T10660/1 **TEST CERTIFICATE** **CG Power Systems** **Transformer (T1) Division**	Smart solutions. Strong relationships

Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

APPLIED VOLTAGE TEST

Winding's Under Test	Test volt [kV]	Test Time(Sec)	Freq.[Hz]	Remarks
HV + IV+N wdg to other wdg and Tank	38	60	50	WITHSTOOD OK
LV wdg to other wdg and Tank	95	60	50	WITHSTOOD OK

WITNESSED BY	TESTED BY	CHECKED BY
		510043

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

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ISO/IEC 17025
NABL NO.T1620

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Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA: 500 **Customer :** PGCIL

MEASUREMENT OF NO LOAD LOSS AND NO LOAD CURRENT

Base MVA for % No-load Current (MVA) : 500
Tap Position No. : 9
Transformer Energised from : LV
Before Dielectric Tests Date : 10/05/2016

% kV	Freq. [Hz]	C.T. Ratio / P.T. Ratio	R.M.S. Volt (kV) / Avg. Volt (kV)	Current Reading (Amp) U	V	W	Avg.	No Load Loss (kW)	No Load Current as % of rated Current	Corr. Losses (kW)
				Power Reading (kW) W1	W2	W3	Total			
90	50.00	30/1	29.681	2.0308	1.4392	2.5666	2.012	55.630	0.023	55.671
		66000/110	29.703	22.640	9.765	23.225	55.630			
100	50.00	30/1	32.961	3.7425	2.0718	3.5552	3.123	74.360	0.036	74.459
		66000/110	33.005	29.758	7.056	37.550	74.364			
110	50.01	30/1	36.159	16.2807	10.8981	12.1617	13.114	106.490	0.150	106.933
		66000/110	36.310	41.940	-23.612	88.160	106.488			

WITNESSED BY	TESTED BY	CHECKED BY
		810043

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

ISO/IEC 17025 NABL NO.T1620	CGL/T1/TTR/T10660/1 **TEST CERTIFICATE** **CG Power Systems** **Transformer (T1) Division**	Smart solutions. Strong relationships

Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

TESTS ON ON - LOAD TAP CHANGER (OLTC)

OLTC Make	:	Easun-MR
OLTC Serial Number	:	501375
Type	:	3 x MI 1203 300/D 10.19.3W MA-2

- **Eight complete operating cycles with the transformer not energized**
- **One complete operating cycle with the transformer not energized, with 85% of the rated auxiliary supply voltage**
- **One complete operating cycle of OLTC with the transformer energized at rated voltage and frequency at No-Load carried out and found satisfactory**
- **Ten tap-changed operations with ±2 steps on either side of the principal tapping with rated current of the transformer with one winding short-circuited, carried out and found satisfactory**

WITNESSED BY	TESTED BY	CHECKED BY

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

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NABL NO.T1620

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Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

SWITCHING IMPULSE VOLTAGE WITHSTAND TEST

Rated Voltage	Test Voltage [kVp]			Waveform	Polarity
[kV]	-	-	SI	Tp/Td/Tz	
400	-	-	1050	[≥100/≥200/≥1000 µS]	[-] Negative

Phase Applied	Phase - 1U			Phase - 1V			Phase - 1W		
Terminal	HV - 1U			HV - 1V			HV - 1W		
Tap Position	-			-			-		
WaveShape	321.8/307.6/>1000 µS			325.3/301.2/>1000 µS			320.9/304.9/>1000 µS		
Test Sequence	Wave No.	Voltage		Wave No.	Voltage		Wave No.	Voltage	
		[%]	[kVp]		[%]	[kVp]		[%]	[kVp]
RFW	1	61.92	650.2	1	62.78	659.2	1	62.17	652.8
FW	2	99.81	1048	2	101.14	1062	2	99.05	1040
FW	3	100.10	1051	3	100.29	1053	3	99.71	1047
FW	4	100.19	1052	4	99.52	1045	4	99.81	1048

RFW : Reduced Full Wave / FW : Full Wave

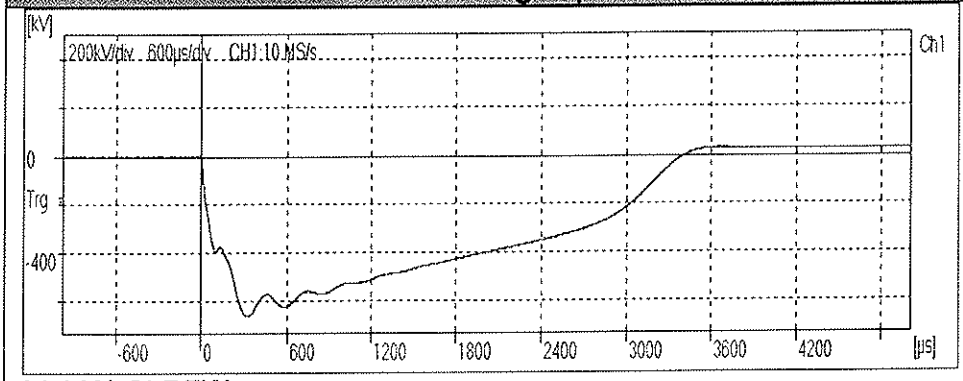
Result : Transformer withstood the Test Satisfactory.

WITNESSED BY	TESTED BY	CHECKED BY

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

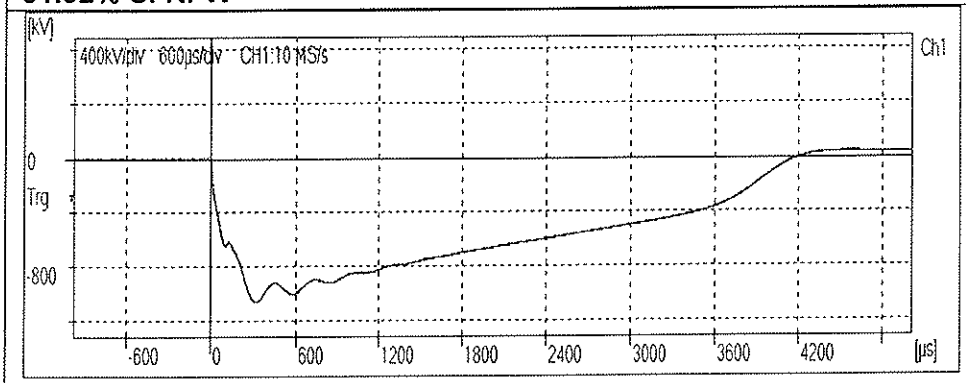
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	11/05/2016

SI - Switching Impulse on HV, Terminal 1U



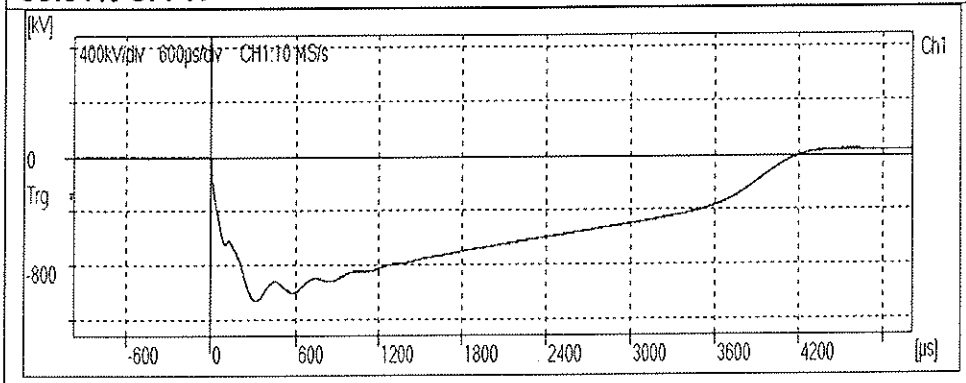
61.92% SI RFW

No. = 4323
Up = -650.2 kV
Tp = 321.8 µs
Td = 307.6 µs
Tz = >1000 µs



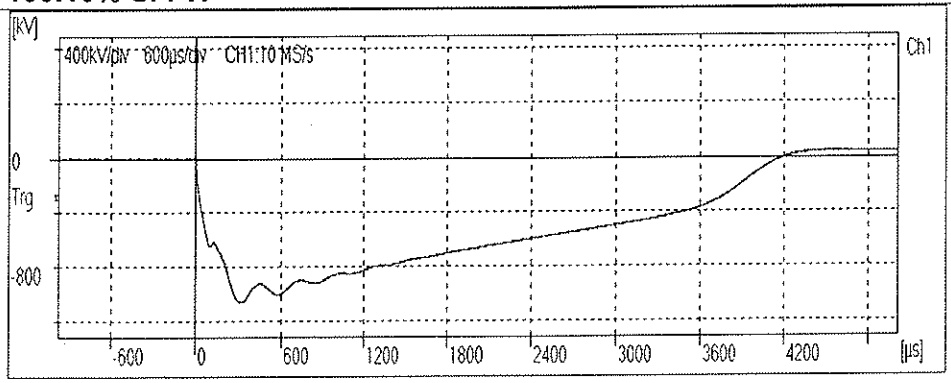
99.81% SI FW

No. = 4325
Up = -1048 kV
Tp = 322.4 µs
Td = 308.7 µs
Tz = >1000 µs



100.10% SI FW

No. = 4327
Up = -1051 kV
Tp = 322.1 µs
Td = 312.4 µs
Tz = >1000 µs



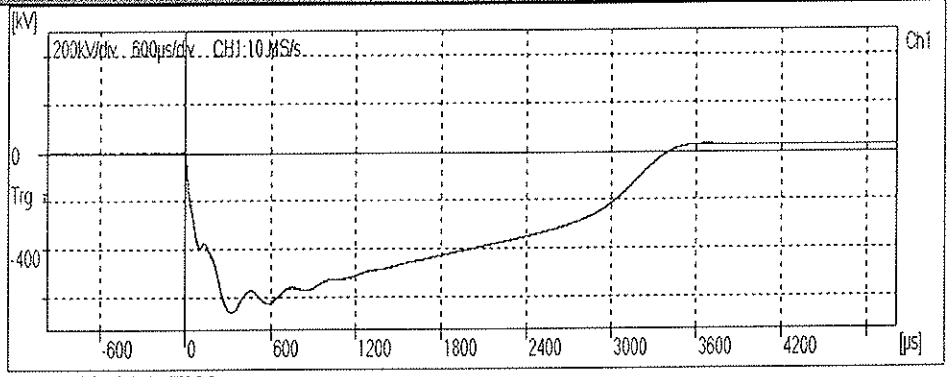
100.19% SI FW

No. = 4329
Up = -1052 kV
Tp = 322.5 µs
Td = 312.7 µs
Tz = >1000 µs

WITNESSED BY : TESTED BY : CHECKED BY :

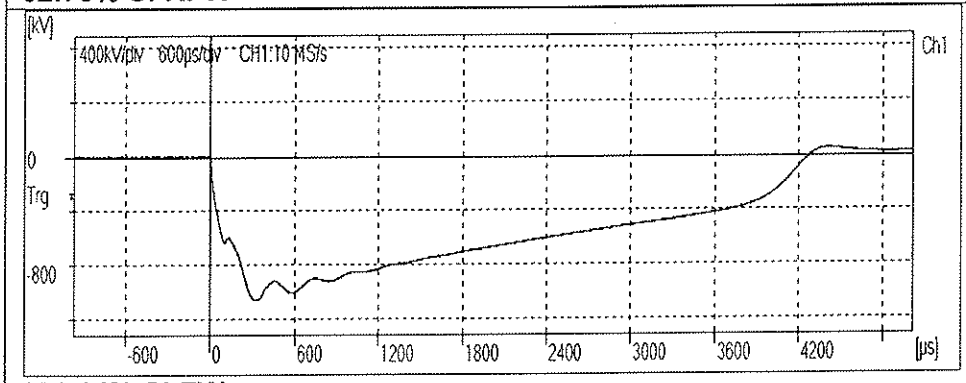
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	11/05/2016

SI - Switching Impulse on HV, Terminal 1V



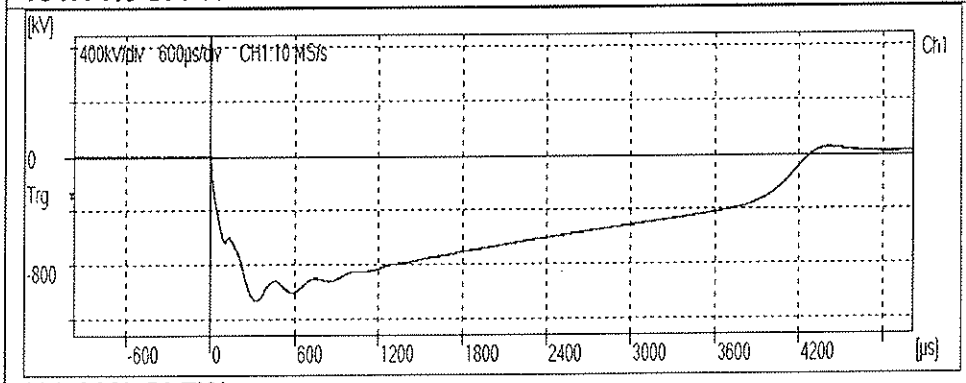
62.78% SI RFW

No. = 4331
Up = -659.2 kV
Tp = 325.3 µs
Td = 301.2 µs
Tz = >1000 µs



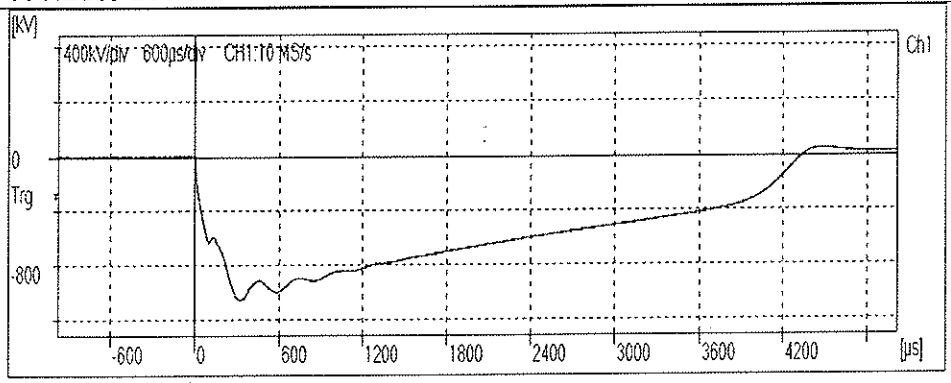
101.14% SI FW

No. = 4333
Up = -1062 kV
Tp = 325.7 µs
Td = 307.5 µs
Tz = >1000 µs



100.29% SI FW

No. = 4335
Up = -1053 kV
Tp = 325.5 µs
Td = 308.9 µs
Tz = >1000 µs



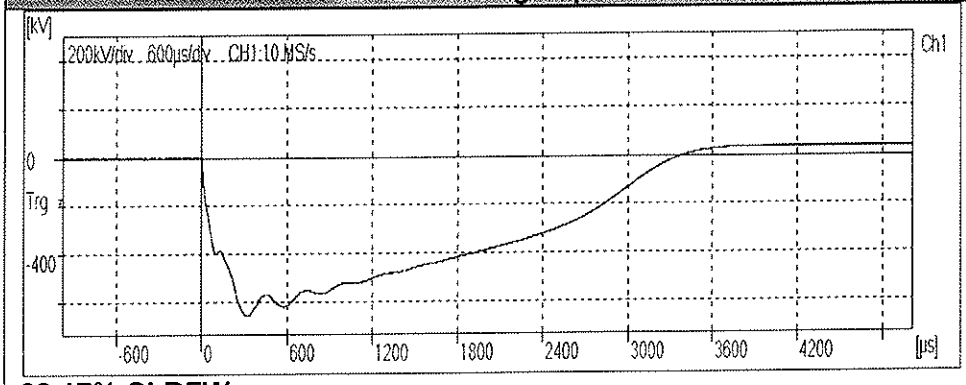
99.52% SI FW

No. = 4337
Up = -1045 kV
Tp = 325.8 µs
Td = 308.7 µs
Tz = >1000 µs

WITNESSED BY : TESTED BY : CHECKED BY :

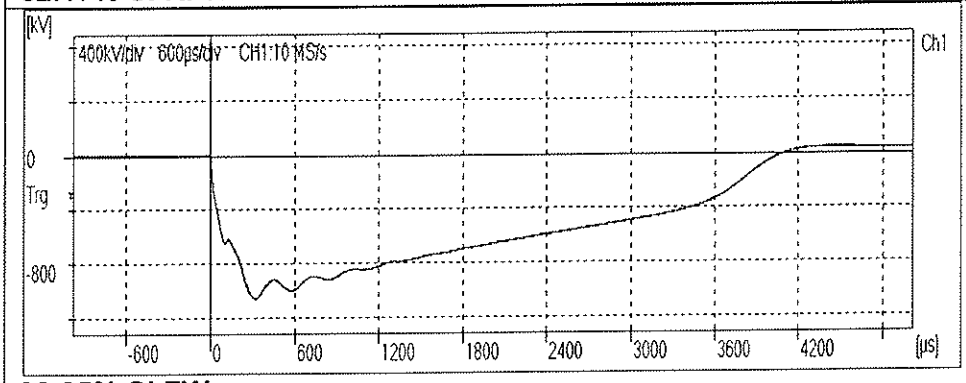
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	11/05/2016

SI - Switching Impulse on HV, Terminal 1W



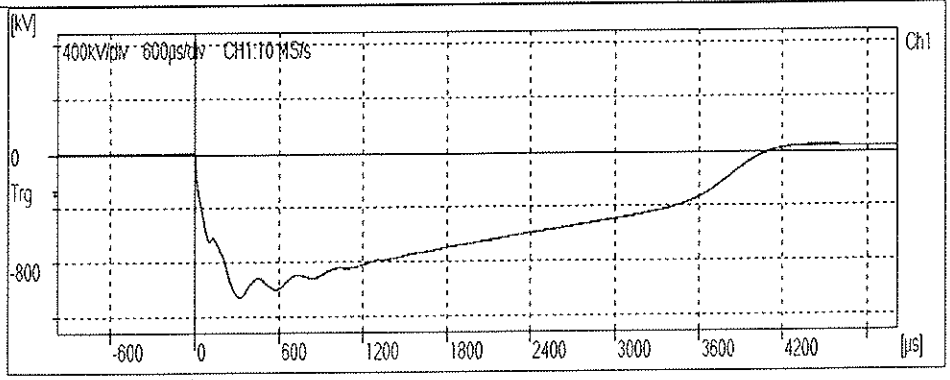
62.17% SI RFW

No. = 4339
Up = -652.8 kV
Tp = 320.9 µs
Td = 304.9 µs
Tz = >1000 µs



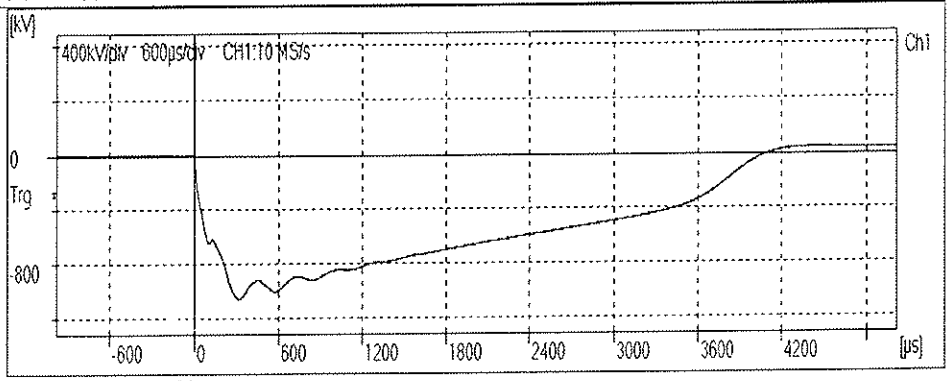
99.05% SI FW

No. = 4341
Up = -1040 kV
Tp = 321.5 µs
Td = 308.4 µs
Tz = >1000 µs



99.71% SI FW

No. = 4343
Up = -1047 kV
Tp = 321.6 µs
Td = 312.7 µs
Tz = >1000 µs



99.81% SI FW

No. = 4345
Up = -1048 kV
Tp = 321.6 µs
Td = 313.8 µs
Tz = >1000 µs

WITNESSED BY : TESTED BY : CHECKED BY :

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

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Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

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Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST

Rated Voltage	Test Voltage [kVp]			Standard Waveform	Polarity
[kV]	FW	CW	-	T1/T2/Tc	
400	1300	1430	-	[1.2 ± 0.36 / 50 ± 10/3-6] µS	[-] Negative

Phase Applied	Phase - 1U	Phase - 1V	Phase - 1W
Terminal	HV - 1U	HV - 1V	HV - 1W
Tap Position	1	9	17
WaveShape	1.921/45.95/4.400 µs	1.900/46.06/4.400 µs	1.912/46.10/4.390 µs

Test Sequence	Wave No.	Voltage		Wave No.	Voltage		Wave No.	Voltage	
		[%]	[kVp]		[%]	[kVp]		[%]	[kVp]
RFW	1	61.95	805.4	1	61.92	804.9	1	61.87	804.3
FW	2	99.85	1298	2	99.92	1299	2	99.92	1299
RCW	3	61.95	805.3	3	62.09	807.2	3	61.99	805.9
FCW	4	109.54	1424	4	109.38	1422	4	109.46	1423
FCW	5	109.62	1425	5	109.38	1422	5	109.54	1424
FW	6	100.23	1303	6	100.08	1301	6	100.00	1300
FW	7	99.69	1296	7	100.00	1300	7	99.92	1299

RFW : Reduced Full Wave / FW : Full Wave / RCW : Reduced Chopped Wave / CW : Chopped Wave

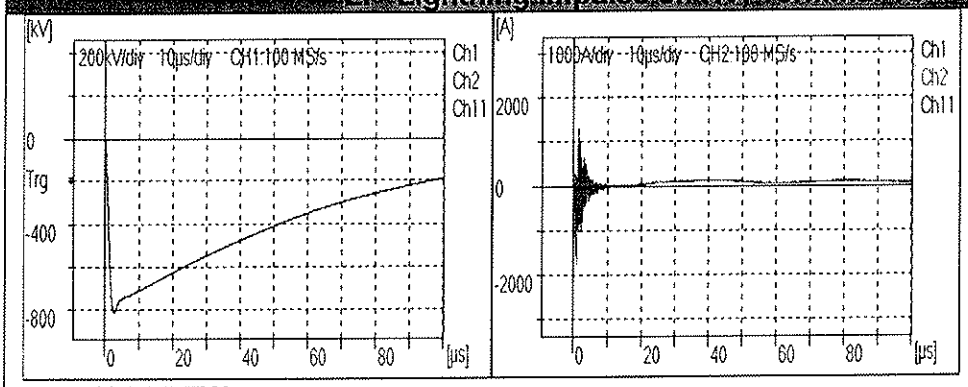
Result : Transformer withstood the Test Satisfactory.

WITNESSED BY	TESTED BY	CHECKED BY
		5/10/13

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

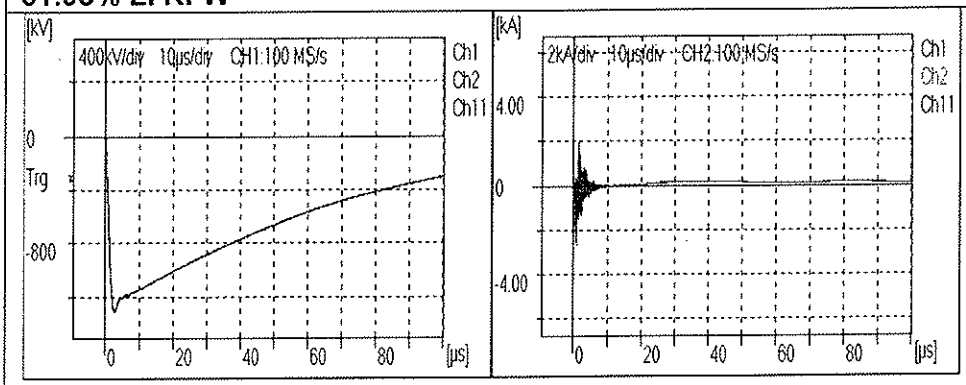
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on HV Terminal 1U



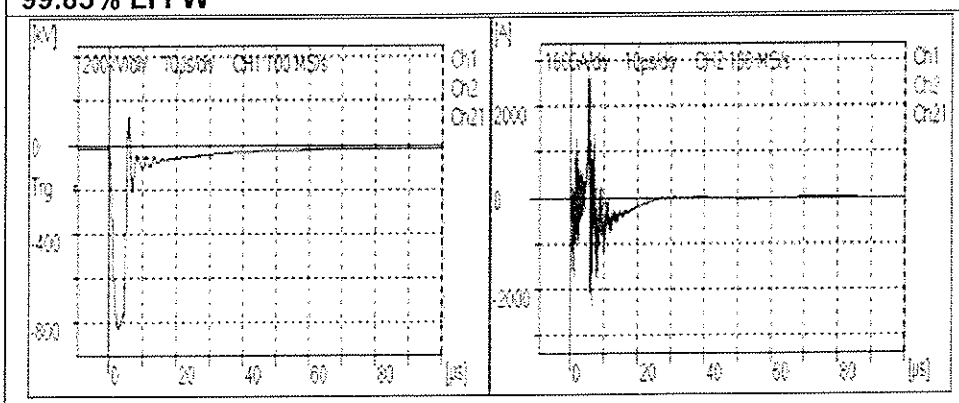
No. = 4228
Up = -805.4 kV
T1 = 1.921 µs
T2 = 45.95 µs
Ip = -1868 A
β = 4.510 %

61.95% LI RFW



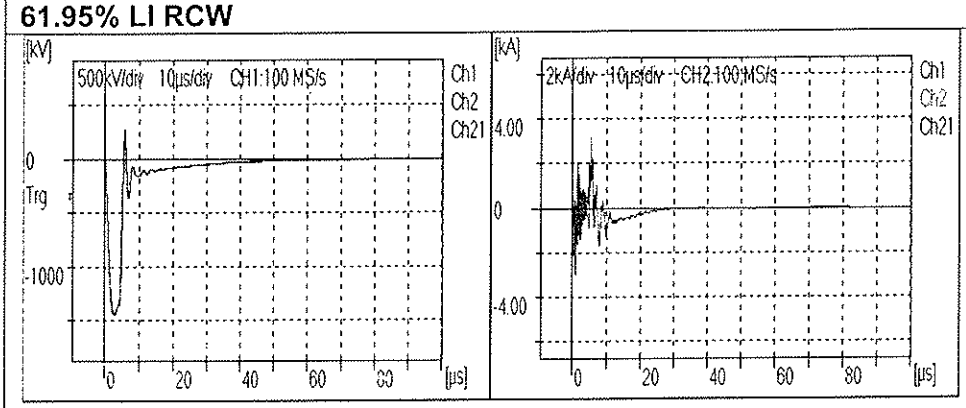
No. = 4229
Up = -1298 kV
T1 = 1.935 µs
T2 = 46.14 µs
Ip = -2854 A
β = 4.101 %

99.85% LI FW



No. = 4230
Up = -805.3 kV
T1 = 1.919 µs
Tc = 4.400 µs
Ip = 2838 A

61.95% LI RCW



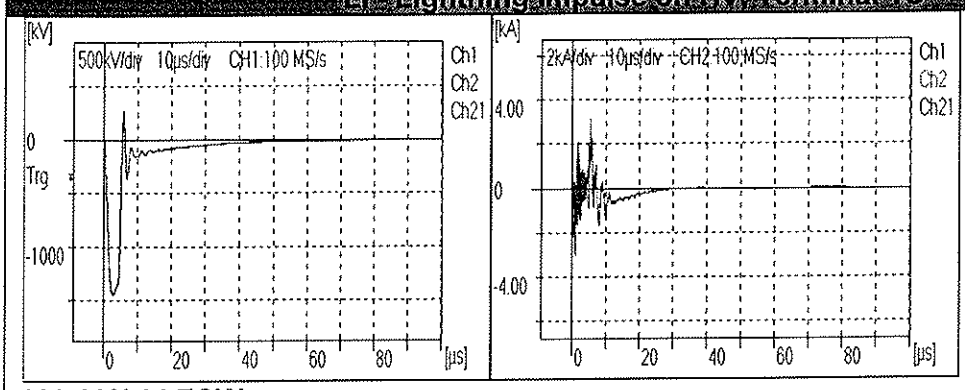
No. = 4231
Up = -1424 kV
T1 = 1.938 µs
Tc = 4.740 µs
Ip = 3142 A

109.54% LI FCW

WITNESSED BY : TESTED BY : CHECKED BY :

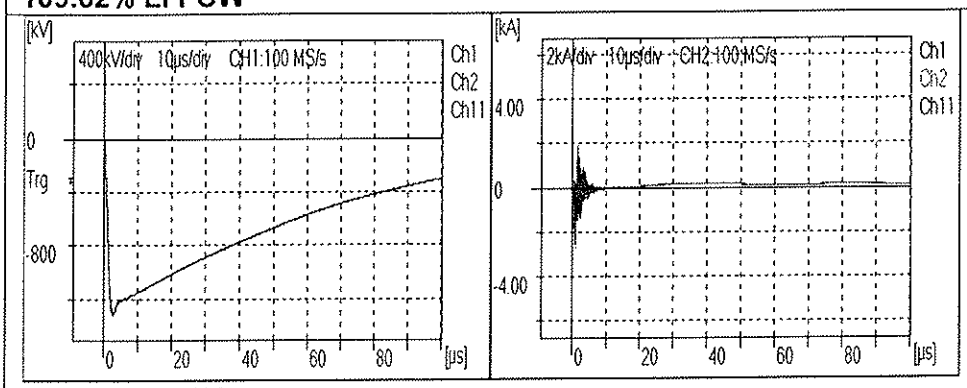
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on HV Terminal 1U



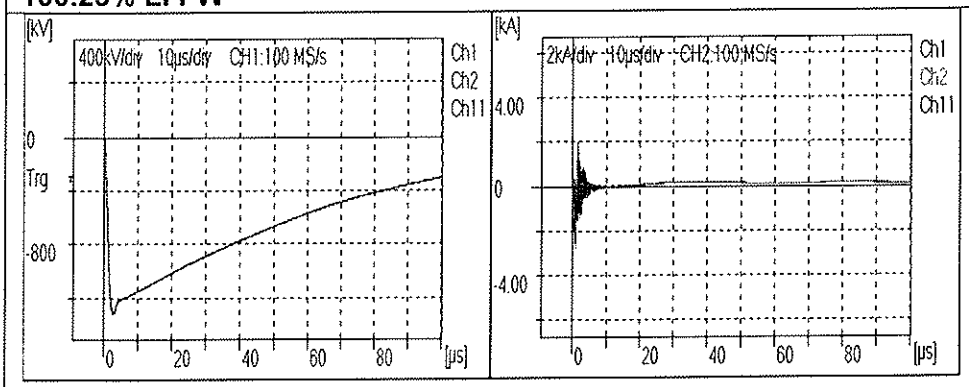
109.62% LI FCW

No. = 4232
Up = -1425 kV
T1 = 1.931 µs
Tc = 4.700 µs
Ip = 3169 A



100.23% LI FW

No. = 4233
Up = -1303 kV
T1 = 1.933 µs
T2 = 46.08 µs
Ip = -2832 A
β = 4.709 %



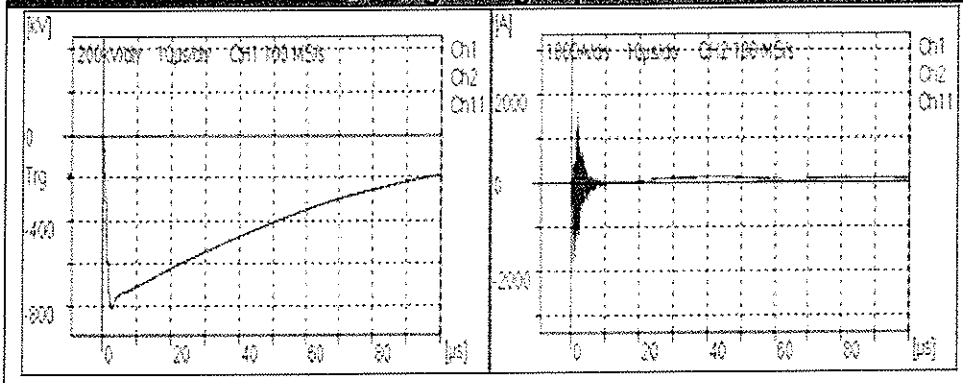
99.69% LI FW

No. = 4234
Up = -1296 kV
T1 = 1.930 µs
T2 = 46.13 µs
Ip = -2828 A
β = 4.685 %

WITNESSED BY : TESTED BY CHECKED BY :

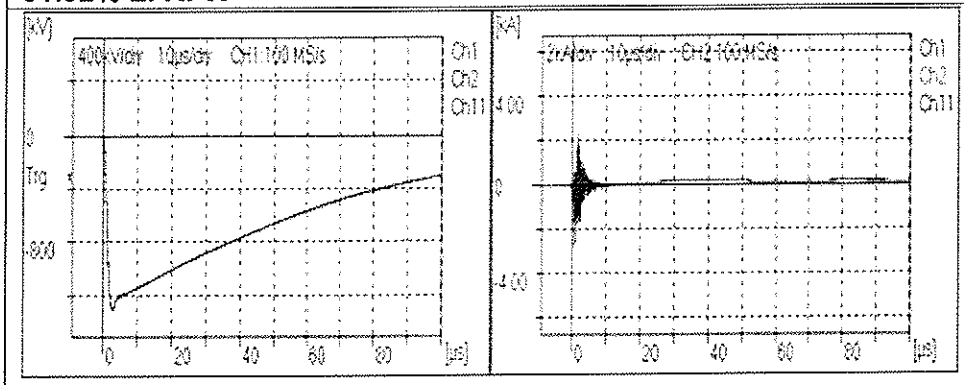
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on HV Terminal - LV



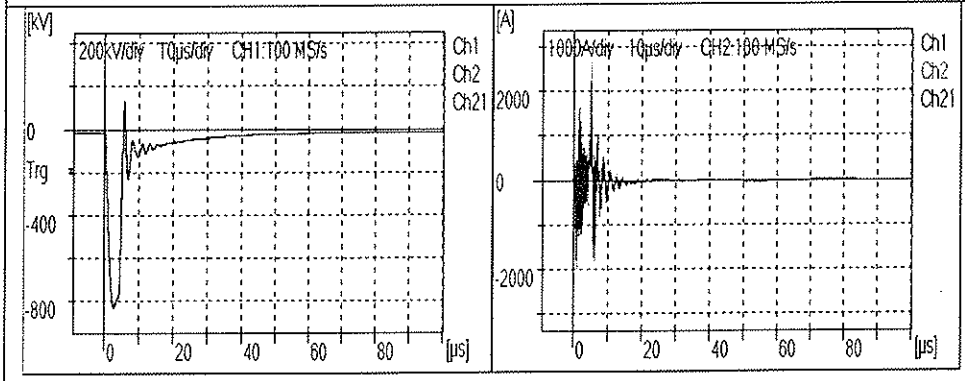
No. = 4236
Up = -804.9 kV
T1 = 1.900 µs
T2 = 46.06 µs
Ip = -1892 A
β = 4.460 %

61.92% LI RFW



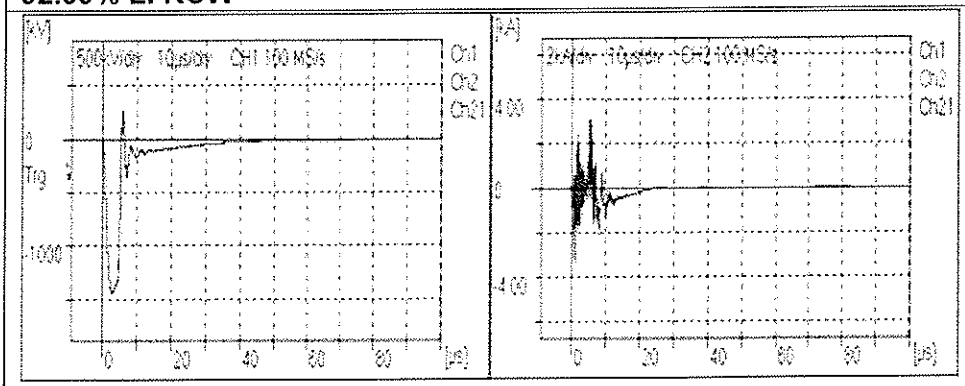
No. = 4237
Up = -1299 kV
T1 = 1.914 µs
T2 = 46.24 µs
Ip = -2882 A
β = 4.665 %

99.92% LI FW



No. = 4239
Up = -807.2 kV
T1 = 1.902 µs
Tc = 4.400 µs
Ip = 2897 A

92.09% LI RCW



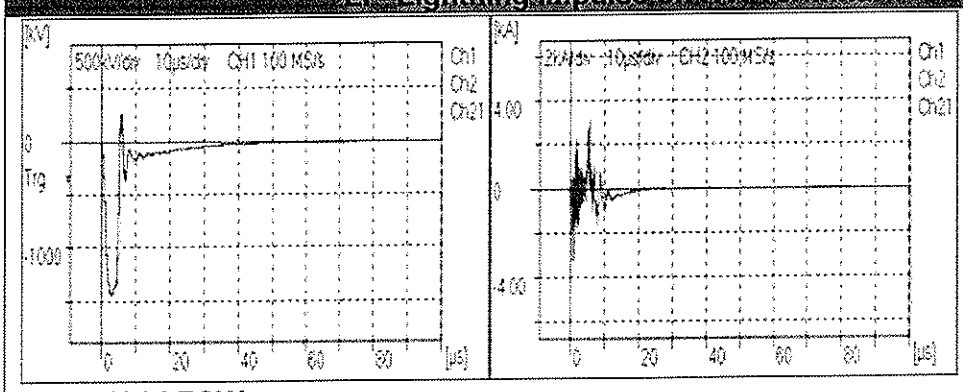
No. = 4240
Up = -1422 kV
T1 = 1.919 µs
Tc = 4.750 µs
Ip = 3194 A

109.38% LI FCW

WITNESSED BY : TESTED BY : CHECKED BY :

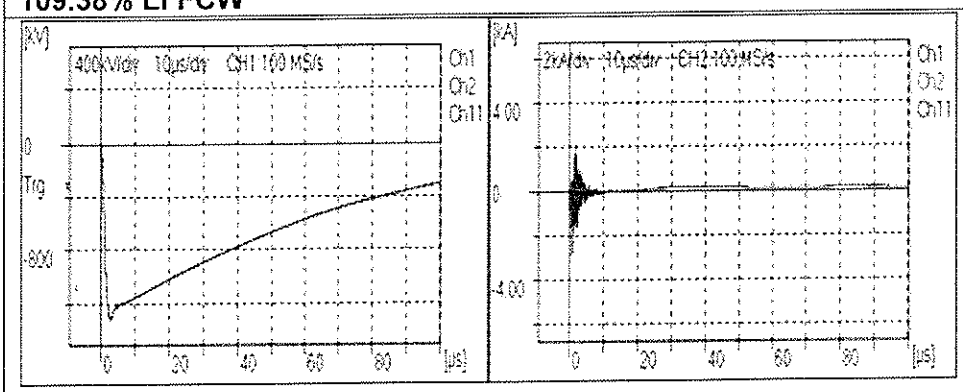
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on HV Terminal 1V



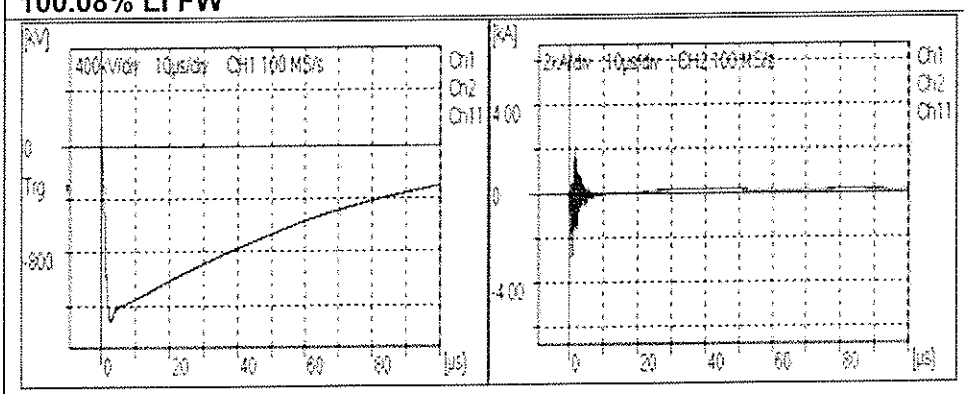
109.38% LI FCW

No. = 4241
Up = -1422 kV
T1 = 1.914 µs
Tc = 4.700 µs
Ip = 3123 A



100.08% LI FW

No. = 4242
Up = -1301 kV
T1 = 1.916 µs
T2 = 46.19 µs
Ip = -2879 A
β = 4.601 %



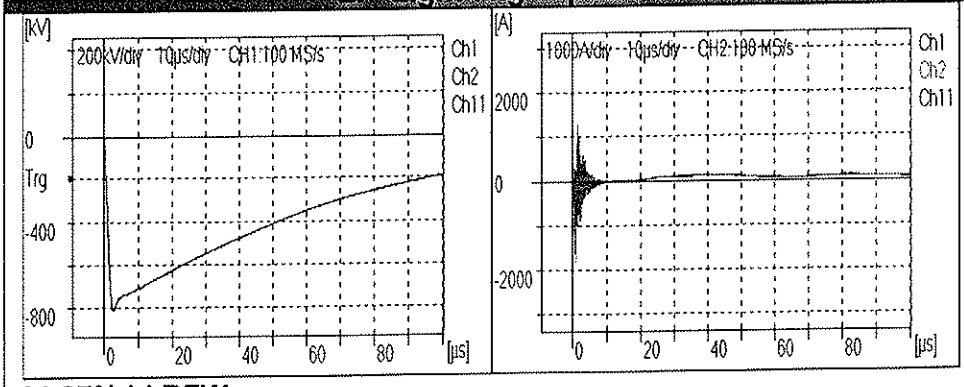
100% LI FW

No. = 4243
Up = -1300 kV
T1 = 1.913 µs
T2 = 46.25 µs
Ip = -2889 A
β = 4.660 %

WITNESSED BY : TESTED BY : CHECKED BY :

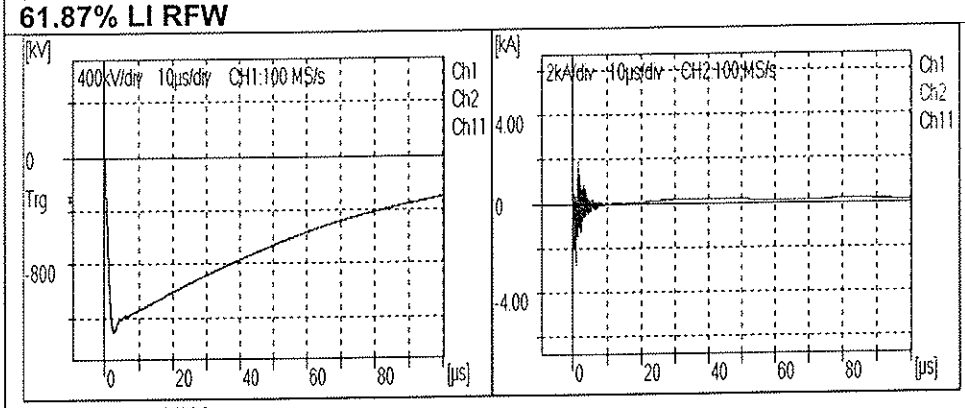
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on HV Terminal 1W



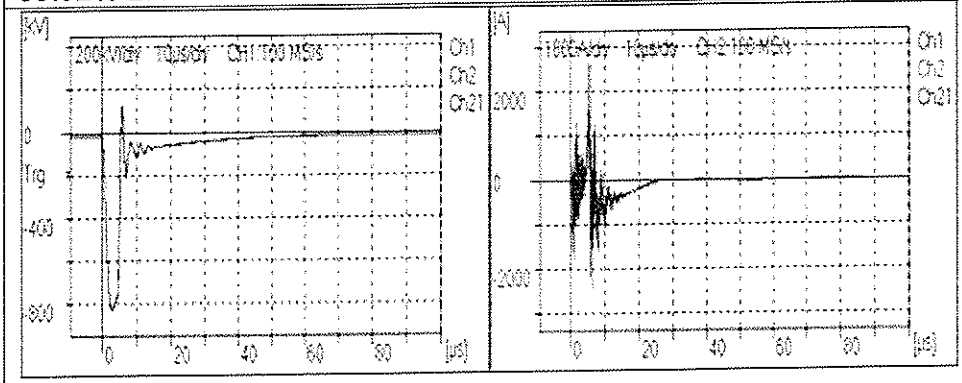
No. = 4244
Up = -804.3 kV
T1 = 1.912 µs
T2 = 46.10 µs
Ip = -1836 A
β = 4.887 %

61.87% LI RFW



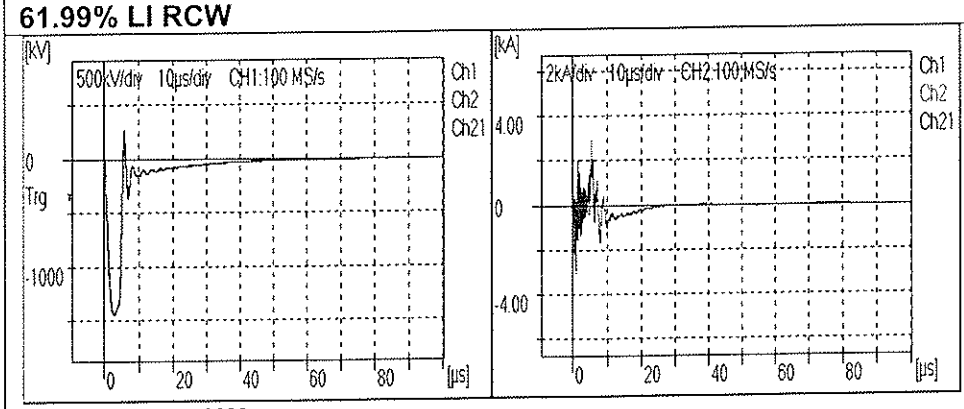
No. = 4245
Up = -1299 kV
T1 = 1.927 µs
T2 = 46.30 µs
Ip = -2895 A
β = 4.373 %

99.92% LI FW



No. = 4246
Up = -805.9 kV
T1 = 1.908 µs
Tc = 4.390 µs
Ip = 2798 A

61.99% LI RCW



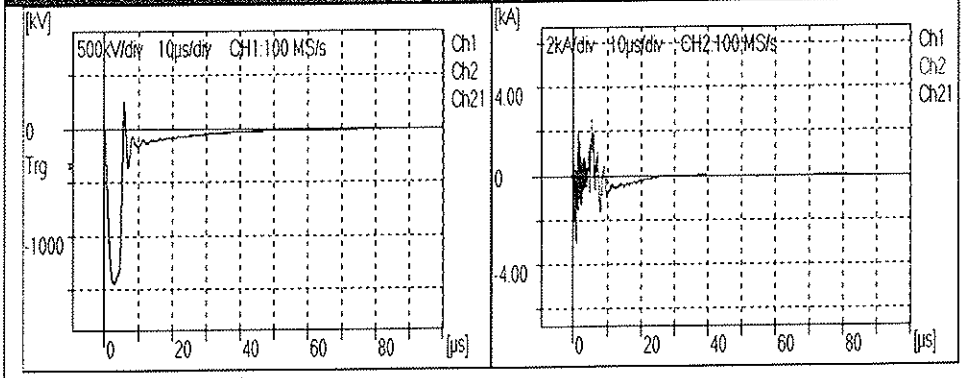
No. = 4247
Up = -1423 kV
T1 = 1.928 µs
Tc = 4.720 µs
Ip = 3020 A

109.46% LI FCW

WITNESSED BY : TESTED BY : CHECKED BY :

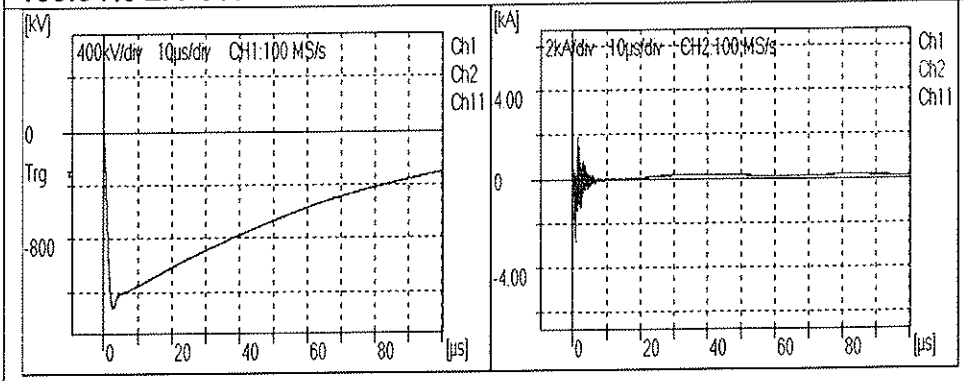
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI : Lightning Impulse on HV Terminal 1W



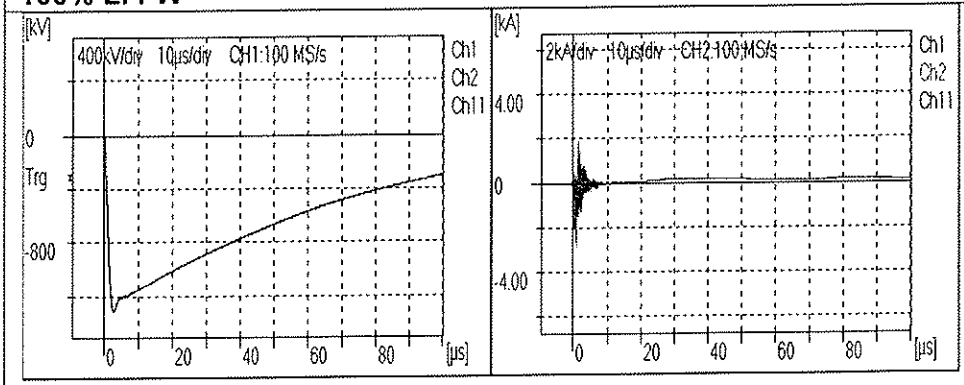
109.54% LI FCW

No. = 4248
Up = -1424 kV
T1 = 1.926 µs
Tc = 4.680 µs
Ip = 3040 A



100% LI FW

No. = 4249
Up = -1300 kV
T1 = 1.929 µs
T2 = 46.27 µs
Ip = -2874 A
β = 4.358 %



99.92% LI FW

No. = 4250
Up = -1299 kV
T1 = 1.927 µs
T2 = 46.15 µs
Ip = -2882 A
β = 4.487%

WITNESSED BY : TESTED BY : CHECKED BY :

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

Smart solutions.
Strong relationships

Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST

Rated Voltage	Test Voltage [kVp]			Standard Waveform	Polarity
[kV]	FW	CW	-	T1/T2/Tc	
220	950	1045	-	[1.2 ± 0.36 / 50 ± 10/3-6] µS	[-] Negative

Phase Applied	Phase - 2U	Phase - 2V	Phase - 2W
Terminal	IV - 2U	IV - 2V	IV - 2W
Tap Position	-	-	-
WaveShape	2.418/48.18/4.430 µs	2.381/44.56/4.403 µs	2.291/47.79/4.383 µs

Test Sequence	Wave No.	Voltage		Wave No.	Voltage		Wave No.	Voltage	
		[%]	[kVp]		[%]	[kVp]		[%]	[kVp]
RFW	1	60.45	574.3	1	60.18	571.7	1	60.33	573.1
FW	2	99.36	943.9	2	99.31	943.4	2	99.26	943.0
RCW	3	60.26	572.5	3	60.41	573.9	3	61.19	581.3
FCW	4	109.89	1044	4	110.00	1045	4	110.95	1054
FCW	5	110.00	1045	5	110.11	1046	5	111.16	1056
FW	6	99.88	948.9	6	100.25	952.4	6	100.06	950.6
FW	7	100.00	950	7	99.86	948.7	7	99.93	949.3

RFW : Reduced Full Wave / FW : Full Wave / RCW : Reduced Chopped Wave / CW : Chopped Wave

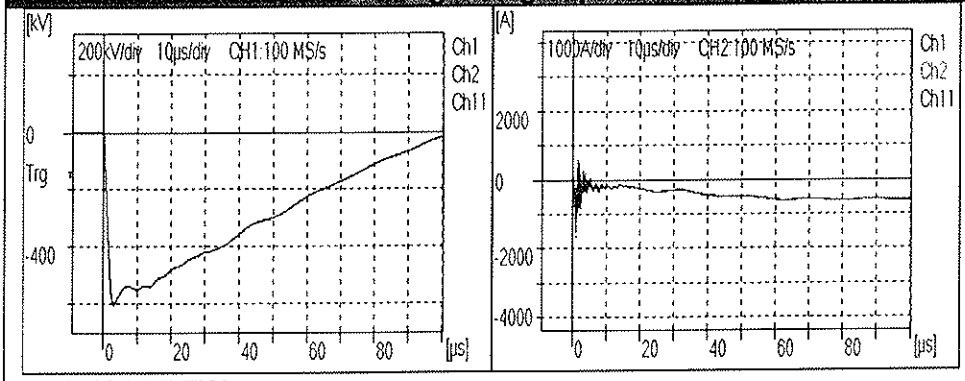
Result : Transformer withstood the Test Satisfactory.

