DNV·GL

KEMA TYPE TEST CERTIFICATE OF SHORT-CIRCUIT PERFORMANCE

Object A three-phase oil-immersed power transformer with on-load tap-changer **2300-15**

Type SFZ-26000/132 **Serial No.** 1522043

Rated power	26000 kVA
Rated voltage	132 kV ± 11 × 0,91% / 11,5 kV
Connection symbol	Dyn11
Rated frequency	50 Hz

Manufacturer Shandong Dachi Electric Co., Ltd., Heze, China *)

Client Shandong Dachi Electric Co., Ltd., Heze, China

Tested by KEMA Nederland B.V., Arnhem, The Netherlands

Date of tests 19 August to 28 October 2015

The object, constructed in accordance with the description, drawings and photographs incorporated in this Certificate, has been subjected to the series of proving tests in accordance with

IEC 60076-5 (2006)

This Type Test Certificate has been issued by KEMA following exclusively the STL Guides.

The results are shown in the record of Proving Tests and the oscillograms attached hereto. The values obtained and the general performance are considered to comply with the above Standard with respect to the dynamic ability to withstand short-circuits.

This Certificate applies only to the object tested. The responsibility for conformity of any object having the same type references as that tested rests with the Manufacturer.
*) as declared by the manufacturer

This Certificate consists of 71 pages in total.

KEMA Nederland B.V.

J.P. Fonteijne
Executive Vice President
KEMA Laboratories

KEMA Laboratories

Arnhem, 30 November 2015

INFORMATION SHEET

1 KEMA Type Test Certificate

A KEMA Type Test Certificate contains a record of a series of (type) tests carried out in accordance with a recognized standard. The equipment tested has fulfilled the requirements of this standard and the relevant ratings assigned by the manufacturer are endorsed by DNV GL. In addition, the test object's technical drawings have been verified and the condition of the test object after the tests is assessed and recorded. The Certificate contains the essential drawings and a description of the equipment tested. A KEMA Type Test Certificate signifies that the object meets all the requirements of the named subclauses of the standard. It can be identified by gold-embossed lettering on the cover and a gold seal on its front sheet.
The Certificate is applicable to the equipment tested only. DNV GL is responsible for the validity and the contents of the Certificate. The responsibility for conformity of any object having the same type references as the one tested rests with the manufacturer.
Detailed rules on types of certification are given in DNV GL's Certification procedure applicable to KEMA Laboratories.

2 KEMA Report of Performance

A KEMA Report of Performance is issued when an object has successfully completed and passed a subset (but not all) of test programmes in accordance with a recognized standard. In addition, the test object's technical drawings have been verified and the condition of the test object after the tests is assessed and recorded. The report is applicable to the equipment tested only. A KEMA Report of Performance signifies that the object meets the requirements of the named subclauses of the standard. It can be identified by silver-embossed lettering on the cover and a silver seal on its front sheet.
The sentence on the front page of a KEMA Report of Performance will state that the tests have been carried out in accordance with …… The object has complied with the relevant requirements.

3 KEMA Test Report

A KEMA Test Report is issued in all other cases. Reasons for issuing a KEMA Test Report could be:

- Tests were performed according to the client's instructions.
- Tests were performed only partially according to the standard.
- No technical drawings were submitted for verification and/or no assessment of the condition of the test object after the tests was performed.
- The object failed one or more of the performed tests.

The KEMA Test Report can be identified by the grey-embossed lettering on the cover and grey seal on its front sheet.
In case the number of tests, the test procedure and the test parameters are based on a recognized standard and related to the ratings assigned by the manufacturer, the following sentence will appear on the front sheet. The tests have been carried out in accordance with the client's instructions. Test procedure and test parameters were based on ..... If the object does not pass the tests such behaviour will be mentioned on the front sheet. Verification of the drawings (if submitted) and assessment of the condition after the tests is only done on client's request.
When the tests, test procedure and/or test parameters are not in accordance with a recognized standard, the front sheet will state the tests have been carried out in accordance with client's instructions.

4 Official and uncontrolled test documents

The official test documents of DNV GL are issued in bound form. Uncontrolled copies may be provided as loose sheets or as a digital file for convenience of reproduction by the client. The copyright has to be respected at all times.

5 Accreditation of KEMA Laboratories

The KEMA Laboratories of DNV GL are accredited in accordance with ISO/IEC 17025 by the respective national accreditation bodies. The KEMA Laboratories in the Netherlands are in the RvA register under nos. L020, L218, K006, K009 and I049. The KEMA Laboratory in the United States is accredited by the A2LA under no. 0553.01. The KEMA Laboratory in the Czech Republic is accredited by CAI under no. 1035.

TABLE OF CONTENTS

1 IDENTIFICATION OF THE OBJECT TESTED

1.1 Ratings/characteristics of the object tested

Voltage	132 kV ± 11 × 0,91% / 11,5 kV	X
Power	26000 kVA	
Current	113,7 A / 1305,3 A	
Short-circuit impedance	13,06 %	X
Connection symbol	Dyn11	
Cooling method	ONAF	
Frequency	50 Hz	X
Category	II	
Apparent system power	10000 MVA	

X = This rating has been proved by the tests of this Certificate.

1.2 Description of the object tested

A three-phase oil-immersed power transformer with on-load tap-changer

1.3 List of drawings

The manufacturer has guaranteed that the object submitted for tests has been manufactured in accordance with the following drawings and/or documents. KEMA has verified that these drawings and/or documents adequately represent the object tested. The manufacturer is responsible for the correctness of these drawings and/or documents and the technical data presented.

The following drawings and/or documents have been included in this Certificate:

Drawing no./document no.	Revision
8DB.860.6753.1	-
1DB.710.6753	-
0DB.319.6753.1	-
1DB.710.6753.2	-

The following drawings and/or documents are only listed for reference and are kept in KEMA's files:

Drawing no./document no.	Revision
5DB.640.6753.1	-
5DB.602.6753.1	-
5DB.516.6753.11	-
6DB.602.6753.2	-
5DB.516.6753.10	-
5DB.700.6753	-
5DB.602.6753.3	-
0DB.319.6753	-

2 GENERAL INFORMATION

2.1 The tests were witnessed by

Name	Company
Chen, G.	Shandong Dachi Electric Co., Ltd.,
Chen, X.	Heze, China
Xu, C.	

2.2 The tests were observed by

Routine tests carried out before the short-circuit tests

The routine tests carried out before the short-circuit tests were not witnessed by a KEMA inspector.

Short-circuit tests

Name	Company
Nijman, R.M.	KEMA Nederland B.V., Arnhem, The Netherlands

Routine tests carried out after the short-circuit tests

Name	Company
Houtepen, R.	KEMA Nederland B.V., Arnhem, The Netherlands

2.3 The transformer was inspected by

Name	Company
Houtepen, R.	KEMA Nederland B.V., Arnhem, The Netherlands

2.4 Accuracy of measurement

The guaranteed uncertainty for the measured voltages and currents taking into account the total measuring system, is less than 5%, unless mentioned otherwise.

3 LEGEND

Phase indications

If more than one phase is recorded on oscillogram, the phases are indicated by the digits 1, 2 and 3. These phases 1, 2 and 3 correspond to the phase values in the columns of the accompanying table, respectively from left to right.

Explanation of the letter symbols and abbreviations on the oscillograms

pu	Per unit (the reference length of one unit is represented by the black bar on the oscillogram)
I1pri	Primary current transformer
I1sec	Secondary current transformer
I2pri	Primary current transformer
I2sec	Secondary current transformer
I3pri	Primary current transformer
I3sec	Secondary current transformer
Itank	Tank current test object
U1S	Supply voltage
U2S	Supply voltage
U3S	Supply voltage

4 REACTANCE MEASUREMENT OVERVIEW

Tap position 1

Test number	Reactance								
	Measured between the phases			Calculated per leg			Change per leg		
	Ω			Ω			%		
	A-B	A-C	B-C	A	B	C	A	B	C
Before tests	222,4	222,9	221,6	333,8	335,2	331,4	-	-	-
AT 150819-4005	222,4	222,9	221,6	333,7	335,3	331,5	0,0	0,0	0,0
AT 150819-4007	222,4	222,9	221,6	333,7	335,2	331,5	0,0	0,0	0,0
AT 150819-4008	222,4	222,9	221,6	333,7	335,2	331,4	0,0	0,0	0,0
After tests	222,4	222,9	221,7	333,7	335,3	331,6	0,0	0,0	0,0

Tap position 12

Test number	Reactance								
	Measured between the phases			Calculated per leg			Change per leg		
	Ω			Ω			%		
	A-B	A-C	B-C	A	B	C	A	B	C
Before tests	175,1	174,9	174,4	263,0	262,5	261,1	-	-	-
AT 150819-4010	175,1	174,9	174,5	263,0	262,5	261,3	0,0	0,0	0,1
AT 150819-4011	175,1	174,9	174,5	263,1	262,6	261,2	0,0	0,0	0,0
AT 150819-4012	175,2	174,9	174,5	263,2	262,5	261,2	0,1	0,0	0,0
After tests	175,1	175,0	174,5	263,0	262,6	261,3	0,0	0,0	0,1

Tap position 23

Test number	Reactance								
	Measured between the phases			Calculated per leg			Change per leg		
	Ω			Ω			%		
	A-B	A-C	B-C	A	B	C	A	B	C
Before tests	140,7	140,4	140,2	211,5	210,4	209,9	-	-	-
AT 150819-4014	140,7	140,4	140,2	211,5	210,5	210,0	0,0	0,0	0,1
AT 150819-4015	140,7	140,4	140,2	211,5	210,5	210,0	0,0	0,0	0,0
AT 150819-4016	140,7	140,4	140,2	211,5	210,5	210,0	0,0	0,0	0,1
After tests	140,7	140,4	140,2	211,5	210,5	210,0	0,0	0,0	0,1

Maximum deviation

The maximum deviation in reactance per leg was 0,1%.

The maximum deviation allowed in accordance with IEC 60076-5 is 2,0%.

Note:

Reactance calculated per leg value as if primary windings are connected in star configuration

5 SUMMARY OF TESTS

Short-circuit tests								
Test no.			150819 4004	150819 4005	150819 4007	150819 4008	150819 4010	150819 4011
Tap position			1	1	1	1	12	12
	C	kV	73,8	78,6	78,7	79,5	72,2	72,1
Voltage, phase value, beginning	B	kV	69,2	77,7	77,8	78,6	71,0	71,1
	A	kV	72,8	78,9	78,8	79,6	72,0	72,0
	C	kV	72,2	78,3	78,4	79,1	71,7	71,8
Voltage, phase value, end	B	kV	67,9	77,5	77,5	78,3	70,7	70,9
	A	kV	71,9	78,5	78,4	79,3	71,6	71,7
	C	kA	-1,54	1,82	-1,80	1,85	1,25	-1,20
Current HV-winding, peak value	B	kA	-0,94	-0,98	-0,98	-0,99	2,04	-2,04
	A	kA	1,55	-1,80	1,78	-1,83	-2,17	2,11
	C	kA	0,59	0,68	0,68	0,69	0,80	0,79
Current HV-winding, phase value, beginning	B	kA	0,64	0,67	0,67	0,68	0,79	0,79
	A	kA	0,60	0,68	0,68	0,69	0,80	0,79
	C	kA	0,59	0,67	0,67	0,68	0,79	0,79
Current HV-winding, phase value, end	B	kA	0,63	0,67	0,67	0,68	0,78	0,78
	A	kA	0,60	0,68	0,68	0,68	0,79	0,79
	C	kA	0,59	0,68	0,68	0,69	0,80	0,79
Current HV-winding, phase value, average	B	kA	0,64	0,67	0,67	0,68	0,79	0,79
	A	kA	0,60	0,68	0,68	0,69	0,80	0,79
	C	kA	-16,5	18,8	-18,7	18,9	-18,8	19,0
Current LV-winding, peak value	B	kA	-16,6	18,4	-18,5	18,5	25,7	-25,8
	A	kA	21,1	-24,7	24,8	-24,7	-20,5	20,4
	C	kA	7,98	8,75	8,75	8,85	9,26	9,25
Current LV-winding, phase value, beginning	B	kA	8,04	8,77	8,77	8,86	9,22	9,24
	A	kA	7,68	8,86	8,89	8,93	9,34	9,37
	C	kA	7,94	8,70	8,69	8,78	9,18	9,18
Current LV-winding, phase value, end	B	kA	7,98	8,71	8,71	8,80	9,17	9,16
	A	kA	7,71	8,82	8,83	8,88	9,28	9,30
	C	kA	7,98	8,74	8,74	8,84	9,25	9,24
Current LV-winding, phase value, average	B	kA	8,04	8,77	8,77	8,86	9,22	9,23
	A	kA	7,32	8,42	8,44	8,93	9,34	9,37
	C	s	0,249	0,249	0,250	0,250	0,257	0,257
Current duration	B	s	0,249	0,249	0,250	0,250	0,255	0,256
	A	s	0,249	0,249	0,250	0,250	0,257	0,257

Remarks	
150819-4004	No visible disturbance. Test parameters below tolerance due to saturation of test stations transformers.
150819-4005	No visible disturbance.
150819-4007	No visible disturbance.
150819-4008	No visible disturbance.
150819-4010	No visible disturbance.
150819-4011	No visible disturbance.

Short-circuit tests (continued)								
Test no.			150819 4012	150819 4014	150819 4015	150819 4016		
Tap position			12	23	23	23		
	C	kV	72,3	64,9	64,9	64,8		
Voltage, phase value, beginning	B	kV	71,5	64,2	64,1	64,1		
	A	kV	72,5	64,9	65,0	65,0		
	C	kV	72,0	64,6	64,5	64,5		
Voltage, phase value, end	B	kV	71,1	63,8	63,7	63,7		
	A	kV	72,1	64,6	64,6	64,6		
	C	kA	1,19	-2,34	2,36	-2,34		
Current HV-winding, peak value	B	kA	2,08	2,34	-2,33	2,34		
	A	kA	-2,15	1,32	-1,35	1,32		
	C	kA	0,80	0,89	0,90	0,89		
Current HV-winding, phase value, beginning	B	kA	0,79	0,89	0,89	0,89		
	A	kA	0,80	0,89	0,90	0,89		
	C	kA	0,79	0,88	0,89	0,89		
Current HV-winding, phase value, end	B	kA	0,79	0,88	0,88	0,88		
	A	kA	0,79	0,88	0,89	0,88		
	C	kA	0,80	0,89	0,90	0,89		
Current HV-winding, phase value, average	B	kA	0,79	0,89	0,89	0,89		
	A	kA	0,80	0,89	0,89	0,89		
	C	kA	-19,5	-26,0	26,0	-26,1		
Current LV-winding, peak value	B	kA	25,8	19,6	-19,6	19,7		
	A	kA	-20,0	20,0	-19,9	20,0		
	C	kA	9,30	9,32	9,32	9,33		
Current LV-winding, phase value, beginning	B	kA	9,29	9,31	9,32	9,30		
	A	kA	9,38	9,43	9,37	9,43		
	C	kA	9,22	9,22	9,22	9,23		
Current LV-winding, phase value, end	B	kA	9,22	9,21	9,21	9,21		
	A	kA	9,31	9,33	9,30	9,33		
	C	kA	9,29	9,30	9,30	9,31		
Current LV-winding, phase value, average	B	kA	9,28	9,29	9,30	9,29		
	A	kA	9,38	9,42	9,37	9,43		
	C	s	0,257	0,263	0,263	0,263		
Current duration	B	s	0,256	0,264	0,263	0,263		
	A	s	0,257	0,264	0,264	0,264		

Remarks	
150819-4012	No visible disturbance.
150819-4014	No visible disturbance.
150819-4015	No visible disturbance.
150819-4016	No visible disturbance.

6 SHORT-CIRCUIT TESTS

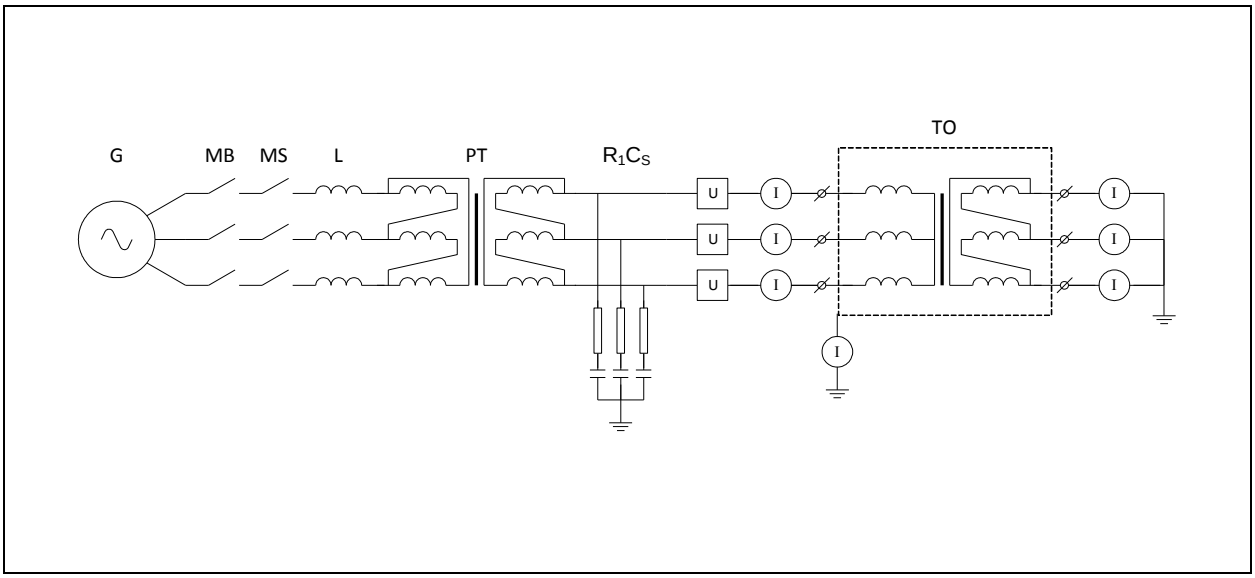
Standard and date

Standard	IEC 60076-5
Test date(s)	19 August 2015

6.1 Condition before test

Transformer previously subjected to routine test, carried out at the factory of the manufacturer without presence of a KEMA inspector, see Appendix A.
Supply to HV windings.
LV windings pre-set short-circuited by means of shunts and earthed.
Neutral point solidly earthed.
Tank earthed via an earth fault current indicating CT.

6.2 Test circuit S01



G	= Generator	TO	= Test Object	U	= Voltage Measurement to earth
MB	= Master Breaker	L	= Reactor	I	= Current Measurement
MS	= Make Switch	R	= Resistor		
PT	= Power Transformer	C	= Capacitor		

Supply		
Power	MVA	1768
Frequency	Hz	50
Phase(s)		3
Voltage	kV	162
Current	kA	6,3
Impedance	Ω	14,8
Power factor		< 0,1
Neutral		not earthed

Voltage control elements added (supply)		
C_s	µF	0,79
R_1	Ω	282

Load	
Short-circuit point	earthed

Remarks: -

6.3 Calculation sheet short-circuit current

System power of: 10000 MVA
System voltage of: 132 kV

Tap position	1 Max.	12 Nom.	23 Min.
Tap voltage	145,2 kV	132,0 kV	118,8 kV
Impedance voltage	13,69%	13,06%	12,95%
Resistance (75 °C)	0,41%	0,41%	0,49%

Tap position 1 Max.

Supply voltage: 145,2 kV
Terminal voltage: 143,0 kV

Short-circuit current	Minimum value	Rated	Maximum value
HV current	0,67 kA	0,74 kA	0,82 kA
LV current	8,45 kA	9,39 kA	10,33 kA
LV peak current	22,74 kA	23,94 kA	25,13 kA

HV reactance: 111,0 Ω
HV inductance: 353,2 mH

Tap position 12 Nom.

Supply voltage: 132,0 kV
Terminal voltage: 129,4 kV

Short-circuit current	Minimum value	Rated	Maximum value
HV current	0,77 kA	0,85 kA	0,94 kA
LV current	8,82 kA	9,80 kA	10,78 kA
LV peak current	23,74 kA	24,99 kA	26,24 kA

HV reactance: 87,48 Ω
HV inductance: 278,5 mH

Tap position 23 Min.

