



ABB S.p.A.
Power Grids Division



TEST REPORT

OUTDOOR THREE-PHASE TRANSFORMER

TESTS EXECUTED AT: ABB MONSELICE PLANT - (ITALY)

Doc. N. 1LIT880062K1000

Monselice: 22-23/06/17

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SERIAL NUMBER

1LIT755483-01

ITEM

/

PROJECT

Project P1497- Glassenbury Road

CUSTOMER

ABB Ltd (United Kingdom)

ORDER

TS01-4500783290 of 20/12/2016

FINAL CUSTOMER

G2 Energy Ltd (United Kingdom)

RATED POWER

40000 kVA

COOLING

ONAN

RATED VOLTAGE H.V.

132000 V +9 -9 x 1.670 %

RATED VOLTAGE L.V.

33000 V

RATED CURRENT H.V. ref. to [132000 V]

175.0 A

RATED CURRENT L.V. ref. to [33000 V]

699.8 A

CONNECTION SYMBOL

YNd11

FREQUENCY

50 Hz

REFERENCE STANDARDS

IEC 60076

DURATION OF THE TEST

START:

22/06/2017

END:

23/06/2017

TEST RESULT

SUCCESSFULLY CHECKED

WITNESSED BY

DATE:

Mr. : JAGDEEP SINGH

(G2 ENERGY)

23/6/17

Mr. : HERMAN BAYERN

(NEC)

23/06/17

Mr. : TOM ROBINSON

(NEC)

23/6/17

Mr. : STEVE FREEMAN

(ABB FES U.K.)

23/06/17

Mr. : MASSIMO TRIVELLIN

(ABB S.p.A.)

22-23/06/2017



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OBJECT: TRANSFORMER

SERIAL N°: 1LIT755483-01

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ATTACHED

<input type="checkbox"/>	A	Insulating oil	Page 1 - 1
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<input type="checkbox"/>	C	FRA test	Page 1 ÷ 9

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SUMMARY DATA

	P.E.I.	k P.E.I. x Sn	
	(%)	(MVA)	
REQUIREMENT	99.684		
MEASUREMENT	99.725	11.347	

		REQUIREMENT	TOLERANCE %		MEASUREMENT
			penalties	rejection	
No-load loss at 0.9 x R.V.	(W)				11310
No-load loss at Rated Voltage	(W)	14500	/	+15	15619
No-load loss at 1.1 x R.V.	(W)				28423
No-load current at 0.9 x R.V.	(%)				0.042
No-load current at Rated Voltage	(%)				0.091
No-load current at 1.1 x R.V.	(%)				0.651
Load Loss (W)	referred at ratio 132000/33000 V	185000	/	+15	194103
Short - circuit impedance (%)	POS. 10 40000 kVA	15.00	/	±7.5	15.49
Load Loss (W)	referred at ratio 151840/33000 V				193267
Short - circuit impedance (%)	POS. 1 40000 kVA				16.72
Load Loss (W)	referred at ratio 112160/33000 V				206161
Short - circuit impedance (%)	POS. 19 40000 kVA				14.50
Total Losses (W) referr. at ratio	132000/33000 V	199500	/	+10	209722

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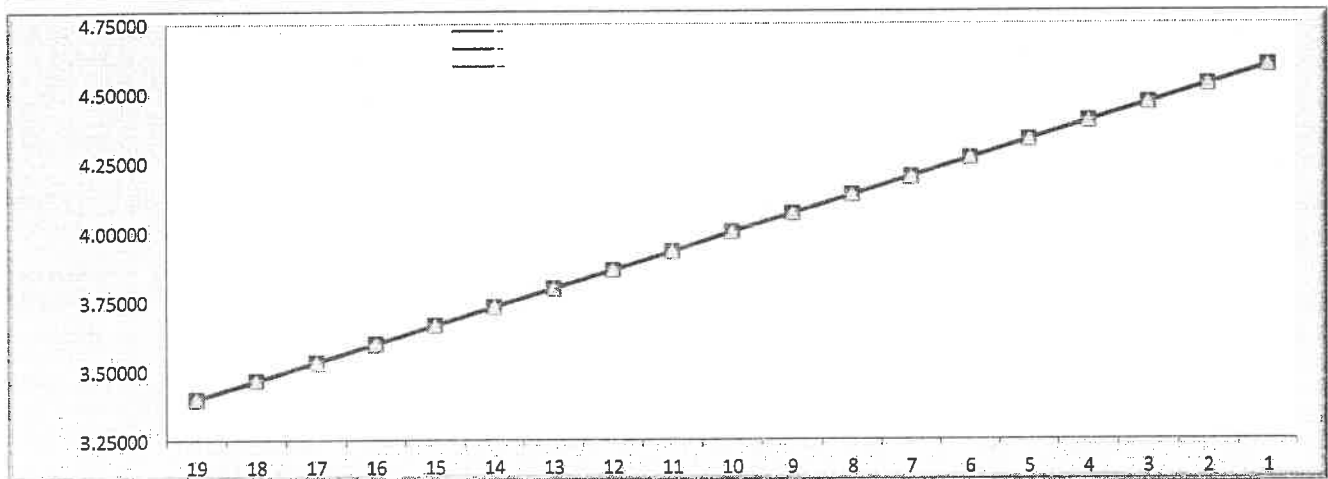
TEST PASSED

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MEASUREMENT OF VOLTAGE RATIO

[illegible]

max IEC tolerance = ± 0.5 % - (on principal tap)



CHECK OF PHASE DISPLACEMENT: Connection symbol YNd11 : VERIFIED

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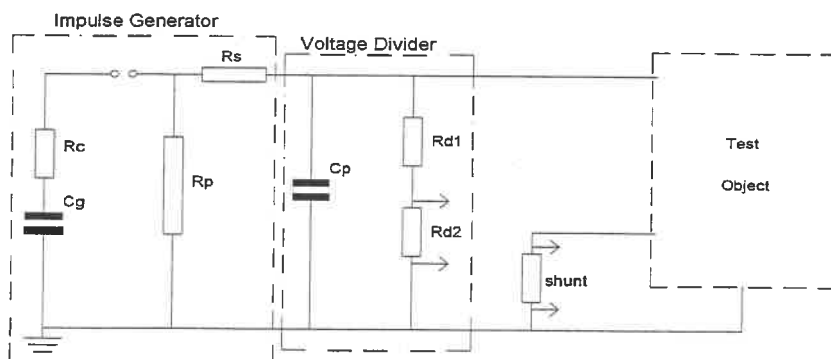
FULL WAVE LIGHTNING IMPULSE TEST (LI)

TEST WINDING: H.V.

TEST VOLTAGE: 550 kV

TERMINAL UNDER TEST	1U	1V	1W	1N	2U	2V	2W	
1U		Connected to Ground	Connected to Ground	Conn. to Ground by Shunt	Connected to Ground	Connected to Ground	Connected to Ground	
1V	Connected to Ground		Connected to Ground	Conn. to Ground by Shunt	Connected to Ground	Connected to Ground	Connected to Ground	
1W	Connected to Ground	Connected to Ground		Conn. to Ground by Shunt	Connected to Ground	Connected to Ground	Connected to Ground	

MEASURED WAVE SHAPE :					Toll. IEC	
Front		0.95		μs	1.2 μs ± 30%	TAP
POLARITY : NEGATIVE		Tail		43.4	μs	Chang.
		Reverse polarity		12.8	%	Pos.
Oscill. N°	Testing voltage kV %		terminal	note		
1	275.0	50	1U	reduced full wave		19
2	"	"	"	reduced full wave		
3	550.0	100	"	full wave		
4	"	"	"	full wave		
5	"	"	"	full wave		
6	275.0	50	1V	reduced full wave		10
7	550.0	100	"	full wave		
8	"	"	"	full wave		
9	"	"	"	full wave		
10	275.0	50	1W	reduced full wave		1
11	550.0	100	"	full wave		
12	"	"	"	full wave		
13	"	"	"	full wave		



Circuit parameters

Rs =	308	ohm
Rp =	638	ohm
Cp =	420	pF
Rd1 =	300	ohm
Rd2 =	Signal	
shunt =	0.5	ohm



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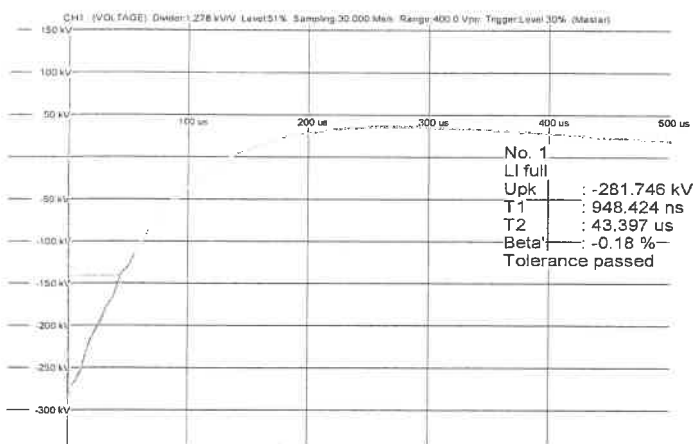
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FULL WAVE LIGHTNING IMPULSE (LI) TEST

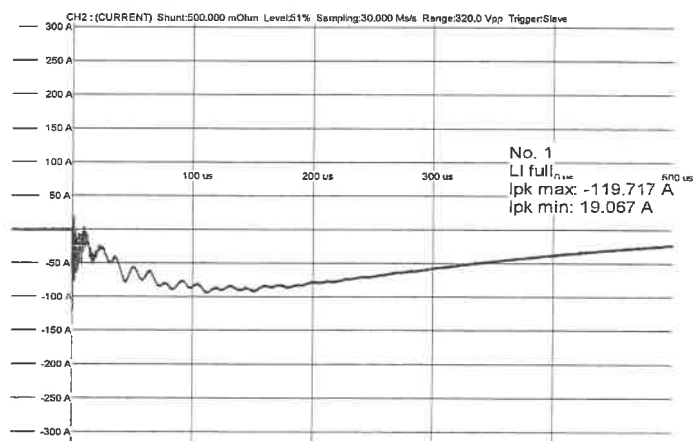
TEST WINDING:

1U

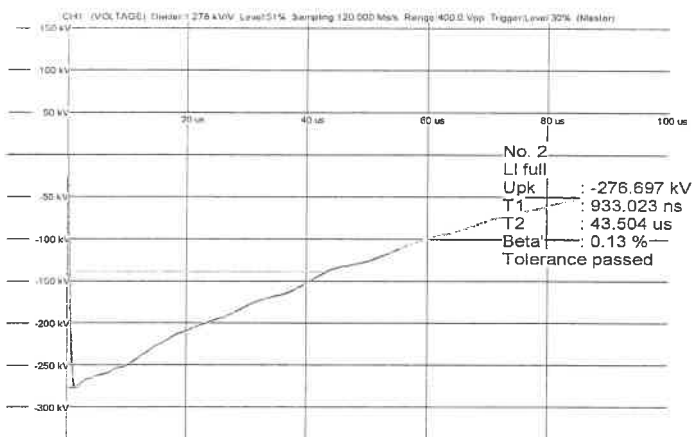
CH: 1 VOLTAGE N° 1



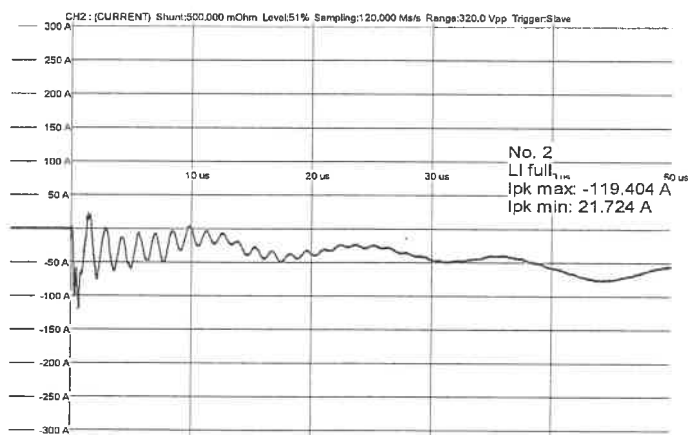
CH: 2 CURRENT N° 1



CH: 1 VOLTAGE N° 2



CH: 2 CURRENT N° 2



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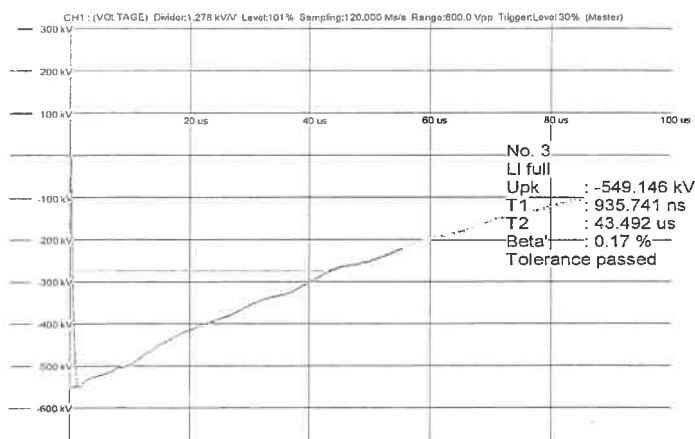
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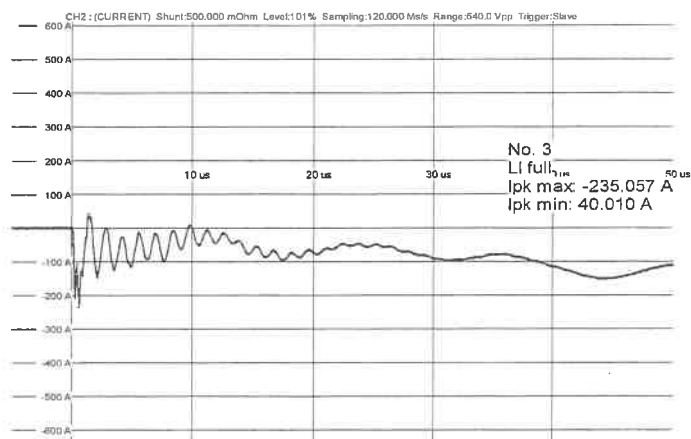
FULL WAVE LIGHTNING IMPULSE (LI) TEST

