10 TEST REPORTS

Datum Date	Izradio Designed	Odobrio Approved	Pr Re
VIII 2005.	ing. Tašlak	mr. Biloš	

KONČAR D&ST
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KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Page : 1

TRANSFORMER

Type: TBP 50000-123/A
Serial No. : CT1283 - 461785

ROUTINE TESTS:	TEST REPORT No.:	Page :	STANDARD
Measurement of voltage ratio and check vector group	461785	2 / 6	IEC 60076-1 (10.3)
Measurement of winding resistance	461785	2 / 6	IEC 60076-1 (10.2)
Measurement of short-circuit impedance and load losses	461785	3 / 6	IEC 60076-1 (10.4)
Measurement of no-load losses and current	461785	4 / 6	IEC 60076-1 (10.5)
Measurement of no-load current at 400 V and 50 Hz	461785	4 / 6	
Measurement of insulation resistance	461785	5 / 6	IEC 60076-1 (10.1.3)
Separate sourse AC withstand voltage test (applied potential test)	461785	5 / 6	IEC 60076-3 (11)
Induced overvoltage test	461785	5 / 6	IEC 60076-3 (12)
Test on on-load tap changer	461785	5 / 6	IEC 60076-1 (10.8)
Check of auxiliary equipment according to drawing CS0855	461785	5 / 6	
PD measurement (ACSD test)	461785	6 / 6	IEC 60076-3 (12)
Lightning impulse (LI) test	496	---	IEC 60076-3 (13)
Test on insulating of oil	461785	supplement 1	IEC 60156
Oil leakage test	461785	supplement 2	

ALL SPECIFIED TESTS AND MEASUREMENTS WERE PERFORMED.
TRANSFORMER PASSED THE TESTS AND MEASUREMENTS MET SPECIFIED TOLERANCES.

The test was carried out in the presence of :

Tested by :	Approved by :	Date and stamp :
K. Gluhak,dipl.ing.	Zvonimir Mas,dipl.ing.	04.08.2005.

TRANSFORMER

Serial No. : CT1283 - 461785

RATING PLATE

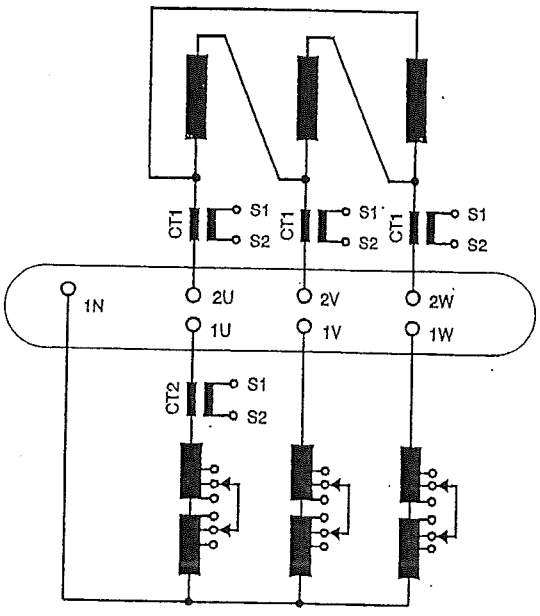
KONČAR D&ST

TRANSFORMER WITH OFF-CIRCUIT TAPPING

Type	TBP 50000-123/A	No.	CT1283-461785	Year of Manufact.	2005		
Rated Freq.	50 Hz	Number of Phases	3	Standard	IEC 60076		
	LI550 AC230 / LI60 AC20			Vector Group Symbol	YNd1		
Rated Power	50000 kVA			Type of Cooling	ONAN/ONAF		

	H.V.	L.V.	H.V.	L.V.			
1	115500	6300 V	249.9	4582.1 A	Imp. Voltage (at 40MVA)	11,0	%
2	112750		256.0		Transp. mass	52	t
3	110000		262.4		Untanking Mass	32.5	t
4	107250		269.2		Mass of Oil	12	t
5	104500		276.2		Total Mass	60	t

ONAN Cooling up to 40 MVA



Current transformers:
CT1: 4000/1A; 20VA; 5P20
CT2: 225/2A; 10VA cl.3; Fs5

MADE IN CROATIA 348870

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Serial No. : 461785
		Page : 1 / 6

CUSTOMER :

1.0.	RATING VALUES				
Transformer type :	TBP 50000-123/A		Tap-changer type :	U III 300-123-06 05 OME	
Serial No. :	461785		Serial No. :	1006652	
Winding :	H.V.	L.V.		ONAN cooling up to (MVA)	40
Insulation level :	LI550 AC230	LI60 AC20		Part No. :	CT1283
Rated power (kVA)	50000	50000		Transport mass (t)	52.0
Rated voltage (V)	115500			Oil mass (t)	12.0
	110000	6300		Total mass (t)	60.0
	104500			Frequency (Hz)	50
Rated current (A)	249.9			Vector group :	YNd1
	262.4	4582.1		Type of cooling :	ONAN / ONAF
	276.2			Tested in acc. :	IEC 60076-1

2.0.	TEST RESULTS				
2.1.1.	Impedance voltage (at 40 MVA and temperature 75° C)				
Winding :	H.V. / L.V.			----	----
Tap position	1	3	5	----	----
Rated (%)				----	----
Guaranteed (%)		>= 10.7		----	----
Measured (%)	11.02	11.04	11.35		
2.1.2.	Load losses (at 40 MVA and temperature 75°C)				
Rated (kW)	----	154.00	----	----	----
Guaranteed (kW)	----	177.10	----	----	----
Measured (kW)	144.06	146.66	157.37		
2.3.	No - load loss and current				
	Loss			Current (at 40 MVA)	
Voltage (%)	95.0	100.0	105.0	Voltage (%)	100.0
Rated (kW)	----	23.00	----	Rated (%)	----
Guaranteed (kW)	----	26.45	----	Guaranteed (%)	----
Measured (kW)	18.0	20.6	24.1	Measured (%)	2.05
2.4.	Total losses (at 40 MVA and temperature 75°C)				
Tap position	1	3	5	----	----
Rated (kW)	----	177.00	----	----	----
Guaranteed (kW)	----	194.70	----	----	----
Measured (kW)	164.66	167.26	177.97		
2.5.	Efficiency				
	Winding H.V. / L.V. at position 3				
Load (%)	25	50	75	100	125
Measured PF=1.0 (%)	99.76	99.77	99.73	99.67	99.60
Guaranteed (%)	-----	-----	-----	-----	-----
Measured PF=0.8 (%)	99.70	99.71	99.66	99.58	99.50
Guaranteed (%)	-----	-----	-----	-----	-----
2.6.	Regulation		Load (%)	100	125
Guaranted PF=1.0 (%)	-----	----------	Measured (%)	0.90	1.13
Guaranted PF=0.8 (%)	-----	----------	Measured (%)	7.23	9.04

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT			Serial No. : 461785	
				Page : 2 / 6	
TRANSFORMER TYPE :	TBP 50000-123/A			Part No. :	CT1283
3 . 0 .	**Measurement voltage ratio and vector group**				(by compensator)
Tap position	Phase 1U (%)	Phase 1V (%)	Phase 1W (%)	Voltage (V)	Calculated ratio
1	0.06	0.06	0.06	115500	188.951
2	0.06	0.06	0.06	112750	193.560
3	0.06	0.06	0.06	110000 / 6300	2000 / 198.399
4	0.06	0.06	0.06	107250	203.486
5	0.06	0.06	0.06	104500	208.841
(H.V. / L.V.)	Vector group is :	YNd1			
3 . 1 .	**Measurement of winding resistance in (Ohm)**			(measurement at temperature 27 °C)	
Winding H.V.	1U - 1V	1U - 1W	1V - 1W		
1	0.932	0.934	0.932		
3	0.888	0.889	0.890		
5	0.847	0.845	0.847		
Winding L.V.	2u - 2v	2u - 2w	2v - 2w		
----	0.00215	0.00216	0.00215		

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Serial No. : 461785
		Page : 3 / 6

TRANSFORMER TYPE :	TBP 50000-123/A	Part No. : CT1283

2.1.	Load losses and impedance voltage measurement				
Combination **	H.V. / L.V.	H.V. / L.V.	H.V. / L.V.		
Tap position	1	3	5		
Temperature (°C)	27	27	27		
Frequency (Hz)	50	50	50		
Measured voltage (u-v)	8013	7746	7565		
(u-w)	8037	7767	7582		
(v-w)	8029	7762	7575		
Average	8026	7758	7574		
Constant	1	1	1		
VOLTAGE (V)	8026	7758	7574		
Measured current (u)	126.2	134.2	141.2		
(v)	125.8	133.9	140.8		
(w)	126.2	134.2	141.2		
Average	126.1	134.1	141.1		
Constant	1	1	1		
CURRENT (A)	126.1	134.1	141.1		
Measured power (u)	16260	17060	18810		
(v)	18120	18810	20180		
(w)	17630	18270	19750		
Total	52010	54140	58740		
Constant	1	1	1		
LOAD LOSSES (W)	52010	54140	58740		
Calculated to (kVA)	50000	50000	50000		
(A)	249.9	262.4	276.2		
LOAD LOSSES (W)	204263	207295	225075		
I2 R losses (W)	155183	159632	164662		
Stray losses (W)	49080	47663	60413		
Impedance voltage (V)	15905.6	15180.5	14825.9		
(%)	13.771	13.800	14.187		
Temperature (°C)	**75**	**75**	**75**		
I2 R losses (W)	183613	188878	194829		
Stray losses (W)	41481	40283	51059		
LOAD LOSSES (W)	225094	229161	245888		
Impedance voltage (V)	15906.7	15181.1	14826.5		
(%)	13.772	13.801	14.188		
CALCULATED TO 40 MVA					
LOAD LOSSES (W)	144060	146663	157368		
Impedance voltage (V)	12725.4	12144.9	11861.2		
(%)	11.018	11.041	11.350		

NOTE : **Measuring equipement : NORMA Power Analyser Type D6133T**

** : Connected / Shortcircuit winding

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Serial No. : 461785
		Page : 4 / 6
TRANSFORMER TYPE : TBP 50000-123/A		Part No. : CT1283

2 . 3 .	No - load losses and no - load current measurement				
Voltage (%)	95.0	100.0	105.0		
RMS measured vltg. (u-v)	6002	6321	6645		
(u-w)	6004	6323	6647		
(v-w)	6005	6324	6650		
Average	6004	6323	6647		
Constant	1	1	1		
RMS VOLTAGE (V)	6004	6323	6647		
Mean measured vltg. (u-v)	5981	6294	6608		
(u-w)	5987	6300	6614		
(v-w)	5991	6307	6627		
Average	5986	6300	6616		
Constant	1	1	1		
MEAN VOLTAGE (V)	5986	6300	6616		
Form factor	1.113	1.114	1.115		
Measured current (u)	2.568	3.080	4.173		
(v)	1.863	2.235	3.099		
(w)	1.915	2.380	3.359		
Average	2.115	2.565	3.544		
Constant	1	1	1		
CURRENT (A)	2.115	2.565	3.544		
Measured power (u)	7527	8680	10254		
(v)	5922	6845	8313		
(w)	4571	5112	5657		
Total	18020	20637	24224		
Constant	1	1	1		
LOSSES (W)	18020	20637	24224		
Correction (W)	-54	-75	-113		
LOSSES (W)	17966	20562	24111		

NOTE : **Measuring equipement : NORMA Power Analyser Type D6133T**

MEASUREMENT AT FREQUENCY 50 (Hz) ON WINDING : L.V.

The power was corrected to the sine - wave voltage basis .

2. 3. 1.	Measurement of no - load current at 388 (V) , and 50 (Hz)				
Winding	Phase U (m A)	Phase V (m A)	Phase W (m A)		
H.V. - tap position 3	1.85	1.13	1.92		

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Serial No. : 461785
		Page : 5 / 6

TRANSFORMER TYPE :	TBP 50000-123/A	Part No. : CT1283

3.2. Measurement of insulation resistance (MOhm), (measured by MEGGER 2500 V)

Between	R 15 "	R 60 "	R 60 " / R 15 "	(measurement at temperature 27 °C)	
H.V. - (L.V. + earth)	2850	4050	1.42		
L.V. - (H.V. + earth)	1750	2750	1.57		
(H.V. + L.V.) - earth	2500	3420	1.37		
core - (earth)	1750	2550	1.46		

3.3. Dielectric test of the transformer

Lightning impulse test — Test repotr No.: 496

	Between	Test voltage (kV)	Frequency (Hz)	Duration (sec)
Separate - source voltage withstand test	H.V. - (L.V. + earth)	230	50	60
	L.V. - (H.V. + earth)	20	50	60
	core - (earth)	2	50	60
Induced overvoltage test				
	1U - 1V - 1W	230	200	30
NOTE :	Winding H.V. - tap position 1			

1. Tap changer was tested in accordance with : IEC 60076 - 1 (clause 10.8.1).
2. Functionally test of the auxiliary box has been done in accordance with drawing No.: CS0855.
3. Polarity test was done on current transformers :

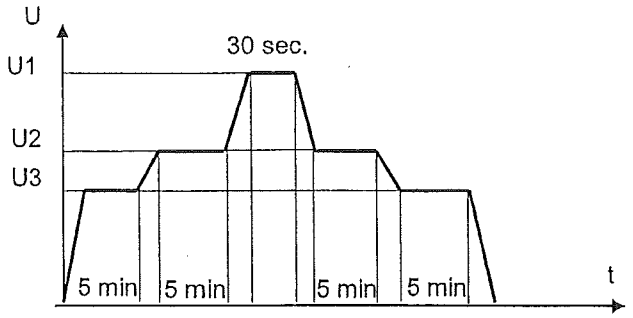
phase " 2u " : CT1 - 4000 / 1 A ; 20 VA ; 5P20 Ser.No.: 523887
phase " 2v " : CT1 - 4000 / 1 A ; 20 VA ; 5P20 Ser.No.: 523888
phase " 2w " : CT1 - 4000 / 1 A ; 20 VA ; 5P20 Ser.No.: 523889
phase " 1U " : CT2 - 225 / 2 A ; 10 VA ; cl.3; Fs5 Ser.No.: 523893

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Serial No. : 461785
		Page : 6 / 6

TRANSFORMER TYPE :	TBP 50000-123/A	Part No. :	CT1283

3 . 4 . 1.	SUPPLEMENT 1 - ACSD TEST

3 . 4 . 1. 1.	Test sequence and levels



Standard:	IEC 60076-3
Supply	three-phase
Supplied terminals	2u - 2v - 2w
Tap position	1
Supply frequency (Hz)	200
U3 (kV)	135
U2 (kV)	160
U1 (kV)	230
Allowed PD at voltage level (pC)	
U3	<100
U2	<300

3 . 4 . 1. 2.	Measuring equipement, calibration and background noise level				
Measuring equipement:	PD detector:	"Tettex" balanced PD bridge type 9112			
	Oscilloscope:	"Protek" type 6504			
	Calibrator:	"Tettex" type 9216			
Calibration:				(Calibraton performed with 100 pC)	
	Calibration signal	1U	1V	1W	
	Measured (pC)				
	1U	100	50	35	
	1V	50	100	35	
	1W	35	35	100	
Background noise level with source connected and voltage 0 (V):			< 10 pC		

3 . 4 . 1. 3.	Test and PD measurement				
	Voltage level	Duration (min)	Measured on phase (pC)		
			1U	1V	1W
	U3	5.0	45	40	50
	U2	5.0	35	30	45
	U1	0.5	---	---	---
	U2	5.0	35	30	45
	U3	5.0	45	40	50

3 . 4 . 1. 4.	Results

No collapse of voltage observed.

Measured level of PD is lower than in IEC 60076 - 3 specified.

TRANSFORMER PASSED ACSD TEST.

NOTE :

KONČAR D&ST

IMPULSE TEST REPORT

Test report no. 496

Page: 1/12

Transformer type		Serial number	Customer	
TBP 50000-123/A		CT1283-461785		
H.V. winding (V)		L.V. winding (V)		
Tap position	Voltage (V)	Voltage (V)		
-	-	-		
3	110000	6300		
-	-	-		
Connection symbol	YNd1	Rated short-circuit impedance	10.7%	

1. Specified test voltages — Standard: IEC 60076 - 3

Terminals	Full wave		Chopped wave	
	kV	Wave shape (μs)	kV	Time to chopping (μs)
1U, 1V, 1W	550	1.2/50	-	-
2U, 2V, 2W	60	1.2/50	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

2. Measurements

The measurement was carried out with measuring device "Haefely" type HIAS 742 and capacitive voltage divider type CS 700. The calibration of the measuring device was checked in accordance with IEC 60060-2 and IEC 61083-1.

3. Result

By comparing the voltage and current records it has been proved that the transformer withstood the test.

4. Remarks

a) Voltage and current wave records are stored by Manufacturer in files: 461785

The test was carried out in presence of:

Tested by:	Approved by:	Date and stamp:
Krešimir Gluhak,dipl. ing.	Zvonimir Mas,dipl.ing.	04.08.2005.