WITNESSED BY	TESTED BY	CHECKED BY
		5/10/13

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

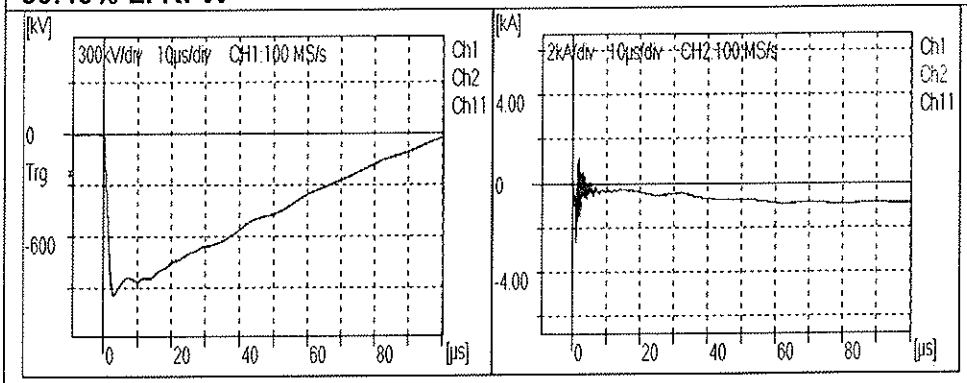
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on LV Terminal 20



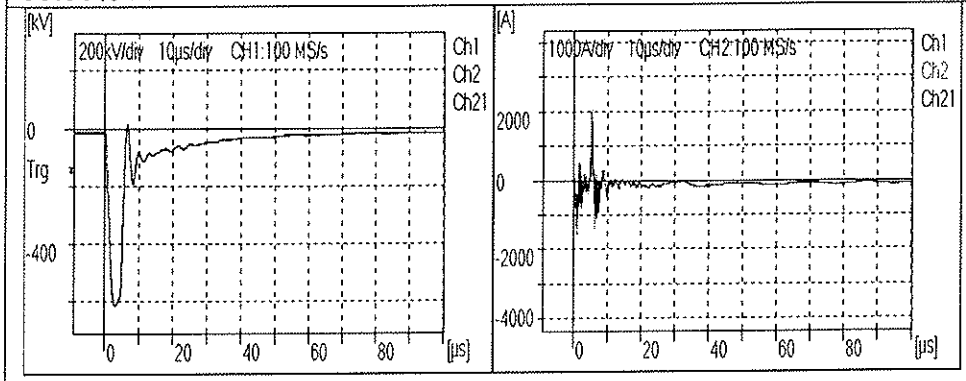
No. = 4275
Up = -574.3 kV
T1 = 2.418 µs
T2 = 48.18 µs
Ip = -1685.2 A
β = 3.170 %

60.45% LI RFW



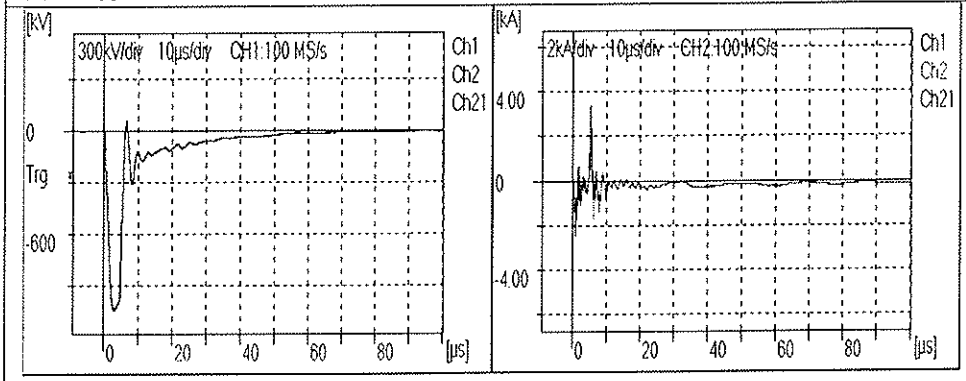
No. = 4276
Up = -943.9 kV
T1 = 2.443 µs
T2 = 48.38 µs
Ip = -2603 A
β = 2.589 %

99.36% LI FW



No. = 4277
Up = -572.5 kV
T1 = 2.428 µs
Tc = 4.430 µs
Ip = 2101 A

60.26% LI RCW



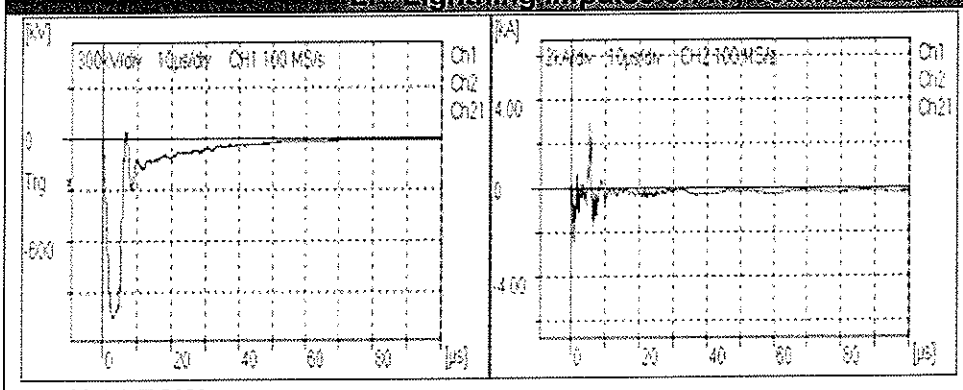
No. = 4278
Up = -1044 kV
T1 = 2.445 µs
Tc = 4.890 µs
Ip = 3577 A

109.89% LI FCW

WITNESSED BY : TESTED BY : CHECKED BY :

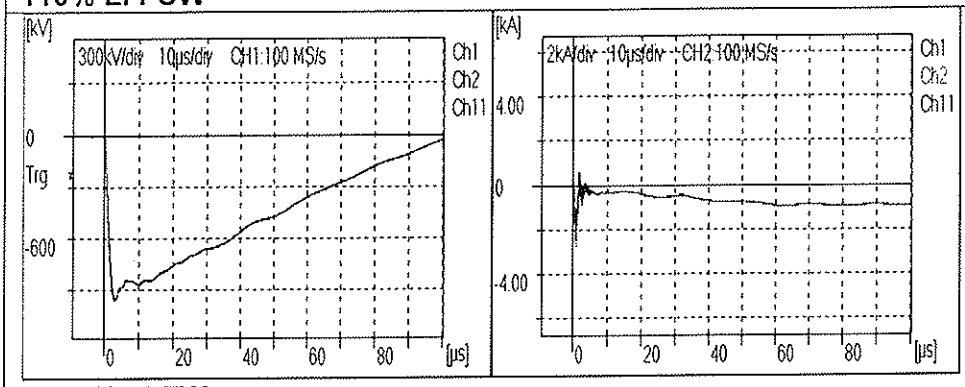
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on IV, Terminal 2U



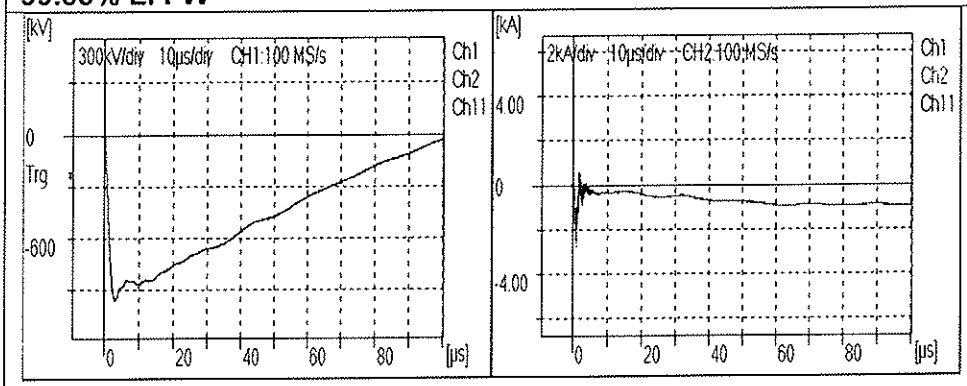
110% LI FCW

No. = 4279
Up = -1045 kV
T1 = 2.447 µs
Tc = 4.960 µs
Ip = 3594 A



99.88% LI FW

No. = 4280
Up = -948.9 kV
T1 = 2.442 µs
T2 = 48.45 µs
Ip = -2623 A
β = 2.533 %



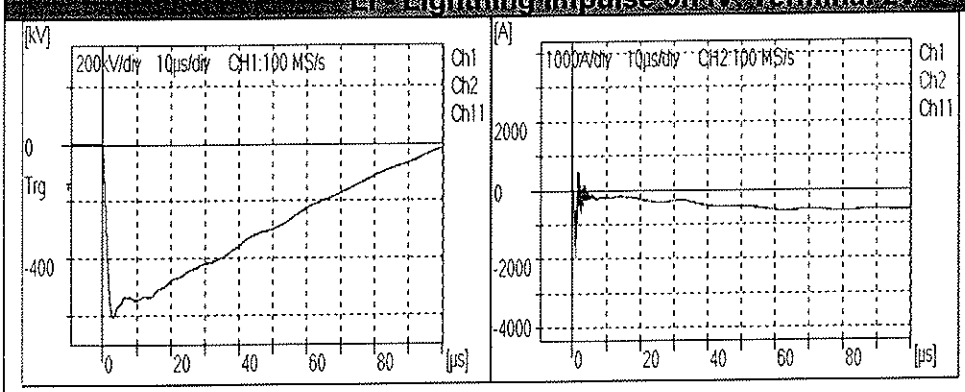
100% LI FW

No. = 4281
Up = -950.0 kV
T1 = 2.442 µs
T2 = 48.49 µs
Ip = -2624 A
β = 2.564 %

WITNESSED BY : TESTED BY : CHECKED BY :

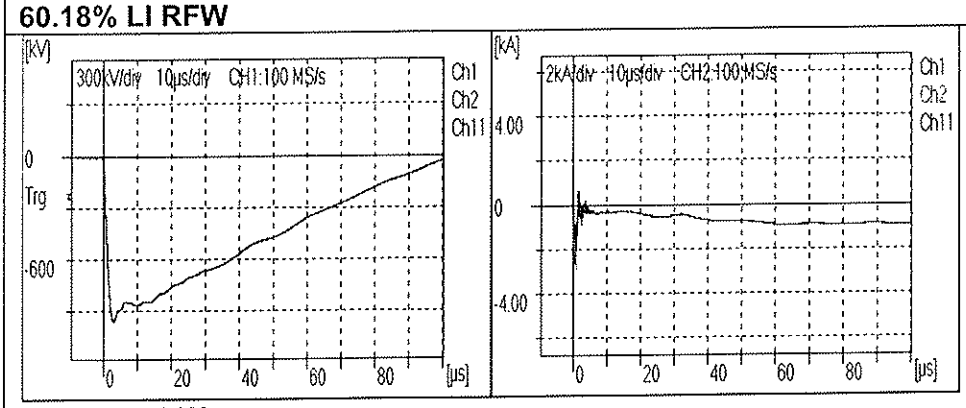
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

L1 - Lightning Impulse on IV Terminal 2V



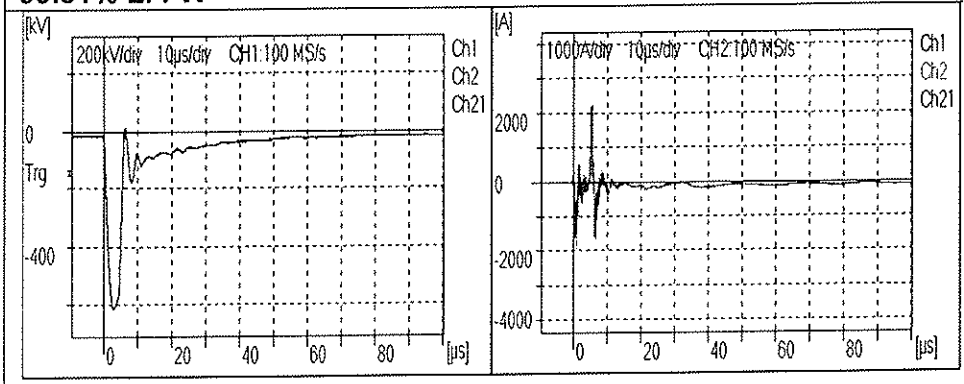
No. = 4268
Up = -571.7 kV
T1 = 2.381 µs
T2 = 44.56 µs
Ip = -1686.4 A
β = 2.703 %

60.18% LI RFW



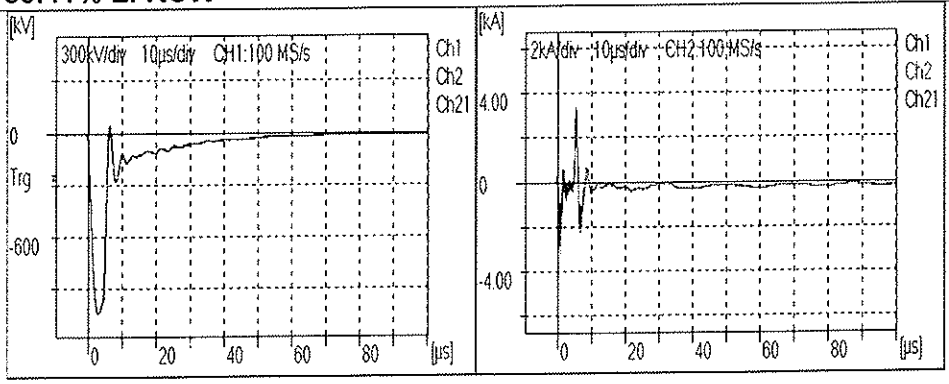
No. = 4269
Up = -943.4 kV
T1 = 2.406 µs
T2 = 44.95 µs
Ip = -2675 A
β = 2.323 %

99.31% LI FW



No. = 4270
Up = -573.9 kV
T1 = 2.388 µs
Tc = 4.403 µs
Ip = 2111 A

60.41% LI RCW



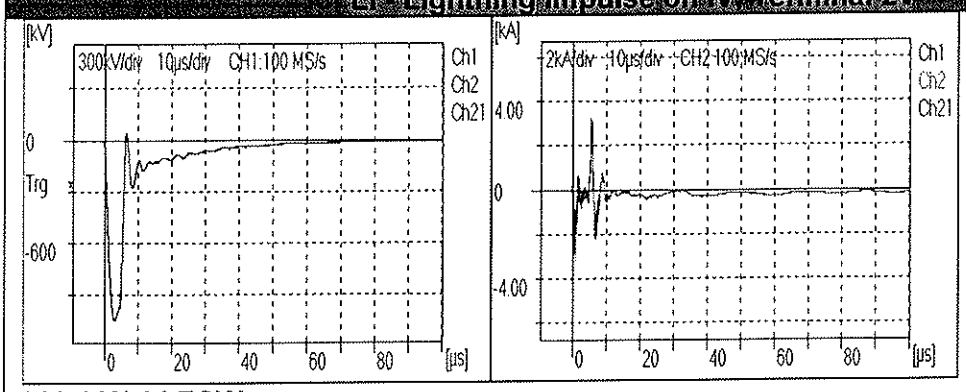
No. = 4271
Up = -1045 kV
T1 = 2.405 µs
Tc = 4.850 µs
Ip = 3557 A

110% LI FCW

WITNESSED BY : TESTED BY : CHECKED BY :

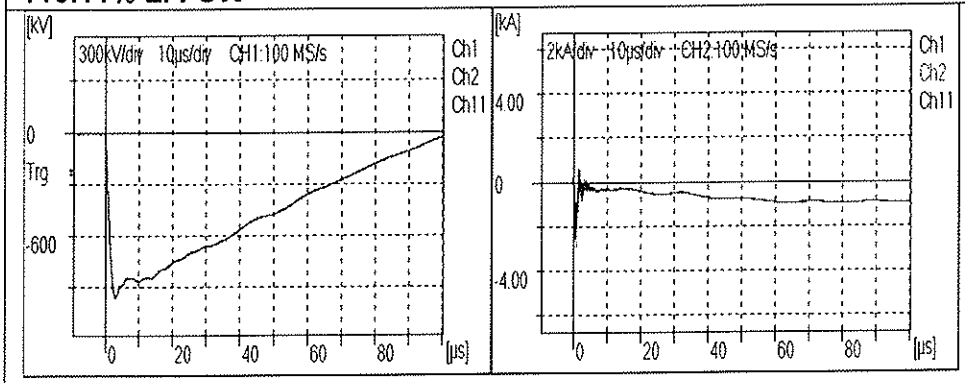
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on IV, Terminal 2V



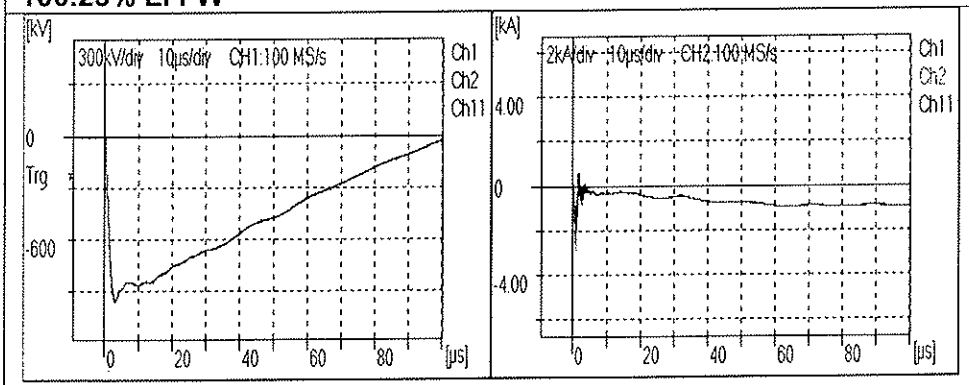
110.11% LI FCW

No. = 4272
Up = -1046 kV
T1 = 2.407 µs
Tc = 4.900 µs
Ip = 3564 A



100.25% LI FW

No. = 4273
Up = -952.4 kV
T1 = 2.404 µs
T2 = 44.98 µs
Ip = -2681 A
β = 2.261 %



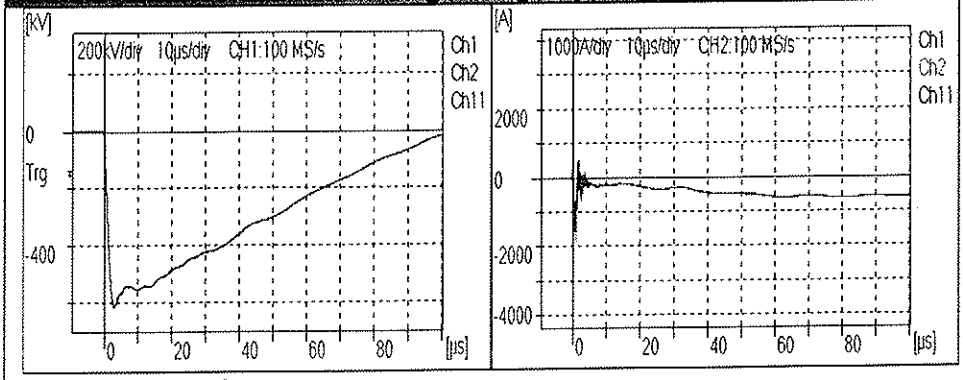
99.86% LI FW

No. = 4274
Up = -948.7 kV
T1 = 2.405 µs
T2 = 44.96 µs
Ip = -2670 A
β = 2.156 %

WITNESSED BY : TESTED BY : CHECKED BY :

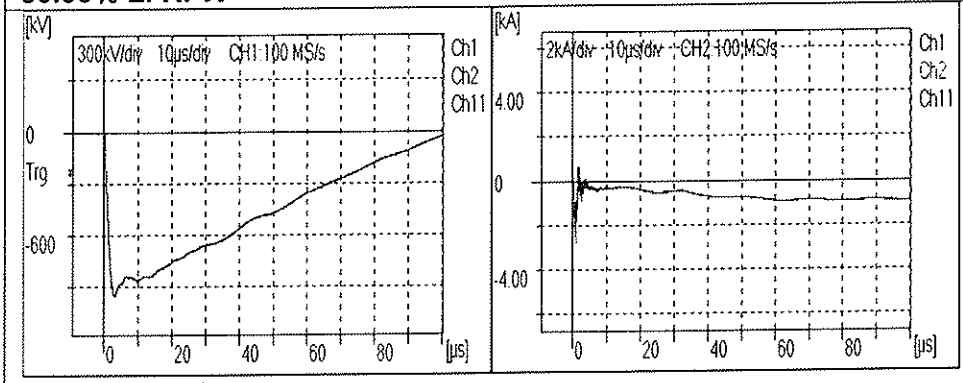
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on IV - Terminal 2W



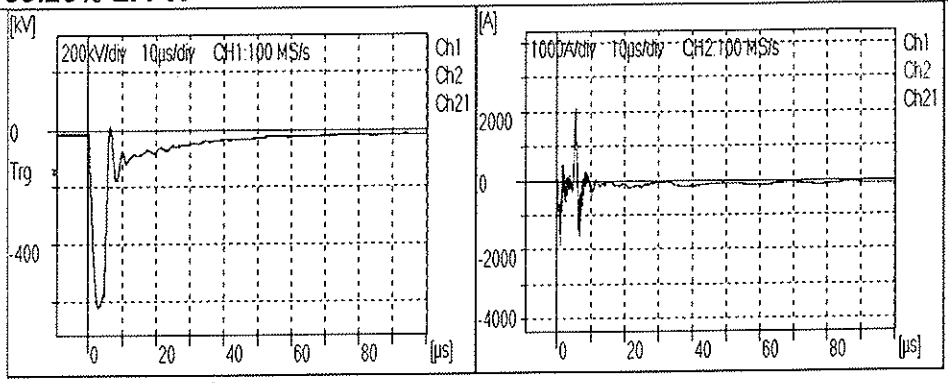
60.33% LI RFW

No. = 4261
Up = -573.1 kV
T1 = 2.291 µs
T2 = 47.79 µs
Ip = -1693.7 A
β = 1.843 %



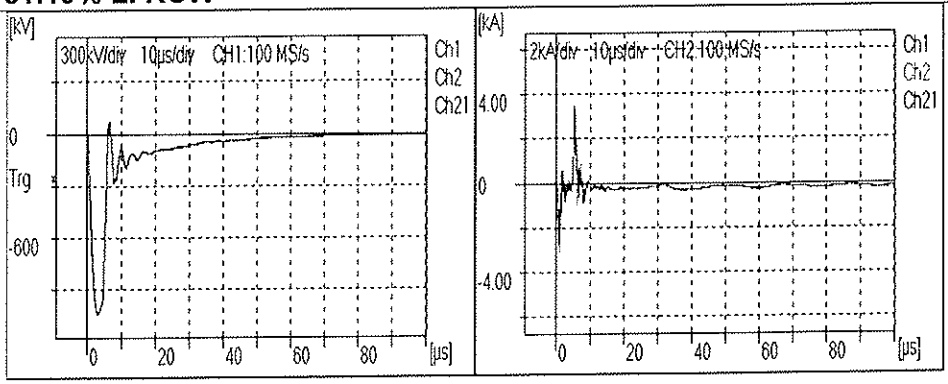
99.26% LI FW

No. = 4262
Up = -943.0 kV
T1 = 2.277 µs
T2 = 48.12 µs
Ip = -2694 A
β = 1.520 %



61.19% LI RCW

No. = 4263
Up = -581.3 kV
T1 = 2.269 µs
Tc = 4.383 µs
Ip = 2015 A



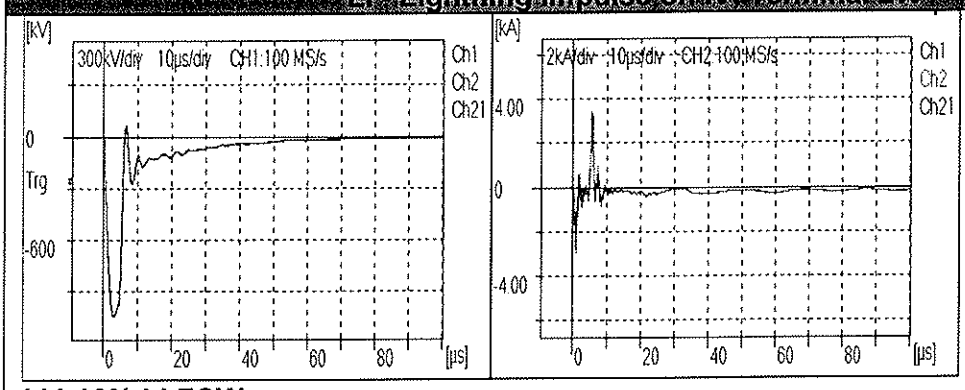
110.95% LI FCW

No. = 4264
Up = -1054 kV
T1 = 2.226 µs
Tc = 4.345 µs
Ip = 3523 A

WITNESSED BY : TESTED BY : CHECKED BY :

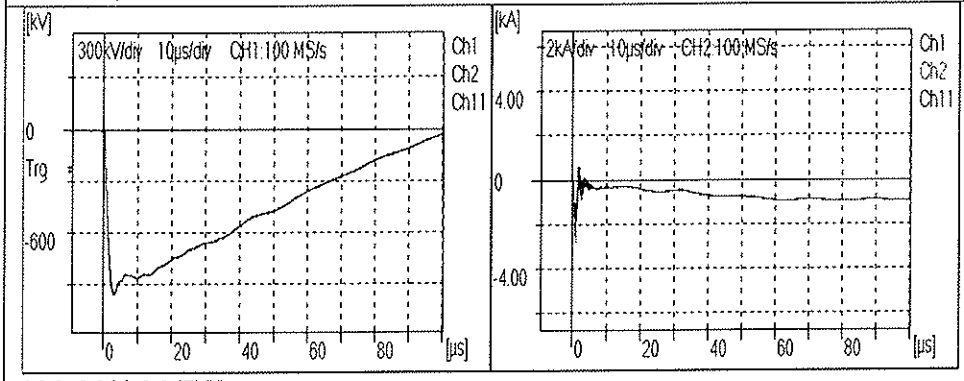
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on IV Terminal 2W



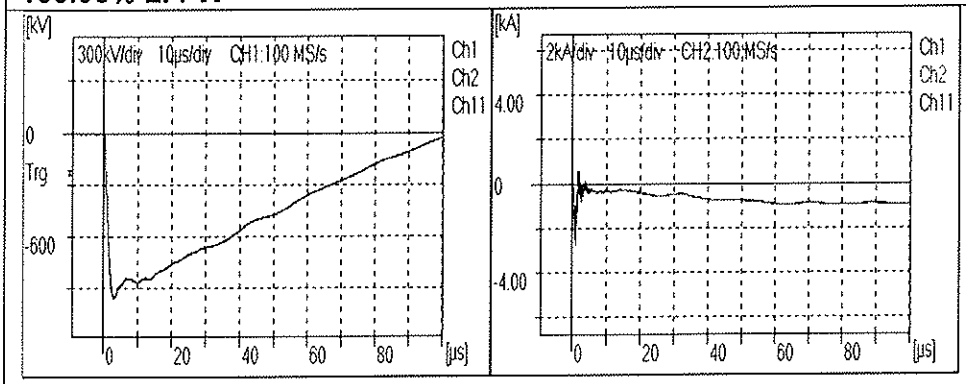
111.16% LI FCW

No. = 4265
Up = -1056 kV
T1 = 2.224 µs
Tc = 4.358 µs
Ip = 3534 A



100.06% LI FW

No. = 4266
Up = -950.6 kV
T1 = 2.273 µs
T2 = 48.24 µs
Ip = -2625 A
β = 1.420 %



99.93% LI FW

No. = 4267
Up = -949.3 kV
T1 = 2.278 µs
T2 = 48.18 µs
Ip = -2623 A
β = 1.415 %

WITNESSED BY : TESTED BY : CHECKED BY :

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

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Date : 10/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST

Rated Voltage	Test Voltage [kVp]			Standard Waveform	Polarity
[kV]	FW	CW	-	T1/T2/Tc	
	250	275	-	[1.2 ± 0.36 / 50 ± 10/3-6] µS	[-] Negative

Phase Applied	Phase - 3U	Phase - 3V	Phase - 3W
Terminal	LV - 3U	LV - 3V	LV - 3W
Tap Position	-	-	-
WaveShape	1.653/41.52/5.710 µs	1.596/41.45/5.676 µs	1.648/41.44/5.912 µs

Test Sequence	Wave No.	Voltage		Wave No.	Voltage		Wave No.	Voltage	
		[%]	[kVp]		[%]	[kVp]		[%]	[kVp]
RFW	1	60.08	150.2	1	60.24	150.6	1	60.48	151.2
FW	2	99.32	248.3	2	99.36	248.4	2	99.64	249.1
RCW	3	59.96	149.9	3	60.68	151.7	3	60.64	151.6
FCW	4	109.52	273.8	4	109.20	273	4	109.20	273
FCW	5	109.72	274.3	5	109.92	274.8	5	110.00	275
FW	6	99.72	249.3	6	99.48	248.7	6	99.72	249.3
FW	7	99.96	249.9	7	100.04	250.1	7	99.96	249.9

RFW : Reduced Full Wave / FW : Full Wave / RCW : Reduced Chopped Wave / CW : Chopped Wave

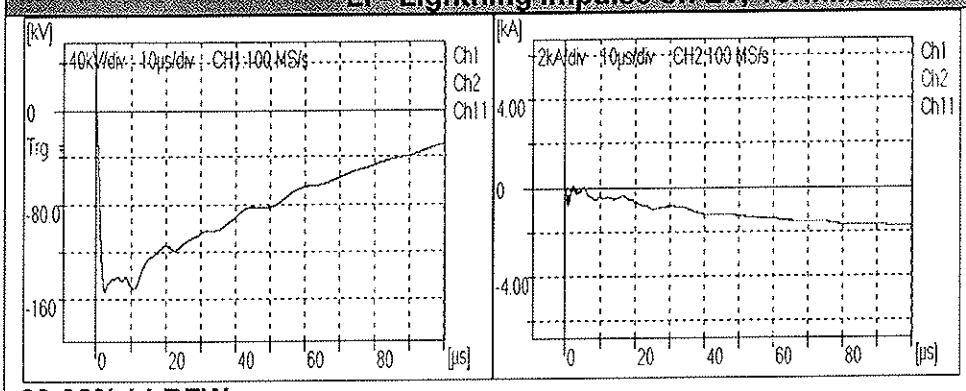
Result : Transformer withstood the Test Satisfactory.

WITNESSED BY	TESTED BY	CHECKED BY

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

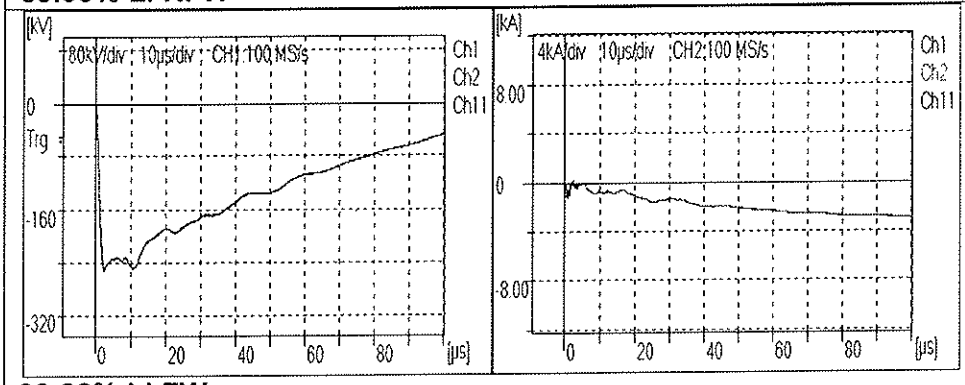
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on LV, Terminal 3U



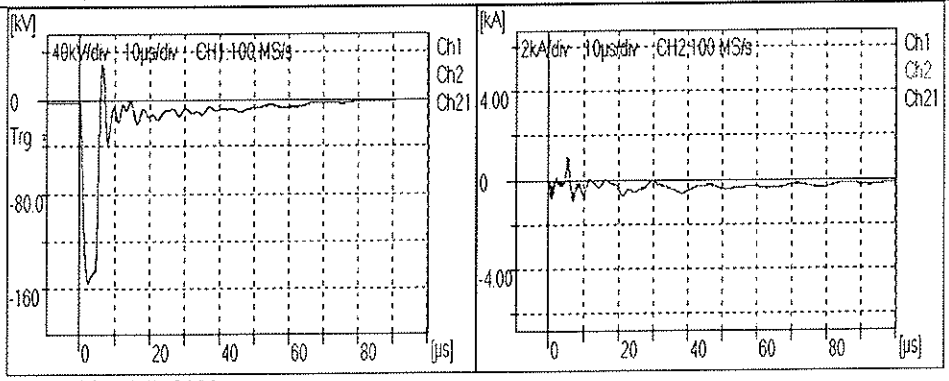
No. = 4286
Up = -150.2 kV
T1 = 1.653 µs
T2 = 41.52 µs
Ip = -1758 A
β = 2.909 %

60.08% LI RFW



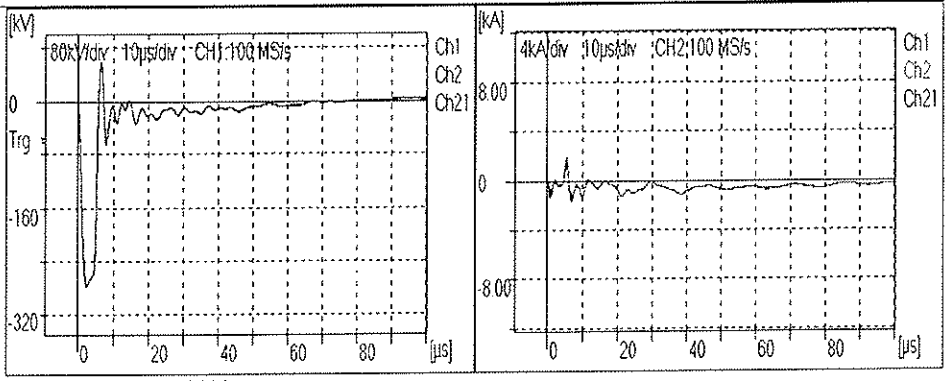
No. = 4287
Up = -248.3 kV
T1 = 1.645 µs
T2 = 41.74 µs
Ip = -2881 A
β = 2.933 %

99.32% LI FW



No. = 4289
Up = -149.9 kV
T1 = 1.612 µs
Tc = 5.710 µs
Ip = 1086 A

59.96% LI RCW



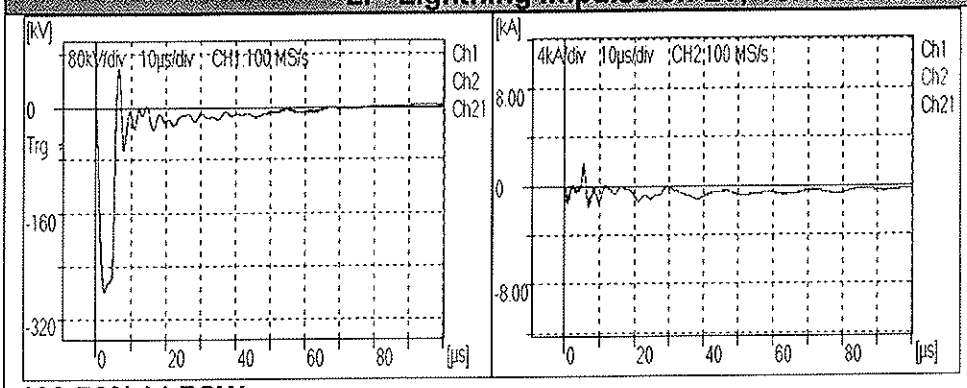
No. = 4290
Up = -273.8 kV
T1 = 1.614 µs
Tc = 5.953 µs
Ip = 1942 A

109.52% LI FCW

WITNESSED BY : TESTED BY : CHECKED BY :

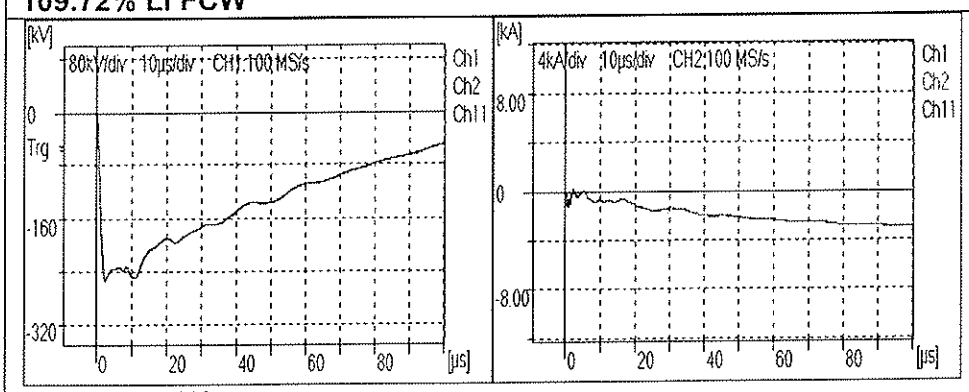
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on LV, Terminal 3U



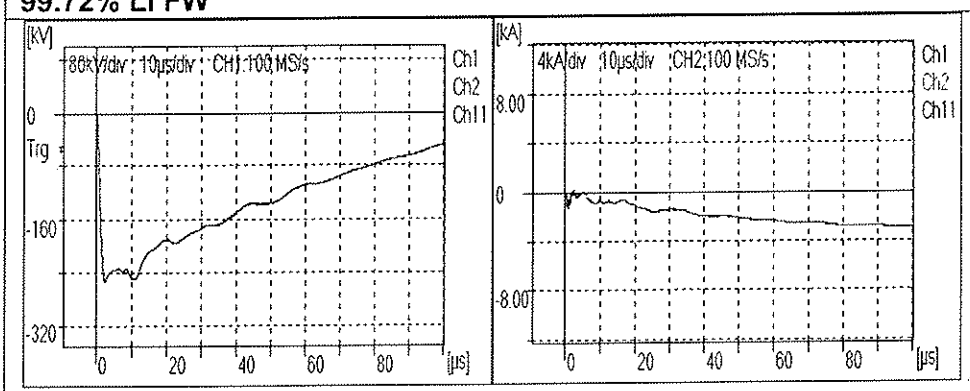
109.72% LI FCW

No. = 4292
Up = -274.3 kV
T1 = 1.608 µs
Tc = 5.804 µs
Ip = 1954 A



99.72% LI FW

No. = 4293
Up = -249.3 kV
T1 = 1.645 µs
T2 = 41.70 µs
Ip = -2917 A
β = 2.948 %



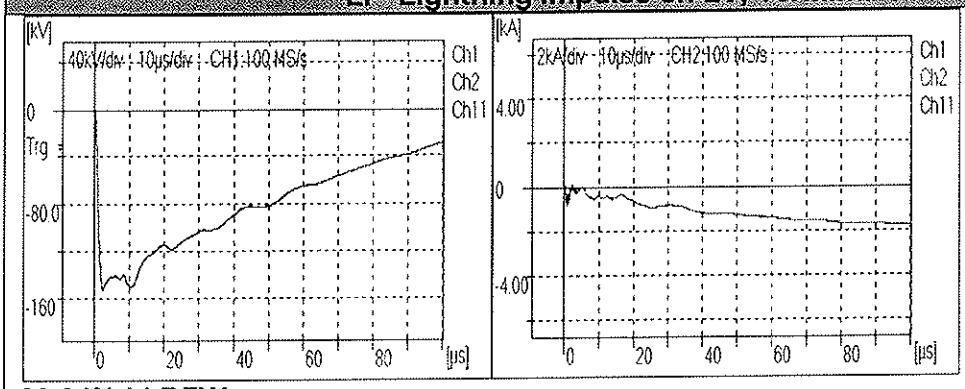
99.96% LI FW

No. = 4294
Up = -249.9 kV
T1 = 1.644 µs
T2 = 41.74 µs
Ip = -2921 A
β = 2.782 %

WITNESSED BY : TESTED BY : CHECKED BY :

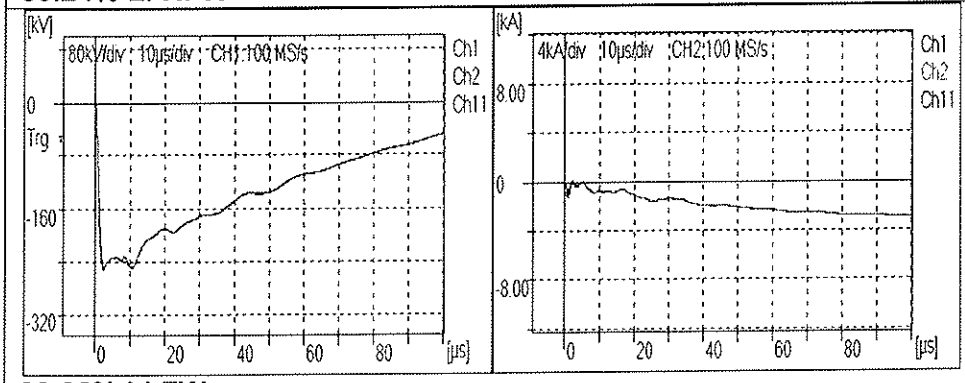
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on LV, Terminal 3V



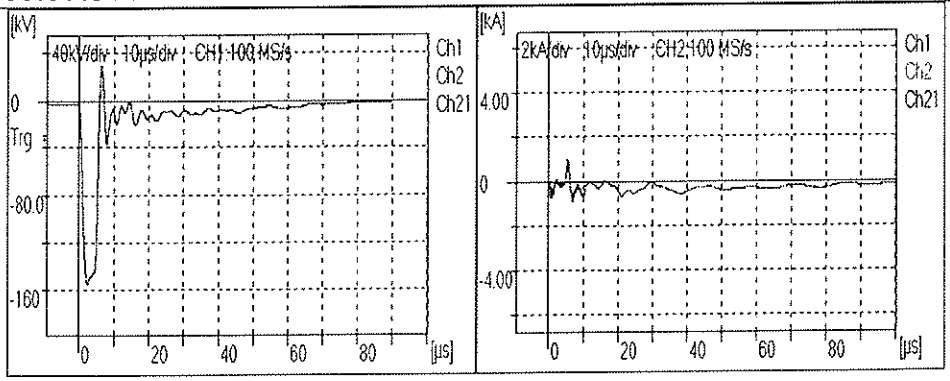
60.24% LI RFW

No. = 4295
Up = -150.6 kV
T1 = 1.596 µs
T2 = 41.45 µs
Ip = -1744 A
β = 2.688 %



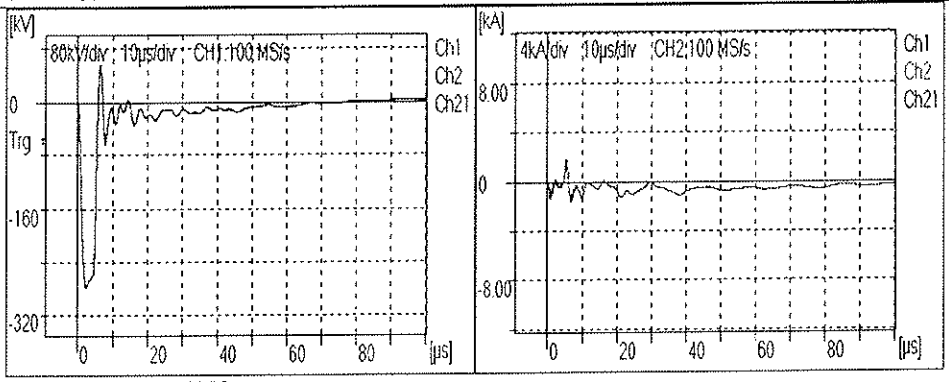
99.36% LI FW

No. = 4296
Up = -248.4 kV
T1 = 1.599 µs
T2 = 41.69 µs
Ip = -2885 A
β = 2.374 %



60.68% LI RCW

No. = 4297
Up = -151.7 kV
T1 = 1.567 µs
Tc = 5.676 µs
Ip = 1082 A



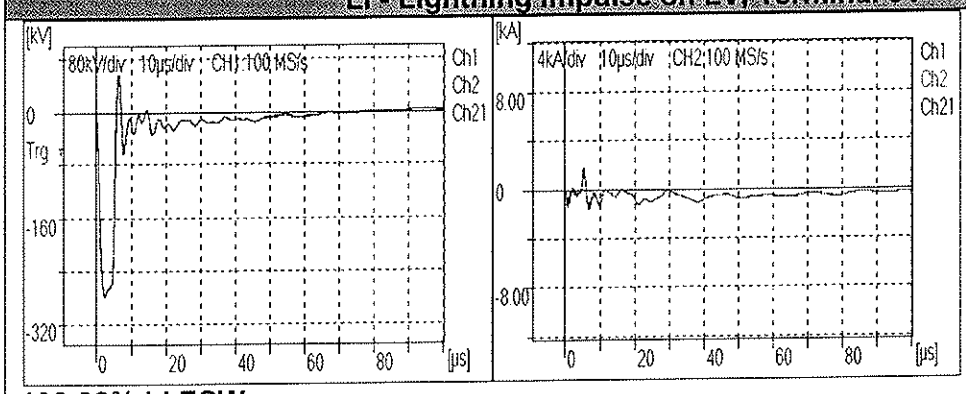
109.20% LI FCW

No. = 4298
Up = -273.0 kV
T1 = 1.563 µs
Tc = 5.855 µs
Ip = 1893 A

WITNESSED BY : TESTED BY : CHECKED BY :

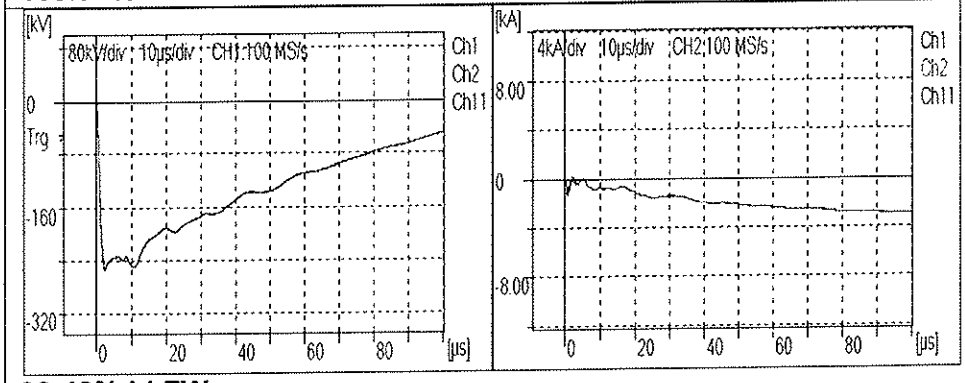
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on LV, Terminal 3V



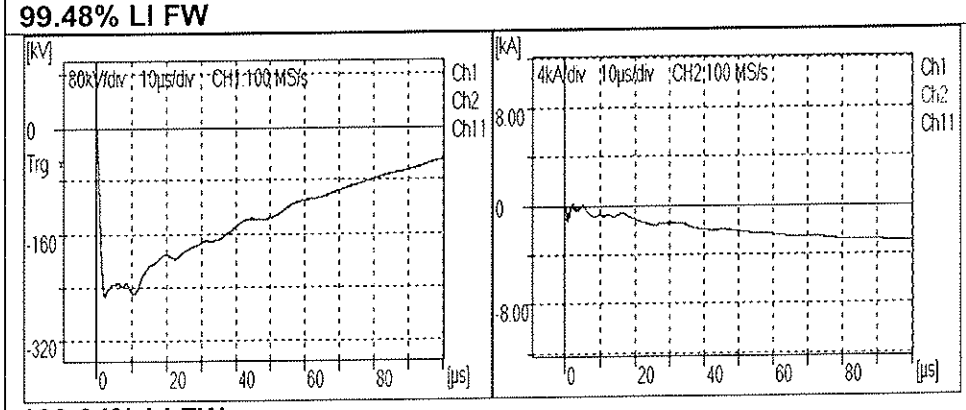
109.92% LI FCW

No. = 4299
Up = -274.8 kV
T1 = 1.553 µs
Tc = 5.677 µs
Ip = 1860 A



99.48% LI FW

No. = 4300
Up = -248.7 kV
T1 = 1.593 µs
T2 = 41.68 µs
Ip = -2925 A
β = 2.367 %



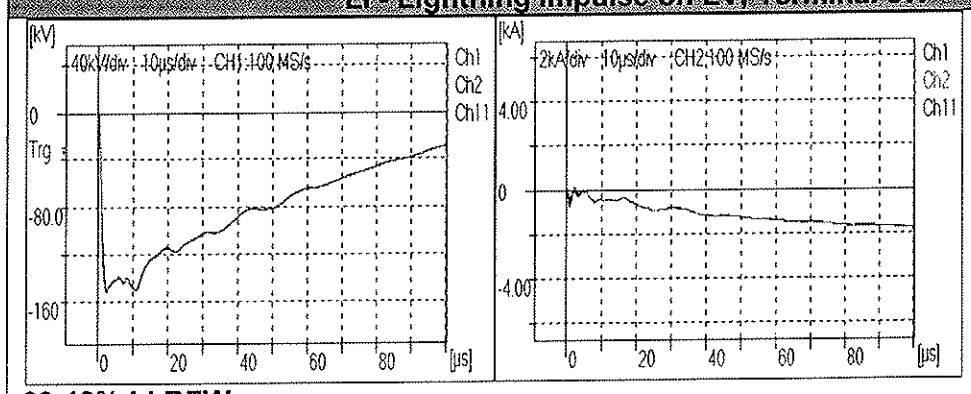
100.04% LI FW

No. = 4301
Up = -250.1 kV
T1 = 1.595 µs
T2 = 41.68 µs
Ip = -2928 A
β = 2.363 %

WITNESSED BY : TESTED BY : CHECKED BY :

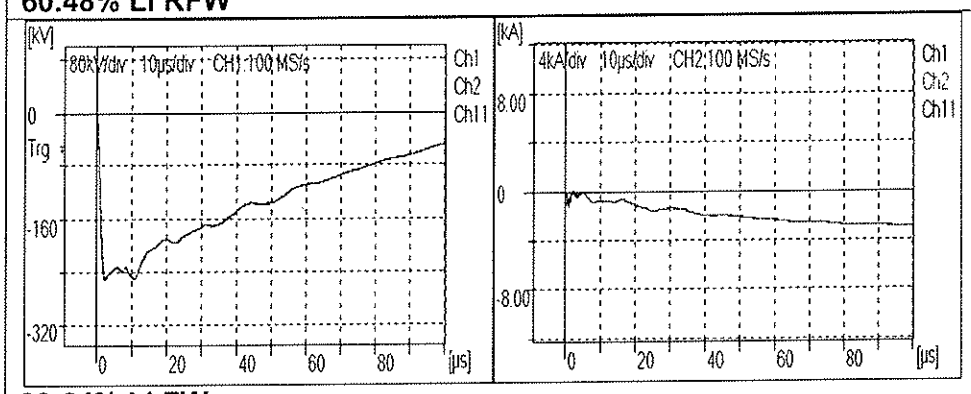
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on LV, Terminal 3W



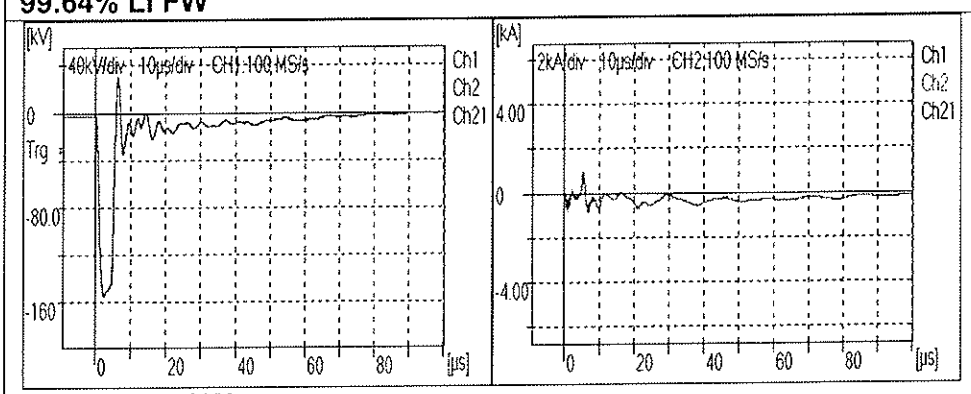
60.48% LI RFW

No. = 4302
Up = -151.2 kV
T1 = 1.648 µs
T2 = 41.44 µs
Ip = -1742 A
β = 2.991 %



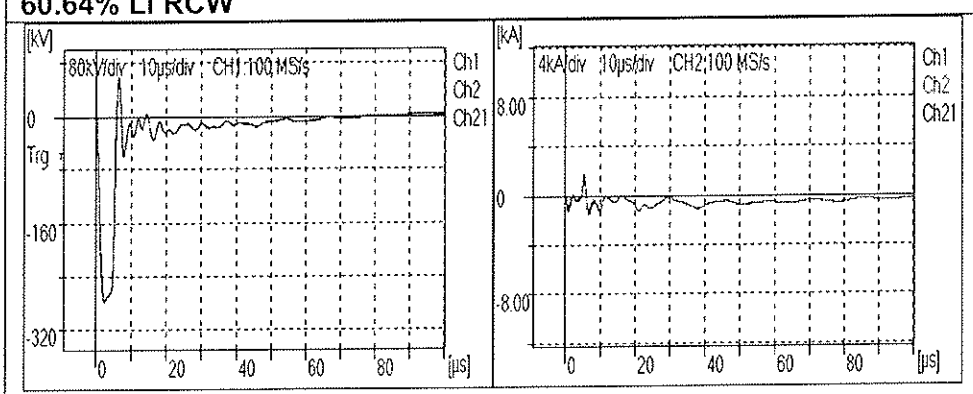
99.64% LI FW

No. = 4303
Up = -249.1 kV
T1 = 1.646 µs
T2 = 41.62 µs
Ip = -2897 A
β = 2.854 %



60.64% LI RCW

No. = 4304
Up = -151.6 kV
T1 = 1.616 µs
Tc = 5.912 µs
Ip = 1036 A



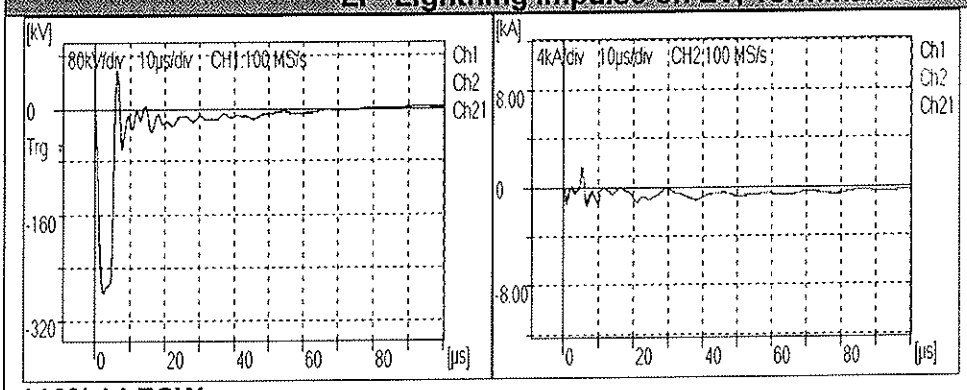
109.20% LI FCW

No. = 4305
Up = -273.0 kV
T1 = 1.609 µs
Tc = 5.795 µs
Ip = 1762 A

WITNESSED BY : TESTED BY : CHECKED BY :

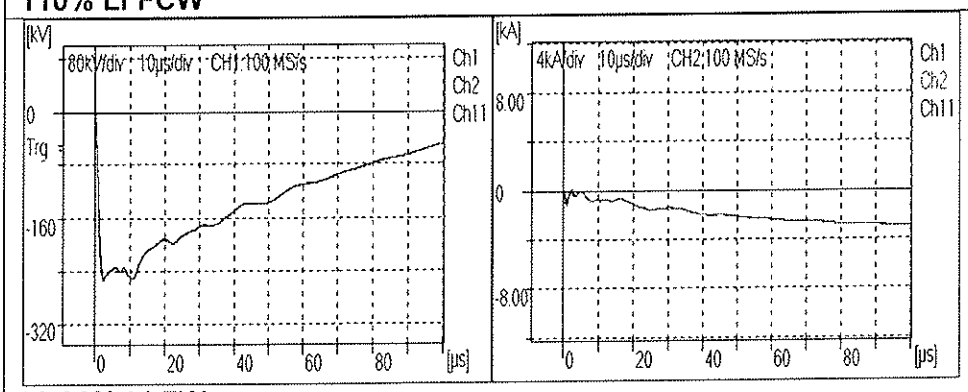
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	10/05/2016

LI - Lightning Impulse on LV, Terminal 3W



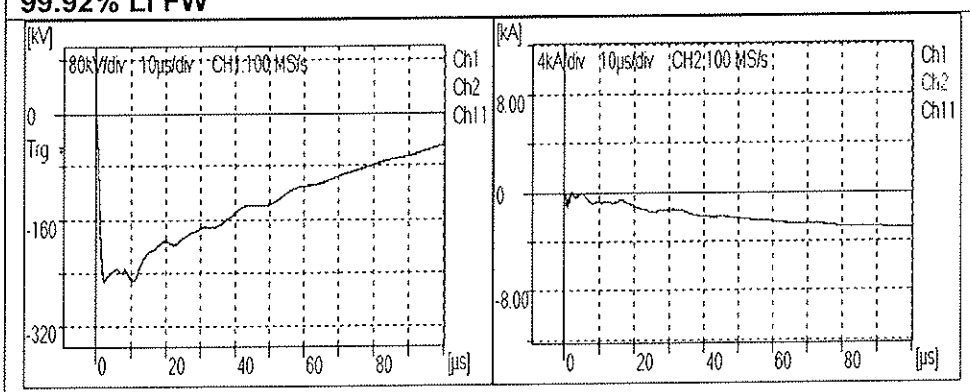
110% LI FCW

No. = 4306
Up = -275.0 kV
T1 = 1.608 µs
Tc = 5.874 µs
Ip = 1734 A



99.92% LI FW

No. = 4307
Up = -249.3 kV
T1 = 1.646 µs
T2 = 41.64 µs
Ip = -2920 A
β = 2.876 %



99.96% LI FW

No. = 4308
Up = -249.9 kV
T1 = 1.647 µs
T2 = 41.62 µs
Ip = -2916 A
β = 2.895 %

WITNESSED BY : TESTED BY : CHECKED BY :

CG Power System
Transformer (T1) Division

TEST RESULT

LIGHTNING IMPULSE TEST.