Supply voltage: 118,8 kV
Terminal voltage: 115,9 kV

Short-circuit current	Minimum value	Rated	Maximum value
HV current	0,86 kA	0,95 kA	1,05 kA
LV current	8,85 kA	9,84 kA	10,82 kA
LV peak current	23,83 kA	25,08 kA	26,34 kA

HV reactance: 70,25 Ω
HV inductance: 223,6 mH

Peak factor according to IEC = 2,55 Zsupply / Ztrafo = 1,99%
Peak factor according to X/R = 2,70

6.4 Photographs before test

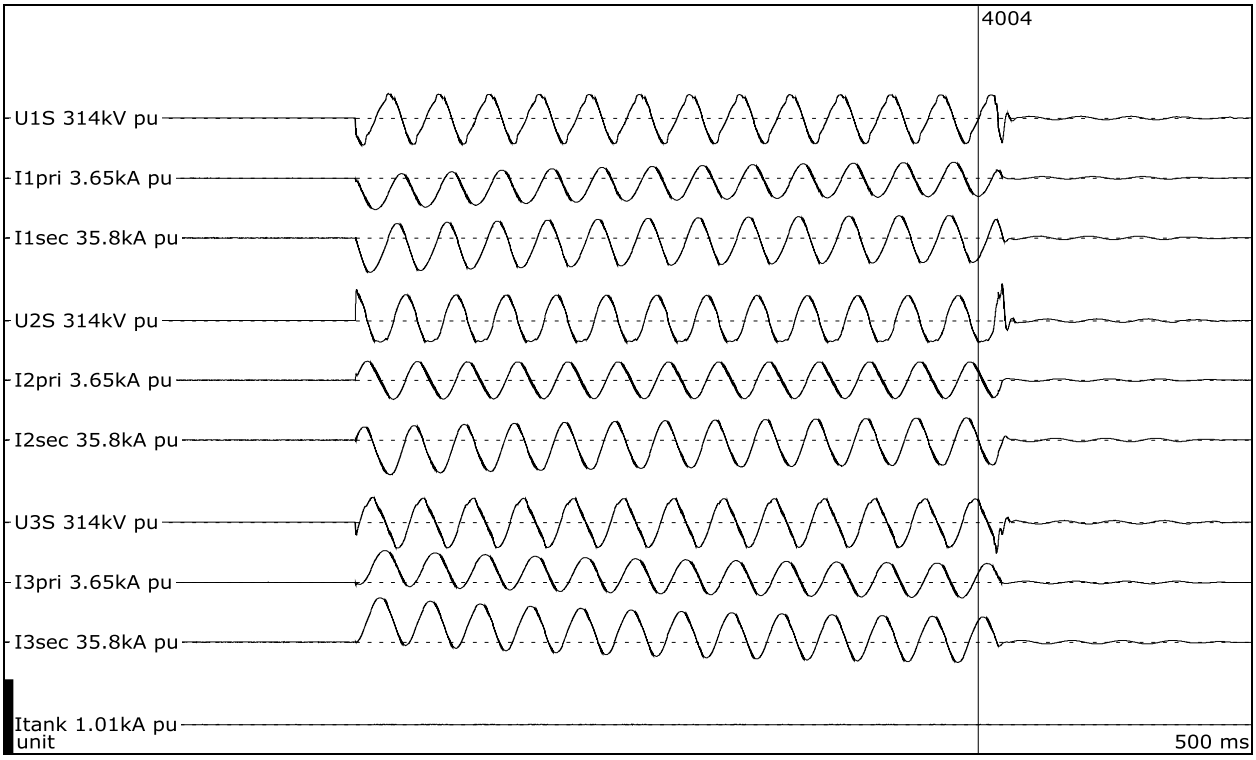

BEFORE TEST
150819-4004

6.5 Test results and oscillograms

Overview of test numbers
150819-4004, 4005, 4007, 4008, 4010 to 4012, 4014 to 4016

Remarks
-

Short-circuit test

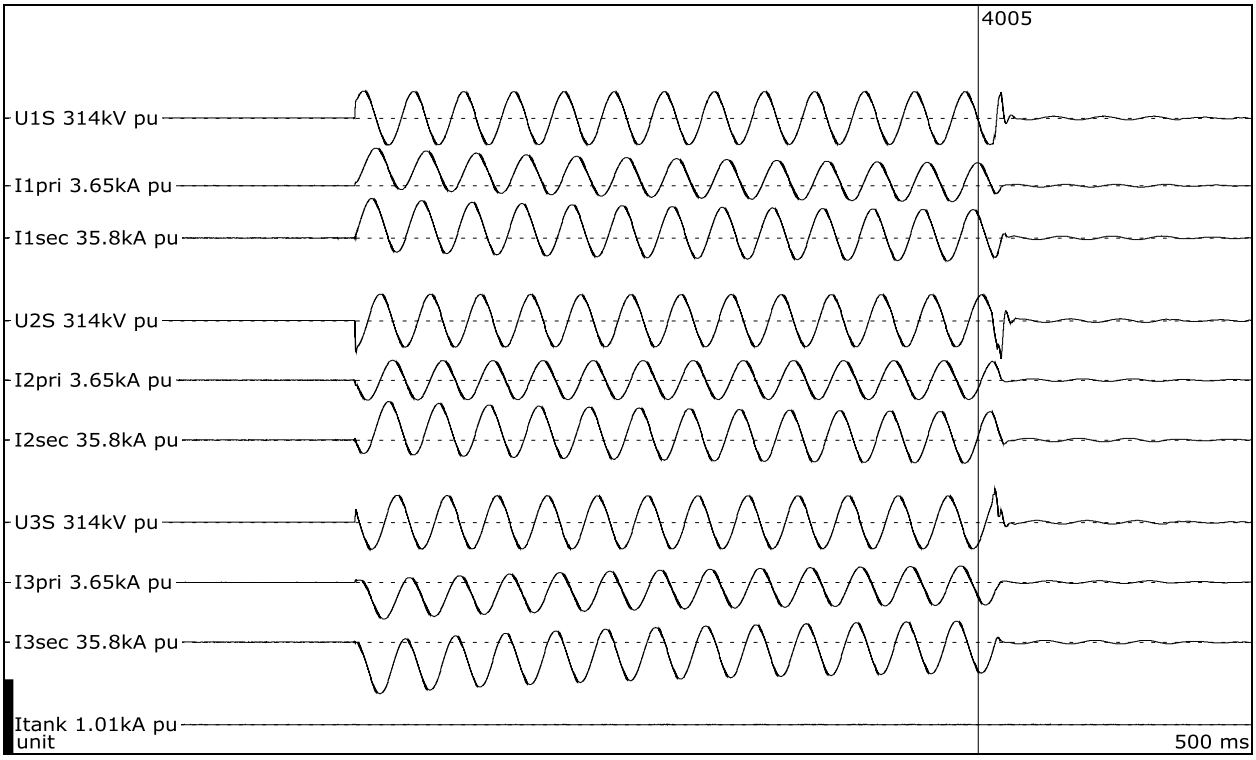


Test number: **150819-4004**

Phase		C	B	A
Tap position		1		
Voltage, phase value, beginning	kV	73,8	69,2	72,8
Voltage, phase value, end	kV	72,2	67,9	71,9
Current HV-winding, peak value	kA	-1,54	-0,94	1,55
Current HV-winding, phase value, beginning	kA	0,59	0,64	0,60
Current HV-winding, phase value, end	kA	0,59	0,63	0,60
Current HV-winding, phase value, average	kA	0,59	0,64	0,60
Current LV-winding, peak value	kA	-16,5	-16,6	21,1
Current LV-winding, phase value, beginning	kA	7,98	8,04	7,68
Current LV-winding, phase value, end	kA	7,94	7,98	7,71
Current LV-winding, phase value, average	kA	7,98	8,04	7,32
Current duration	s	0,249	0,249	0,249

Remarks: No visible disturbance.
Test parameters below tolerance due to saturation of test stations transformers.

Short-circuit test

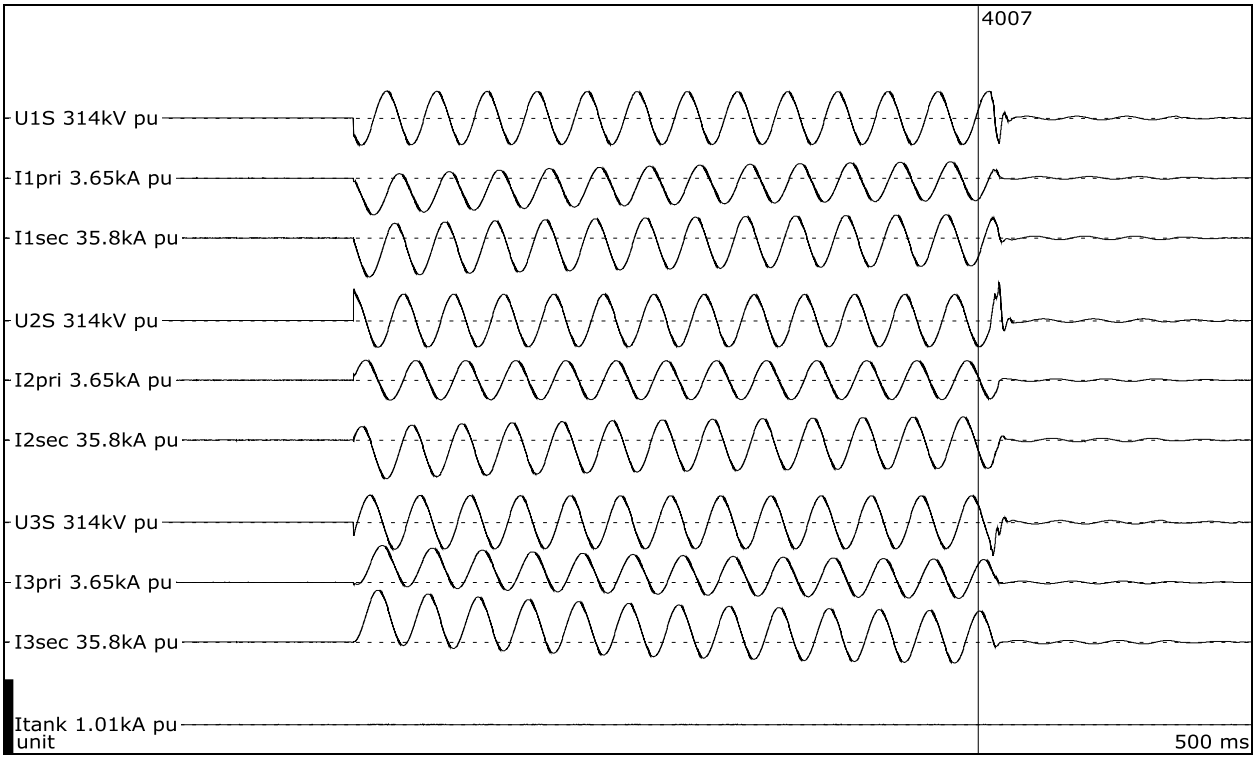


Test number: **150819-4005**

Phase		C	B	A
Tap position		1		
Voltage, phase value, beginning	kV	78,6	77,7	78,9
Voltage, phase value, end	kV	78,3	77,5	78,5
Current HV-winding, peak value	kA	1,82	-0,98	-1,80
Current HV-winding, phase value, beginning	kA	0,68	0,67	0,68
Current HV-winding, phase value, end	kA	0,67	0,67	0,68
Current HV-winding, phase value, average	kA	0,68	0,67	0,68
Current LV-winding, peak value	kA	18,8	18,4	-24,7
Current LV-winding, phase value, beginning	kA	8,75	8,77	8,86
Current LV-winding, phase value, end	kA	8,70	8,71	8,82
Current LV-winding, phase value, average	kA	8,74	8,77	8,42
Current duration	s	0,249	0,249	0,249

Remarks: No visible disturbance.

Short-circuit test

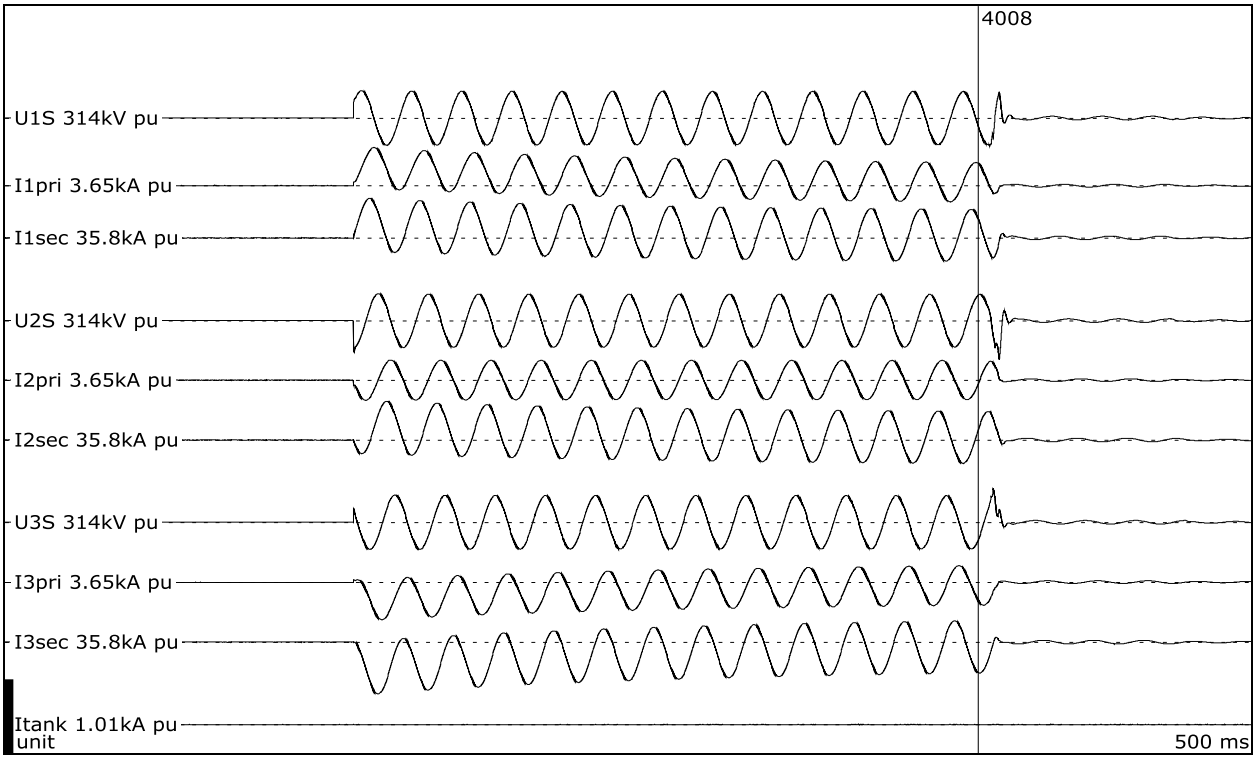


Test number: **150819-4007**

Phase		C	B	A
Tap position		1		
Voltage, phase value, beginning	kV	78,7	77,8	78,8
Voltage, phase value, end	kV	78,4	77,5	78,4
Current HV-winding, peak value	kA	-1,80	-0,98	1,78
Current HV-winding, phase value, beginning	kA	0,68	0,67	0,68
Current HV-winding, phase value, end	kA	0,67	0,67	0,68
Current HV-winding, phase value, average	kA	0,68	0,67	0,68
Current LV-winding, peak value	kA	-18,7	-18,5	24,8
Current LV-winding, phase value, beginning	kA	8,75	8,77	8,89
Current LV-winding, phase value, end	kA	8,69	8,71	8,83
Current LV-winding, phase value, average	kA	8,74	8,77	8,44
Current duration	s	0,250	0,250	0,250

Remarks: No visible disturbance.

Short-circuit test

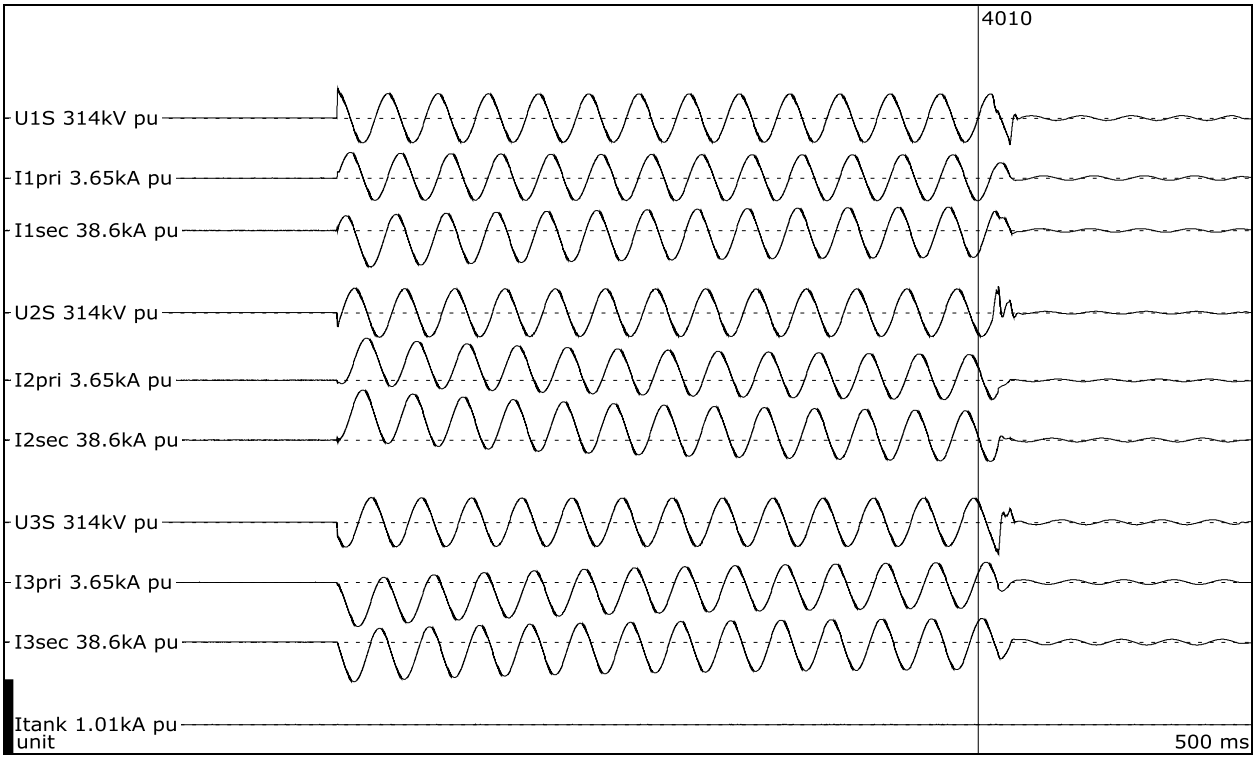


Test number: **150819-4008**

Phase		C	B	A
Tap position		1		
Voltage, phase value, beginning	kV	79,5	78,6	79,6
Voltage, phase value, end	kV	79,1	78,3	79,3
Current HV-winding, peak value	kA	1,85	-0,99	-1,83
Current HV-winding, phase value, beginning	kA	0,69	0,68	0,69
Current HV-winding, phase value, end	kA	0,68	0,68	0,68
Current HV-winding, phase value, average	kA	0,69	0,68	0,69
Current LV-winding, peak value	kA	18,9	18,5	-24,7
Current LV-winding, phase value, beginning	kA	8,85	8,86	8,93
Current LV-winding, phase value, end	kA	8,78	8,80	8,88
Current LV-winding, phase value, average	kA	8,84	8,86	8,93
Current duration	s	0,250	0,250	0,250

Remarks: No visible disturbance.