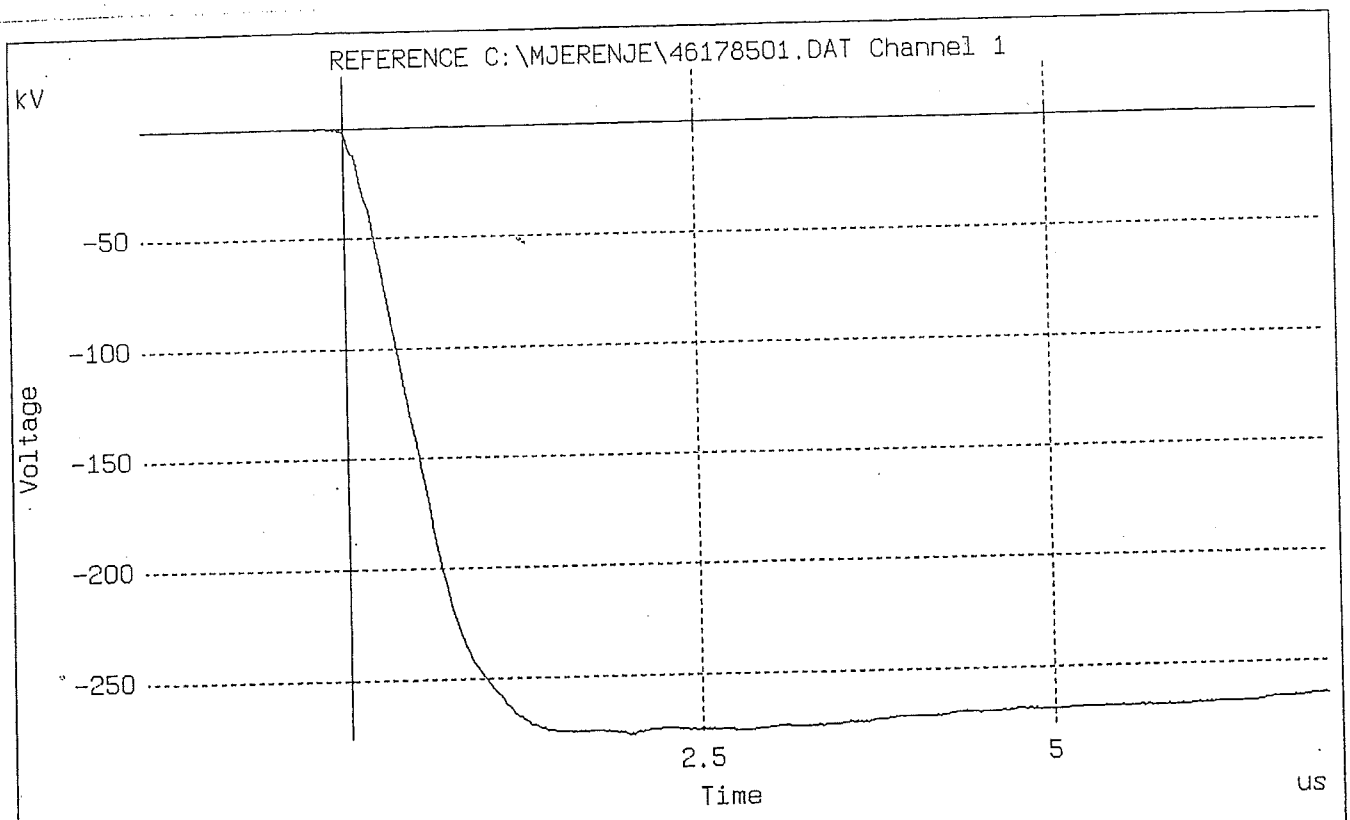
5. Testing of H.V. winding

5.1. Connection of terminals

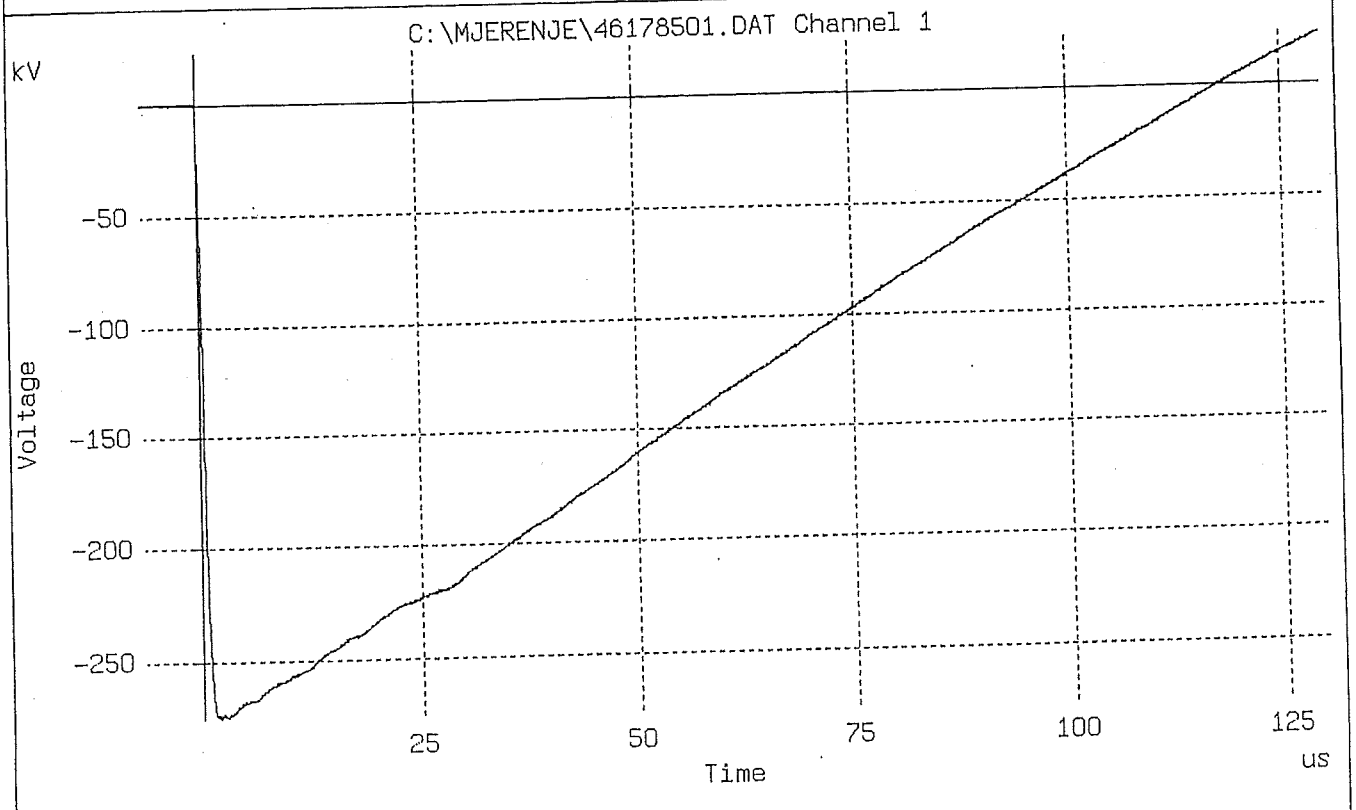
line terminal under test	connected to the impulse voltage generator
other line terminals of the winding under test	short circuited and directly earthed
neutral terminal 1N	earthed through shunt S1
2U, 2V, 2W	short circuited and earthed

5.2. Order of tests

Terminal	Tap position	Description	Page
1U	3	Voltage wave shape check Applied voltage and current through shunt S1 oscillograms	3 4
1V	3	Applied voltage and current through shunt S1 oscillograms	5
1W	3	Applied voltage and current through shunt S1 oscillograms	6



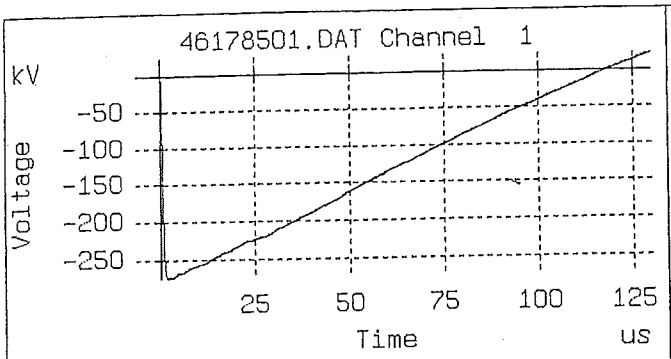
CS 700 50% LI full
-275.8kV T1=1.05us T2=58.7us



CS 700 50% LI full
-275.8kV T1=1.05us T2=58.7us

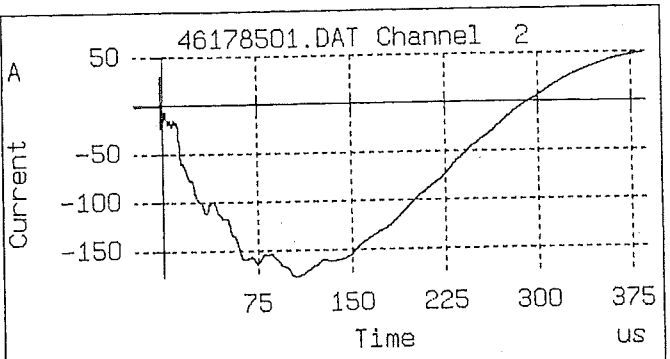
04.08.2005

Screen plotout



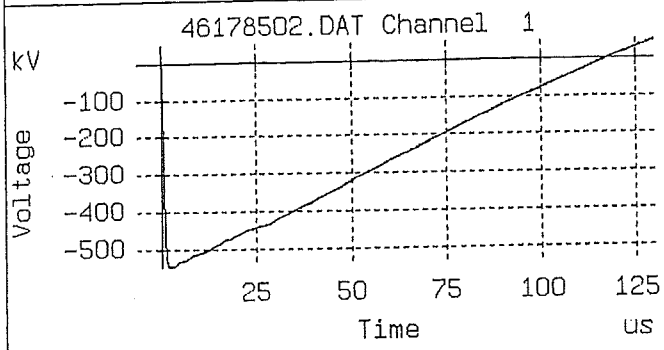
CS 700 50% LI full

-275.8kV T1=1.05us T2=58.7us



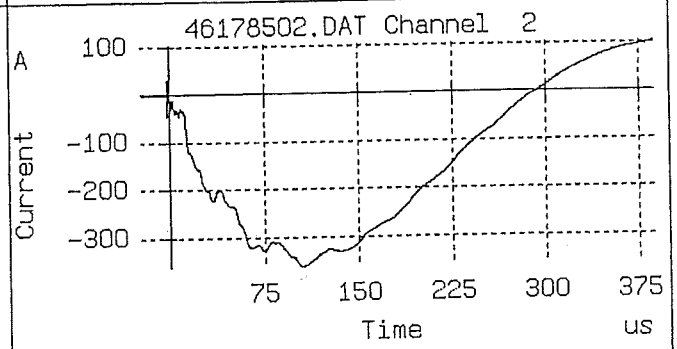
S1 50% LI full

Max:-176.7A Min:50.68A



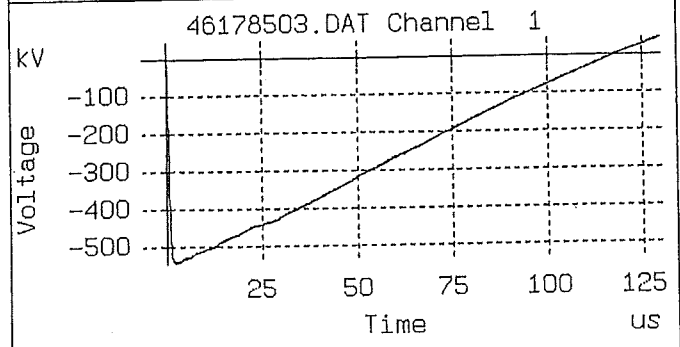
CS 700 100% LI full

-546.3kV T1=1.09us T2=58.7us



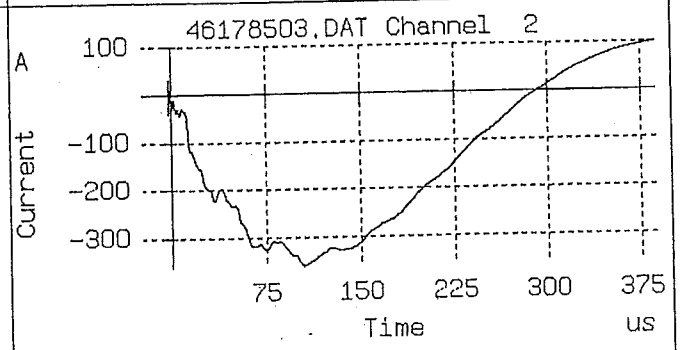
S1 100% LI full

Max:-360.5A Min:101.6A



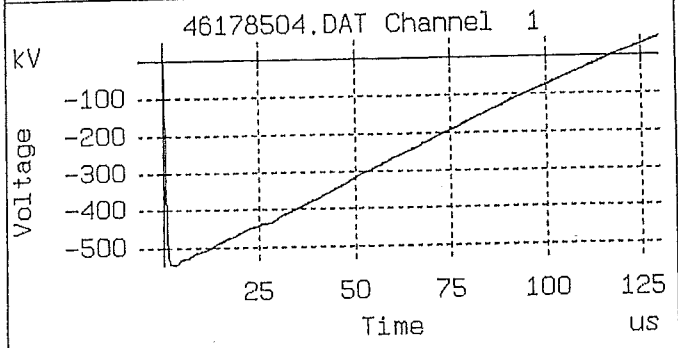
CS 700 100% LI full

-545.5kV T1=1.08us T2=58.8us



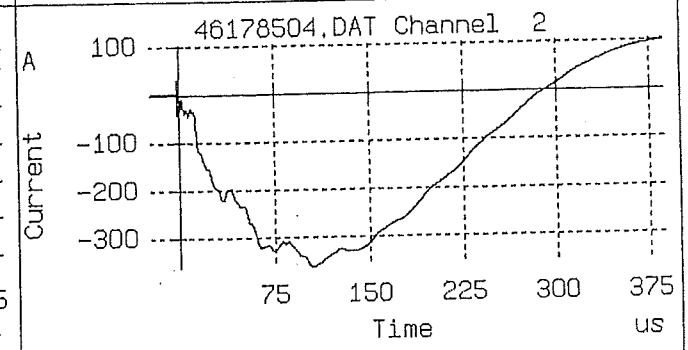
S1 100% LI full

Max:-360.5A Min:101.6A



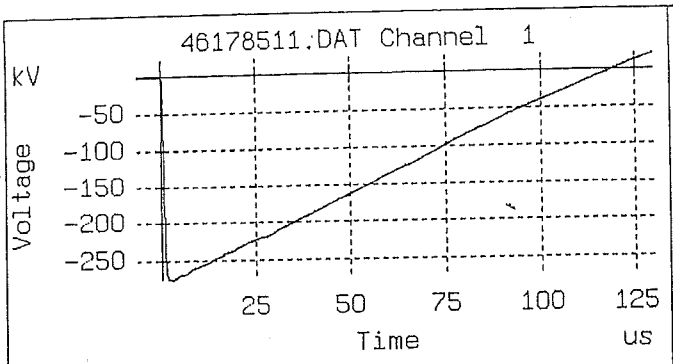
CS 700 100% LI full

-545.5kV T1=1.08us T2=58.8us



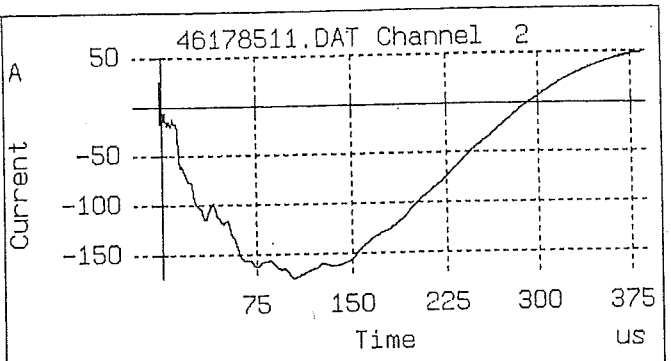
S1 100% LI full

Max:-359.9A Min:101.6A



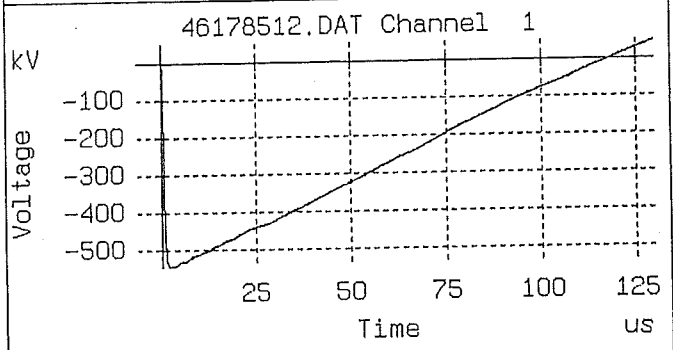
CS 700 50% LI full

-275.1kV T1=1.04us T2=59.3us



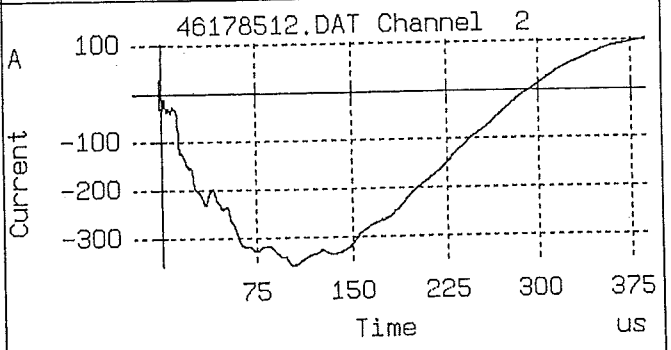
S1 50% LI full

Max:-174.3A Min:50.68A



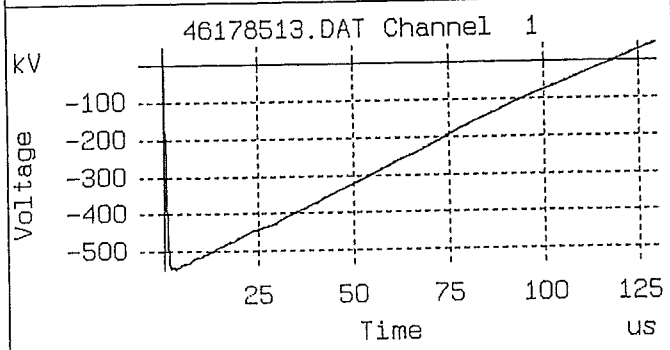
CS 700 100% LI full

-547kV T1=1.08us T2=59.3us



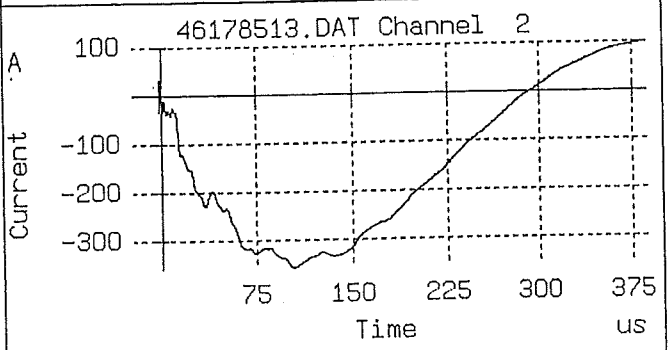
S1 100% LI full

Max:-358.1A Min:101.6A



CS 700 100% LI full

-547kV T1=1.09us T2=59.3us



S1 100% LI full

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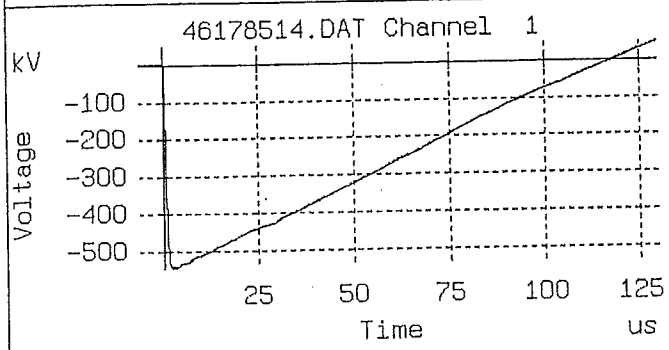
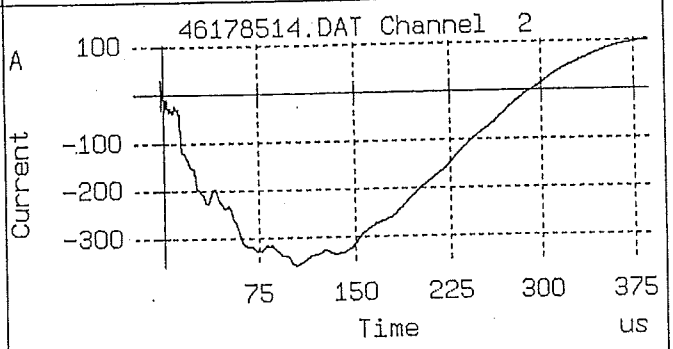


CS 700 100% LI full

-547.8kV T1=1.08us T2=59.4us



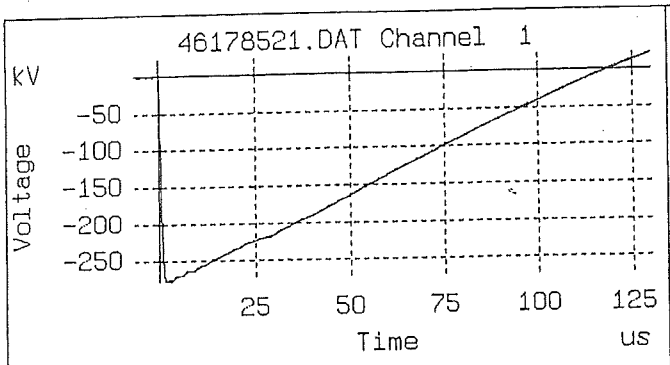
S1 100% LI full

Max:-358.1A Min:101.6A

KONČAR D&ST

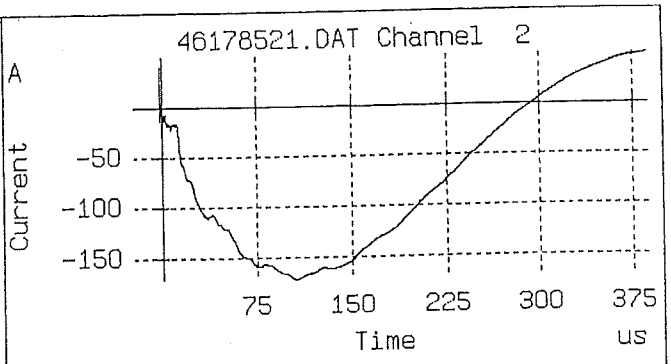
IMPULSE TEST REPORT

Test report no. 496



CS 700 50% LI full

-275.8kV T1=1.04us T2=59us



S1 50% LI full

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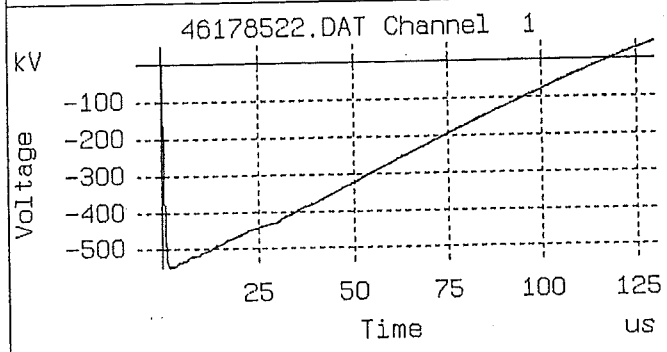
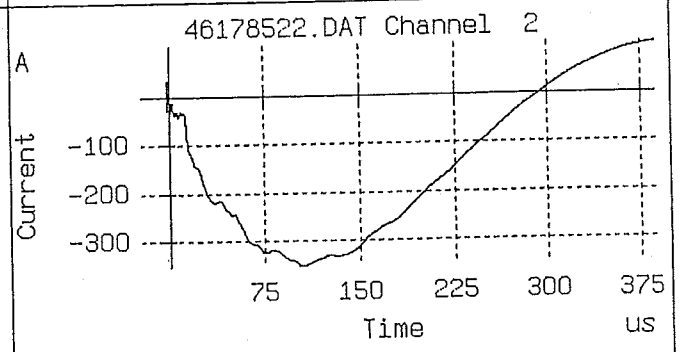