DATE : 10-05-16 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 500 CUSTOMER : PGCIL

TRANSFER SURG ON LV TERMINALS

TERMINAL NAME : HV-LV RATED BIL :- 1300 KV

WINDING-TERMINAL	SHOT NO.	PERCENTAGE OF RATED BIL	kVp	TYPE	LV kVp
1U1	1	61.92	804.9	RFW	28.52
	2	99.85	1298.0	FW	48.25

TERMINAL NAME : IV-LV RATED BIL :- 950 KV

WINDING-TERMINAL	SHOT NO.	PERCENTAGE OF RATED BIL	kVp	TYPE	LV kVp
2U1	1	60.48	574.6	RFW	106.25
	2	100.07	950.7	FW	175.20

Test Passed satisfactorily

Witnessed By : Checked By : Tested By :

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

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Strong relationships

Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

INDUCED OVER VOLTAGE WITHSTAND TEST WITH PARTIAL DISCHARGE MEASUREMENT

IVPD

Um = 400 kV

Calibration Signal : 50,100,200,500 pC

Test Frequency : 200 Hz

All partial discharge measurements are in pC

Test Volt. [kV]	Time in Mins		1U	2U	1V	2V	1W	2W
277.14	A	1	50	48	51	49	50	45
364.9	B	5	45	49	44	41	47	41
415.7	C	30 Sec	OK	OK	OK	OK	OK	OK
364.9	D	5	52	51	53	49	55	47
364.9	D	10	50	51	51	49	51	48
364.9	D	15	48	52	50	51	52	48
364.9	D	20	45	48	48	49	50	48
364.9	D	25	48	49	50	51	50	50
364.9	D	30	48	48	51	48	52	50
364.9	D	35	50	49	51	49	51	50
364.9	D	40	49	50	49	52	49	50
364.9	D	45	48	51	49	51	47	52
364.9	D	50	50	52	50	54	51	49
364.9	D	55	47	51	48	51	48	51
364.9	D	60	50	52	51	51	52	51
277.14	E	1	48	49	49	50	52	51

	Background PD Level
Before Test	15
After Test	17

WITNESSED BY	TESTED BY	CHECKED BY
		E10043

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

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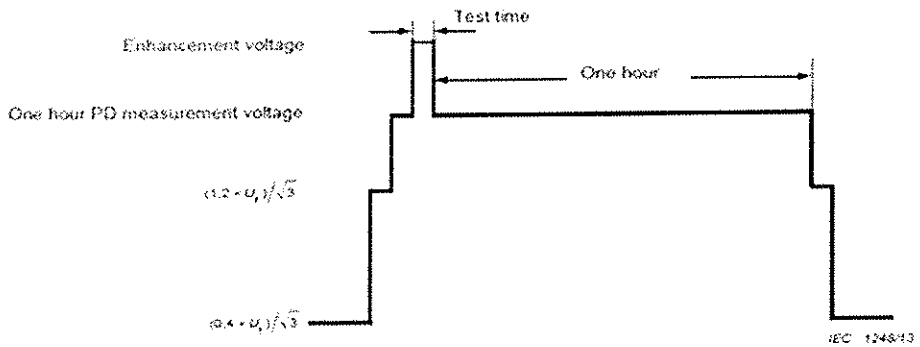
Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

INDUCED OVER VOLTAGE WITHSTAND TEST WITH PARTIAL DISCHARGE MEASUREMENT



induced voltage test with partial discharge measurement (IVPD)

WITNESSED BY	TESTED BY	CHECKED BY

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

Smart solutions.
Strong relationships

Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

LINE TERMINAL AC VOLTAGE WITHSTAND TEST

Ph. Under Test	Test Voltage [kV]	Test time [Sec]	Freq. [Hz]
Phase-U	570	30	200
Phase-V	570	30	200
Phase-W	570	30	200

Remark : WITHSTOOD OK

WITNESSED BY	TESTED BY	CHECKED BY
		10v43

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

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Date : 13/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF LOAD LOSS AND IMPEDANCE VOLTAGE

Combination Name : IV/HV

Supplied Winding : IV	**Shorted Winding : HV**	**Base MVA : 500**
C.T.Ratio : 2000/1	**P.T.Ratio : 66000/110**	
Top Oil Temp : 37 °C	**Bottom Oil Temp : 33.3 °C**	**Avg Oil Temp : 35.15 °C**

Tap Pos	Rated Parameters		Measured Voltage & Current		% of Rated Curr.	Measured Load Loss			Total Load Loss	Freq
	Volt.	Curr.	Volt.	Curr.		W1	W2	W3		
IV	[kV]	[A]	[V]	[A]		[W]	[W]	[W]	[kW]	[Hz]
1	220.000	1,312.200	23190.70	1314.2000	100.15	107660	146350	212070	466.08	50.00
9	220.000	1,312.200	28248.50	1311.0000	99.91	104450	141980	205730	452.16	50.01
17	220.000	1,312.200	37019.50	1312.9000	100.05	133670	181690	263280	578.64	49.98

Calculations

Supply Side : IV **Short Circuit : HV** **Temperature [°C] : 35.15 °C**

Measurement

Cooling Type : ODAF [500 MVA] **Combination Name : IV/HV**

Tap Position		1	9	17						
Measured Impedance voltage [Vm]	[kV]	23.19	28.25	37.02						
Corrected Impedance Voltage at Rated Current	[kV]	23.15	28.28	37.00						
Applied Current [ISc]	A	1,314.20	1,311.00	1,312.90						
Rated Current [IHR]	A	1312.20	1312.20	1312.20						
Measured Load Loss [LLM]	[kW]	466.08	452.16	578.64						
Corrected Load Loss At Rated Current [LLC]	[kW]	464.66	452.99	578.02						

WITNESSED BY	TESTED BY	CHECKED BY
		210043

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

Smart solutions.
Strong relationships

Date : 13/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF LOAD LOSS AND IMPEDANCE VOLTAGE

Cooling Type : ODAF [500 MVA] **Combination Name : IV/HV**

Tap Position				1	9	17						
Rated Current [IHR]	[IV]		A	656.10	590.49	510.30						
Rated Current [ILR]	[HV]		A	656.10	721.71	801.90						
Avg. Resistance [RhAvg]	[IV]	at 42.05 °C	Ohms	0.172703	0.172703	0.172703						
Avg. Resistance [RlAvg]	[HV]	at 42.05 °C	Ohms	0.155530	0.118593	0.155490						
Copper Loss[I²R] [CLh]	[IV]	at 42.05 °C	[kW]	223.03	180.65	134.92						
Copper Loss[I²R] [CLl]	[HV]	at 42.05 °C	[kW]	200.85	185.31	299.96						
Total Loss[I²R]		at 42.05 °C	[kW]	423.88	365.96	434.88						
Total Loss[I²R] [TCL]		at 35.15 °C	[kW]	413.32	356.85	424.05						
Corrected Load Loss [LLC]		at 35.15 °C	[kW]	464.66	452.99	578.02						
Stray Loss [SL =LLC - TCL]		at 35.15 °C	[kW]	51.34	96.14	153.97						
% Z		at 35.15 °C	%	10.52	12.85	16.82						
% R		at 35.15 °C	%	0.09	0.09	0.12						
% X		at 35.15 °C	%	10.52	12.85	16.82						
Total Copper Loss[I²R]		at 75 °C	[kW]	474.20	409.41	486.51						
Stray Loss		at 75 °C	[kW] At Test Freq	44.75	83.80	134.20						
Stray Loss		at 75 °C	[kW] @ 50 Hz	44.75	83.77	134.30						
Load Loss		at 75 °C	[kW] At Test Freq	518.95	493.21	620.71						
Load Loss at [500 MVA]		at 75 °C	[kW] @ 50 Hz	518.95	493.18	620.81						
% X		at 75 °C	%	10.52	12.85	16.82						
% R		at 75 °C	%	0.10	0.10	0.12						
% Z at [500 MVA] at 50 Hz		at 75 °C	%	10.52	12.85	16.82						

WITNESSED BY	TESTED BY	CHECKED BY
		510043

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

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Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF LOAD LOSS AND IMPEDANCE VOLTAGE

Combination Name : HV/LV

Supplied Winding : HV	**Shorted Winding : LV**	**Base MVA : 167**
C.T.Ratio : 500/1	**P.T.Ratio : 66000/110**	
Top Oil Temp : 39.4 °C	**Bottom Oil Temp : 36.3 °C**	**Avg Oil Temp : 37.85 °C**

Tap Pos	Rated Parameters		Measured Voltage & Current		% of Rated Curr.	Measured Load Loss			Total Load Loss	Freq
	Volt.	Curr.	Volt.	Curr.		W1	W2	W3		
HV	[kV]	[A]	[V]	[A]		[W]	[W]	[W]	[kW]	[Hz]
1	440.000	219.140	70274.90	188.2167	85.89	73500	92100	110400	276.00	50.04
9	400.000	241.050	73083.90	208.5633	86.52	76800	97200	120600	294.60	49.98
17	360.000	267.830	72034.30	217.7800	81.31	75900	95100	117900	288.90	50.00

Calculations

Supply Side : HV **Short Circuit : LV** **Temperature [°C] : 37.85 °C**

Measurement

Cooling Type : ODAF [167 MVA] **Combination Name : HV/LV**

Tap Position		1	9	17						
Measured Impedance voltage [Vm]	[kV]	70.27	73.08	72.03						
Corrected Impedance Voltage at Rated Current	[kV]	81.81	84.46	88.58						
Applied Current [ISc]	A	188.22	208.56	217.78						
Rated Current [IHR]	A	219.14	241.05	267.83						
Measured Load Loss [LLM]	[kW]	276.00	294.60	288.90						
Corrected Load Loss At Rated Current [LLC]	[kW]	374.13	393.54	436.95						

WITNESSED BY	TESTED BY	CHECKED BY
		5/10/16

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Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF LOAD LOSS AND IMPEDANCE VOLTAGE

Cooling Type : ODAF [167 MVA] **Combination Name : HV/LV**

Tap Position				1	9	17						
Rated Current [IHR]	[HV]		A	219.14	241.05	267.83						
Rated Current [ILR]	[LV]		A	2921.83	2921.83	2921.83						
Avg. Resistance [RhAvg]	[HV]	at 42.05 °C	Ohms	0.328233	0.291297	0.328193						
Avg. Resistance [RlAvg]	[LV]	at 42.05 °C	Ohms	0.022824	0.022824	0.022824						
Copper Loss[I^2R] [CLh]	[HV]	at 42.05 °C	[kW]	47.29	50.78	70.63						
Copper Loss[I^2R] [CLl]	[LV]	at 42.05 °C	[kW]	194.86	194.86	194.86						
Total Loss[I^2R]		at 42.05 °C	[kW]	242.15	245.64	265.49						
Total Loss[I^2R] [TCL]		at 37.85 °C	[kW]	238.48	241.92	261.47						
Corrected Load Loss [LLC]		at 37.85 °C	[kW]	374.13	393.54	436.95						
Stray Loss [SL =LLC - TCL]		at 37.85 °C	[kW]	135.65	151.62	175.48						
% Z		at 37.85 °C	%	18.58	21.12	24.61						
% R		at 37.85 °C	%	0.22	0.24	0.26						
% X		at 37.85 °C	%	18.58	21.12	24.61						
Total Copper Loss[I^2R]		at 75 °C	[kW]	271.00	274.91	297.13						
Stray Loss		at 75 °C	[kW] At Test Freq	119.37	133.43	154.42						
Stray Loss		at 75 °C	[kW] @ 50 Hz	119.20	133.54	154.45						
Load Loss		at 75 °C	[kW] At Test Freq	390.37	408.34	451.55						
Load Loss at [167 MVA]		at 75 °C	[kW] @ 50 Hz	390.20	408.45	451.58						
Load Loss at [500 MVA]		at 75 °C	[kW] @ 50 Hz	3497.79	3661.39	4048.01						
% X		at 75 °C	%	18.58	21.12	24.61						
% R		at 75 °C	%	0.23	0.24	0.27						
% Z at [167 MVA] at 50 Hz		at 75 °C	%	18.58	21.12	24.61						
% Z at [500 MVA] at 50 Hz		at 75 °C	%	55.63	63.23	73.68						

WITNESSED BY	TESTED BY	CHECKED BY
		E10043

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

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NABL NO.T1620

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Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF LOAD LOSS AND IMPEDANCE VOLTAGE

Combination Name : IV/LV

Supplied Winding : IV	Shorted Winding : LV	Base MVA : 167
C.T.Ratio : 500/1	P.T.Ratio : 66000/110	
Top Oil Temp : 39.4 °C	Bottom Oil Temp : 36.3 °C	Avg Oil Temp : 37.85 °C

Tap Pos	Rated Parameters		Measured Voltage & Current		% of Rated Curr.	Measured Load Loss			Total Load Loss	Freq
	Volt.	Curr.	Volt.	Curr.		W1	W2	W3		
IV	[kV]	[A]	[V]	[A]		[W]	[W]	[W]	[kW]	[Hz]
-	220.000	438.270	35374.80	439.7183	100.33	117840	129660	130230	377.73	50.01

Calculations

Supply Side : IV **Short Circuit : LV** **Temperature [°C] : 37.85 °C**

Measurement

Cooling Type : ODAF [167 MVA] **Combination Name : IV/LV**

Tap Position		-								
Measured Impedance voltage [Vm]	[kV]	35.37								
Corrected Impedance Voltage at Rated Current	[kV]	35.25								
Applied Current [ISc]	A	439.72								
Rated Current [IHR]	A	438.27								
Measured Load Loss [LLM]	[kW]	377.73								
Corrected Load Loss At Rated Current [LLC]	[kW]	375.24								

WITNESSED BY	TESTED BY	CHECKED BY

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Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF LOAD LOSS AND IMPEDANCE VOLTAGE

Cooling Type : ODAF [167 MVA] **Combination Name : IV/LV**

Tap Position				-								
Rated Current [IHR]	[IV]		A	438.27								
Rated Current [ILR]	[LV]		A	2921.83								
Avg. Resistance [RhAvg]	[IV]	at 42.05 °C	Ohms	0.172703								
Avg. Resistance [RlAvg]	[LV]	at 42.05 °C	Ohms	0.022824								
Copper Loss[I^2R] [CLh]	[IV]	at 42.05 °C	[kW]	99.52								
Copper Loss[I^2R] [CLl]	[LV]	at 42.05 °C	[kW]	194.86								
Total Loss[I^2R]		at 42.05 °C	[kW]	294.38								
Total Loss[I^2R] [TCL]		at 37.85 °C	[kW]	289.92								
Corrected Load Loss [LLC]		at 37.85 °C	[kW]	375.24								
Stray Loss [SL =LLC - TCL]		at 37.85 °C	[kW]	85.32								
% Z		at 37.85 °C	%	16.02								
% R		at 37.85 °C	%	0.22								
% X		at 37.85 °C	%	16.02								
Total Copper Loss[I^2R]		at 75 °C	[kW]	329.45								
Stray Loss		at 75 °C	[kW] At Test Freq	75.08								
Stray Loss		at 75 °C	[kW] @ 50 Hz	75.05								
Load Loss		at 75 °C	[kW] At Test Freq	404.53								
Load Loss at [167 MVA]		at 75 °C	[kW] @ 50 Hz	404.50								
Load Loss at [500 MVA]		at 75 °C	[kW] @ 50 Hz	3625.98								
% X		at 75 °C	%	16.02								
% R		at 75 °C	%	0.24								
% Z at [167 MVA] at 50 Hz		at 75 °C	%	16.02								
% Z at [500 MVA] at 50 Hz		at 75 °C	%	47.96								

WITNESSED BY	TESTED BY	CHECKED BY

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

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Date : 15/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF NO LOAD LOSS AND NO LOAD CURRENT

Base MVA for % No-load Current (MVA) : 500
Tap Position No. : 9
Transformer Energised from : LV
After Dielectric Tests Date : 15/05/2016

% kV	Freq. [Hz]	C.T. Ratio / P.T. Ratio	R.M.S. Volt (kV) / Avg. Volt (kV)	Current Reading (Amp) U	V	W	Avg.	Power Reading (kW) W1	W2	W3	Total	No Load Loss (kW)	No Load Current as % of rated Current	Corr. Losses (kW)
90	50.00	30/1	29.707	1.3919	2.5527	2.0978	2.014					55.710	0.023	55.750
		66000/110	29.728	9.293	22.856	23.557	55.706							
100	50.01	30/1	32.962	2.258	3.4731	3.9104	3.214					74.410	0.037	74.510
		66000/110	33.007	5.773	36.686	31.955	74.414							
110	50.01	30/1	36.150	11.6721	12.0198	16.7958	13.496					106.900	0.154	107.349
		66000/110	36.302	-27.738	86.684	47.954	106.900							

WITNESSED BY	TESTED BY	CHECKED BY

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

CG Power System
Transformer (T1) Division

TEST RESULT

SHORT DURATION TEMPERATURE RISE TEST

DATE : 15/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 500 CUSTOMER : PGCIL.

SHORT DURATION HEAT RUN AT RATED CURRENT @ TAP NO. 17

Time	Voltage	Ambient Temperature (℃)			Top Oil	Oil Rise	Bott Oil
(Hrs)	(kV)	A	B	Avg.	(℃)	(℃)	(℃)
20:30	36.33	OVER EXCITATION AT 110% OF VOLTAGE					
21:00	36.32	37.1	36.9	37.00	48.80	11.80	44.8
21:30	36.36	36.8	36.2	36.50	48.80	12.30	44.8
22:00	36.40	36.4	35.8	36.10	48.90	12.80	45.0
22:30	36.42	36.1	35.5	35.80	49.20	13.40	45.1

TEST PASSED SATISFACTORILY.

Witnessed By : Checked By : Tested By :

CGL/T1/TTR/T10660/1

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Date : 16/05/2016 **W.O.No :** T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

SFRA MEASUREMENT

SFRA for Winding : HV at Tap : 1, 9 & 17

TEST OBJECT	: 500 MVA , 400/220/33 KV, YNa0d11
VOLTAGE CLASS	: 400
W.O. No.	: T10660
SERIAL No.	: T10660/1
CUSTOMER	: PGCIL
TEST DATE	: 16/05/2016
TIME OF TEST	: Pre - Dispatch
TESTED AT	: Transformer (T1) Division

Transformer Condition under Test

a) **Transformer was fully filled with Oil**

b) **Transformer tap switch kept at 1,9 & 17 position.**

c) **Transformer fitted with Original bushings.**

WITNESSED BY	TESTED BY	CHECKED BY

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

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Transformer (T1) Division

ISO/IEC 17025
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Date : 16/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

SFRA MEASUREMENT

Test Connections

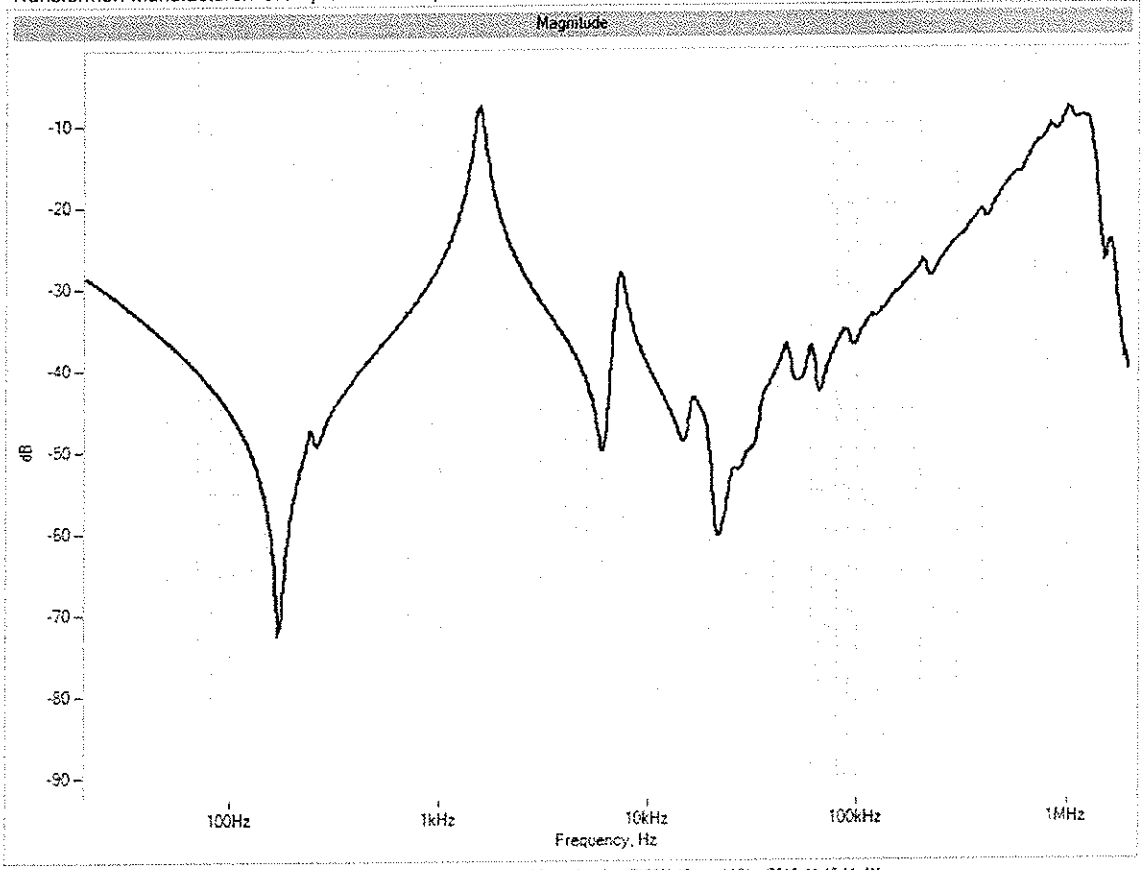
Trace No	Red Lead position	Black Lead Position	Other Terminal Condition
1	1U	2U	OPEN
2	1V	2V	OPEN
3	1W	2W	OPEN
4	1U	N	OPEN
5	1V	N	OPEN
6	1W	N	OPEN
7	1U	N	IV SHORTED
8	1V	N	IV SHORTED
9	1W	N	IV SHORTED
10	2U	N	OPEN
11	2V	N	OPEN
12	2W	N	OPEN
13	2U	N	LV SHORTED
14	2V	N	LV SHORTED
15	2W	N	LV SHORTED
16	3U	3W	OPEN
17	3V	3U	OPEN
18	3W	3V	OPEN

WITNESSED BY	TESTED BY	CHECKED BY

TAP NO. 1

Sweep Frequency Response Analyzer Test Report

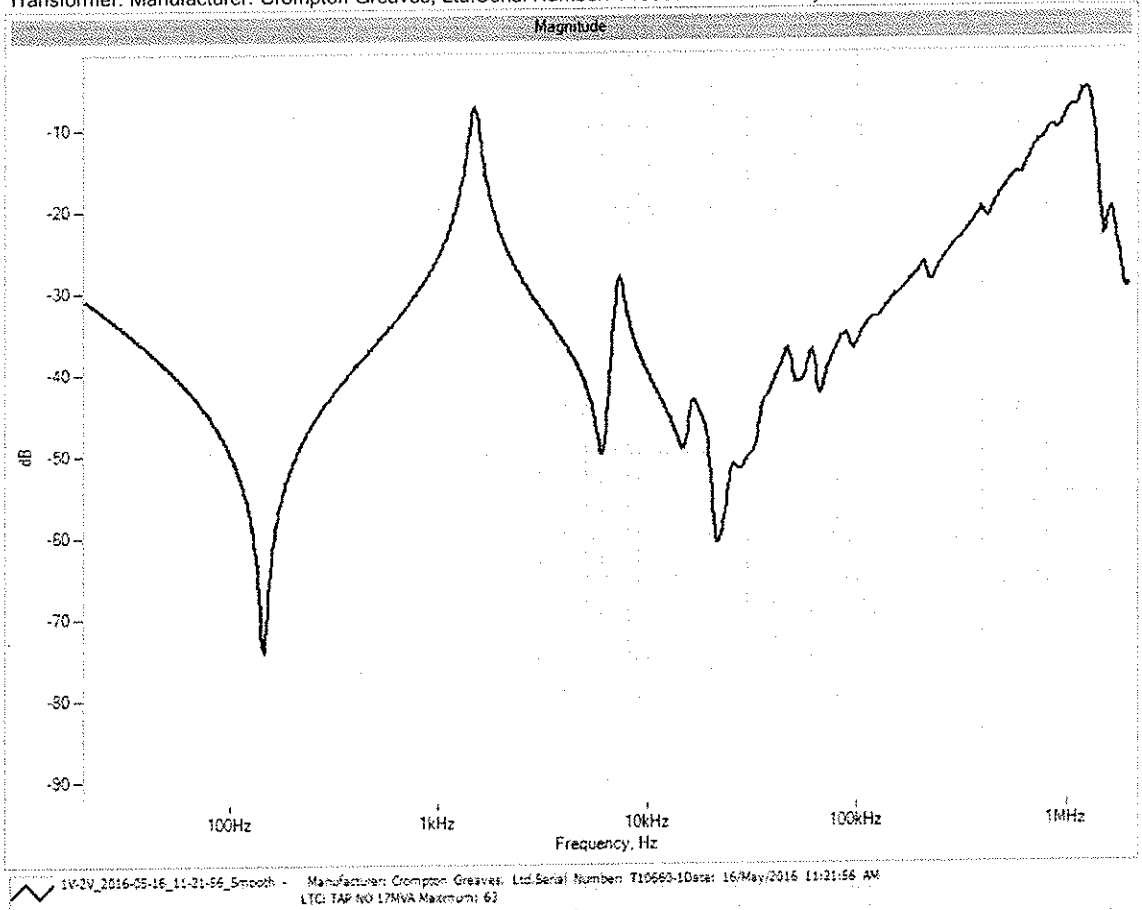
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:18:11 AM



10-20_2016-05-16_11-18-11_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:18:11 AM
LTC: TAP NO: 17MVA Maximum: 63

Sweep Frequency Response Analyzer Test Report

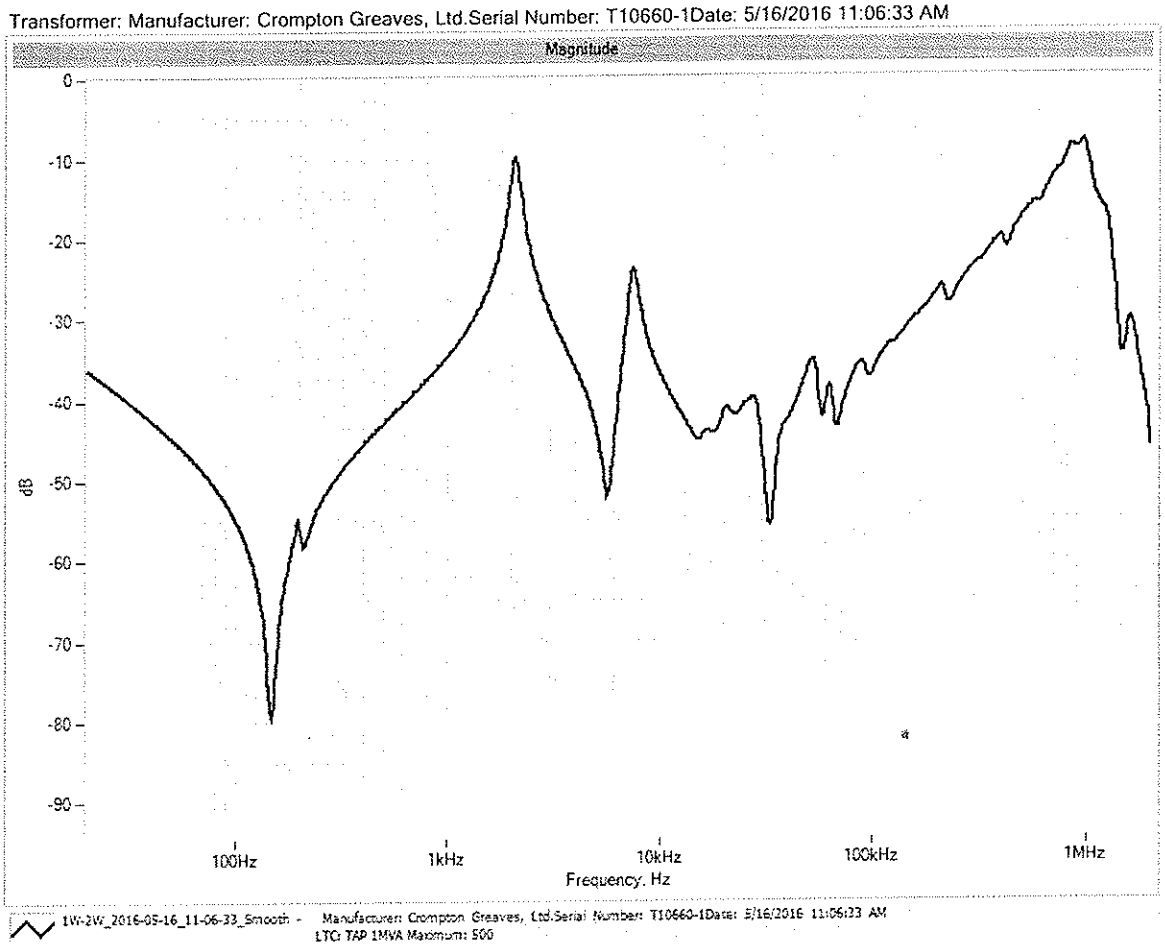
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:21:56 AM



Cont.

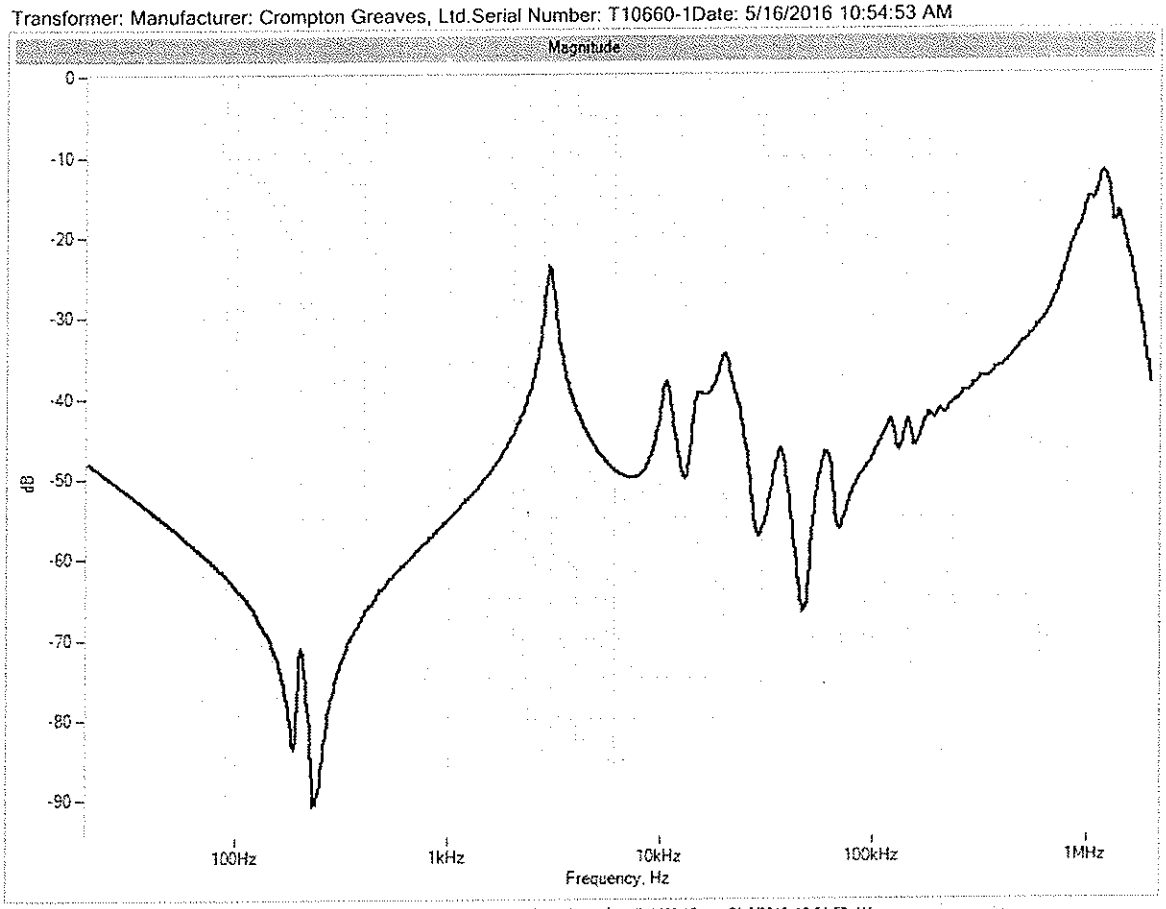
Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 11:06:33 AM



Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:54:53 AM

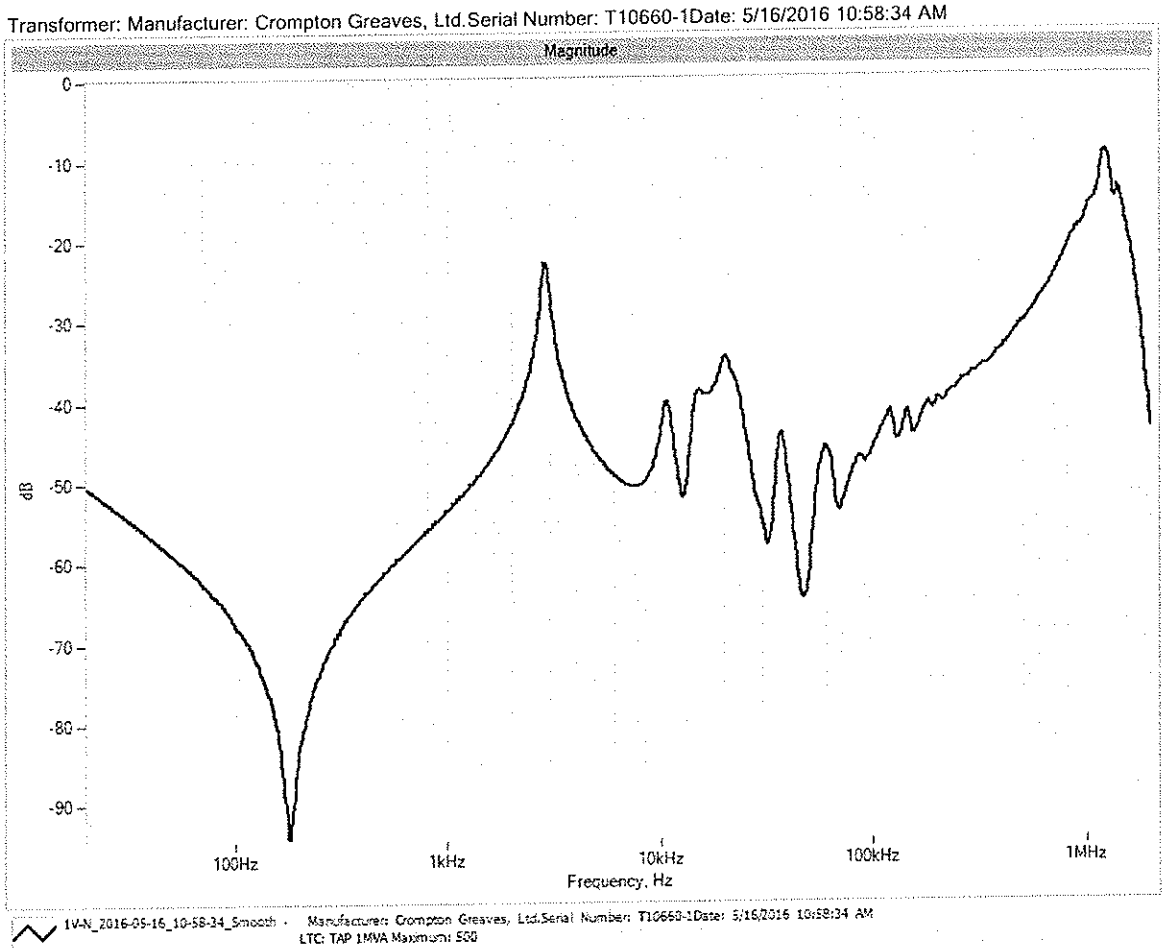


1U-N_2016-05-16_10-54-53_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:54:53 AM
LTC: TAP 1MVA Maximum: 500

C.V.—+

Sweep Frequency Response Analyzer Test Report

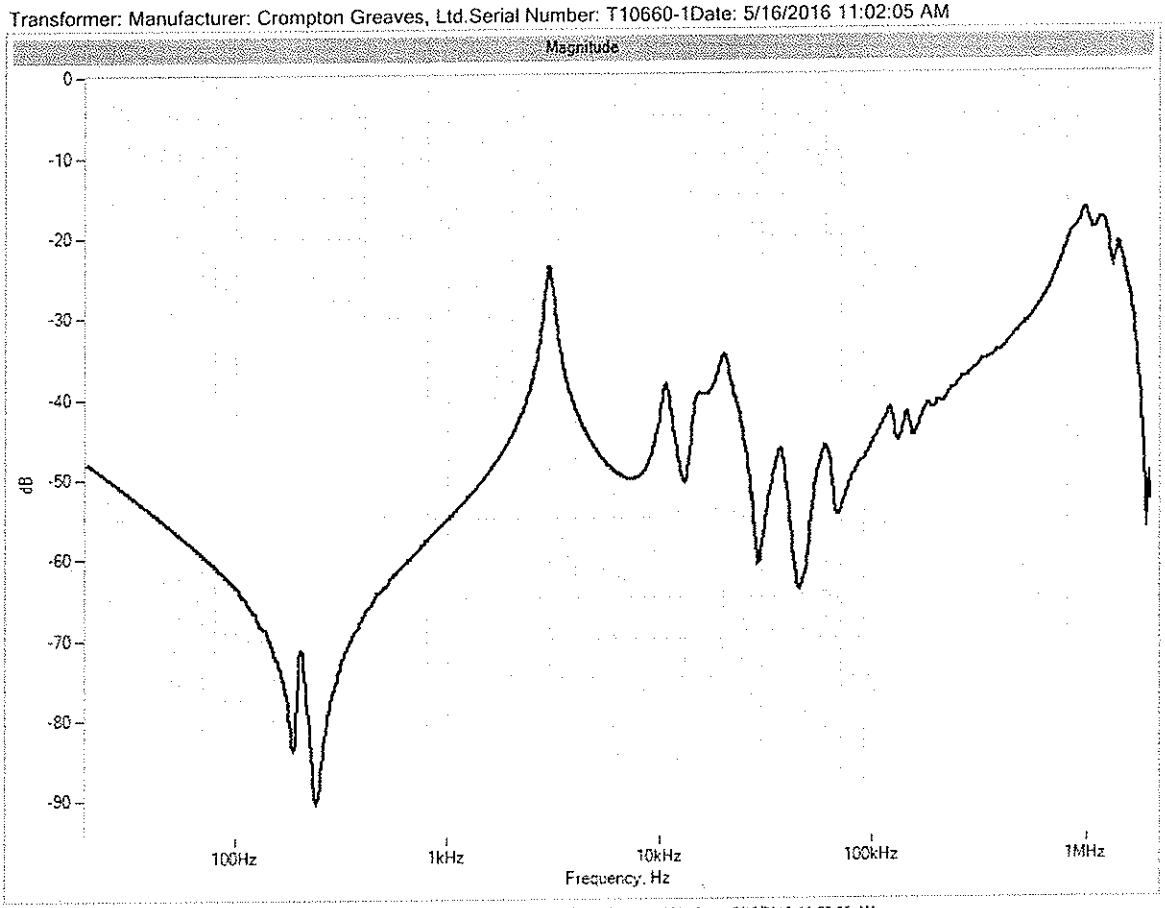
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:58:34 AM



Monday, May 16, 2016

Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 11:02:05 AM

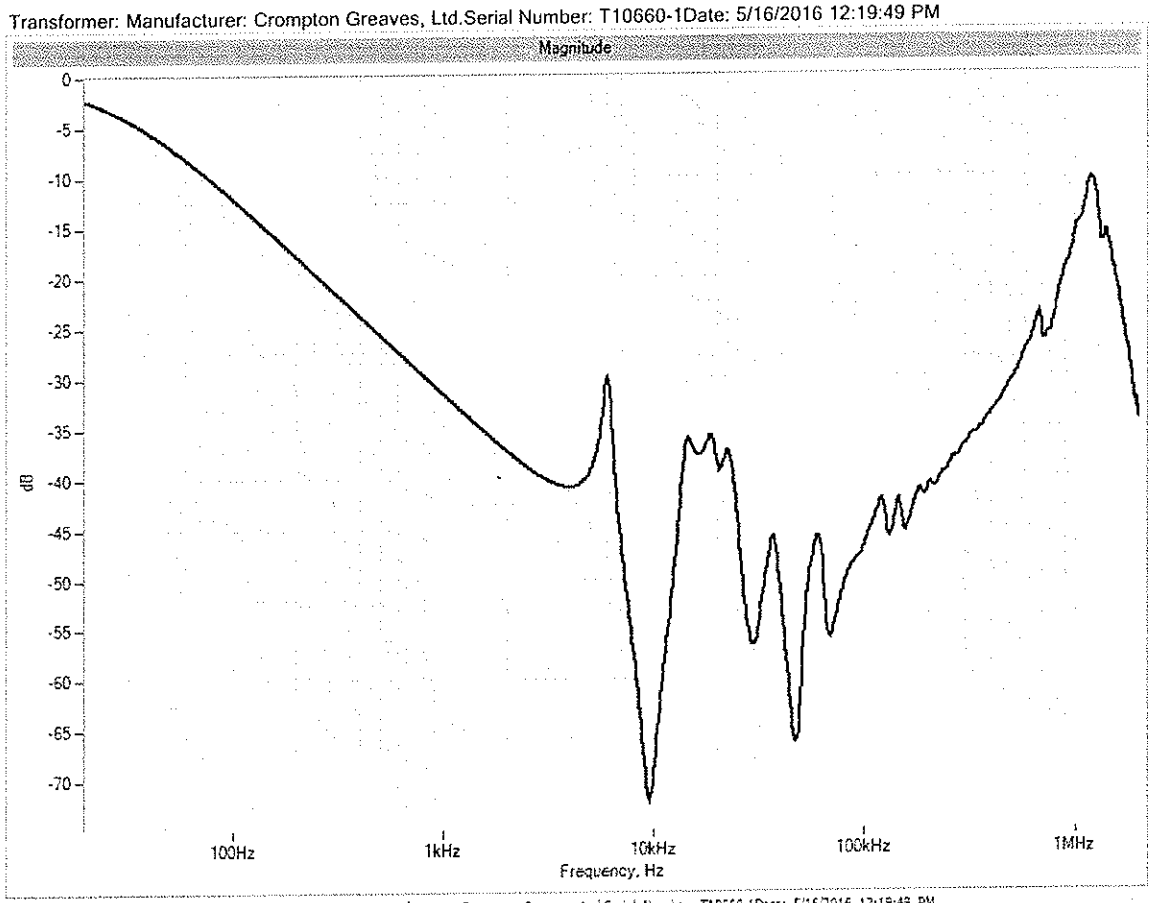


1W-N_2016-05-16_11-02-05_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 11:02:05 AM
LTC: TAP 1MVA Maximum: 500

c.v.t

Sweep Frequency Response Analyzer Test Report

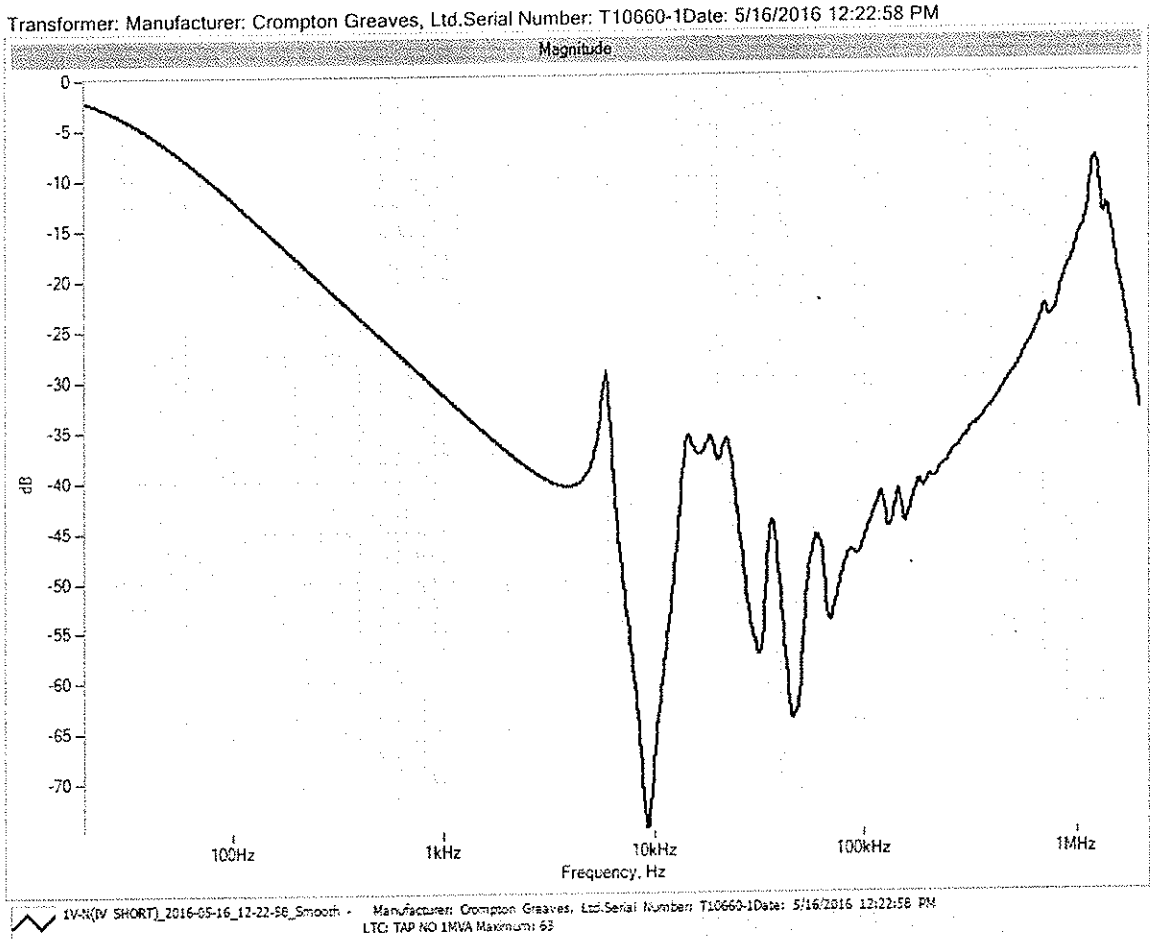
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:19:49 PM