Short-circuit test

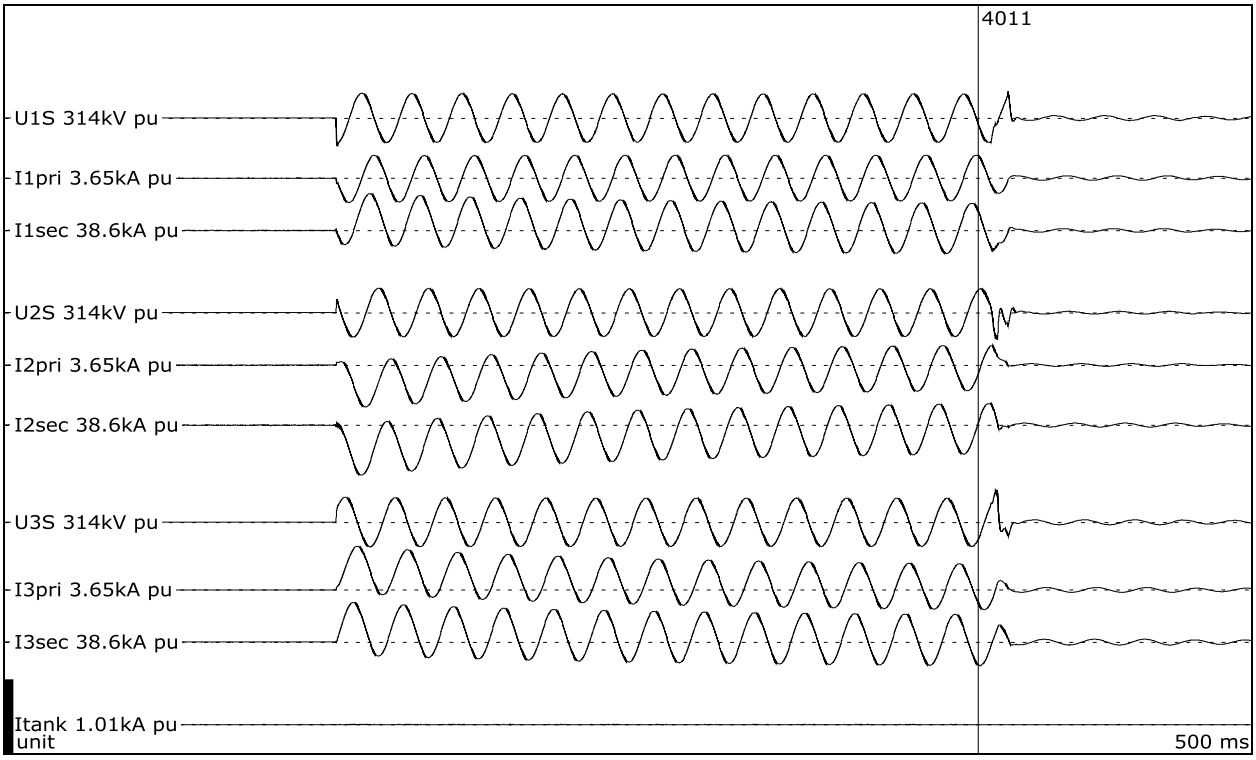


Test number: **150819-4010**

Phase		C	B	A
Tap position		12		
Voltage, phase value, beginning	kV	72,2	71,0	72,0
Voltage, phase value, end	kV	71,7	70,7	71,6
Current HV-winding, peak value	kA	1,25	2,04	-2,17
Current HV-winding, phase value, beginning	kA	0,80	0,79	0,80
Current HV-winding, phase value, end	kA	0,79	0,78	0,79
Current HV-winding, phase value, average	kA	0,80	0,79	0,80
Current LV-winding, peak value	kA	-18,8	25,7	-20,5
Current LV-winding, phase value, beginning	kA	9,26	9,22	9,34
Current LV-winding, phase value, end	kA	9,18	9,17	9,28
Current LV-winding, phase value, average	kA	9,25	9,22	9,34
Current duration	s	0,257	0,255	0,257

Remarks: No visible disturbance.

Short-circuit test

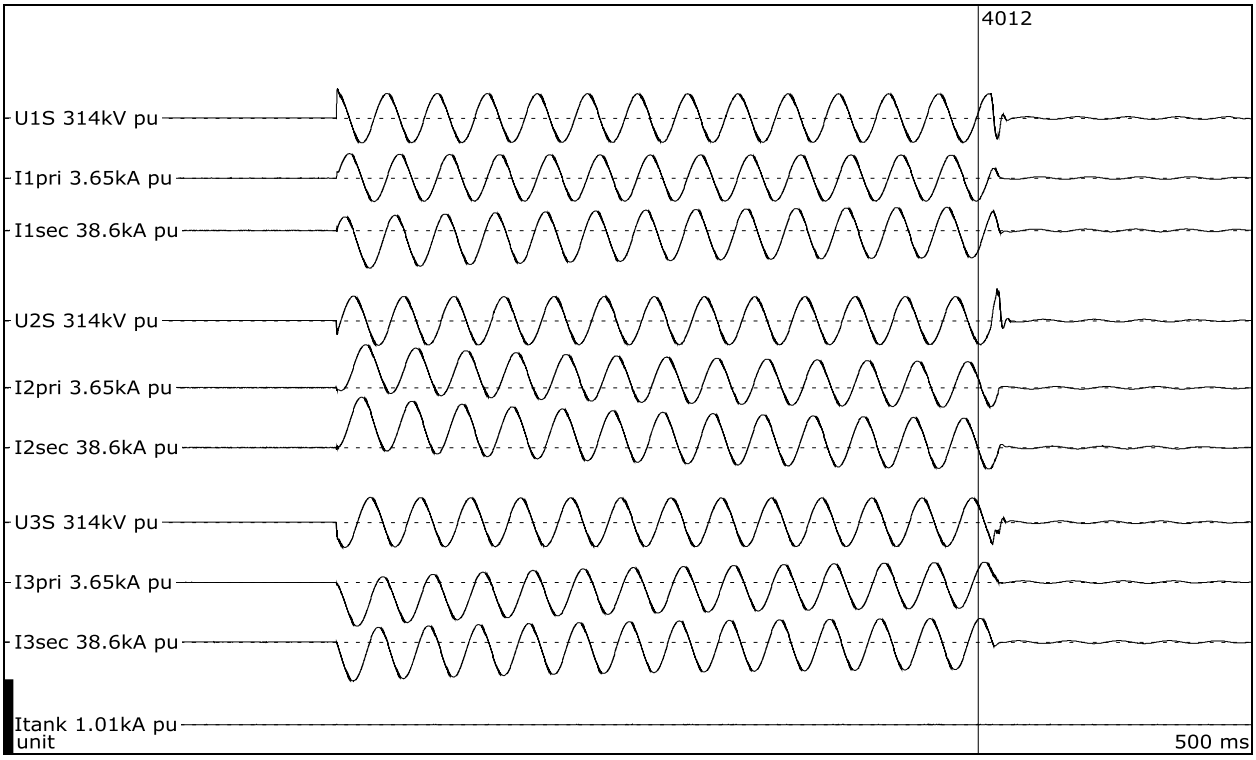


Test number: **150819-4011**

Phase		C	B	A
Tap position		12		
Voltage, phase value, beginning	kV	72,1	71,1	72,0
Voltage, phase value, end	kV	71,8	70,9	71,7
Current HV-winding, peak value	kA	-1,20	-2,04	2,11
Current HV-winding, phase value, beginning	kA	0,79	0,79	0,79
Current HV-winding, phase value, end	kA	0,79	0,78	0,79
Current HV-winding, phase value, average	kA	0,79	0,79	0,79
Current LV-winding, peak value	kA	19,0	-25,8	20,4
Current LV-winding, phase value, beginning	kA	9,25	9,24	9,37
Current LV-winding, phase value, end	kA	9,18	9,16	9,30
Current LV-winding, phase value, average	kA	9,24	9,23	9,37
Current duration	s	0,257	0,256	0,257

Remarks: No visible disturbance.

Short-circuit test

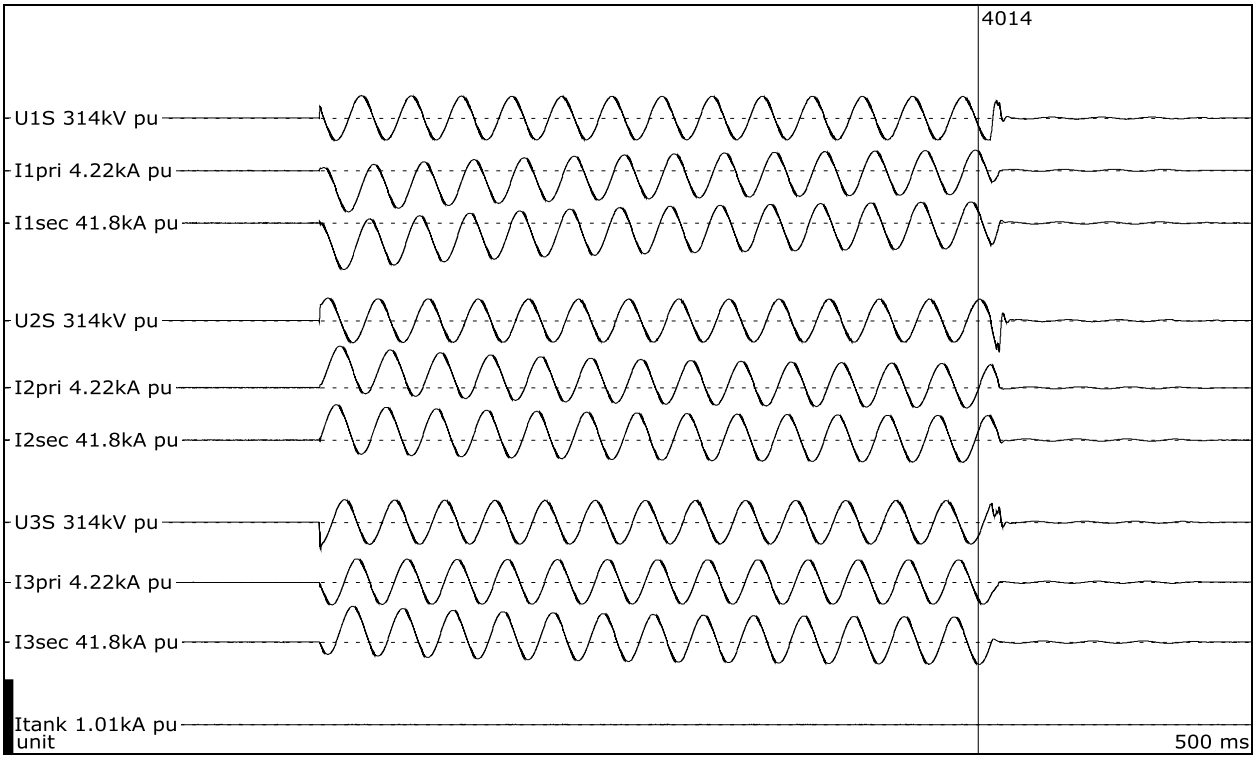


Test number: 150819-4012

Phase		C	B	A
Tap position		12		
Voltage, phase value, beginning	kV	72,3	71,5	72,5
Voltage, phase value, end	kV	72,0	71,1	72,1
Current HV-winding, peak value	kA	1,19	2,08	-2,15
Current HV-winding, phase value, beginning	kA	0,80	0,79	0,80
Current HV-winding, phase value, end	kA	0,79	0,79	0,79
Current HV-winding, phase value, average	kA	0,80	0,79	0,80
Current LV-winding, peak value	kA	-19,5	25,8	-20,0
Current LV-winding, phase value, beginning	kA	9,30	9,29	9,38
Current LV-winding, phase value, end	kA	9,22	9,22	9,31
Current LV-winding, phase value, average	kA	9,29	9,28	9,38
Current duration	s	0,257	0,256	0,257

Remarks: No visible disturbance.

Short-circuit test

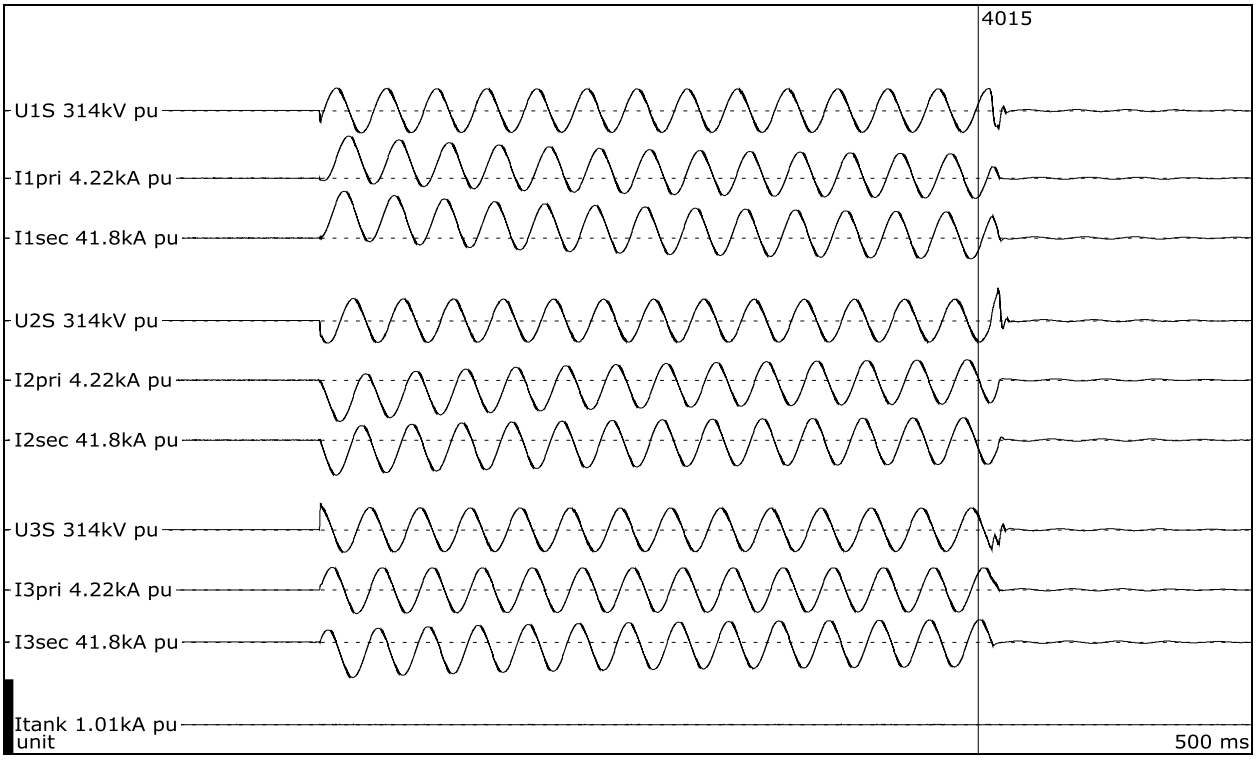


Test number: **150819-4014**

Phase		C	B	A
Tap position		23		
Voltage, phase value, beginning	kV	64,9	64,2	64,9
Voltage, phase value, end	kV	64,6	63,8	64,6
Current HV-winding, peak value	kA	-2,34	2,34	1,32
Current HV-winding, phase value, beginning	kA	0,89	0,89	0,89
Current HV-winding, phase value, end	kA	0,88	0,88	0,88
Current HV-winding, phase value, average	kA	0,89	0,89	0,89
Current LV-winding, peak value	kA	-26,0	19,6	20,0
Current LV-winding, phase value, beginning	kA	9,32	9,31	9,43
Current LV-winding, phase value, end	kA	9,22	9,21	9,33
Current LV-winding, phase value, average	kA	9,30	9,29	9,42
Current duration	s	0,263	0,264	0,264

Remarks: No visible disturbance.

Short-circuit test

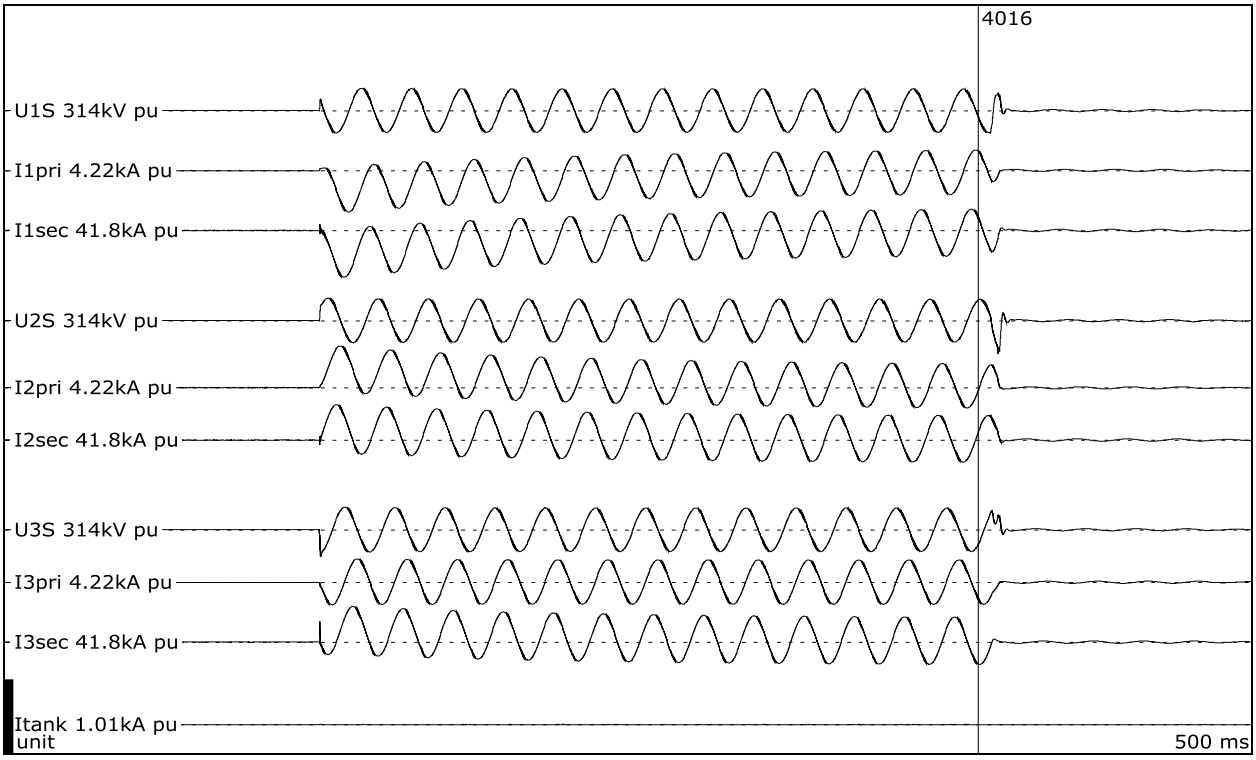


Test number: **150819-4015**

Phase		C	B	A
Tap position		23		
Voltage, phase value, beginning	kV	64,9	64,1	65,0
Voltage, phase value, end	kV	64,5	63,7	64,6
Current HV-winding, peak value	kA	2,36	-2,33	-1,35
Current HV-winding, phase value, beginning	kA	0,90	0,89	0,90
Current HV-winding, phase value, end	kA	0,89	0,88	0,89
Current HV-winding, phase value, average	kA	0,90	0,89	0,89
Current LV-winding, peak value	kA	26,0	-19,6	-19,9
Current LV-winding, phase value, beginning	kA	9,32	9,32	9,37
Current LV-winding, phase value, end	kA	9,22	9,21	9,30
Current LV-winding, phase value, average	kA	9,30	9,30	9,37
Current duration	s	0,263	0,263	0,264

Remarks: No visible disturbance.

Short-circuit test



Test number: **150819-4016**

Phase		C	B	A
Tap position		23		
Voltage, phase value, beginning	kV	64,8	64,1	65,0
Voltage, phase value, end	kV	64,5	63,7	64,6
Current HV-winding, peak value	kA	-2,34	2,34	1,32
Current HV-winding, phase value, beginning	kA	0,89	0,89	0,89
Current HV-winding, phase value, end	kA	0,89	0,88	0,88
Current HV-winding, phase value, average	kA	0,89	0,89	0,89
Current LV-winding, peak value	kA	-26,1	19,7	20,0
Current LV-winding, phase value, beginning	kA	9,33	9,30	9,43
Current LV-winding, phase value, end	kA	9,23	9,21	9,33
Current LV-winding, phase value, average	kA	9,31	9,29	9,43
Current duration	s	0,263	0,263	0,264

Remarks: No visible disturbance.

6.6 Condition after test

Externally no visible change.