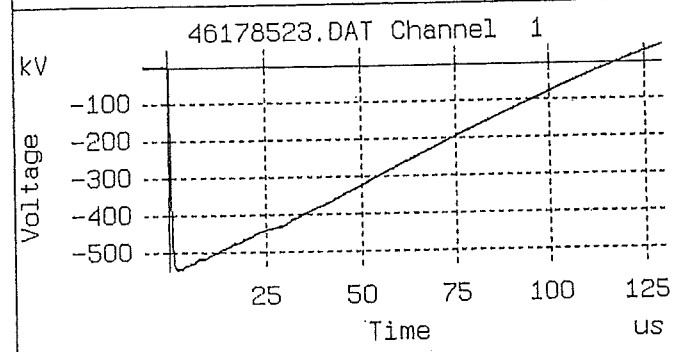
CS 700 100% LI full

-547kV T1=1.08us T2=59us



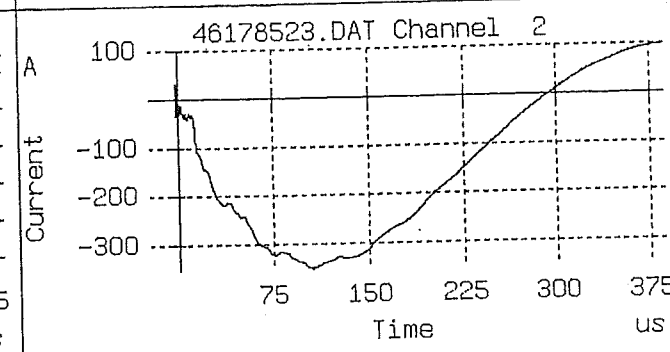
S1 100% LI full

Max:-350.8A Min:99.8A



CS 700 100% LI full

-547kV T1=1.08us T2=58.9us



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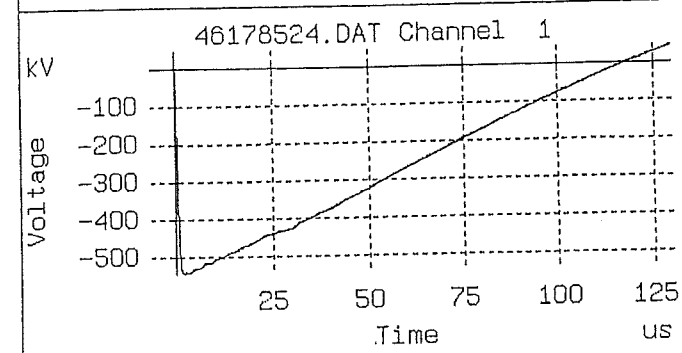
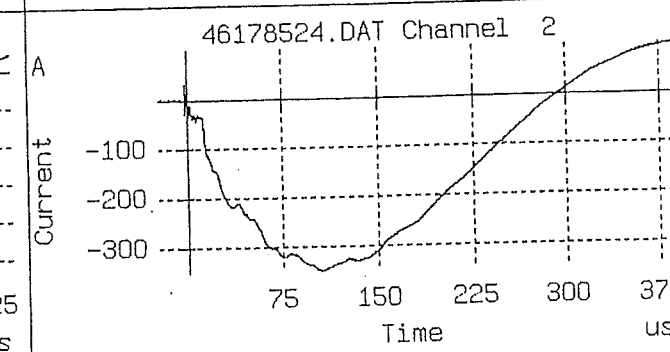


CS 700 100% LI full

-547kV T1=1.08us T2=59us



S1 100% LI full

Max:-350.8A Min:99.8A

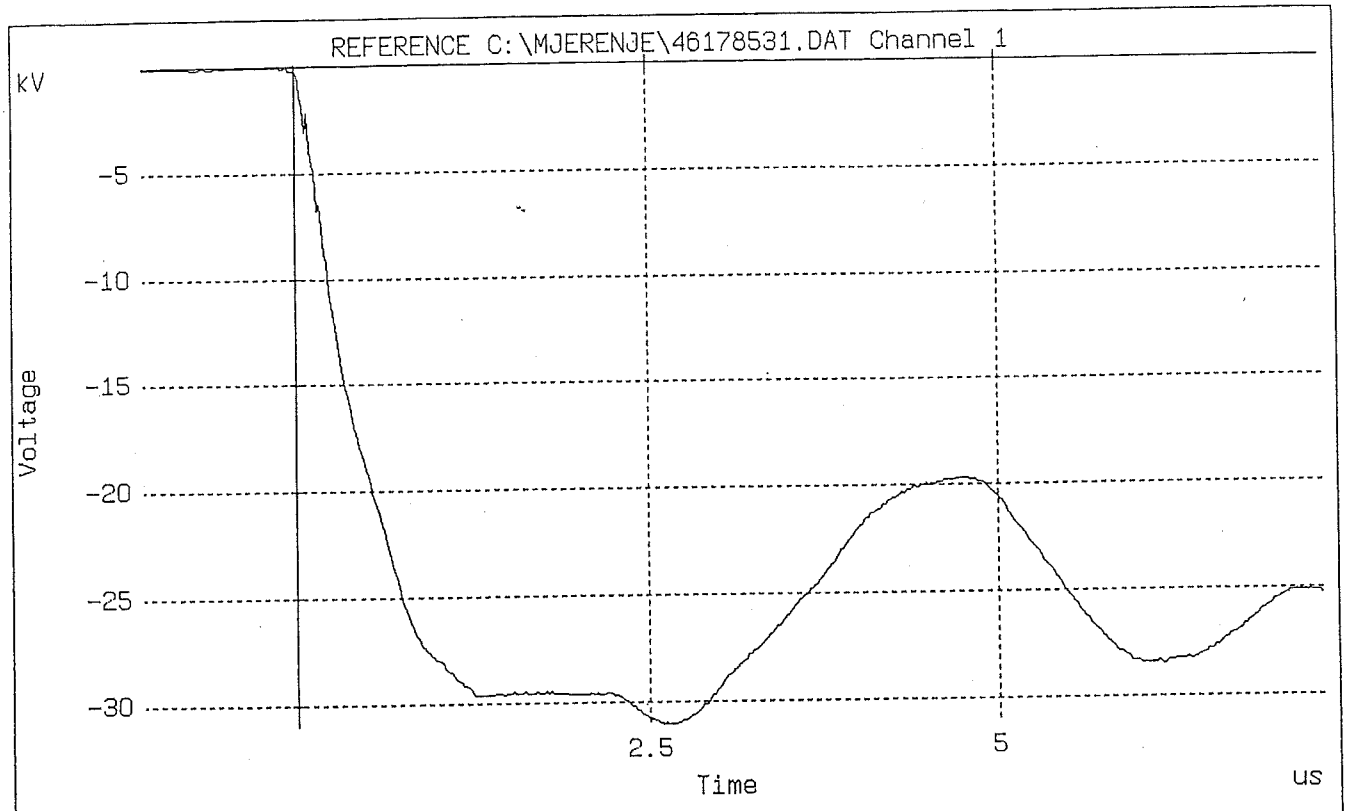
6. Testing of L.V. winding

6.1. Connection of terminals

line terminal under test	connected to the impulse voltage generator
other line terminals of the winding under test	earthed through resistors of 400 Ω and shunt S1
1U, 1V, 1W, 1N	short circuited and directly earthed

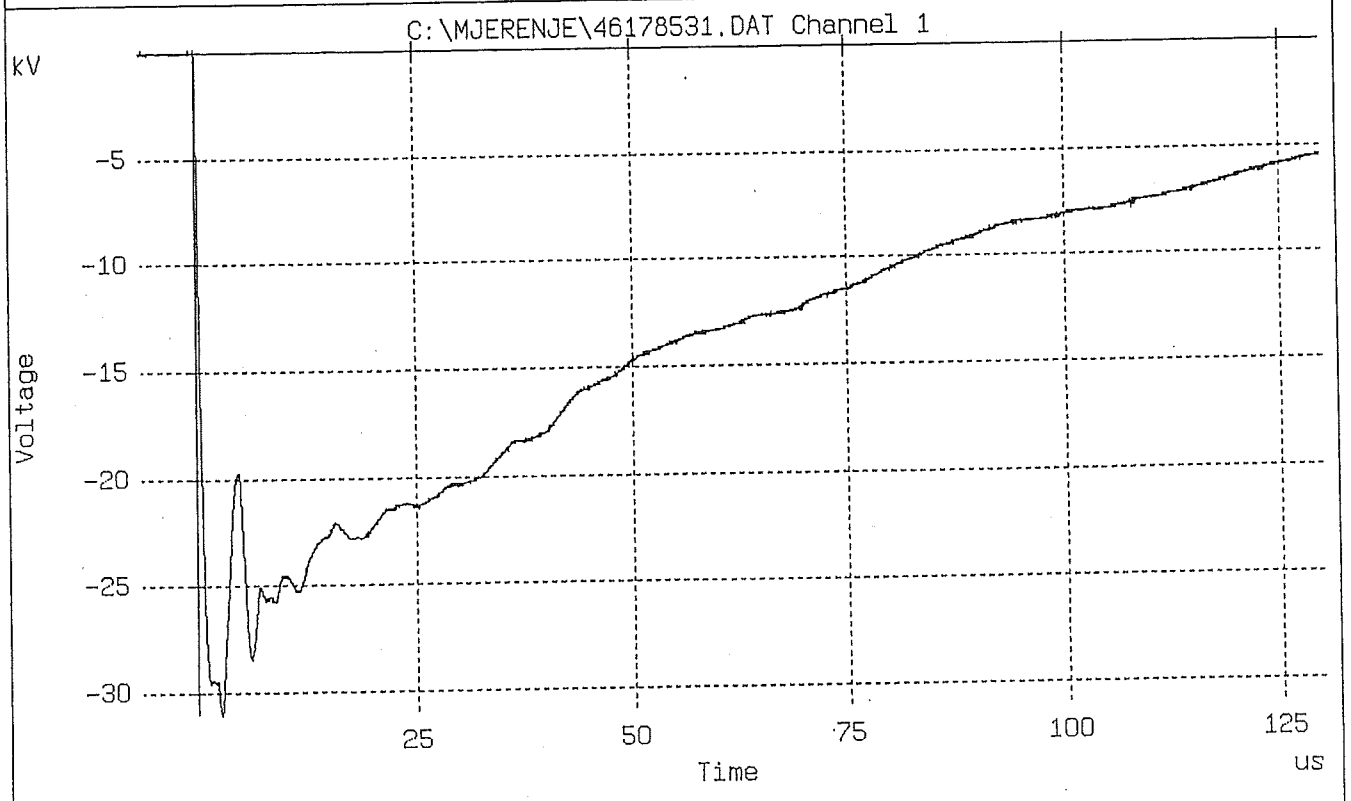
6.2. Order of tests

Terminal	Tap position	Description	Page
2U	-	Voltage wave shape check Applied voltage and current through shunt S1 oscillograms	8 9
2V	-	Applied voltage and current through shunt S1 oscillograms	10
2W	-	Applied voltage and current through shunt S1 oscillograms	11



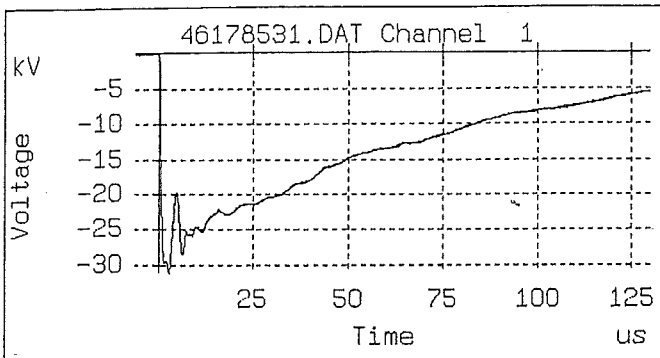
CS 700 50% LI full

-30.91kV T1=1.28us T2=47.2us



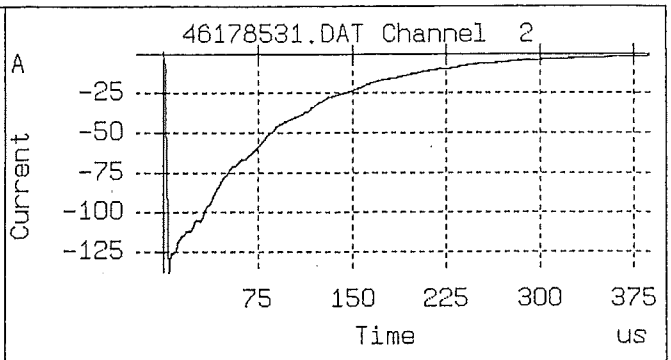
CS 700 50% LI full

-30.91kV T1=1.28us T2=47.2us



CS 700 50% LI full

-30.91kV T1=1.28us T2=47.2us Accuracy



S1 50% LI full

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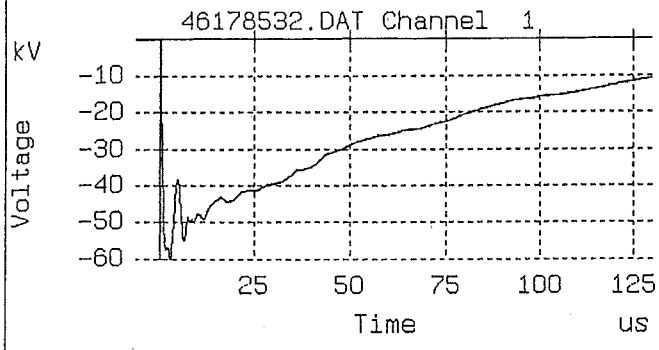
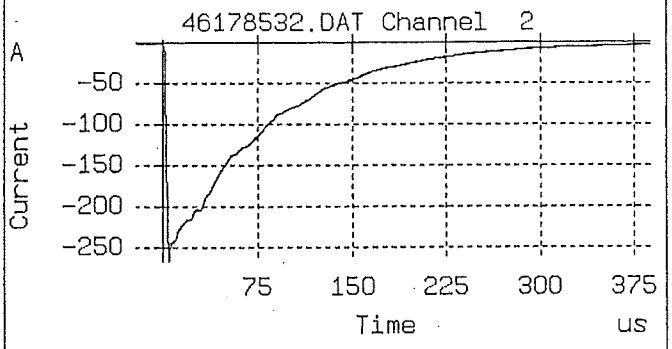


CS 700 100% LI full

-60.08kV T1=1.3us T2=47.7us



S1 100% LI full

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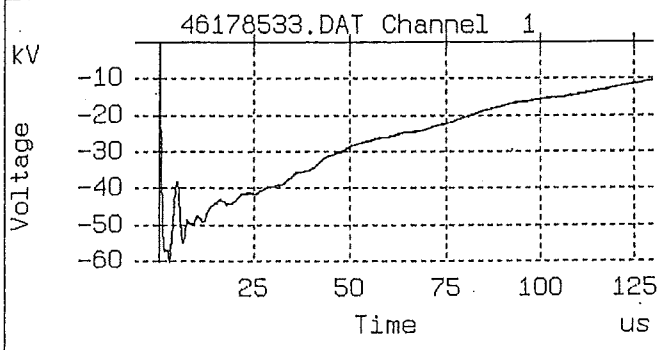
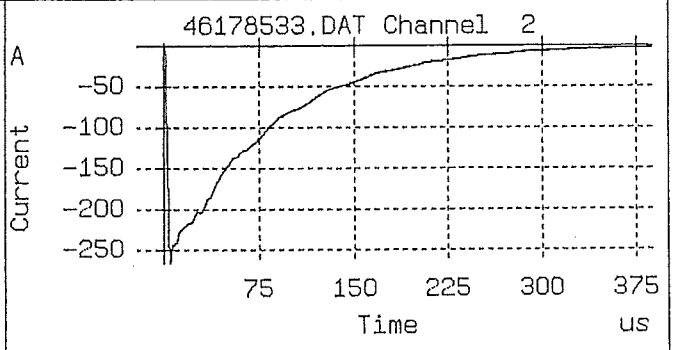


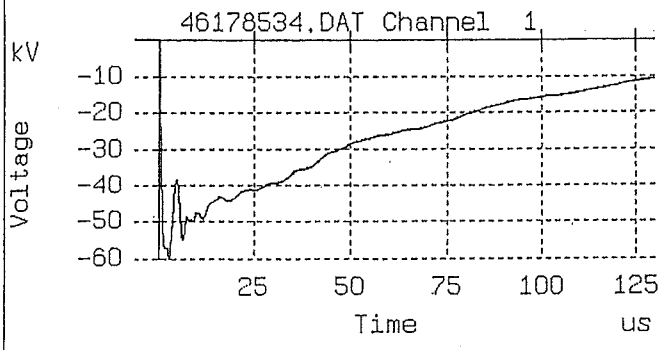
CS 700 100% LI full

-60.08kV T1=1.3us T2=47.7us



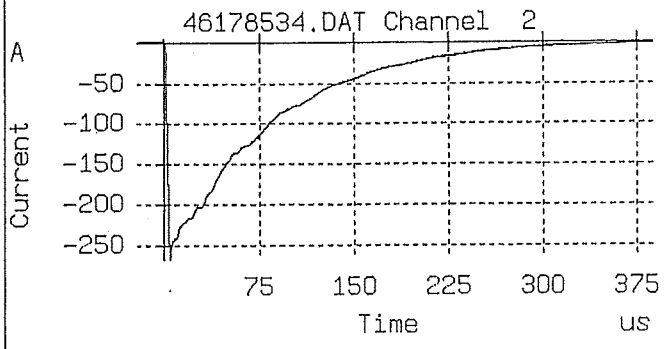
S1 100% LI full

Max:-265.3A Min:3.281A



CS 700 100% LI full

-60.08kV T1=1.3us T2=47.8us



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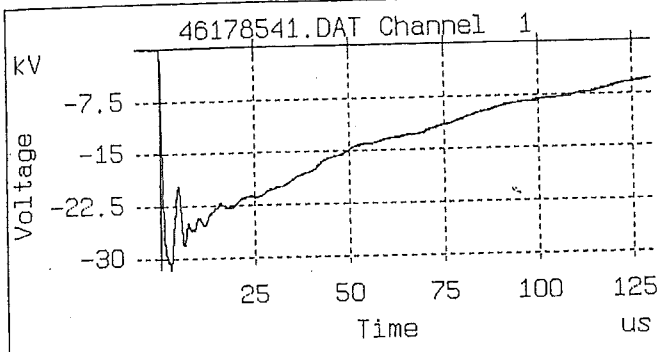
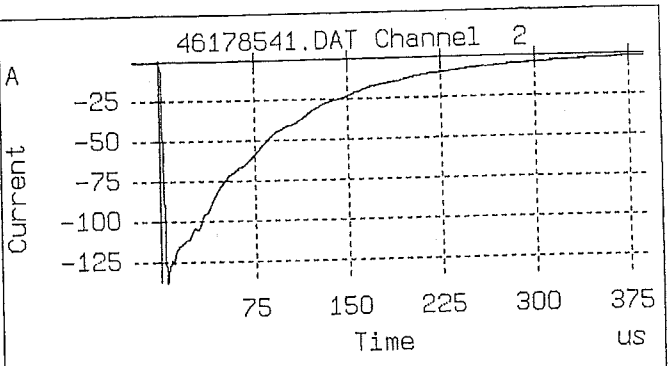