1U-N(IV SHORT)_2016-05-16_12-19-49_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:19:49 PM
LTC: TAP NO 1MVA Maximum: 63

Sweep Frequency Response Analyzer Test Report

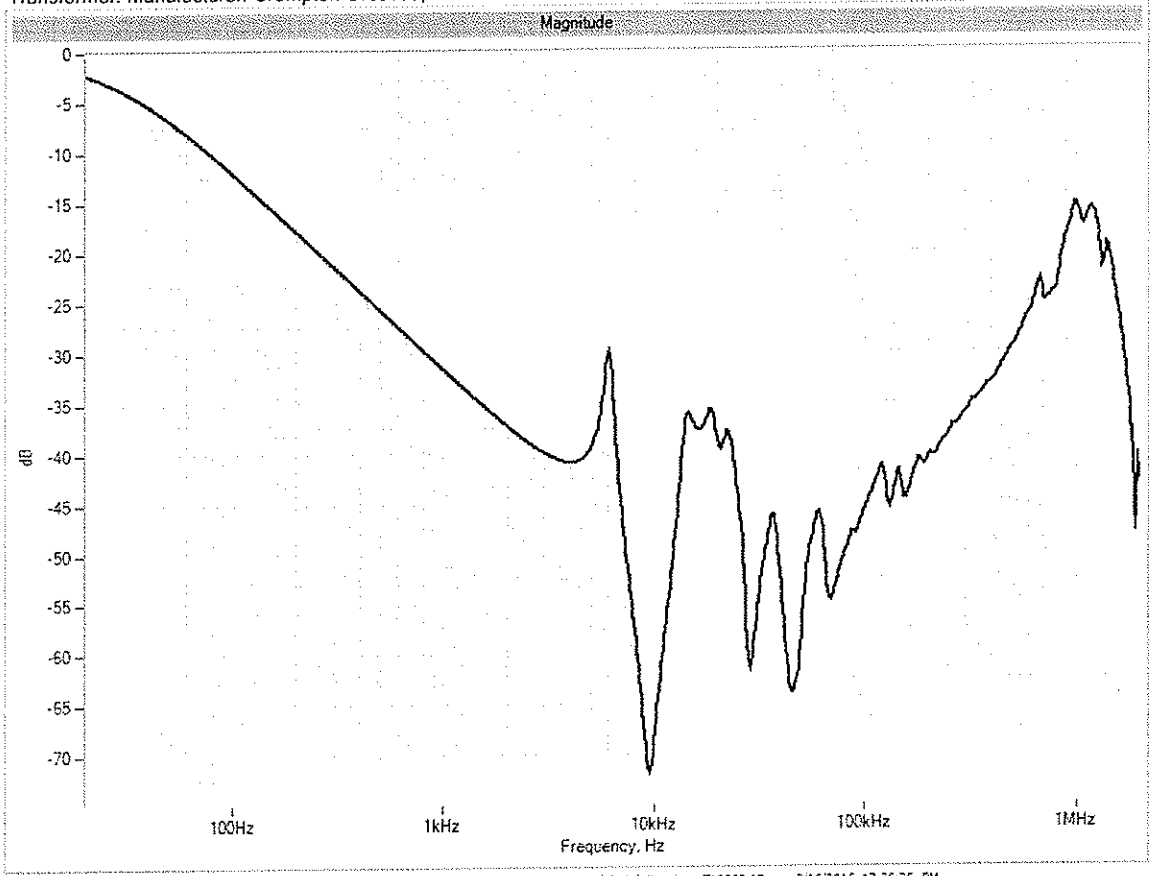
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:22:58 PM



Monday, May 16, 2016

Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:26:35 PM

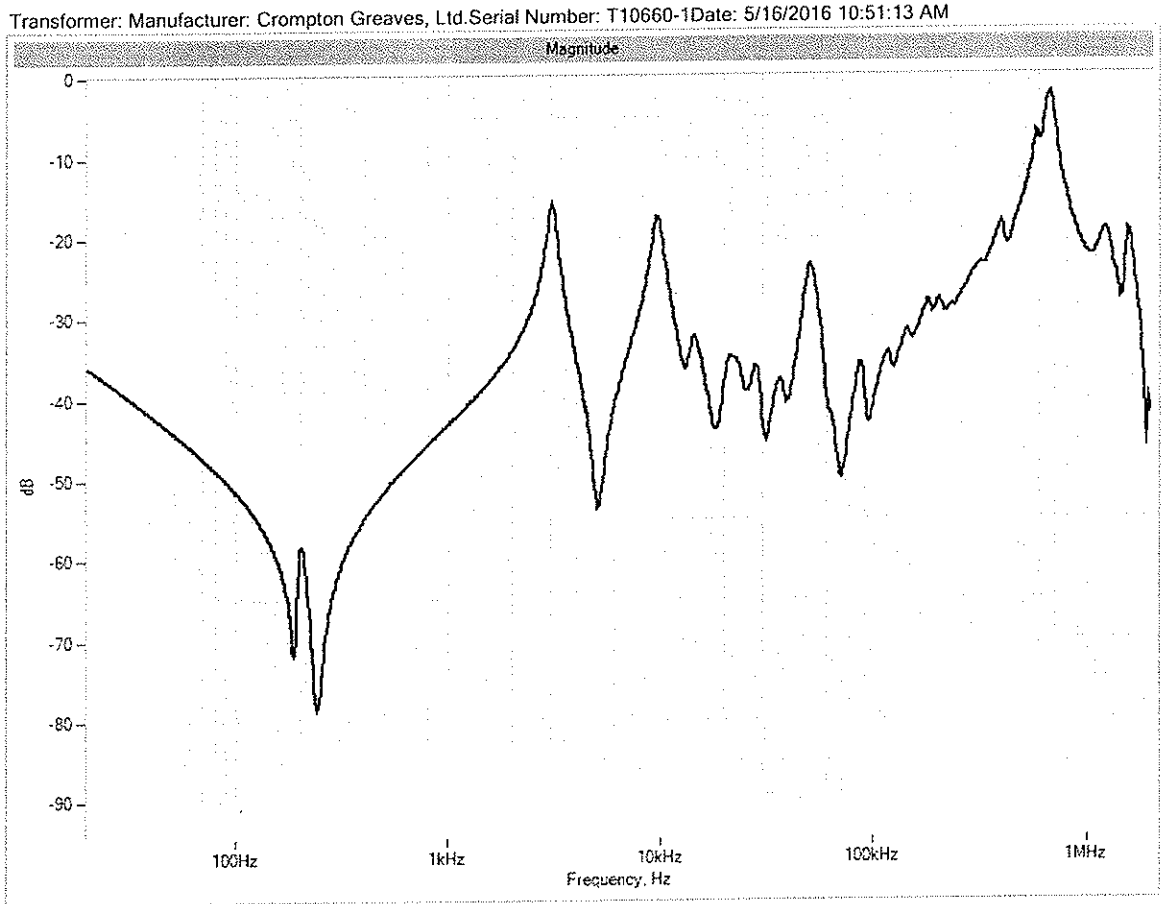


1W-N(EV SHORT)_2016-05-16_12-26-35_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:26:35 PM
LTC: TAP NO 1MVA Maximum: 63

Monday, May 16, 2016

Sweep Frequency Response Analyzer Test Report

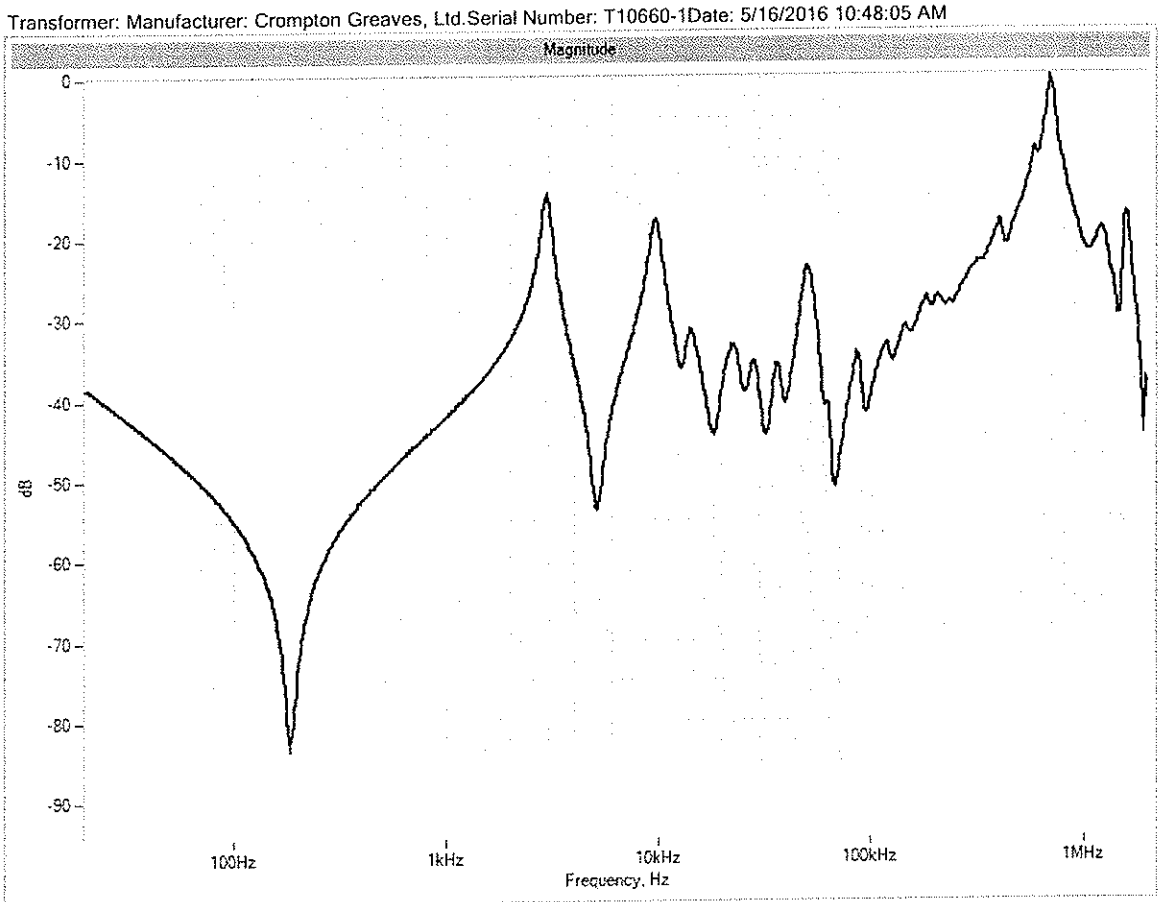
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:51:13 AM



2U-N_2016-05-16_10-51-13_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:51:13 AM
LTC: TAP 1MVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

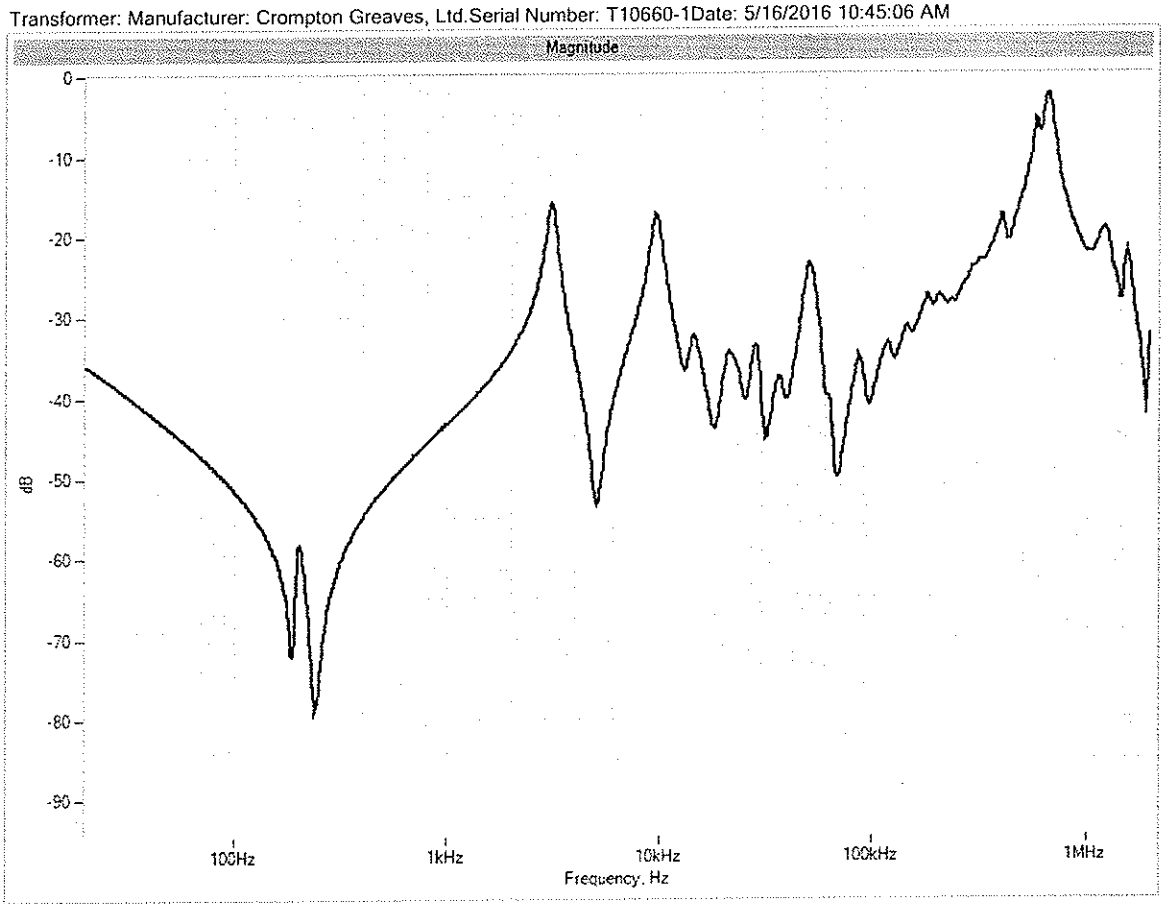
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:48:05 AM



ZV-N_2016-05-16_10-48-05_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:48:05 AM
LTC: TAP 1MVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

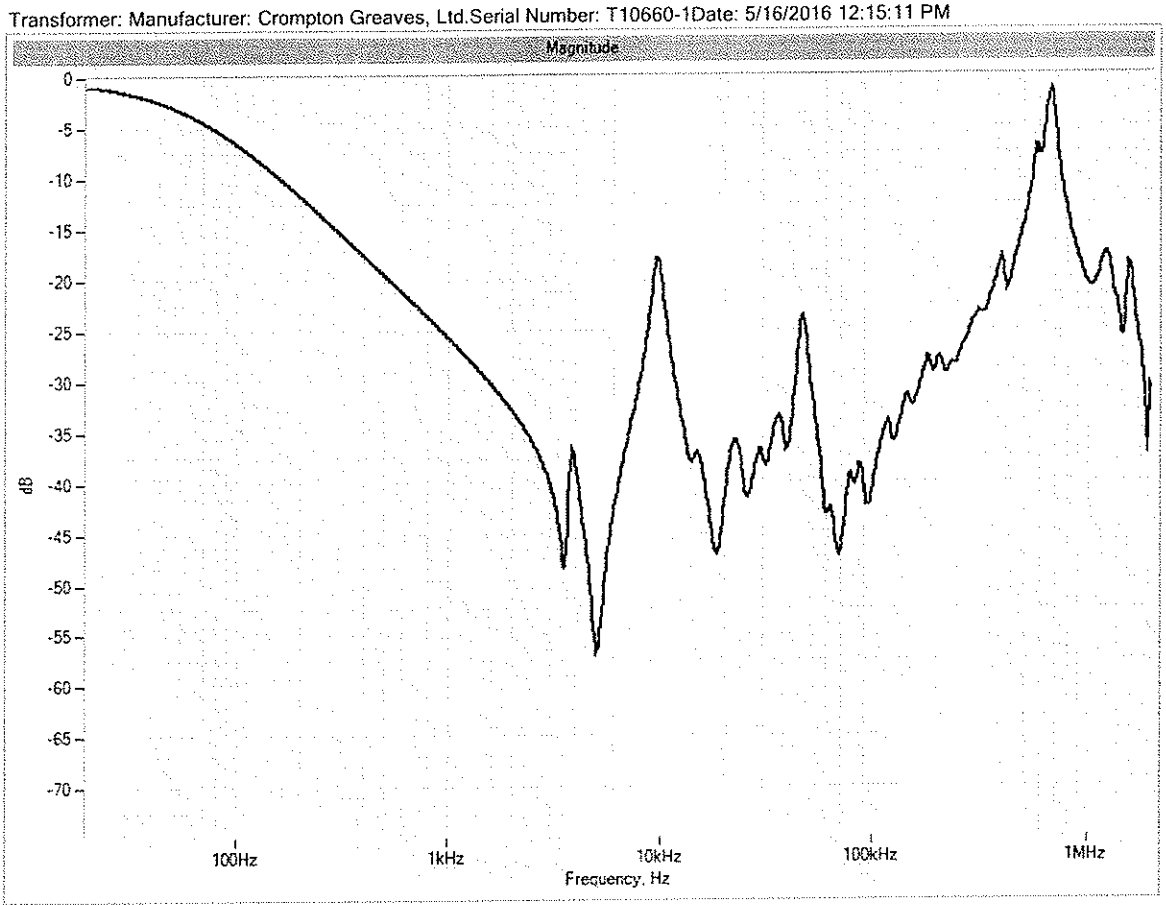
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:45:06 AM



2W-N_2016-05-16_10-45-06_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:45:06 AM
LTC: TAP 1MVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

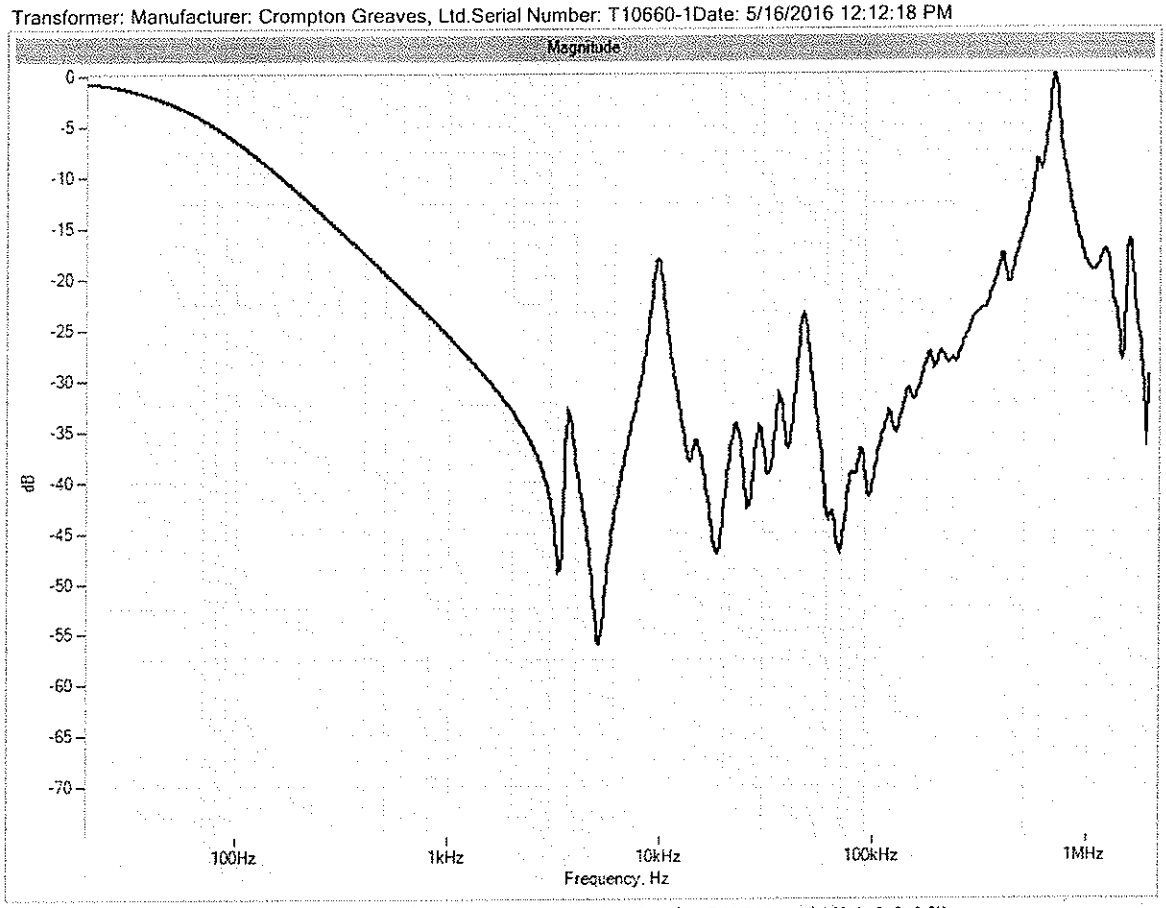
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:15:11 PM



2U-N(TV SHORT)_2016-05-16_12-15-11_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:15:11 PM
LTC: TAP NO 1MVA Maximum: 63

Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:12:18 PM

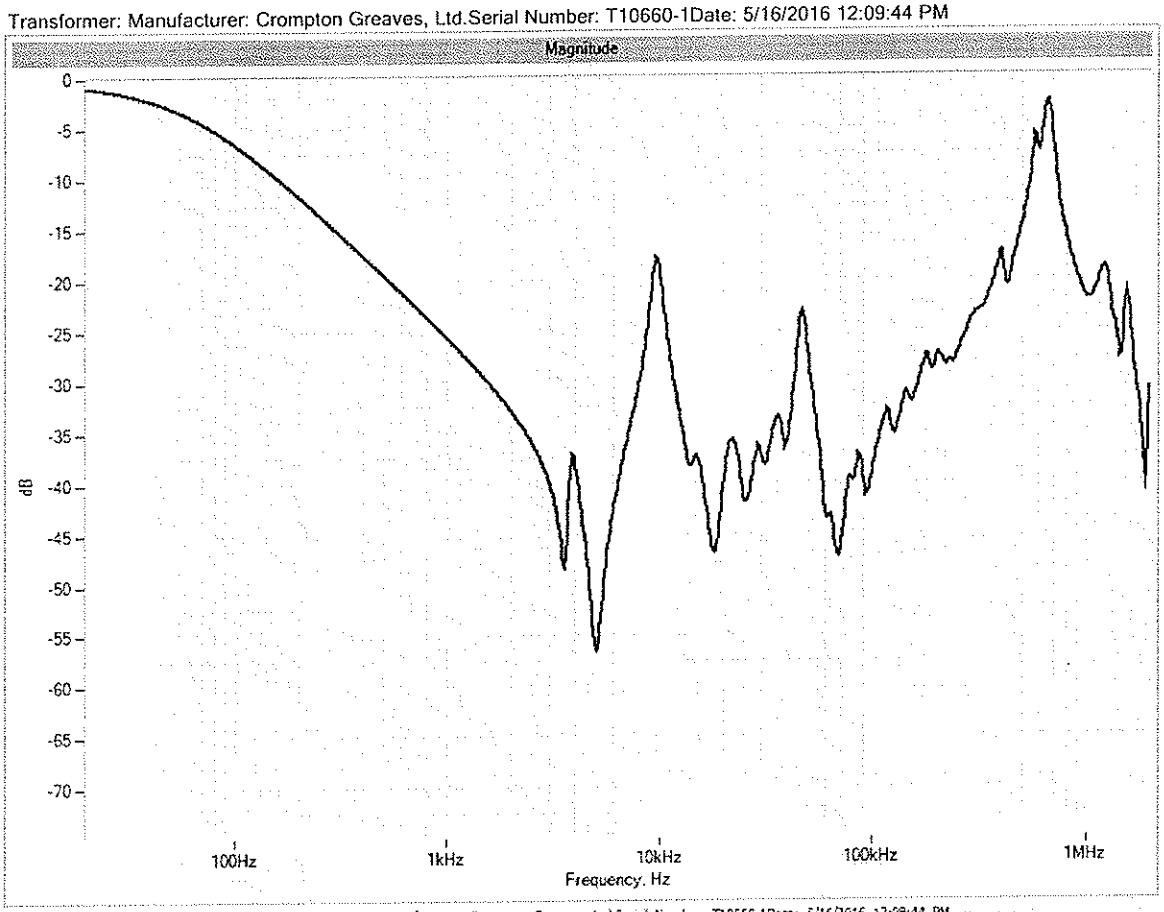


2V-N(TV SHORT)_2016-05-16_12-12-18_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:12:16 PM
LTC: TAP NO 1MVA Maximum: 63

c.v.t.

Sweep Frequency Response Analyzer Test Report

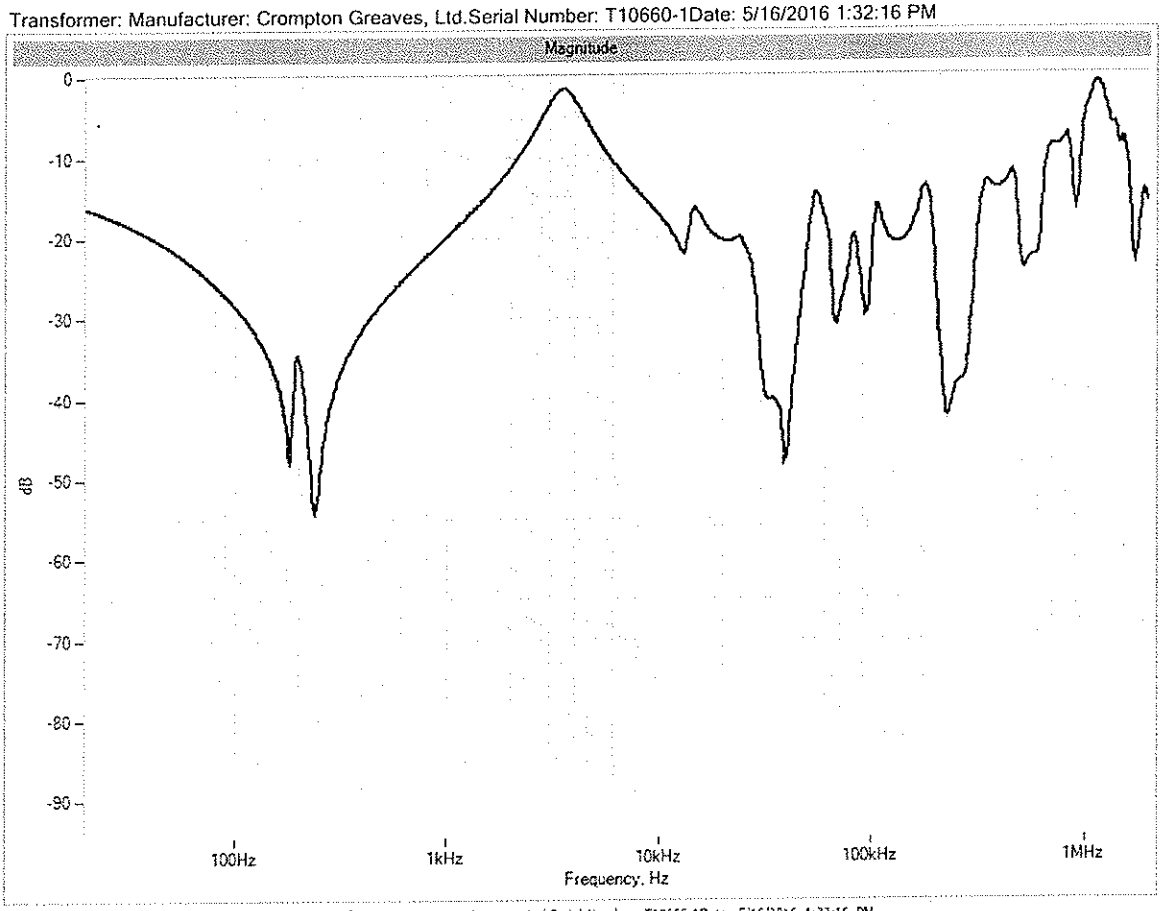
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:09:44 PM



2W-N(TV SHORT)_2016-05-16_12-09-44_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:09:44 PM
LTC: TAP NO 1MVA Maximum: 63

Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:32:16 PM

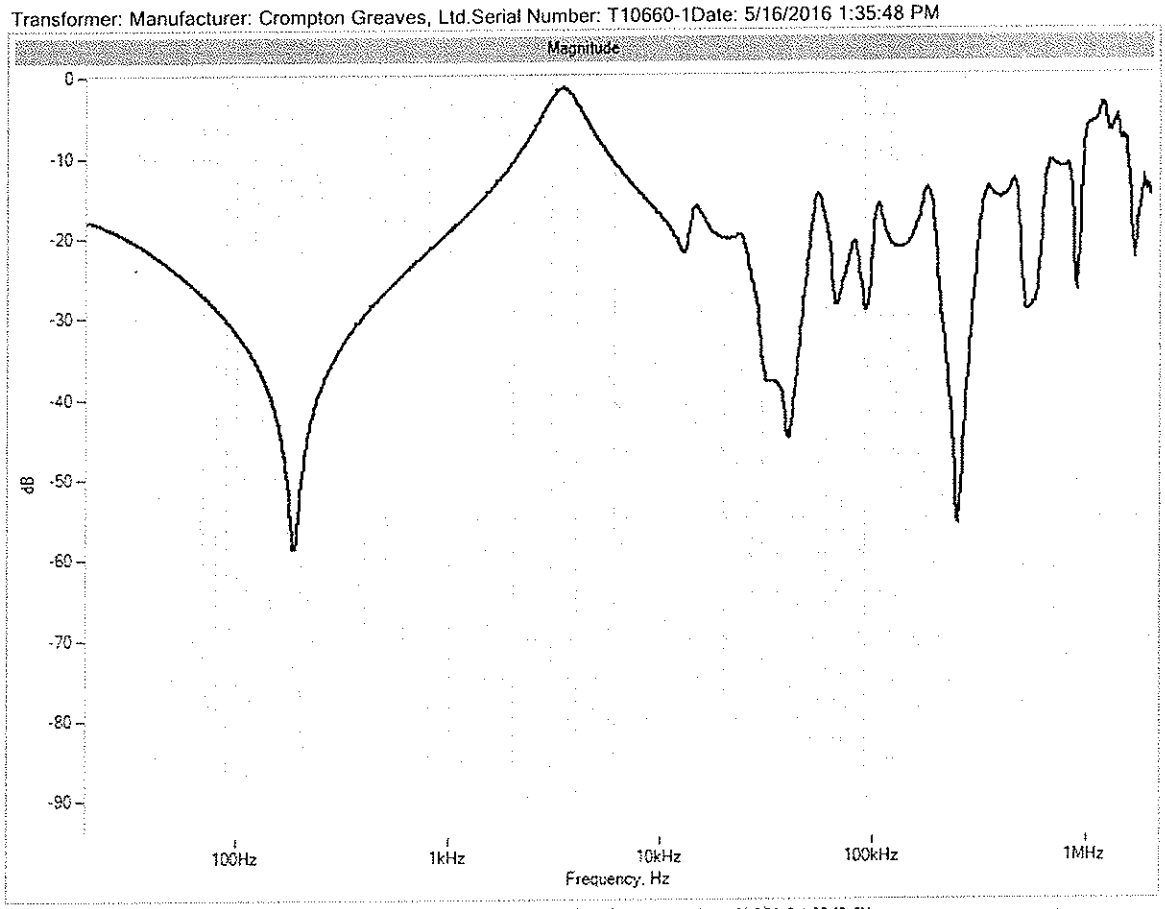


30-3W_2016-05-16_13-32-16_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:32:16 PM
LTC: 1MVA Maximum: 500

C.V.—7.

Sweep Frequency Response Analyzer Test Report

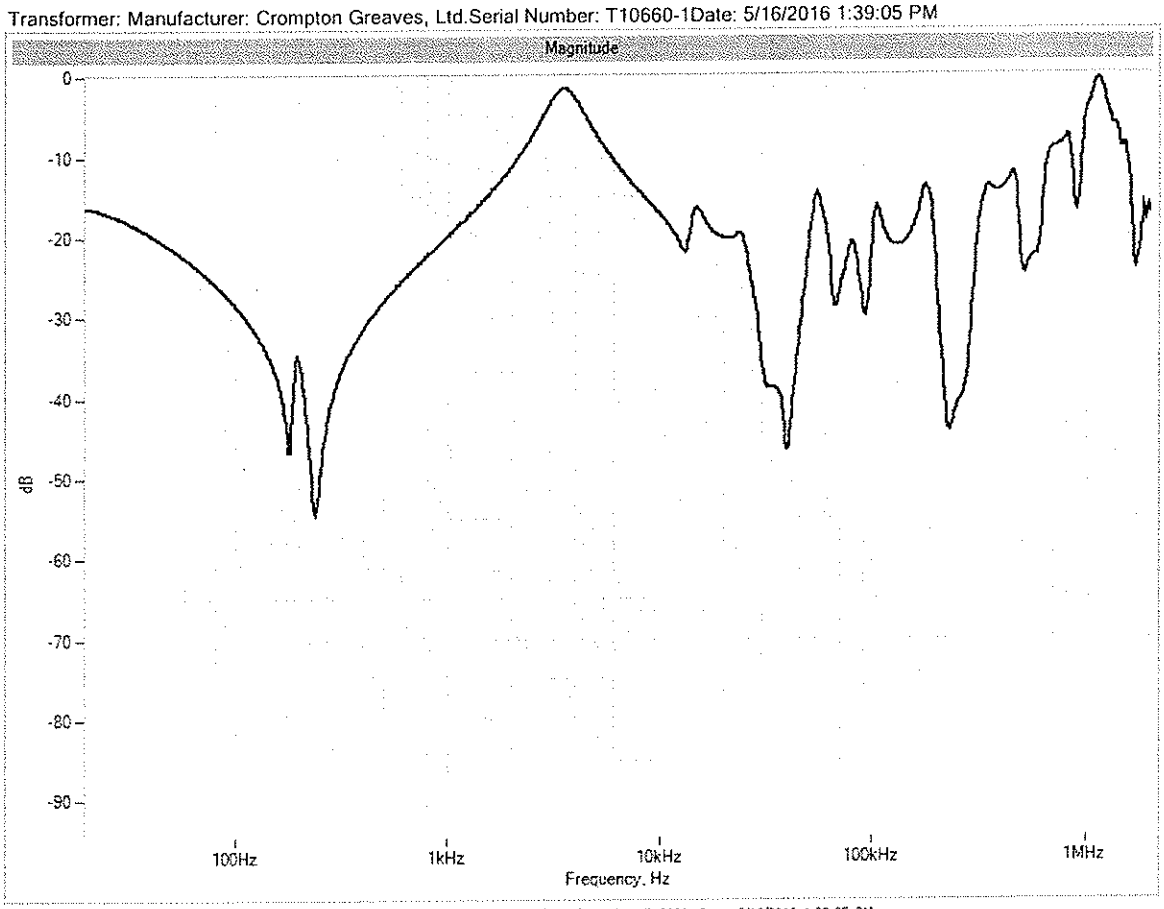
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:35:48 PM



3V-3U_2016-05-16_13-35-48_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:35:48 PM
LTC: 1MVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:39:05 PM

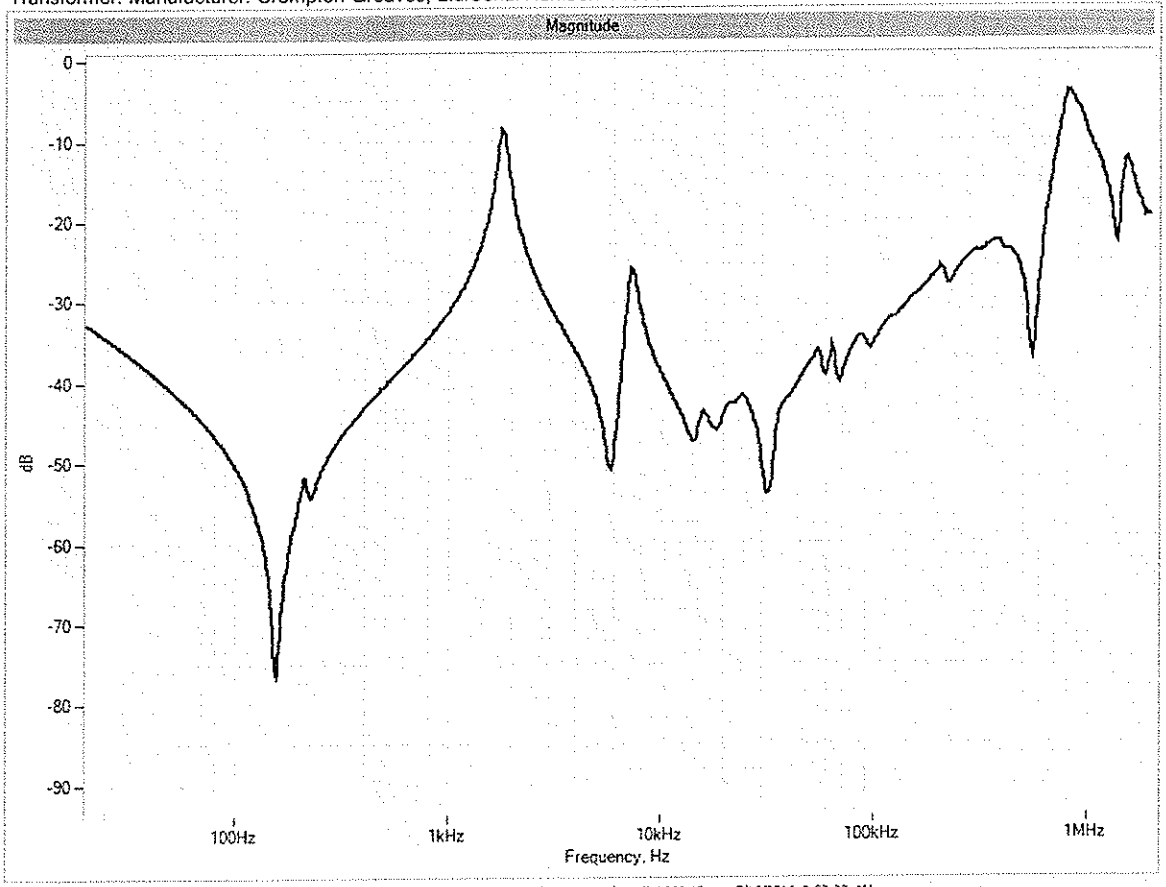


3W-3V_2016-05-16_13-39-05_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:39:05 PM
LTC: 1MVA Maximum: 500

TAP NO. 9B

Sweep Frequency Response Analyzer Test Report

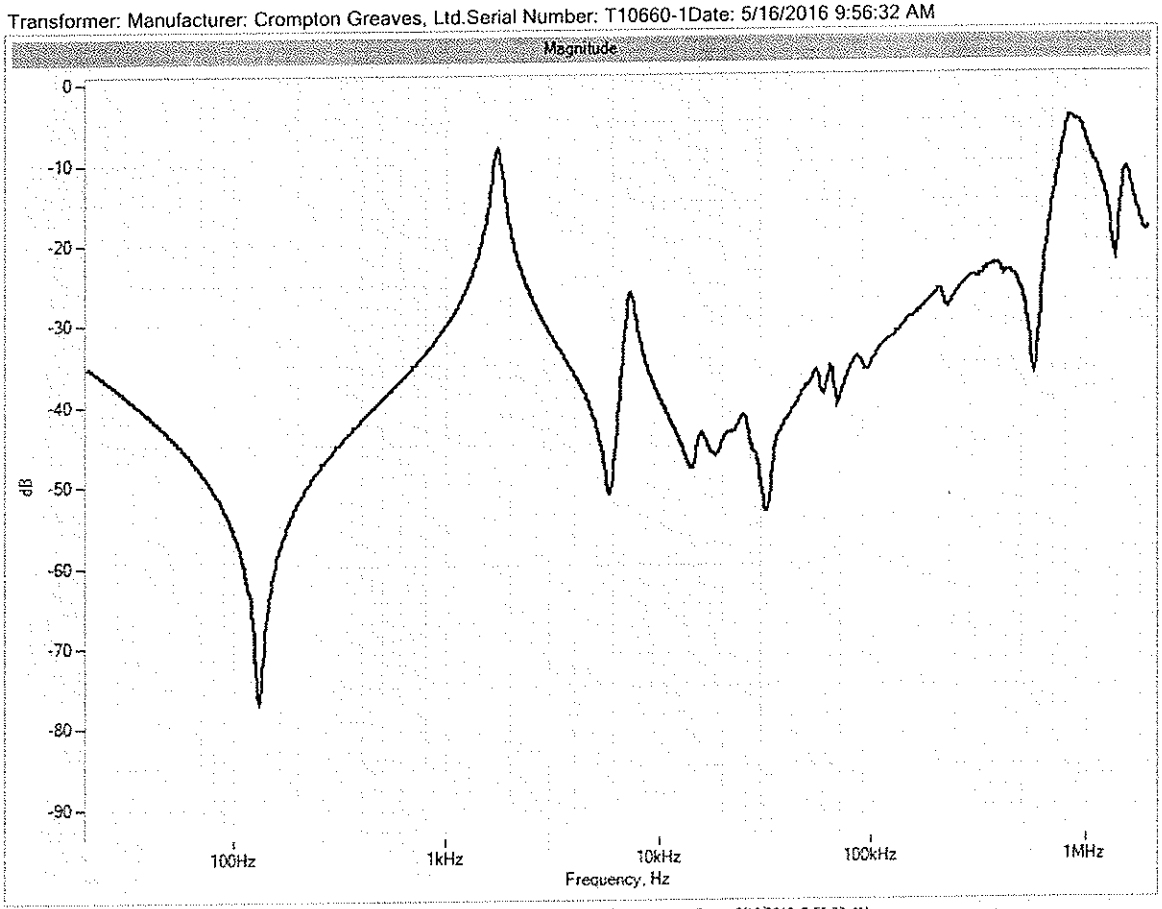
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 9:53:32 AM



1U-2U_2016-05-16_09-52-32_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 9:53:32 AM
LTC: TAP 95MVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

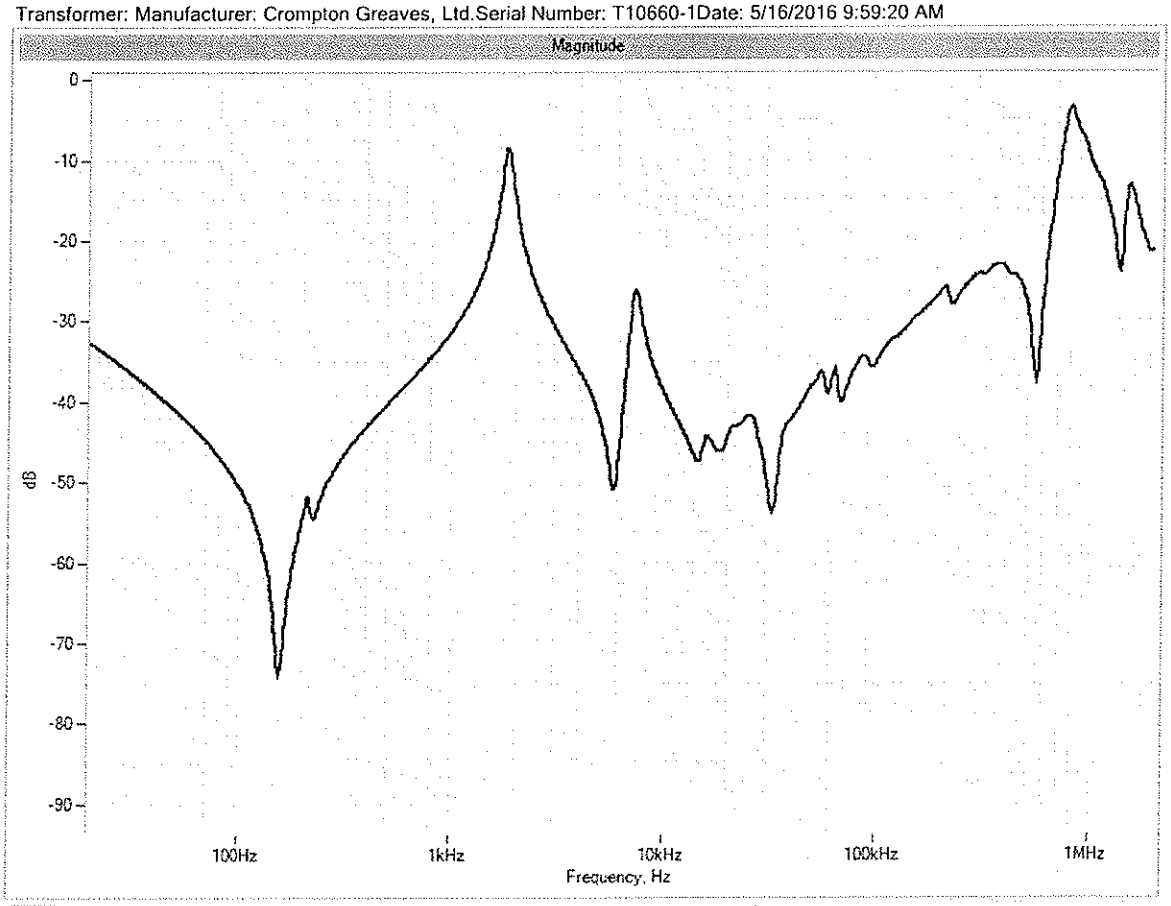
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 9:56:32 AM



1V-2V_2016-05-16_09-56-32_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 9:56:32 AM
LTC: TAP 5BMVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

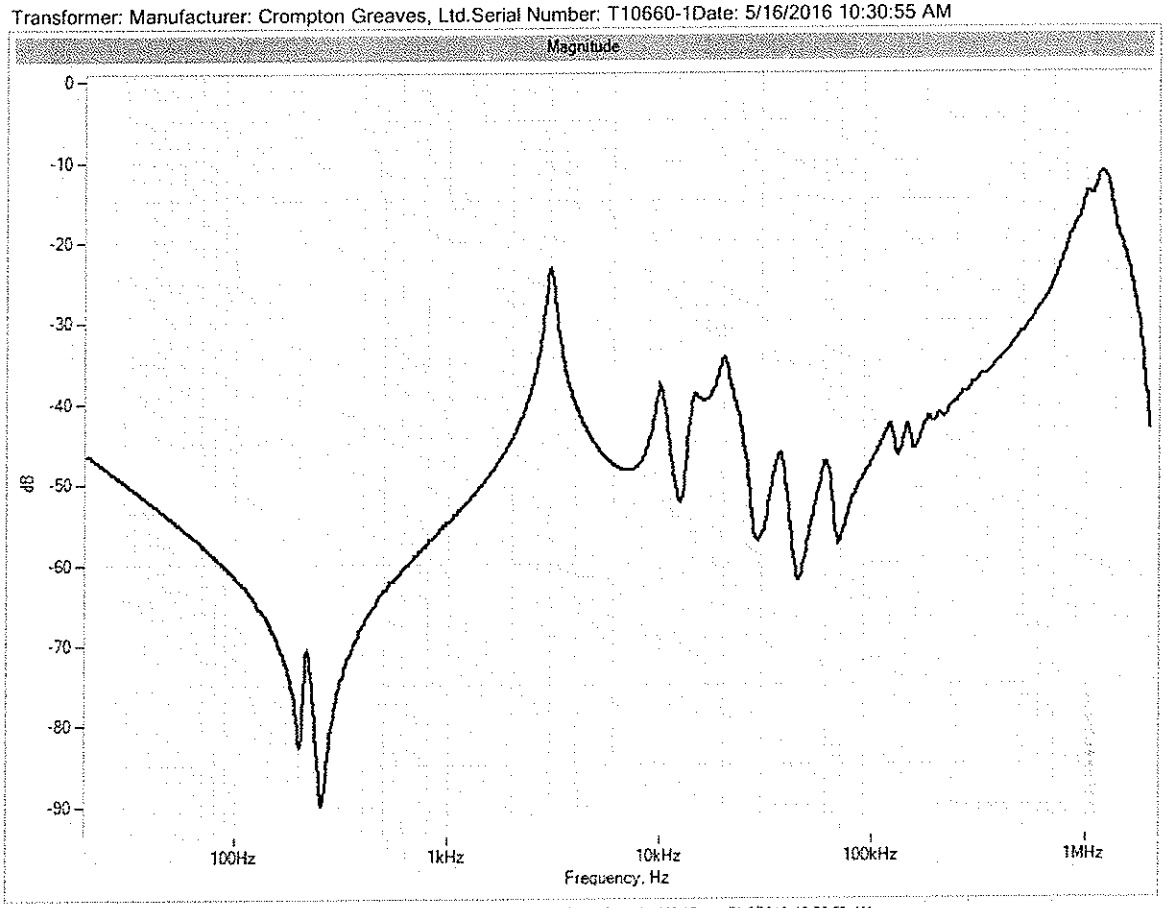
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 9:59:20 AM



1W-2W_2016-05-16_09-59-20_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 9:59:20 AM
LTC: TAP 9BMVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

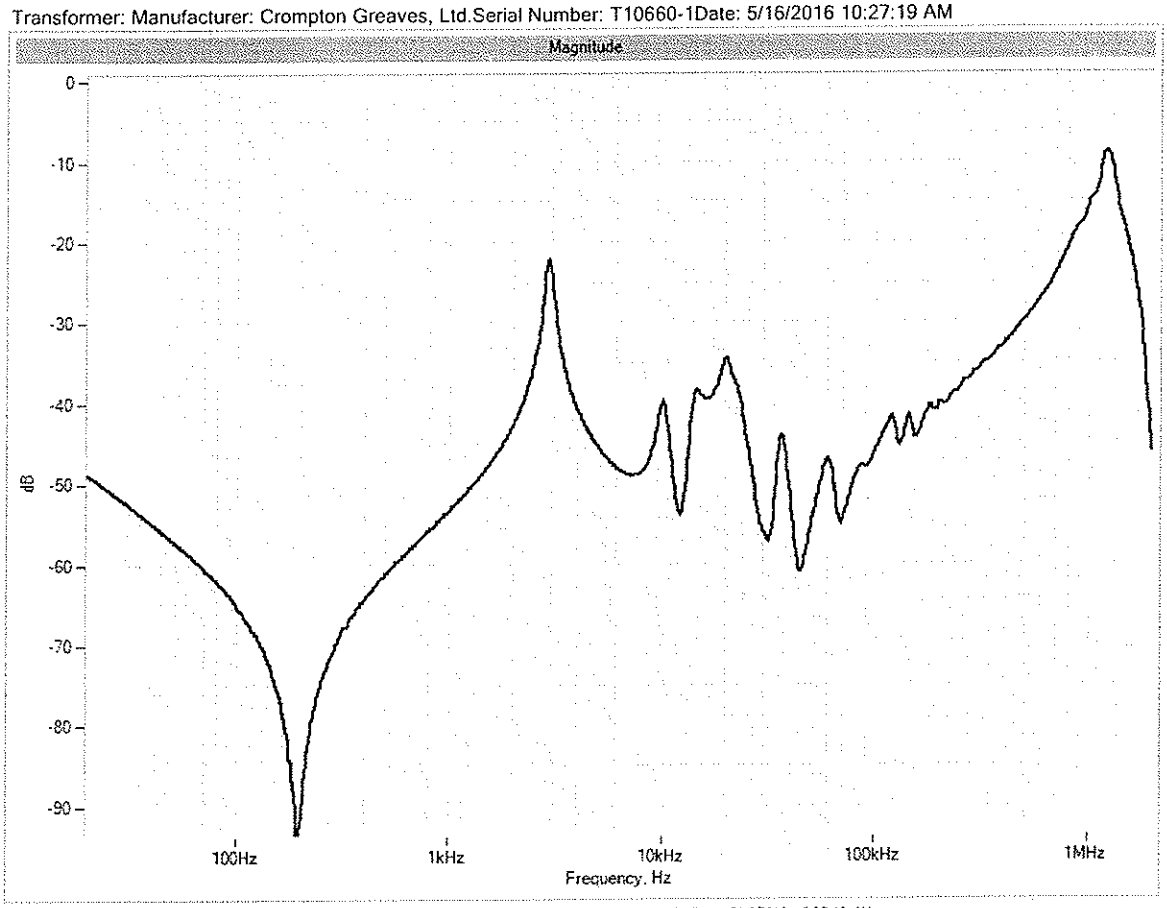
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:30:55 AM