TEST WINDING: 4U

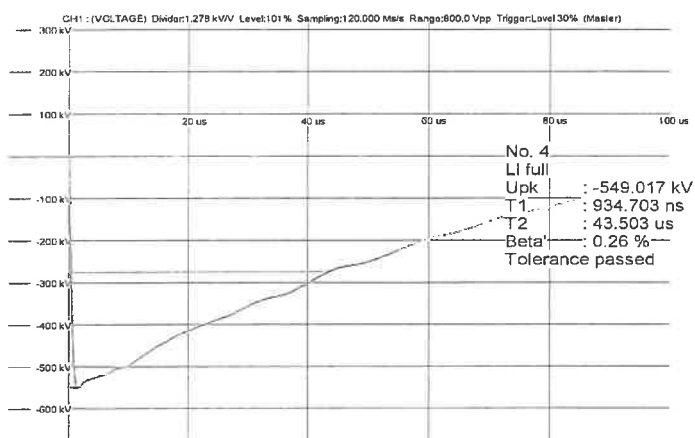
CH: 1 VOLTAGE N° 3



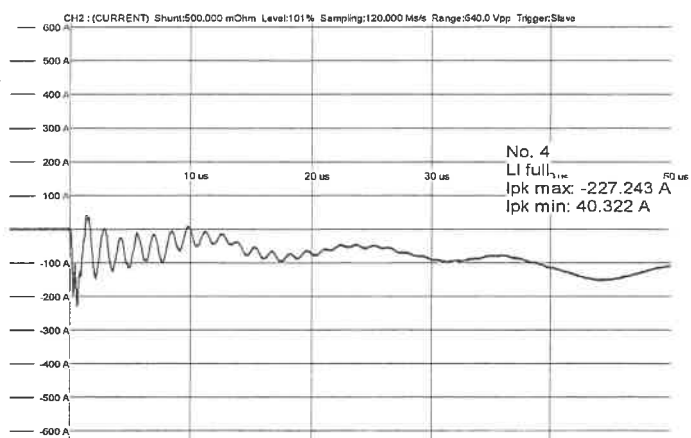
CH: 2 CURRENT N° 3



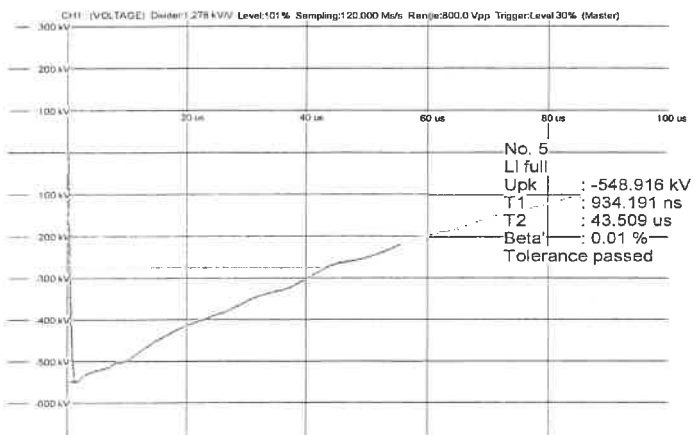
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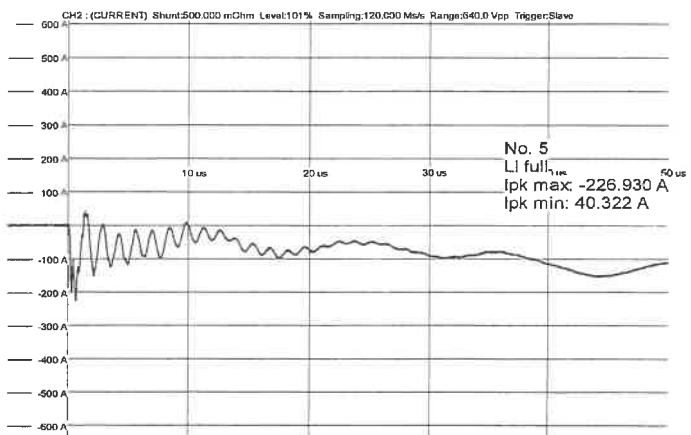
CH: 2 CURRENT N° 4



CH: 1 VOLTAGE N° 5



CH: 2 CURRENT N° 5



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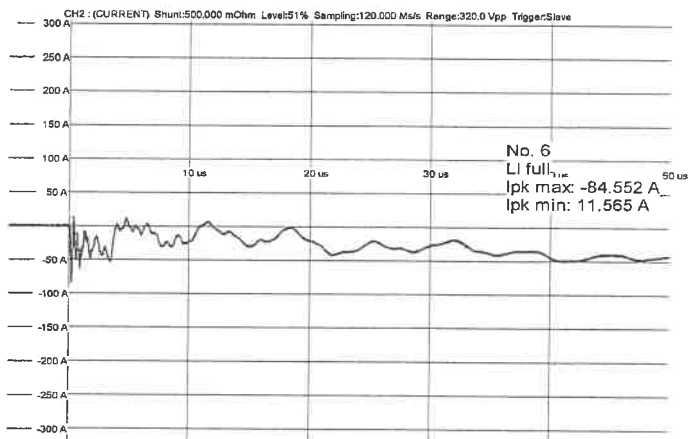
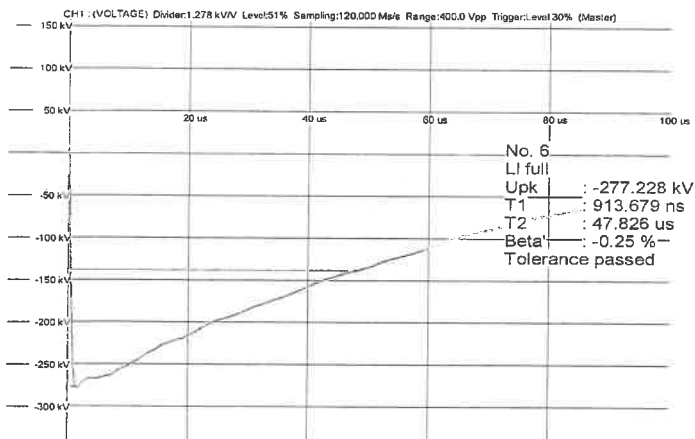
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FULL WAVE LIGHTNING IMPULSE (LI) TEST

TEST WINDING: 1V

CH: 1 VOLTAGE N° 6

CH: 2 CURRENT N° 6



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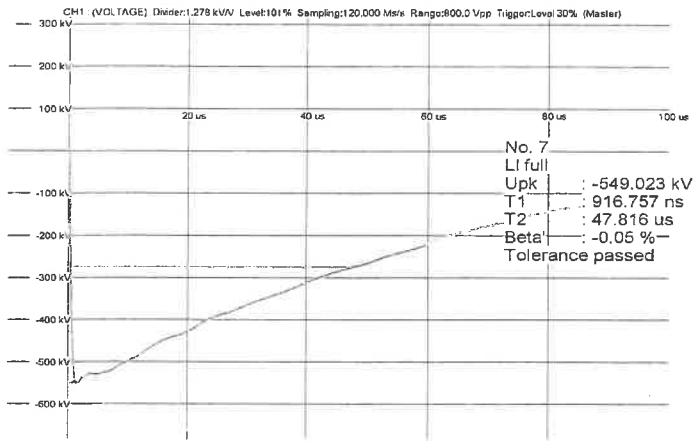
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FULL WAVE LIGHTNING IMPULSE (LI) TEST

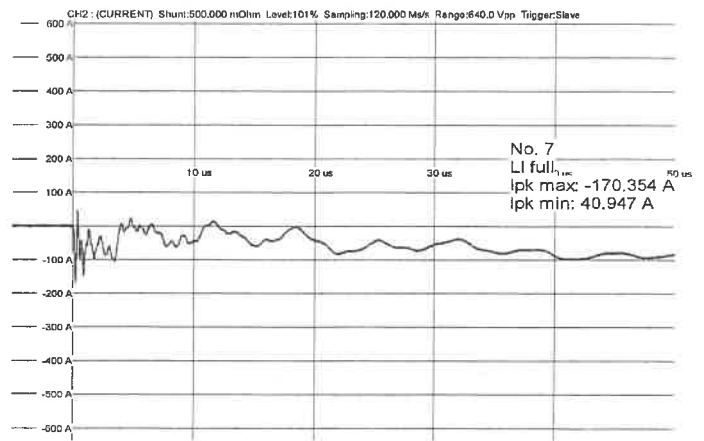
TEST WINDING:

1V

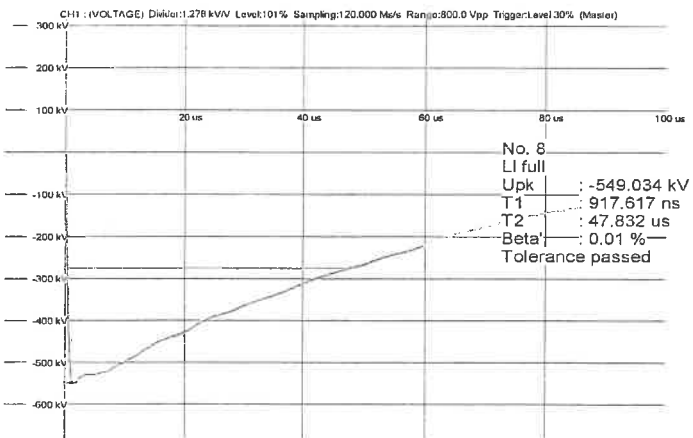
CH: 1 VOLTAGE N° 7



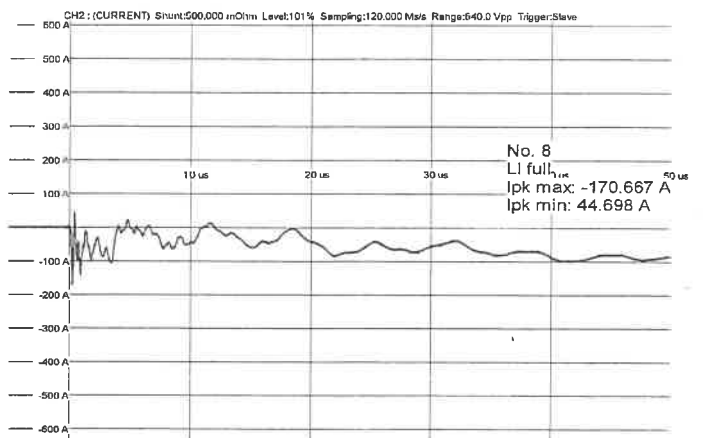
CH: 2 CURRENT N° 7



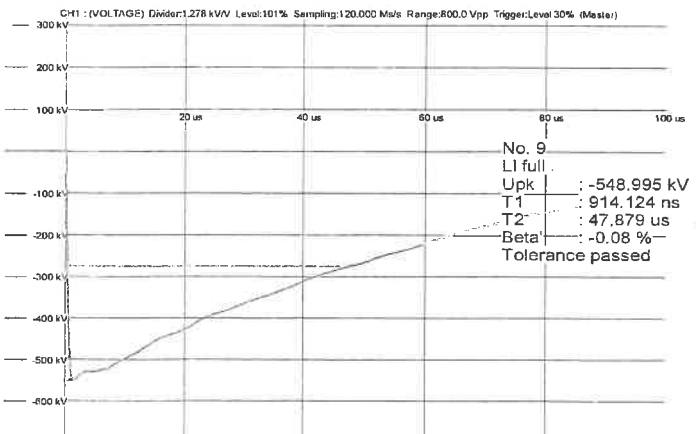
CH: 1 VOLTAGE N° 8



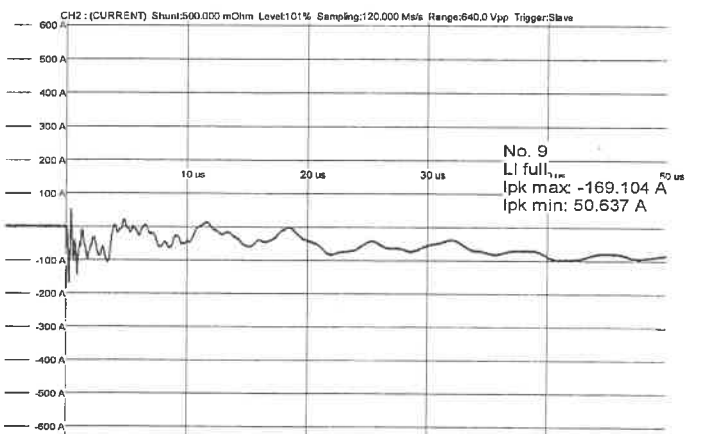
CH: 2 CURRENT N° 8



CH: 1 VOLTAGE N° 9



CH: 2 CURRENT N° 9



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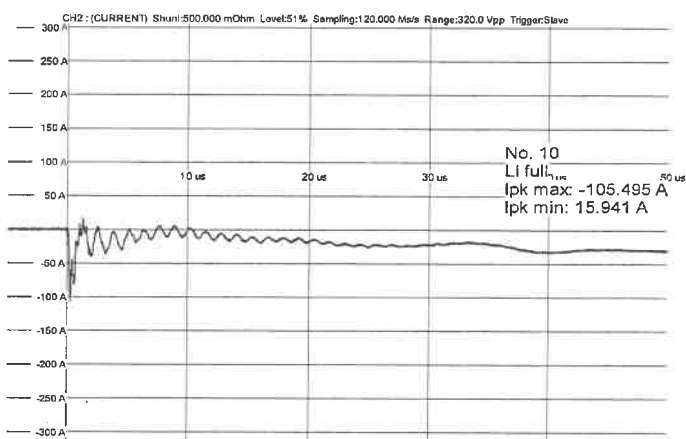
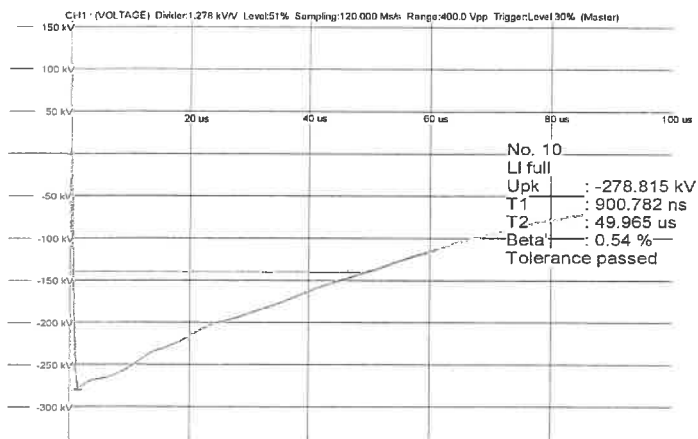
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FULL WAVE LIGHTNING IMPULSE (LI) TEST

TEST WINDING: 1W

CH: 1 VOLTAGE N°10

CH: 2 CURRENT N°10



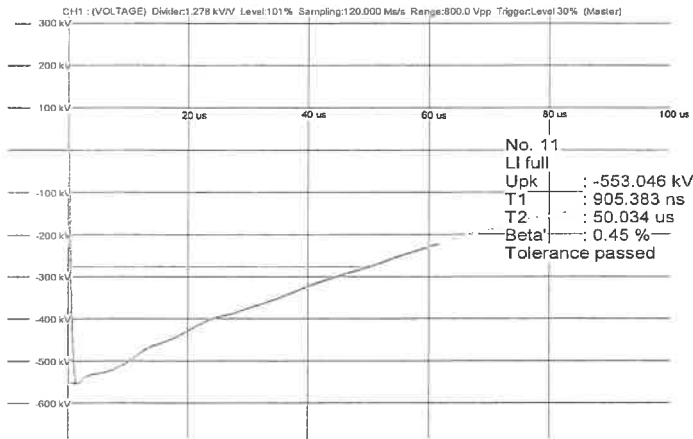
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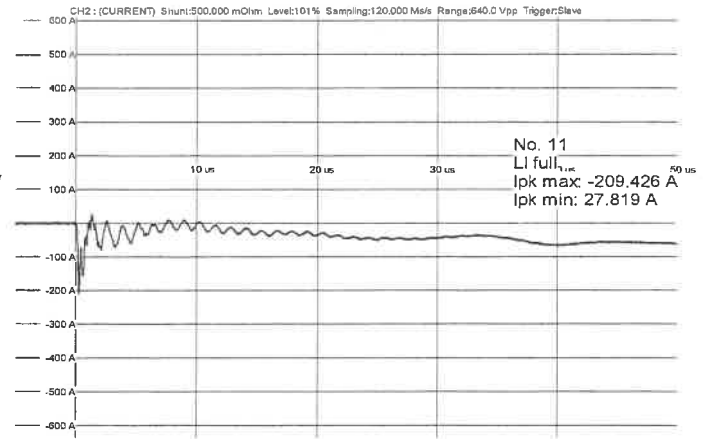
FULL WAVE LIGHTNING IMPULSE (LI) TEST

TEST WINDING: 1W

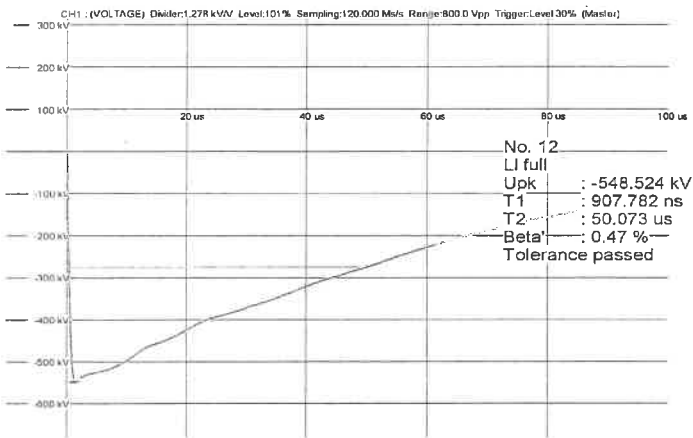
CH: 1 VOLTAGE N°11



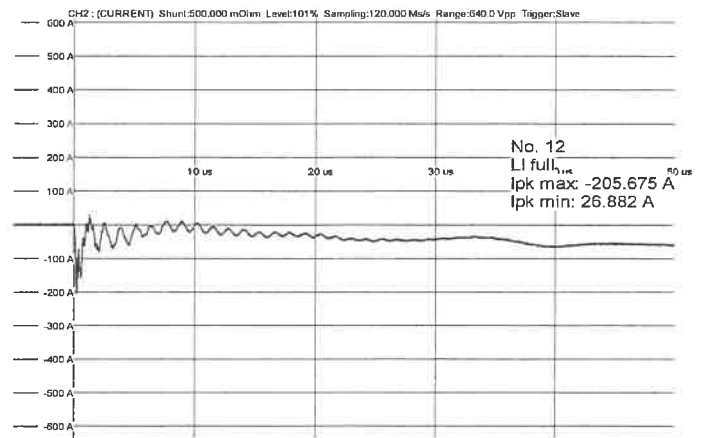
CH: 2 CURRENT N°11



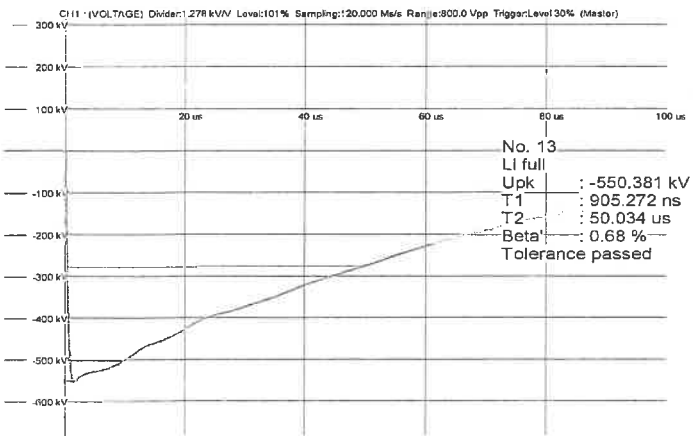
CH: 1 VOLTAGE N°12



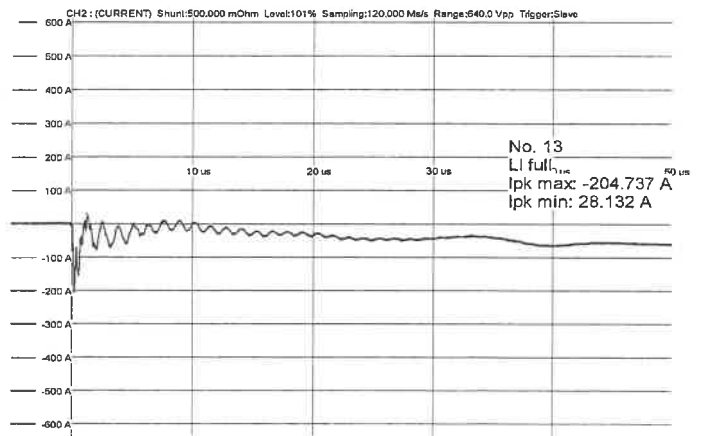
CH: 2 CURRENT N°12



CH: 1 VOLTAGE N°13






CH: 2 CURRENT N°13



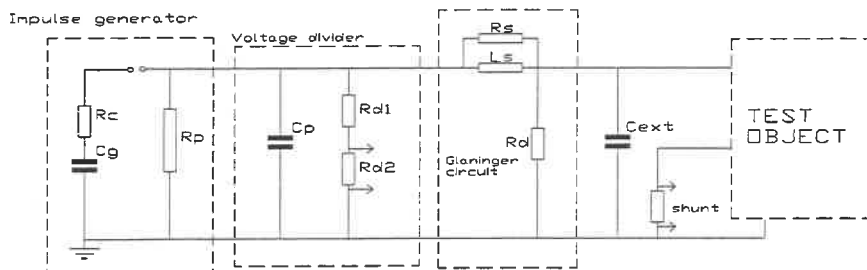
FULL WAVE LIGHTNING IMPULSE TEST (LI)

TEST WINDING: **L.V.**

TEST VOLTAGE: **170** kV

TERMINAL UNDER TEST	2U	2V	2W		1U	1V	1W	1N
2U		Connected to the other phase not tested and both connected to ground through shunt	Connected to the other phase not tested and both connected to ground through shunt		Connected to Ground	Connected to Ground	Connected to Ground	Connected to Ground
2V	Connected to the other phase not tested and both connected to ground through shunt		Connected to the other phase not tested and both connected to ground through shunt		Connected to Ground	Connected to Ground	Connected to Ground	Connected to Ground
2W	Connected to the other phase not tested and both connected to ground through shunt	Connected to the other phase not tested and both connected to ground through shunt			Connected to Ground	Connected to Ground	Connected to Ground	Connected to Ground

MEASURED WAVE SHAPE :					Toll. IEC	
Polarity: NEGATIVE						
Front					1.07 μ s	1.2 μ s \pm 30%
Tail					44.9 μ s	50 μ s \pm 20%
Reverse polarity					7.0 %	<50%
Oscill. N°	Testing voltage		terminal	note		TAP
	kV	%				Chang.
						Pos.
1	85.0	50	2U	reduced full wave		
2	"	"	"	reduced full wave		
3	170.0	100	"	full wave		
4	"	"	"	full wave		
5	"	"	"	full wave		
6	85.0	50	2V	reduced full wave		
7	170.0	100	"	full wave		
8	"	"	"	full wave		
9	"	"	"	full wave		
10	85.0	50	2W	reduced full wave		
11	170.0	100	"	full wave		
12	"	"	"	full wave		
13	"	"	"	full wave		