CS 700 50% LI full

-31.36kV T1=1.4us T2=46.6us Accuracy



S1 50% LI full

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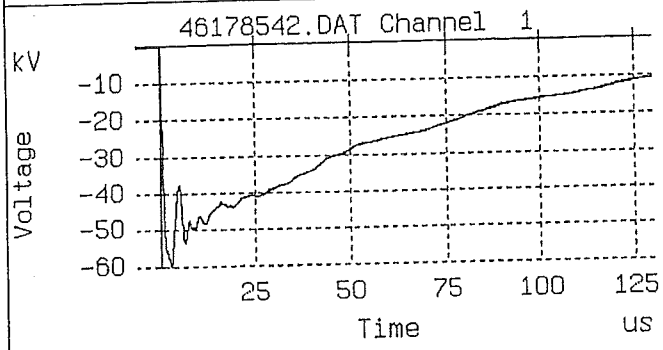
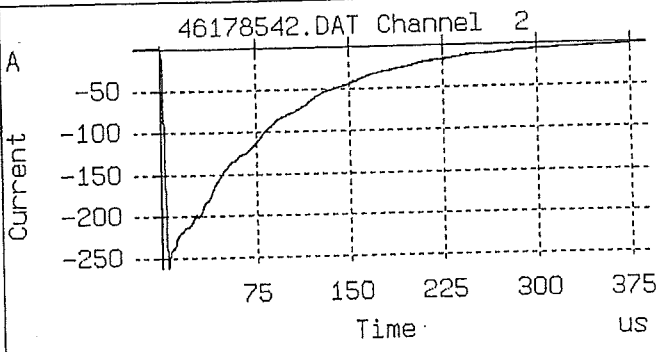


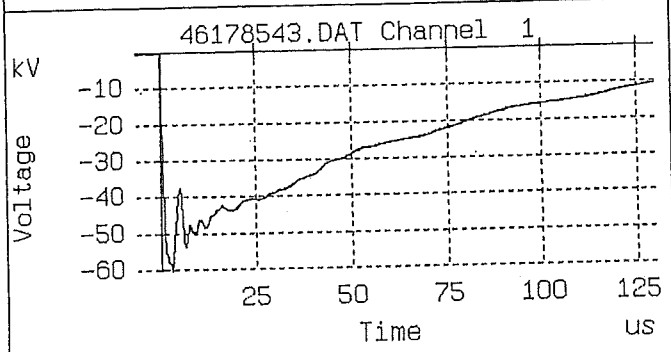
CS 700 100% LI full

-60.08kV T1=1.44us T2=46.4us



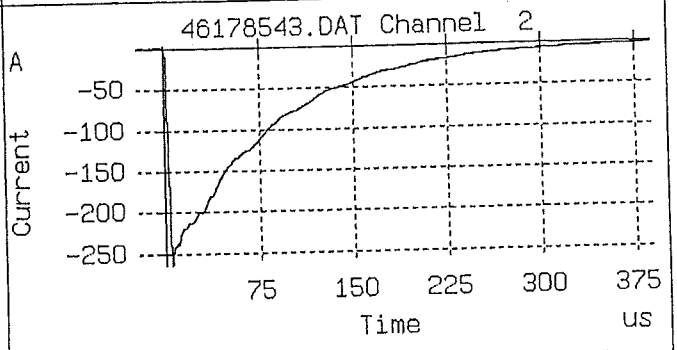
S1 100% LI full

Max:-262.5A Min:3.281A



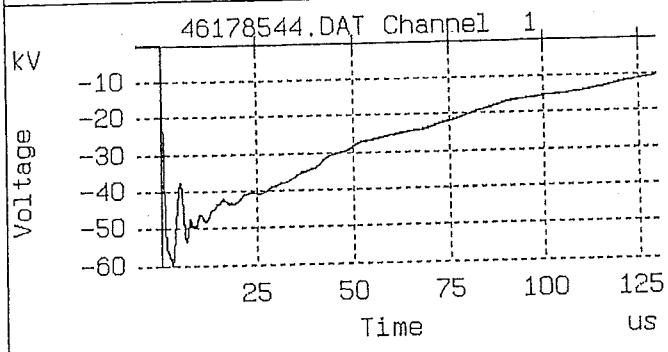
CS 700 100% LI full

-60.08kV T1=1.42us T2=46.5us



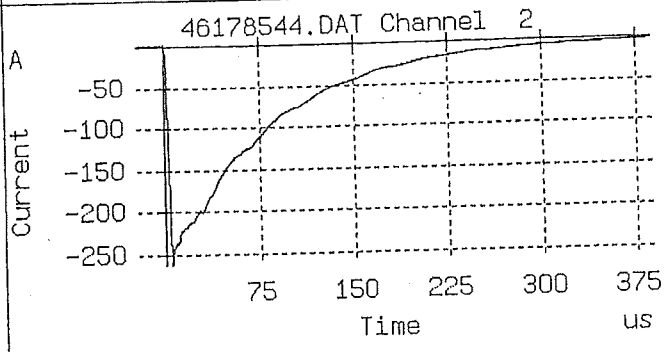
S1 100% LI full

Max:-263A Min:2.813A



CS 700 100% LI full

-60.08kV T1=1.43us T2=46.4us



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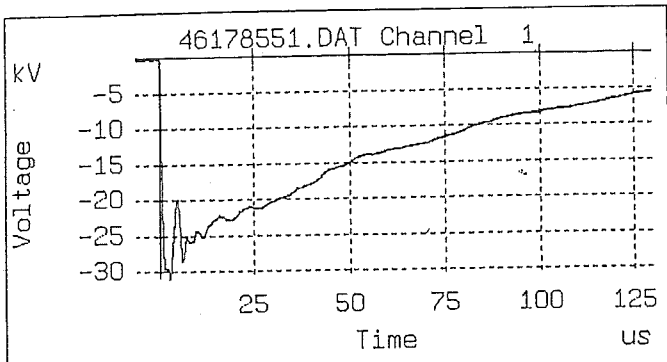
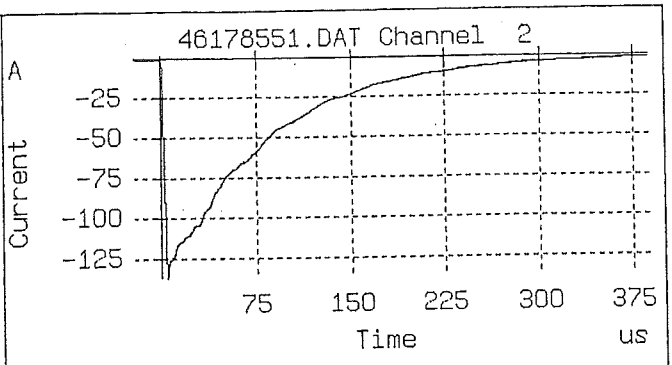


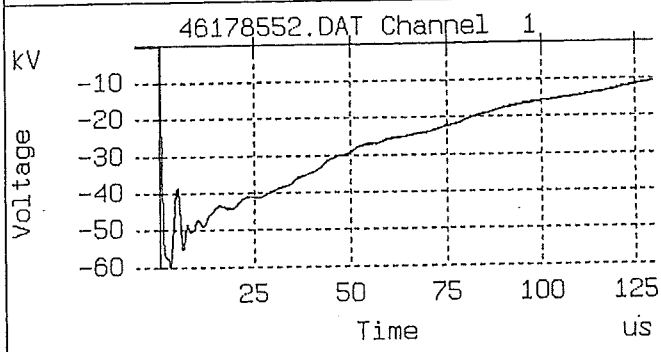
CS 700 50% LI full

-30.83kV T1=1.21us T2=47.5us Accuracy



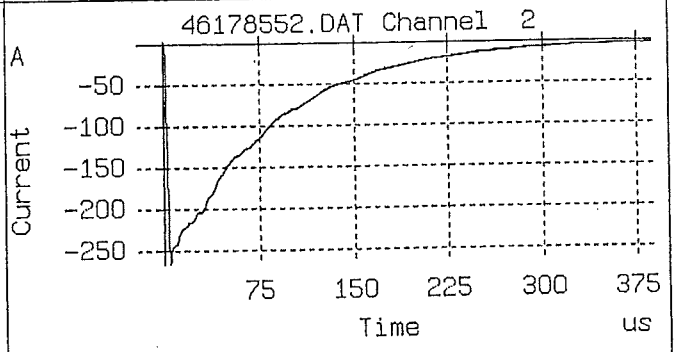
S1 50% LI full

Max:-136.9A Min:1.875A



CS 700 100% LI full

-60.08kV T1=1.22us T2=47.5us



S1 100% LI full

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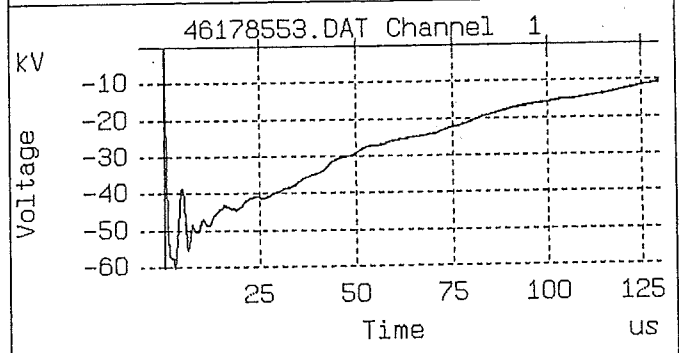
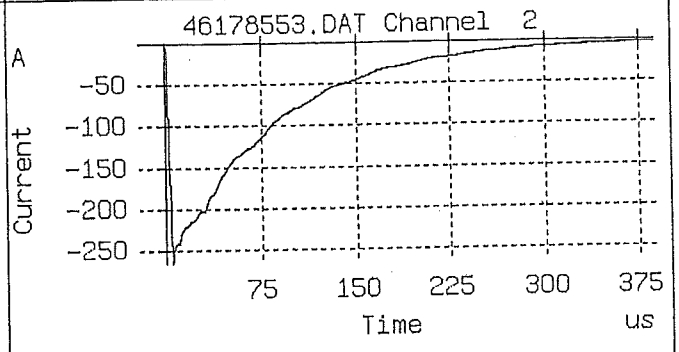


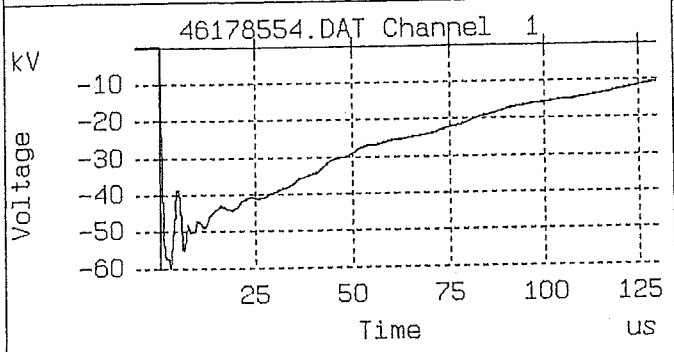
CS 700 100% LI full

-60.16kV T1=1.23us T2=47.6us



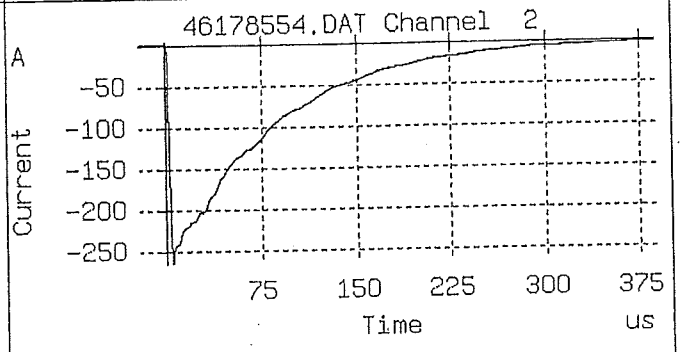
S1 100% LI full

Max:-266.3A Min:2.344A



CS 700 100% LI full

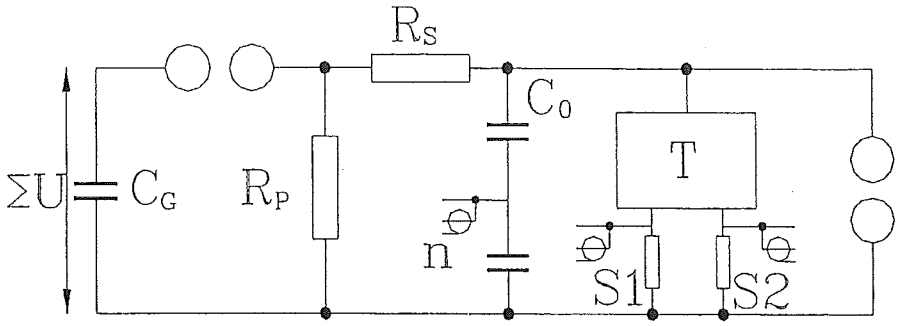
-60.08kV T1=1.22us T2=47.5us



S1 100% LI full

Max:-265.3A Min:3.281A

7.1 Equivalent lightning impulse circuit



7.2 Impulse circuit 's constants

	H.V. winding	L.V. winding		
C_G (pF)	75000	300000		
R_S (Ω)	264	206		
R_P (Ω)	3200	800		
C_0 (pF)	1000	1000		
n	497.3	497.3		
S1 (Ω)	1	1		
S2 (Ω)	-	-		

KONČAR D&ST

Izvještaj o ispitivanju nepropusnosti

Oil leakage test report

Tip transformatora:
Transformer type: TBP 50000-123/A (Košice)

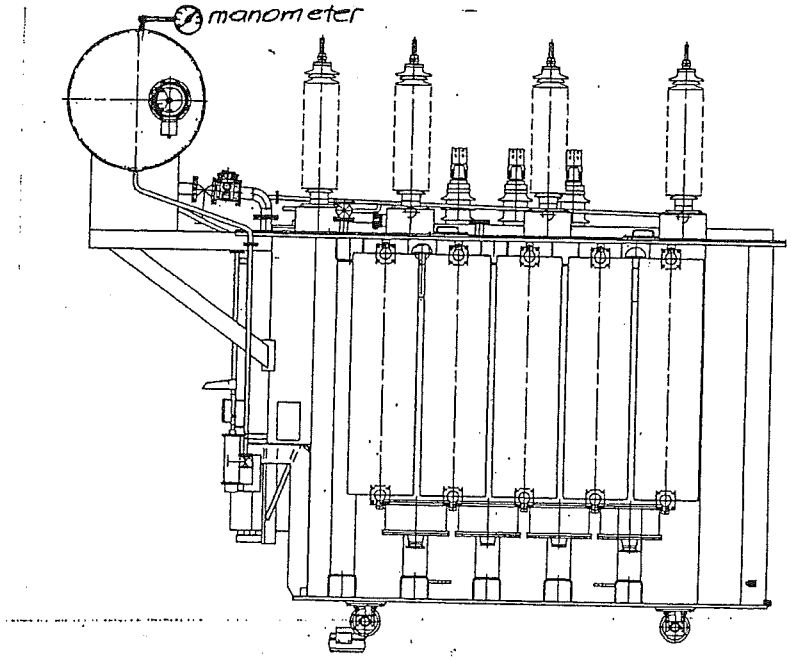
kom:
pcs:

Tvornički broj:
Serial number(s): No. 461785

Uvjeti ispitivanja / Testing conditions

Ispitno sredstvo Testing media	Transformatorsko ulje Transformer oil	
Temperatura ispitnog sredstva Temperature of testing media	20°C	
Tlak Pressure kN/m²	30 kN/m²	on the top of the tank
Trajanje ispitivanja Duration	24 h	Begin. 01.08-2005 Finish 02.08-2005

Shema ispitivanja - Way of testing (scheme)



Tests were carried out in the presence:

Test result: No leakage

Datum / Date:	Ispitivanje proveo: Testing performed by:	
02,08-2005	QI-03	F. Erdec

KONČAR
Distributivni i specijalni transformatori d.d.
Zagreb

MEĐUFAZNA KONTROLA
IN-PROCESS INSPECTION 2

KONČAR D&ST	*Dielectric strength of insulating oil*	
Type of transformer:	**TRP 50000-123/A**	
Serial number:	461785	
Oil :	Shell dx	
	Breakdown voltage (kV)	
Test nr. 1	65,39	
Test nr. 2	87,96	
Test nr. 3	71,41	
Test nr. 4	88,54	
Test nr. 5	85,18	
Test nr. 6	77,31	
Σ		
Oil temperature (° C)	24	
Dielectric strength (kV)	**79,30**	
Date: 21.7.2005	Oil tested acc. to : **IEC 60156** (d=2,5 mm; f=50 Hz)	*Tested by :* *Tina Brajdić*

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Distributivni i specijalni transformatori d.d.
Zagreb

ULAZNA KONTROLA
IN-COMING INSPECTION 1

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Page : i

TRANSFORMER

Type: TBP 50000-123/A
Serial No. : CT1283 - 461786

ROUTINE TESTS:	TEST REPORT No.:	Page :	STANDARD
Measurement of voltage ratio and check vector group	461786	2 / 6	IEC 60076-1 (10.3)
Measurement of winding resistance	461786	2 / 6	IEC 60076-1 (10.2)
Measurement of short-circuit impedance and load losses	461786	3 / 6	IEC 60076-1 (10.4)
Measurement of no-load losses and current	461786	4 / 6	IEC 60076-1 (10.5)
Measurement of no-load current at 400 V and 50 Hz	461786	4 / 6	
Measurement of insulation resistance	461786	5 / 6	IEC 60076-1 (10.1.3)
Separate sourse AC withstand voltage test (applied potential test)	461786	5 / 6	IEC 60076-3 (11)
Induced overvoltage test	461786	5 / 6	IEC 60076-3 (12)
Test on on-load tap changer	461786	5 / 6	IEC 60076-1 (10.8)
Check of auxiliary equipment according to drawing CS0855	461786	5 / 6	
PD measurement (ACSD test)	461786	6 / 6	IEC 60076-3 (12)
Lightning impulse (LI) test	497	---	IEC 60076-3 (13)
Test on insulating of oil	461786	supplement 1	IEC 60156
Oil leakage test	461786	supplement 2	

ALL SPECIFIED TESTS AND MEASUREMENTS WERE PERFORMED.
TRANSFORMER PASSED THE TESTS AND MEASUREMENTS MET SPECIFIED TOLERANCES.

The test was carried out in the presence of :

Mr.CHEDAL-ANGLAY Olivier - AIR LIQUIDE
Mr.Knauthe Jens - AREVA, Energietechnik GmbH

Tested by :	Approved by :	Date and stamp :
V.Gojević,dipl.ing.	Zvonimir Mas,dipl.ing.	28.07.2005.