10-N_2016-05-16_10-30-55_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:30:55 AM
LTC: TAP 9BMVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

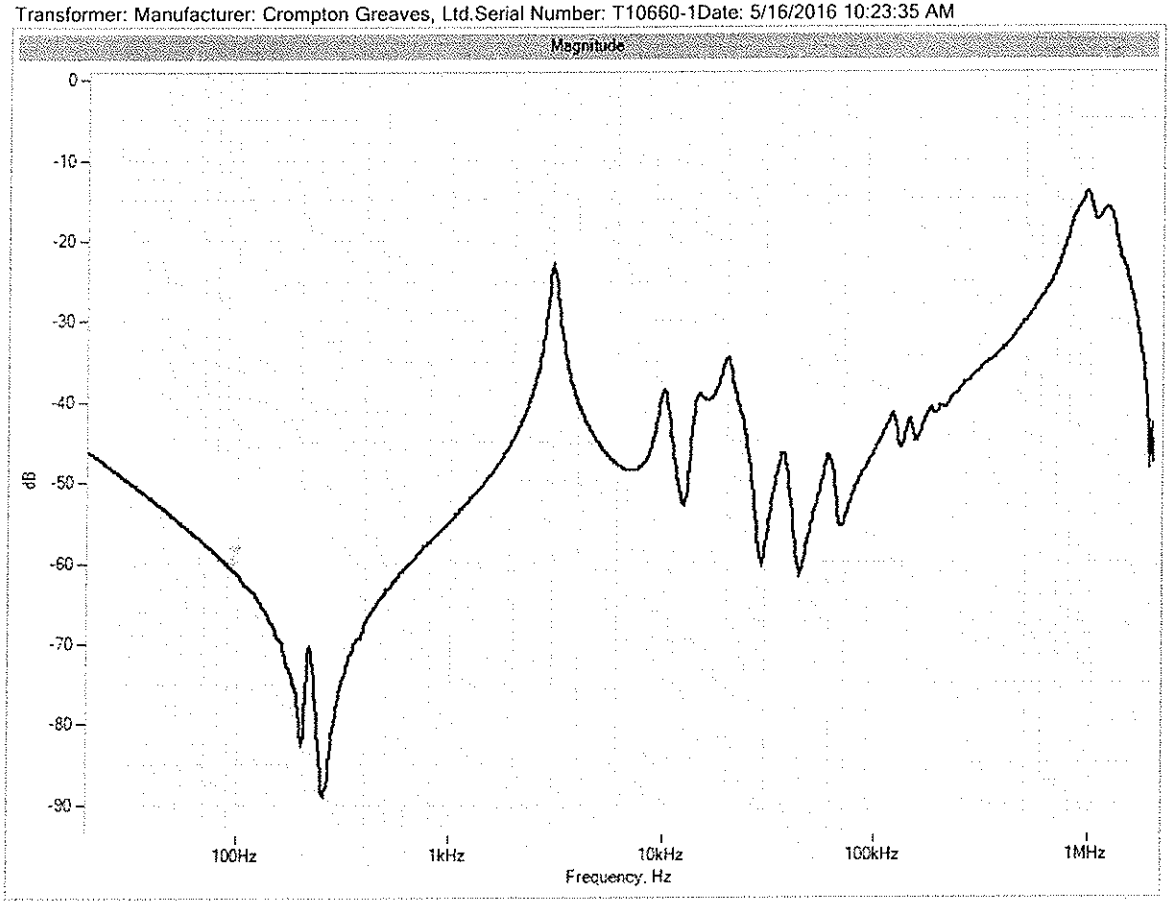
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:27:19 AM



1V-N_2016-05-16_10-27-19_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:27:19 AM
LTC: TAP 9BMVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

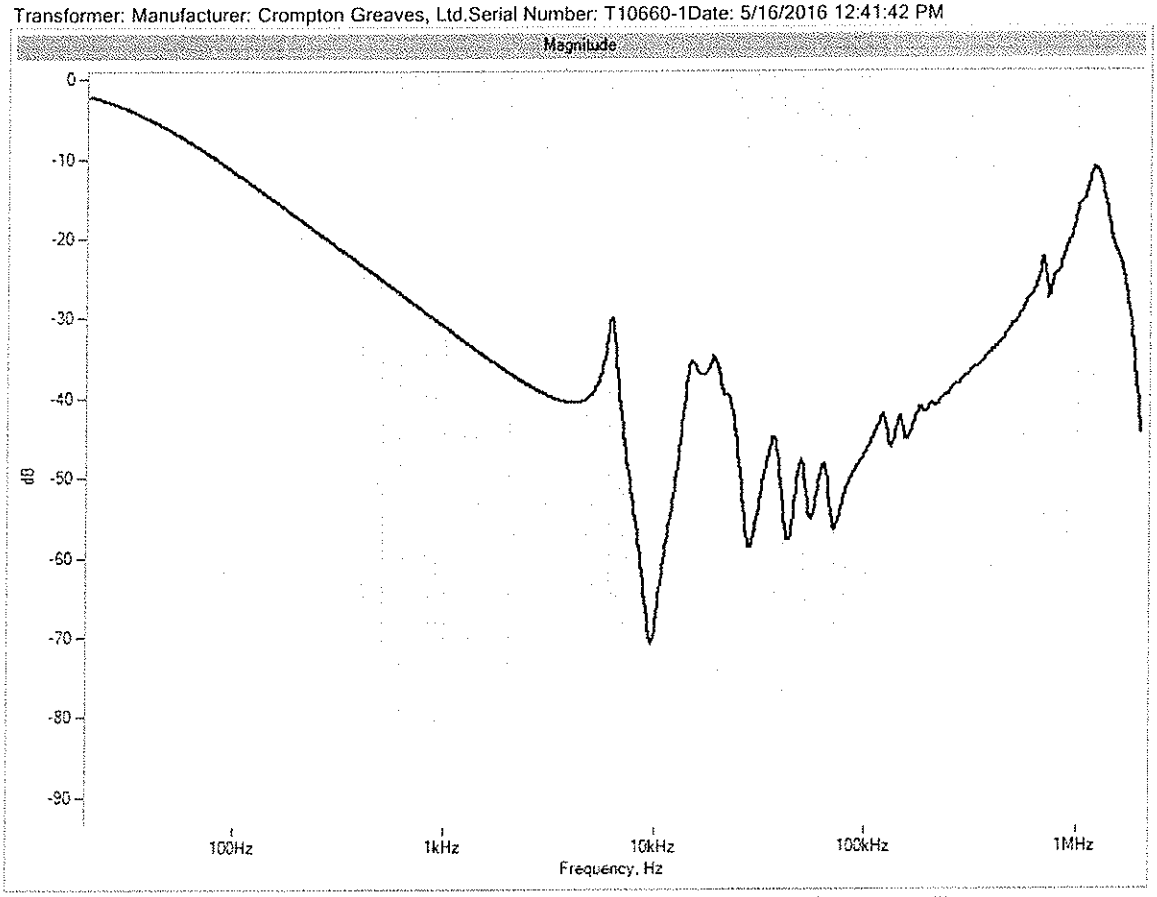
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:23:35 AM



1W-R_2016-05-16_10-23-35_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:23:35 AM
LTC TAP 9BMVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

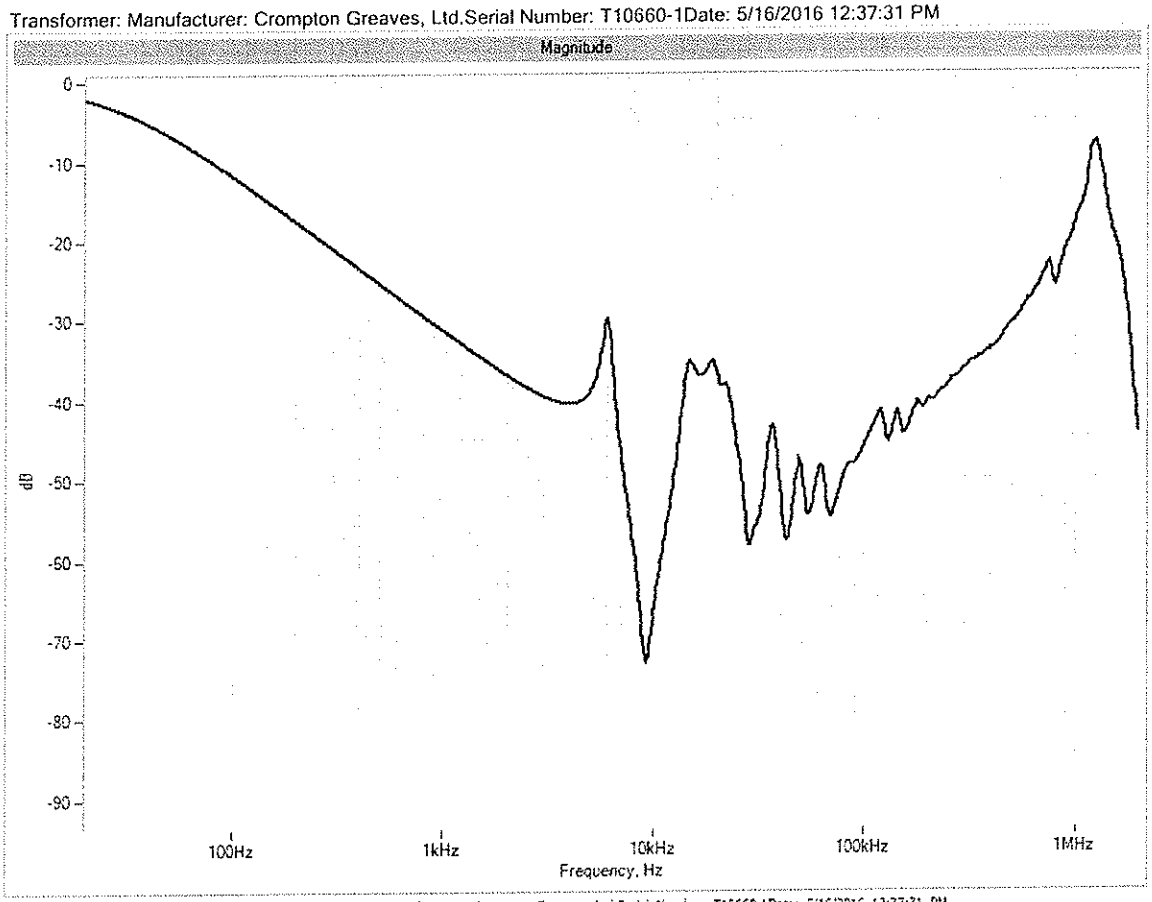
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:41:42 PM



1U1-1N(IV SHORT)_2016-05-16_12-41-42_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:41:42 PM
LTC: 98MVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

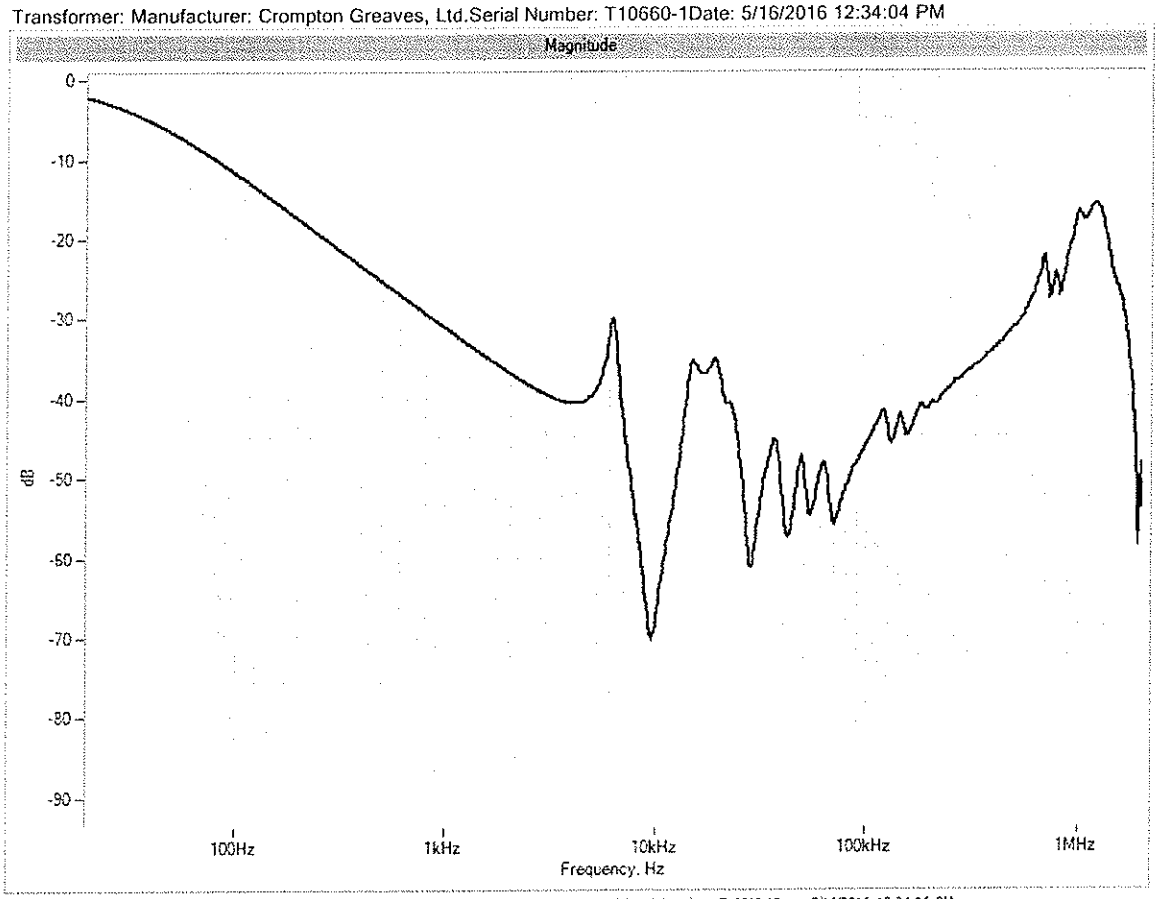
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:37:31 PM



1V1-1N(IV SHORT)_2016-05-16_12-37-31_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:37:31 PM
LTC: 98MVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

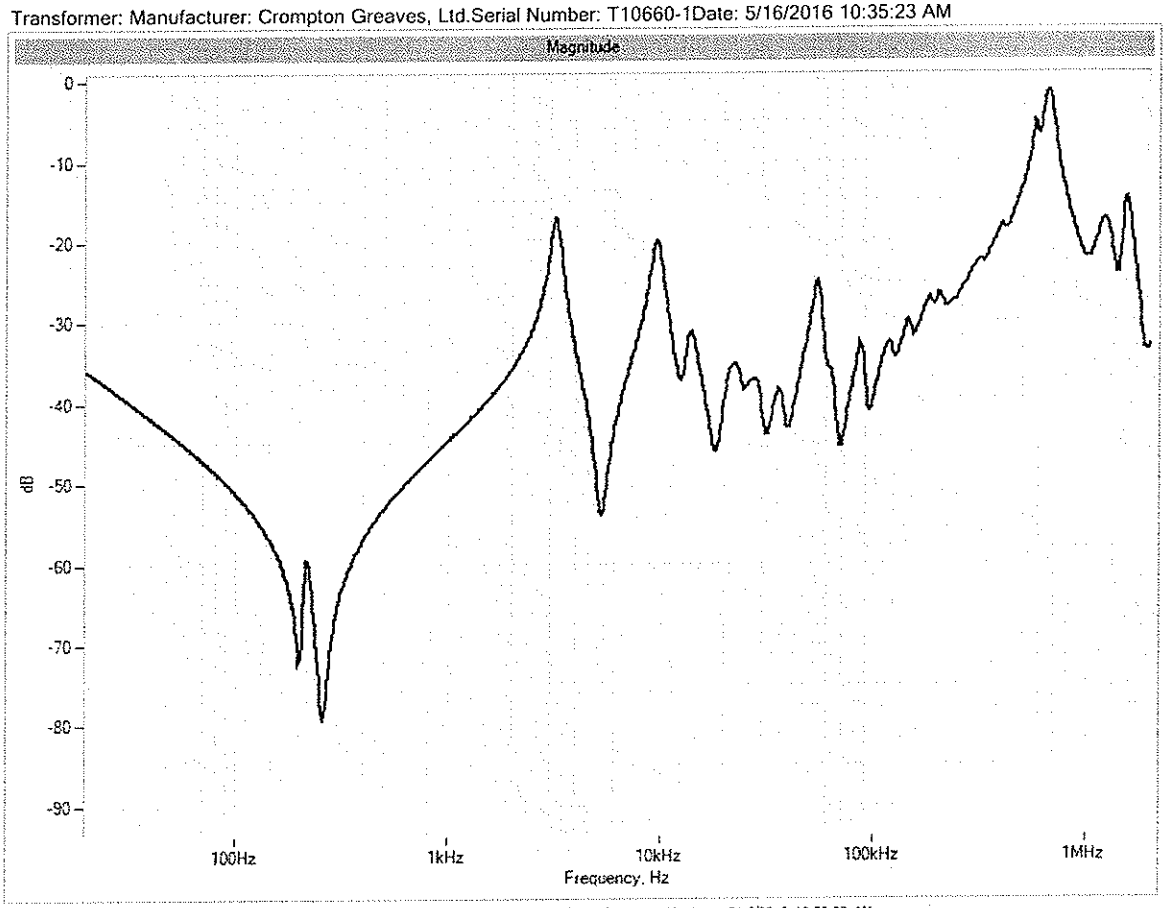
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:34:04 PM



1W1-1N(IV SHORT)_2016-05-16_12-34-04_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:34:04 PM
LTC: 98MVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

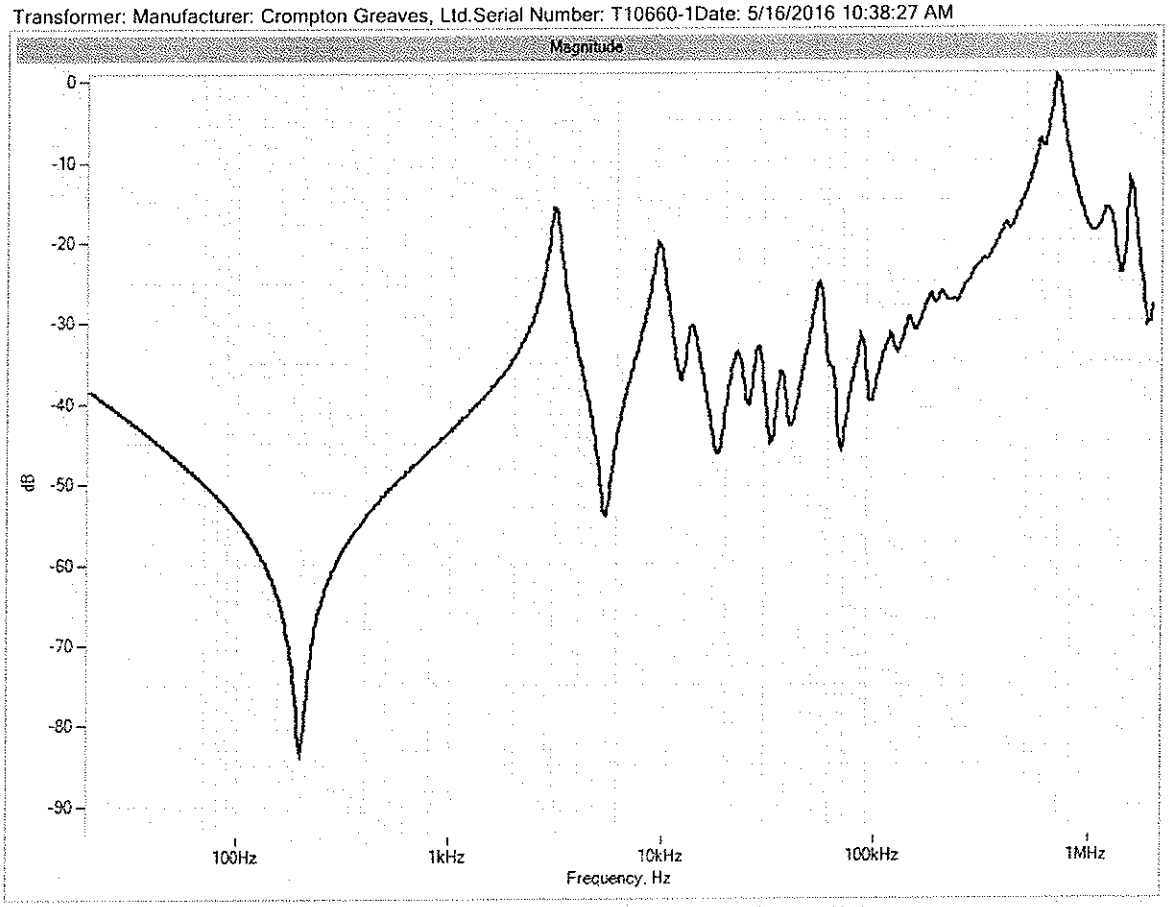
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:35:23 AM



20-N_2016-05-16_10-35-23_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:35:23 AM
LTC: TAP 9BMVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

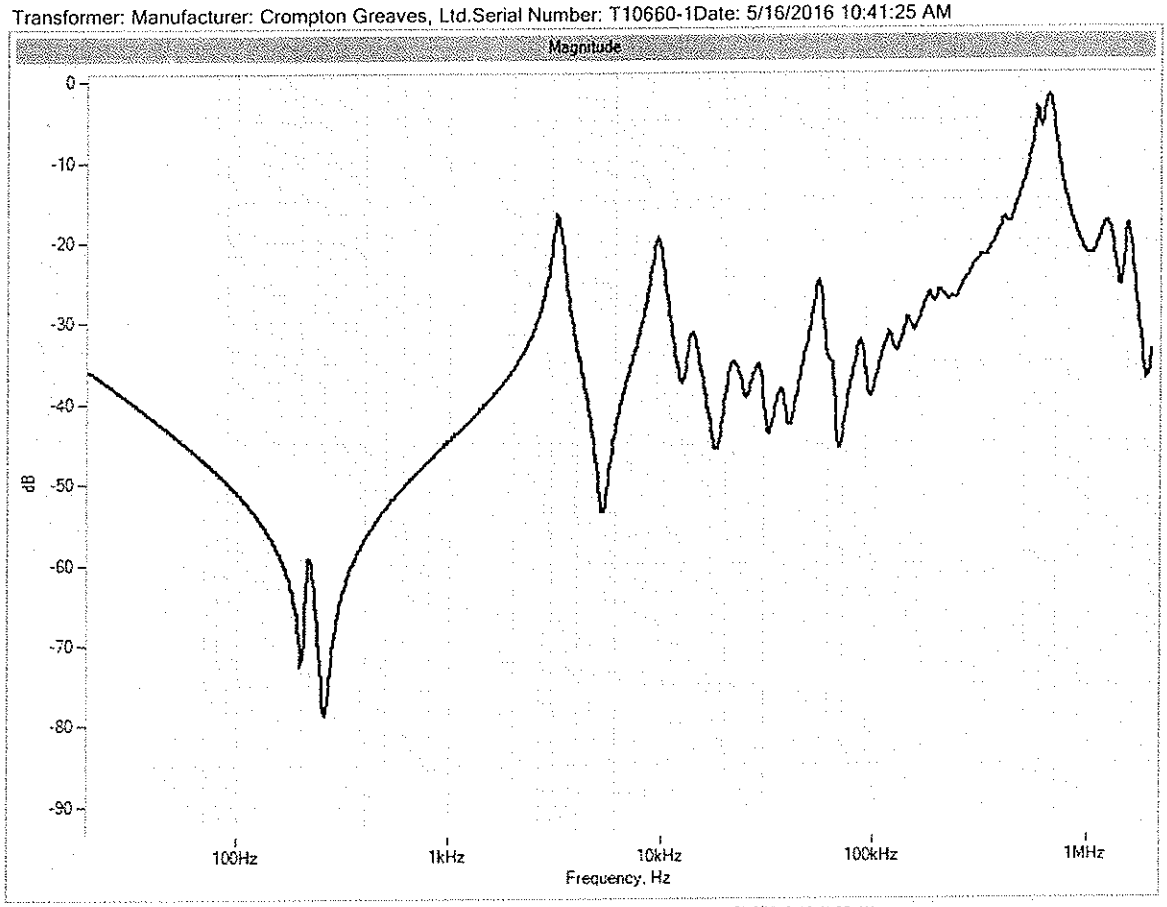
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:38:27 AM



2V-N_2016-05-16_10-38-27_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:38:27 AM
LTC: TAP 98MVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

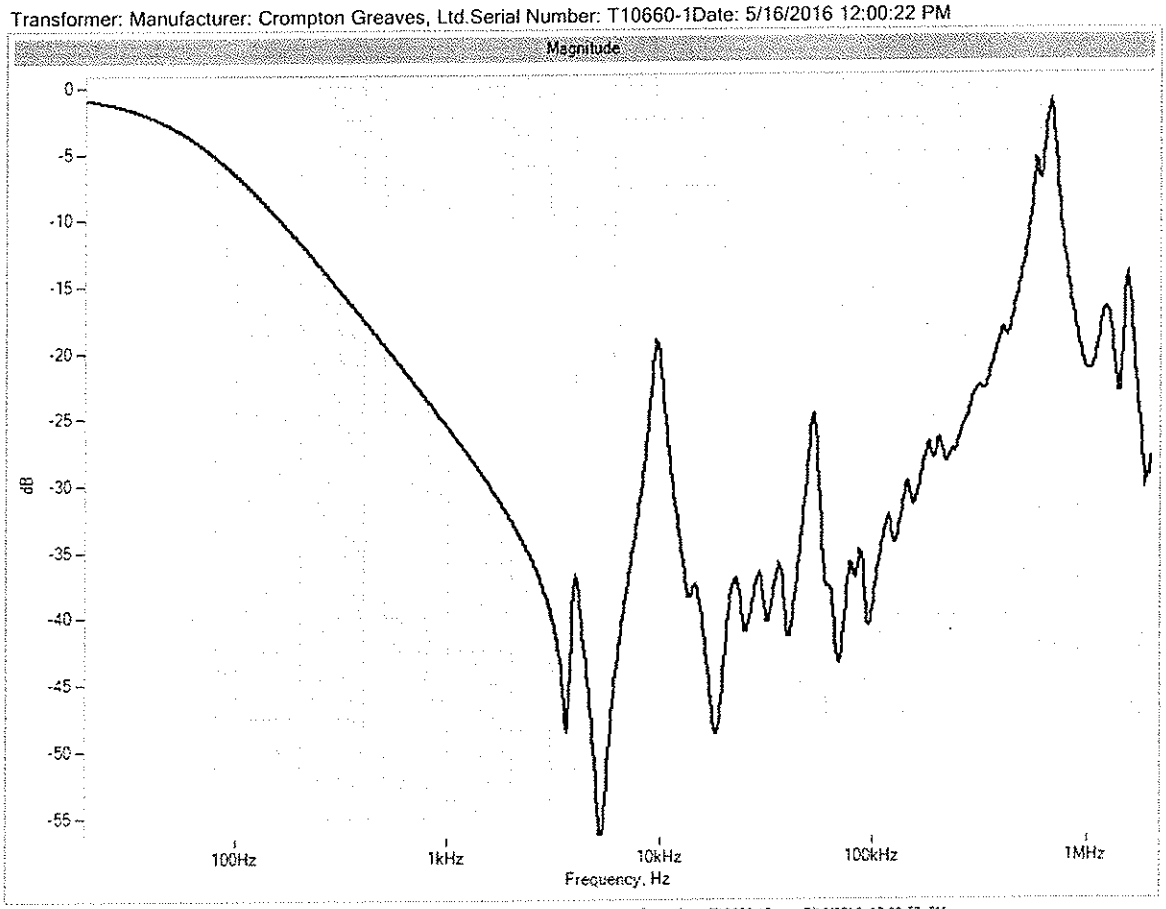
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:41:25 AM



2W-N_2016-05-16_10-41-25_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 10:41:25 AM
LTC: TAP 9BMVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

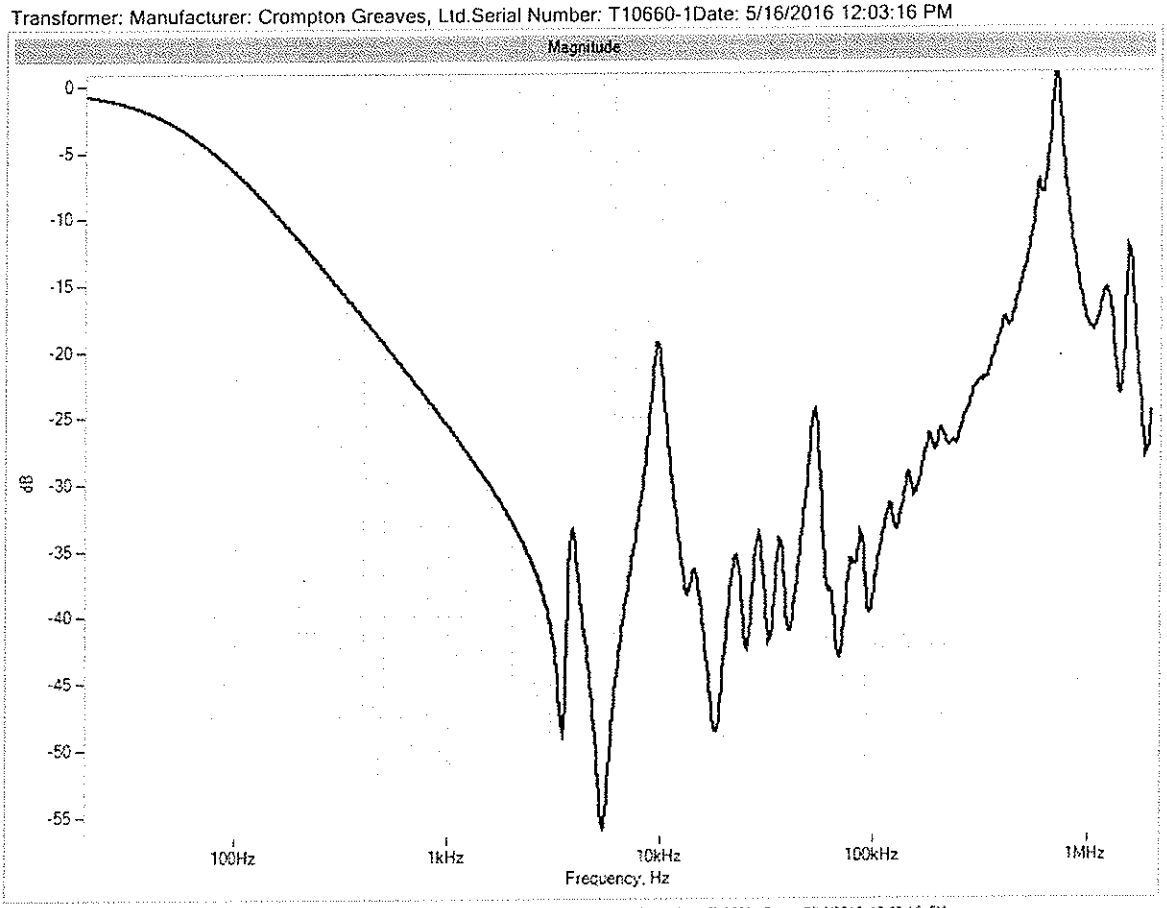
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:00:22 PM



2U-N(TV SHORT)_2016-05-16_12-00-22_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:00:22 PM
LTC: TAP NO 9BMVA Maximum: 63

Sweep Frequency Response Analyzer Test Report

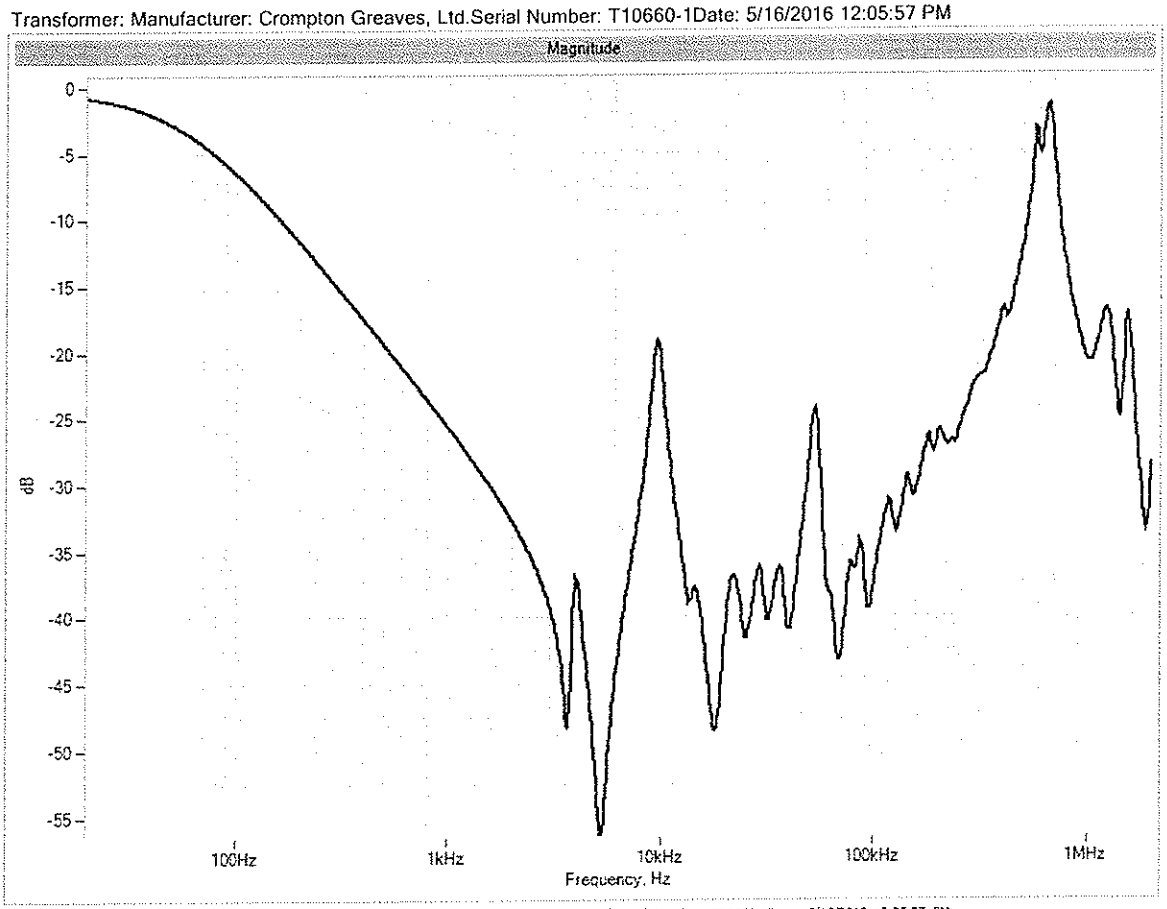
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:03:16 PM



2V-A(TV SHORT)_2016-05-16_12-03-16_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:03:16 PM
LTC: TAP NO 98MVA Maximum: 63

Sweep Frequency Response Analyzer Test Report

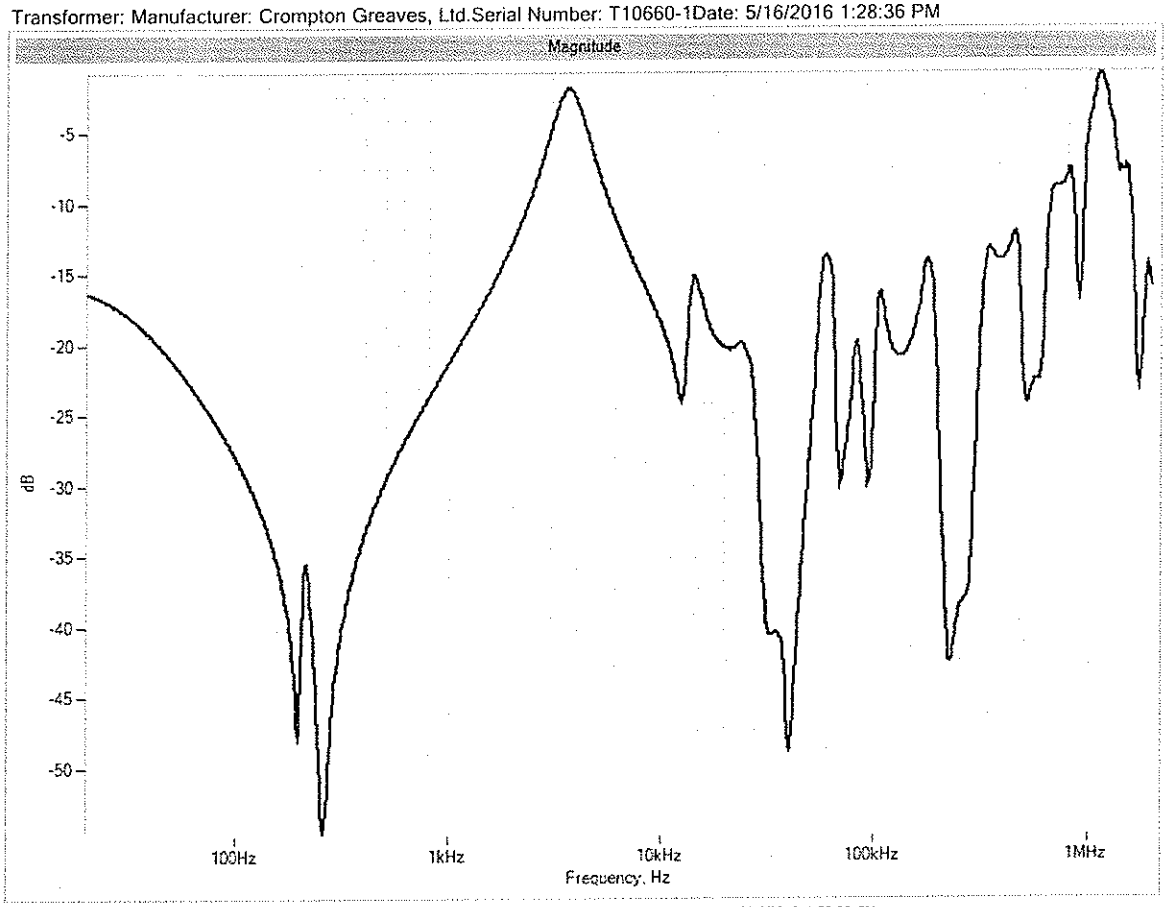
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:05:57 PM



2W-N(TV SHORT)_2016-05-16_12-05-57_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 12:05:57 PM
LTC: TAP NO 9BMVA Maximum: 63

Sweep Frequency Response Analyzer Test Report

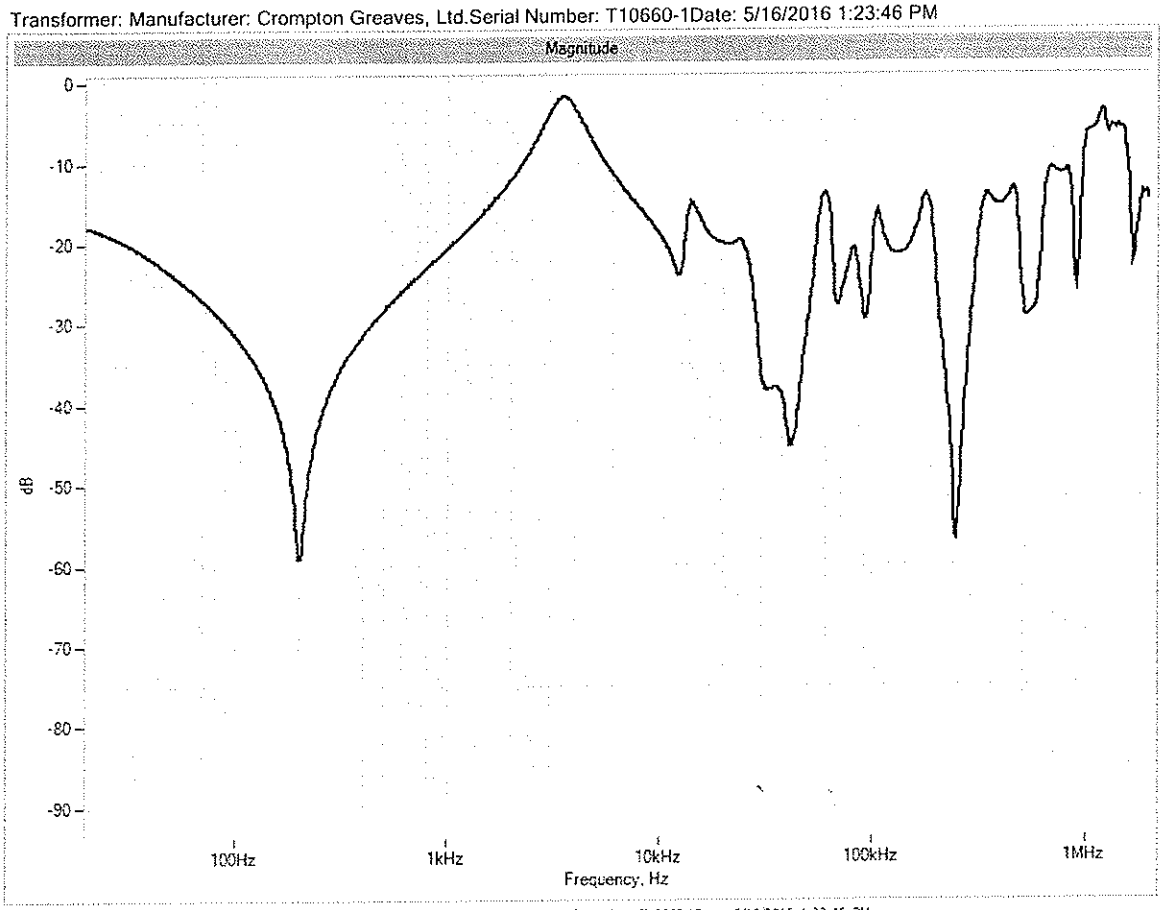
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:28:36 PM



3U-3W_2016-05-16_13-28-36_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:28:36 PM
LTC: 9BMVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

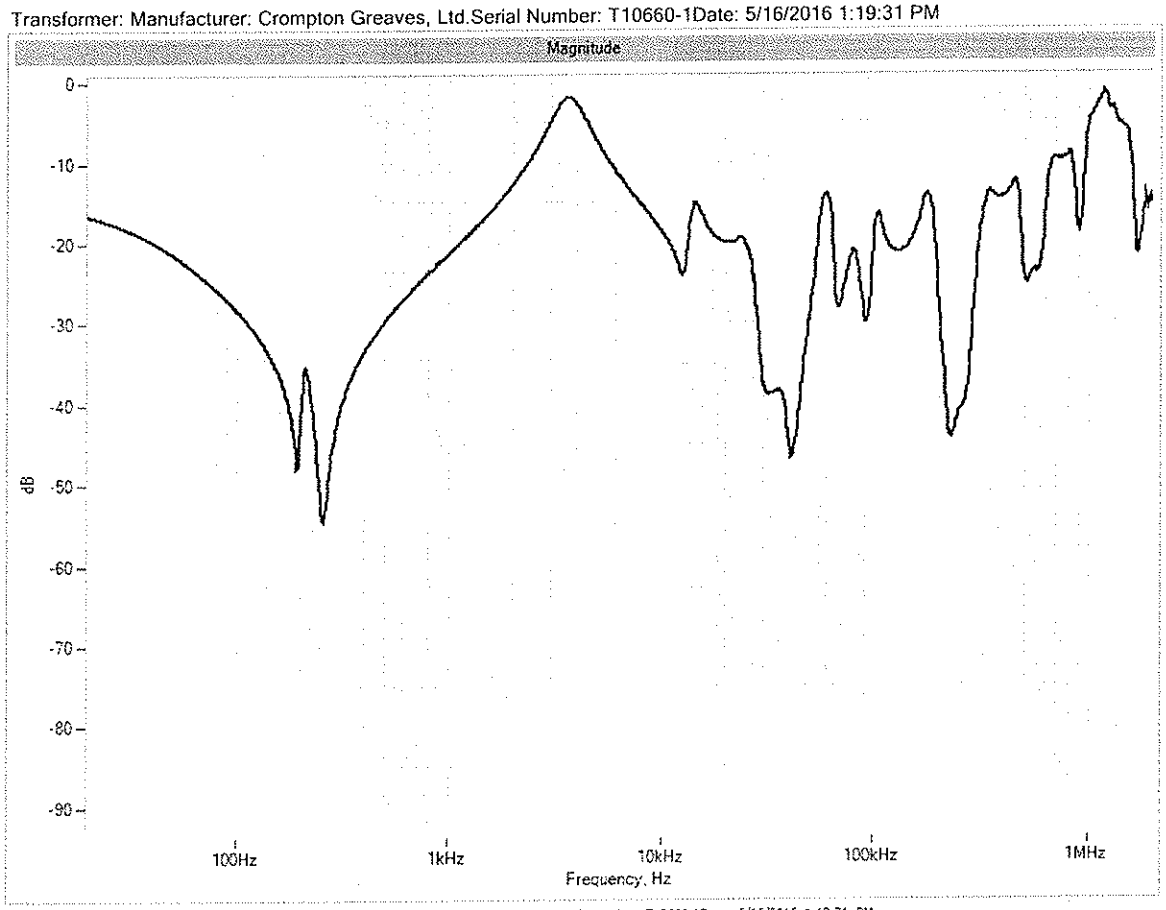
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:23:46 PM



3V-3U_2016-05-16_13-23-46_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:23:46 PM
LTC: 9BMVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:19:31 PM

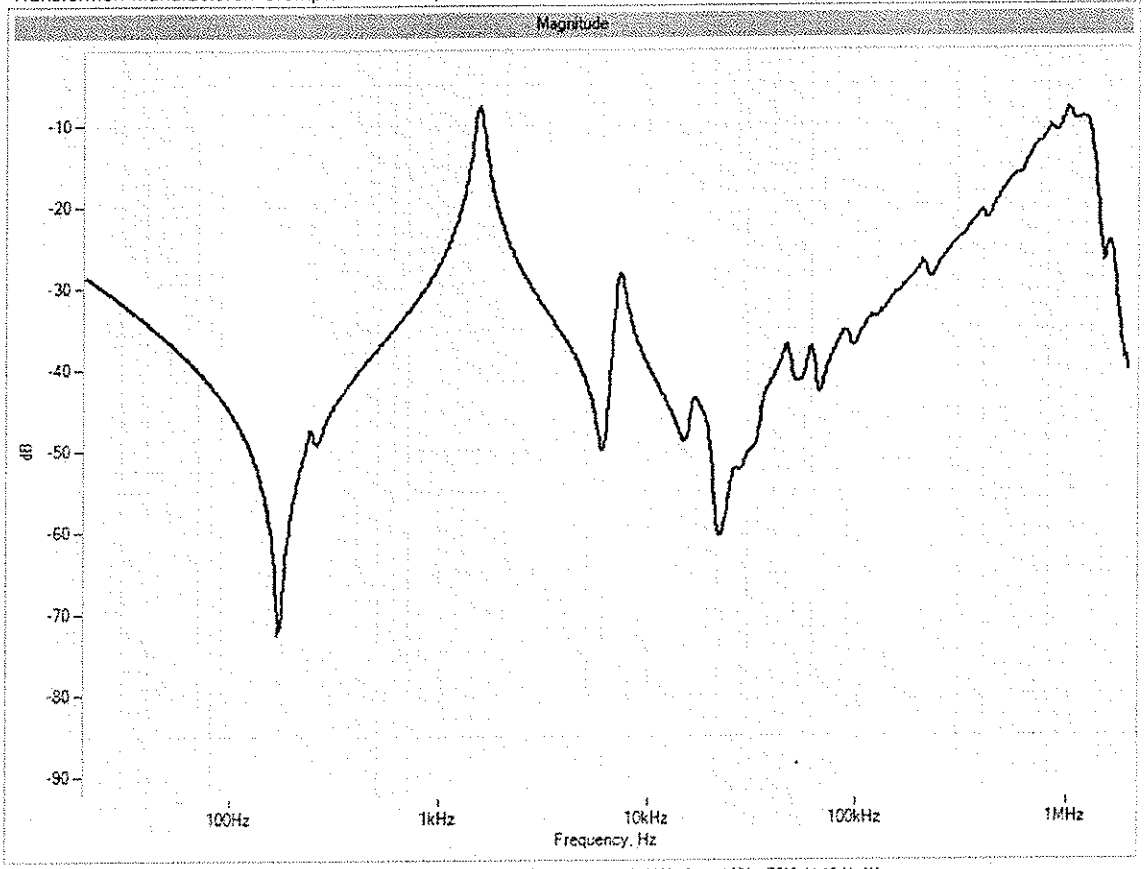


3W-3V_2016-05-16_13-19-31_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 5/16/2016 1:19:31 PM
LTC: SBMVA Maximum: 500

TAP NO. 17

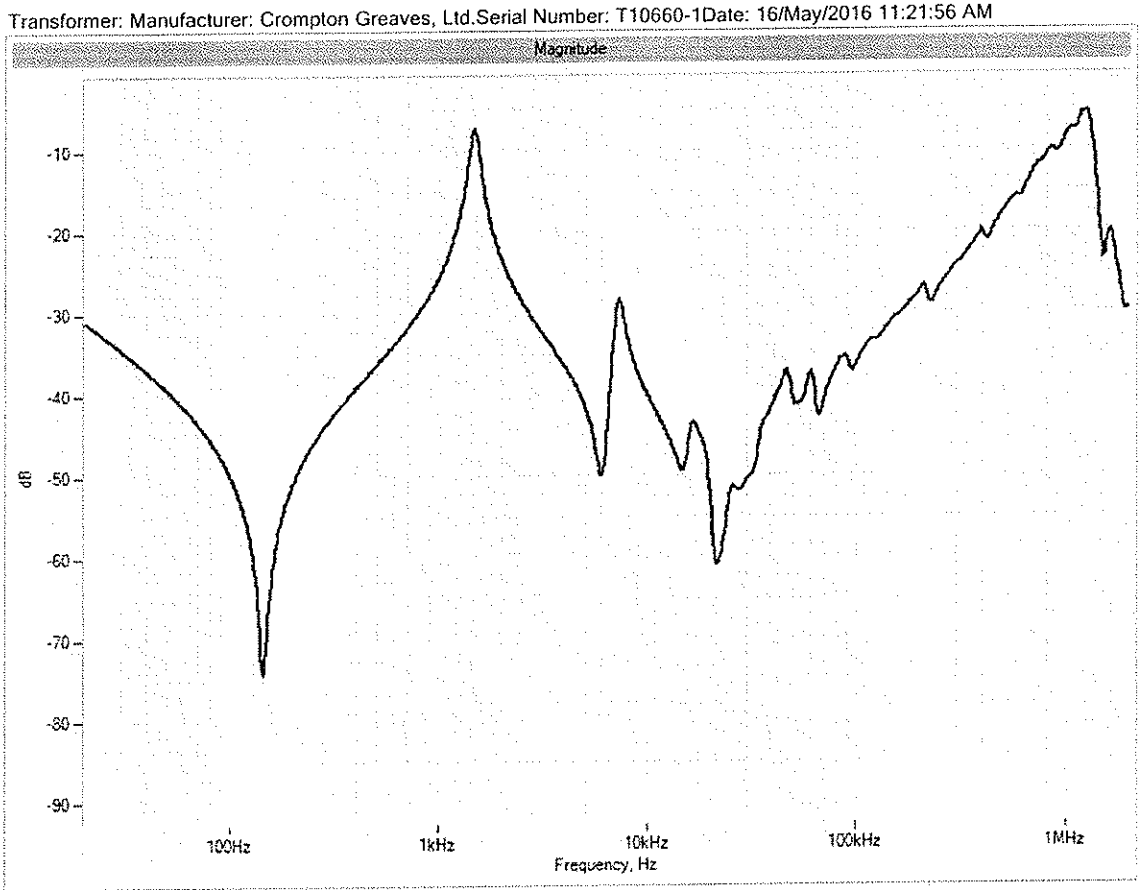
Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:18:11 AM



Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:21:56 AM

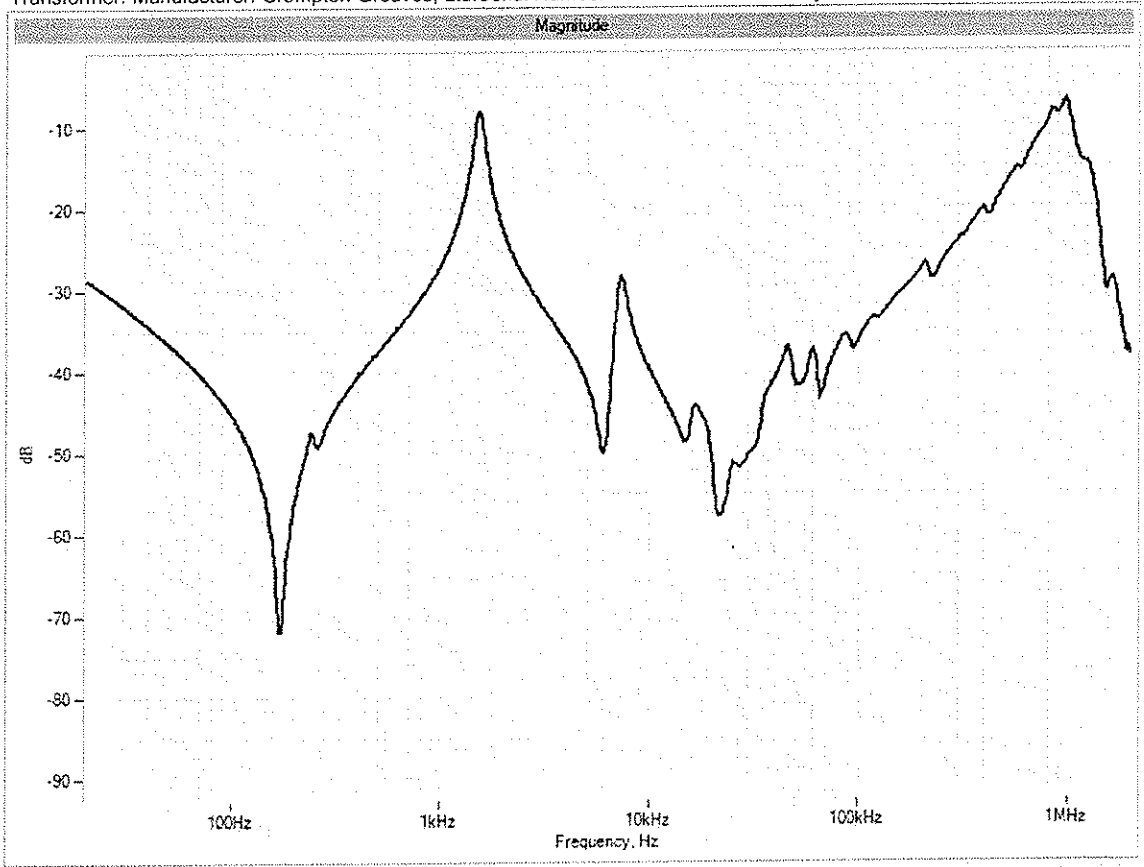


1W-2V_2016-05-16_11-21-56_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:21:56 AM
LTC: TAP NO 17MVA Maximum: 63

C.V.A.

Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:25:21 AM

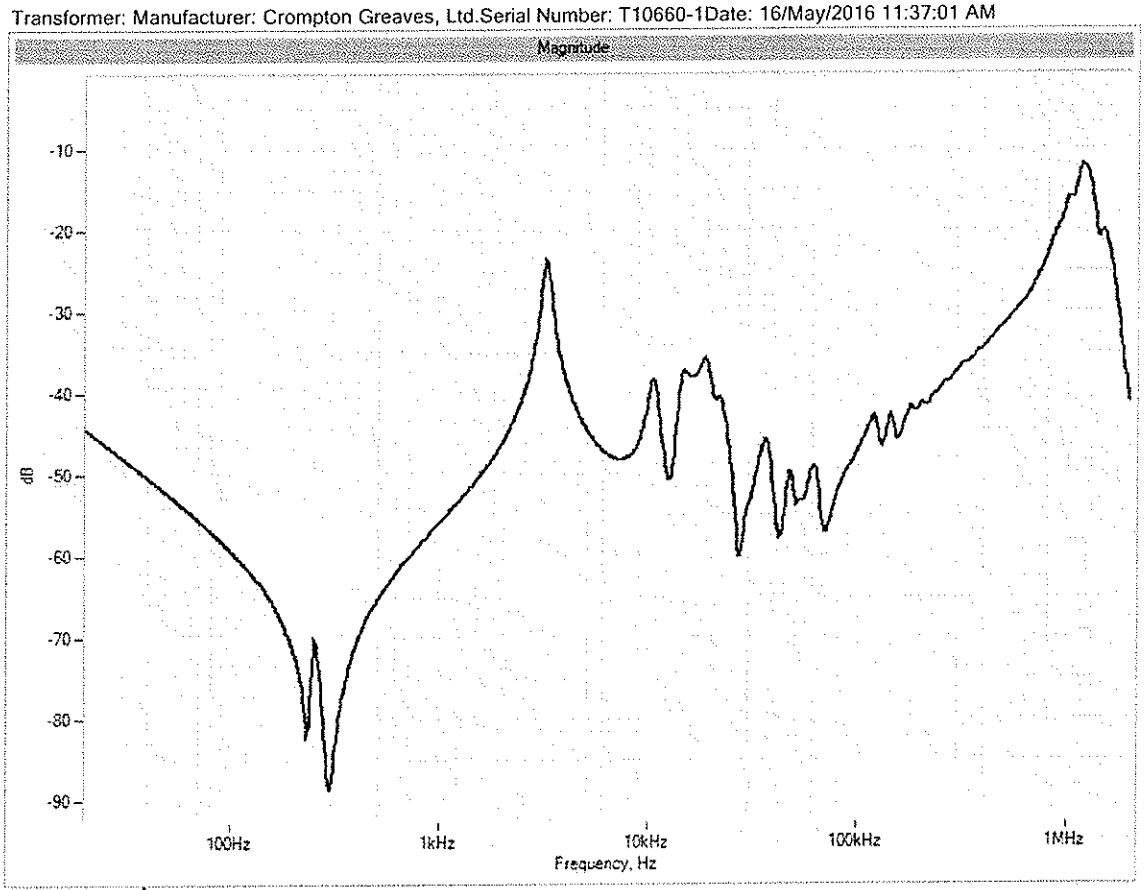


1W-2W_2016-05-16_11-25-21_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:25:21 AM
LTC: TAP NO 17MVA Maximum: 63

C.V.—A

Sweep Frequency Response Analyzer Test Report

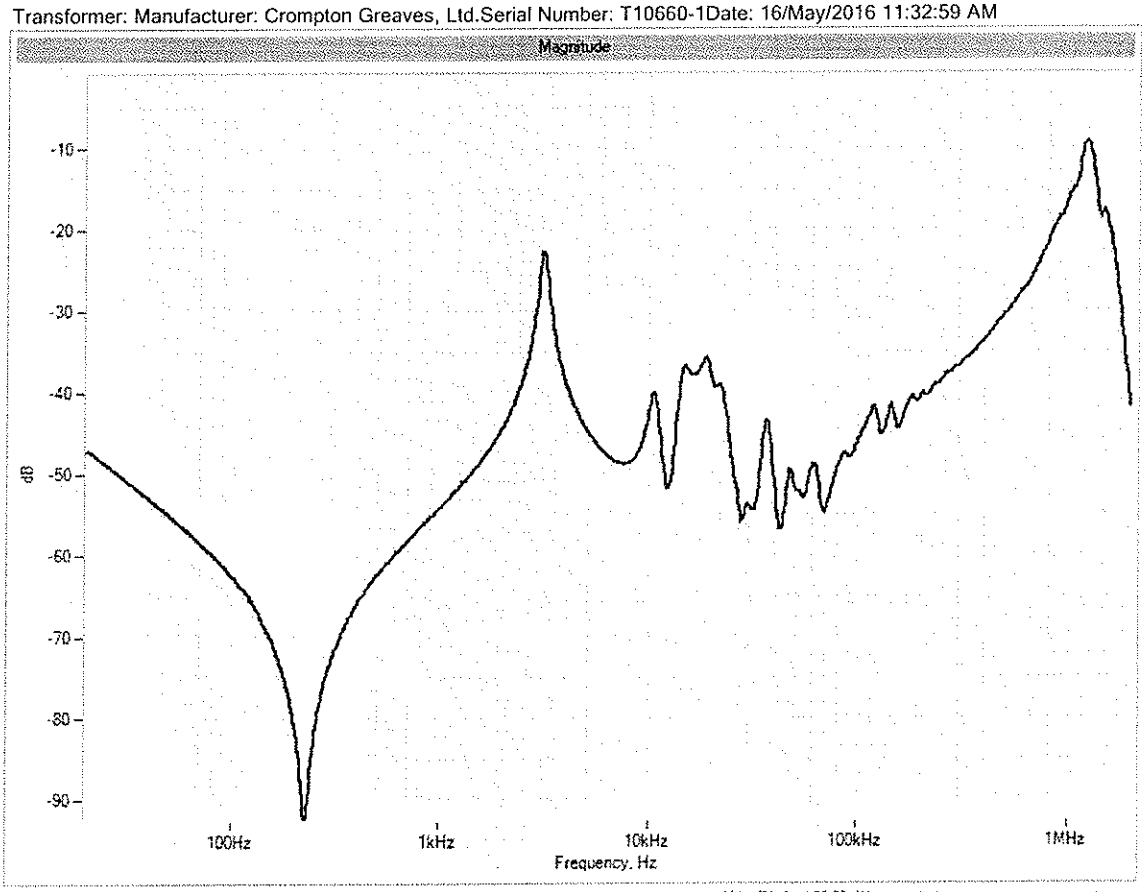
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:37:01 AM



1U-N_2016-05-16_11-37-01_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:37:01 AM
LTC: TAP NO 17MVA Maximum: 63

Sweep Frequency Response Analyzer Test Report

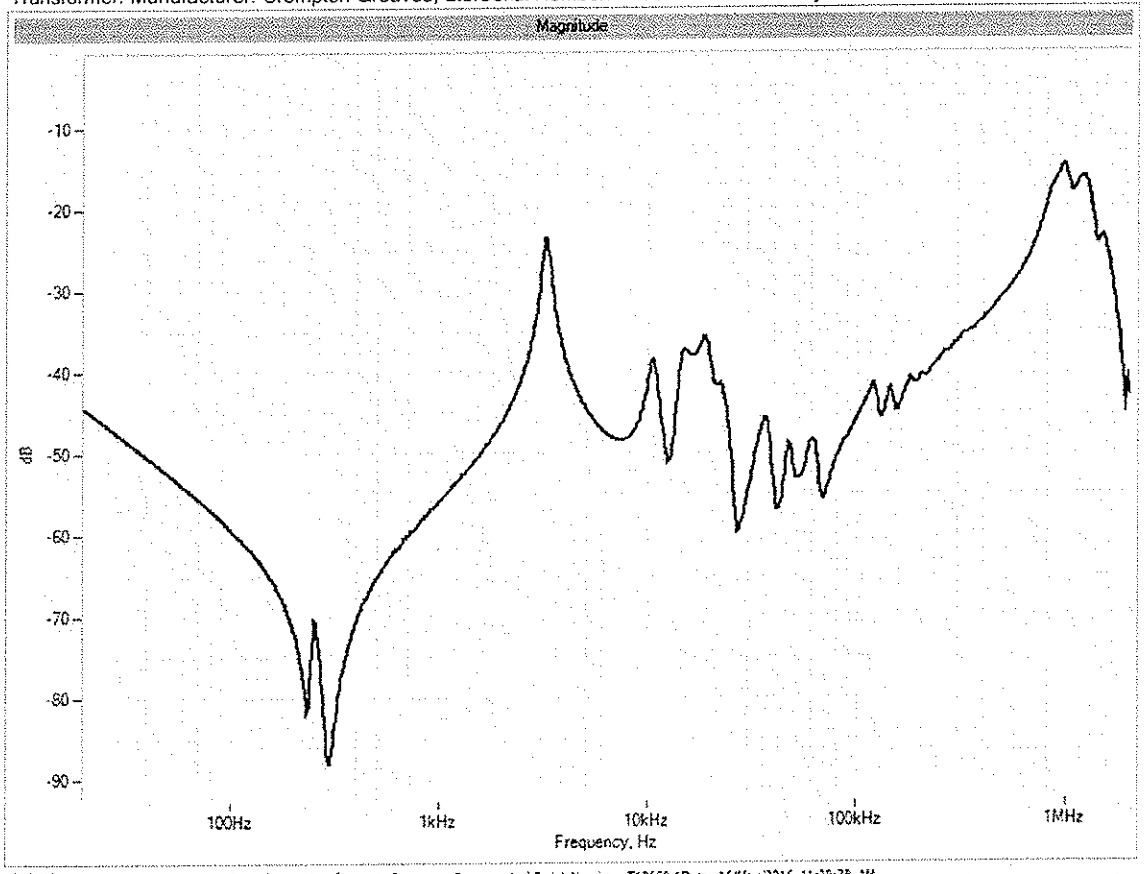
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:32:59 AM



IN-N_2016-05-16_11-32-59_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:32:59 AM
LTC: TAP NO 17MVA Maximum: 63

Sweep Frequency Response Analyzer Test Report

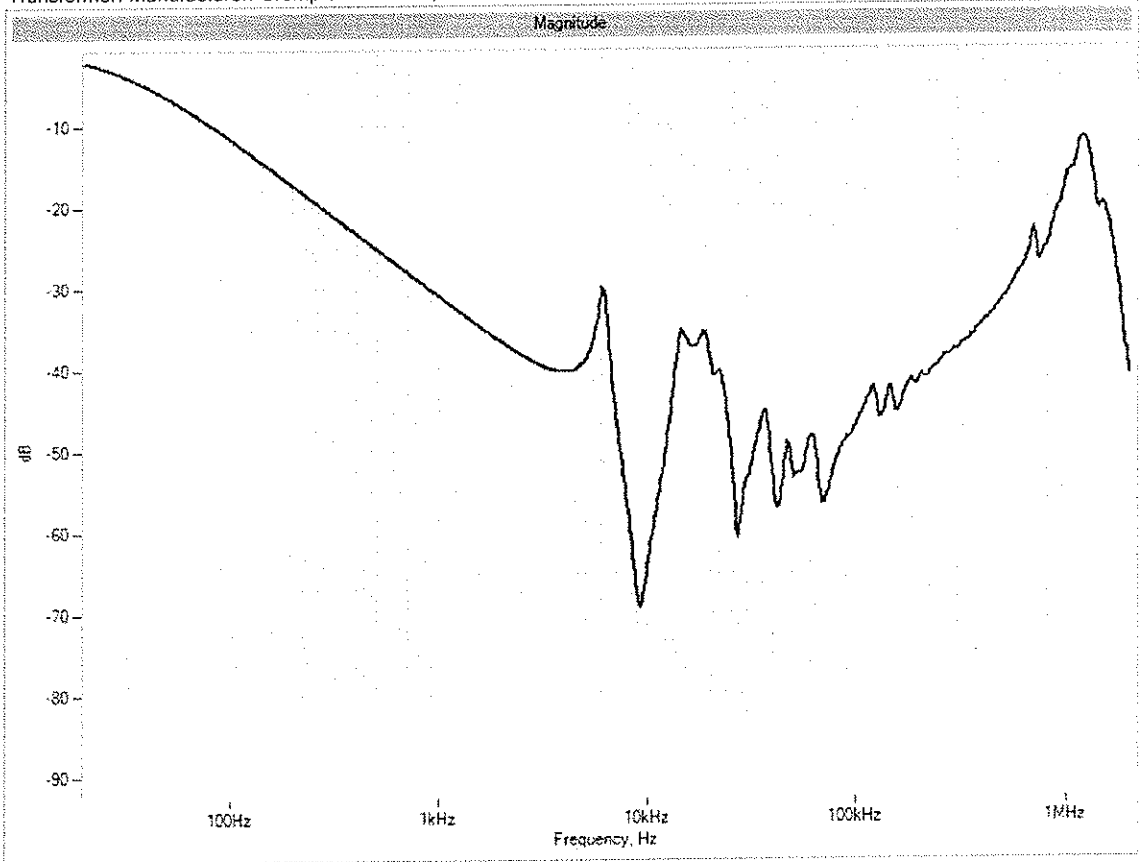
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:29:38 AM



IW-N_2016-05-16_11-29-38_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:29:38 AM
LTC TAP NO 17MVA Maximum: 63

Sweep Frequency Response Analyzer Test Report

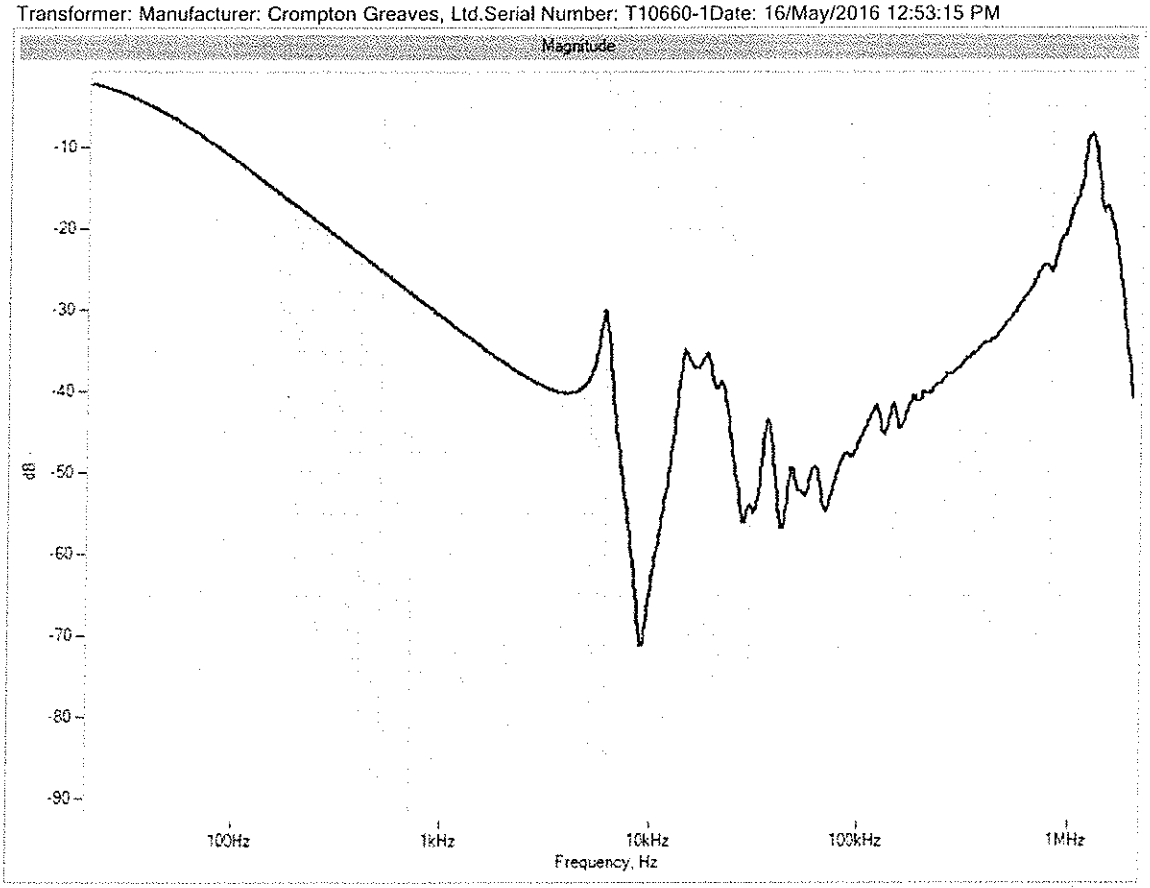
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 12:45:40 PM



1U1-1N(IV SHORT)_2016-05-16_12-45-40_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 12:45:40 PM
LTC: 17MVA Maximum: 500

Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 12:53:15 PM

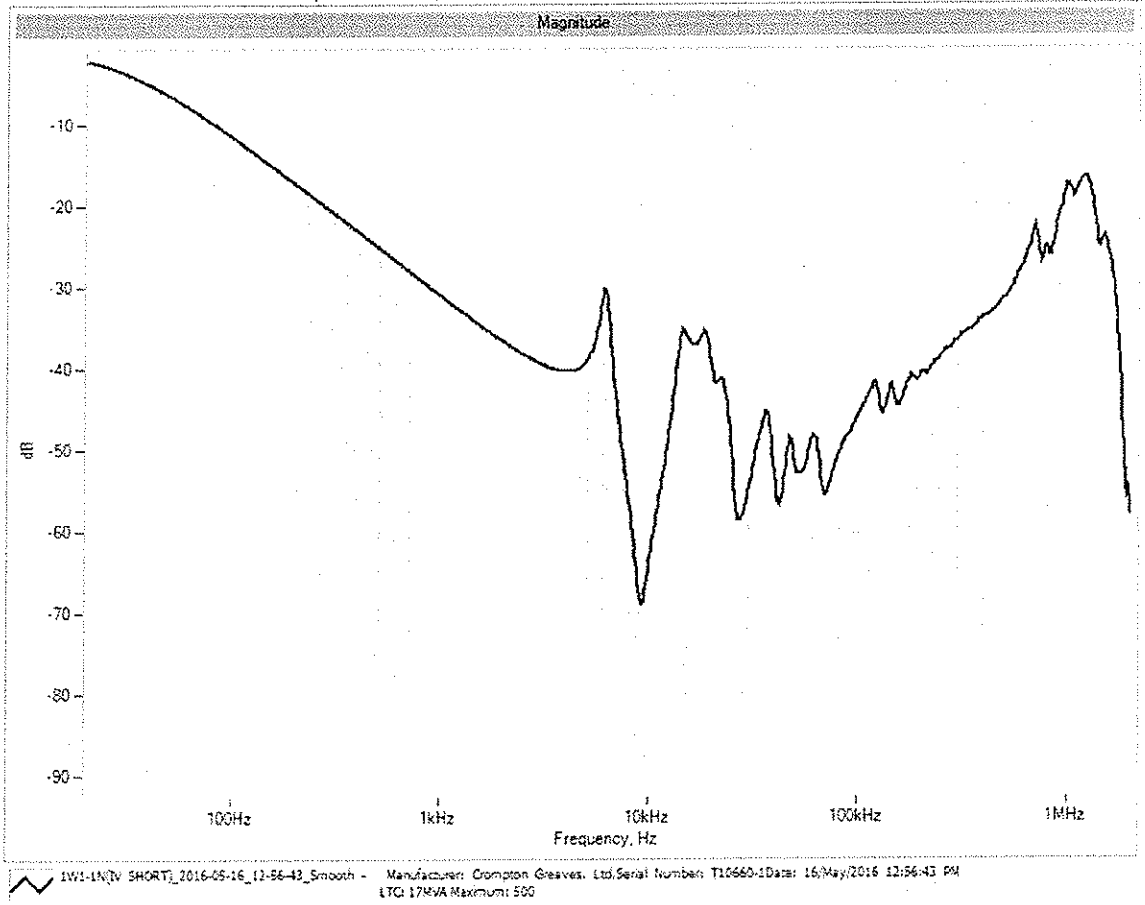


1V1-1N(IV SHORT)_2016-05-16_12-53-15_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 12:53:15 PM
LTC: 17MVA Maximum: 500

C.V — 1

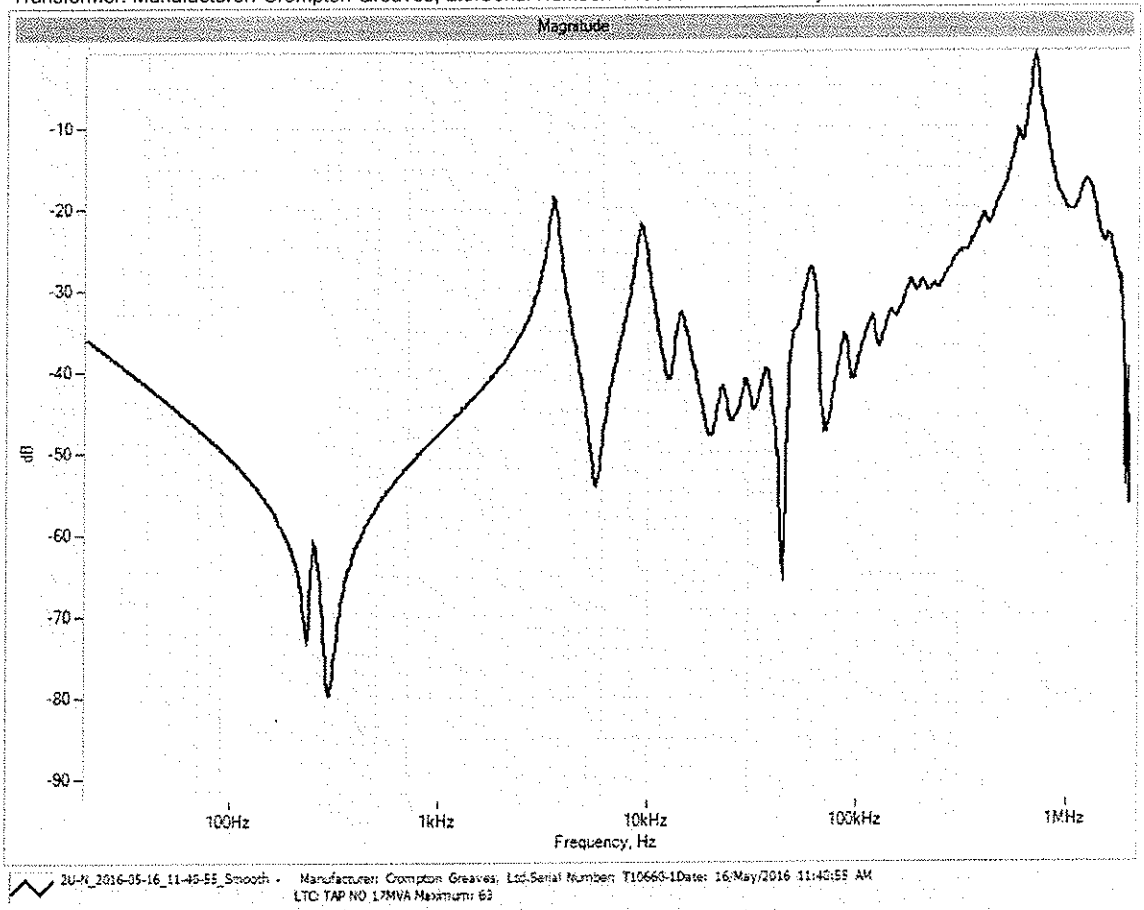
Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 12:56:43 PM



Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:40:55 AM



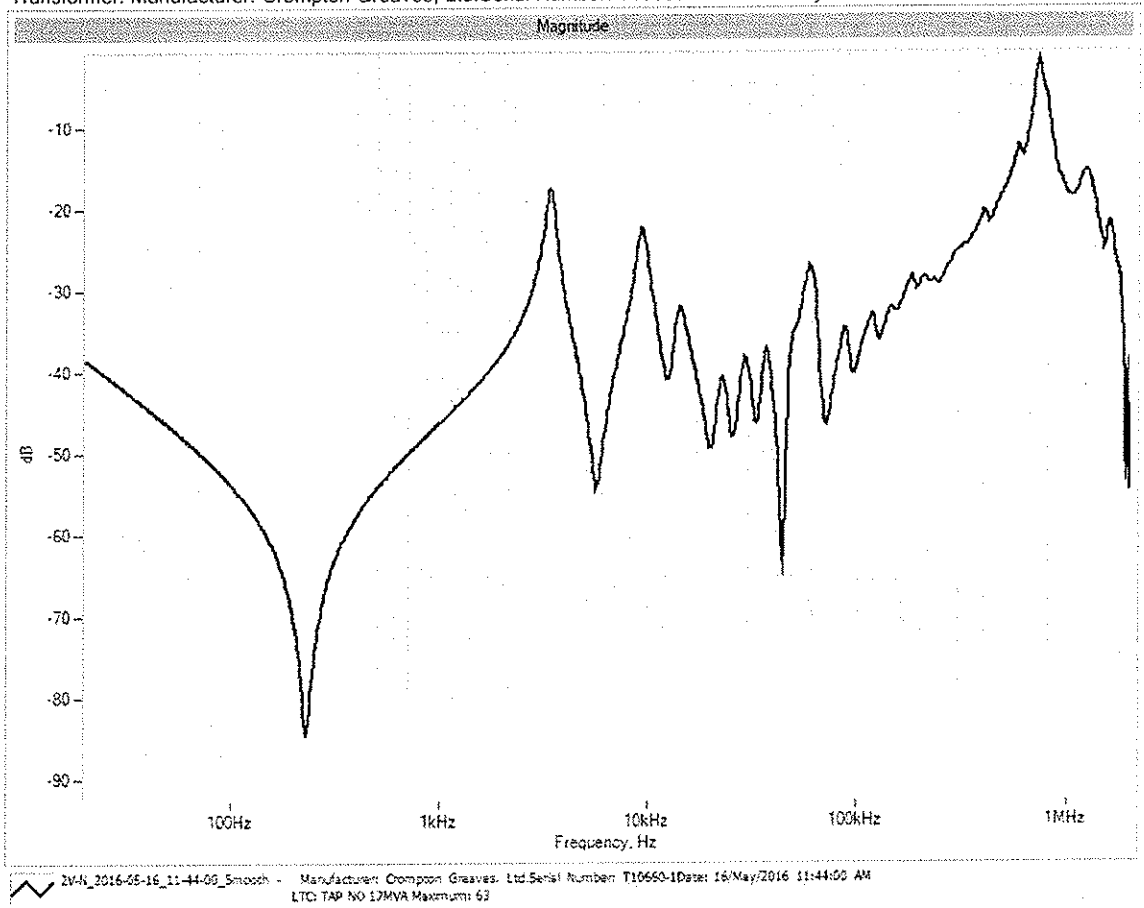
Page 1

Monday, May 16, 2016

16

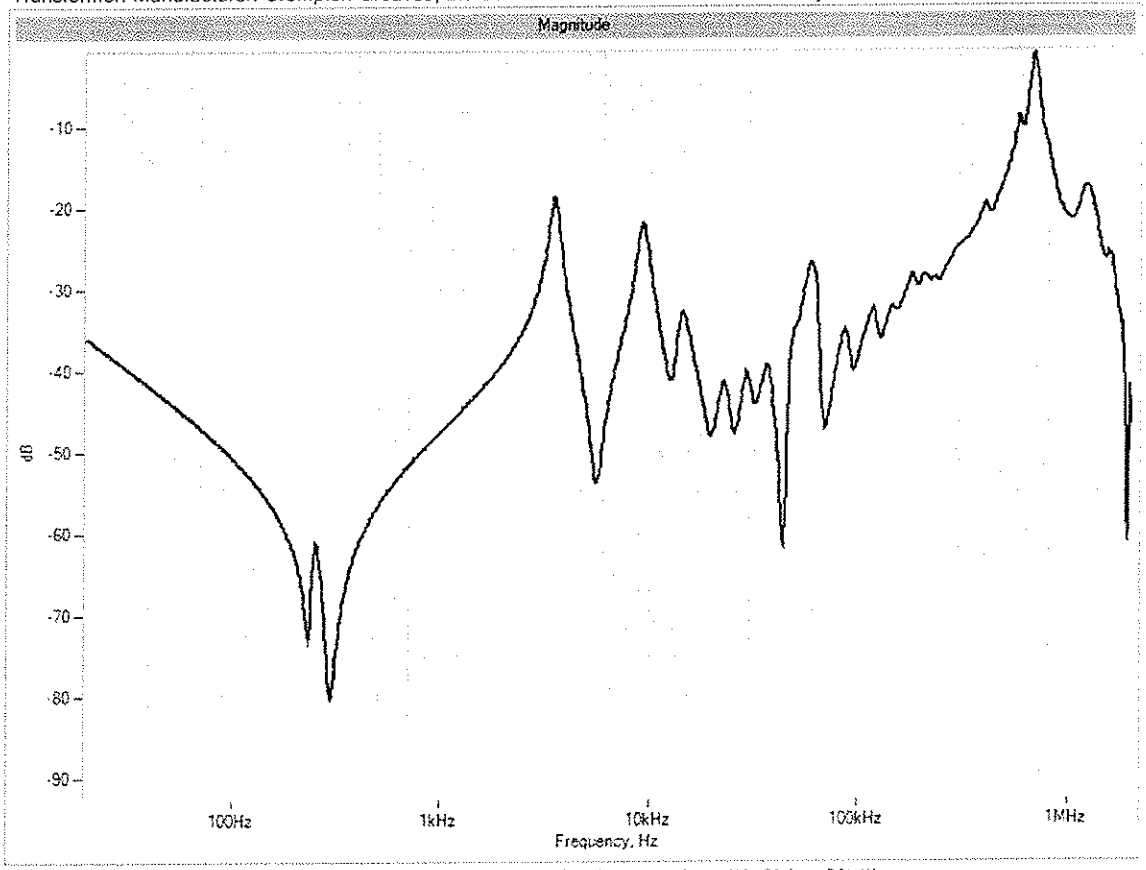
Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:44:00 AM



Sweep Frequency Response Analyzer Test Report

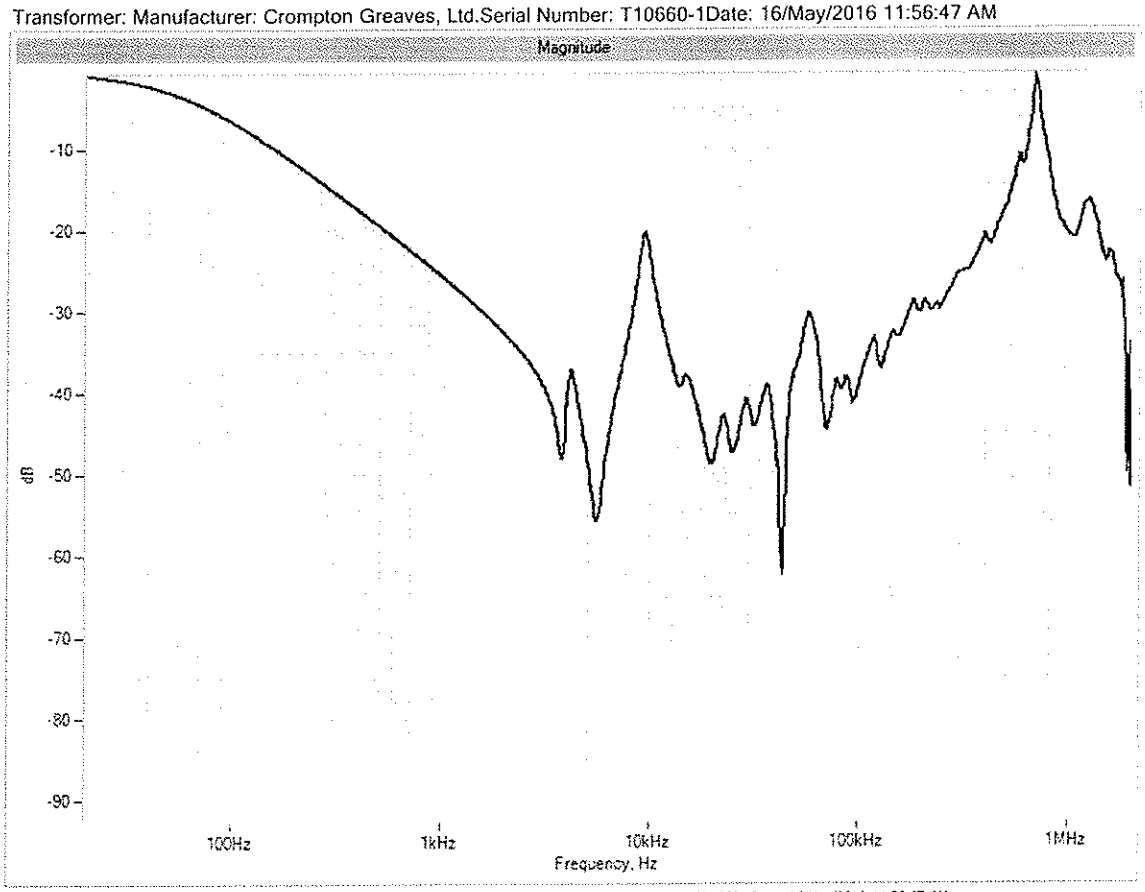
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:47:01 AM



2W-N_2016-05-16_11-47-01_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:47:01 AM
LTC: TAP NO 17MVA Maximum: 63

Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:56:47 AM

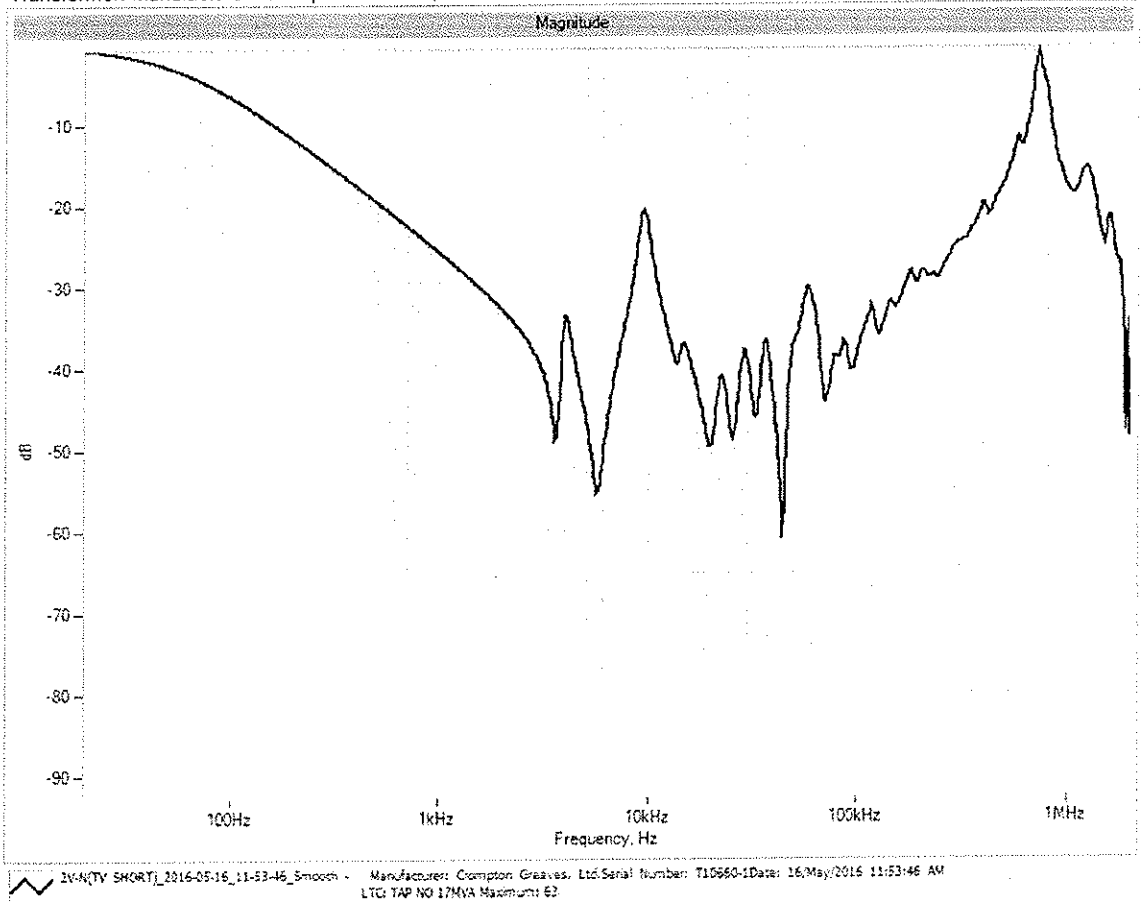


2U-N(TV SHORT)_2016-05-16_11-56-47_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:56:47 AM
LTC TAP NO 17MVA Maximum 63

C.V—4

Sweep Frequency Response Analyzer Test Report

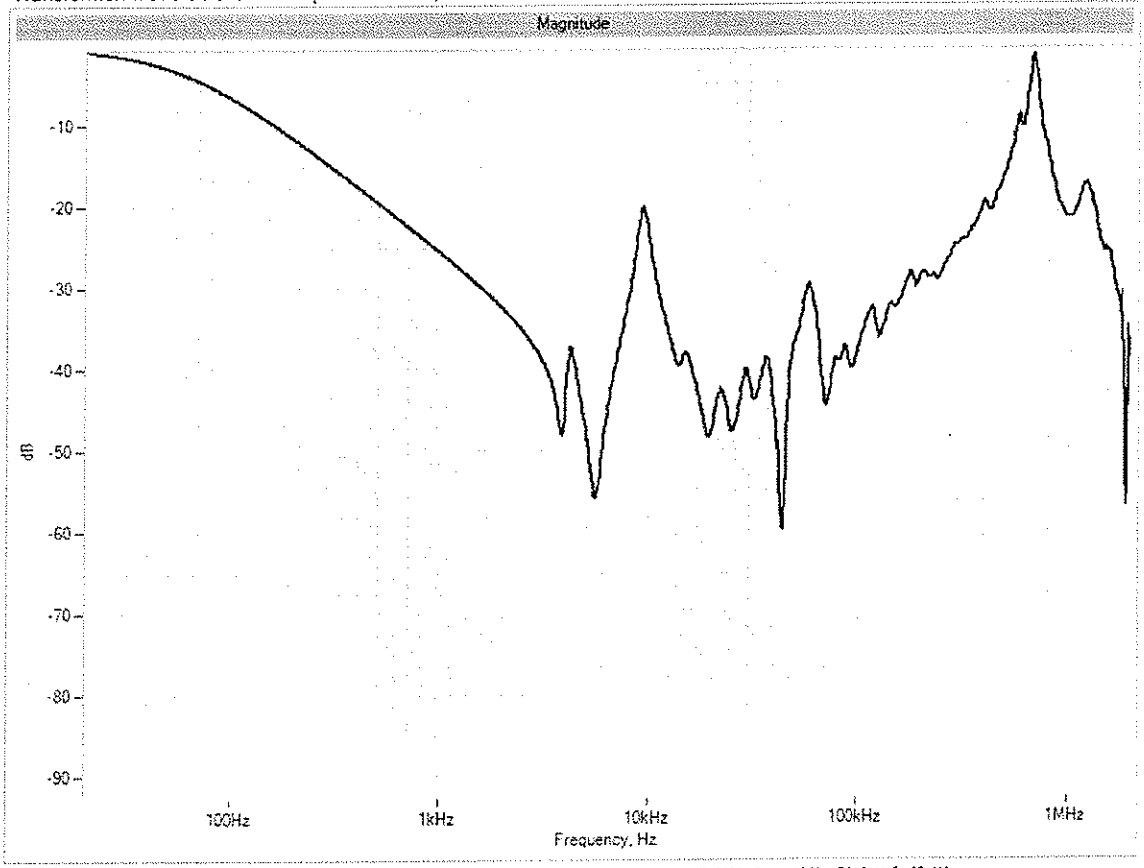
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:53:46 AM



C.S.—4

Sweep Frequency Response Analyzer Test Report

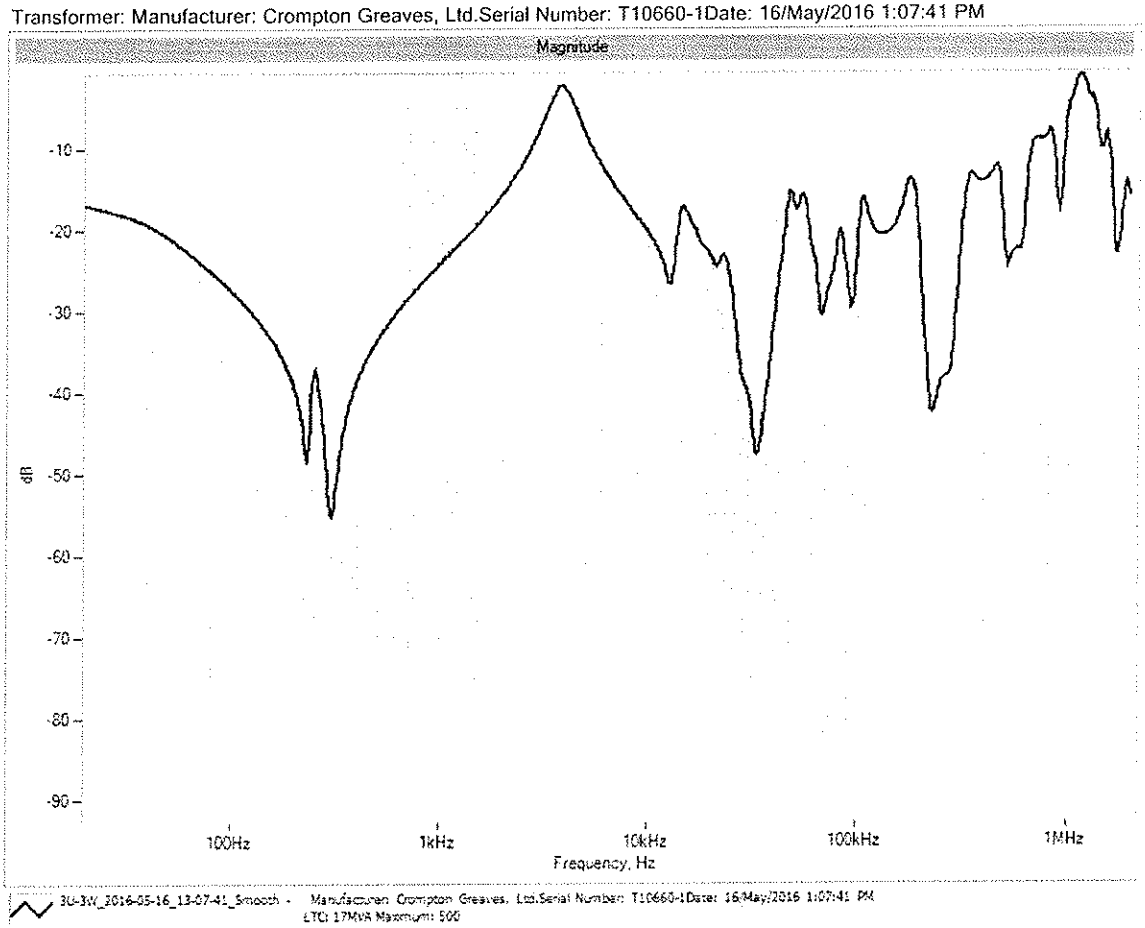
Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:51:08 AM



2W-N(TV SHORT)_2016-05-16_11-51-08_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 11:51:08 AM
LTC: TAP NO 17MVA Maximum: 63

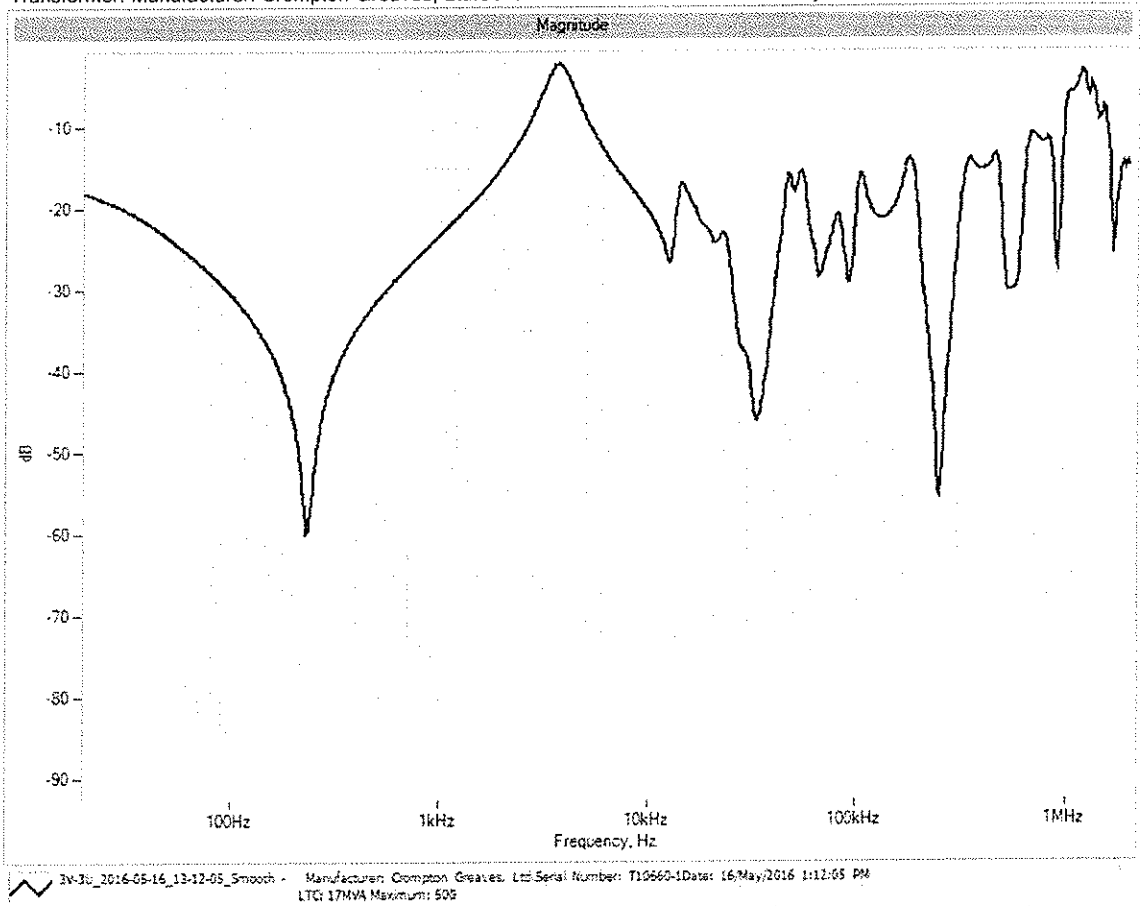
Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 1:07:41 PM



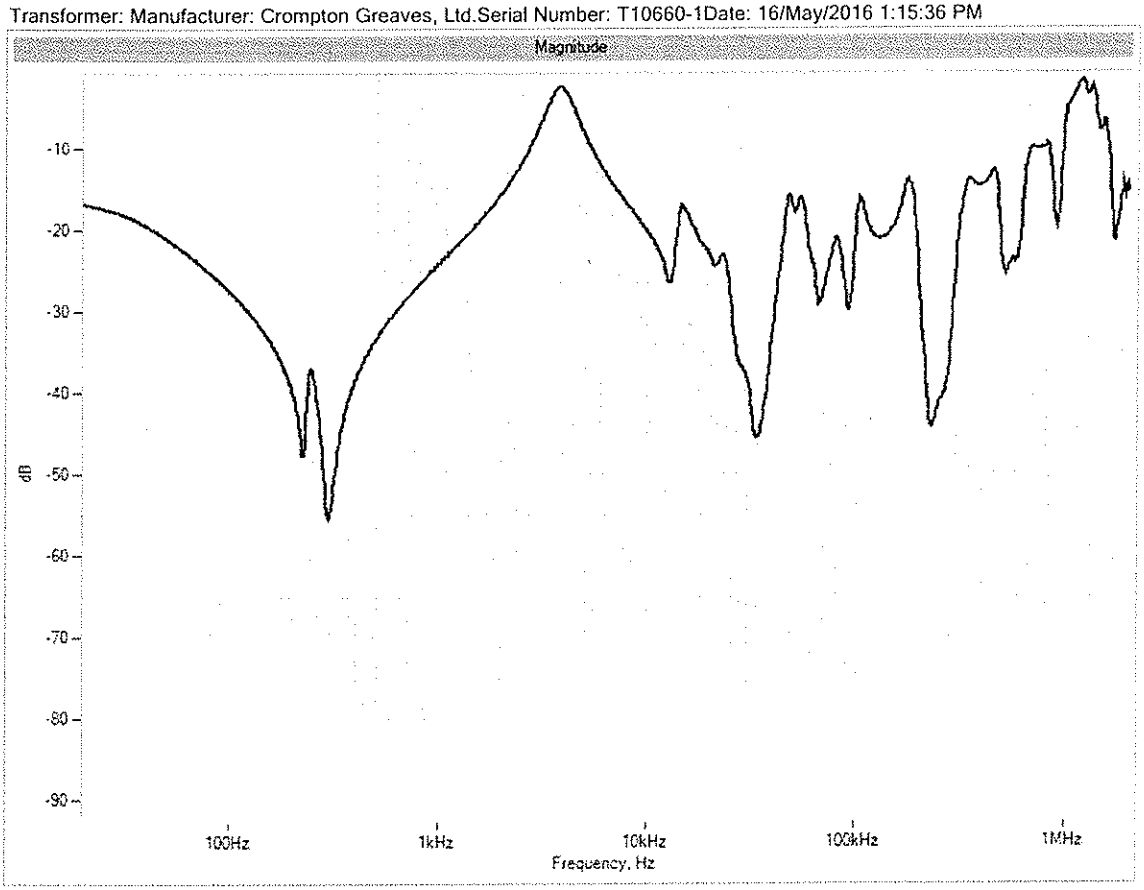
Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 1:12:05 PM



Sweep Frequency Response Analyzer Test Report

Transformer: Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 1:15:36 PM



3W-3V_2016-05-16_13-15-36_Smooth - Manufacturer: Crompton Greaves, Ltd.Serial Number: T10660-1Date: 16/May/2016 1:15:36 PM
LTC: 17MVA Maximum: 500

INDEX

W. O. No. T10660

Sr. No. : T10660/1

MVA : 500

kV : 400/220/33

Freq. : 50 Hz.