6.7 Photographs after test


AFTER TEST
150819-4016

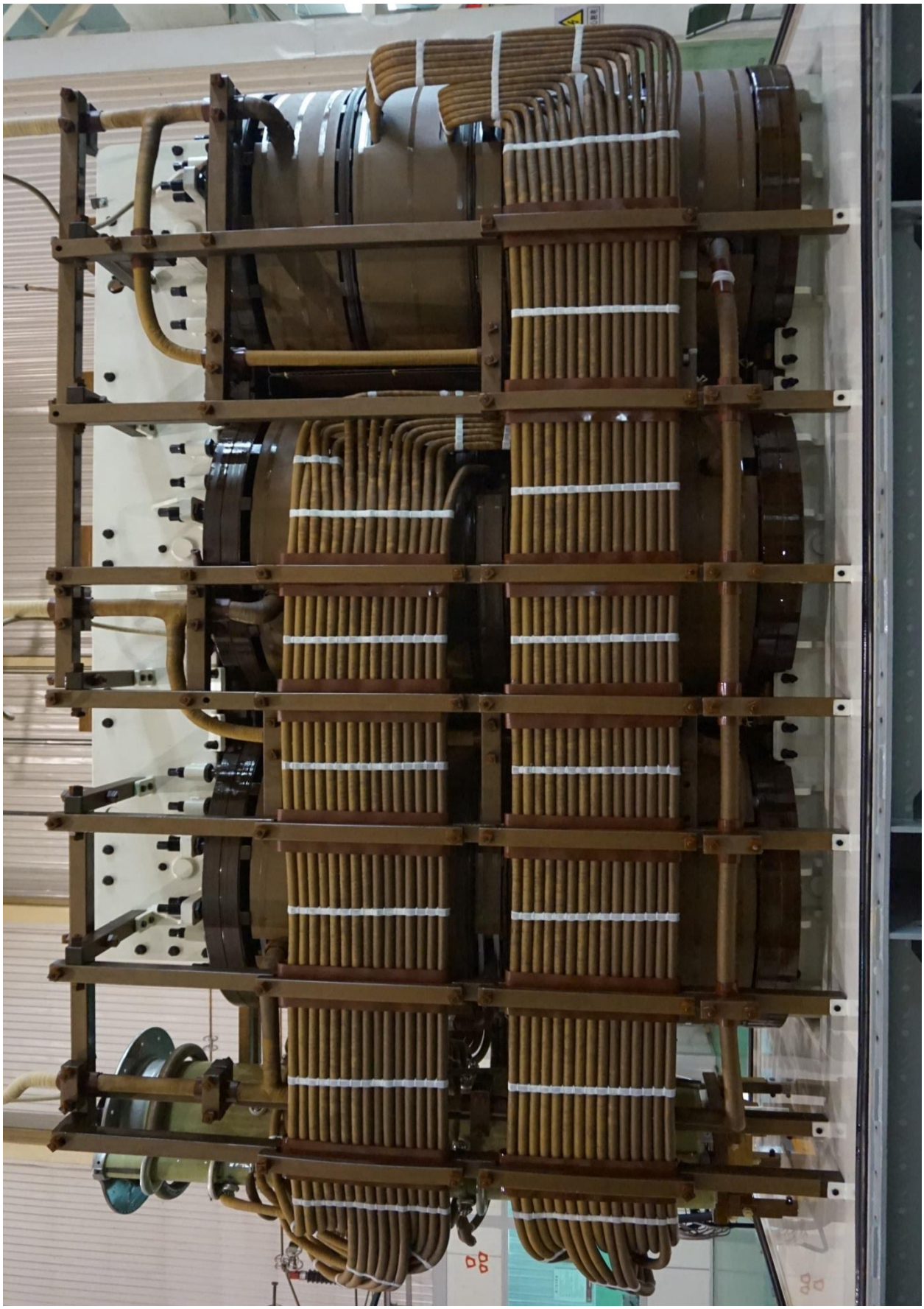
7 INSPECTION OF THE ACTIVE PART

On 28 October 2015 the transformer was untanked and the active part was inspected by a KEMA inspector at the factory of the manufacturer.

The out-of-tank inspection with respect to displacements, deformations of core and windings, connections and supporting structures or traces of discharges did not reveal any apparent defects.

7.1 Photographs during inspection


无
限

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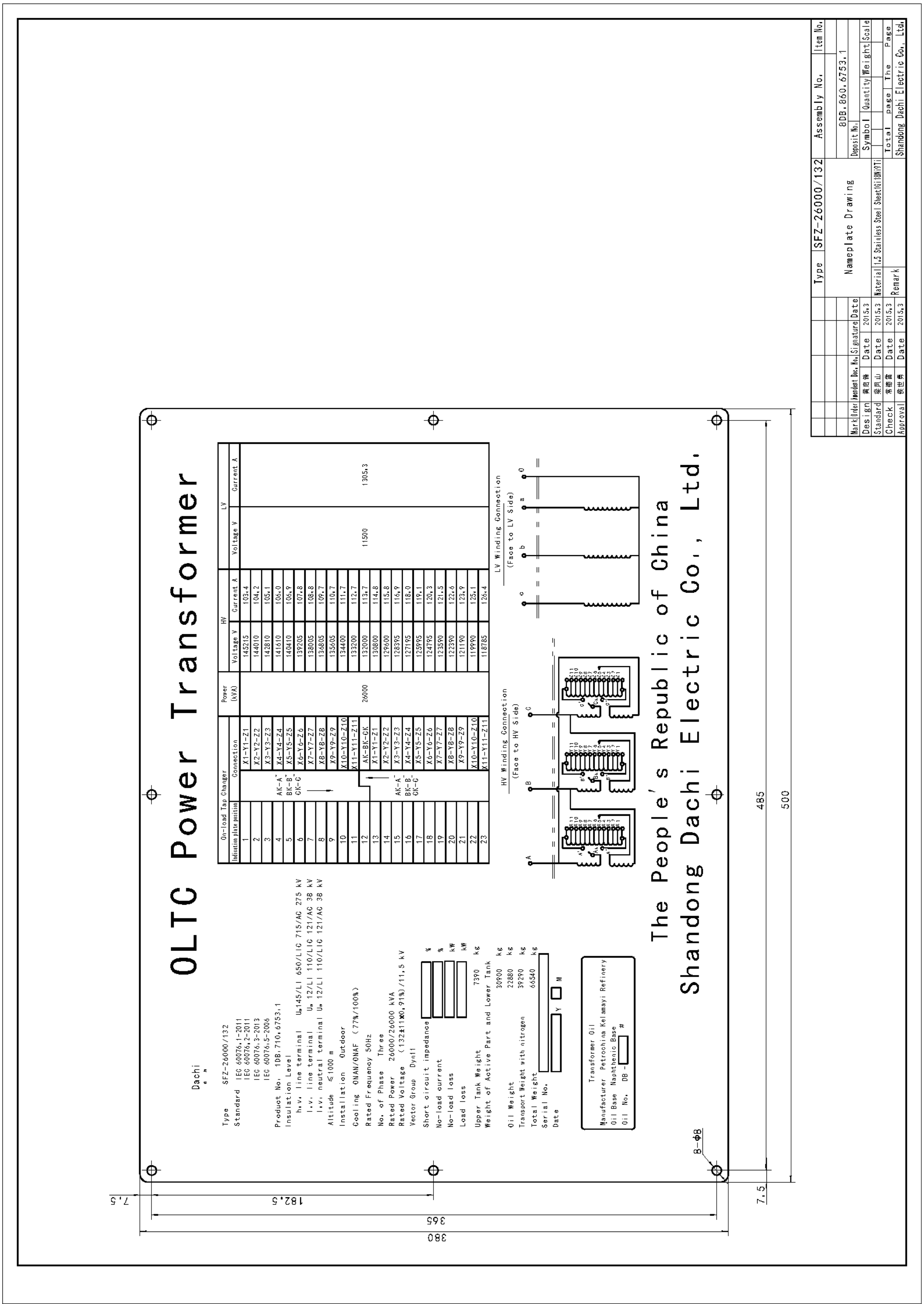
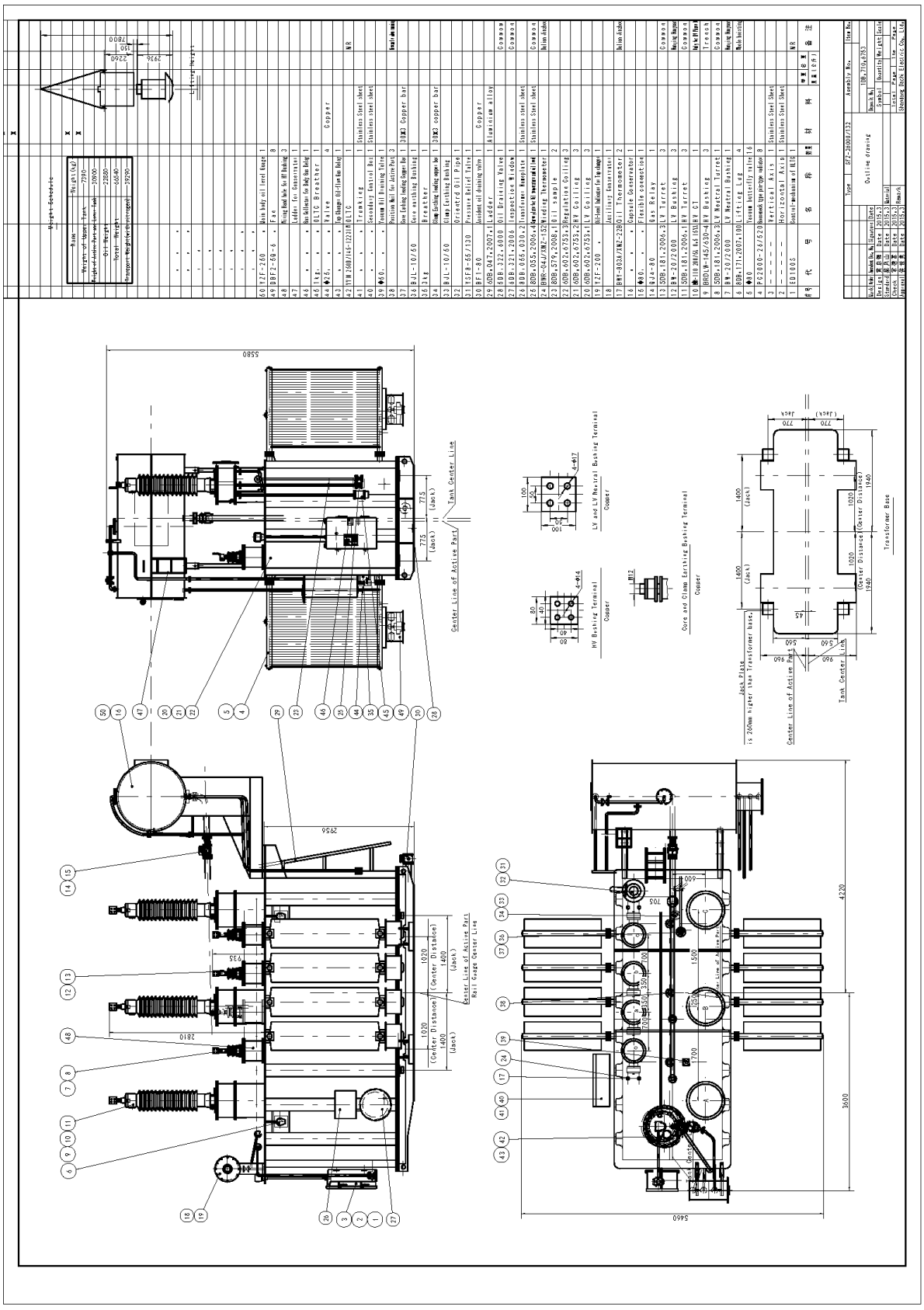
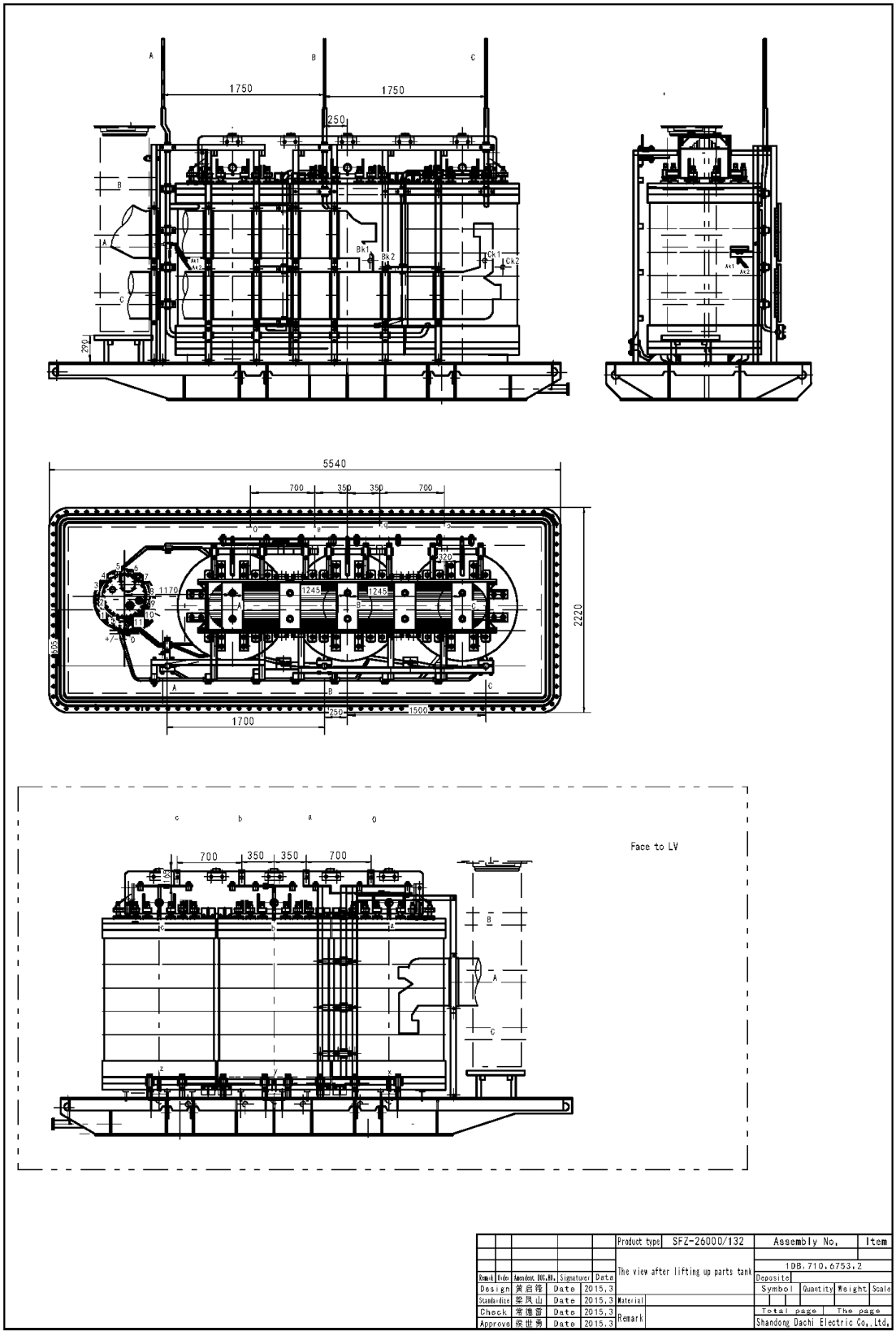
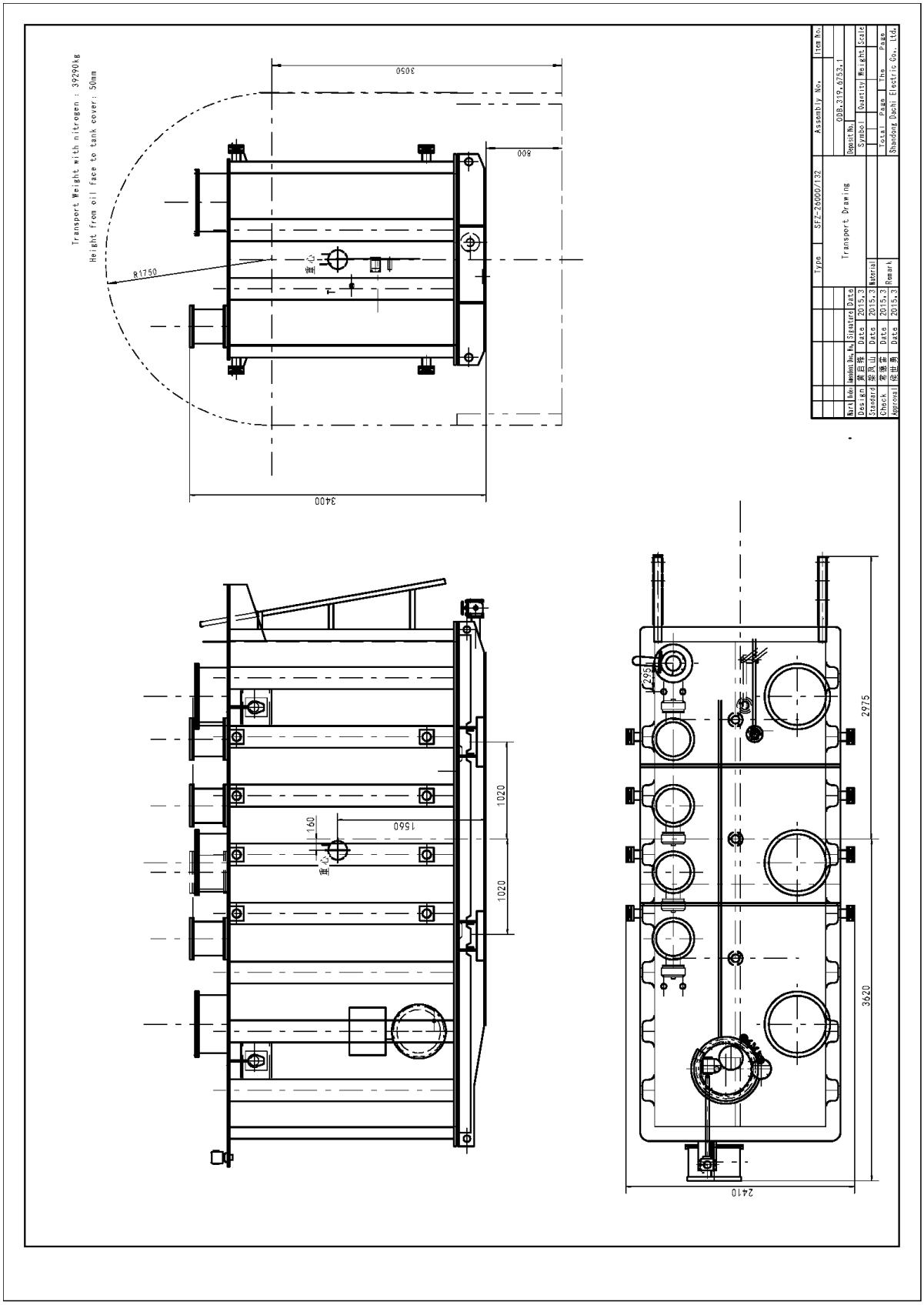
8 DRAWINGS


OLTC Power Transformer
The People's Republic of China
Shandong Dachi Electric Co., Ltd.
Nameplate Drawing
SFZ-26000/132
8DB.860.6753.1




1750
1750
250
5540
700
350
350
700
2220
1700
250
1500
Face to LV
Product type SFZ-26000/132
Assembly No.
Item
The view after lifting up parts tank
1DB.710.6753.2
Design 黄启锋 Date 2015.3
Standardize 娄凤山 Date 2015.3
Check 李德富 Date 2015.3
Approve 侯世勇 Date 2015.3
Material
Remark
Deposite
Symbol
Quantity
Weight
Scale
Total page
The page
Shandong Dachi Electric Co.,Ltd.


Transport Weight with nitrogen : 39290kg
Height from oil face to tank cover: 50mm
3050
800
R1750
重心
3400
1020
1020
160
1560
重心
2975
2410
Assembly No.
Item No.
Drawing No.
Quantity
Weight
Scale
Total
Page
Sheet
Name
Material
Remark
Type
SFZ-26000/132
Transport Drawing
Design
Standard
Check
Approval
Signature
Date
2015.3
Shandong Dachi Electric Co., Ltd.

Appendix A Routine tests before the short-circuit tests

Routine tests before the short-circuit tests were carried out at the factory of the manufacturer in May 2015 without the presence of a KEMA inspector.

See enclosed report on the following pages.

The responsibility for the content of this report rests with the manufacturer.