Circuit parameters

R_s =	59	ohm
R_p =	34	ohm
C_p =	420	pF
R_{d1} =	300	ohm
R_{d2} =	Signal	
shunt =	0.1	ohm
L_s =	0.4	mH
R_d =	125	ohm



OBJECT: TRANSFORMER

Monselice: 22-23/06/17

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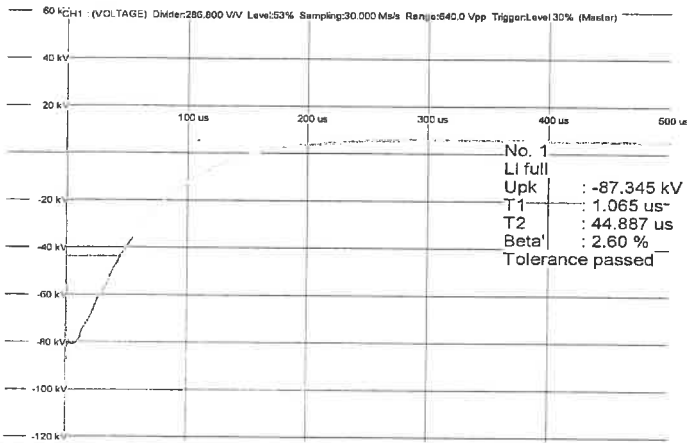
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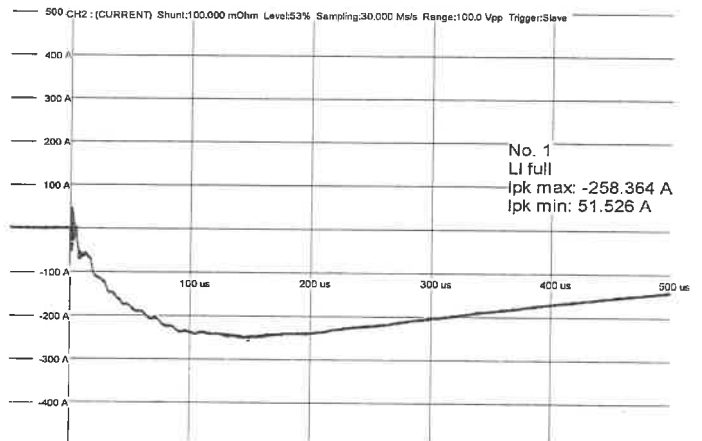
FULL WAVE LIGHTNING IMPULSE (LI) TEST

TEST WINDING: 20

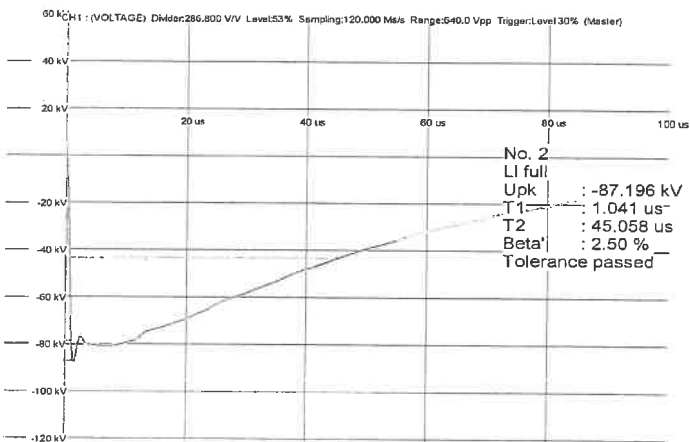
CH: 1 VOLTAGE N° 1



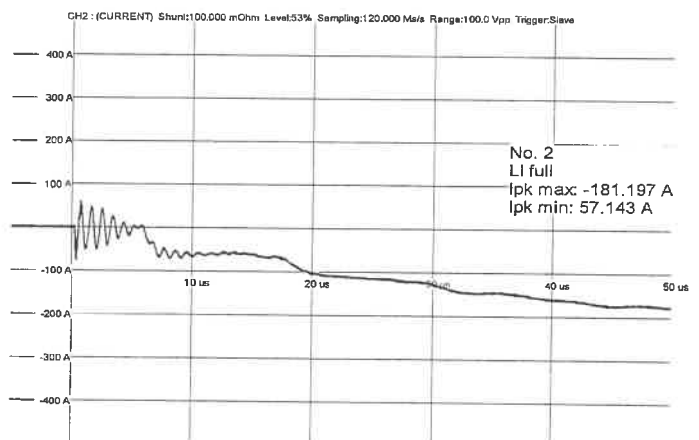
CH: 2 CURRENT N° 1



CH: 1 VOLTAGE N° 2



CH: 2 CURRENT N° 2



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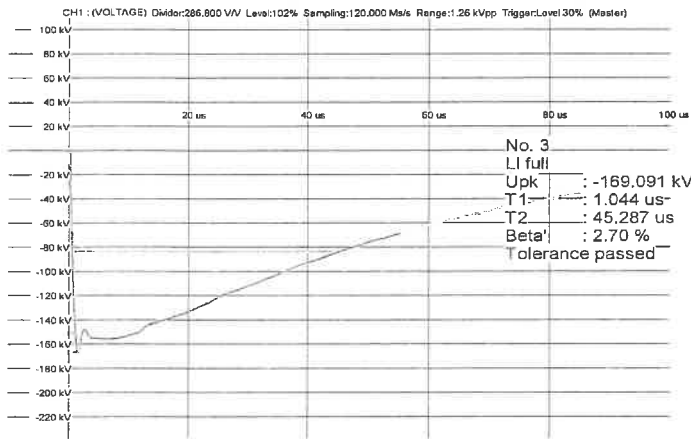
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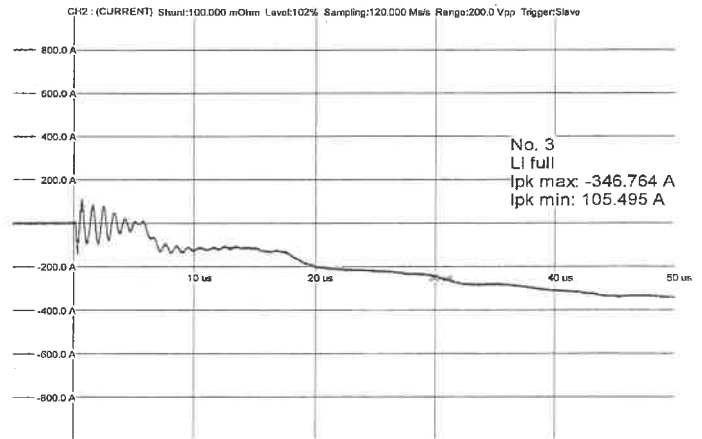
FULL WAVE LIGHTNING IMPULSE (LI) TEST

TEST WINDING: 2U

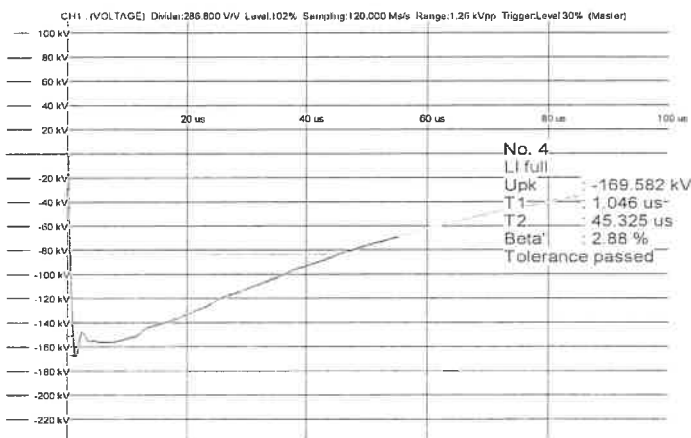
CH: 1 VOLTAGE N° 3



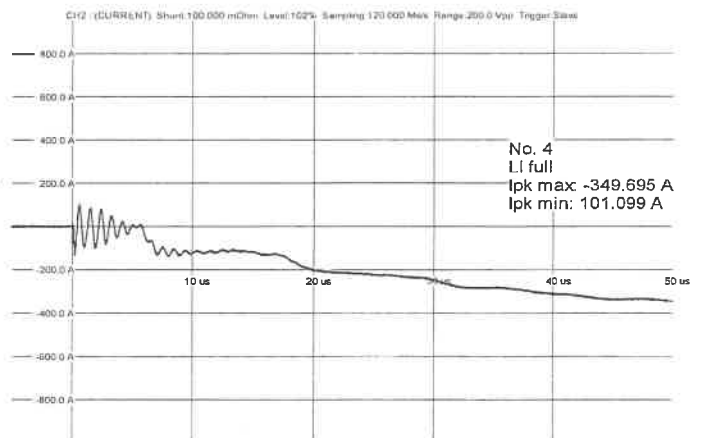
CH: 2 CURRENT N° 3



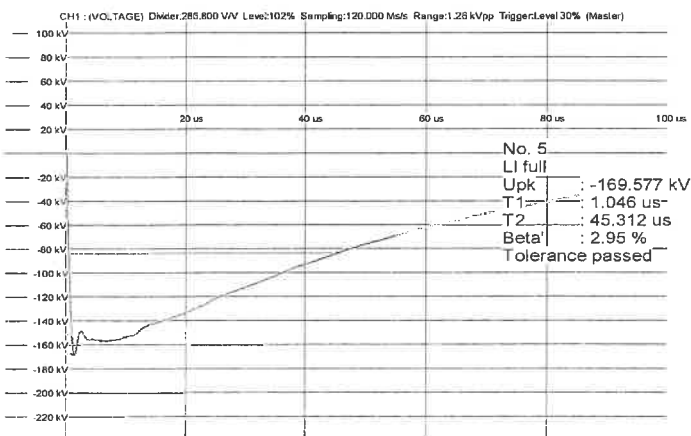
CH: 1 VOLTAGE N° 4



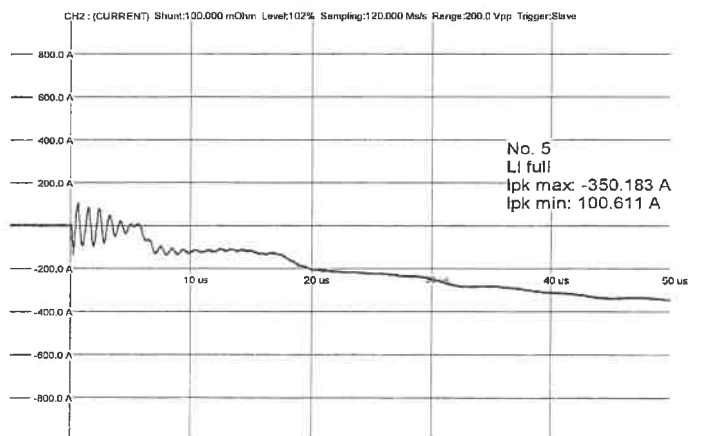
CH: 2 CURRENT N° 4



CH: 1 VOLTAGE N° 5



CH: 2 CURRENT N° 5



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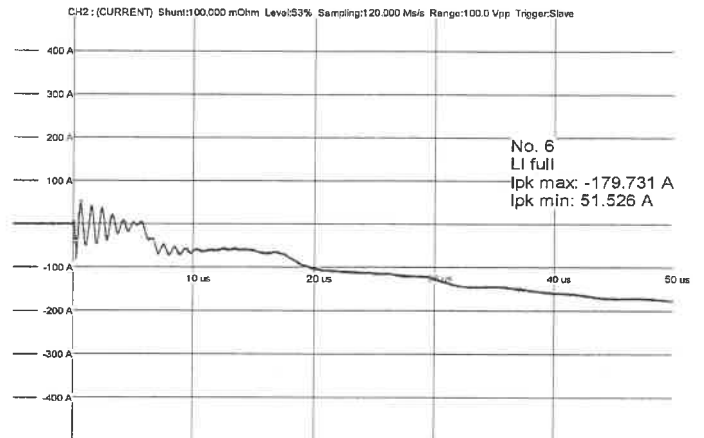
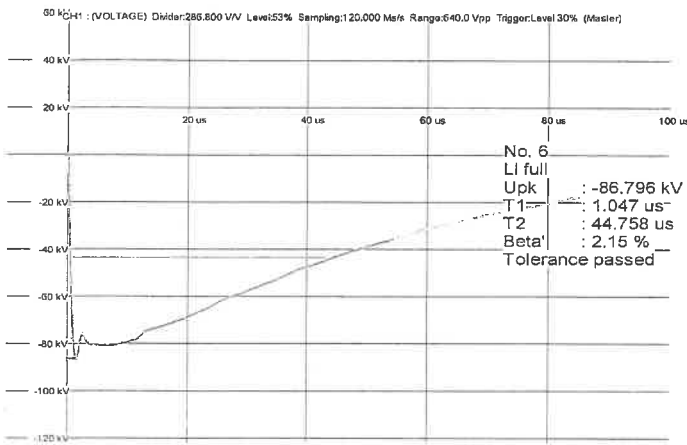
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FULL WAVE LIGHTNING IMPULSE (LI) TEST