COOLING : ONAN/ONAF/ODAF

Customer : PGCIL

No.	Test	Page No
	TYPE TESTS	
1	Measurment of Harmonics of No load Current.	1
2	Lightning Impulse Test On Neutral Terminal.	2-3
3	Temperature rise test	4-29
4	Cooler Loss Measurment	30
5	Measurment of Zero Phase Sequence @ N tap (For three phase transformer only)	31-32
6	Mesurment of accostic noise level test @ ODAF	33-34

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

Smart solutions.
Strong relationships

Date : 15/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF HARMONICS

MEASUREMENT OF HARMONICS IN THE NO-LOAD CURRENT

Transformer excited at rated frequency for 100% of rated voltage

Odd Harmonics	Freq [Hz]	At 100 % Ur		
		U %	V %	W %
Fundamental	50	100	100	100
03rd	150	0.057	2.040	0.616
05th	250	0.118	0.627	0.276
07th	350	1.711	3.987	1.690
09th	450	0.025	0.594	0.172
11th	550	0.012	0.504	0.134

WITNESSED BY	TESTED BY	CHECKED BY
	C.V.	

ISO/IEC 17025 NABL NO.T1620	CGL/T1/TTR/T10660/1 **TEST CERTIFICATE** **CG Power Systems** **Transformer (T1) Division**	Smart solutions. Strong relationships

Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

LIGHTNING IMPULSE VOLTAGE WITHSTAND TEST ON NEUTRAL TERMINAL

Winding	HV-N
Test Circuit	Neutral
Impulse On	Neutral (N)
Tap Position	9
Wave Shape	3.276/55.70 µs
Test Voltage	95
Standard Waveform	[UPTO 13/ 50 ± 10] µS
Polarity	[-] Negative

Test Sequence	Wave No.	Voltage [%]	Voltage [kVp]
RFW	1	68.61	65.18
FW	2	100	95
FW	3	99.92	94.92
FW	4	99.75	94.76

RFW : Reduced Full Wave / FW : Full Wave

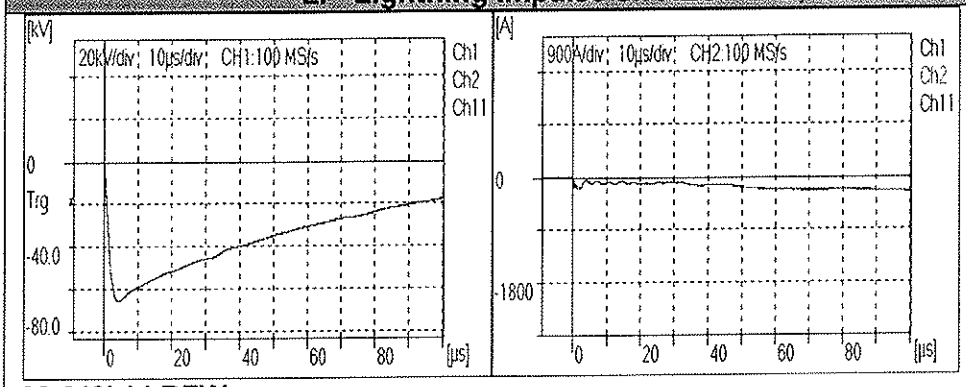
Result : Transformer withstood the Test Satisfactory.

WITNESSED BY	TESTED BY	CHECKED BY

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

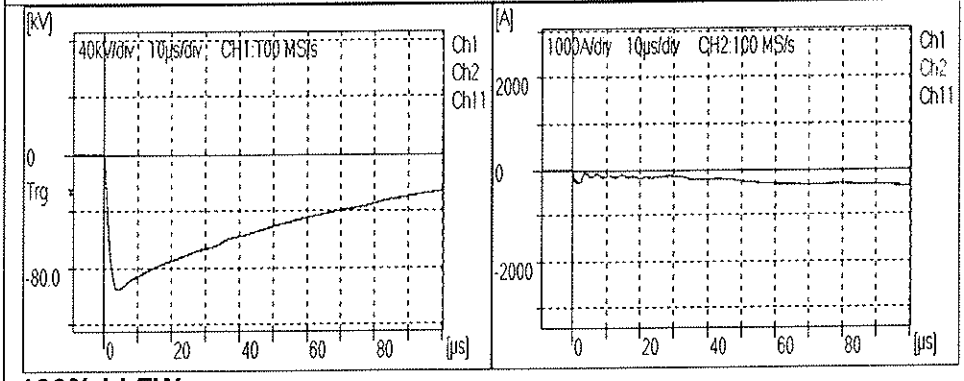
CUSTOMER :	PGCIL
SR. NO. :	T10660/1
MVA :	500
DATE :	11/05/2016

LI - Lightning Impulse on NEUTRAL, Terminal N



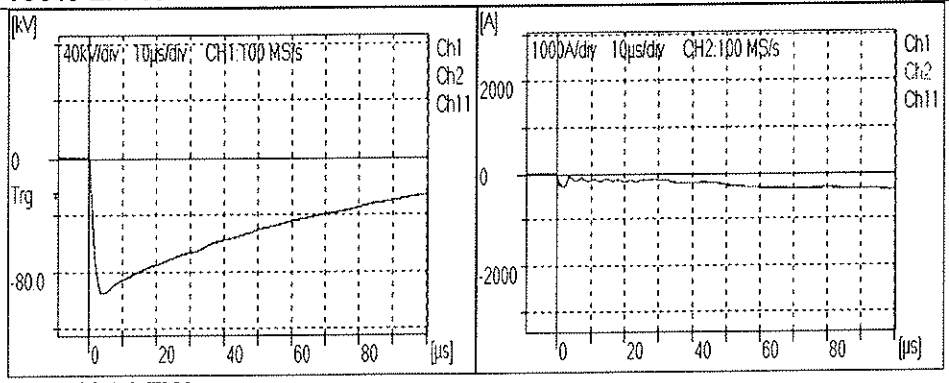
No. = 4313
Up = -65.18 kV
T1 = 3.276 µs
T2 = 55.70 µs
Ip = -257.6 A
β = 3.784 %

68.61% LI RFW



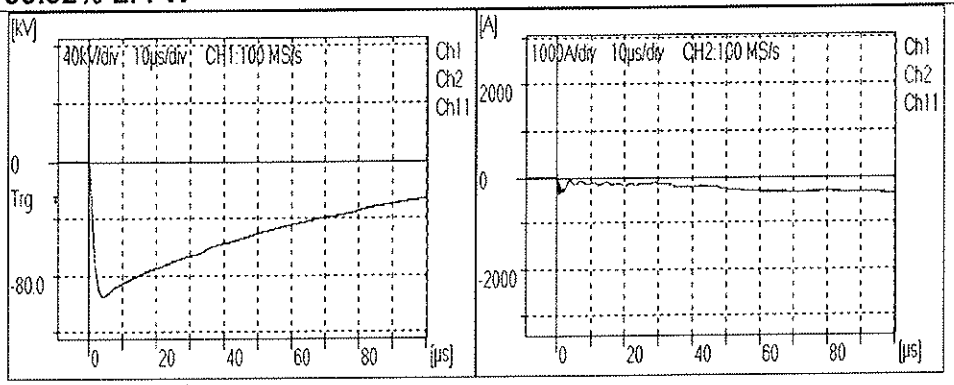
No. = 4314
Up = -95.00 kV
T1 = 3.267 µs
T2 = 55.64 µs
Ip = -369.9 A
β = 3.827 %

100% LI FW



No. = 4315
Up = -94.92 kV
T1 = 3.264 µs
T2 = 55.68 µs
Ip = -370.5 A
β = 3.770 %

99.92% LI FW



No. = 4316
Up = -94.76 kV
T1 = 3.275 µs
T2 = 55.80 µs
Ip = -369.4 A
β = 3.689 %

99.75% LI FW

WITNESSED BY : TESTED BY : CHECKED BY :

CG Power Systems
Transformer(T1) Division

TEMPERATURE RISE TEST REPORT

DATE :16/05/2016

MVA : 500

W.O. NO. : T10660 **SERIAL NO. T10660/1**

CUSTOMER : PGCIL

Type of Cooling	ONAN (°C)		ONAF (°C)		ODAF (°C)					
	Tested	Guar.	Tested	Guar.	Tested	Guar.				
Top Oil Rise	34.95	50.00	32.82	50.00	24.52	50.00				
SERIES Winding	33.23	55.00	33.13	55.00	31.23	55.00				
COMMON Winding	34.31	55.00	34.87	55.00	34.06	55.00				
LV Winding	37.70	55.00	36.65	55.00	39.37	55.00				

Temperature rise test performed at tap no.17

Test performed in accordance with : IEC 60076 PART II

Witnessed By : .

Prepared by : VIGNESHWARAN.C
Date of test :13/05/2016 TO 15/05/2016
Certificate issued on : **16/05/2016**

Issued by :

Pravin Zagade
for CROMPTON GREAVES LTD
Transformer Division
Quality Assurance

TEST RESULT

TEMPERATURE RISE TEST

DATE : 13/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 300 CUSTOMER : PGCIL COOLING TYPE: ONAN

Tap No. = 17

Losses to be Supplied = No Load Loss + (300/500)2 x Load Loss

= 78 + (300/500)2 x 1014.12 = 443.08 KW

Losses Supplied = 443 KW

Time	Volts	AMPS	Loss	Ambient Temperature (°C)					Top Oil	Oil Rise	Cooler Top 1	Cooler Btm.1	Cooler Top 2	Cooler Btm.2
(Hrs)	(kV)	(kA)	(kW)	A	B	C	D	Avg.	(°C)	(°C)	(°C)	(°C)	(°C)	(°C)
10:30	Temperature rise test started													
10:30	31.93	1.13	447.60	33.8	33.9	33.4	33.5	33.65	37.1	3.45	36.5	33.8	34.4	32.3
11:00	31.91	1.13	447.60	34.9	35.3	34.6	34.7	34.88	38.7	3.82	37.0	34.4	35.2	32.8
11:30	31.89	1.13	452.40	35.3	35.8	35.1	35.1	35.33	42.9	7.57	39.8	34.7	38.7	33.0
12:00	31.84	1.12	451.20	36.0	36.4	35.7	35.7	35.95	48.7	12.75	47.3	35.4	47.2	33.5
12:30	31.80	1.12	452.40	36.6	37.0	36.3	36.4	36.58	53.0	16.42	51.7	36.8	52.6	34.1
13:00	31.77	1.12	451.20	37.0	37.3	36.7	36.9	36.98	56.1	19.12	54.8	38.7	55.8	34.9
13:30	31.36	1.11	442.80	37.4	37.6	37.1	37.5	37.40	58.6	21.20	57.3	40.3	58.4	36.2
14:00	31.42	1.11	444.00	37.8	37.9	37.5	37.9	37.78	60.7	22.92	59.6	41.7	60.7	38.5
14:30	31.70	1.12	445.20	38.1	38.2	37.7	38.3	38.08	62.5	24.42	61.6	42.8	62.7	40.6
15:00	31.42	1.11	446.40	38.4	38.5	38.0	38.7	38.40	63.8	25.40	63.1	44.2	64.2	43.8
15:30	31.36	1.11	442.80	38.5	38.5	38.0	38.8	38.45	65.0	26.55	64.4	44.6	65.6	44.4
16:00	31.40	1.12	444.20	38.3	38.3	37.7	38.9	38.30	66.5	28.20	65.7	45.2	67.0	44.8
16:30	31.22	1.11	443.80	38.1	37.7	38.8	37.7	38.08	67.4	29.32	66.8	45.8	68.1	45.4
17:00	31.31	1.11	443.40	38.0	38.1	37.6	38.7	38.10	68.3	30.20	67.7	46.3	69.0	45.8
17:30	31.30	1.10	445.20	37.7	37.7	37.3	38.4	37.78	68.9	31.12	68.4	46.4	69.7	45.9
18:00	31.31	1.10	446.40	37.2	37.2	36.8	38.1	37.33	69.3	31.97	68.9	46.4	70.1	46.2
18:30	31.51	1.11	446.40	36.8	36.8	36.2	37.7	36.88	68.6	31.72	67.8	46.5	68.5	46.0
19:00	31.42	1.11	446.20	36.4	36.4	36.0	37.4	36.55	68.5	31.95	66.9	45.9	68.3	45.8
19:30	31.41	1.11	446.40	36.1	36.1	35.7	37.0	36.23	68.6	32.37	68.0	46.1	69.5	45.9
20:00	31.47	1.10	447.10	35.7	35.6	35.1	36.6	35.75	68.5	32.75	69.0	46.1	70.5	46.1
20:30	31.31	1.10	445.00	35.4	35.3	34.7	36.3	35.43	68.7	33.27	69.5	46.3	71.1	46.3
21:00	31.43	1.11	446.53	35.3	35.1	34.6	36.1	35.28	69.4	34.12	70.0	46.5	71.4	46.3
21:30	31.54	1.10	446.67	35.3	35.1	34.7	35.9	35.25	70.2	34.95	70.3	46.7	71.7	46.8
21:30	Load reduced to the rated current for 1 Hr.													
22:00				35.2	35.1	34.6	35.7	35.2	69.8	34.7	69.9	46.4	71.1	46.7
22:30	Shut down for series & common wndg. Resistance			35.1	34.9	34.5	35.5	35.0	69.0	34.0	69.3	46.2	70.3	46.5
23:15	Re-energised for IV - LV combination.													
23:45				34.6	34.7	34.4	35.1	34.7	63.1	28.4	63.5	43.4	64.1	43.7
0:15	Shut down for LV wndg. Resistance			34.6	34.6	34.4	34.8	34.6	61.4	26.8	61.6	42.6	62.4	42.4
0:00	ONAN Temperature rise test completed													

TEST PASSED SATISFACTORILY.

Witnessed By : Checked By : Tested By :

CG Power System
Transformer (T1) Division

TEST RESULT

TEMPERATURE RISE TEST

DATE : 13/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 300 CUSTOMER : PGCIL COOLING TYPE: ONAN

Calculations : FOR SERIES WINDING

1) Top oil rise at steady state	=	34.95	°C
2) Hot resistance at shutdown	=	169.219	milli ohms
3) Cold resistance	=	154.89	milli ohms
4) Avg temp for Cold resistance	=	42.05	°C
5) Wdg. temp at shutdown =[{(Hot Res at Shutdown)/(Cold Res)}*(235+avgtemp for cold R)]-235	=	67.68	°C
6) Avg ambient at shutdown	=	35.00	°C
7) Avg. oil rise at shutdown = Oil rise at shutdown - (cooler average temp)	=	22.28	°C
8) Avg. Oil Rise a steady state = Oil rise at steadystate - (cooler average temp)	=	22.83	°C
9) Gradient = winding temp at shutdown - Avg ambient at shutdown - Avg Oil Rise at shutdown	=	10.41	°C
10) Winding Temp Rise = Avg oil rise at steady state + Gradient	=	33.23	°C
11) Hot Spot Temperature = Top Oil Rise + (1.3* Gradient) + Yearly Average Ambient (i.e. 20)		68.48	°C

Witnessed By: Checked By: Tested By:

TEST RESULT

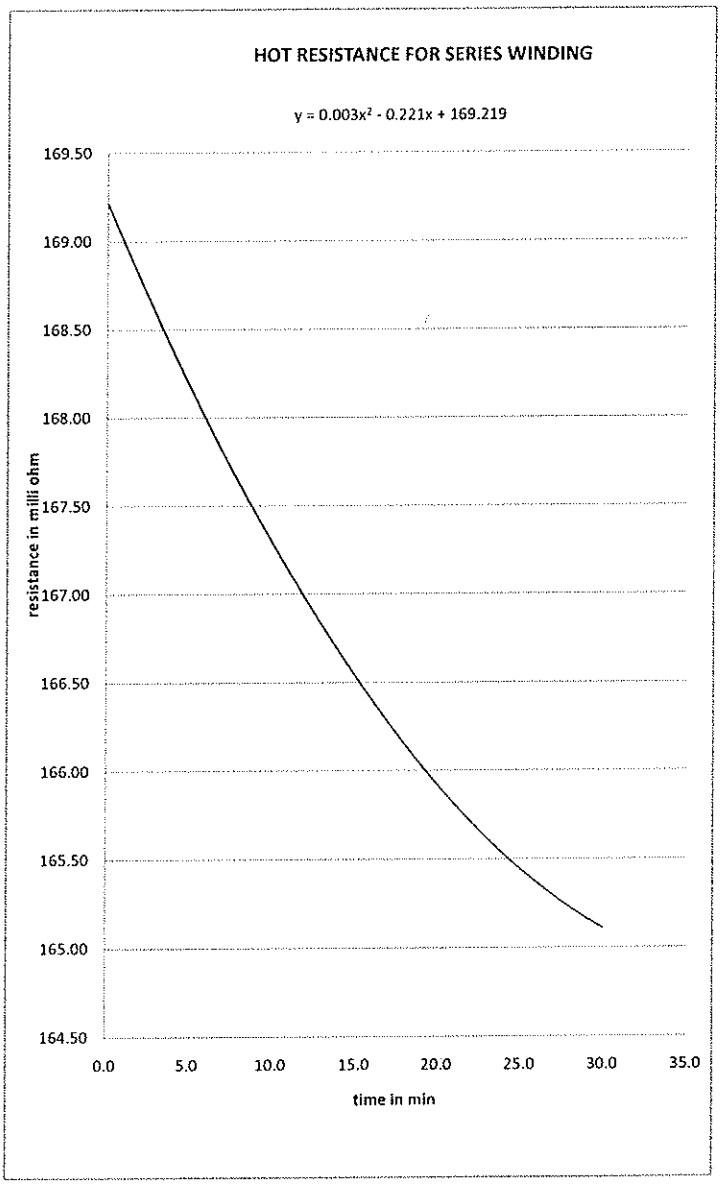
TEMPERATURE RISE TEST

DATE : 13/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 300 CUSTOMER : PGCIL COOLING TYPE: ONAN

Series Wndg.

Time	Resistance milliohm
3.0	168.62
3.5	168.55
4.0	168.43
4.5	168.32
5.0	168.21
5.5	168.10
6.0	167.98
6.5	167.89
7.0	167.79
7.5	167.69
8.0	167.60
8.5	167.52
9.0	167.42
9.5	167.34
10.0	167.26
10.5	167.17
11.0	167.09
11.5	167.02
12.0	166.93
12.5	166.86
13.0	166.79
13.5	166.74
14.0	166.66
14.5	166.59
15.0	166.53
15.5	166.47
16.0	166.40
16.5	166.34
17.0	166.28
17.5	166.22
18.0	166.16
18.5	166.11
19.0	166.05
19.5	166.00
20.0	165.95
20.5	165.89
21.0	165.86
21.5	165.79
22.0	165.74
22.5	165.70
23.0	165.64
23.5	165.60
24.0	165.55
24.5	165.51
25.0	165.47
25.5	165.42
26.0	165.38
26.5	165.33
27.0	165.29
27.5	165.25
28.0	165.21
28.5	165.17
29.0	165.14
29.5	165.09
30.0	165.05



TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

CG Power System
Transformer (T1) Division

TEST RESULT

TEMPERATURE RISE TEST

DATE : 13/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 300 CUSTOMER : PGCIL COOLING TYPE: ONAN

Calculations : FOR COMMON WINDING

1) Top oil rise at steady state	=	34.95	°C
2) Hot resistance at shutdown	=	188.965	milli ohms
3) Cold resistance	=	172.35	milli ohms
4) Avg temp for Cold resistance	=	42.05	°C
5) Wdg. temp at shutdown =[{(Hot Res at Shutdown)/(Cold Res)}*(235+avgtemp for cold R)]-235	=	68.76	°C
6) Avg ambient at shutdown	=	35.00	°C
7) Avg. oil rise at shutdown = Oil rise at shutdown - (cooler average temp)	=	22.28	°C
8) Avg. Oil Rise a steady state = Oil rise at steadystate - (cooler average temp)	=	22.83	°C
9) Gradient = winding temp at shutdown - Avg ambient at shutdown - Avg Oil Rise at shutdown	=	11.48	°C
10) Winding Temp Rise = Avg oil rise at steady state + Gradient	=	34.31	°C
11) Hot Spot Temperature = Top Oil Rise + (1.3* Gradient) + Yearly Average Ambient (i.e. 20)		69.88	°C

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

TEST RESULT

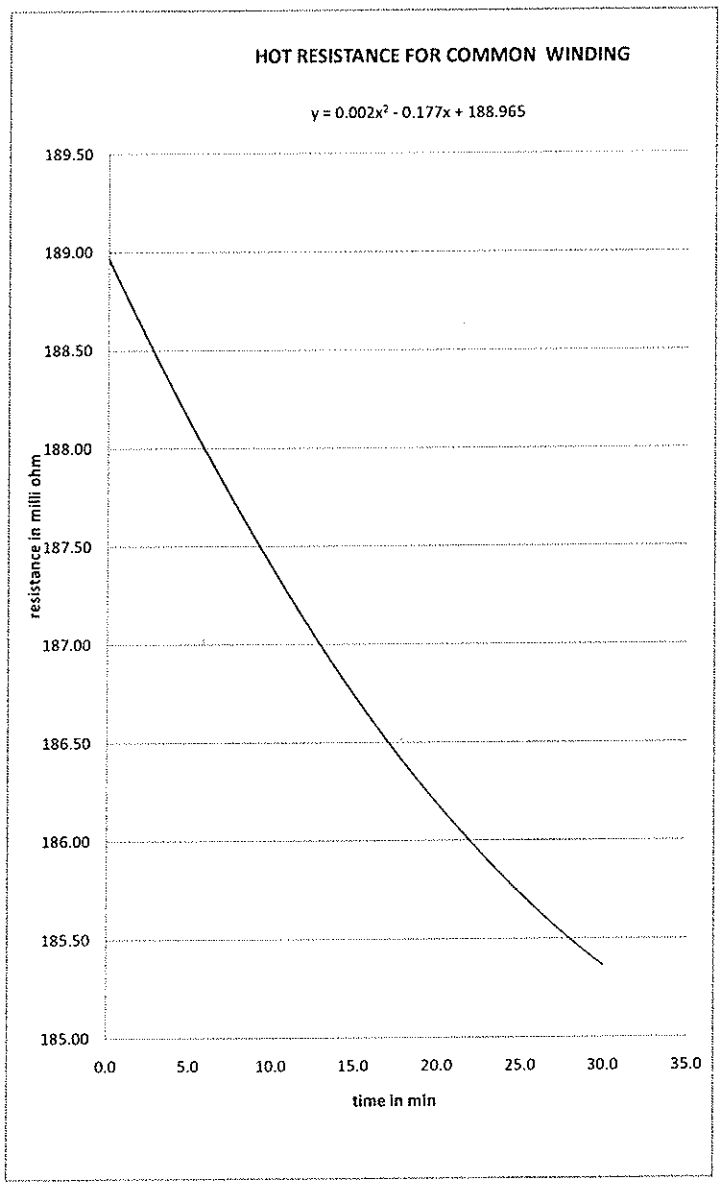
TEMPERATURE RISE TEST

DATE : 13/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 300 CUSTOMER : PGCIL COOLING TYPE: ONAN

Common Wndg.

Time	Resistance milliohm
3.0	188.46
3.5	188.41
4.0	188.32
4.5	188.22
5.0	188.14
5.5	188.06
6.0	187.96
6.5	187.89
7.0	187.81
7.5	187.73
8.0	187.66
8.5	187.58
9.0	187.51
9.5	187.43
10.0	187.37
10.5	187.30
11.0	187.23
11.5	187.16
12.0	187.10
12.5	187.04
13.0	186.96
13.5	186.91
14.0	186.85
14.5	186.79
15.0	186.73
15.5	186.67
16.0	186.62
16.5	186.56
17.0	186.51
17.5	186.46
18.0	186.40
18.5	186.35
19.0	186.30
19.5	186.25
20.0	186.19
20.5	186.15
21.0	186.10
21.5	186.05
22.0	186.00
22.5	185.96
23.0	185.92
23.5	185.87
24.0	185.81
24.5	185.78
25.0	185.74
25.5	185.70
26.0	185.66
26.5	185.62
27.0	185.57
27.5	185.53
28.0	185.49
28.5	185.45
29.0	185.40
29.5	185.37
30.0	185.33



TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

CG Power System
Transformer (T1) Division

TEST RESULT

TEMPERATURE RISE TEST

DATE : 13/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 300 CUSTOMER : PGCIL COOLING TYPE: ONAN

Calculations : FOR LV WINDING

1) Top oil rise at steady state	=	34.95	°C
2) Hot resistance at shutdown	=	24.834	milli ohms
3) Cold resistance	=	22.818	milli ohms
4) Avg temp for Cold resistance	=	42.05	°C
5) Wdg. temp at shutdown =[{(Hot Res at Shutdown)/(Cold Res)}*(235+avgtemp for cold R)]-235	=	66.53	°C
6) Avg ambient at shutdown	=	34.60	°C
7) Avg. oil rise at shutdown = Oil rise at shutdown - (cooler average temp)	=	17.05	°C
8) Avg. Oil Rise a steady state = Oil rise at steadystate - (cooler average temp)	=	22.83	°C
9) Gradient = winding temp at shutdown - Avg ambient at shutdown - Avg Oil Rise at shutdown	=	14.88	°C
10) Winding Temp Rise = Avg oil rise at steady state + Gradient	=	37.70	°C
11) Hot Spot Temperature = Top Oil Rise + (1.3* Gradient) + Yearly Average Ambient (i.e. 20)		74.29	°C

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

TEST RESULT

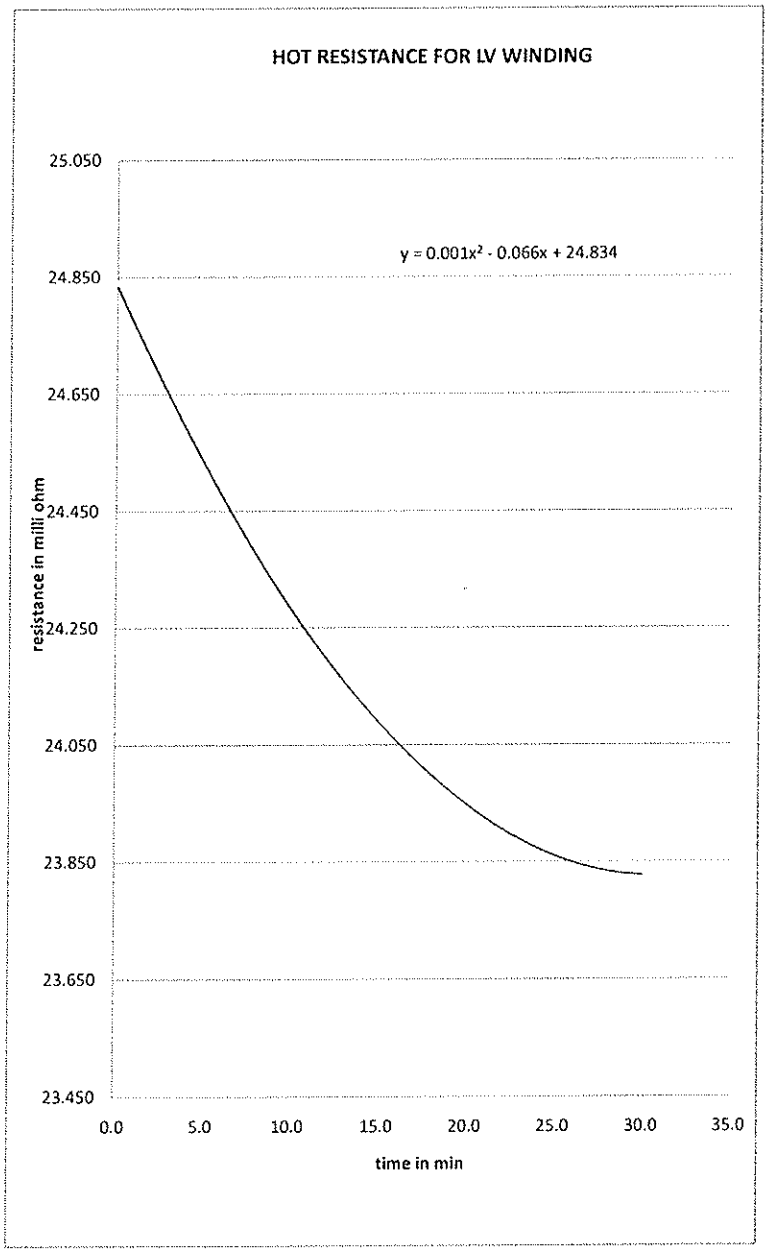
TEMPERATURE RISE TEST

DATE : 13/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 300 CUSTOMER : PGCIL COOLING TYPE: ONAN

LV Wndg.

Time	Resistance milliohm
3.0	24.696
3.5	24.654
4.0	24.610
4.5	24.574
5.0	24.538
5.5	24.504
6.0	24.472
6.5	24.440
7.0	24.410
7.5	24.384
8.0	24.358
8.5	24.334
9.0	24.308
9.5	24.286
10.0	24.264
10.5	24.244
11.0	24.222
11.5	24.202
12.0	24.184
12.5	24.166
13.0	24.148
13.5	24.132
14.0	24.116
14.5	24.102
15.0	24.086
15.5	24.072
16.0	24.058
16.5	24.046
17.0	24.032
17.5	24.018
18.0	24.008
18.5	23.996
19.0	23.984
19.5	23.974
20.0	23.964
20.5	23.952
21.0	23.942
21.5	23.932
22.0	23.922
22.5	23.914
23.0	23.904
23.5	23.896
24.0	23.886
24.5	23.878
25.0	23.870
25.5	23.862
26.0	23.854
26.5	23.848
27.0	23.840
27.5	23.832
28.0	23.826
28.5	23.818
29.0	23.812
29.5	23.804
30.0	23.798



TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

CG Power System
Transformer (T1) Division

TEST RESULT

TEMPERATURE RISE TEST

DATE : 13/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 300 CUSTOMER : PGCIL COOLING TYPE: ONAN

TIME (Hrs)	WTI (°C) HV	WTI (°C)IV	WTI (°C)LV	OTI (°C)
10:30	Temperature rise test started			
10:30	38	38	40	40
11:00	40	40	40	40
11:30	44	44	44	44
12:00	49	48	48	48
12:30	54	52	52	52
13:00	56	54	55	54
13:30	58	57	58	56
14:00	60	59	60	58
14:30	61	60	62	60
15:00	62	61	63	61
15:30	63	62	64	62
16:00	66	64	66	63
16:30	68	67	67	65
17:00	68	68	68	65
17:30	69	68	68	66
18:00	69	68	68	66
18:30	69	68	68	67
19:00	68	68	68	67
19:30	68	68	68	67
20:00	68	68	68	67
20:30	68	68	68	67
21:00	68	68	68	67
21:30	68	69	69	67
21:30	Load reduced to the rated current for 1 Hr.			
22:00	68	68	70	67
22:30	68	68	69	67
22:30	Shut down for series & common wndg. Resistance			
23:15	Re-energised for IV - LV combination.			
23.45	64	64	68	66
0.15	62	63	68	65
0.15	ONAN Temperature rise test completed			

REMARK : 1. O.T.I refers to installed oil temperature indicator.
2. W.T.I refers to installed winding temperature indicator.

TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

TEST RESULT

TEMPERATURE RISE TEST

DATE : 14/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 400 CUSTOMER : PGCIL COOLING TYPE: ONAF

Tap No. = 17

Losses to be Supplied = No Load Loss + (400/500)2 x Load Loss

= 78 + (400/500)2 x 1014.12 = 727.04 KW

Losses Supplied = 727 KW

Time	Volts	AMPS	Loss	Ambient Temperature (°C)					Top Oil	Oil Rise	Cooler Top 1	Cooler Btm.1	Cooler Top 2	Cooler Btm.2
(Hrs)	(kV)	(kA)	(kW)	A	B	C	D	Avg.	(°C)	(°C)	(°C)	(°C)	(°C)	(°C)
1:00	Temperature rise test started													
1:30	39.64	1.41	727.20	34.4	34.2	34.2	34.4	34.30	59.3	25.00	58.3	40.6	59.6	40.1
2:00	39.56	1.40	727.20	34.3	34.1	34.0	34.2	34.15	63.8	29.65	62.6	38.8	64.8	39.1
2:30	39.70	1.41	727.20	34.1	34.1	33.9	34.0	34.03	66.7	32.67	65.9	38.7	67.9	39.0
3:00	39.75	1.41	727.10	34.1	34.0	33.8	33.9	33.95	68.3	34.35	68.0	39.2	69.6	39.8
3:30	39.72	1.41	727.20	33.8	33.9	33.6	33.9	33.80	68.3	34.50	68.3	39.3	69.7	39.8
4:00	39.73	1.41	727.80	33.7	33.8	33.5	33.8	33.70	68.1	34.40	68.1	39.2	69.5	39.7
4:30	39.76	1.41	727.90	33.6	33.7	33.4	33.8	33.63	68.0	34.37	67.9	39.1	69.3	39.5
5:00	39.53	1.41	727.30	33.5	33.6	33.4	33.8	33.58	67.8	34.22	67.8	39.0	69.3	39.7
5:30	39.58	1.41	727.40	33.5	33.6	33.3	33.8	33.55	68.0	34.45	67.9	38.9	69.4	39.6
6:00	39.69	1.41	727.10	33.4	33.5	33.2	33.8	33.48	68.5	35.02	68.3	38.8	69.9	39.7
6:30	39.60	1.41	727.50	33.4	33.4	33.2	33.7	33.43	68.8	35.37	68.7	38.9	70.2	39.7
7:00	39.77	1.41	727.60	33.2	33.3	33.2	33.8	33.38	68.9	35.52	68.8	39.0	70.3	39.7
7:30	39.78	1.41	727.80	33.3	33.4	33.3	33.9	33.48	69.1	35.62	68.9	39.4	70.4	39.9
8:00	39.66	1.41	727.10	33.6	33.8	33.4	34.0	33.70	69.2	35.50	68.9	39.7	70.5	40.3
8:30	39.67	1.41	727.90	33.9	33.7	33.6	34.3	33.88	69.2	35.32	69.1	40.1	70.6	40.4
9:00	39.88	1.41	727.60	34.4	34.4	34.0	34.8	34.40	69.4	35.00	69.2	40.5	70.7	41.2
9:30	39.90	1.41	733.20	35.0	35.0	34.5	35.2	34.93	69.4	34.47	69.2	40.8	70.8	41.4
10:00	39.84	1.41	732.00	35.8	35.8	35.2	35.9	35.68	69.7	34.02	69.5	41.7	71.0	41.9
10:30	39.79	1.41	730.80	36.5	36.5	35.9	36.7	36.40	70.0	33.60	69.9	42.2	71.3	42.5
11:00	39.77	1.41	730.80	37.2	37.2	36.6	37.3	37.08	70.4	33.32	70.2	42.6	71.7	43.0
11:30	39.90	1.41	732.40	37.9	37.9	37.2	37.9	37.73	70.9	33.17	70.7	43.2	72.1	43.8
12:00	39.85	1.41	731.60	38.7	38.6	38.0	38.6	38.48	71.3	32.82	71.2	43.9	72.6	44.4
12:00	Load reduced to the rated current for 1 Hr.													
12:30				39.1	39.0	38.4	39.0	38.88	71.5	32.63	71.5	44.2	72.8	44.6
13:00	Shut down for series & common wndg. Resistance			39.2	39.1	38.6	39.3	39.05	70.8	31.75	70.9	44.1	72.0	44.6
14:00	Re-energised for IV - LV combination.													
14:30				39.9	39.4	39.0	40.0	39.58	64.2	24.63	64.5	43.5	64.2	43.9
15:00	Shut down for LV wndg. Resistance			39.9	39.5	39.1	40.0	39.63	63.7	24.08	64.0	43.2	64.8	44.2
15:00	ONAF Temperature rise test completed													

TEST PASSED SATISFACTORILY.

Witnessed By : Checked By : Tested By :

CG Power System
Transformer (T1) Division

TEST RESULT

TEMPERATURE RISE TEST

DATE : 14/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 400 CUSTOMER : PGCIL COOLING TYPE: ONAF

Calculations : FOR SERIES WINDING

1) Top oil rise at steady state = 32.82 °C

2) Hot resistance at shutdown = 171.317 milli ohms

3) Cold resistance = 154.89 milli ohms

4) Avg temp for Cold resistance = 42.05 °C

5) Wdg. temp at shutdown = 71.43 °C
=[{(Hot Res at Shutdown)/(Cold Res)}*(235+avgtemp for cold R)]-235

6) Avg ambient at shutdown = 39.05 °C

7) Avg. oil rise at shutdown = 18.20 °C
= Oil rise at shutdown - (cooler average temp)

8) Avg. Oil Rise a steady state = 18.95 °C
= Oil rise at steadystate - (cooler average temp)

9) Gradient = 14.18 °C
= winding temp at shutdown - Avg ambient at shutdown - Avg Oil Rise at shutdown

10) Winding Temp Rise = 33.13 °C
= Avg oil rise at steady state + Gradient

11) Hot Spot Temperature 71.26 °C
= Top Oil Rise + (1.3* Gradient) + Yearly Average Ambient (i.e. 20)

Witnessed By: Checked By: Tested By:

TEST RESULT

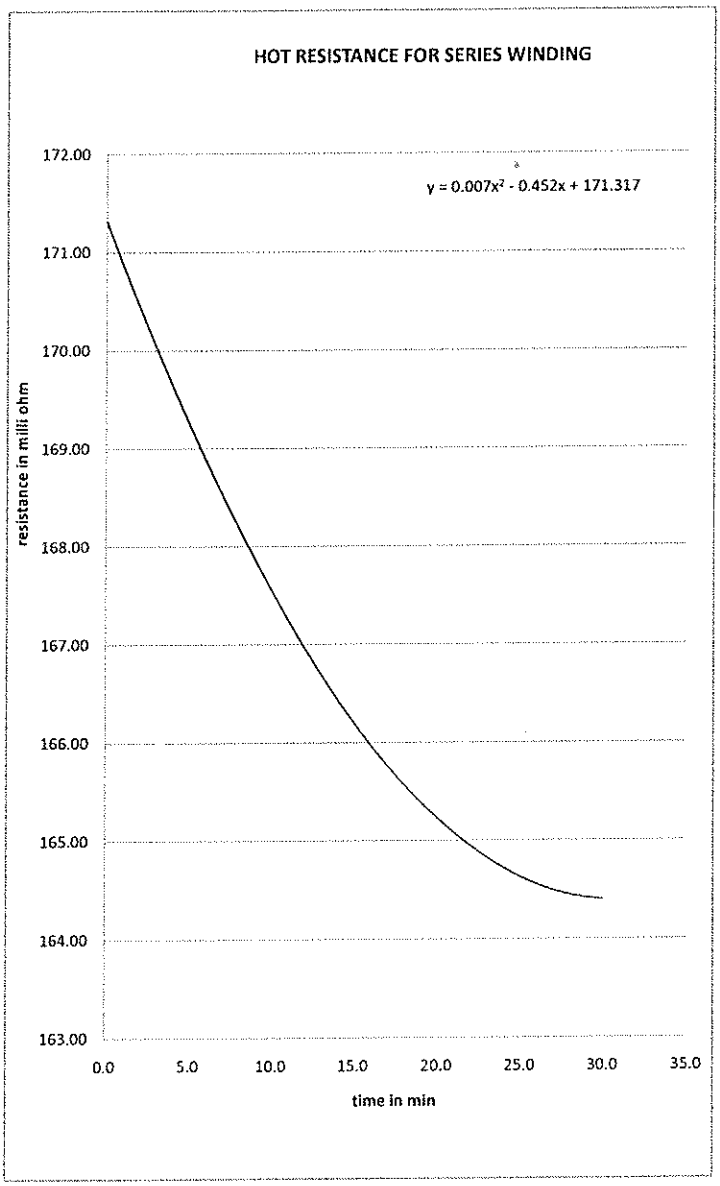
TEMPERATURE RISE TEST

DATE : 14/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 400 CUSTOMER : PGCIL COOLING TYPE: ONAF

Series Wndg.

Time	Resistance milliohm
2.5	171.19
3.0	170.60
3.5	169.76
4.0	169.53
4.5	169.30
5.0	169.09
5.5	168.90
6.0	168.70
6.5	168.52
7.0	168.33
7.5	168.17
8.0	168.00
8.5	167.84
9.0	167.69
9.5	167.53
10.0	167.40
10.5	167.26
11.0	167.13
11.5	166.99
12.0	166.88
12.5	166.75
13.0	166.65
13.5	166.54
14.0	166.43
14.5	166.31
15.0	166.21
15.5	166.12
16.0	166.02
16.5	165.92
17.0	165.83
17.5	165.75
18.0	165.66
18.5	165.53
19.0	165.51
19.5	165.42
20.0	165.35
20.5	165.28
21.0	165.21
21.5	165.14
22.0	165.07
22.5	165.01
23.0	164.95
23.5	164.89
24.0	164.83
24.5	164.77
25.0	164.71
25.5	164.65
26.0	164.59
26.5	164.53
27.0	164.47
27.5	164.41
28.0	164.36
28.5	164.31
29.0	164.26
29.5	164.21
30.0	164.17



TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

CG Power System
Transformer (T1) Division

TEST RESULT

TEMPERATURE RISE TEST

DATE : 14/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 400 CUSTOMER : PGCIL COOLING TYPE: ONAF

Calculations : FOR COMMON WINDING

1) Top oil rise at steady state	=	32.82	°C
2) Hot resistance at shutdown	=	191.715	milli ohms
3) Cold resistance	=	172.350	milli ohms
4) Avg temp for Cold resistance	=	42.05	°C
5) Wdg. temp at shutdown =[{(Hot Res at Shutdown)/(Cold Res)}*(235+avgtemp for cold R)]-235	=	73.18	°C
6) Avg ambient at shutdown	=	39.05	°C
7) Avg. oil rise at shutdown = Oil rise at shutdown - (cooler average temp)	=	18.20	°C
8) Avg. Oil Rise a steady state = Oil rise at steadystate - (cooler average temp)	=	18.95	°C
9) Gradient = winding temp at shutdown - Avg ambient at shutdown - Avg Oil Rise at shutdown	=	15.93	°C
10) Winding Temp Rise = Avg oil rise at steady state + Gradient	=	34.87	°C
11) Hot Spot Temperature = Top Oil Rise + (1.3* Gradient) + Yearly Average Ambient (i.e. 20)		73.53	°C

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

TEST RESULT

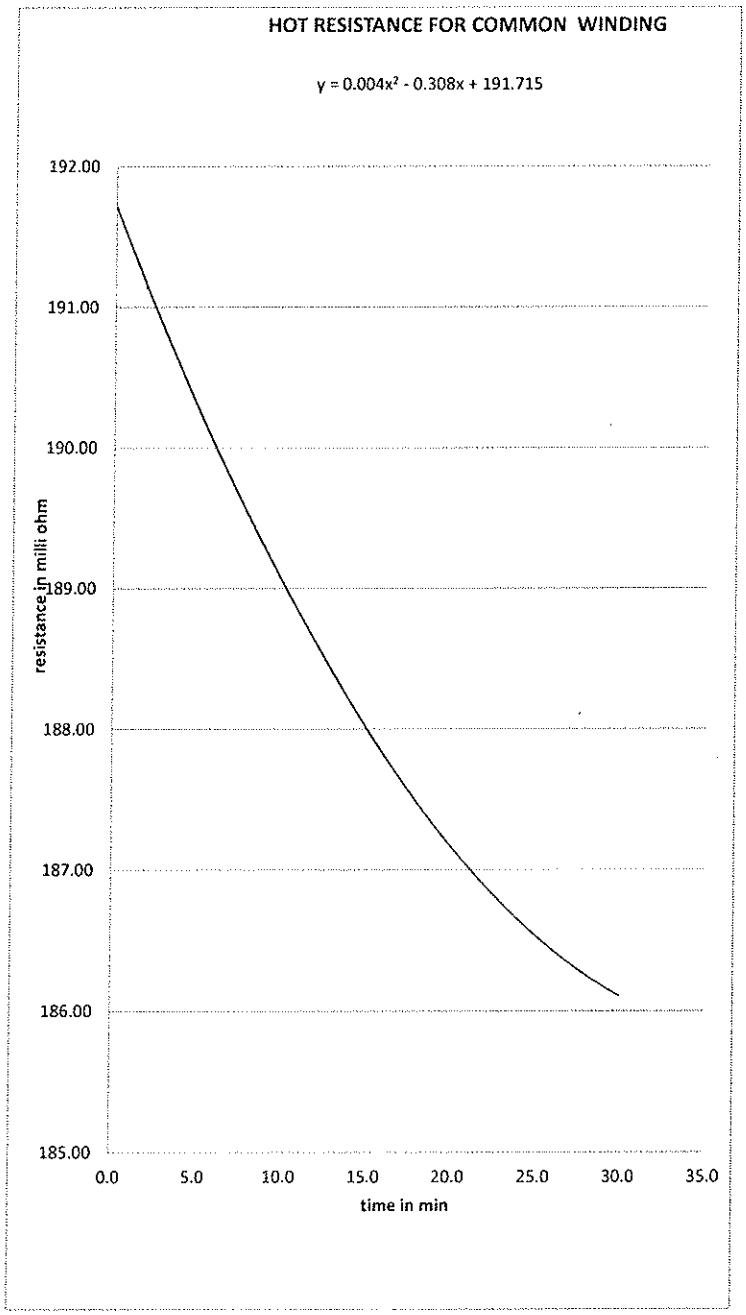
TEMPERATURE RISE TEST

DATE : 14/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 400 CUSTOMER : PGCIL COOLING TYPE: ONAF

Common Wndg.

Time	Resistance milliohm
2.5	191.31
3.0	190.98
3.5	190.31
4.0	190.63
4.5	190.47
5.0	190.31
5.5	190.14
6.0	190.00
6.5	189.86
7.0	189.75
7.5	189.59
8.0	189.46
8.5	189.33
9.0	189.21
9.5	189.09
10.0	188.97
10.5	188.86
11.0	188.76
11.5	188.65
12.0	188.54
12.5	188.45
13.0	188.36
13.5	188.27
14.0	188.17
14.5	188.11
15.0	188.00
15.5	187.92
16.0	187.83
16.5	187.75
17.0	187.66
17.5	187.60
18.0	187.52
18.5	187.46
19.0	187.39
19.5	187.28
20.0	187.20
20.5	187.13
21.0	187.06
21.5	186.99
22.0	186.92
22.5	186.86
23.0	186.80
23.5	186.74
24.0	186.68
24.5	186.62
25.0	186.56
25.5	186.50
26.0	186.44
26.5	186.38
27.0	186.33
27.5	186.28
28.0	186.23
28.5	186.18
29.0	186.13
29.5	186.09
30.0	186.03



TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

CG Power System
Transformer (T1) Division

TEST RESULT

TEMPERATURE RISE TEST

DATE : 14/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 400 CUSTOMER : PGCIL COOLING TYPE: ONAF

Calculations : FOR LV WINDING

1) Top oil rise at steady state	=	32.82	°C
2) Hot resistance at shutdown	=	25.209	milli ohms
3) Cold resistance	=	22.818	milli ohms
4) Avg temp for Cold resistance	=	42.05	°C
5) Wdg. temp at shutdown =[{(Hot Res at Shutdown)/(Cold Res)}*(235+avgtemp for cold R)]-235	=	71.08	°C
6) Avg ambient at shutdown	=	39.63	°C
7) Avg. oil rise at shutdown = Oil rise at shutdown - (cooler average temp)	=	13.73	°C
8) Avg. Oil Rise a steady state = Oil rise at steadystate - (cooler average temp)	=	18.92	°C
9) Gradient = winding temp at shutdown - Avg ambient at shutdown - Avg Oil Rise at shutdown	=	17.73	°C
10) Winding Temp Rise = Avg oil rise at steady state + Gradient	=	36.65	°C
11) Hot Spot Temperature = Top Oil Rise + (1.3* Gradient) + Yearly Average Ambient (i.e. 20)		75.87	°C

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

TEST RESULT

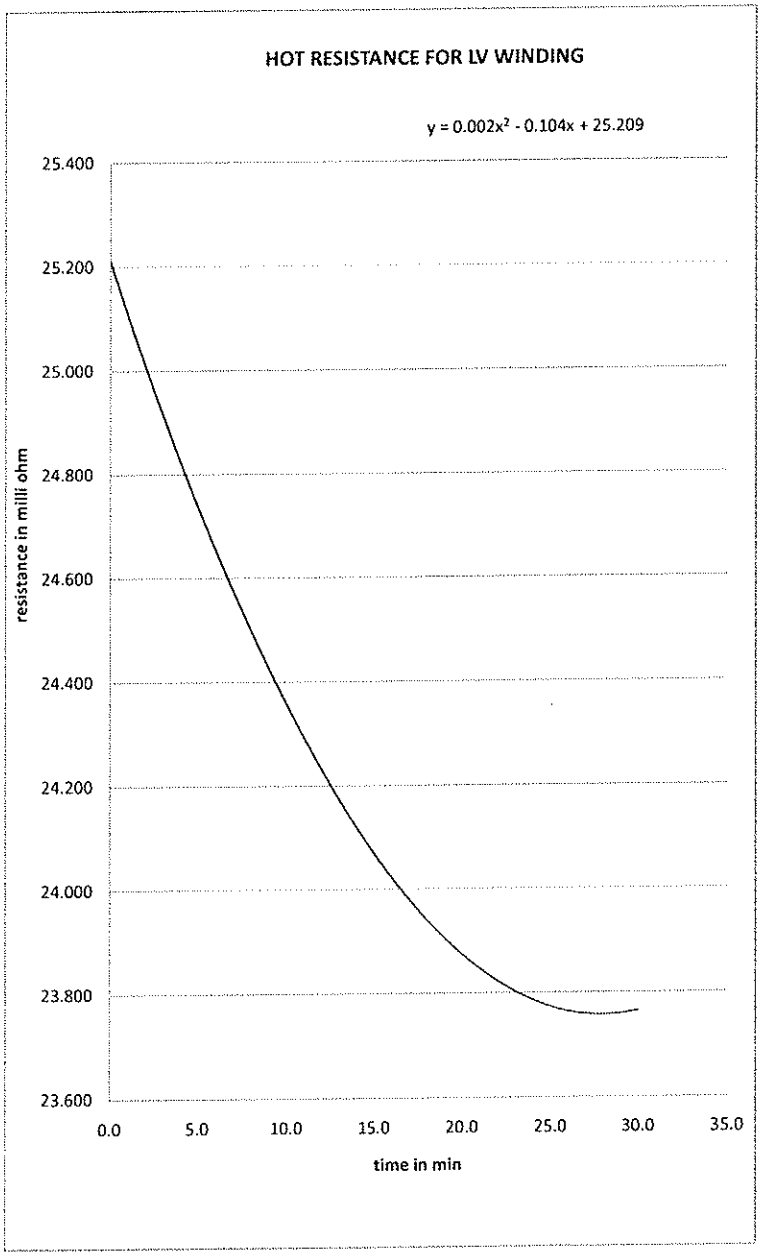
TEMPERATURE RISE TEST

DATE : 14/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 400 CUSTOMER : PGCIL COOLING TYPE: ONAF

LV Wndg.