达 驰

试验报告
TEST REPORT

试品名称：有载调压电力变压器
Product:On Load Tap Changer Power Transformer
试品型号： **SFZ-26000/132**
Product type: SFZ-26000/132
试品编号： **1522043**
Product number: 1522043
试验日期： **2015-05**
Test date: May. 2015

中国. 山东达驰电气有限公司
Shandong Dachi Electric Co.,Ltd of China

1. 试品参数 Parameter of product

额定容量				
Rated power	**26000**	**/**	**26000**	**kVA**
额定电压				
Rated voltage:	**132**	**/**	**11.5**	**kV**
额定电流				
Rated current:	**113.7**	**/**	**1305.3**	**A**
额定频率				
Rated frequency		**50 Hz**		
相　数				
Phase	**3**			
联结组标号				
Connection group		**Dyn11**		
分接范围				
Tapping range	**132± 11×0.91% / 11.5 kV**			
冷却方式				
Method of cooling		**ONAN / ONAF**		
绝缘水平				
Insulating level	**h.v. 线路端子**			
	h.v. Line terminal		**Um 145/LI 650/LIC 715/AC 275 kV**	
	l.v. 线路端子			
	l.v. Line terminal		**Um 12/LI 110/LIC 121/AC 38 kV**	

2. 试验标准Standards of test

IEC 60076-1：2011 《电力变压器 第1部分 总则 Power transformer Part 1：General》

IEC 60076-3：2013 《电力变压器 第3部分 绝缘水平、绝缘试验和外绝缘空气间隙 Power transformer-Part3：Insulation levels，dielectric tests and external clearances in air》

IEC 60076-4：2002 《电力变压器 第4部分：电力变压器和电抗器的雷电冲击和操作冲击试验导则 Power transformer-Part 4：Guide to the lighting impule and switching impule testing-Power transformer and reactor》

3. 试验项目及结果Test item and result

3.1 密封试验 Leakage test

方 法 Method	施加压力 (kPa) Applied pressure	持续时间 h Duration	结 果 Result
气 压 法 Atmospherci pressure (normal pressure=101kPa)	30	24	合 格 Passed

3.2 绝缘电阻及极化指数测量 Measurement of insulation resistance and polarisation index

油温 Temprature of oil(℃)： 27.5

测定部位 Measurement position	绝缘电阻GΩ Insulation resistance		极化指数 polarisation index	结 果 Results
	R_{60}	R_{600}	R_{600}/R_{60}	
高压—低压壳体及地 h.v.-l.v.&E	25.40	39.12	1.54	合 格 Passed
低压—高压壳体及地 l.v.-h.v.&E	22.50	35.33	1.57	合 格 Passed
高低压—壳体及地 h.v.&l.v.--E	26.80	40.74	1.52	合 格 Passed
铁心—壳体及地 Core-tank&E	9.89	---	---	合 格 Passed
夹件—壳体及地 Clamps-tank&E	9.65	---	---	合 格 Passed

3.3 介质损耗(tgδ%)的测量

Measurement of dielectric loss (tgδ%) 油温 Temprature of oil (℃)： 27.5

加 压 部 位 Applied voltage position	施加电压 (KV) Applied voltage	测量电容 (nF) Measured capacitance	实测值 % Measured value	校正值20℃ % Emended value	结 果 Results
高压--低压及地 h.v.-l.v.&E	9.999	7.739	0.198	0.163	合 格 Passed
低压--地及高压 l.v.-h.v.&E	9.999	13.51	0.248	0.204	合 格 Passed
高压低压--地 h.v.&l.v.--E	9.999	12.30	0.253	0.208	合 格 Passed

3.4 变压器绕组变形试验 Transformer winding deformation test

武汉高压研究所 BRTCII 变压器绕组特征测试仪

WuHan High Voltage Institute BRTCII Transformer winding feature tester

波形附后 Wave Shape is attached

3.5 电压比测量及电压矢量关系的校定

Measurement of voltage ratio and check of connection

高压绕组 h.v. winding		低压绕组 l.v. winding	测量偏差% Measured deviation			连接组标号 Connection group symbol
分接Tap	电压kV Voltage		AB/ab	BC/bc	CA/ca	
1	145.2132	11.5000	0.14	0.15	0.15	Dyn11
2	144.0120		0.12	0.13	0.13	
3	142.8108		0.12	0.12	0.11	
4	141.6096		0.11	0.12	0.12	
5	140.4084		0.09	0.10	0.10	
6	139.2072		0.09	0.09	0.09	
7	138.0060		0.08	0.09	0.09	
8	136.8048		0.08	0.07	0.80	
9	135.6036		0.06	0.07	0.06	
10	134.4024		0.06	0.06	0.06	
11	133.2012		0.05	0.05	0.05	
12	132.0000		0.03	0.03	0.03	
13	130.7988		0.02	0.03	0.03	
14	129.5976		0.01	0.02	0.02	
15	128.3964		0.00	0.01	0.01	
16	127.1952		0.00	0.00	0.00	
17	125.9940		0.00	0.00	0.00	
18	124.7928		-0.02	-0.01	-0.01	
19	123.5916		-0.02	-0.02	-0.01	
20	122.3904		-0.04	-0.03	-0.03	
21	121.1892		-0.04	-0.04	-0.04	
22	119.9880		-0.06	-0.06	-0.05	
23	118.7868		-0.07	-0.07	-0.07	

3.6 绕组电阻测量

Measurement of winding resistance　　油温 **Tempratureof oil (℃) :27.5**

绕　组 **winding**	分接位置 **Tap position**	实　测　值 **Measured value** （Ω）			不平衡率 **Unbalanced %**
		AB	BC	CA	
高	1	2.619	2.621	2.617	0.15
	2	2.590	2.591	2.586	0.19
	3	2.558	2.560	2.556	0.16
	4	2.527	2.530	2.526	0.16
	5	2.500	2.499	2.496	0.16
	6	2.466	2.469	2.465	0.16
	7	2.436	2.439	2.436	0.12
	8	2.405	2.409	2.406	0.17
	9	2.379	2.380	2.376	0.17
	10	2.348	2.349	2.345	0.17
	11	2.316	2.319	2.316	0.13
	12	2.288	2.289	2.286	0.13
压	13	2.318	2.321	2.318	0.13
	14	2.350	2.354	2.347	0.30
	15	2.380	2.382	2.379	0.13
	16	2.408	2.413	2.410	0.21
	17	2.440	2.443	2.440	0.12
	18	2.472	2.473	2.471	0.08
	19	2.497	2.503	2.501	0.24
h.v. winding	20	2.529	2.533	2.532	0.16
	21	2.556	2.562	2.561	0.23
	22	2.589	2.592	2.591	0.12
	23	2.618	2.621	2.620	0.11
低　压 **l.v. winding**		ao	bo	co	
		0.006388	0.006375	0.006422	0.73

3.7 空载损耗及空载电流测量

Measurement of no-load loss and current

电压百分数% Percent of rated voltage	平均值电压 kV Average voltage	有效值电压 kV Virtual value voltage	空载电流 No-load current		空载损耗(kW) No-load loss
			A	%	
90	10.350	10.367	0.765	0.059	10.692
100	11.506	11.475	0.814	0.062	13.396
105	12.068	12.027	0.997	0.076	15.075
110	12.656	12.663	1.503	0.115	17.422

3.8 空载电流谐波测量(100%)

no-load current harmonic wave measurement (100%)

谐波次数 number of harmonic wave	H01 %		
1	100.0000	100.0000	100.0000
3	17.9202	39.2769	10.8659
5	22.7494	26.3830	23.4248
7	10.0180	13.5392	11.0335
9	0.0000	0.0000	0.0000

3.9 工频耐压试验

Power freqency with stand voltage test

施加电压端 Applied terminal	试验电压（kV） AC test voltage	试验时间（s） Test time	结 果Results
高压—低压及地 h.v. —l.v.&E	275	60	合 格 Passed
低压—高压及地 l.v. —h.v.&E	38	60	合 格 Passed

3.10 带局部放电的感应耐压试验（IVPD）　　频率 **frequency：200 Hz**

Induced voltage withstand test with parts discharge measurement

施加电压Applied Voltage		持续时间 Duration	局部放电量 pc		
倍数 multiple	相对相电压（kV） phase to phase		Partial discharge capacity		
			A	B	C
0.4Ur	52.8	记录背景PD值 Background value of PD	20	20	20
1.2Ur	158.4	1 min	25	25	25
1.58Ur	208.6	5 min	30	30	20
2Ur	264	30 S	/	/	/
1.58Ur	208.6	5 min	30	50	20
		10 min	30	50	20
		15 min	30	50	20
		20 min	30	50	20
		25 min	30	50	20
		30 min	30	50	20
		35 min	30	50	20
		40 min	30	50	20
		45 min	30	50	20
		50 min	30	50	20
		55 min	30	50	20
		60 min	30	50	20
1.2Ur	158.4	1 min	25	25	20
0.4Ur	52.8	记录背景PD值 Background value of PD	20	20	20

3.11负载损耗及阻抗电压测量

Measurement of load loss and short impedance voltage

油温 **Temprature of oil (℃)**：28.4

测量 绕组 **Windings**	分接位置 **Tap position**	施加电流 （A） **Current**	测量电压 （kV） **Voltage**	负载损耗（kW） **75℃ Load loss**	短路阻抗 75℃ % **Impedance voltage**
高压-低压 **H.V.- L.V.**	1	70.330	13.521	105.805	13.69
	12	75.105	11.383	106.252	13.06
	23	82.351	10.022	125.984	12.95

3.12 零序阻抗测量 Measurement of zero-sequence impedance

测量端子 **Measurement terminal**	电 压 （V） **Voltage**	电 流 （A） **Current**	Z_O （Ω / 相 phase）
o-abc	27.0	103.5	0.78

3.13 套管式电流互感器试验 Bushing CT Test

型号 Type	编号 No.	电流比实测值 Current Ratio Measured Value	极性检查Polarity	绝缘试验 Insulation Test	工频耐压试验 P.F Withstand
LR-145	20150560	39.93	减极性 Negative	合格 Passed	合格 Passed
LR-15	20150562	655.30	减极性 Negative	合格 Passed	合格 Passed
LR-15	20150561	654.19	减极性 Negative	合格 Passed	合格 Passed
LR-15	20150563	655.36	减极性 Negative	合格 Passed	合格 Passed
LR-15	20150564	655.27	减极性 Negative	合格 Passed	合格 Passed

3.14 电容式套管试验

Oil paper capacitor type bushing test 温度temperature(℃)：27.5

套管型号 **type**	BRDLW4-145/800-4 （A、B、C PHASE BUSHING）		
产地 **maufacturer**	传奇电气（沈阳）有限公司 **TRENCH ELECTRIC CO.,LTD**		
套管编号 **Product serial Number**	1504636	1504633	1504634
施加电压 **applied voltage**（kV）	9.999	9.999	9.999
tgδ% （实测值**measured value**）	0.240	0.240	0.241
Cx （pF）	302.1	303.3	301.9
标称电容 **nominal capacitance** （pF）	306	307	306

3.15 有载开关试验

Test of on-load tap changer

开关型号 **Tap changer type**	制造单位 **Manufacturer**	出厂序号 **Serial number**
VVIII2500-145-12231W	**MR**	**1593670**

a. 变压器不激磁，在额定辅助电压下分接开关完成8个完全操作循环.
At rated auxiliary voltage and no excitation,tap changer run eight complete cycles of

b. 变压器在额定激磁条件下，空载试验时，分接开关完成1个操作循环.
At rated excitation and no-load test condition,tap changer run one cycle of operation.

c. 变压器不激磁，在85%额定辅助电压下分接开关完成1个操作循环.
At 85% rated auxiliary voltage and no excitation,tap changer be run one cycle of operation.

d. 变压器负载试验时，在主分接两侧±2级间完成10次分接变换.
At load test,tap-changer run ten times at ±2 step side of principal tap.

4. 试验结论：Test conclusion

SFZ-26000/132 1522043 号有载调压电力变压器上述例行试验及部分特殊试验
SFZ-26000/132 1522043 On load tap change power transformer routine test and
的试验项目、方法及结果符合IEC60076-1：2011、IEC60076-3：2013、IEC60076-4：2002、
partial special test result with IEC60076-1:2011、IEC60076-3:2013、IEC60076-4:2002、
等标准及技术协议要求。
standards and technical agreements requirements.

试品试验Test：合格Passed

编制 Edited by：

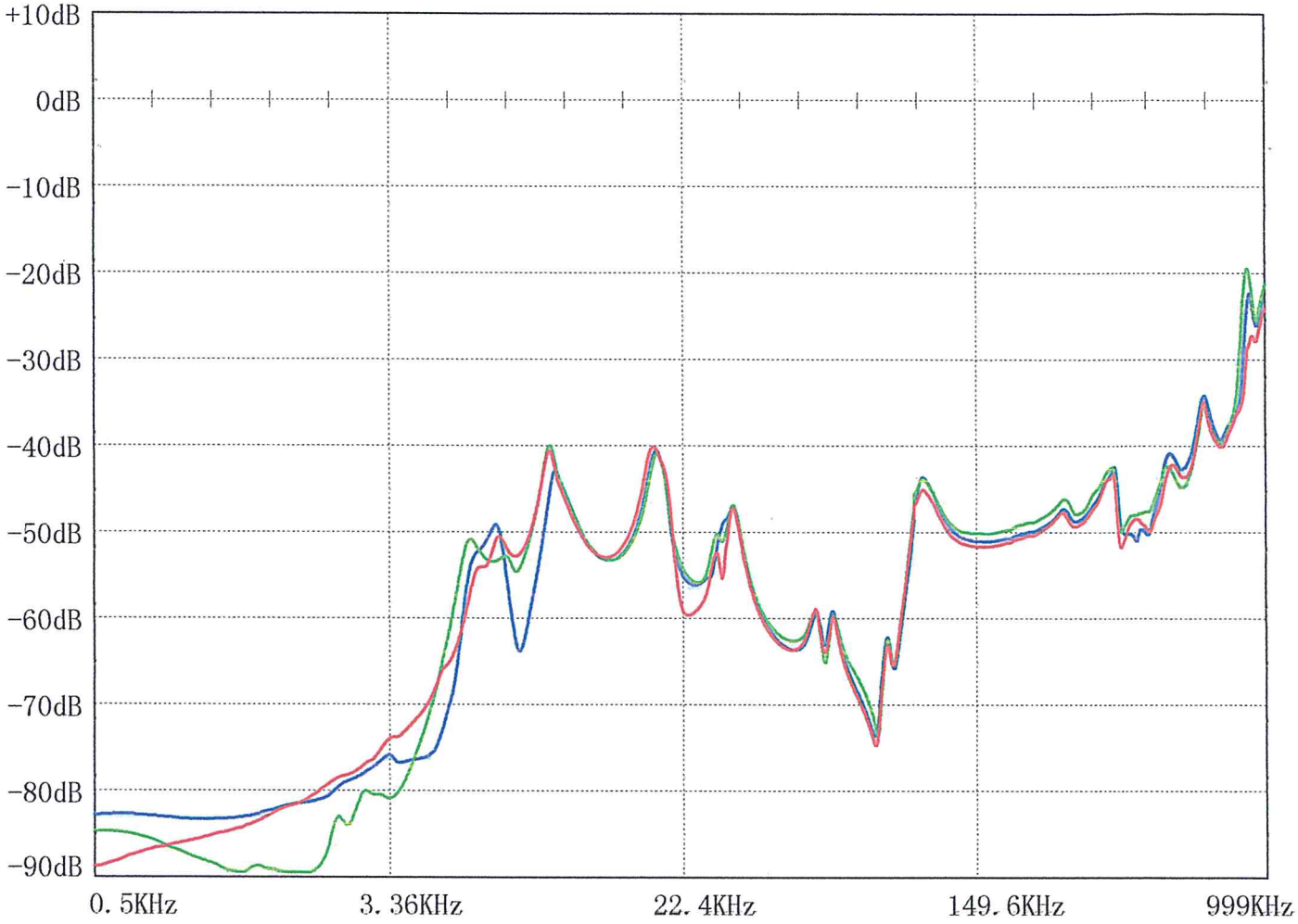
校核Inspected by：

审核Examined by：

审定Authorized by：

变压器绕组变形测试报告

打印于2015-5-28 10:47:16



变压器编号：1522043

变压器型号：SFZ-26000/132

曲线1：SF0HCA00.DAT 信号注入点:高压绕组之C点，测量点:A点 测于2015-5-23

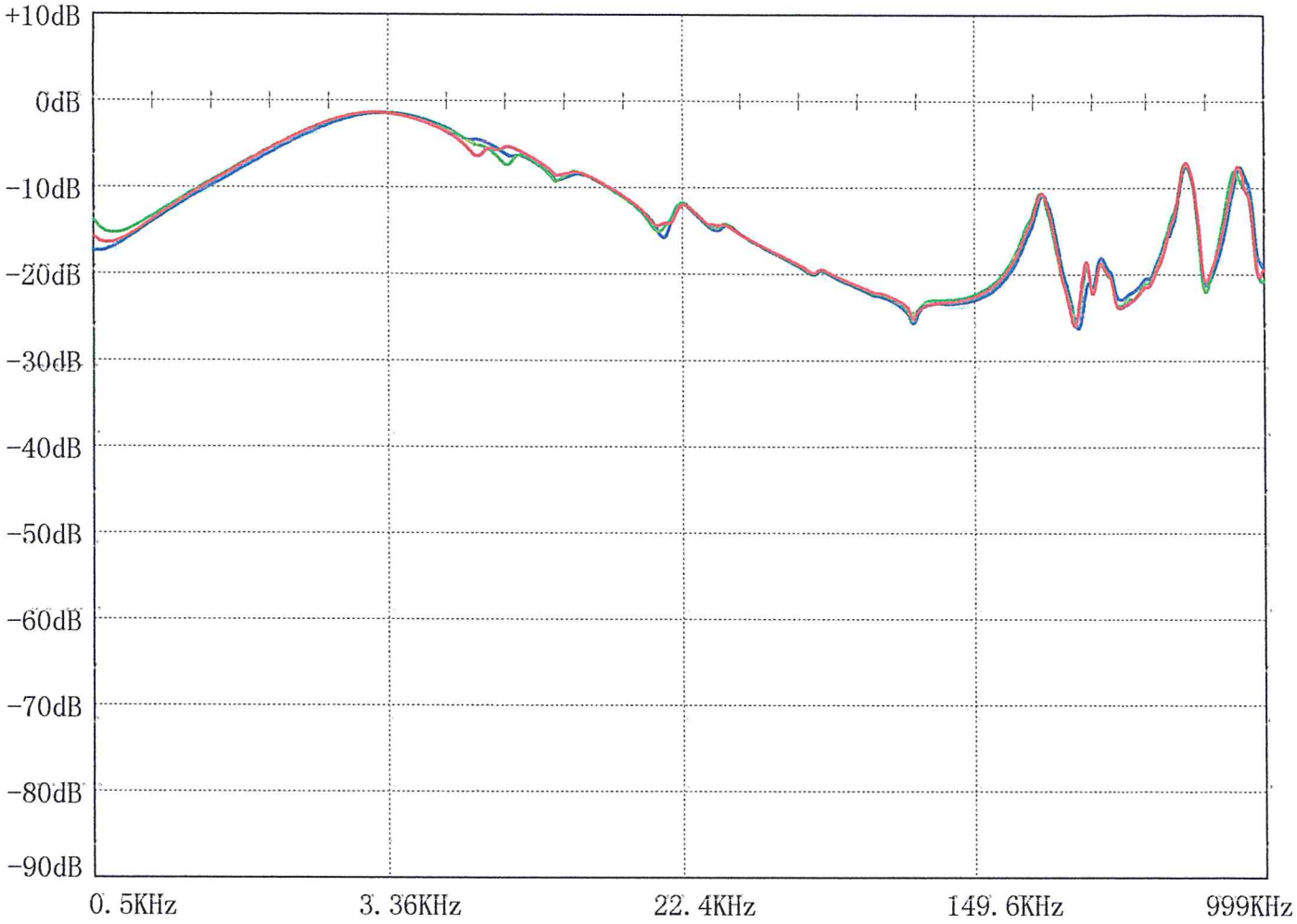
曲线2：SF0HAB00.DAT 信号注入点:高压绕组之A点，测量点:B点 测于2015-5-23

曲线3：SF0HBC00.DAT 信号注入点:高压绕组之B点，测量点:C点 测于2015-5-23

相关系数	0.5k--30k	30k--300k	300k--1000k	0.5k--1000k
R12	0.96	0.99	0.97	0.98
R13	0.96	0.99	0.99	0.98
R23	0.98	0.99	0.96	0.99

变压器绕组变形测试报告

打印于2015-5-28 10:47:27



变压器编号：1522043

变压器型号：SFZ-26000/132

曲线1：SF0L0A00.DAT	信号注入点:低压绕组之0点，	测量点:A点	测于2015-5-23
曲线2：SF0L0B00.DAT	信号注入点:低压绕组之0点，	测量点:B点	测于2015-5-23
曲线3：SF0L0C00.DAT	信号注入点:低压绕组之0点，	测量点:C点	测于2015-5-23

相关系数	0.5k--30k	30k--300k	300k--1000k	0.5k--1000k
R12	0.99	0.99	0.97	0.99
R13	0.99	0.99	0.98	0.99
R23	0.99	0.99	0.99	0.99

Appendix B Routine tests after the short-circuit tests

Routine tests after the short-circuit tests were carried out at the factory of the manufacturer in October 2015 in presence of a KEMA inspector.