TEST WINDING: 2V

CH: 1 VOLTAGE N° 6

CH: 2 CURRENT N° 6



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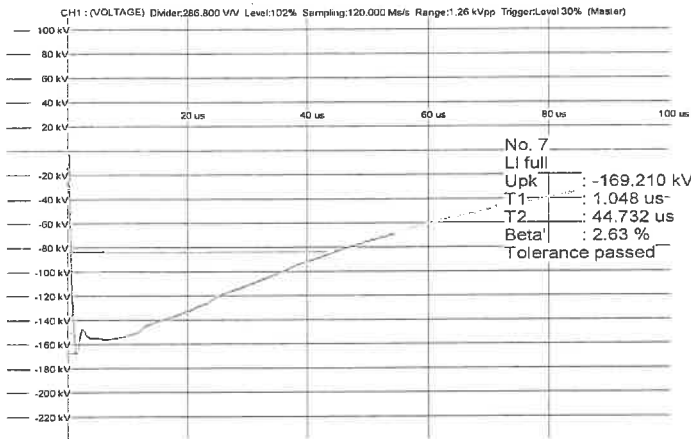
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FULL WAVE LIGHTNING IMPULSE (LI) TEST

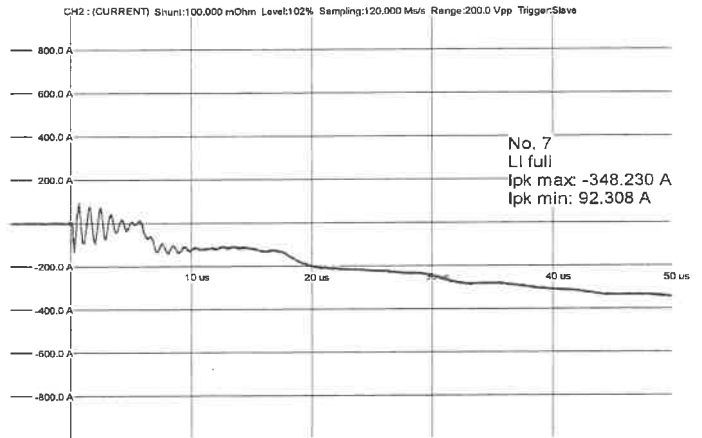
TEST WINDING:

2V

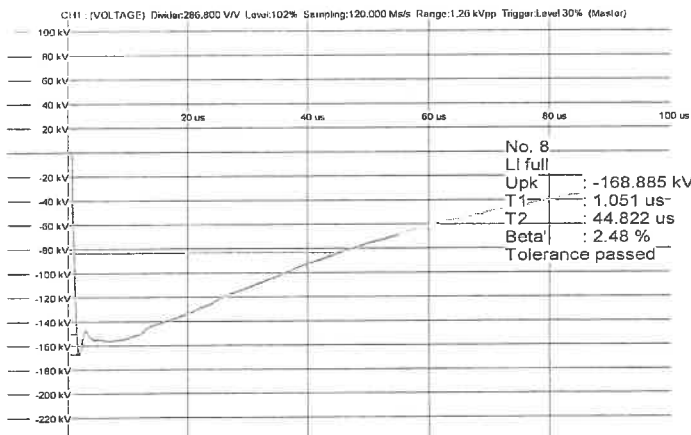
CH: 1 VOLTAGE N° 7



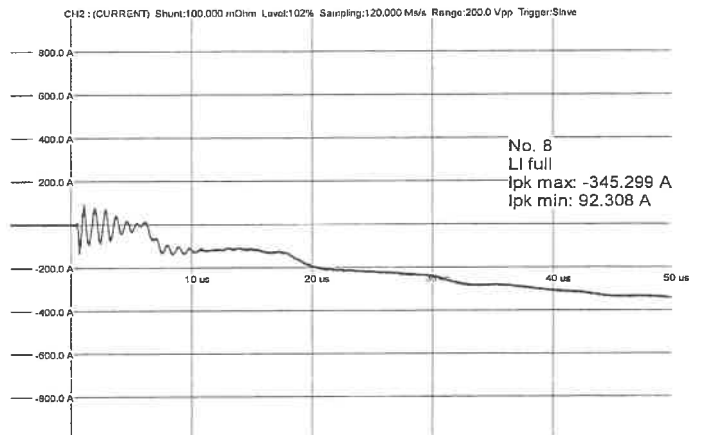
CH: 2 CURRENT N° 7



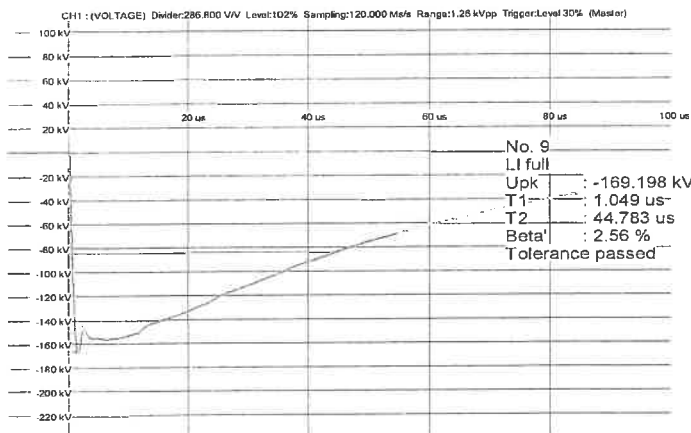
CH: 1 VOLTAGE N° 8



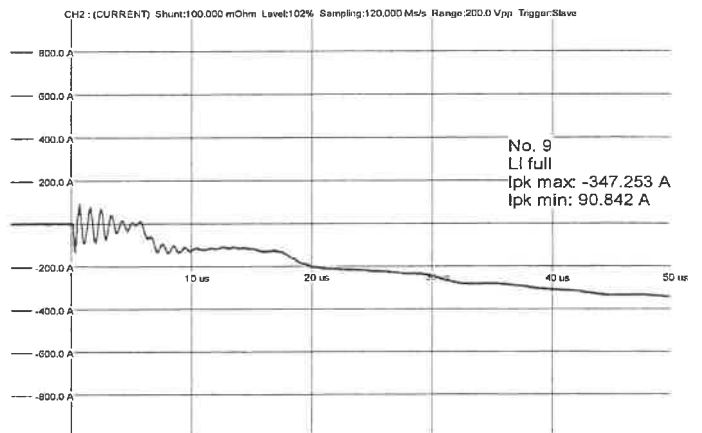
CH: 2 CURRENT N° 8



CH: 1 VOLTAGE N° 9



CH: 2 CURRENT N° 9



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OBJECT: TRANSFORMER

Monselice: 22-23/06/17

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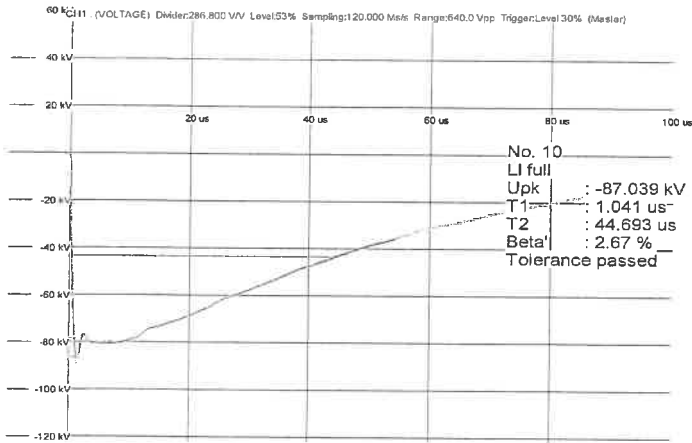
FULL WAVE LIGHTNING IMPULSE (LI) TEST

TEST WINDING: 2W

CH: 1

VOLTAGE

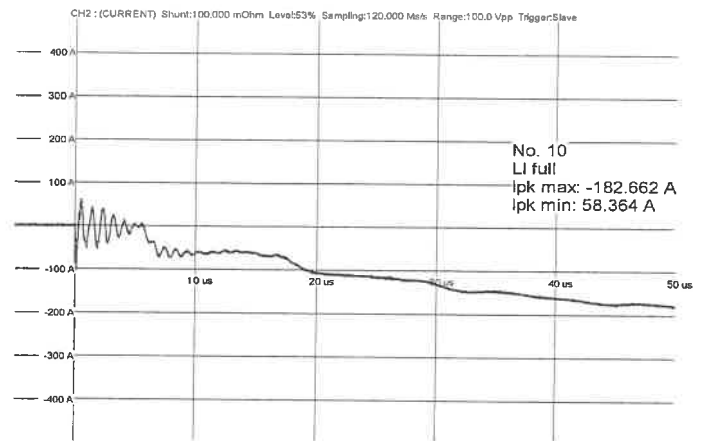
N°10



CH: 2

CURRENT

N°10



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OBJECT: TRANSFORMER

Monselice: 22-23/06/17

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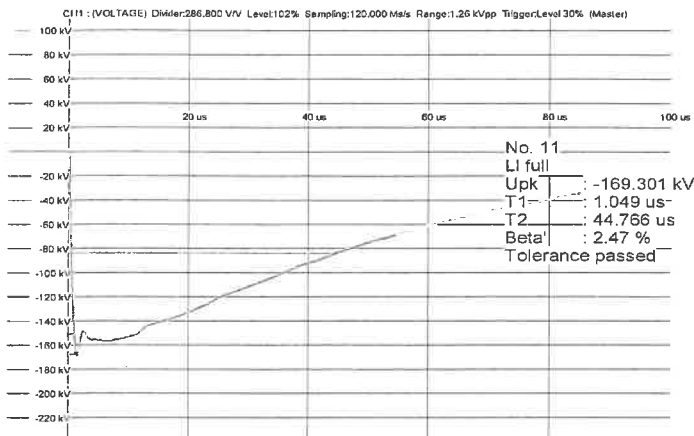
SERIAL N°: 1LIT755483-01

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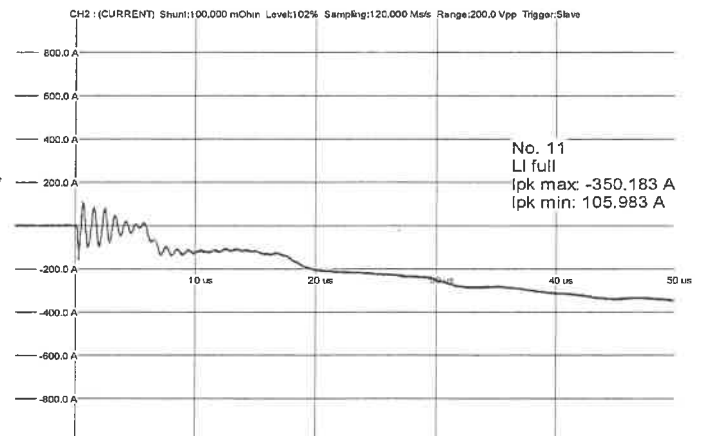
FULL WAVE LIGHTNING IMPULSE (LI) TEST