Time	Resistance milliohm
3.0	25.012
3.5	24.944
4.0	24.874
4.5	24.810
5.0	24.748
5.5	24.692
6.0	24.638
6.5	24.588
7.0	24.542
7.5	24.498
8.0	24.456
8.5	24.418
9.0	24.382
9.5	24.346
10.0	24.314
10.5	24.282
11.0	24.254
11.5	24.226
12.0	24.200
12.5	24.174
13.0	24.150
13.5	24.128
14.0	24.106
14.5	24.084
15.0	24.066
15.5	24.046
16.0	24.028
16.5	24.010
17.0	23.994
17.5	23.978
18.0	23.962
18.5	23.946
19.0	23.932
19.5	23.918
20.0	23.904
20.5	23.892
21.0	23.878
21.5	23.868
22.0	23.856
22.5	23.844
23.0	23.832
23.5	23.822
24.0	23.812
24.5	23.802
25.0	23.792
25.5	23.782
26.0	23.774
26.5	23.764
27.0	23.756
27.5	23.748
28.0	23.740
28.5	23.732
29.0	23.724
29.5	23.716
30.0	23.706



TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

CG Power System
Transformer (T1) Division

TEST RESULT

TEMPERATURE RISE TEST

DATE : 14/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 400 CUSTOMER : PGCIL COOLING TYPE: ONAF

TIME (Hrs)	WTI (°C) HV	WTI (°C)IV	WTI (°C)LV	OTI (°C)
1:00	Temperature rise test started			
1:30	62	62	60	64
2:00	64	63	62	64
2:30	66	66	66	64
3:00	68	68	67	66
3:30	68	68	67	66
4:00	68	68	67	66
4:30	68	68	67	66
5:00	68	68	67	66
5:30	68	68	67	66
6:00	68	68	67	66
6:30	68	68	68	66
7:00	68	69	68	67
7:30	68	69	68	67
8:00	68	69	68	67
8:30	68	69	68	67
9:00	68	69	68	67
9:30	68	69	68	67
10:00	68	69	69	67
10:30	72	72	70	69
11:00	72	70	70	70
11:30	72	72	71	70
12:00	72	72	71	70
12:00	Load reduced to the rated current for 1 Hr.			
12.30	72	72	71	70
13.00	72	73	71	70
13:00	Shut down for series & common wndg. Resistance			
13.00	Re-energised for IV - LV combination.			
14.30	66	66	74	68
15.00	65	65	74	68
15.00	ONAF Temperature rise test completed			

REMARK : 1. O.T.I refers to installed oil temperature indicator.
2. W.T.I refers to installed winding temperature indicator.

TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

TEST RESULT

TEMPERATURE RISE TEST

DATE : 14-15/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 500 CUSTOMER : PGCIL COOLING TYPE: ODAF

Tap No. = 17

Losses to be Supplied = No Load Loss + (500/500)2 x Load Loss

= 78 + (500/500)2 x 1014.22 = 1092.22 KW

Losses Supplied = 1092 KW

Time	Volts	AMPS	Loss	Ambient Temperature (°C)					Top Oil	Oil Rise	Cooler Top 1	Cooler Btm.1	Cooler Top 2	Cooler Btm.2
(Hrs)	(kV)		Kw	A	B	C	D	Avg.	(°C)	(°C)	(°C)	(°C)	(°C)	(°C)
15:45	Temperature rise test started													
15:45	48.85	1.73	1096	39.5	39.3	39.0	39.9	39.43	60.5	21.07	61.0	42.8	61.4	42.7
16:15	48.46	1.71	1102	39.3	38.9	38.8	39.6	39.15	53.5	14.35	52.7	50.9	53.0	50.9
16:45	48.39	1.71	1106	39.1	38.8	38.7	39.4	39.00	55.7	16.70	55.6	52.8	56.2	53.3
17:15	48.36	1.71	1110	39.1	38.7	38.5	39.2	38.88	57.6	18.72	57.9	54.9	58.6	55.4
17:45	47.92	1.69	1094	39.1	38.5	38.4	39.2	38.80	60.2	21.40	60.2	58.3	61.5	58.8
18:15	47.85	1.69	1095	38.7	38.1	37.9	39.2	38.48	61.6	23.12	61.3	59.6	62.5	60.7
18:45	47.88	1.69	1093	38.4	37.7	37.8	39.0	38.23	62.9	24.67	63.2	59.3	63.9	60.0
19:15	47.88	1.69	1093	37.8	37.2	37.3	38.5	37.70	62.4	24.70	62.7	59.0	63.4	59.7
19:45	47.96	1.7	1096	37.5	36.7	37.0	38.2	37.35	62.1	24.75	62.4	58.3	63.1	59.4
20:15	47.94	1.69	1094	37.2	36.2	36.6	37.9	36.98	61.6	24.62	62.1	58.0	62.8	58.9
20:45	47.99	1.7	1093	37.0	35.9	36.4	37.6	36.73	61.4	24.67	61.9	58.2	62.6	58.8
21:15	47.93	1.7	1093	36.7	35.6	36.1	37.2	36.40	61	24.60	62.7	57.6	62.4	58.3
21:45	47.87	1.69	1093	36.7	35.5	35.8	36.9	36.23	60.9	24.67	61.5	58.2	62.2	58.1
22:15	47.92	1.7	1093	36.6	35.4	35.7	36.7	36.10	60.8	24.70	61.4	57.7	62.1	58.1
22:45	47.98	1.7	1094	36.5	35.4	35.6	36.5	36.00	60.6	24.60	61.2	57.2	61.9	58.0
23:15	47.96	1.7	1095	36.5	35.3	35.7	36.3	35.95	60.7	24.75	61.2	57.2	61.9	58.0
23:45	47.99	1.7	1094	36.4	35.2	35.6	36.4	35.90	60.6	24.70	61.0	57.3	61.8	57.9
0:15	47.90	1.69	1093	36.2	35.1	35.5	36.3	35.78	60.5	24.72	60.9	57.2	61.7	57.9
0:45	47.92	1.7	1093	35.8	34.8	35.2	36.3	35.53	60.4	24.87	60.9	56.9	61.6	57.6
1:15	47.86	1.7	1093	35.8	34.5	34.9	36.0	35.30	60.2	24.90	60.7	56.9	61.4	57.5
1:45	47.99	1.7	1093	35.3	34.3	34.7	35.9	35.05	60.1	25.05	60.6	56.9	61.3	57.3
2:15	48.00	1.7	1093	35.3	34.2	34.6	35.8	34.98	59.9	24.92	60.5	56.9	61.2	57.2
2:45	48.01	1.7	1094	35.3	34.0	34.6	35.5	34.85	59.7	24.85	60.2	55.9	60.9	56.9
3:15	48.06	1.7	1093	35.2	33.6	34.4	35.2	34.60	59.5	24.90	59.9	55.8	60.6	56.7
3:45	48.05	1.7	1093	35.0	33.4	34.2	35.0	34.40	59.3	24.90	59.7	55.6	60.4	56.4
4:15	48.04	1.7	1093	34.8	33.1	33.9	34.7	34.13	59.0	24.87	59.5	55.3	60.2	56.2
4:45	48.05	1.7	1094	34.6	32.8	33.3	34.3	33.75	58.7	24.95	59.3	55.0	59.9	55.9
5:15	48.03	1.7	1093	34.4	32.5	33.3	34.3	33.63	58.5	24.87	59.2	55.0	59.8	55.8
5:45	48.04	1.7	1094	34.3	32.5	33.2	34.2	33.55	58.4	24.85	59.0	54.8	59.6	55.7
6:15	48.05	1.7	1093	34.3	32.6	33.2	34.0	33.53	58.2	24.67	58.9	55.0	59.5	55.6

CONTINUE ON NEXT PAGE.....

TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

TEST RESULT

TEMPERATURE RISE TEST

DATE : 14-15/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 500 CUSTOMER : PGCIL COOLING TYPE: ODAF

Tap No. = 17

Losses to be Supplied = No Load Loss + (500/500)2 x Load Loss

= 78 + (500/500)2 x 1014.22 = 1092.22 KW

Losses Supplied = 1092 KW

Time	Volts	AMPS	Loss	Ambient Temperature (°C)					Top Oil	Oil Rise	Cooler Top 1	Cooler Btm.1	Cooler Top 2	Cooler Btm.2
(Hrs)	(kV)		Kw	A	B	C	D	Avg.	(°C)	(°C)	(°C)	(°C)	(°C)	(°C)
	CONTINUED.....													
6:45	48.04	1.70	1093	34.4	32.8	33.1	33.7	33.50	58.2	24.70	58.9	55.0	59.5	55.6
7:15	48.05	1.70	1093	34.3	33.2	32.8	33.6	33.48	58.3	24.82	58.9	55.0	59.5	55.6
7:45	48.03	1.70	1093	34.5	33.7	32.9	33.7	33.70	58.5	24.80	59.1	55.4	59.7	55.8
8:15	48.06	1.70	1093	35.2	34.4	33.3	34.0	34.23	58.9	24.67	59.5	56.0	60.1	56.3
8:45	48.03	1.70	1093	35.9	35.2	33.9	34.4	34.85	59.4	24.55	60.0	56.3	60.6	56.8
9:15	48.03	1.69	1094	36.8	35.9	34.6	35.3	35.65	59.9	24.25	60.5	56.8	61.1	57.3
9:45	48.10	1.69	1094	37.5	36.6	35.4	36.0	36.38	60.6	24.22	61.0	58.0	62.0	58.0
10:15	48.16	1.70	1093	38.2	37.5	36.0	36.5	37.05	61	23.95	61.5	58.0	62.2	58.6
10:45	48.06	1.70	1100	39.0	38.1	36.7	37.3	37.78	61.7	23.92	62.3	58.6	62.8	59.2
11:15	48.03	1.70	1098	39.6	38.6	37.4	38.0	38.40	62.3	23.90	62.7	59.1	63.4	59.8
11:45	48.02	1.70	1096	40.1	39.1	38.0	38.6	38.95	62.8	23.85	63.3	59.7	63.9	60.3
12:15	47.97	1.70	1098	40.4	39.6	38.4	39.0	39.35	63.2	23.85	63.7	60.2	64.3	60.7
12:45	47.95	1.70	1099	40.6	39.8	38.8	39.4	39.65	63.7	24.05	64.1	60.4	64.7	61.1
13:15	47.98	1.70	1096	41.0	40.2	39.2	39.9	40.08	64	23.92	64.6	60.9	64.2	61.6
13:45	47.97	1.70	1095	41.1	40.3	39.5	40.2	40.28	64.3	24.02	64.8	61.1	65.4	61.7
14:15	47.91	1.69	1099	41.3	40.6	39.6	40.4	40.48	64.7	24.22	65.1	61.4	65.7	62.1
14:45	47.90	1.69	1095	41.4	40.7	39.7	40.5	40.58	65.1	24.52	65.3	61.6	66.0	62.4
14:45	Load reduced to the rated current for 1 Hr.													
15:15				41.5	40.8	40.0	40.6	40.73	63.7	22.97	64.1	60.4	64.5	61.2
15:45	Shut down for series & common wndg. Resistance			41.2	40.6	39.9	40.6	40.58	62.5	21.93	63.0	59.5	63.4	60.2
16:30	Re-Energized transformer for IV/TV combination @ Rated Current													
17:00				39.9	39.5	39.0	39.8	39.55	54.5	14.95	54.6	51.5	53.9	52.0
17:30	Shut down for LV wndg. Resistance			39.7	39.3	38.6	39.4	39.25	53.5	14.25	53.5	51.1	53.5	51.3
	ODAF Temperature rise test completed													

TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

CG Power System
Transformer (T1) Division

TEST RESULT

TEMPERATURE RISE TEST

DATE : 14-15/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 500 CUSTOMER : PGCIL COOLING TYPE: ODAF

Calculations : FOR SERIES WINDING

1) Top oil rise at steady state	=	24.52	°C
2) Hot resistance at shutdown	=	170.160	milli ohms
3) Cold resistance	=	154.89	milli ohms
4) Avg temp for Cold resistance	=	42.05	°C
5) Wdg. temp at shutdown =[{(Hot Res at Shutdown)/(Cold Res)}*(235+avgtemp for cold R)]-235	=	69.36	°C
6) Avg ambient at shutdown	=	40.58	°C
7) Avg. oil rise at shutdown = Oil rise at shutdown - (cooler average temp)	=	20.25	°C
8) Avg. Oil Rise a steady state = Oil rise at steadystate - (cooler average temp)	=	22.70	°C
9) Gradient = winding temp at shutdown - Avg ambient at shutdown - Avg Oil Rise at shutdown	=	8.54	°C
10) Winding Temp Rise = Avg oil rise at steady state + Gradient	=	31.23	°C
11) Hot Spot Temperature = Top Oil Rise + (1.3* Gradient) + Yearly Average Ambient (i.e. 20)		55.62	°C

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

TEST RESULT

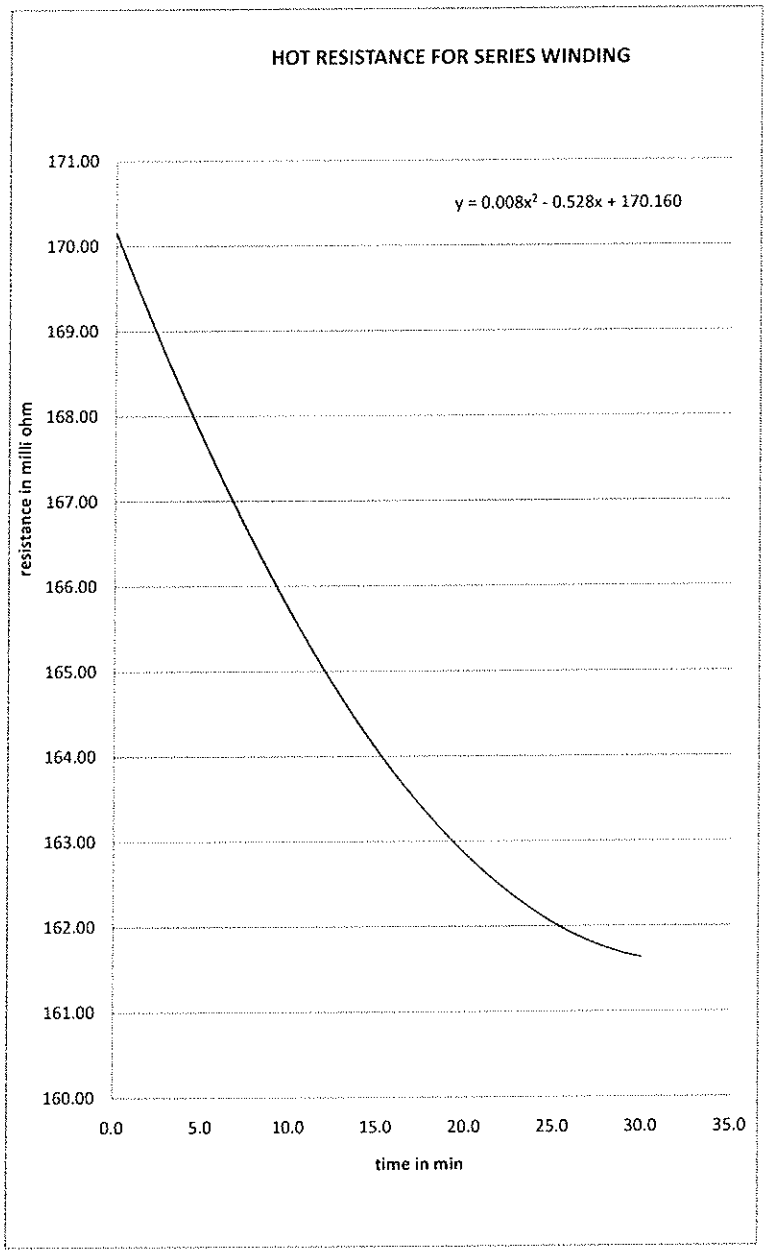
TEMPERATURE RISE TEST

DATE : 14-15/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 500 CUSTOMER : PGCIL COOLING TYPE: ODAF

Series Wndg.

Time	Resistance milliohm
2.0	169.59
2.5	169.14
3.0	168.82
3.5	168.52
4.0	168.22
4.5	167.94
5.0	167.67
5.5	167.43
6.0	167.19
6.5	166.94
7.0	166.72
7.5	166.51
8.0	166.30
8.5	166.10
9.0	165.91
9.5	165.73
10.0	165.55
10.5	165.38
11.0	165.21
11.5	165.05
12.0	164.90
12.5	164.74
13.0	164.61
13.5	164.46
14.0	164.33
14.5	164.20
15.0	164.07
15.5	163.95
16.0	163.82
16.5	163.71
17.0	163.59
17.5	163.48
18.0	163.37
18.5	163.27
19.0	163.17
19.5	163.07
20.0	162.97
20.5	162.87
21.0	162.78
21.5	162.69
22.0	162.60
22.5	162.51
23.0	162.42
23.5	162.35
24.0	162.27
24.5	162.18
25.0	162.11
25.5	162.03
26.0	161.95
26.5	161.88
27.0	161.81
27.5	161.74
28.0	161.67
28.5	161.60
29.0	161.53
29.5	161.47
30.0	161.42



TEST PASSED SATISFACTORILY.

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Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

CG Power System
Transformer (T1) Division

TEST RESULT

TEMPERATURE RISE TEST

DATE : 14-15/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 500 CUSTOMER : PGCIL COOLING TYPE: ODAF

Calculations : FOR COMMON WINDING

1) Top oil rise at steady state	=	24.52	°C
2) Hot resistance at shutdown	=	191.099	milli ohms
3) Cold resistance	=	172.35	milli ohms
4) Avg temp for Cold resistance	=	42.05	°C
5) Wdg. temp at shutdown =[{(Hot Res at Shutdown)/(Cold Res)}*(235+avgtemp for cold R)]-235	=	72.19	°C
6) Avg ambient at shutdown	=	40.58	°C
7) Avg. oil rise at shutdown = Oil rise at shutdown - (cooler average temp)	=	20.25	°C
8) Avg. Oil Rise a steady state = Oil rise at steadystate - (cooler average temp)	=	22.70	°C
9) Gradient = winding temp at shutdown - Avg ambient at shutdown - Avg Oil Rise at shutdown	=	11.36	°C
10) Winding Temp Rise = Avg oil rise at steady state + Gradient	=	34.06	°C
11) Hot Spot Temperature = Top Oil Rise + (1.3* Gradient) + Yearly Average Ambient (i.e. 20)		59.29	°C

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

TEST RESULT

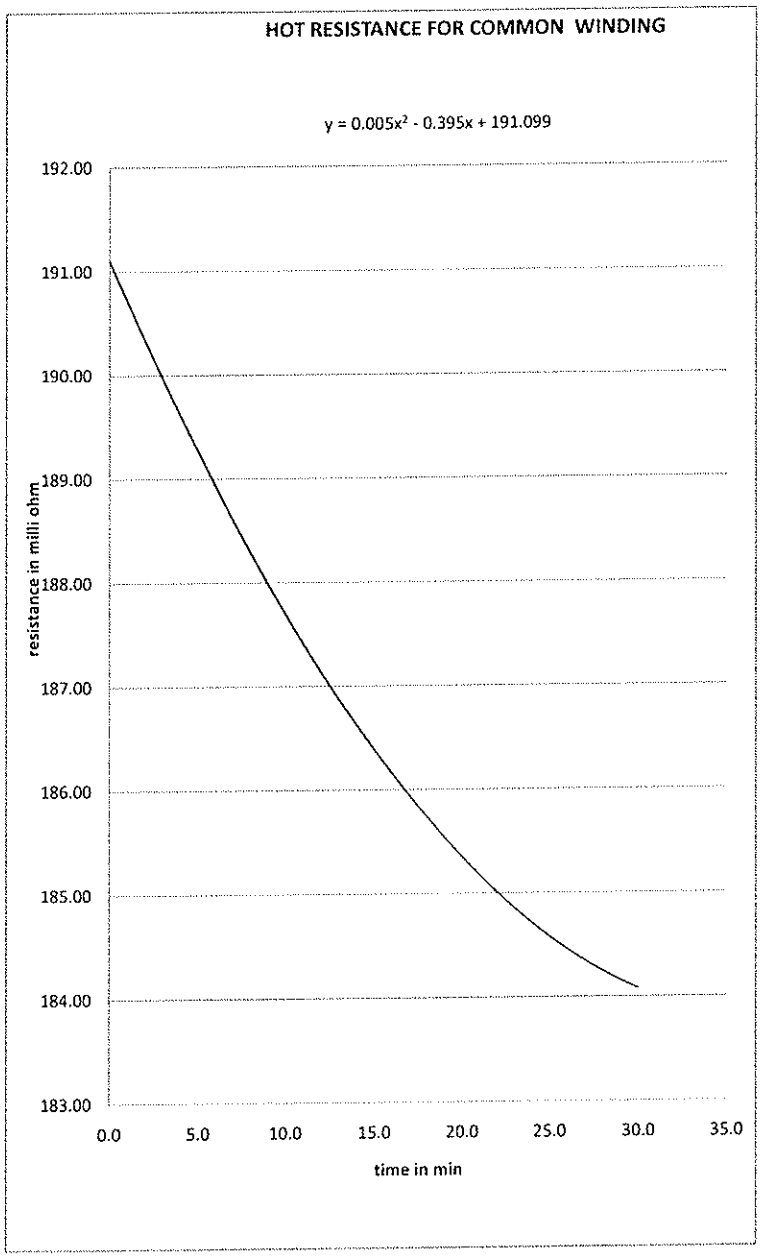
TEMPERATURE RISE TEST

DATE : 14/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 400 CUSTOMER : PGCIL COOLING TYPE: ONAF

Common Wndg.

Time	Resistance milliohm
2.0	190.50
2.5	190.29
3.0	190.07
3.5	189.85
4.0	189.64
4.5	189.44
5.0	189.24
5.5	189.06
6.0	188.87
6.5	188.70
7.0	188.53
7.5	188.36
8.0	188.21
8.5	188.05
9.0	187.90
9.5	187.76
10.0	187.61
10.5	187.48
11.0	187.34
11.5	187.21
12.0	187.09
12.5	186.96
13.0	186.84
13.5	186.73
14.0	186.61
14.5	186.50
15.0	186.38
15.5	186.27
16.0	186.18
16.5	185.97
17.0	185.90
17.5	185.88
18.0	185.78
18.5	185.69
19.0	185.60
19.5	185.50
20.0	185.41
20.5	185.33
21.0	185.24
21.5	185.17
22.0	185.08
22.5	185.00
23.0	184.92
23.5	184.84
24.0	184.79
24.5	184.69
25.0	184.62
25.5	184.55
26.0	184.48
26.5	184.41
27.0	184.34
27.5	184.27
28.0	184.20
28.5	184.13
29.0	184.07
29.5	184.01
30.0	183.96



TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451; Fax : 91-22-5783271

CG Power System
Transformer (T1) Division

TEST RESULT

TEMPERATURE RISE TEST

DATE : 14-15/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 500 CUSTOMER : PGCIL COOLING TYPE: ODAF

Calculations : FOR LV WINDING

1) Top oil rise at steady state	=	24.52	°C
2) Hot resistance at shutdown	=	25.040	milli ohms
3) Cold resistance	=	22.818	milli ohms
4) Avg temp for Cold resistance	=	42.05	°C
5) Wdg. temp at shutdown =[{(Hot Res at Shutdown)/(Cold Res)}*(235+avgtemp for cold R)]-235	=	69.03	°C
6) Avg ambient at shutdown	=	39.25	°C
7) Avg. oil rise at shutdown = Oil rise at shutdown - (cooler average temp)	=	13.10	°C
8) Avg. Oil Rise a steady state = Oil rise at steadystate - (cooler average temp)	=	22.70	°C
9) Gradient = winding temp at shutdown - Avg ambient at shutdown - Avg Oil Rise at shutdown	=	16.68	°C
10) Winding Temp Rise = Avg oil rise at steady state + Gradient	=	39.37	°C
11) Hot Spot Temperature = Top Oil Rise + (1.3* Gradient) + Yearly Average Ambient (i.e. 20)		66.20	°C

Witnessed By: Checked By: Tested By:

Transformer (T1) Division, Kanjur (E), Mumbai 400 042. Tel: 91-22-5782451 ; Fax : 91-22-5783271

TEST RESULT

TEMPERATURE RISE TEST

DATE : 14-15/05/2016 W.O. NO. : T10660 SERIAL NO. : T10660/1

MVA : 500 CUSTOMER : PGCIL COOLING TYPE: ODAF

LV Wndg.

Time	Resistance milliohm
2.5	24.914
3.0	24.788
3.5	24.684
4.0	24.582
4.5	24.494
5.0	24.410
5.5	24.334
6.0	24.262
6.5	24.198
7.0	24.136
7.5	24.082
8.0	24.028
8.5	23.980
9.0	23.936
9.5	23.894
10.0	23.856
10.5	23.820
11.0	23.786
11.5	23.754
12.0	23.726
12.5	23.698
13.0	23.672
13.5	23.648
14.0	23.626
14.5	23.604
15.0	23.584
15.5	23.566
16.0	23.548
16.5	23.530
17.0	23.514
17.5	23.500
18.0	23.486
18.5	23.472
19.0	23.460
19.5	23.448
20.0	23.436
20.5	23.424
21.0	23.414
21.5	23.404
22.0	23.394
22.5	23.384
23.0	23.374
23.5	23.366
24.0	23.358
24.5	23.350
25.0	23.342
25.5	23.336
26.0	23.328
26.5	23.322
27.0	23.314
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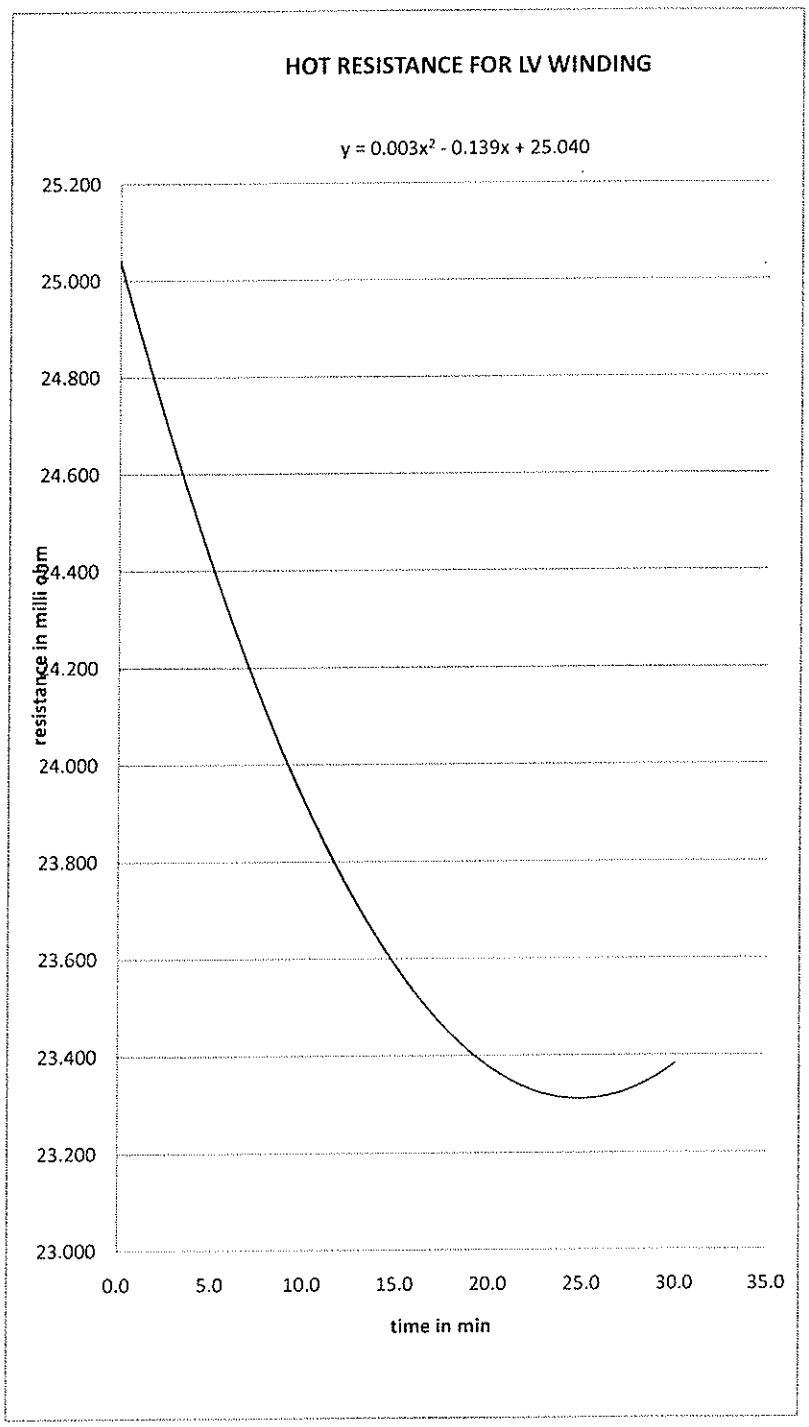
29.5	23.284
30.0	23.280



TEST PASSED SATISFACTORILY.

Witnessed By: Checked By: Tested By:

CG Power System
Transformer (T1) Division

TEST RESULT

DATE : 14-15/05/2016 W.O.NO. : T10660 SERIAL NO.: T10660/1

MVA : 500 CUSTOMER : PGCIL COOLING TYPE: ODAF

TEMPERATURE RISE TEST

TIME (Hrs)	OTI	WTI		
		HV	IV	LV
15:45	ODAF STARTED			
15:45	60	63	62	53
16:15	59	64	62	56
16:45	59	64	62	56
17:15	59	64	62	58
17:45	60	65	63	59
18:15	62	68	66	62
18:45	62	68	66	63
19:15	62	68	66	63
19:45	62	68	66	62
20:15	62	68	67	62
20:45	63	68	67	62
21:15	62	68	66	61
21:45	63	68	67	61
22:15	63	68	67	61
22:45	63	68	67	61
23:15	63	68	67	61
23:45	63	68	67	61
0:15	63	68	67	61
0:45	63	68	67	61
1:15	63	68	67	61
1:45	62	68	66	60
2:15	62	68	66	60
2:45	62	68	66	60
3:15	62	68	66	60
3:45	62	68	66	60
4:15	62	68	66	60
4:45	62	68	66	60
5:15	62	68	66	60
5:45	62	68	66	60

TIME	OTI	WTI		
		HV	IV	LV
6:15	62	68	66	60
6:45	62	68	66	59
7:15	62	68	66	59
7:45	62	68	66	59
8:15	62	68	66	59
8:45	62	68	66	59
9:15	62	68	66	59
9:45	62	68	66	60
10:15	62	68	66	61
10:45	62	68	66	61
11:15	62	68	66	62
11:45	62	68	66	62
12:15	62	68	67	62
12:45	62	68	67	62
13:15	62	68	67	62
13:45	62	68	67	62
14:15	63	68	67	63
14:45	63	70	67	63
14:45	RATED CURRENT APPLIED			
15:15	63	68	67	63
15:45	63	68	66	63
15:45	SHUT DOWN HV/IV			
16:30	RE-ENERGIZED IV/TV			
17:00	59	68	67	66
17:30	58	67	66	68
17:30	SHUT DOWN LV			
17:30	ODAF COMPLETED			

TEST PASSED SATISFACTORILY.

Witnessed By : Checked By : Tested By :

ISO/IEC 17025 NABL NO.T1620	CGL/T1/TTR/T10660/1 **TEST CERTIFICATE** **CG Power Systems** **Transformer (T1) Division**	Smart solutions. Strong relationships

Date : 15/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF POWER TAKEN BY COOLER CIRCUIT

NO OF FANS RUNNING = 12 NOS.

NO OF PUMPS RUNNING = 2 NOS.

Average voltage L-L	406.38 V
Total Current	26.95 A
Measured frequency	50 Hz
Measured Loss	14.156 kW

TOTAL LOSS = 14.156 kW
GUARANTEED LOSS = 16.5 kW

WITNESSED BY	TESTED BY	CHECKED BY

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

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Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

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Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

MEASUREMENT OF ZERO PHASE SEQUENCE IMPEDANCE

Cooling Type : **ODAF [500 MVA]** Frequency : **50** Hz

Supply : **HV** | Short Circuit : - | Open : **IV**

Supply given between 3-phase terminals shorted together and Neutral terminal.
Another winding 3-phase terminals kept open.

Tap No.	U Rated	I Rated	U Meas.	I Meas.	Ohms	%Z at 50 Hz	Frequency
	[kV]	[Amp]	[kV]	[Amp]	[3V/I]		(Hz)
9	400.0000	721.71	16.095	240.585	200.698	62.717	50

Cooling Type : **ODAF [500 MVA]]** Frequency : **50.001** Hz

Supply : **HV** | Short Circuit : **IV** | Open : **-**

Supply given between 3-phase terminals shorted together and Neutral terminal.
Another 3-phase winding terminals shorted together with Neutral terminal.

Tap No.	U Rated	I Rated	U Meas.	I Meas.	Ohms	%Z at 50 Hz	Frequency
	[kV]	[Amp]	[kV]	[Amp]	[3V/I]		(Hz)
9	400.0000	721.71	3.271	240.855	40.742	12.732	50.001

Cooling Type : **ODAF [500 MVA]** Frequency : **50** Hz

Supply : **IV** | Short Circuit : - | Open : **HV**

Supply given between 3-phase terminals shorted together and Neutral terminal.
Another winding 3-phase terminals kept open.

Tap No.	U Rated	I Rated	U Meas.	I Meas.	Ohms	%Z at 50 Hz	Frequency
	[kV]	[Amp]	[kV]	[Amp]	[3V/I]		(Hz)
9	220.0000	1312.2	6.758	437.740	46.32	47.846	50

WITNESSED BY	TESTED BY	CHECKED BY
		E10043

CGL/T1/TTR/T10660/1

ISO/IEC 17025
NABL NO.T1620

TEST CERTIFICATE

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Date : 11/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA : 500 **Customer :** PGCIL

Cooling Type : **ODAF [500 MVA]** Frequency : **50.002** Hz

Supply : **IV** | Short Circuit : **HV** | Open : -

Supply given between 3-phase terminals shorted together and Neutral terminal.
Another 3-phase winding terminals shorted together with Neutral terminal.

Tap No.	U Rated	I Rated	U Meas.	I Meas.	Ohms	%Z at 50 Hz	Frequency
	[kV]	[Amp]	[kV]	[Amp]	[3V/I]		(Hz)
9	220.0000	1312.2	1.380	438.515	9.441	9.749	50.002

WITNESSED BY	TESTED BY	CHECKED BY
		6/05/13

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

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NABL NO.T1620

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Date : 15/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA :500 **Customer :** PGCIL

MEASUREMENT OF ACOUSTIC NOISE LEVEL

Noise level measured in accordance with specification : **NEMA-TR1**

Test Conditions

Excitation voltage[kV] : 33 **Tap position** : 9

Test Frequency[Hz] : 50 **Guaranteed Noise Level [dB]** : 80 (MAX)

Transformer Energised at Rated Voltage						
	Before Energising Transformer Ambient (dB)		Cooling ODAF (dB)		After de-enrgising Transformer Ambient (dB)	
Point No	1/3 rd Height	2/3 rd Height	1/3 rd Height	2/3 rd Height	1/3 rd Height	2/3 rd Height
1	66.5	67.1	77.6	78.2	66.8	67.1
2			77.8	78.1		
3			77.9	78.3		
4			78.1	78.6		
5	66.6	67.2	78.3	78.8	66.7	66.9
6			78.2	79.2		
7			78.3	78.5		
8			78.1	78.6		
9			77.4	78.1		
10	66.3	66.7	77.6	77.9	66.1	66.4
11			77.4	77.8		
12			78.1	78.5		
13			78.3	79.1		
14			78.8	78.5		
15	66.4	66.9	78.6	78.8	66.3	66.7
16			78.8	79.1		
17			78.4	78.6		

WITNESSED BY	TESTED BY	CHECKED BY

Transformer (T1) Division, Kanjur (E), Mumbai - 400042, Tel - 9122 6755 8275/74/73

CGL/T1/TTR/T10660/1

TEST CERTIFICATE

CG Power Systems

Transformer (T1) Division

ISO/IEC 17025
NABL NO.T1620

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Date : 15/05/2016 **W.O.No:**T10660 **Serial No :** T10660/1

MVA :500 **Customer :** PGCIL

MEASUREMENT OF ACOUSTIC NOISE LEVEL

Transformer Energised at Rated Voltage						
	Before Energising Transformer Ambient (dB)		Cooling ODAF (dB)		After de-enrgising Transformer Ambient (dB)	
Point No	1/3 rd Height	2/3 rd Height	1/3 rd Height	2/3 rd Height	1/3 rd Height	2/3 rd Height
18			78	78.3		
19			77.5	77.6		
20	66.3	66.7	77.4	77.7	67.2	67.4
21			78.3	78.4		
22			78.2	78.5		
23			77.8	78.3		
24			78.6	79.1		
25	66.2	66.6	78.4	79.2	66.6	66.8
26			78.8	79.4		
27			78.3	78.6		
28	67.1	67.2	78.5	78.9	66.5	66.4
Mean:-	66.49	66.92	78.15	78.55	66.61	66.83
Mean Avg:-	66.71		78.35		66.72	

WITNESSED BY	TESTED BY	CHECKED BY
	C. V.	

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CONTROL PANEL INSPECTION REPORT

EQUIPMENT	500 MVA, 400/220/33kV, 3-PHASE 50 HZ AUTO TRANSFORMER
CUSTOMER	PGCIL
WORK ORDER NO. / SR. NO.	T10660/1
DATE	15/05/2016

Following tests and checks have been carried out as per drawing no. T30B1 500MVAE:

M. BOX:

1. 3-Phase Feeder-Incoming supply change over circuit.
2. Power circuit fans and pumps
3. Control circuit fan group and pumps in Local/Remote and Auto/Manual mode.
4. Lamp Indication circuit.
5. Indication signals by simulating conditions.
6. 500V Insulation Resistance test performed and found OK.
7. 2.5 KV Power Frequency Test in auxiliary wiring – for 1 Minute checked.
8. Dimensional checking done and found Ok.

CHECKED BY...	WITNESSED BY...
for Bonde **ABHIJIT PAUL**	**SUJOY SAHA**
FOR CGL	**FOR POWER GRID**

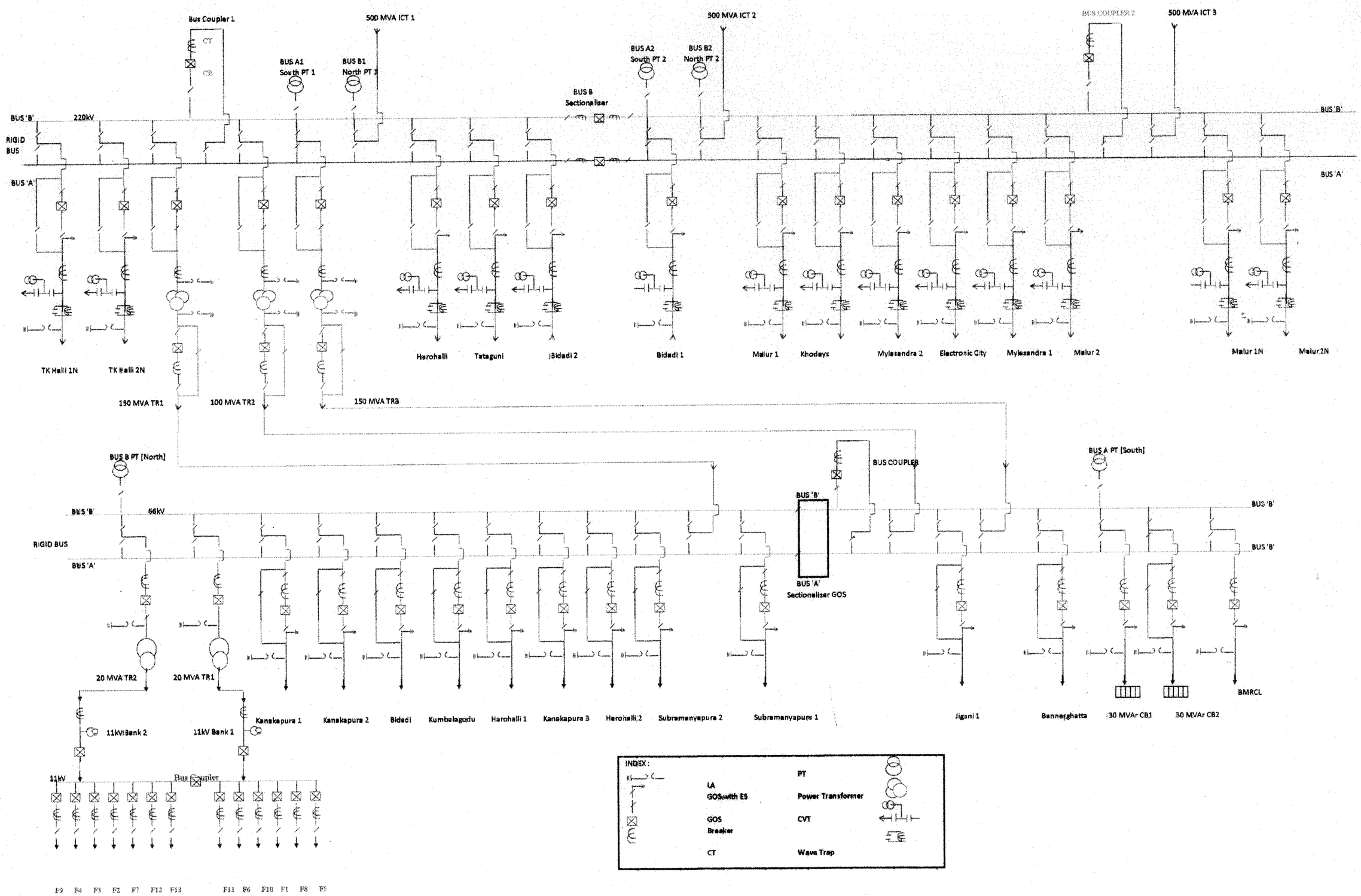
ಕರ್ನಾಟಕ ವಿದ್ಯುತ್ ಪ್ರಸರಣ ನಿಗಮ ನಿಯಮಿತ.

KARNATAKA POWER TRANSMISSION CORPORATION LIMITED

SINGLE LINE DIAGRAM of 220/66/11kV R/s, SOMANAHALLI, KANAKAPURA ROAD, BENGALURU - 560116

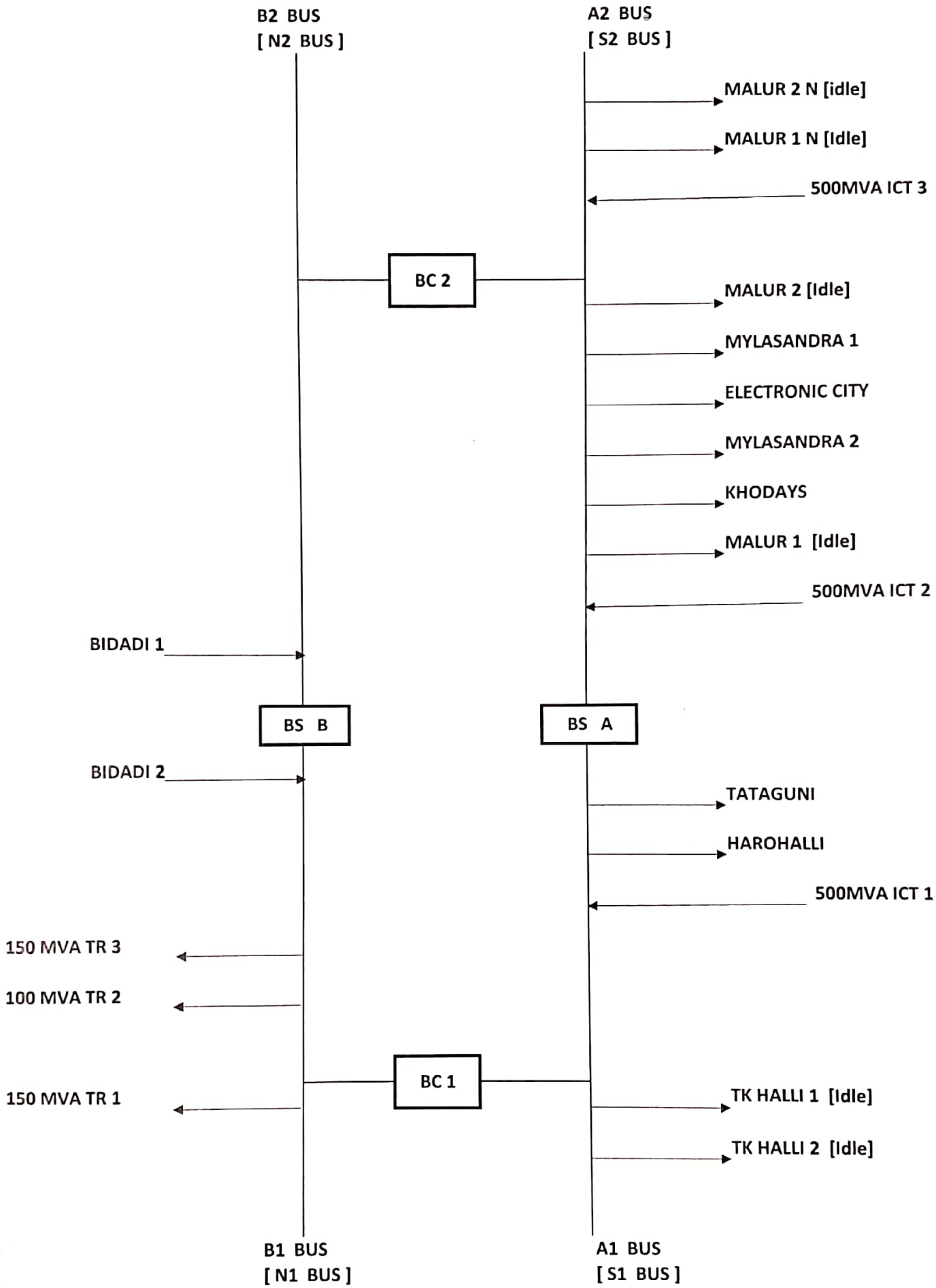
D.O.C : 1.7.1986

Annexure-IV



220kV BUS CONFIGURATION AT 220/66/11kV STATION, SOMANAHALLI, BENGALURU

Annexure-IV



Scanned with CamScanner

Annexure-V

220 kV Trippings details due to fault during April 2023 to May 2026 at 220 kV KPTCL Substation, Somanahalli

Sl.No	Particular	No. of faults				
		2022-23	2023-24	2024-25	2025-26	April- May 2026
1	220 kV ICT-1	1	0	2	1	1*
2	220 kV ICT-2	0	0	1	0	0
3	220 kV ICT-3	0	0	0	0	0
4	Somanahally - Mylasandra	1	0	11	1	1
5	Somanahally - Naganathapura	4	12	12	1	1
6	Somanahally - Yarendanahally	6	5	10	5	1
7	Somanahally - Khodays	3	7	4	4	4
8	Somanahally - BWSSB Tataguni	3	3	7	2	0
9	Somanahally - BWSSB Harohalli	4	7	5	1	3
10	Somanahalli-Malur-1 line	0	0	0	0	0
11	Somanahalli-Malur-2 line	0	0	0	0	0
12	220kV south bus sectionalizer	0	0	0	0	1
	TOTAL	**22**	**34**	**49**	**15**	**11**

*Pertaining to Failure of the Transformer on 31.05.2026

Annexure-VI

SOMANHALLI ICT-1 FAULT FEEDING FROM JAN-2026 TO MAY 2026

Sl. No.	Date	Time	Phase	Relay indication	Fault Current kA (220kv side values)			Fault Duration
					Rph	Yph	Bph	
	JAN 2026 TO MAY 2026							
1	01.03.2026	15:00:02:292	Rph-G	BOC Stg1 Pick up	**2.794**	0.667	0.367	11.2 ms
2	15.03.2026	13:34:41:098	Rph-Yph	BOC Stg1 Pick up	**4.785**	**4.001**	0.816	48.198 ms
3	06.04.2026	13:42:43:057	Rph-G	BOC Stg1 Pick up	**3.527**	0.923	0.653	36.66 ms
4	08.04.2026	14:41:45:00	Rph-Yph	BOC Stg1 Pick up	**3.719**	**3.004**	0.807	47.52 ms
5	21.05.2026	23:36:36:086	Rph-G	BOC Stg1 Pick up	2.395	0.537	0.499	18.3 ms
6	29.05.2026	17:49:40:921	Rph-Yph	BOC Stg1 Pick up	**3.017**	**2.245**	0.888	67.318 ms
7	31.05.2026	20:07:37:032	Rph-Yph	BOC Stg1 Pick up	**9.243**	**8.642**	0.805	During through fault, Converted to Diff. trip Rph 30.375 kA Yph= 29.475 kA winding fault.
	APRIL 2025 TO DEC 2025							
8	07.11.2025	10:58:08:833	Bph-G	BOC Stg1 Pick up	0.692	0.913	**3.819**	48.97 ms
9	12.10.2025	13:57:49:117	Yph- Bph-G	BOC Stg1 Pick up	0.514	1.028	**2.63**	42.9 ms
10	03.10.2025	15:55:14:839	Rph-Yph	HVOC /LVOC Trip	**1.271**	**9.79**	0.86	680 ms
11	23.09.2025	10:33:20:061	Rph-Bph-G	BOC Stg1 Pick up	**2.396**	0.504	1.115	18.348 ms
12	23.09.2025	10:07:43:048	Yph-Bph-G	BOC Stg1 Pick up	0.61	1.088	**2.915**	48.372 ms
13	22.08.2025	14:42:03:355	Rph-Yph	BOC Stg1 Pick up	**2.827**	**2.189**	0.688	10.25 ms
14	13.08.2025	08:51:31:661	Yph-Bph-G	BOC Stg1 Pick up	0.591	**6.244**	**5.751**	47.481 ms
15	13.08.2025	08:26:26:249	Yph-Bph-G	BOC Stg1 Pick up	0.599	1.185	**5.624**	48.430 ms
16	24.05.2025	15:42:36:607	Rph-Yph	BOC Stg1 Pick up	**2.532**	**1.944**	0.601	38.370 ms
17	21.05.2025	19:01:47:310	Rph-Bph-G	BOC Stg1 Pick up	**2.424**	0.537	**2.942**	18.282 ms
18	19.04.2025	16:59:23:023	Rph-Yph	BOC Stg1 Pick up	**2.409**	**1.808**	0.623	29.225 ms
19	04.04.2025	10:16:46:427	Rph-G	BOC Stg1 Pick up	**3.201**	0.912	0.859	46.648 ms

20	03.04.2025	11:45:11:643	Rph-Yph	BOC Stg1 Pick up	**1.476**	**2.483**	0.608	20.016 ms
	Other Past Major Fault							
21	03.10.2024	14:21:00.000	Yph-G	BOC Stg1 Trip	-	**4.810**	-	1.35sec
22	03.10.2024	00:58:00.000	Yph-Bph	BOC Stg1 Trip	**3.500**	**3.500**	-	270ms
23	27.11.2022	22:05:00.000	R-Ph-G	BOC Stg1 Trip	**5.000**	**-**	-	680ms