KONČAR Distributivni i specijalni transformatori d.d. Zagreb
ISPITNA STANICA TESTING STATION 3

TRANSFORMER

Serial No. : CT1283 - 461786

RATING PLATE

KONČAR D&ST

TRANSFORMER WITH OFF-CIRCUIT TAPPING

Type	TBP 50000-123/A	No.	CT1283-	Year of Manufact.	2005
Rated Freq.	50 Hz	Number of Phases	3	Standard	IEC 60076
	LI550 AC230 / LI60 AC20			Vector Group Symbol	YNd1
Rated Power	50000 kVA			Type of Cooling	ONAN/ONAF

	H.V.	L.V.		H.V.	L.V.	
1	115500	6300 V		249.9	4582.1 A	
2	112750			256.0		
3	110000			262.4		
4	107250			269.2		
5	104500			276.2		

Imp. Voltage at (40MVA) ____ %

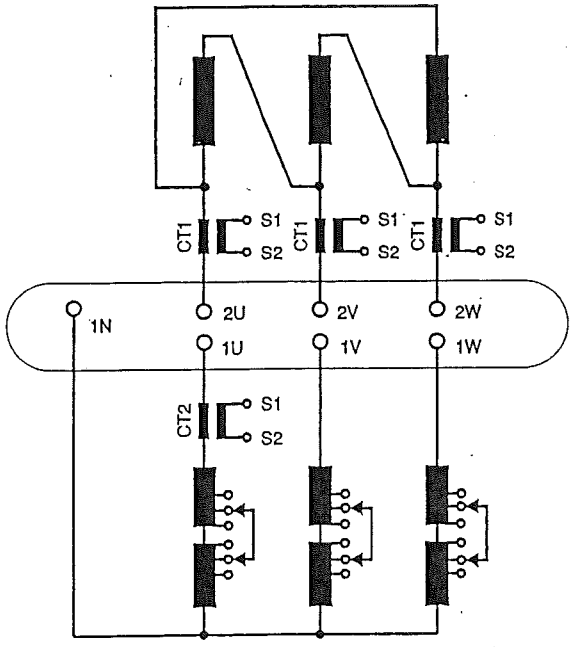
Transp. mass 52 t

Untanking Mass 32.5 t

Mass of Oil 12 t

Total Mass 60 t

ONAN Cooling up to 40 MVA



Current transformers:
CT1: 4000/1A; 20VA; 5P20
CT2: 225/2A; 10VA cl.3; Fs5

MADE IN CROATIA

348870

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Serial No. : 461786
		Page : 1 / 6

CUSTOMER :

1.0.	RATING VALUES				
Transformer type :	TBP 50000-123/A		Tap-changer type :	U III 300-123-06 05 OME	
Serial No. :	461786		Serial No. :	1006653	
Winding :	H.V.	L.V.		ONAN cooling up to (MVA)	40
Insulation level :	LI550 AC230	LI60 AC20		Part No. :	CT1283
Rated power (kVA)	50000	50000		Transport mass (t)	52.0
Rated voltage (V)	115500			Oil mass (t)	12.0
	110000	6300		Total mass (t)	60.0
	104500			Frequency (Hz)	50
Rated current (A)	249.9			Vector group :	YNd1
	262.4	4582.1		Type of cooling :	ONAN / ONAF
	276.2			Tested in acc. :	IEC 60076-1

2.0.	TEST RESULTS				
2. 1. 1.	Impedance voltage (at 40 MVA and temperature 75° C)				
Winding :	H.V. / L.V.			----	----
Tap position	1	3	5	----	----
Rated (%)				----	----
Guaranteed (%)		>= 10.7		----	----
Measured (%)	10.99	11.00	11.30		
2. 1. 2.	Load losses (at 40 MVA and temperature 75°C)				
Rated (k W)	----	154.00	----	----	----
Guaranteed (k W)	----	177.10	----	----	----
Measured (k W)	141.92	145.79	155.48		
2. 3.	No - load loss and current				
	Loss			Current (at 40 MVA)	
Voltage (%)	95.0	100.0	105.0	Voltage (%)	100.0
Rated (k W)	----	23.00	----	Rated (%)	----
Guaranteed (k W)	----	26.45	----	Guaranteed (%)	----
Measured (k W)	18.2	21.0	24.8	Measured (%)	2.08
2. 4.	Total losses (at 40 MVA and temperature 75°C)				
Tap position	1	3	5	----	----
Rated (k W)	----	177.00	----	----	----
Guaranteed (k W)	----	194.70	----	----	----
Measured (k W)	162.92	166.79	176.48		
2. 5.	Efficiency				
	Winding H.V. / L.V. at position 3				
Load (%)	25	50	75	100	125
Measured PF=1.0 (%)	99.76	99.77	99.73	99.67	99.60
Guaranteed (%)	-----	-----	-----	-----	-----
Measured PF=0.8 (%)	99.70	99.71	99.66	99.58	99.50
Guaranteed (%)	-----	-----	-----	-----	-----
2. 6.	Regulation		Load (%)	100	125
Guaranted PF=1.0 (%)	-----	----------	Measured (%)	0.90	1.13
Guaranted PF=0.8 (%)	-----	----------	Measured (%)	7.21	9.01

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Serial No. : 461786
		Page : 2 / 6

TRANSFORMER TYPE :	TBP 50000-123/A	Part No. :	CT1283

3 . 0 .	Measurement voltage ratio and vector group				(by compensator)
Tap position	Phase 1U (%)	Phase 1V (%)	Phase 1W (%)	Voltage (V)	Calculated ratio
1	0.06	0.06	0.06	115500	188.951
2	0.06	0.06	0.06	112750	193.560
3	0.06	0.06	0.06	110000 / 6300	2000 / 198.399
4	0.06	0.06	0.06	107250	203.486
5	0.06	0.06	0.06	104500	208.841
(H.V. / L.V.)	Vector group is :	YNd1			

3 . 1 .	Measurement of winding resistance in (Ohm)			(measurement at temperature 30 °C)	
Winding H.V.	1U - 1V	1U - 1W	1V - 1W		
1	0.929	0.930	0.929		
3	0.889	0.888	0.888		
5	0.845	0.845	0.845		
Winding L.V.	2u - 2v	2u - 2w	2v - 2w		
----	0.00207	0.00206	0.00207		

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Serial No. : 461786
		Page : 3 / 6

TRANSFORMER TYPE :	TBP 50000-123/A	Part No. :	CT1283

2 . 1 .	Load losses and impedance voltage measurement				
Combination **	H.V. / L.V.	H.V. / L.V.	H.V. / L.V.		
Tap position	1	3	5		
Temperature (°C)	30	30	30		
Frequency (Hz)	50	50	50		
Measured voltage (u-v)	7981	7631	7536		
(u-w)	7988	7639	7540		
(v-w)	7980	7628	7530		
Average	7983	7633	7535		
Constant	1	1	1		
VOLTAGE (V)	7983	7633	7535		
Measured current (u)	125.9	132.5	141.1		
(v)	125.5	132.3	140.9		
(w)	125.8	132.5	141.1		
Average	125.7	132.4	141.0		
Constant	1	1	1		
CURRENT (A)	125.7	132.4	141.0		
Measured power (u)	17190	17350	19180		
(v)	17400	17720	19380		
(w)	16860	18060	19970		
Total	51450	53130	58530		
Constant	1	1	1		
LOAD LOSSES (W)	51450	53130	58530		
Calculated to (kVA)	50000	50000	50000		
(A)	249.9	262.4	276.2		
LOAD LOSSES (W)	203351	208685	224589		
I2 R losses (W)	152142	156834	161780		
Stray losses (W)	51209	51851	62809		
Impedance voltage (V)	15870.7	15127.6	14760.0		
(%)	13.741	13.752	14.124		
Temperature (°C)	**75**	**75**	**75**		
I2 R losses (W)	177977	183466	189252		
Stray losses (W)	43775	44324	53692		
LOAD LOSSES (W)	221752	227790	242944		
Impedance voltage (V)	15872.0	15128.3	14760.6		
(%)	13.742	13.753	14.125		
CALCULATED TO 40 MVA					
LOAD LOSSES (W)	141921	145786	155484		
Impedance voltage (V)	12697.6	12102.6	11808.5		
(%)	10.994	11.002	11.300		

NOTE : **Measuring equipement : NORMA Power Analyser Type D6133T**
** : Connected / Shortcircuit winding

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Serial No. : 461786
		Page : 4 / 6

TRANSFORMER TYPE :	TBP 50000-123/A	Part No. :	CT1283

2 . 3 .	No - load losses and no - load current measurement				
Voltage (%)	95.0	100.0	105.0		
RMS measured vltg. (u-v)	6001	6321	6647		
(u-w)	6003	6323	6649		
(v-w)	6004	6324	6652		
Average	6003	6323	6649		
Constant	1	1	1		
RMS VOLTAGE (V)	6003	6323	6649		
Mean measured vltg. (u-v)	5980	6294	6608		
(u-w)	5986	6299	6614		
(v-w)	5989	6305	6625		
Average	5985	6299	6616		
Constant	1	1	1		
MEAN VOLTAGE (V)	5985	6299	6616		
Form factor	1.113	1.114	1.116		
Measured current (u)	2.543	3.087	4.285		
(v)	1.822	2.225	3.216		
(w)	1.945	2.471	3.601		
Average	2.103	2.594	3.701		
Constant	1	1	1		
CURRENT (A)	2.103	2.594	3.701		
Measured power (u)	7647	8873	10541		
(v)	5816	6730	8200		
(w)	4799	5436	6159		
Total	18262	21039	24900		
Constant	1	1	1		
LOSSES (W)	18262	21039	24900		
Correction (W)	-55	-80	-124		
LOSSES (W)	18207	20959	24776		

NOTE : **Measuring equipement : NORMA Power Analyser Type D6133T**

MEASUREMENT AT FREQUENCY 50 (Hz) ON WINDING : L.V.

The power was corrected to the sine - wave voltage basis .

2. 3. 1.	Measurement of no - load current at 387 (V) , and 50 (Hz)				
Winding	Phase U (m A)	Phase V (m A)	Phase W (m A)		
H.V. - tap position 3	1.66	1.03	1.74		

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Serial No. : 461786
		Page : 5 / 6

TRANSFORMER TYPE :	TBP 50000-123/A	Part No. : CT1283

3.2. Measurement of insulation resistance (MOhm), (measured by MEGGER 2500 V) (measurement at temperature 30 °C)

Between	R 15 "	R 60 "	R 60 " / R 15 "
H.V. - (L.V. + earth)	3780	5450	1.44
L.V. - (H.V. + earth)	2280	3860	1.69
(H.V. + L.V.) - earth	3380	4640	1.37
core - (earth)	2250	3260	1.45

3.3. Dielectric test of the transformer

Lightning impulse test — Test repotr No.: 497

	Between	Test voltage (kV)	Frequency (Hz)	Duration (sec)
Separate - source voltage withstand test	H.V. - (L.V. + earth)	230	50	60
	L.V. - (H.V. + earth)	20	50	60
	core - (earth)	2	50	60
Induced overvoltage test				
	1U - 1V - 1W	230	200	30

NOTE : Winding H.V. - tap position 1

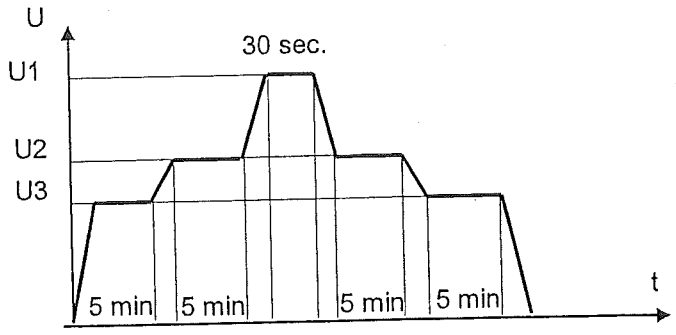
1. Tap changer was tested in accordance with : IEC 60076 - 1 (clause 10.8.1).
2. Functionally test of the auxiliary box has been done in accordance with drawing No.: CS0855.
3. Polarity test was done on current transformers :

phase " 2u " : CT1 - 4000 / 1 A ; 20 VA ; 5P20 Ser.No.: 523890
phase " 2v " : CT1 - 4000 / 1 A ; 20 VA ; 5P20 Ser.No.: 523891
phase " 2w " : CT1 - 4000 / 1 A ; 20 VA ; 5P20 Ser.No.: 523892
phase " 1U " : CT2 - 225 / 2 A ; 10 VA ; cl.3; Fs5 Ser.No.: 523894

KONČAR D&ST ZAGREB	TRANSFORMER TEST REPORT	Serial No. : 461786
		Page : 6 / 6
TRANSFORMER TYPE : TBP 50000-123/A		Part No. : CT1283

3.4.1. SUPPLEMENT 1 - ACSD TEST

3.4.1.1. Test sequence and levels



Standard:	IEC 60076-3
Supply	three-phase
Supplied terminals	2u - 2v - 2w
Tap position	1
Supply frequency (Hz)	200
U3 (kV)	135
U2 (kV)	160
U1 (kV)	230
Allowed PD at voltage level (pC)	
U3	<100
U2	<300

3.4.1.2. Measuring equipement, calibration and background noise level

Measuring equipement:	PD detector:	"Tettex" balanced PD bridge type 9112		
	Oscilloscope:	"Protek" type 6504		
	Calibrator:	"Tettex" type 9216		
Calibration:				(Calibraton performed with 100 pC)
	Calibration signal	1U	1V	1W
	Measured (pC)			
	1U	100	35	30
	1V	40	100	35
	1W	30	30	100
Background noise level with source connected and voltage 0 (V):			< 10 pC	

3.4.1.3. Test and PD measurement

Voltage level	Duration (min)	Measured on phase (pC) 1U	1V	1W
U3	5.0	40	40	40
U2	5.0	35	30	40
U1	0.5	----	----	----
U2	5.0	35	30	40
U3	5.0	40	40	40

3.4.1.4. Results

No collapse of voltage observed.

Measured level of PD is lower than in IEC 60076 - 3 specified.

TRANSFORMER PASSED ACSD TEST.

NOTE :

KONČAR D&ST	*Dielectric strength of insulating oil*	
Type of transformer:	TBP 50000-123/A	
Serial number:	461786	
Oil :	Shell dx	
	Breakdown voltage (kV)	
Test nr. 1	78.82	
Test nr. 2	76.50	
Test nr. 3	73.84	
Test nr. 4	75.92	
Test nr. 5	87.50	
Test nr. 6	81.59	
Σ		
Oil temperature (° C)	25	
Dielectric strength (kV)	**79.03**	
Date: 28.7.2005	Oil tested acc. to : **IEC 60156** (d=2,5 mm; f=50 Hz)	***Tested by :*** *P.Mikulić*

KONČAR
Distributivni i specijalni transformatori d.d.
Zagreb

ULAZNA KONTROLA
IN-COMING INSPECTION
1

KONČAR D&ST

Izvještaj o ispitivanju nepropusnosti

Oil leakage test report

Tip transformatora:
Transformer type: TBP 50000-123/A (Košice)

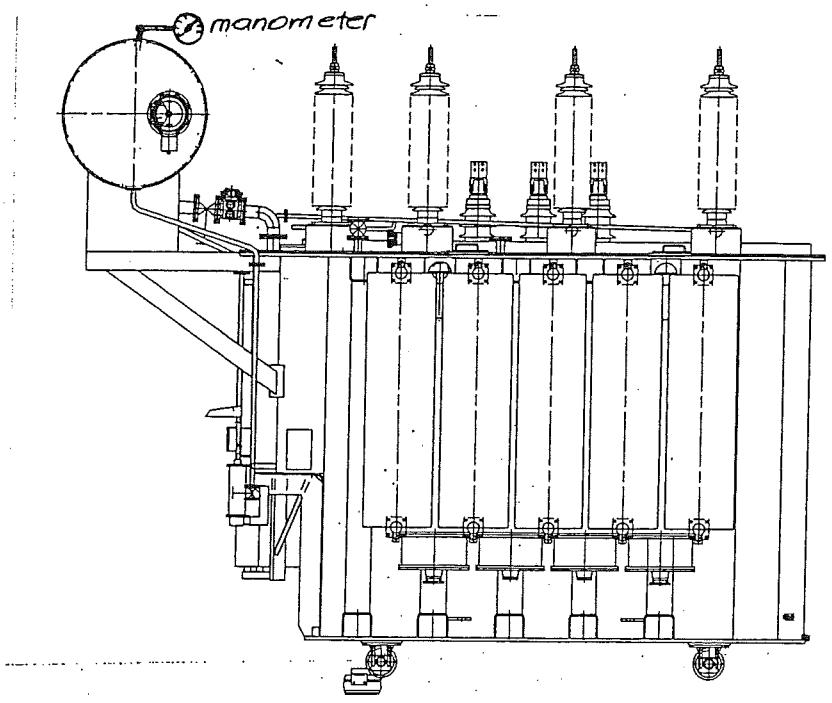
kom:
pcs:

Tvornički broj:
Serial number(s): No. 461786

Uvjeti ispitivanja / Testing conditions

Ispitno sredstvo Testing media	Transformatorsko ulje Transformer oil	
Temperatura ispitnog sredstva Temperature of testing media	20°C	
Tlak Pressure kN/m^2	30 kN/m^2	on the top of the tank
Trajanje ispitivanja Duration	24 h	Begin. 25.07-2005 Finish 26.07-2005

Shema ispitivanja - Way of testing (scheme)



Tests were carried out in the presence:

Test result: No leakage

Datum / Date:	Ispitivanje proveo: Testing performed by:	
26.07-2005	QI-03	F. Erdec

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Zagreb

MEĐUFAZNA KONTROLA
IN-PROCESS INSPECTION 2

KONČAR D&ST

IMPULSE TEST REPORT

Test report no. 497

Transformer type		Serial number	Customer	
TBP 50000-123/A		CT1283-461786		
H.V. winding (V)		L.V. winding (V)		
Tap position	Voltage (V)	Voltage (V)		
-	-	-		
3	110000	6300		
-	-	-		
Connection symbol	YNd1	Rated short-circuit impedance	10.7%	

1. Specified test voltages — Standard: IEC 60076 - 3

Terminals	Full wave		Chopped wave	
	$\hat{}$ kV	Wave shape (µs)	$\hat{}$ kV	Time to chopping (µs)
1U, 1V, 1W	550	1.2/50	-	-
2U, 2V, 2W	60	1.2/50	-	-
-	-	-	-	-
-	-	-	-	-
-	-	-	-	-

2. Measurements

The measurement was carried out with measuring device "Haefely" type HIAS 742 and capacitive voltage divider type CS 700. The calibration of the measuring device was checked in accordance with IEC 60060-2 and IEC 61083-1.

3. Result

By comparing the voltage and current records it has been proved that the transformer withstood the test.

4. Remarks

a) Voltage and current wave records are stored by Manufacturer in files: 461786

The test was carried out in presence of:

Mr.CHEDAL-ANGLAY Olivier - AIR LIQUIDE

Mr.Knauthe Jens - AREVA, Energietechnik GmbH

KONČAR Distributivni i specijalni transformatori d.d. Zagreb

ISPITNA STANICA TESTING STATION

Tested by: Krešimir Gluhak,dipl. ing.

Approved by: Zvonimir Mas,dipl.ing.

Date and stamp: 28.07.2005.