TEST WINDING: ZW

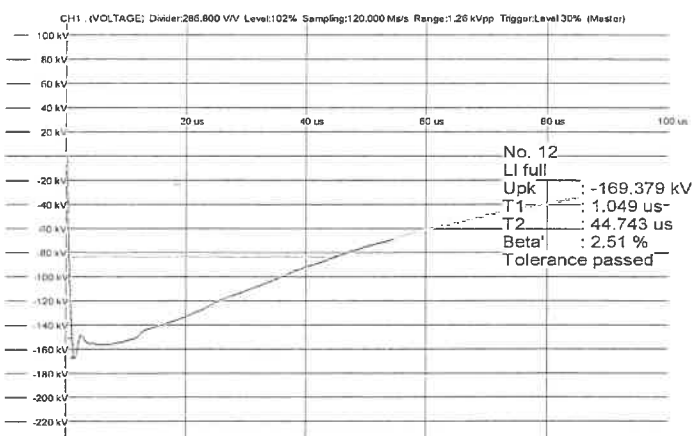
CH: 1 VOLTAGE N°11



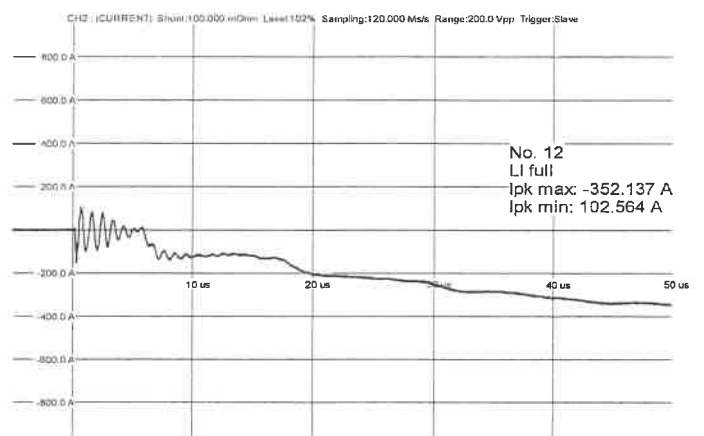
CH: 2 CURRENT N°11



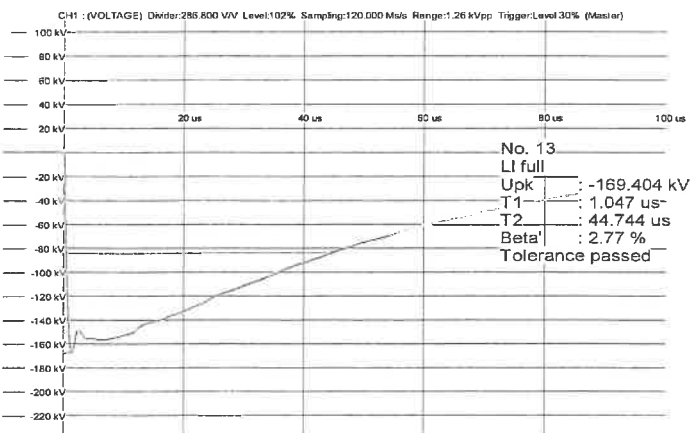
CH: 1 VOLTAGE N°12



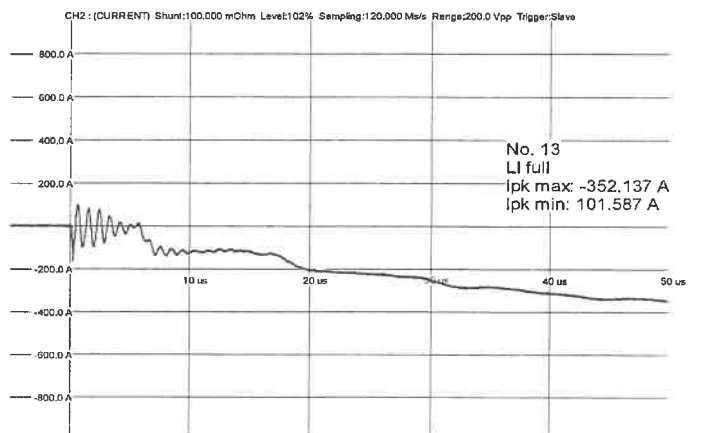
CH: 2 CURRENT N°12



CH: 1 VOLTAGE N°13



CH: 2 CURRENT N°13



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APPLIED VOLTAGE TEST (AV)
(Test frequency 50 Hz - test time 60 sec.)

HV WINDING ENERGIZED TEST VOLTAGE : **95 kV**

RATIO OF HIGH VOLTAGE DIVIDER: 2452.0 rms

LV WINDING ENERGIZED TEST VOLTAGE : **70 kV**

RATIO OF HIGH VOLTAGE DIVIDER: 2452.0 rms

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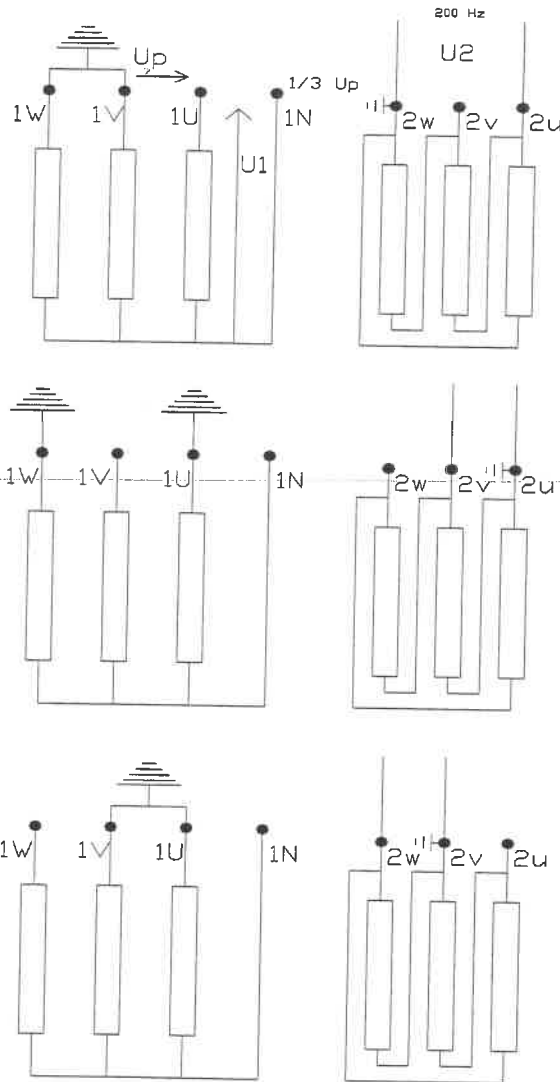
2

TEST PASSED

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LINE TERMINAL AC WITHSTAND TEST (LTAC)

(test frequency 200 Hz - test time 30 sec.)



Tap Changer Position : 10 (132000V) - $K = (132000/1,732/33000) = 2,3094$

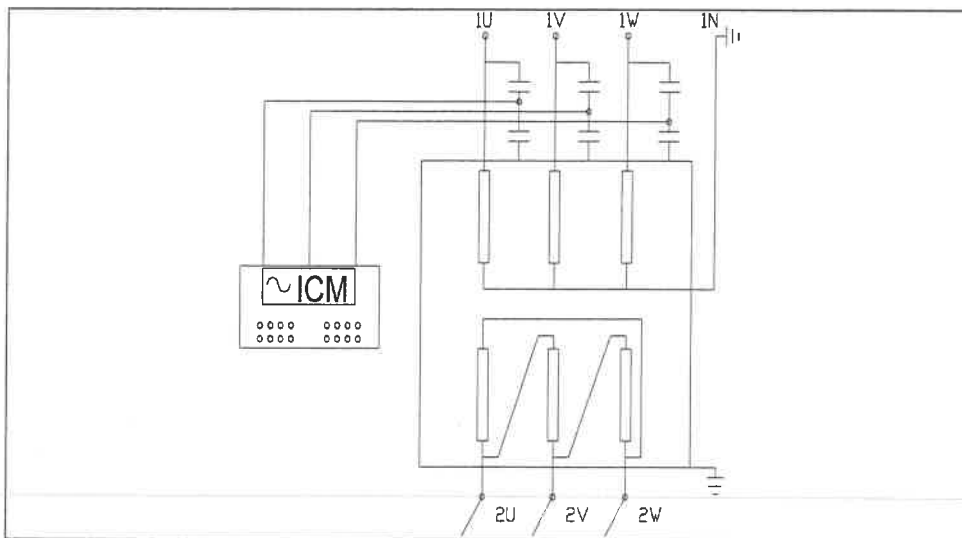
$U_m = 145 \text{ kV}$

$U_p = 230 \text{ kV}$

$U_1 = 2/3 \times U_p = 2/3 \times 230 = 153.3 \text{ kV}$

$U_2 = U_1/K = 153.3/2.3094 = 66.395 \text{ kV}$

Induced Voltage test with partial discharge measurement (IVPD)
test frequency 200 Hz



H.V. Tap Changer Position: 10 (132000 V) - $K = 132000/33000 = 4.0000$

$U_r = 132 \text{ kV}$

TIME	VOLTAGE		VOLTAGE	PHASE	PHASE	PHASE	REQUIREMENT
	H.V.		L.V.	1U	1V	1W	
(min.)		(kV)	(kV)	(pC)	(pC)	(pC)	(pC)
0	0	0.0	0.000	<10	<12	<10	< 50
1	$0.4 \times U_r$	52.8	13.200	<15	<15	<15	
1	$1.2 \times U_r$	158.4	39.600	<20	<20	<20	
5	$1.58 \times U_r$	208.6	52.140	<20	<20	<20	
0.5	$2 \times U_r$	264.0	66.000	/	/	/	
One hour	0	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	5	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	10	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	15	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	20	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	25	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	30	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	35	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	40	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	45	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	50	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	55	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	60	$1.58 \times U_r$	208.6	<20	<20	<20	< 250
	1	$1.2 \times U_r$	158.4	<20	<20	<20	<100
	1	$0.4 \times U_r$	52.8	<15	<15	<15	

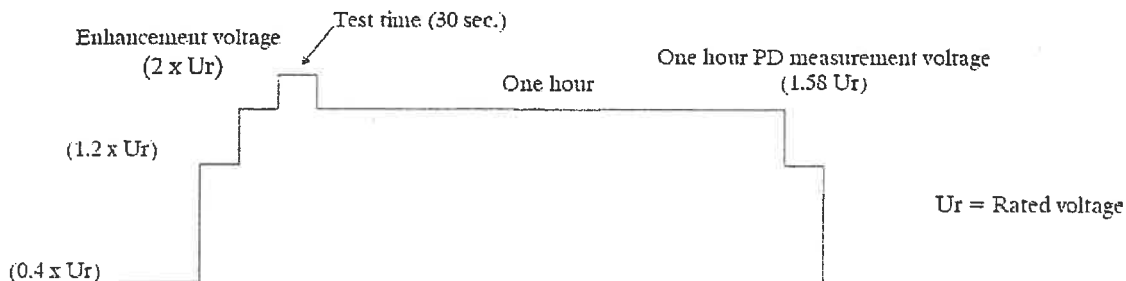




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OBJECT: TRANSFORMER

SERIAL N°: 1LIT755483-01

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NO-LOAD LOSS AND CURRENT MEASUREMENT

Winding energized: **33.000 kV**

Frequency: **50 Hz**

	RMS VOLTAGE			MEAN VALUE VOLTAGE		
	V12 (kV)	V23 (kV)	V31 (kV)	V12 (kV)	V23 (kV)	V31 (kV)
110 % x Un	35.520	35.615	35.423	35.061	35.336	35.048
105 % x Un	34.920	35.002	34.840	34.618	34.856	34.596
Un	33.011	33.063	32.968	32.922	33.044	32.891
95 % x Un	31.380	31.418	31.355	31.345	31.419	31.318
90 % x Un	29.886	29.914	29.872	29.871	29.921	29.850

CURRENT			LOSSES		
I1 (A)	I2 (A)	I3 (A)	W1 (kW)	W2 (kW)	W3 (kW)
2.910	2.620	2.461	10.601	1.849	9.714
1.970	1.723	1.609	9.326	2.361	8.535
0.747	0.607	0.573	6.778	3.001	5.780
0.452	0.336	0.337	5.659	2.887	4.614
0.340	0.229	0.255	4.924	2.660	3.911

RMS VOLTAGE (kV)	MEAN VALUE VOLTAGE (kV)	CURRENT (A)	MEASURED LOSS (kW)	CORRECTED LOSS (kW)
35.519	35.148	2.664	22.164	21.930
34.921	34.690	1.767	20.222	20.088
33.014	32.952	0.642	15.559	15.530
31.384	31.361	0.375	13.160	13.150
29.891	29.881	0.275	11.495	11.491

DATA FROM CURVE OF NO-LOAD TEST:

ref: 40000 (kVA)	0.9 x Rated Voltage	Rated Voltage	1,1 x Rated Voltage
Loss (kW)	11.310	15.619	28.423
L.V. Current (A)	0.293	0.639	4.555
H.V. Current (A)	0.073	0.160	1.139
Percentage of R.C. (%)	0.042	0.091	0.651