See enclosed report on the following pages.

达 驰

试验报告

TEST REPORT

试品名称：有载调压电力变压器
Product:On Load Tap Changer Power Transformer
试品型号： **SFZ-26000/132**
Product type: SFZ-26000/132
试品编号： **1522043**
Product number: 1522043
试验日期： **2015-10**
Test date: Oct. 2015

DNV·GL
Richard Houtepen
Date: 28/10/2015
KEMA Laboratories

中国.山东达驰电气有限公司

Shandong Dachi Electric Co.,Ltd of China

1. 试品参数 Parameter of product

额定容量
Rated power 26000 / 26000 kVA
额定电压
Rated voltage: 132 / 11.5 kV
额定电流
Rated current: 113.7 / 1305.3 A
额定频率
Rated frequency 50 Hz
相 数
Phase 3
联结组标号
Connection group Dyn11
分接范围
Tapping range 132± 11×0.91% / 11.5 kV
冷却方式
Method of cooling ONAN / ONAF
绝缘水平
Insulating level h.v. 线路端子
h.v. Line terminal Um 145/LI 650/LIC 715/AC 275 kV
l.v. 线路端子
l.v. Line terminal Um 12/LI 110/LIC 121/AC 38 kV

2. 试验标准Standards of test

IEC 60076-1：2011 《电力变压器 第1部分 总则 Power transformer Part 1：General》

IEC 60076-3：2013 《电力变压器 第3部分 绝缘水平、绝缘试验和外绝缘空气间隙 Power transformer-Part3：Insulation levels，dielectric tests and external clearances in air》

IEC 60076-4：2002 《电力变压器 第4部分：电力变压器和电抗器的雷电冲击和操作冲击试验导则 Power transformer-Part 4：Guide to the lighting impule and switching impule testing-Power transformer and reactor》

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Date: 28/10/2015
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3. 试验项目及结果Test item and result

3.1 密封试验
Leakage test

方 法 Method	施加压力 (kPa) Applied pressure	持续时间 h Duration	结 果 Result
气 压 法 Atmospherci pressure (normal pressure=101kPa)	30	24	合 格 Passed

3.2 绝缘电阻及极化指数测量 Measurement of insulation resistance and polarisation index

油温 Temprature of oil(℃)： 22.5

测定部位 Measurement position	绝缘电阻GΩ Insulation resistance		极化指数 polarisation index	结 果 Results
	R_{60}	R_{600}	R_{600}/R_{60}	
高压—低压壳体及地 h.v.-l.v.&E	42.1	69.9	1.66	合 格 Passed
低压—高压壳体及地 l.v.-h.v.&E	30.3	59.4	1.96	合 格 Passed
高低压—壳体及地 h.v.&l.v.--E	35.2	64.4	1.83	合 格 Passed
铁心—壳体及地 Core-tank&E	14.6	---	---	合 格 Passed
夹件—壳体及地 Clamps-tank&E	14.5	---	---	合 格 Passed

3.3 介质损耗(tgδ%)的测量
Measurement of dielectric loss (tgδ%)

油温 Temprature of oil (℃)： 22.5

加 压 部 位 Applied voltage position	施加电压 (KV) Applied voltage	测量电容 (nF) Measured capacitance	实测值 % Measured value	校正值20℃ % Emended value	结 果 Results
高压--低压及地 h.v.-l.v.&E	9.993	7.596	0.223	0.209	合 格 Passed
低压--地及高压 l.v.-h.v.&E	9.988	13.52	0.278	0.260	合 格 Passed
高压低压--地 h.v.&l.v.--E	9.988	12.16	0.279	0.261	合 格 Passed

3.4 变压器绕组变形试验 Transformer winding deformation test

武汉高压研究所 BRTCII 变压器绕组特征测试仪

WuHan High Voltage Institute BRTCII Transformer winding feature tester

波形附后 Wave Shape is attached

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3.5 电压比测量及电压矢量关系的校定

Measurement of voltage ratio and check of connection

高压绕组 h.v. winding		低压绕组 l.v. winding	测量偏差 % Measured deviation			连接组标号 Connection group symbol
分接Tap	电压kV Voltage		AB/ab	BC/bc	CA/ca	
1	145.2132		0.13	0.13	0.13	
2	144.0120		0.12	0.12	0.12	
3	142.8108		0.11	0.11	0.11	
4	141.6096		0.11	0.11	0.11	
5	140.4084		0.09	0.09	0.09	
6	139.2072		0.09	0.09	0.09	
7	138.0060		0.08	0.07	0.08	
8	136.8048		0.07	0.07	0.07	
9	135.6036		0.06	0.05	0.06	
10	134.4024		0.05	0.05	0.05	
11	133.2012		0.04	0.04	0.04	
12	132.0000	11.5000	0.03	0.02	0.03	Dyn11
13	130.7988		0.02	0.02	0.02	
14	129.5976		0.00	0.00	0.00	
15	128.3964		0.00	0.00	0.00	
16	127.1952		0.00	0.00	0.00	
17	125.9940		0.00	0.00	0.00	
18	124.7928		-0.02	-0.02	-0.02	
19	123.5916		-0.03	-0.03	-0.02	
20	122.3904		-0.04	-0.04	-0.03	
21	121.1892		-0.05	-0.05	-0.04	
22	119.9880		-0.06	-0.06	-0.06	
23	118.7868		-0.08	-0.08	-0.07	

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3.6 绕组电阻测量

Measurement of winding resistance

油温 **Tempratureof oil (℃) :22.5**

绕组 winding	分接位置 Tap position	实测值 Measured value (Ω)			不平衡率 Unbalanced %
		AB	BC	CA	
高压 h.v. winding	1	2.568	2.574	2.569	0.23
	2	2.541	2.544	2.536	0.31
	3	2.512	2.514	2.507	0.28
	4	2.480	2.484	2.476	0.32
	5	2.451	2.454	2.447	0.29
	6	2.422	2.424	2.417	0.29
	7	2.391	2.394	2.388	0.25
	8	2.360	2.365	2.358	0.30
	9	2.332	2.338	2.329	0.39
	10	2.304	2.306	2.300	0.26
	11	2.274	2.277	2.271	0.26
	12	2.243	2.247	2.242	0.22
	13	2.276	2.278	2.273	0.22
	14	2.306	2.309	2.303	0.26
	15	2.336	2.339	2.333	0.26
	16	2.365	2.368	2.363	0.21
	17	2.396	2.398	2.392	0.25
	18	2.427	2.431	2.423	0.33
	19	2.454	2.457	2.452	0.20
	20	2.483	2.488	2.482	0.24
	21	2.511	2.515	2.510	0.20
	22	2.541	2.544	2.540	0.16
	23	2.569	2.573	2.569	0.16
低压 l.v. winding		ao	bo	co	
		0.006265	0.006254	0.006300	0.73

3.7 空载损耗及空载电流测量

Measurement of no-load loss and current

电压百分数% Percent of rated voltage	平均值电压 kV Average voltage	有效值电压 kV Virtual value voltage	空载电流 No-load current		空载损耗(kW) No-load loss
			A	%	
90	10.350	10.367	0.740	0.057	10.271
100	11.500	11.515	0.917	0.070	13.023
110	12.651	12.657	1.474	0.113	17.044

3.8 空载电流谐波测量(100%)

no-load current harmonic wave measurement (100%)

谐波次数 number of harmonic wave	H01 %		
1	100.0000	100.0000	100.0000
3	11.9115	43.9481	17.5180
5	23.3345	25.9398	21.5738
7	10.9277	13.7833	10.5168
9	0.9396	2.1654	0.0000

3.9 工频耐压试验

Power freqency with stand voltage test

施加电压端 Applied terminal	试验电压（kV） AC test voltage	试验时间（s） Test time	结 果Results
高压—低压及地 h.v. —l.v.&E	275	60	合 格 Passed
低压—高压及地 l.v. —h.v.&E	38	60	合 格 Passed

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3.10 带局部放电的感应耐压试验（IVPD）　　频率 **frequency：200 Hz**

Induced voltage withstand test with parts discharge measurement

施加电压Applied Voltage		持续时间 Duration	局部放电量 pc		
倍数 multiple	相对相电压（kV） phase to phase		Partial discharge capacity		
			A	B	C
0.4Ur	52.8	记录背景PD值 Background value of PD	10	10	9
1.2Ur	158.4	1 min	20	30	20
1.58Ur	208.6	5 min	20	30	40
2Ur	264	30 S	70	80	80
1.58Ur	208.6	5 min	50	50	50
		10 min	50	50	50
		15 min	50	50	50
		20 min	50	50	50
		25 min	50	50	50
		30 min	50	50	50
		35 min	50	50	50
		40 min	50	50	50
		45 min	50	50	50
		50 min	50	50	50
		55 min	50	50	50
		60 min	50	50	50
1.2Ur	158.4	1 min	20	20	20
0.4Ur	52.8	记录背景PD值 Background value of PD	10	10	10

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3.11负载损耗及阻抗电压测量

Measurement of load loss and short impedance voltage

油温 **Temprature of oil (℃)**：23.4

测量绕组 **Windings**	分接位置 **Tap position**	施加电流（A） **Current**	测量电压（kV） **Voltage**	负载损耗（kW）75℃ **Load loss**	短路阻抗 75℃ % **Impedance voltage**	
					20.0MVA	26.0MVA
高压-低压 **H.V.- L.V.**	1	69.441	13.408	105.756	10.58	13.75
	12	75.187	11.406	105.604	10.05	13.07
	23	82.361	10.027	125.400	9.96	12.95

3.12 零序阻抗测量 Measurement of zero-sequence impedance

测量端子 **Measurement terminal**	电 压 （V） **Voltage**	电 流 （A） **Current**	Z_O （Ω / 相 **phase**）
o-abc	27.0	105.1	0.77

3.13 雷电冲击试验 Lightning impulse test

记录见附页 **Test oscillogram records are shown in the last pages.**

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Date: 28/10/2015
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3.14 声级测量 Noise level measurement:

油箱高度tank height(m)h =2.72　　测量高度Measure height(m)：1/3h=0.91

测量高度Measure height(m)：2/3h=1.81

3.14.1 测量数据measurement data

背景噪声sound leveldB (A)			平均 Average (dB)	变压器合成噪声(dB) combined noise
冷却器状态 Radiator condition	测量前 before measured	测量后after measured		
ONAN	38.9	38.6	38.8	56.7
ONAF	38.9	38.6	38.8	65.2

3.14.2 修正系数correction factor

测量室总表面积 total superficial area of measurement room (m^2)	平均吸声系数 average sound-absorbing factor (a)	吸声量 sound-absorbing (A)	距离基准发射面 distance to reference emitting surface (m)	测量表面积 measuring superficial area (m^2)	环境修正值k correction value of enviromrnt (dB)
7920	0.15	1188	0.3	90.100	1.15
7920	0.15	1188	2.0	189.272	2.14

3.14.3 测量结果measurement result

A计权表面声压级 Aweighting acoustic pressure level (dB)	0.3m	55.6
	2.0m	63.1

3.15 风机吸收功率测量 Measurement of power taken by the fan motors

温度temperature(℃)：22.4

型号：DBF2-506　　Supplier：Xi'an NoKo Electric Company Limited

Type：DBF2-506

型号 Serial No.	电压（V）Voltage	电流（A）Current	功率 Power (W)
15070	400	0.83	355
15076	400	0.87	410
15078	400	0.94	437
15077	400	0.91	439
15066	400	0.83	361
15074	400	0.91	431
15071	400	0.93	447
15073	400	0.83	366

3.16 电容式套管试验

Oil paper capacitor type bushing test 温度temperature(℃)：22.4

套管型号 **type**	BRDLW4-145/800-4 （A、B、C PHASE BUSHING）		
产地 **maufacturer**	传奇电气（沈阳）有限公司 **TRENCH ELECTRIC CO.,LTD**		
套管编号 **Product serial Number**	1504636	1504633	1504634
施加电压 **applied voltage**（kV）	9.992	9.994	9.992
tgδ% （实测值**measured value**）	0.230	0.262	0.235
Cx （pF）	302.6	302.7	301.8
标称电容 **nominal capacitance** （pF）	306	307	306

3.17 有载开关试验

Test of on-load tap changer

开关型号 **Tap changer type**	制造单位 **Manufacturer**	出厂序号 **Serial number**
VVIII2500-145-12231W	**MR**	**1593670**

a. 变压器不激磁，在额定辅助电压下分接开关完成8个完全操作循环.
At rated auxiliary voltage and no excitation,tap changer run eight complete cycles of

b. 变压器在额定激磁条件下，空载试验时，分接开关完成1个操作循环.
At rated excitation and no-load test condition,tap changer run one cycle of operation.

c. 变压器不激磁，在85%额定辅助电压下分接开关完成1个操作循环.
At 85% rated auxiliary voltage and no excitation,tap changer be run one cycle of operation.

d. 变压器负载试验时，在主分接两侧±2级间完成10次分接变换.
At load test,tap-changer run ten times at ±2 step side of principal tap.

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Date: 28/10/2015
KEMA Laboratories

4. 试验结论：Test conclusion

SFZ-26000/132 1522043 号有载调压电力变压器上述例行试验及部分特殊试验
SFZ-26000/132 1522043 On load tap change power transformer routine test and
的试验项目、方法及结果符合IEC60076-1：2011、IEC60076-3：2013、IEC60076-4：2002、
partial special test result with IEC60076-1:2011、IEC60076-3:2013、IEC60076-4:2002、
等标准及技术协议要求。
standards and technical agreements requirements.

试品试验Test：　　合格Passed

编制 Edited by：

校核Inspected by：

审核Examined by：

审定Authorized by：

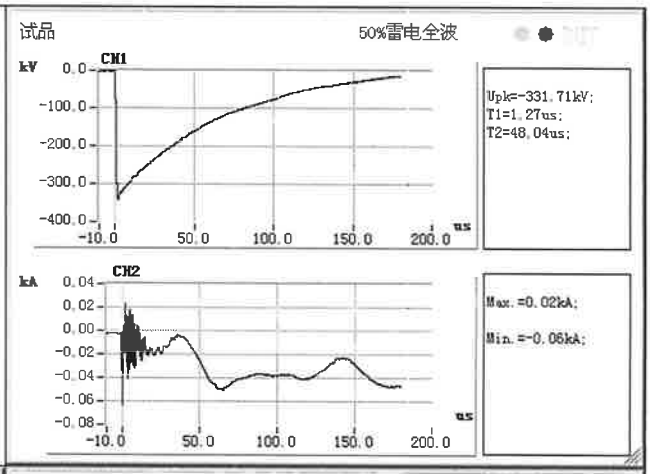
A 相

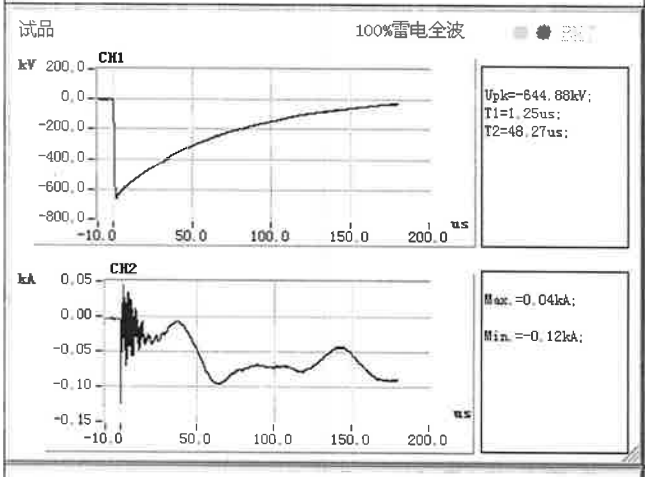
试验极性：负；

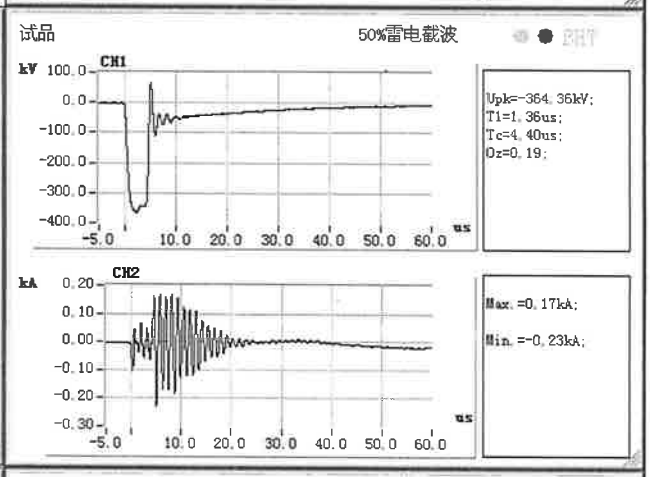
通道 1：电压波；

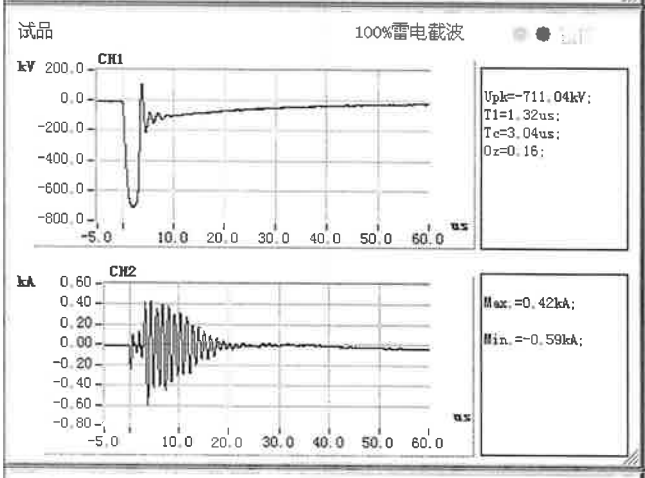
通道 2：中性点电流波；

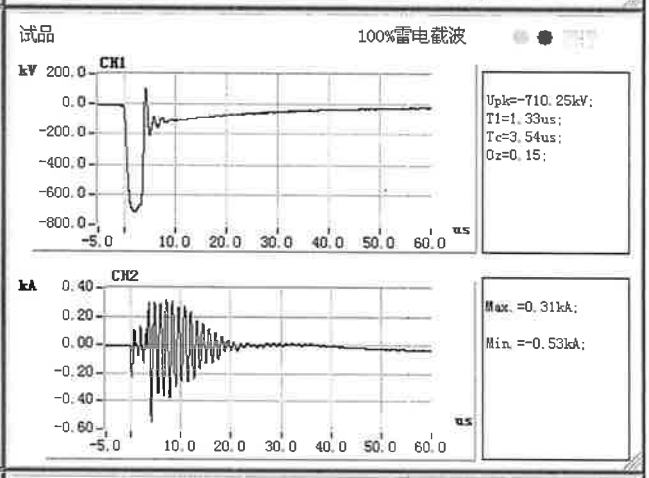
高压绕组分接位置：1

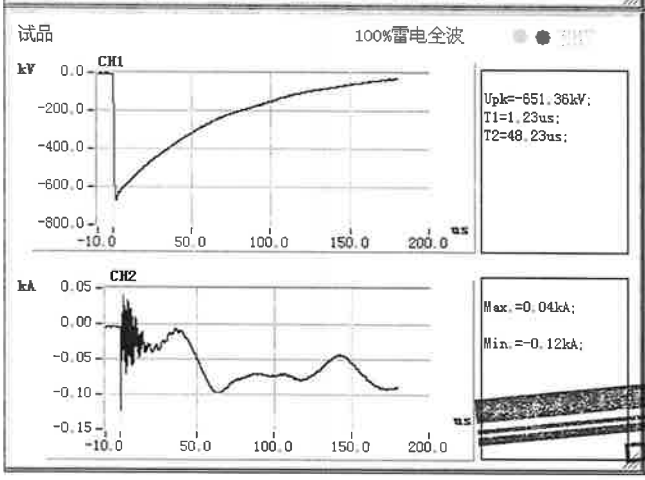


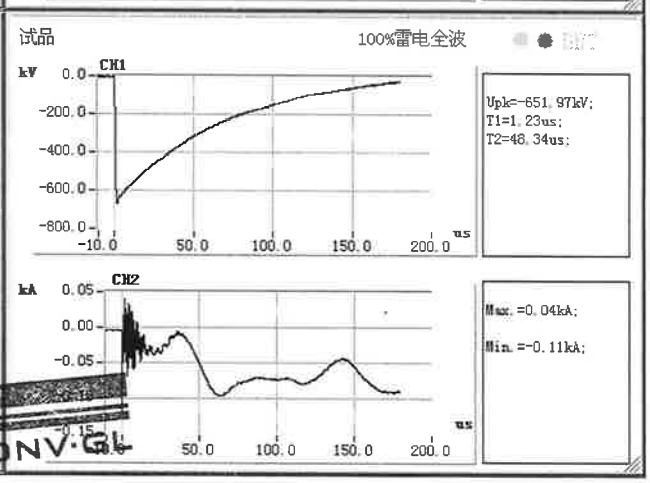












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Richard Houtepen

Date: 28/10/2015

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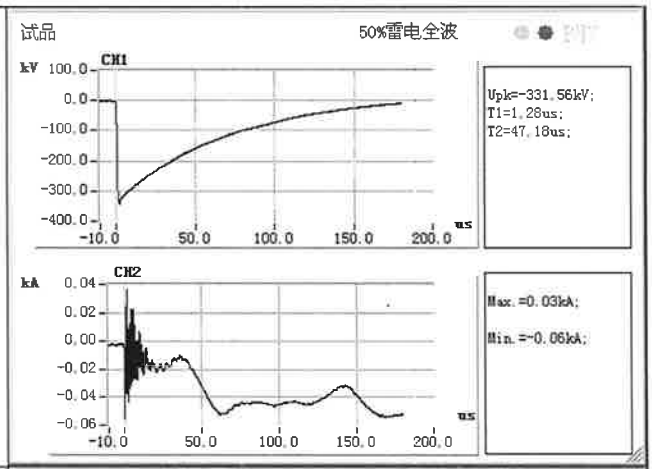
B 相