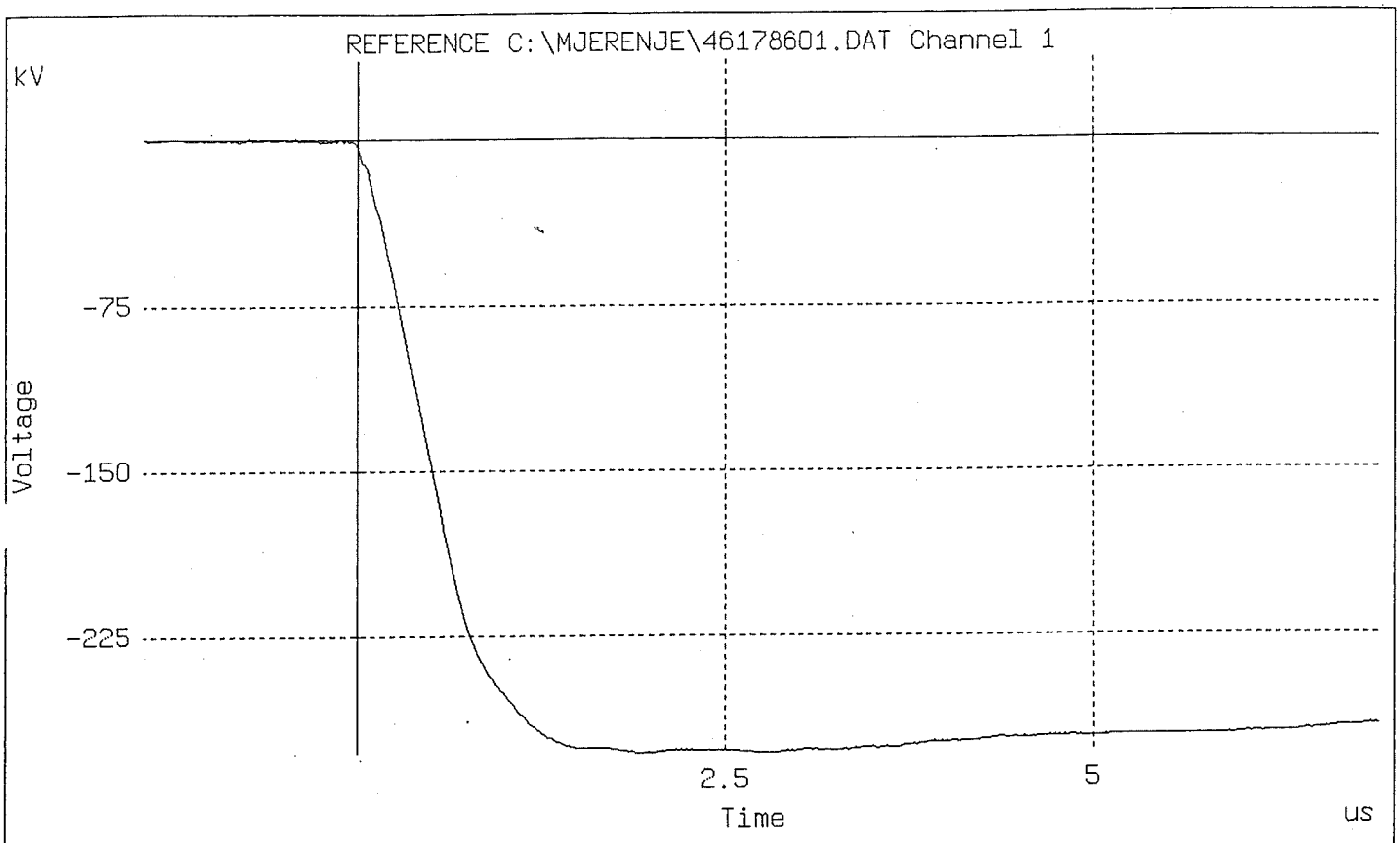
5. Testing of H.V. winding

5.1. Connection of terminals

line terminal under test	connected to the impulse voltage generator
other line terminals of the winding under test	short circuited and directly earthed
neutral terminal 1N	earthed through shunt S1
2U, 2V, 2W	short circuited and earthed

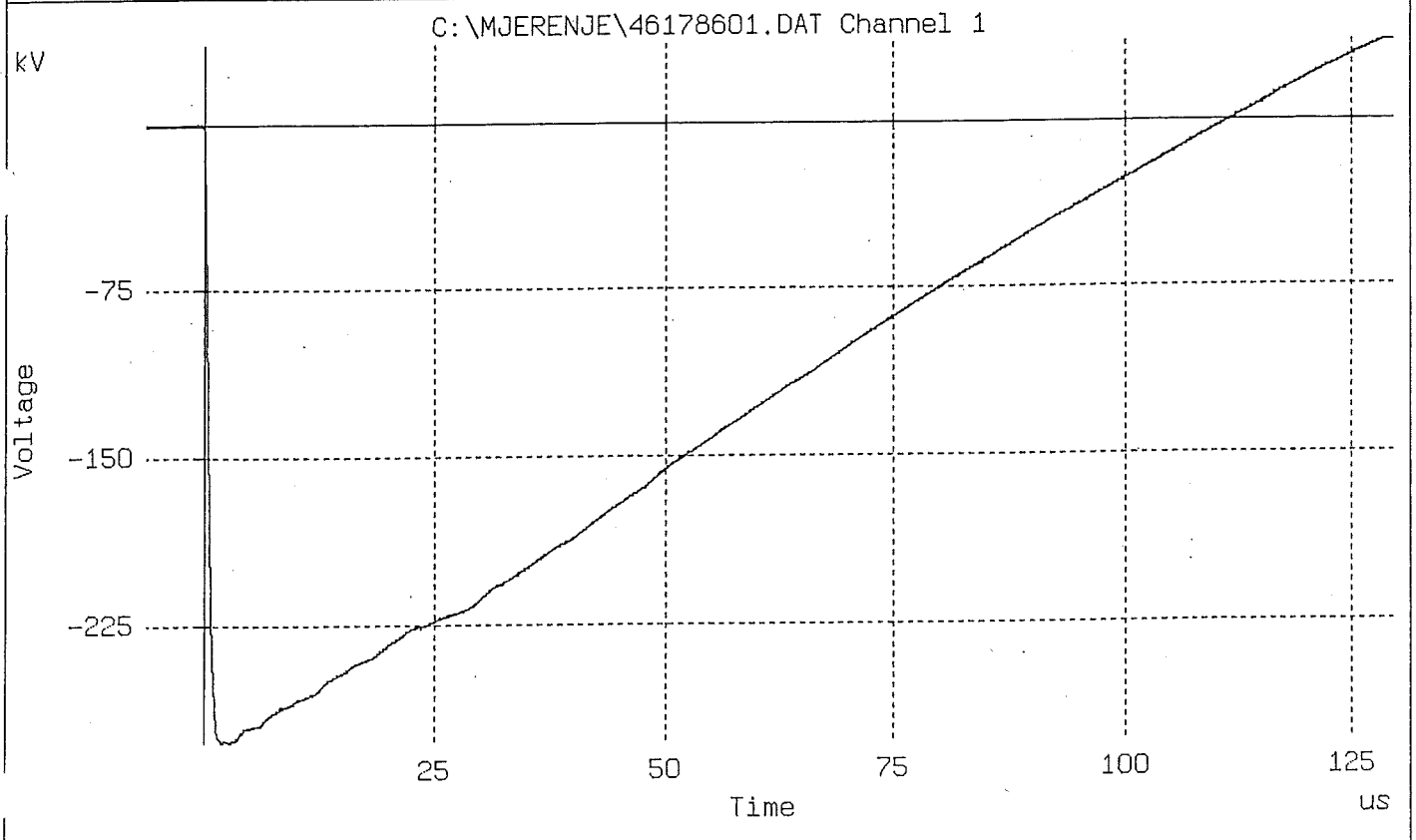
5.2. Order of tests

Terminal	Tap position	Description	Page
1U	3	Voltage wave shape check Applied voltage and current through shunt S1 oscillograms	3 4
1V	3	Applied voltage and current through shunt S1 oscillograms	5
1W	3	Applied voltage and current through shunt S1 oscillograms	6



CS 700 50% LI full

-277.4kV T1=1.12us T2=56.2us

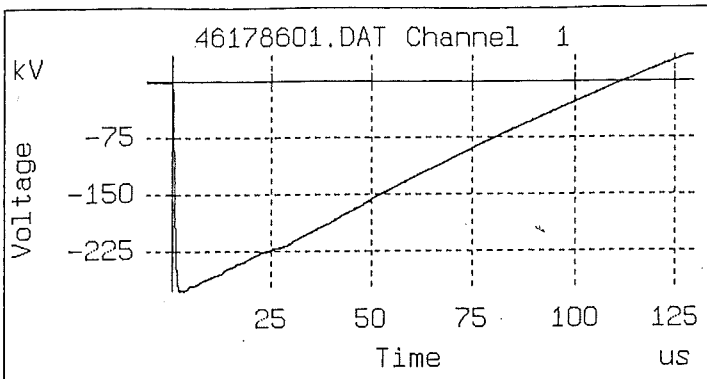


CS 700 50% LI full

-277.4kV T1=1.12us T2=56.2us

Screen plotout

28.07.2005



CS 700 50% LI full

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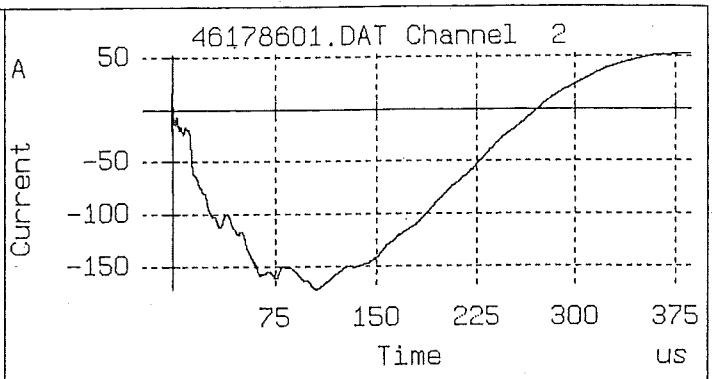
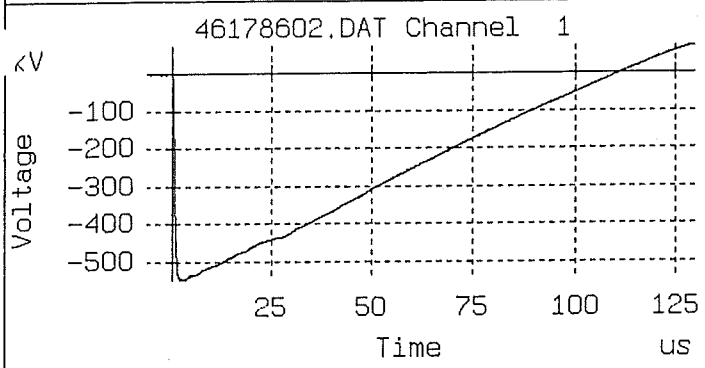


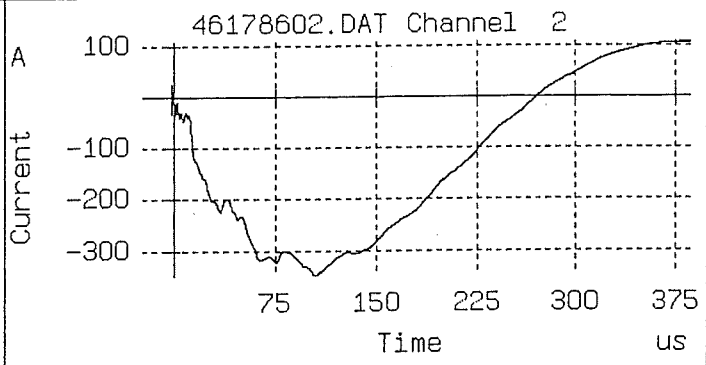
S1 50% LI full

Max:-171.4A Min:53.03A



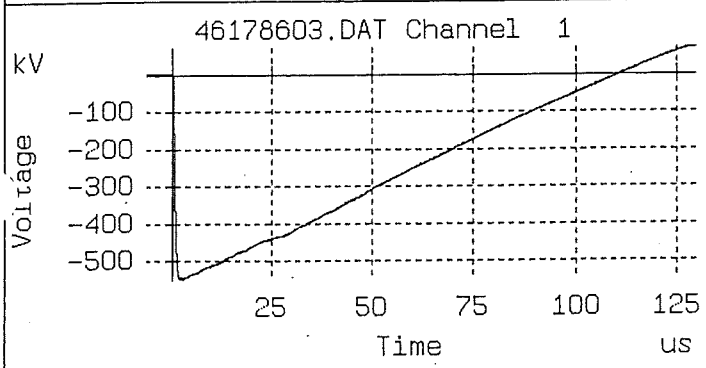
CS 700 100% LI full

-548.6kV T1=1.15us T2=56.1us



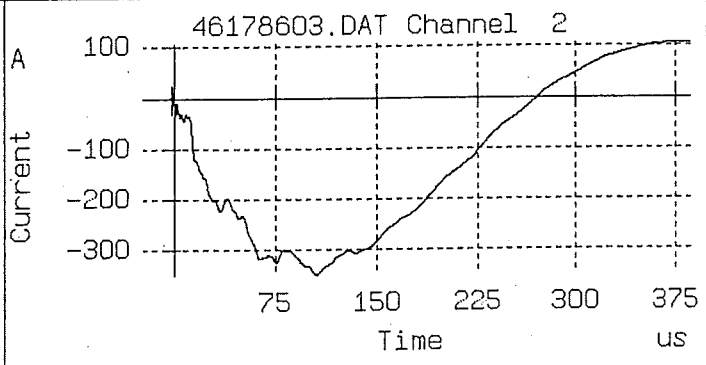
S1 100% LI full

Max:-347.8A Min:105.8A



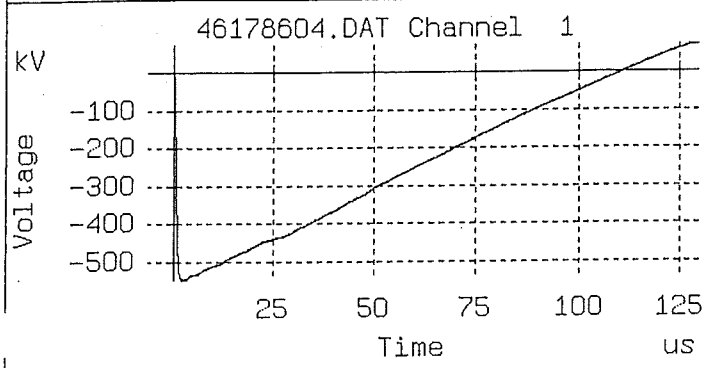
CS 700 100% LI full

-549.4kV T1=1.16us T2=55.9us



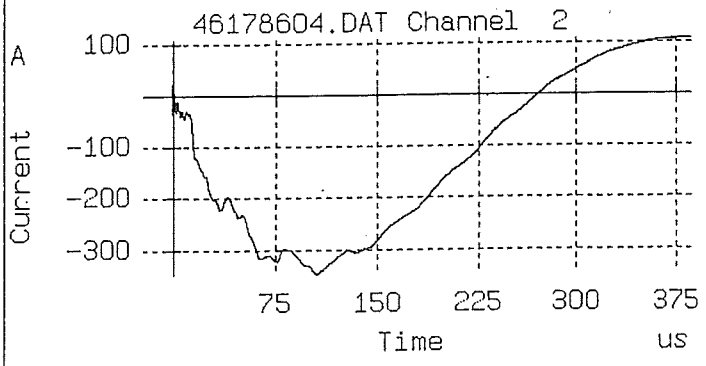
S1 100% LI full

Max:-347.8A Min:106.5A



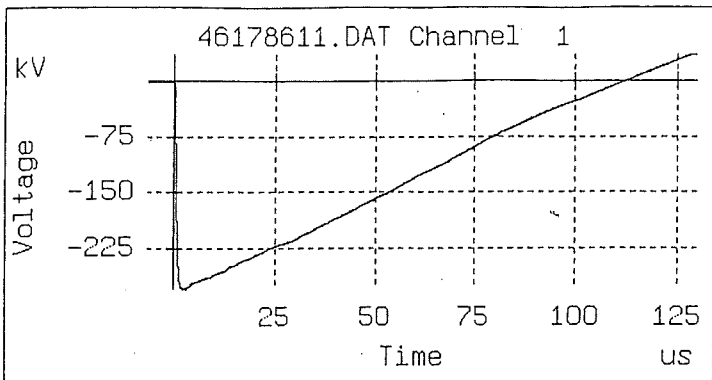
CS 700 100% LI full

-548.6kV T1=1.15us T2=56us



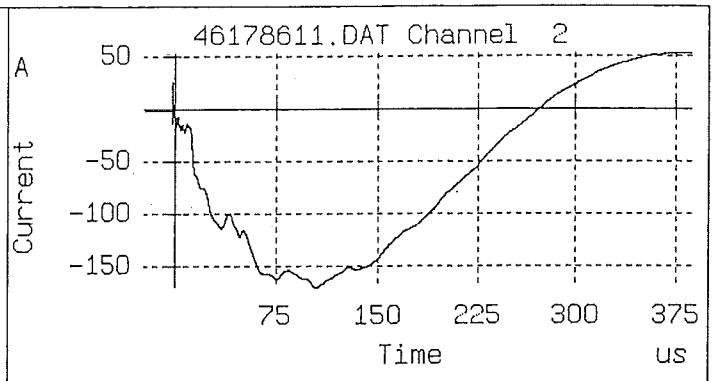
S1 100% LI full

Max:-348.4A Min:105.8A



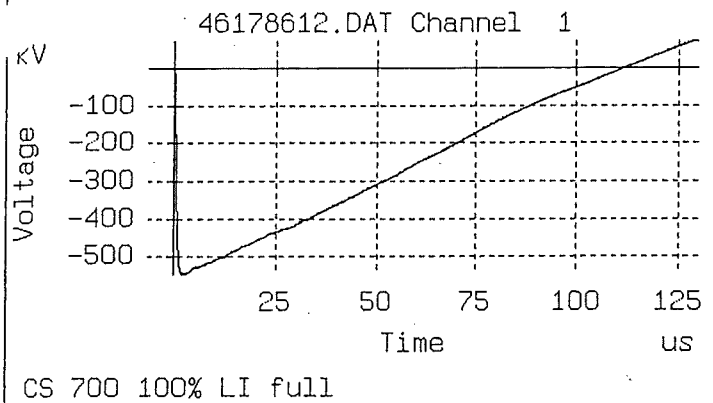
CS 700 50% LI full

-279.3kV T1=1.13us T2=56.7us



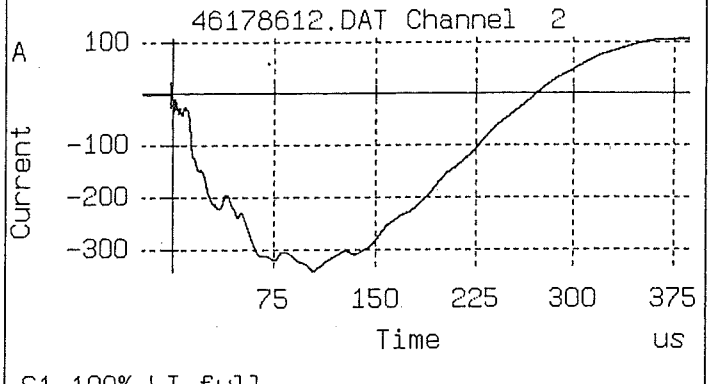
S1 50% LI full

Max:-169.9A Min:53.32A



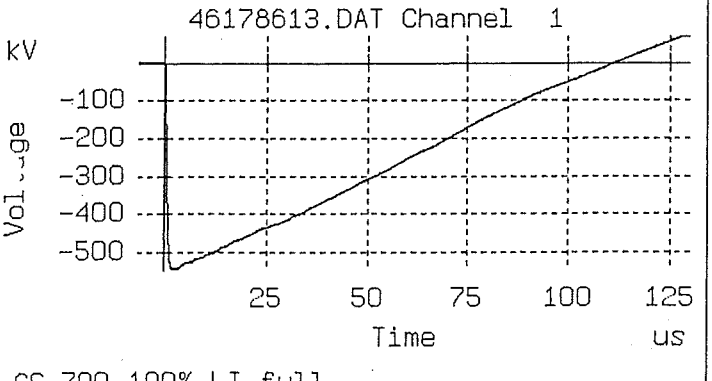
CS 700 100% LI full

-547kV T1=1.16us T2=56.7us



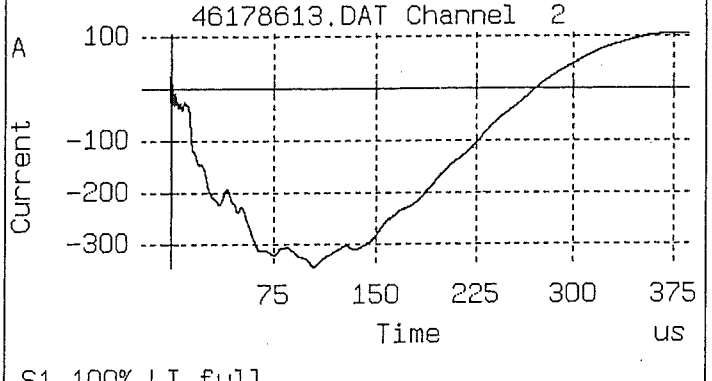
S1 100% LI full

Max:-342.3A Min:105.8A



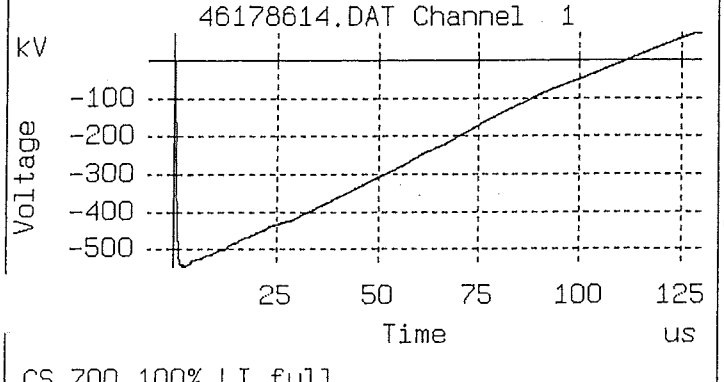
CS 700 100% LI full

-547kV T1=1.16us T2=56.8us



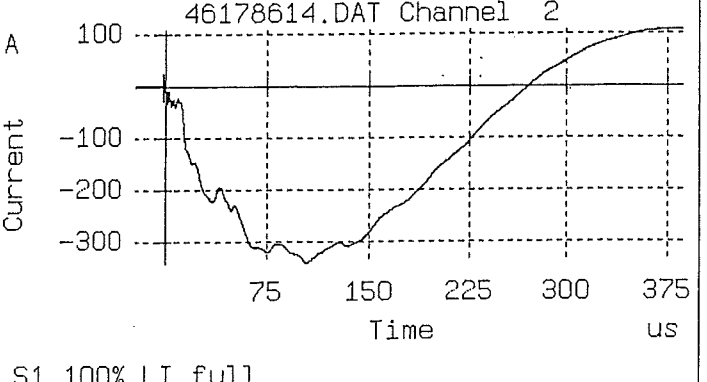
S1 100% LI full

Max:-342.3A Min:105.8A



CS 700 100% LI full

-547.8kV T1=1.16us T2=56.8us



S1 100% LI full

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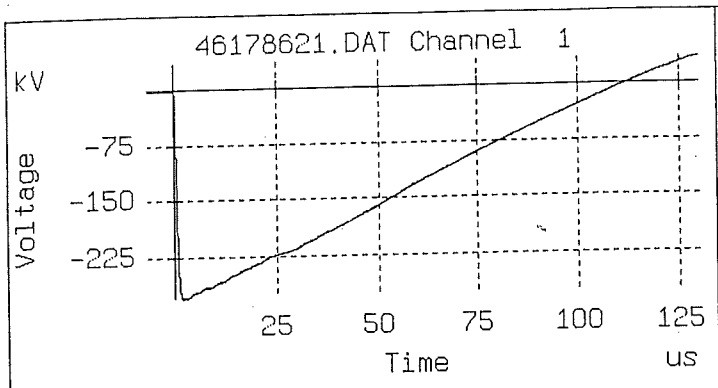
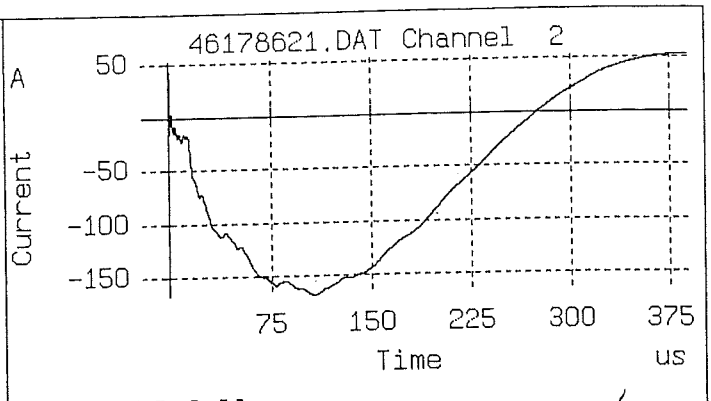