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Power Grids Division

OBJECT: TRANSFORMER

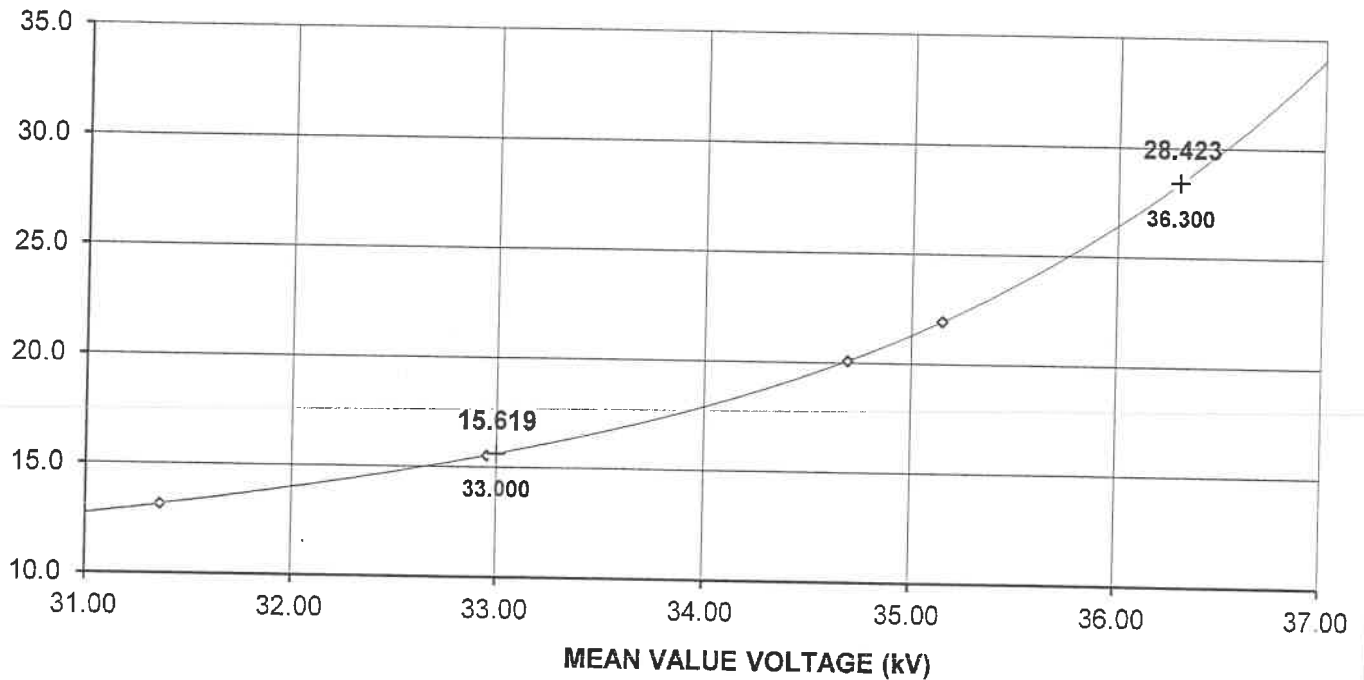
SERIAL N°: 1LIT755483-01

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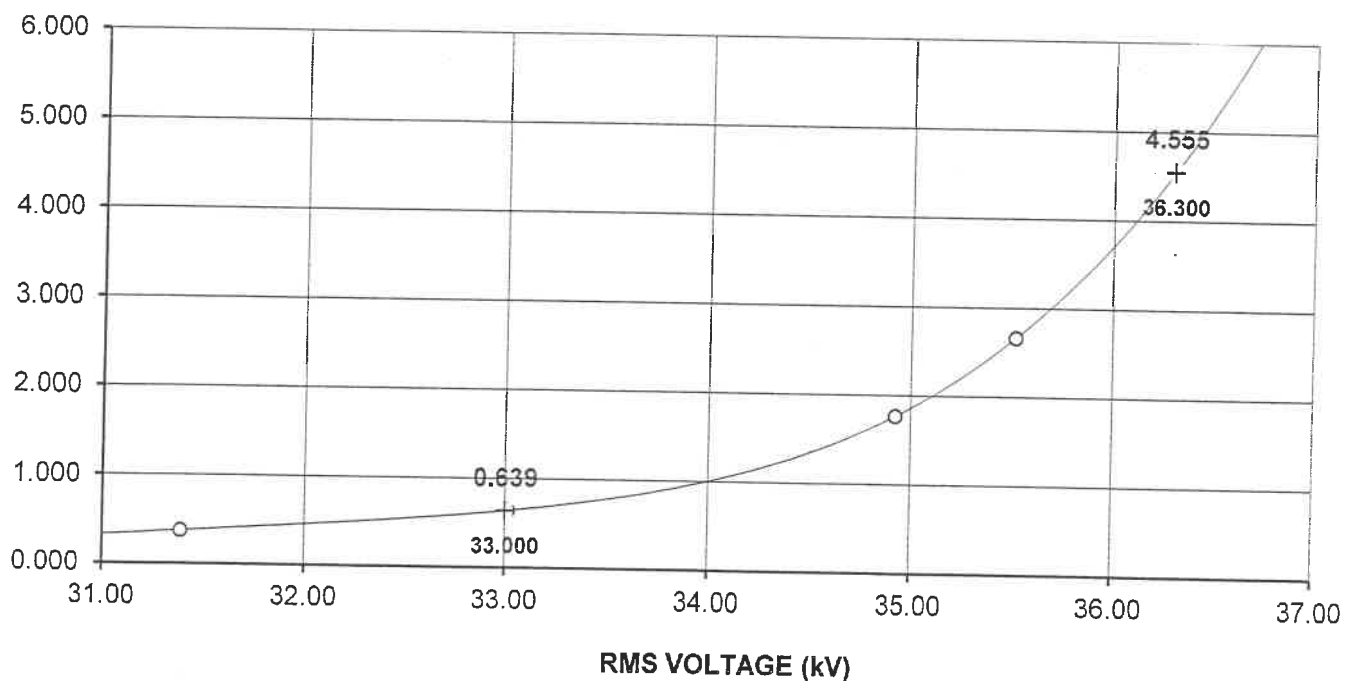
P_o (kW)

NO-LOAD LOSSES



I_o (A)

NO-LOAD CURRENT



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OBJECT: TRANSFORMER

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RESISTANCE MEASUREMENT BETWEEN TWO PHASES

Temp. = 28.8 °C

Windings: Cu

Kt ref. at 75.0 °C = 1.17513

Tap Changer Position	Terminals	Meas. R (Ω)	Average R (Ω)	R 75.0 °C (Ω)	Tap Changer Position	Terminals	Meas. R (Ω)	Average R (Ω)	R 75.0 °C (Ω)
19	1U - 1V	1.4723	1.4669	1.7238	2	1U - 1V	2.1584	2.1590	2.5371
	1V - 1W	1.4659				1V - 1W	2.1597		
	1W - 1U	1.4624				1W - 1U	2.1588		
18	1U - 1V	1.5150	1.5130	1.7779	1	1U - 1V	2.2057	2.2063	2.5927
	1V - 1W	1.5130				1V - 1W	2.2071		
	1W - 1U	1.5109				1W - 1U	2.2061		
17	1U - 1V	1.5649	1.5617	1.8352					
	1V - 1W	1.5600							
	1W - 1U	1.5602							
16	1U - 1V	1.6116	1.6087	1.8904					
	1V - 1W	1.6069							
	1W - 1U	1.6076							
15	1U - 1V	1.6602	1.6569	1.9471					
	1V - 1W	1.6548							
	1W - 1U	1.6558							
14	1U - 1V	1.7061	1.7037	2.0021					
	1V - 1W	1.7019							
	1W - 1U	1.7031							
13	1U - 1V	1.7541	1.7498	2.0563					
	1V - 1W	1.7475							
	1W - 1U	1.7479							
12	1U - 1V	1.8030	1.7978	2.1127					
	1V - 1W	1.7942							
	1W - 1U	1.7963							
11	1U - 1V	1.8474	1.8447	2.1678					
	1V - 1W	1.8426							
	1W - 1U	1.8442							
10	1U - 1V	1.7704	1.7723	2.0827					
	1V - 1W	1.7743							
	1U - 1W	1.7722							
9	1U - 1V	1.8247	1.8249	2.1445					
	1V - 1W	1.8250							
	1W - 1U	1.8249							
8	1U - 1V	1.8718	1.8728	2.2008					
	1V - 1W	1.8735							
	1W - 1U	1.8732							
7	1U - 1V	1.9210	1.9211	2.2576					
	1V - 1W	1.9212							
	1W - 1U	1.9212							
6	1U - 1V	1.9679	1.9685	2.3132					
	1V - 1W	1.9688							
	1W - 1U	1.9688							
5	1U - 1V	2.0157	2.0160	2.3691					
	1V - 1W	2.0162							
	1W - 1U	2.0162							
4	1U - 1V	2.0629	2.0634	2.4247					
	1V - 1W	2.0638							
	1W - 1U	2.0634							
3	1U - 1V	2.1107	2.1111	2.4808	33000 V	2U - 2V	0.090537	0.090622	0.106493
	1V - 1W	2.1116				2V - 2W	0.090688		
	1W - 1U	2.1109				2W - 2U	0.090641		

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Power Grids Division

OBJECT: TRANSFORMER

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RESISTANCE MEASUREMENT BETWEEN TWO PHASES

Temp. = 28.8 °C

Windings H.V.: Cu

Kt ref. at 75.0 °C = 1.17513

Windings L.V.: Cu

Kt ref. at 75.0 °C = 1.17513

Sn (kVA)	H.V. (V)	Terminals	Measure R (Ω)	Average R at 28.8 °C (Ω)	Average R at 75.0 °C (Ω)	RI ² at 28.8 °C (W)	RI ² at 75.0 °C (W)	In (A)
40000	Pos. 10 132000	1U - 1V	1.7704	1.7723	2.0827	81373	95624	175.0
		1V - 1W	1.7743					
		1W - 1U	1.7722					
40000	Pos. 1 151840	1U - 1V	2.2057	2.2063	2.5927	76557	89965	152.1
		1V - 1W	2.2071					
		1W - 1U	2.2061					
40000	Pos. 19 112160	1U - 1V	1.4723	1.4669	1.7238	93283	109620	205.9
		1V - 1W	1.4659					
		1W - 1U	1.4624					
Sn (kVA)	L.V. (V)	Terminals	Measure R (Ω)	Average R at 28.8 °C (Ω)	Average R at 75.0 °C (Ω)	RI ² at 28.8 °C (W)	RI ² at 75.0 °C (W)	In (A)
40000	33000	2U - 2V	0.090537	0.090622	0.106493	66573	78232	699.8
		2V - 2W	0.090688					
		2W - 2U	0.090641					

LOAD LOSS MEASUREMENT

Winding Energized: H.V - Shorted: L.V.

Temp. = 28.8 °C

Test frequency = 50 Hz

Sn (kVA)	VOLTAGE				CURRENT				LOSSES			
	V12 (V)	V23 (V)	V31 (V)	Vm (V)	I1 (A)	I2 (A)	I3 (A)	Im (A)	W1 (W)	W2 (W)	W3 (W)	ΣW (W)
Pos. 10	20492	20470	20137	20366	173.9	175.1	173.7	174.3	76895	47440	45928	170263
40000	20614	20450	20279	20448	175.0	175.0	175.0	175.0	77815	47346	46578	171739
Pos. 1	21967	22009	21770	21915	131.2	131.2	131.5	131.3	68036	14950	45649	128635
40000	25461	25518	25185	25388	152.1	152.1	152.1	152.1	91402	20098	61092	172592
Pos. 19	15683	15686	15389	15586	196.6	198.7	196.6	197.3	87170	28974	49814	165958
40000	16428	16253	16114	16265	205.9	205.9	205.9	205.9	95648	31107	54616	181371

ΣRI ² at 28.8 °C (W)	ΣRI ² at 75.0 °C (W)	Load L. at In (W)	add. at 28.8 °C (W)	add. at 75.0 °C (W)	Load L. 75.0 °C (W)	ZI at 28.8 °C (%)	XI at 50 Hz (%)	RI at 28.8 °C (%)	RI at 75.0 °C (%)	ZI at 75.0 °C (%)	cos Φ 75.0 °C
40000 kVA											
Pos. 10	147945	173856	171739	23794	20248	194103	15.49	15.48	0.4293	0.4853	15.49
Pos. 1	143130	168196	172592	29462	25071	193267	16.72	16.71	0.4315	0.4832	16.72
Pos. 19	159855	187851	181371	21516	18309	206161	14.50	14.49	0.4534	0.5154	14.50
										X/R	
										31.91	
										34.59	
										28.12	

ABB

TEST PASSED

Inspector

INSULATION TEST AND FUNCTIONAL VERIFICATION OF THE AUXILIARY

- ☒ 1 - Power frequency voltage withstand test: 2 kV (A.C.) for 1 min.
- ☒ 2 - Functional auxiliary components check.
- ☒ 3 - Current transformers ratio and polarity check

PAINTING CHECK

cycle: 1LIT880062T0011
color: RAL DESIGN 080 70 05

required thickness: nom. 240 µm

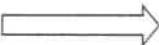

Tank:	(µm)	260	÷	320
Cover:	(µm)	260	÷	320
Conserv.	(µm)	260	÷	320

VISUAL AND DIMENSIONAL CHECK

- ☒ 1 - Verification with drawing 1LIT880062T0001

Rev. B of 07/03/17


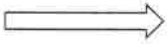

MEASUREMENT OF THE INSULATION RESISTANCE OF CORE AND YOKE

- ☒ 1 - CORE  ground = 7.61 Gohm
- ☒ 1 - YOKE  ground = 5.02 Gohm

Ambient temperature = 28.8 °C - time = 1 min.