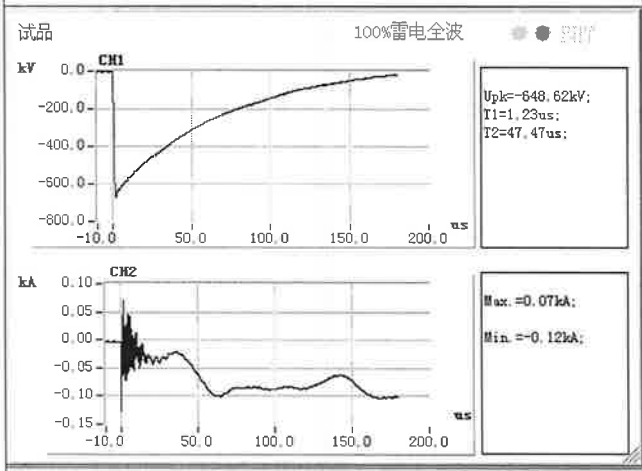
试验极性：负；

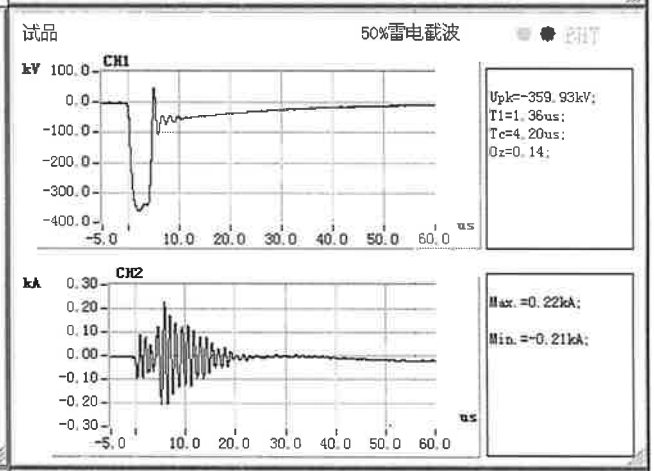
通道 1：电压波；

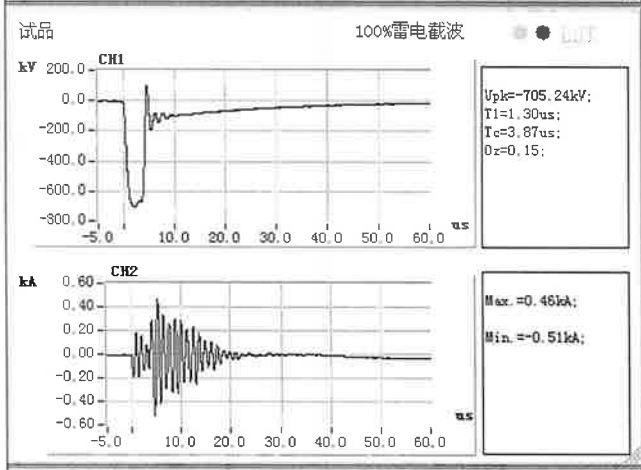
通道 2：中性点电流波；

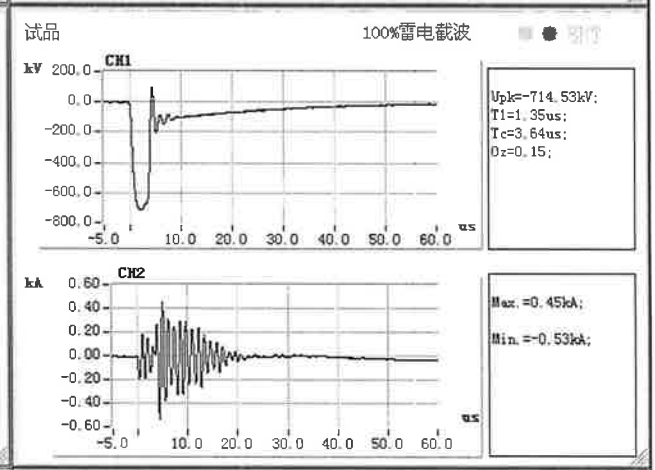
高压绕组分接位置：12

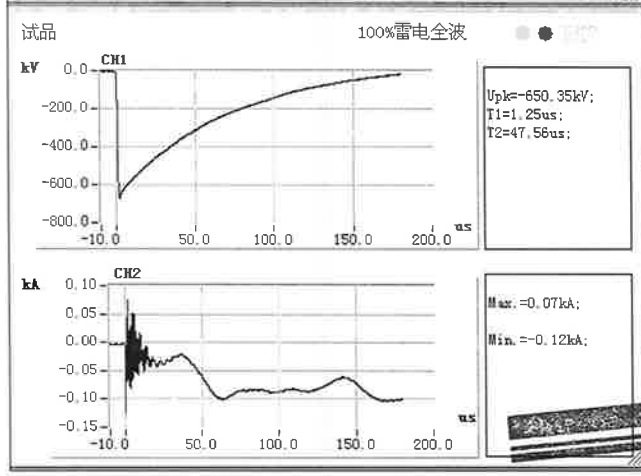


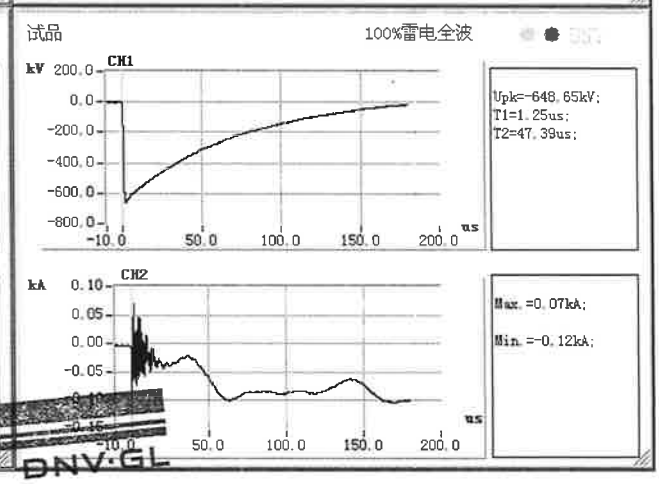












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Richard Houtepen
Date: 28/10/2015
KEMA Laboratories

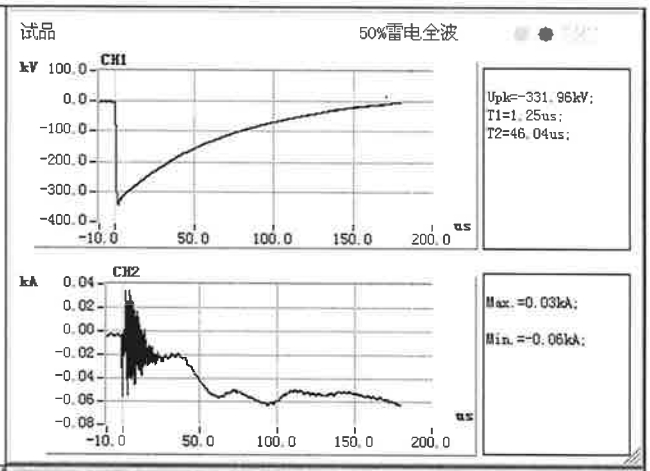
C 相

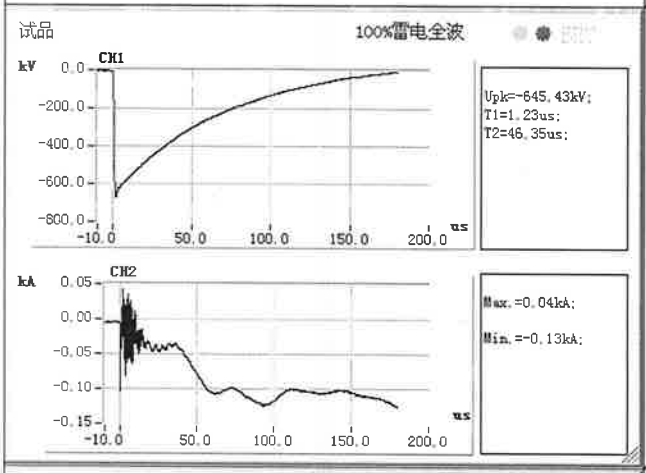
试验极性：负；

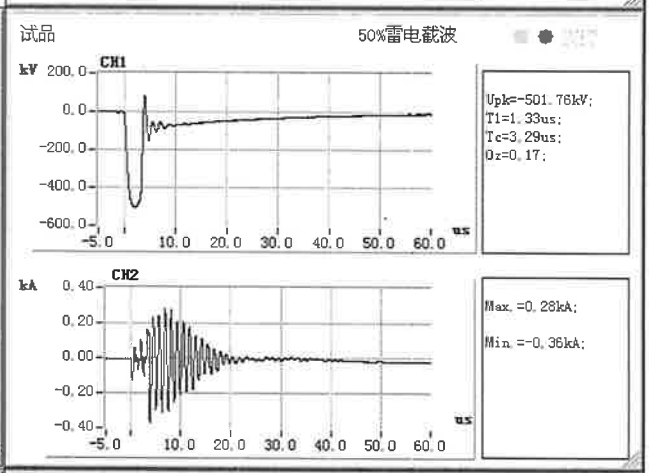
通道 1：电压波；

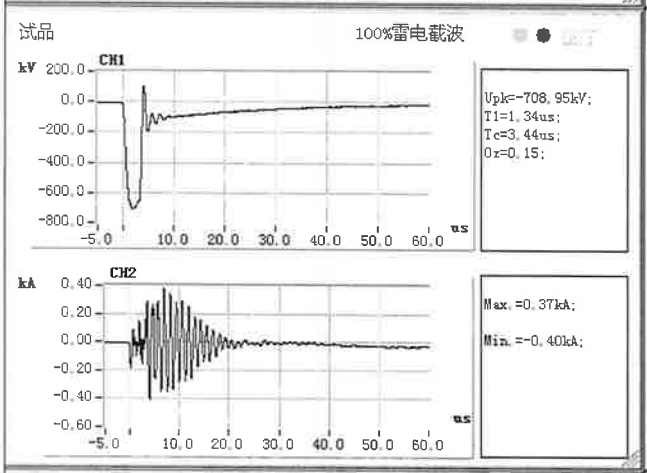
通道 2：中性点电流波；

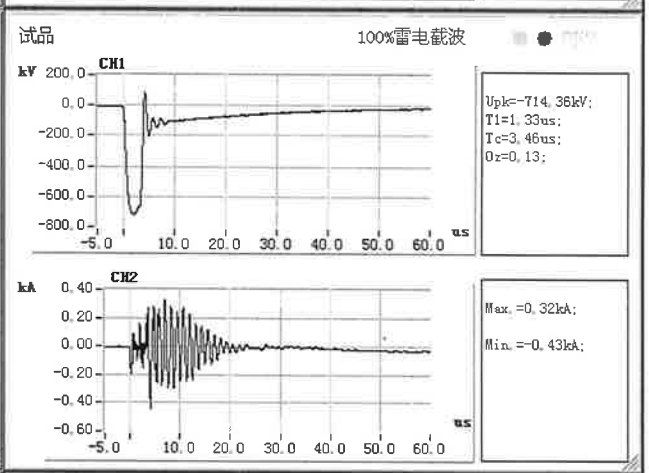
高压绕组分接位置：23

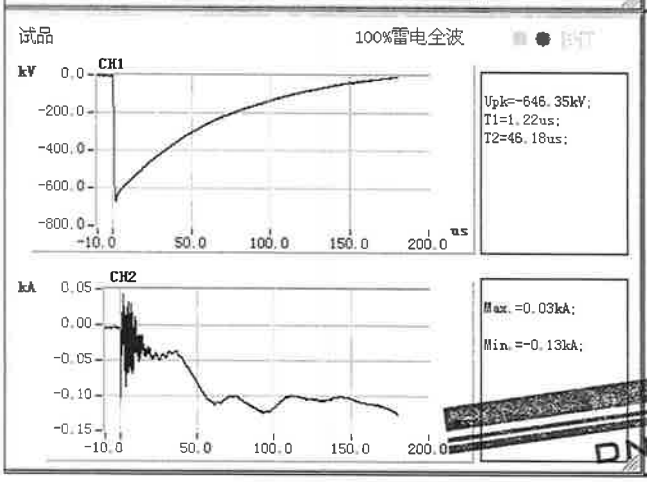


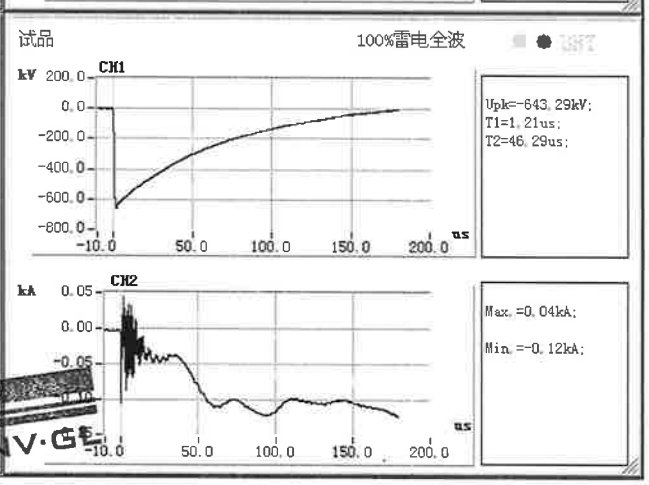












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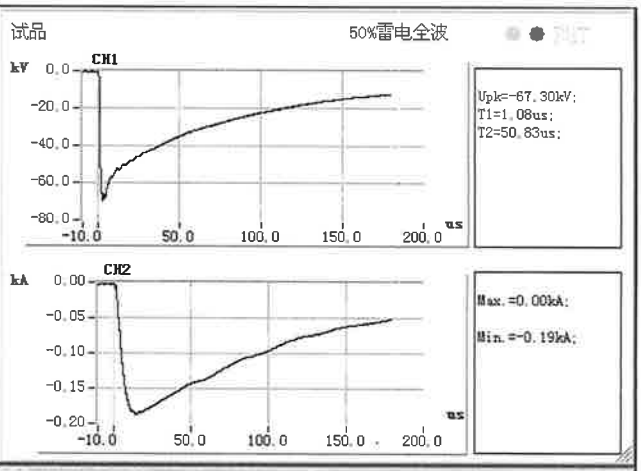
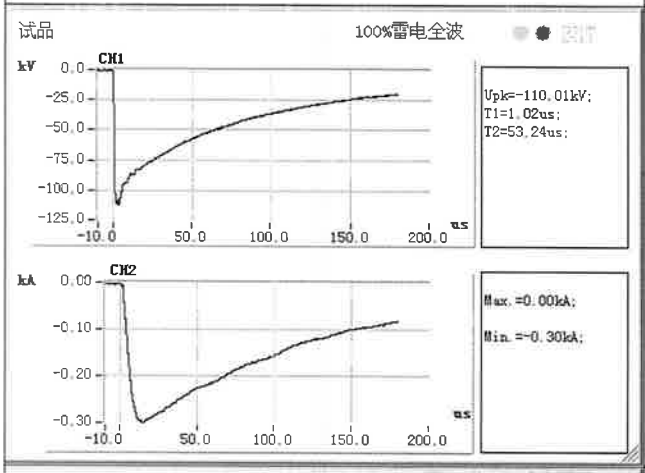
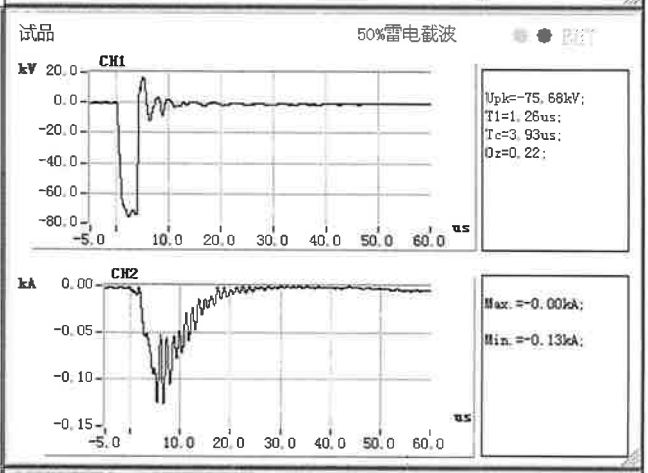
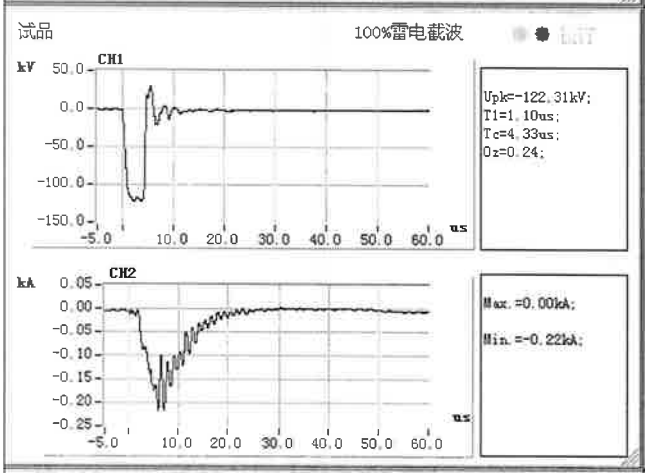
Richard Houtepen
Date: 28/10/2015
KEMA Laboratories