CS 700 50% LI full

-279kV T1=1.12us T2=56.2us



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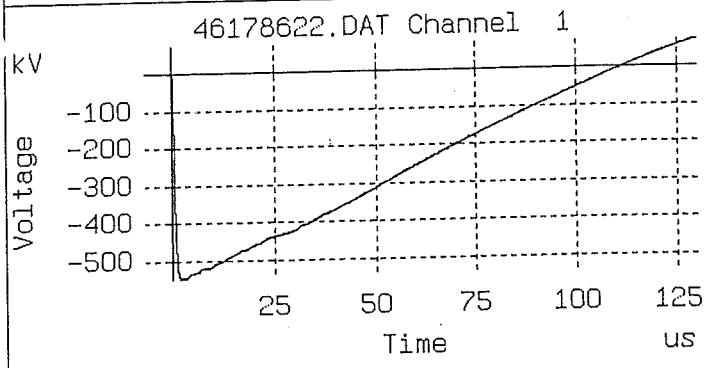

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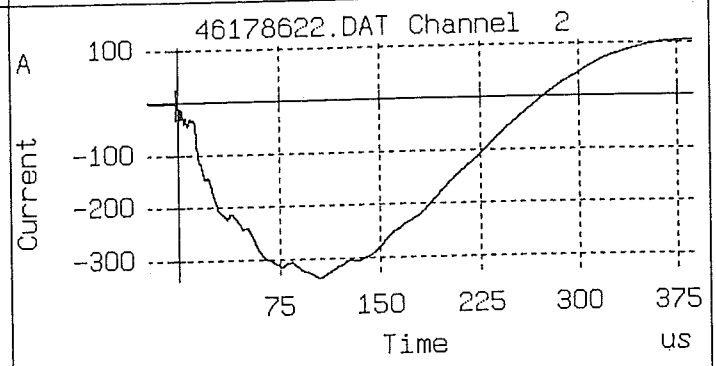
-547.8kV T1=1.15us T2=56.2us



S1 100% LI full

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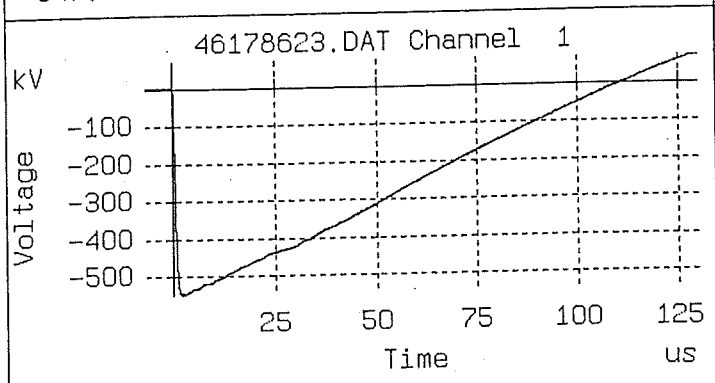

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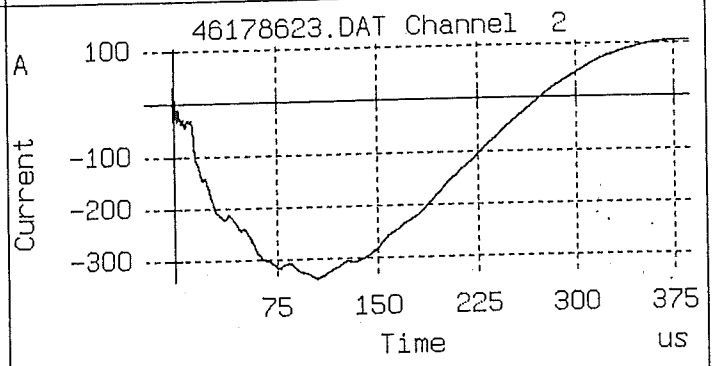
-548.6kV T1=1.15us T2=56.2us



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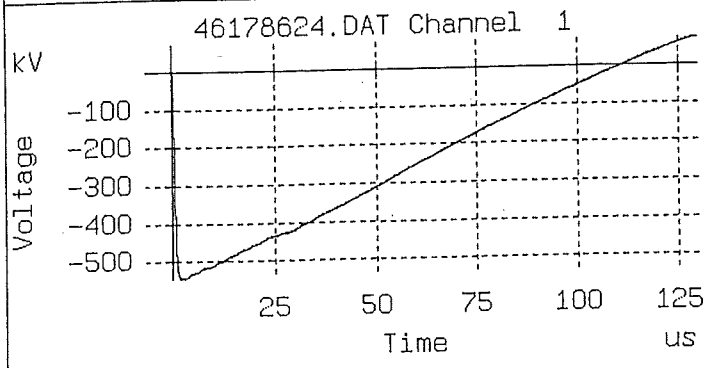
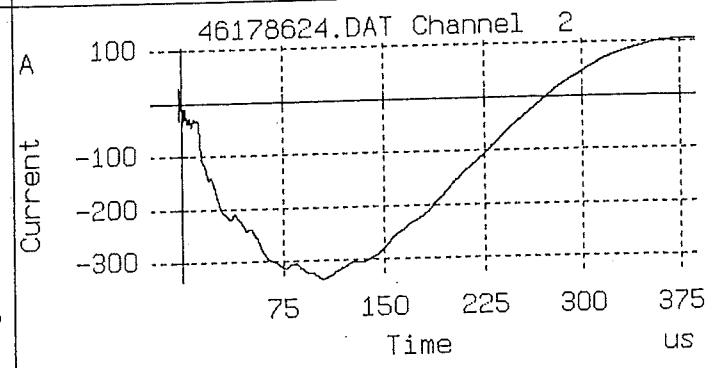


CS 700 100% LI full

-547.8kV T1=1.15us T2=56.3us



S1 100% LI full

Max:-336.3A Min:104.6A

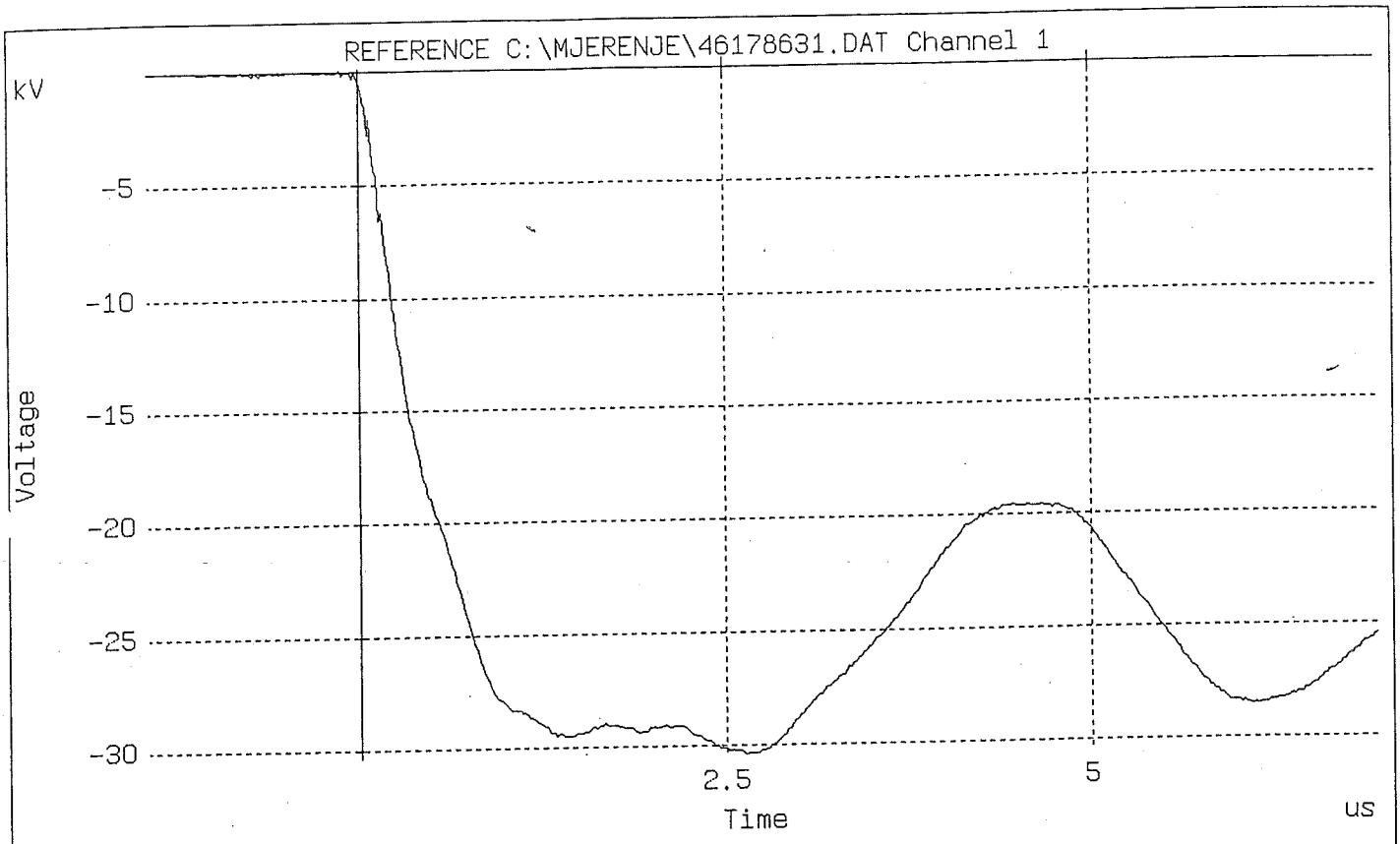
6. Testing of L.V. winding

6.1. Connection of terminals

line terminal under test	connected to the impulse voltage generator
other line terminals of the winding under test	earthed through resistors of 400 Ω and shunt S1
1U, 1V, 1W, 1N	short circuited and directly earthed

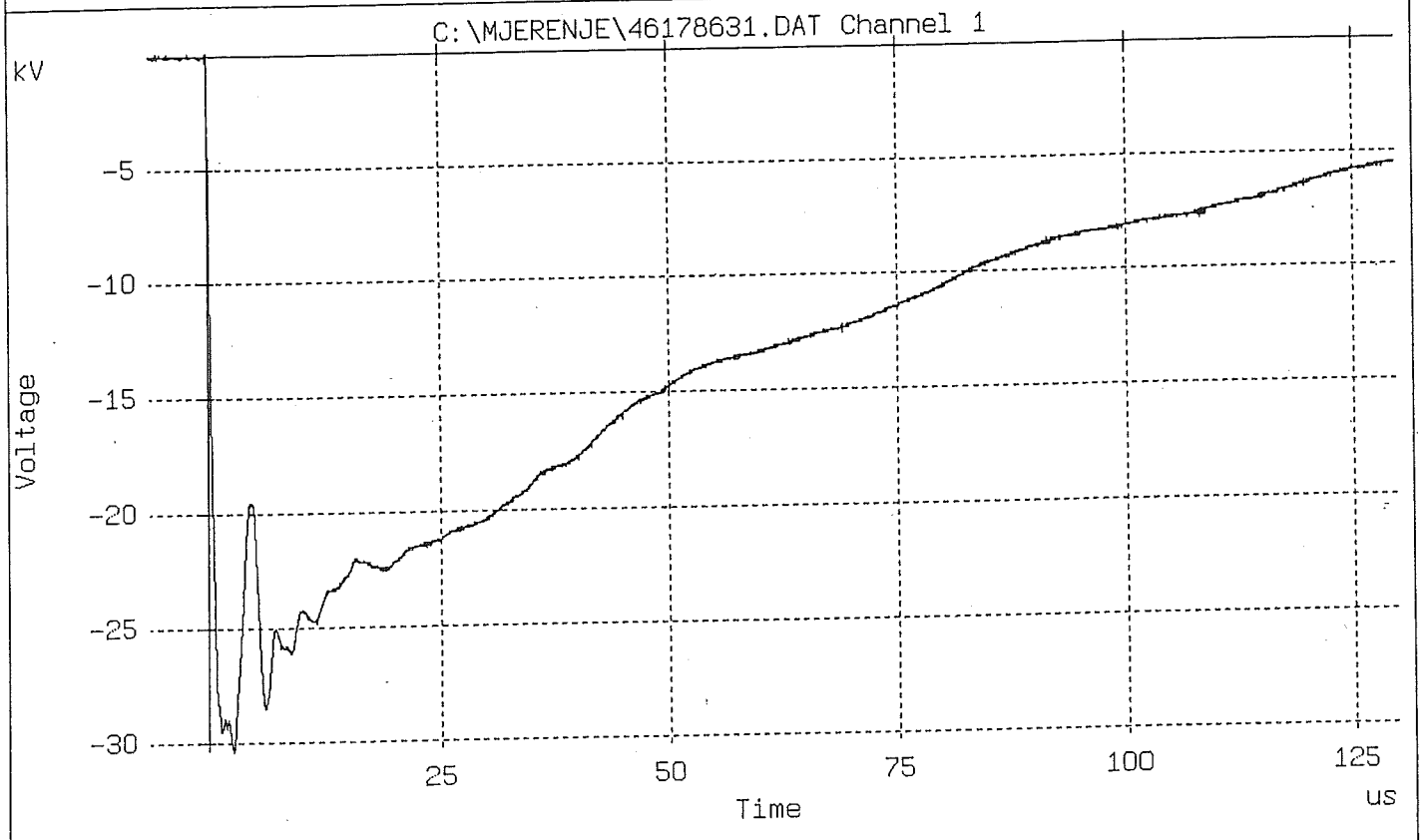
6.2. Order of tests

Terminal	Tap position	Description	Page
2U	-	Voltage wave shape check Applied voltage and current through shunt S1 oscillograms	8 9
2V	-	Applied voltage and current through shunt S1 oscillograms	10
2W	-	Applied voltage and current through shunt S1 oscillograms	11



CS 700 50% LI full

-30.3kV T1=1.13us T2=47.7us

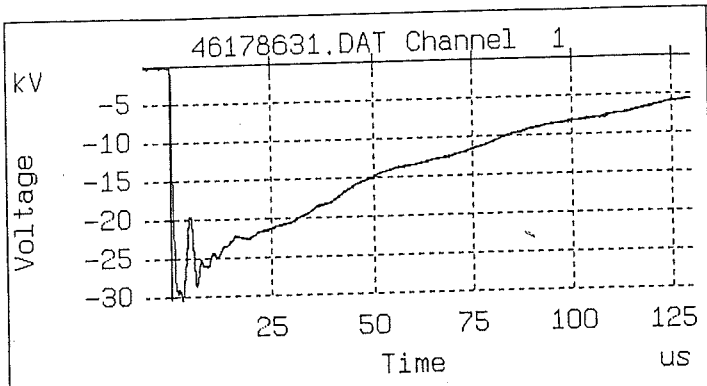


CS 700 50% LI full

-30.3kV T1=1.13us T2=47.7us

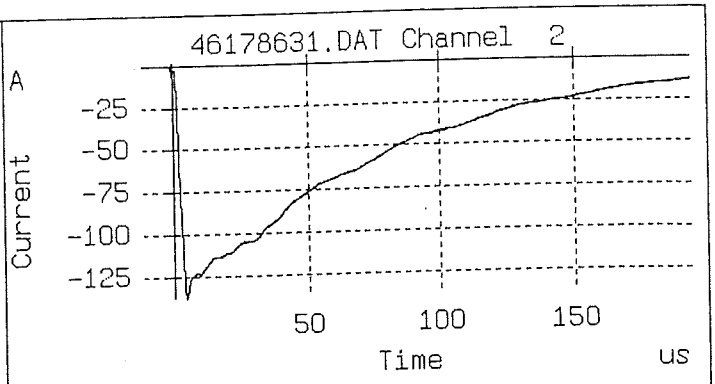
28.07.2005

Screen plotout



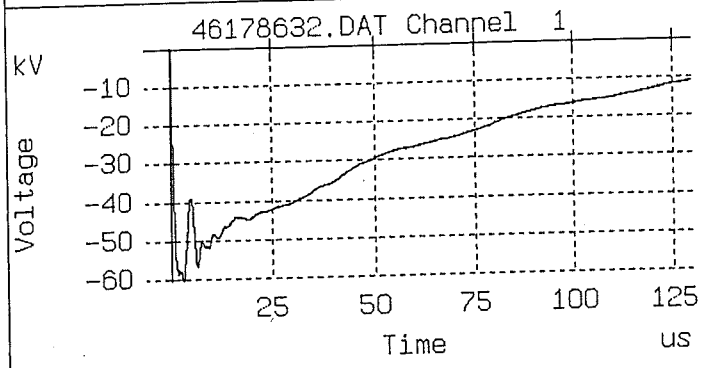
CS 700 50% LI full

-30.3kV T1=1.13us T2=47.7us



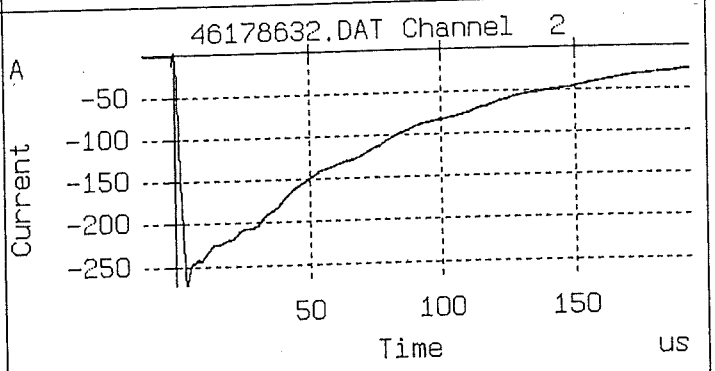
S1 50% LI full

Max:-137.6A Min:1.641A



CS 700 100% LI full

-60.16kV T1=1.14us T2=48.6us



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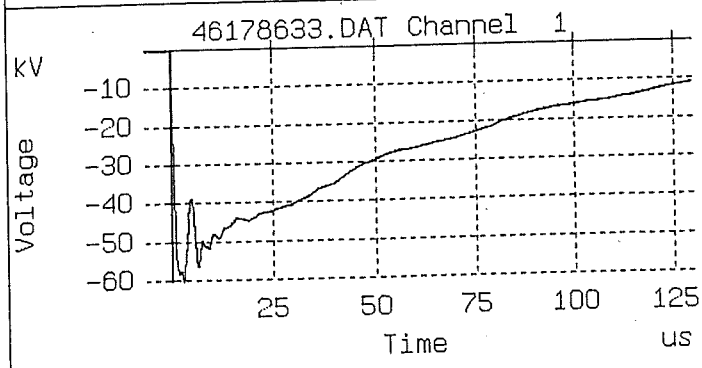
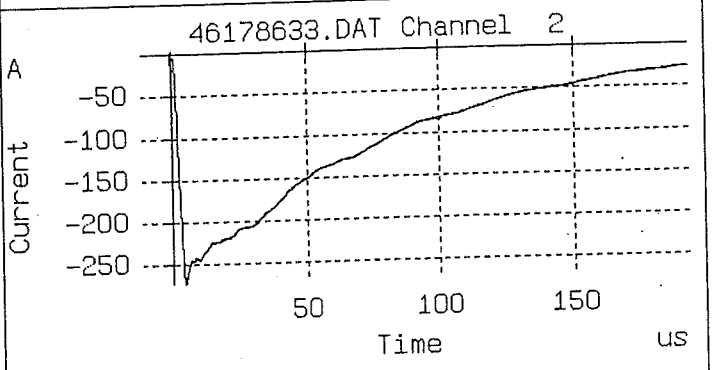