(supply voltage = 2.5 kV D.C.)

MEASUREMENT OF THE INSULATION RESISTANCE OF WINDINGS

- ☒ 1 - H.V.  L.V. + GROUND 8.63 Gohm
- ☒ 2 - L.V.  H.V. + GROUND 10.50 Gohm
- ☒ 3 - H.V. + L.V.  GROUND 8.47 Gohm

Ambient temperature = 28.8 °C - time = 1 min.

(supply voltage = 5 kV D.C.)

TESTS ON ON-LOAD TAP CHANGER

- n° 8 complete operating cycles with the transformer un-energized ;
- n° 1 complete operating cycle with the transformer un-energized, with the auxiliary voltage reduced to 85% of the rated value;
- n° 1 complete operating cycle with the transformer energized at the rated voltage and frequency at no-load;
- n° 10 tap-changer operations with ±2 steps on either side of the principal tapping with as far as possible the rated current of the transformer, with one winding short-circuited.

LEAK TESTING WITH PRESSURE

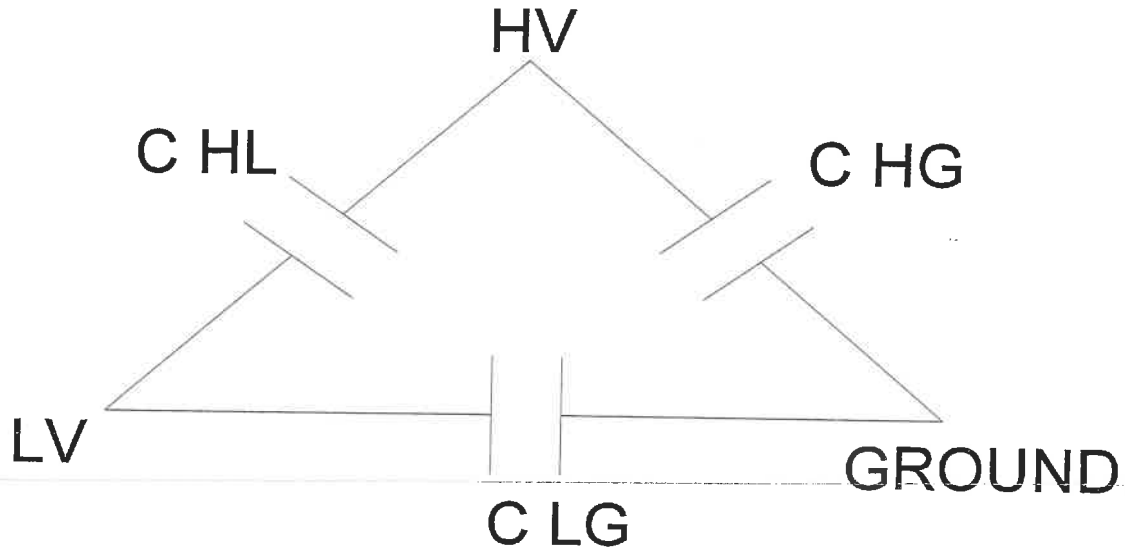
The tank over-pressure test was performed on sealed tank, filled with oil subjected to an over pressure of 30 kPa measured on the bottom of the tank. The duration of test was 24 hours. No leakage was detected.

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Power Grids Division

OBJECT: TRANSFORMER

SERIAL N°: 1LIT755483-01

Monselice: 22-23/06/17

page 27 / 29**MEASUREMENT OF DISSIPATION FACTOR AND CAPACITANCES OF THE INSULATION SYSTEM**

MEASUREMENT	Tgδ (%) at 30.2 °C	Tgδ (%) ref. at 20 °C	Capacitance (pF)
C_{HL}	0.17	0.13	4302
C_{HG}	0.36	0.28	3185
C_{LG}	0.29	0.23	7927

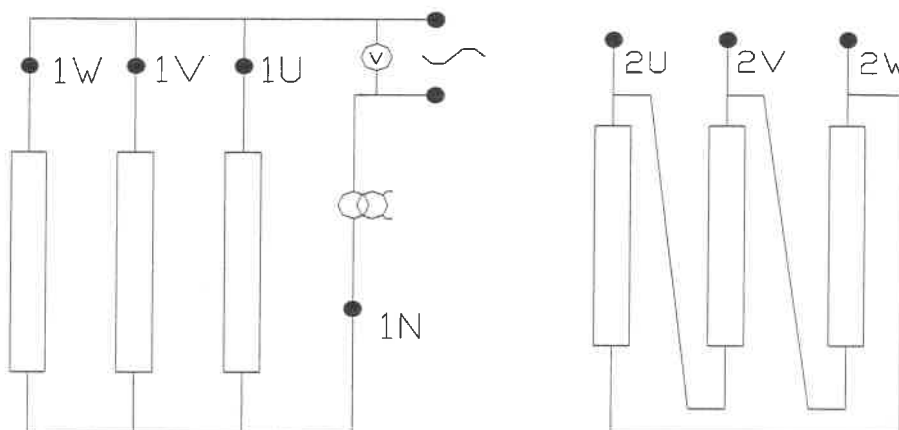
Test Voltage = 10 kV

Ambient Temperature = 30.2 °C

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TEST PASSED

Inspector

MEASUREMENT OF ZERO-SEQUENCE IMPEDANCE

Tap Changer Position: 10

V _m (V)	I _m (A)	Z = (V _m /I _m) x 3 (Ω/phase)	V Phase (V)	I Phase (A)	Z _T (Ω)	Z (%)	S _n (kVA)
1867.0	88.9	63.02	76210.3	175.0	435.6	14.47	40000

Tap Changer Position: 1

V _m (V)	I _m (A)	Z = (V _m /I _m) x 3 (Ω/phase)	V Phase (V)	I Phase (A)	Z _T (Ω)	Z (%)	S _n (kVA)
2407.0	81.1	89.03	87664.7	152.1	576.4	15.45	40000

Tap Changer Position: 19

V _m (V)	I _m (A)	Z = (V _m /I _m) x 3 (Ω/phase)	V Phase (V)	I Phase (A)	Z _T (Ω)	Z (%)	S _n (kVA)
1205.0	84.0	43.04	64755.9	205.9	314.5	13.69	40000

 Note: Z % = (Z / Z_T) x 100

Temp. = 28.8 °C

INSTRUMENTS USED FOR TESTS**MEASUREMENT OF VOLTAGE RATIO AND CHECK OF VECTORIAL GROUP**

- Winding analyser Tettex 2293 sr. n. ABB (ERM 005)

LIGHTNING IMPULSE TEST

- High voltage divider HAEFELY sr. n. ABB (EDT 003).
- High resolution impulse analyzing system Haefely Hias 743 sr. n. ABB (EIS 002).

APPLIED VOLTAGE TEST (AV)

- Peak voltmeter MAKANG sr. n. (EMD 006).
- High voltage divider HUAGAO sr. n. ABB (EDT 004).

INDUCED VOLTAGE TEST WITH PARTIAL DISCHARGE MEASUREMENT (IVPD)

- Digital voltmeter red lion type PAHX sr. n. ABB (EMD 022-023-024)
- N. 3 High voltage dividers Haefely TK 100 sr. n. ABB (EDT 013-014-015).
- Calibrator POWER DIAGNOSTIX sr. n° ABB (ECS 003).

MEASUREMENT OF NO-LOAD LOSS AND CURRENT

- AC power analyzer NORMA cl. 0,1 type 5000 sr. n. ABB (EAP 006)
- Transformer measurement system Haefely 580 sr. n. ABB (ESM 002)

MEASUREMENT OF WINDING RESISTANCE

- Winding analyser Tettex 2293 sr. n. ABB (ERM 005)

MEASUREMENT OF SHORT-CIRCUIT IMPEDANCE AND LOAD LOSS

- AC power analyzer NORMA cl. 0,1 type 5000 sr. n. ABB (EAP 006)
- Transformer measurement system Haefely 580 sr. n. ABB (ESM 002)

AUXILIARY CIRCUIT CHECK

- SCHLEICH mod. GLP2-i sr. n. ABB (EPD 001)

PAINTING CHECK

- Thickness gauge MEGA-CHECK type Master sr. n. ABB (ESP 002).

MEASUREMENT OF INSULATION RESISTANCE OF CORE AND WINDINGS

- Megger MIT520 sr. n. ABB (MGG 003).

MEASUREMENT OF DISSIPATION FACTOR AND CAPACITANCES

- Tettex Micro Midas 2883 sr. n. ABB (EP 003).

MEASUREMENT OF ZERO-SEQUENCE IMPEDANCE

- AC power analyzer NORMA cl. 0,1 type 5000 sr. n. ABB (EAP 006)
- Transformer measurement system Haefely 580 sr. n. ABB (ESM 002)

FREQUENCY RESPONSE ANALYSIS

- Sweep frequency response analyzer MEGGER type FRAX 101 sr. n. ABB (EOS 013)

Inspectorate Antwerp NV
Romeynswael 14
2030 Antwerpen
Belgium

Tel: +32 (0)3 546 08 88
Fax: +32 (0)3 546 08 80
operations@inspectorate.be
www.inspectorate.com



INSPECTORATE

Certificate of Analysis

PRODUCT: Nytro Libra
BATCH NO: 74-T453-170604
BATCH REF NO: N2017/9093/LN11244

DELIVERED FROM: Shoretank 453
DATE BATCH: 05-juni-2017
LOCATION: LBC - Antwerp

Analysis from shoretank performed by Inspectorate Antwerp NV:

Analysis	Method	Unit	Results
Density at 15°C (vac.)	ASTM D4052 / ISO 12185	kg/dm ³	0,8790
Density at 20°C (vac.)	ASTM D4052 / ISO 12185	kg/dm ³	0,8759
Viscosity at 40°C	ASTM D445 / ISO 3104	mm ² /s	9,79
Flash point, PM	ASTM D93A / ISO 2719	°C	149
Colour ASTM	ASTM D1500		L 0,5
Neutralization value	ASTM D974 / IEC 62021	mgKOH/g	< 0,01
Inhibitor content	IEC 60666	% b.w.	< 0,01
Interfacial tension at 25°C	ASTM D971 / EN 14210	mN/m	45,2
Ag-corrosion	DIN 51353		0,00
Cu-corrosion	ASTM D1275		0,00
Corrosive sulphur	IEC 62535		0,00

* Test arranged by Nynas

RECEIVER: ABB SpA-Power Product Division
Monselice, Italy

CONTAINER: SAIU 641658-5
N ORDER NO: IT 438421
C ORDER NO: 4550470849/00050
QUANTITY: 27,140 M.Ton
SEALS IN USE: 334051-2-3-4-5-6
REMARKS:

ANALYSIS: 11.15 Hrs. 07-juni-2017
DATE LOADING: 07-juni-2017
OUR REF: N2017- 9340
LAB REF: LN / 11558

Results obtained by Inspectorate Antwerp NV on a representative sample after loading:

Analysis	Method	Unit	Results
Breakdown Voltage	IEC 60156	kV	55
Tan delta at 90°C	IEC 60247	decimals	0,0002
Water (Karl Fischer)	IEC 60814	ppm	14
Visual appearance	ASTM D4176		Clear&Bright, free from suspended matter

All test results in this CoA comply with specified limits in the corresponding Nynas AB Product Data Sheet (PDS).
PCB compounds shall be none detectable, in accordance with methods ASTM D4059 or IEC 61619.
For the latest PDS edition or for complete Nynas AB specifications regarding specific products, please visit www.nynas.com or contact your local sales contact.

Expire date / Shelf life,
Provided the oil is stored in clean inert tanks at ambient temperatures below 40°C, in darkness, protected from exposure of moisture
In any form, Nynas expect the oil to be within specification for minimum one year from the "DATE BATCH" as specified above.

Sign by Inspectorate Antwerp N.V. on behalf of Nynas AB
Khalid Benkaddor