CS 700 100% LI full

-60.08kV T1=1.14us T2=48.4us



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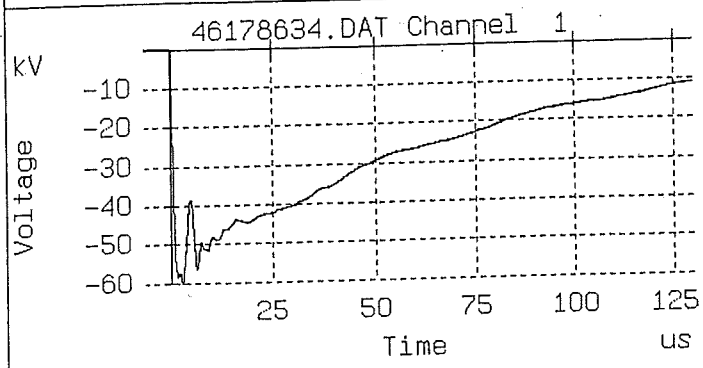
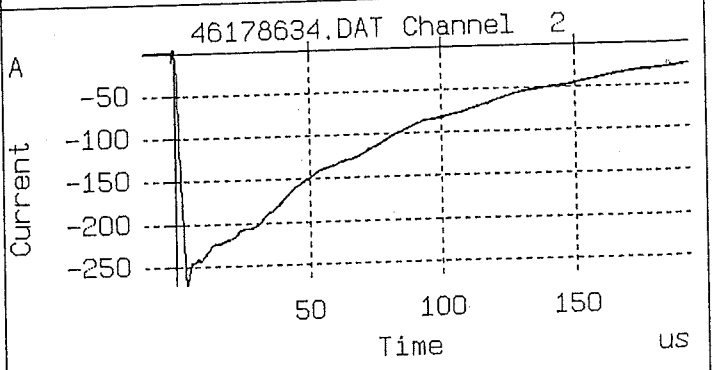


CS 700 100% LI full

-60.08kV T1=1.14us T2=48.4us



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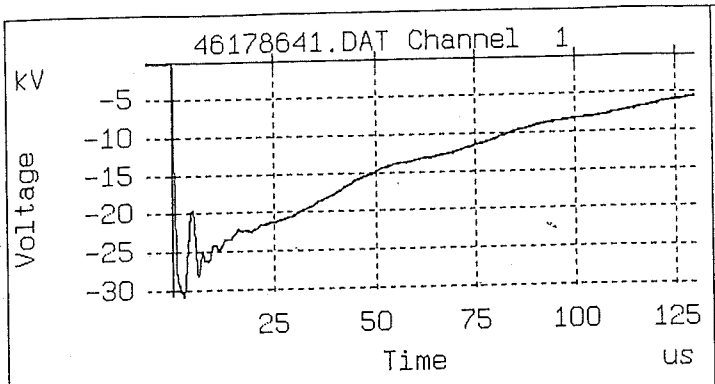
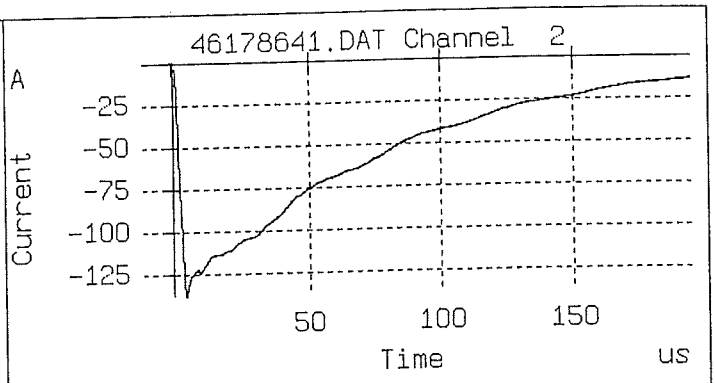


CS 700 50% LI full

-30.76kV T1=1.19us T2=47.4us



S1 50% LI full

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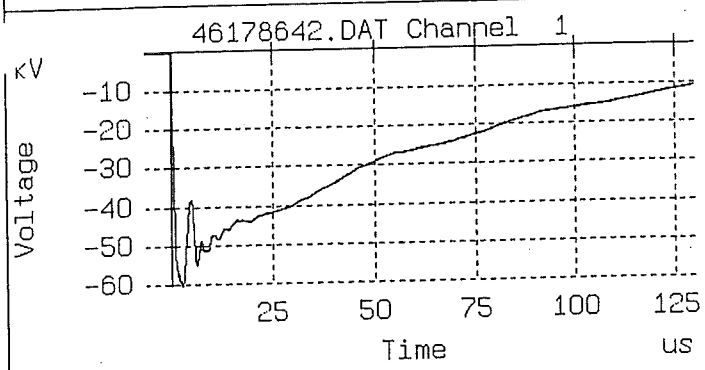
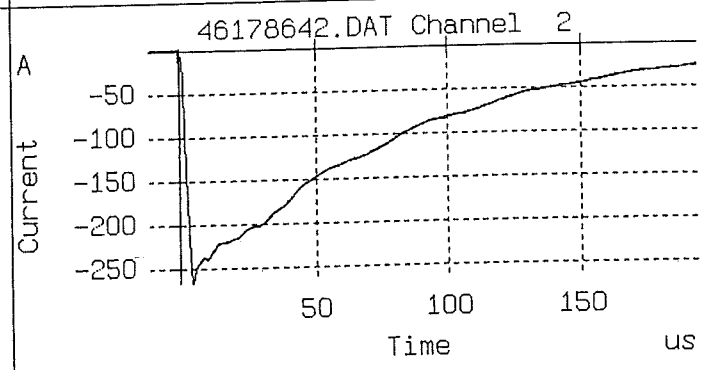


CS 700 100% LI full

-60.16kV T1=1.23us T2=47.3us



S1 100% LI full

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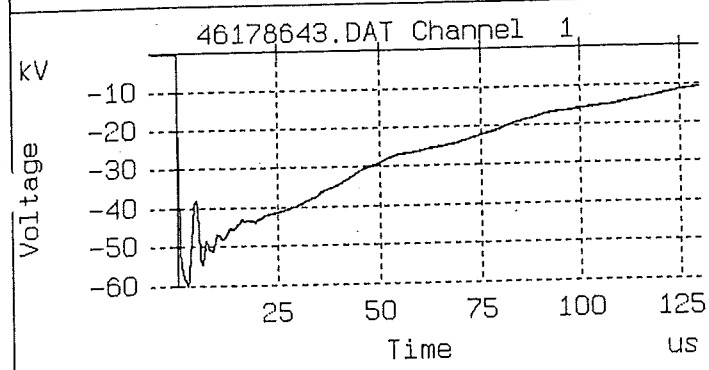
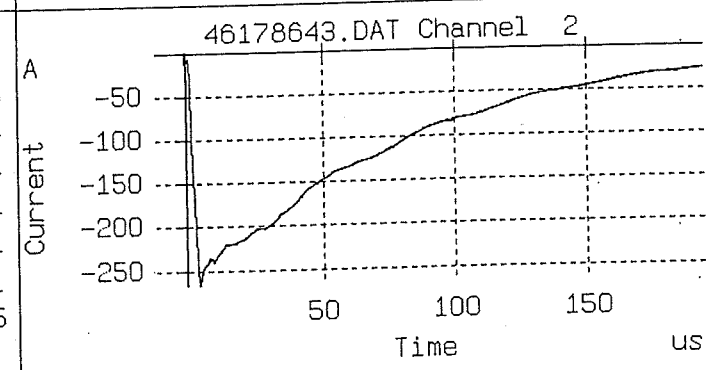


CS 700 100% LI full

-59.93kV T1=1.23us T2=47.6us



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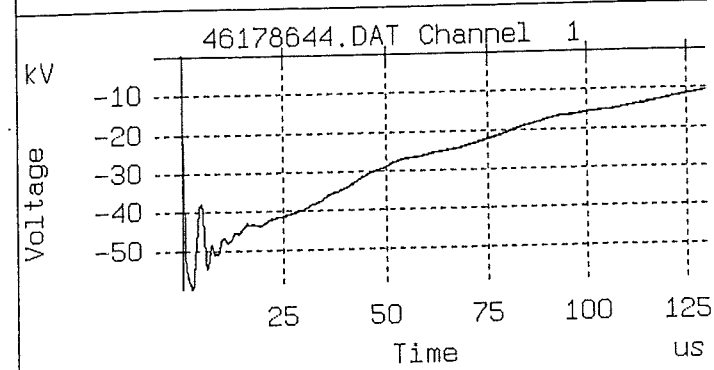
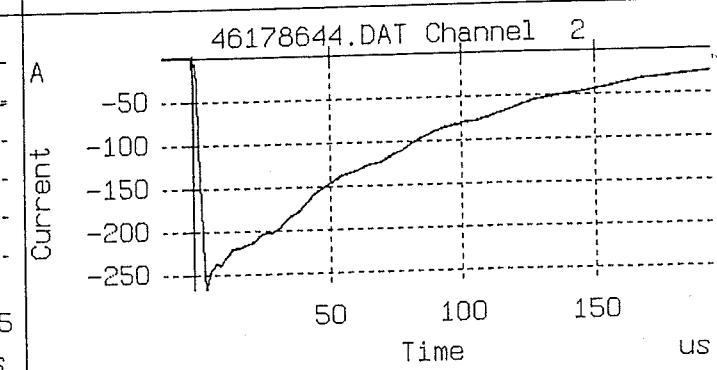
Max:-266.3A Min:1.875A



CS 700 100% LI full

-59.93kV T1=1.24us T2=47.4us



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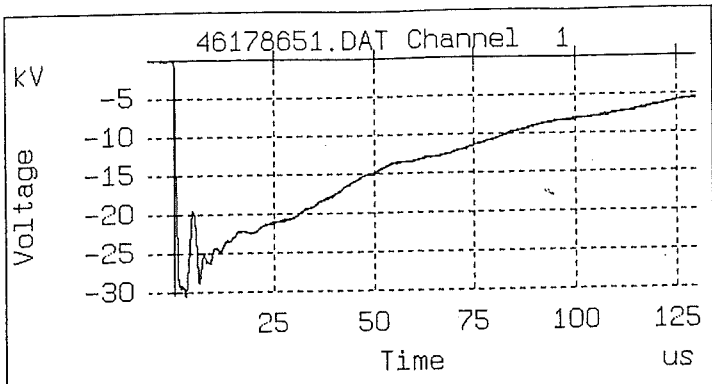
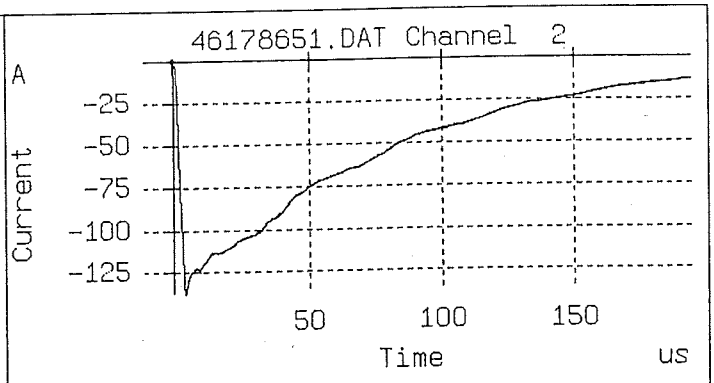


CS 700 50% LI full

-30.38kV T1=1.09us T2=48.4us



S1 50% LI full

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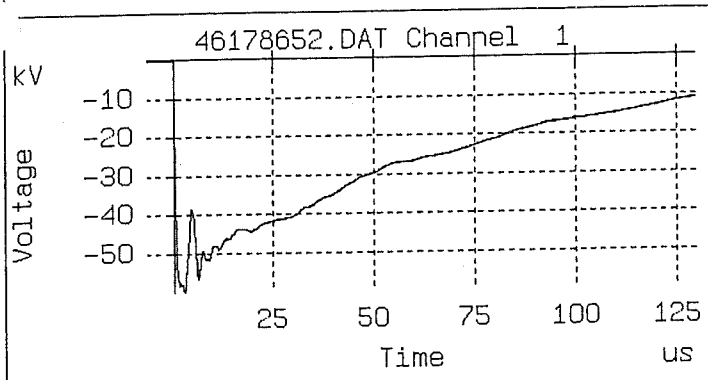
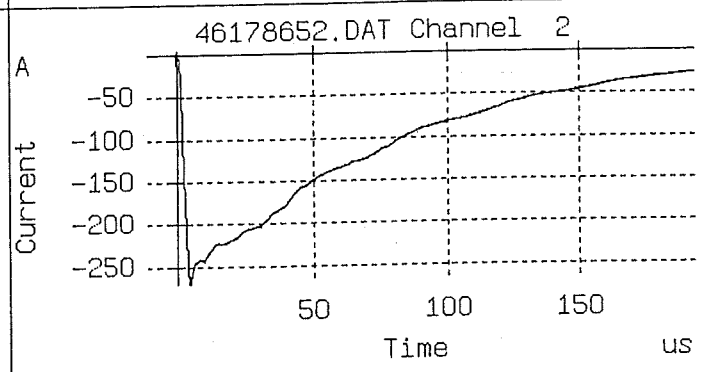


CS 700 100% LI full

-59.86kV T1=1.1us T2=48.7us



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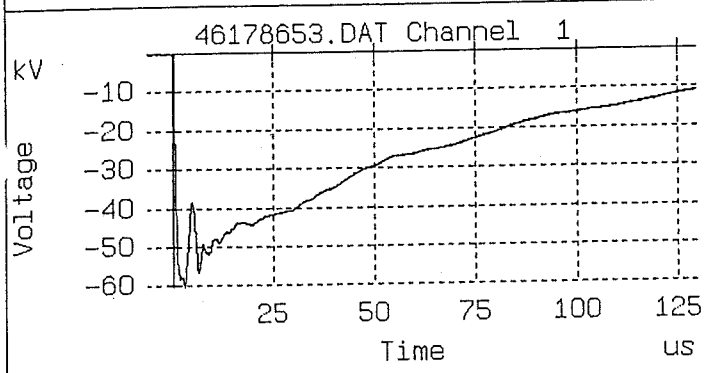
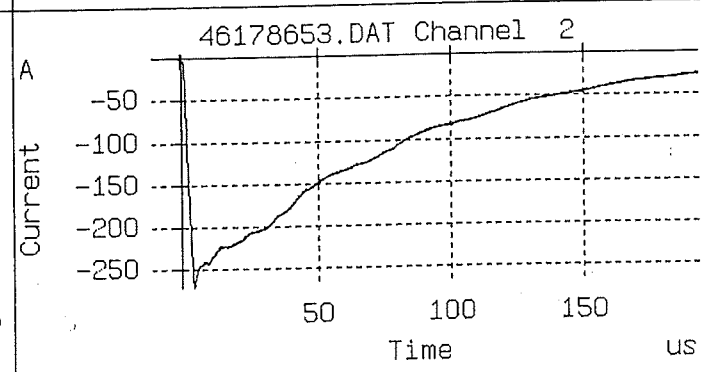


CS 700 100% LI full

-60.01kV T1=1.11us T2=48.3us



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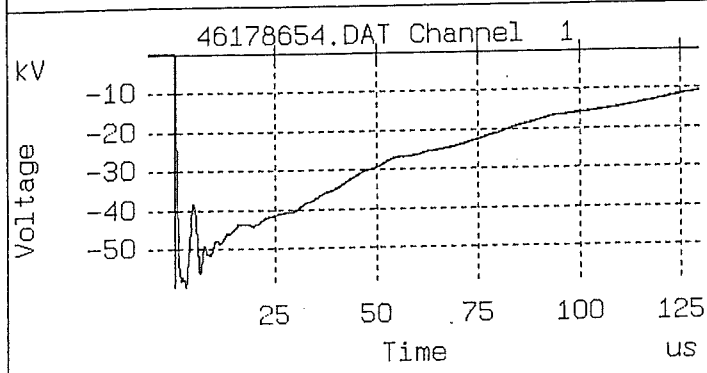
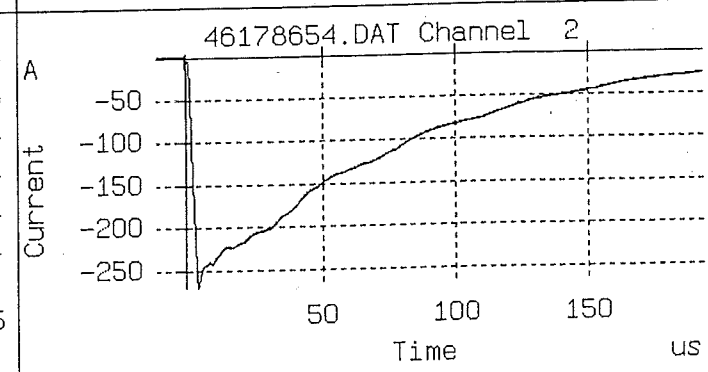


CS 700 100% LI full

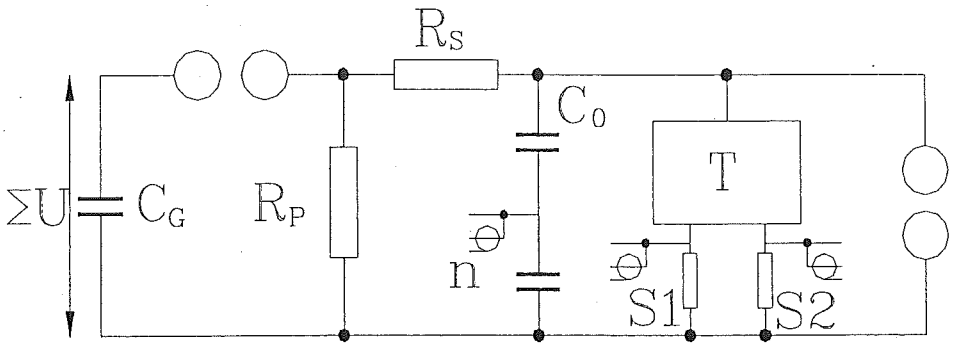
-59.86kV T1=1.11us T2=48.4us



S1 100% LI full

Max:-270A Min:3.281A

7.1 Equivalent lightning impulse circuit



7.2 Impulse circuit ´s constants

	H.V. winding	L.V. winding		
C_G (pF)	75000	300000		
R_S (Ω)	264	206		
R_P (Ω)	3200	800		
C_0 (pF)	1000	1000		
n	497.3	497.3		
S1 (Ω)	1	1		
S2 (Ω)	-	-		