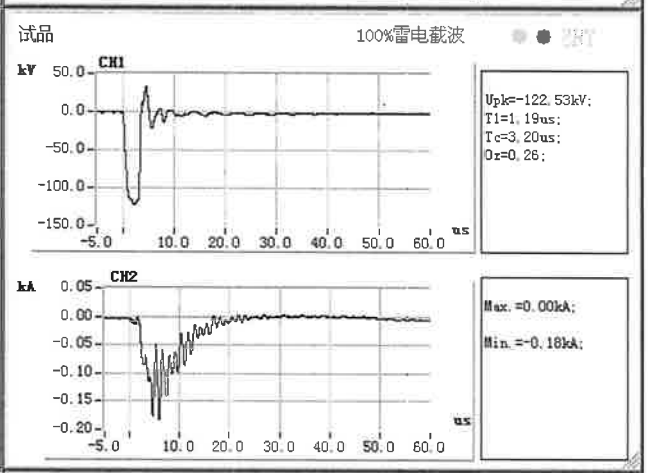
a 相
试验极性：负;
通道 1：电压波;
通道 2：中性点电流波

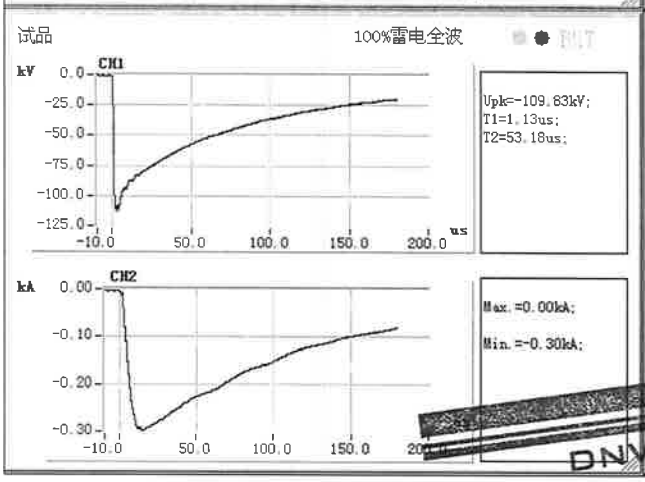


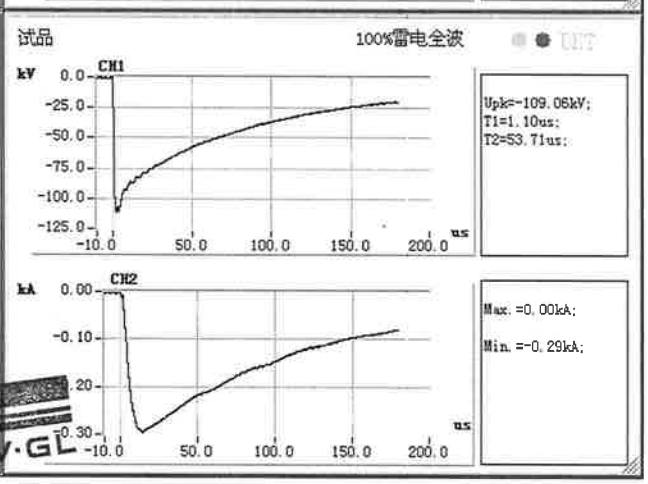












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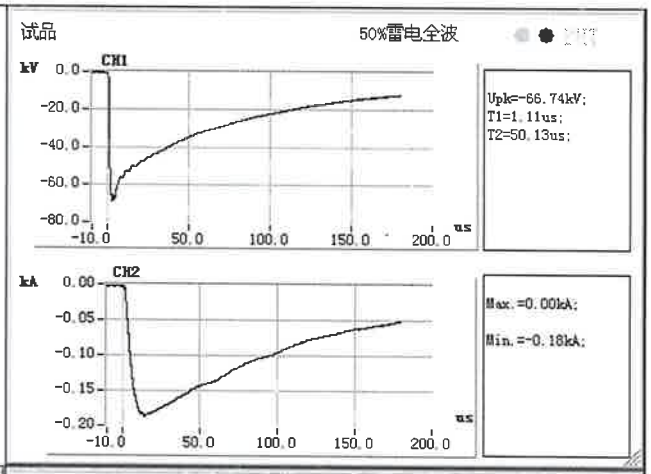
Richard Houtepen
Date: 28/10/2015
KEMA Laboratories

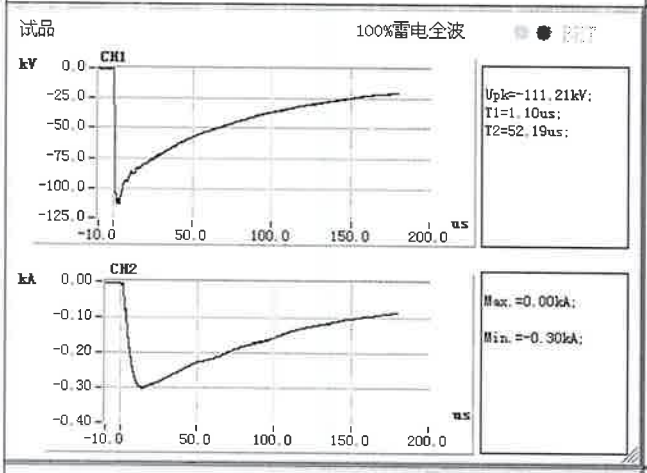
b 相

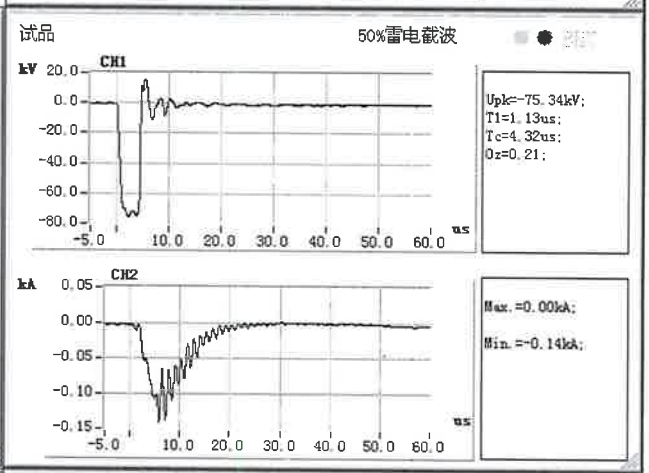
试验极性：负；

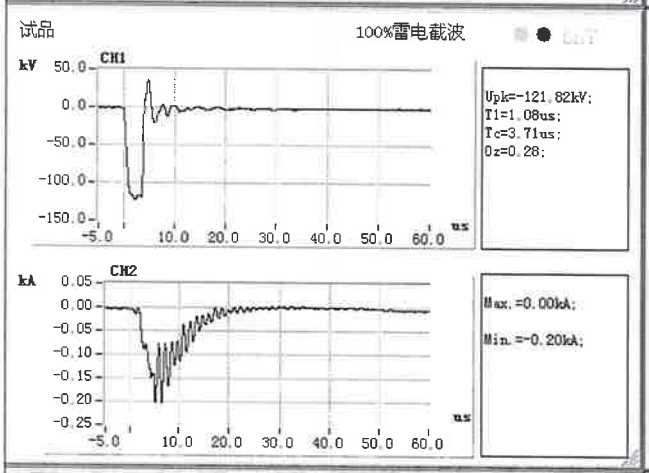
通道 1：电压波；

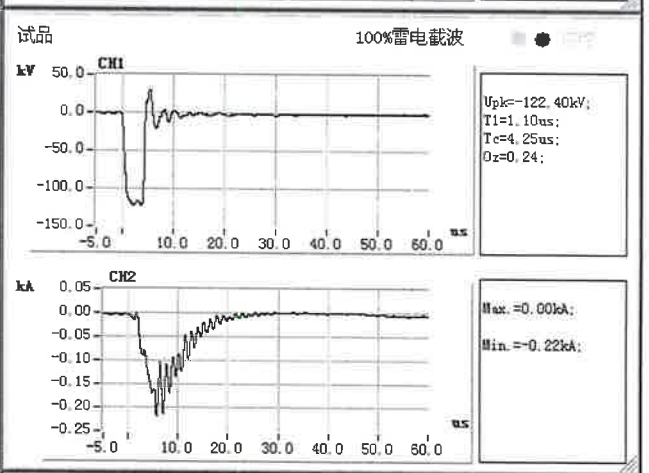
通道 2：中性点电流波

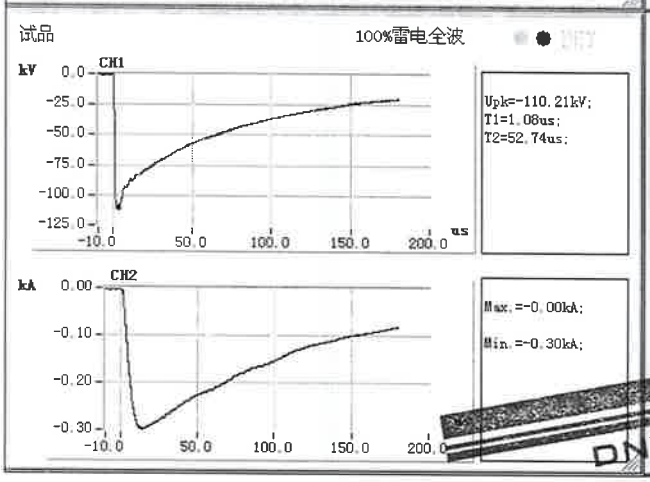


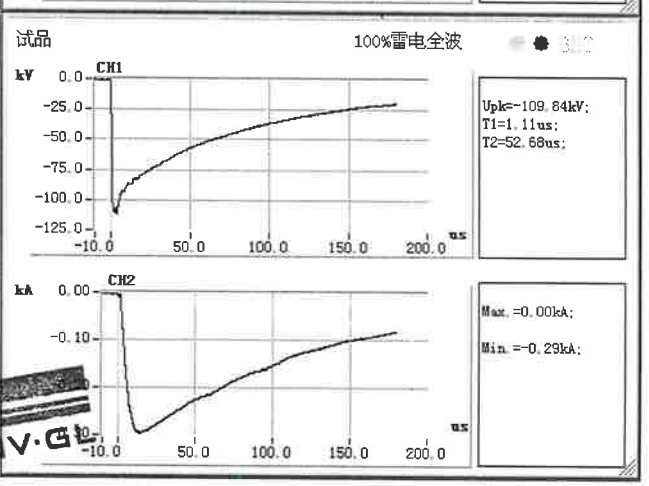












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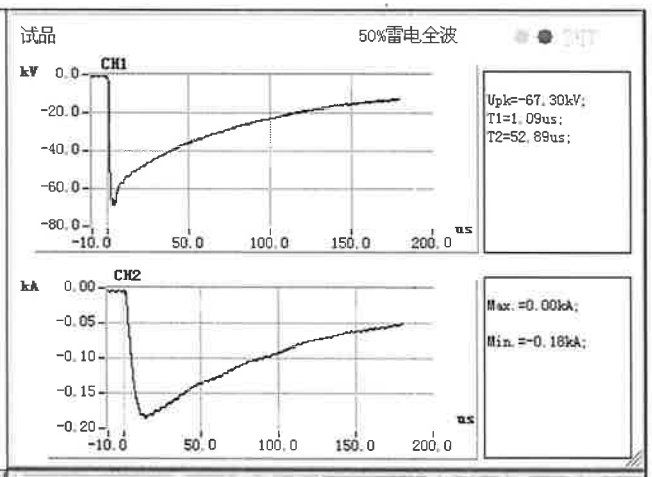
Richard Houtepen
Date: 28/10/2015
KEMA Laboratories

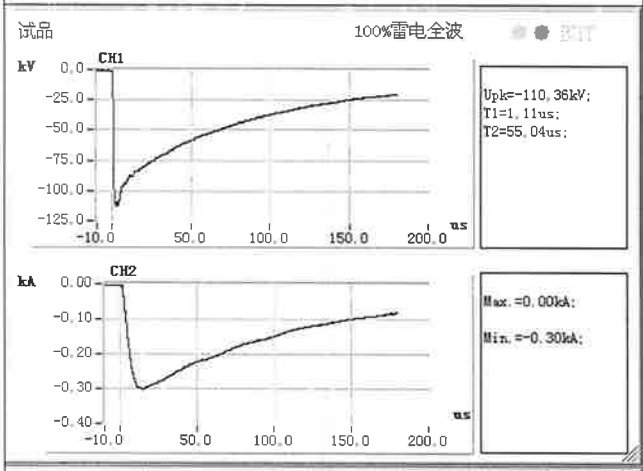
c 相

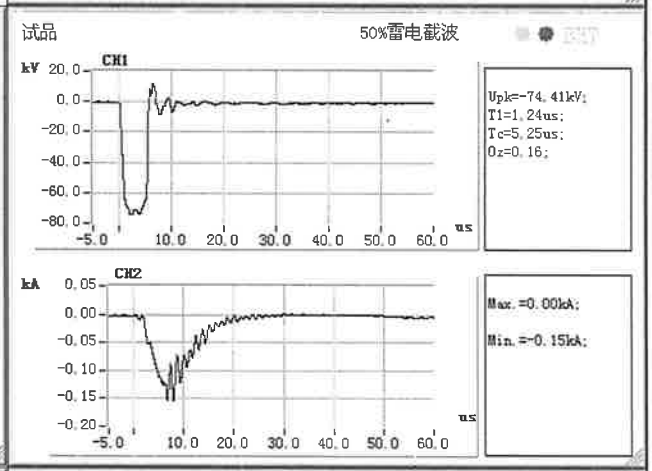
试验极性：负；

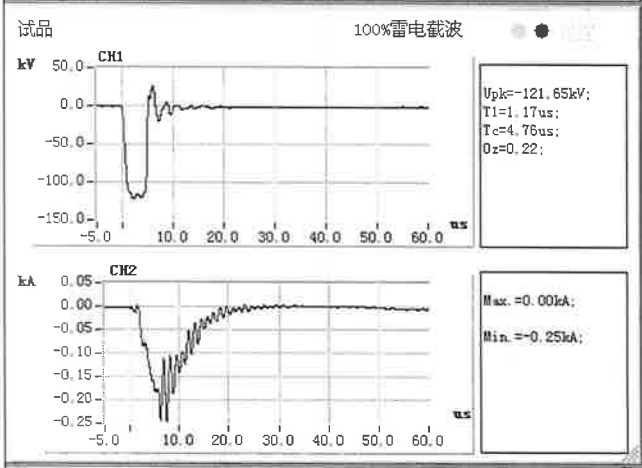
通道 1：电压波；

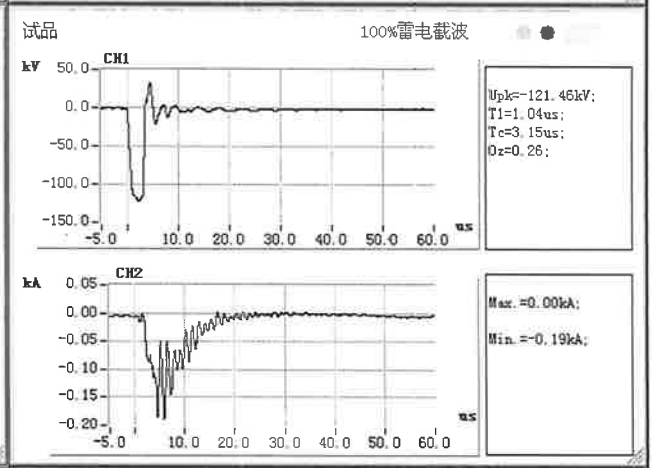
通道 2：中性点电流波

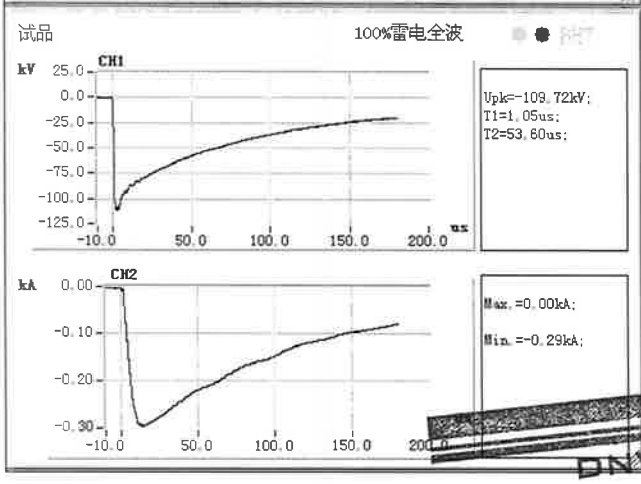


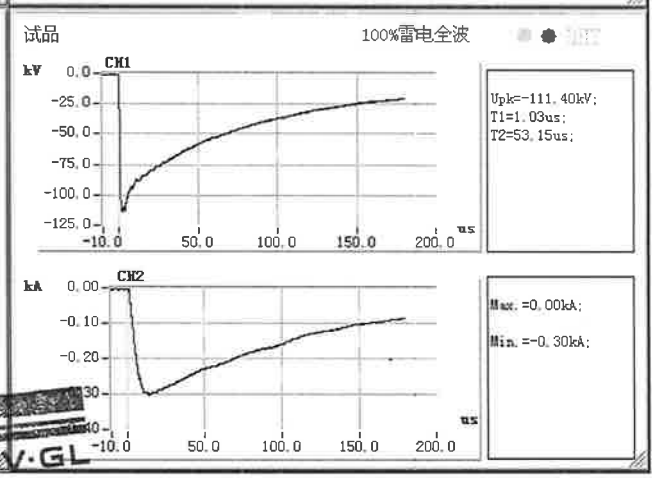












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Richard Houtepen

Date: 28/10/2015

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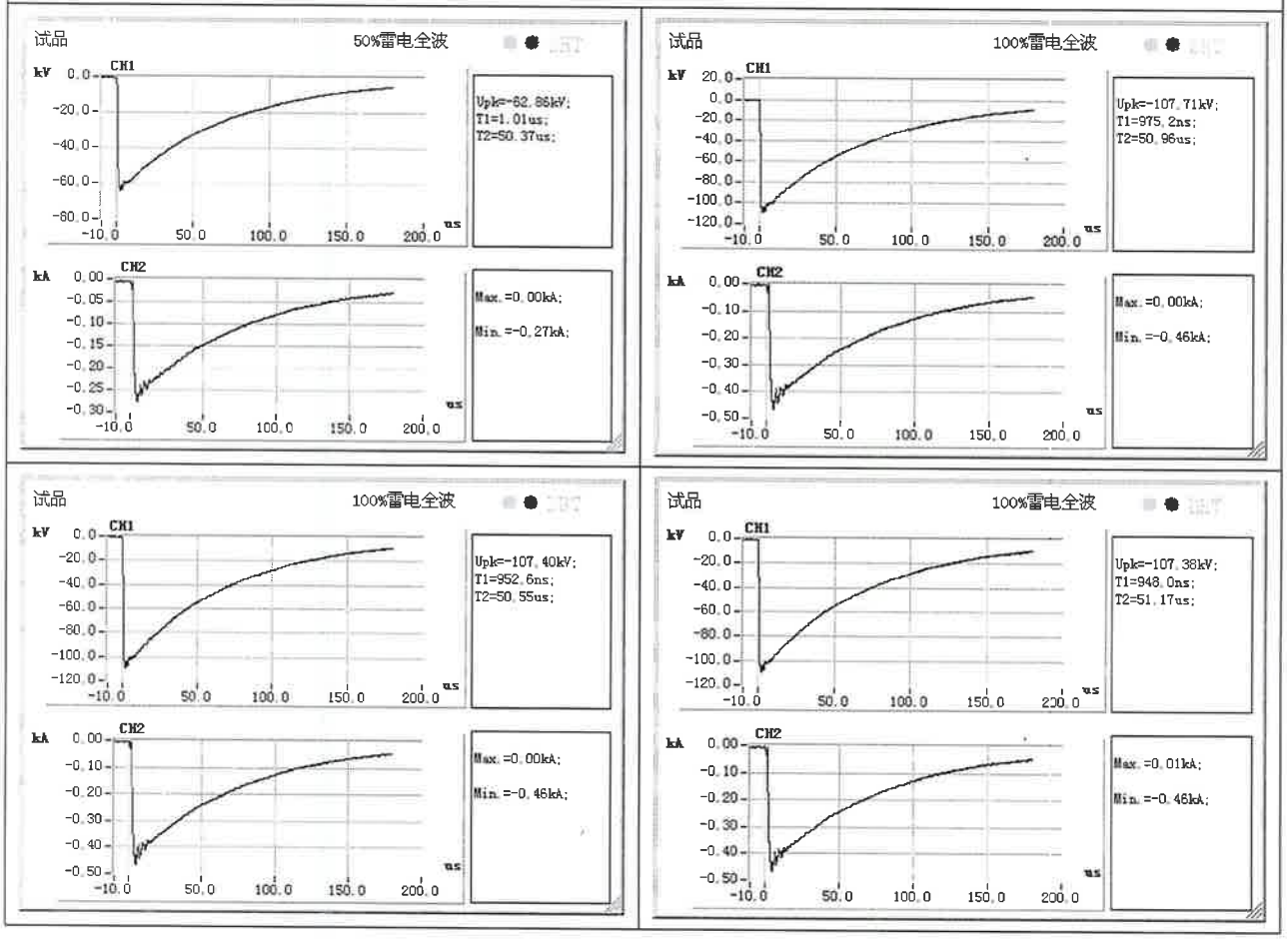
O 相

试验极性：负;

通道 1：电压波;

通道 2：中性点电流波



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Richard Houtepen

Date: 28/10/2015

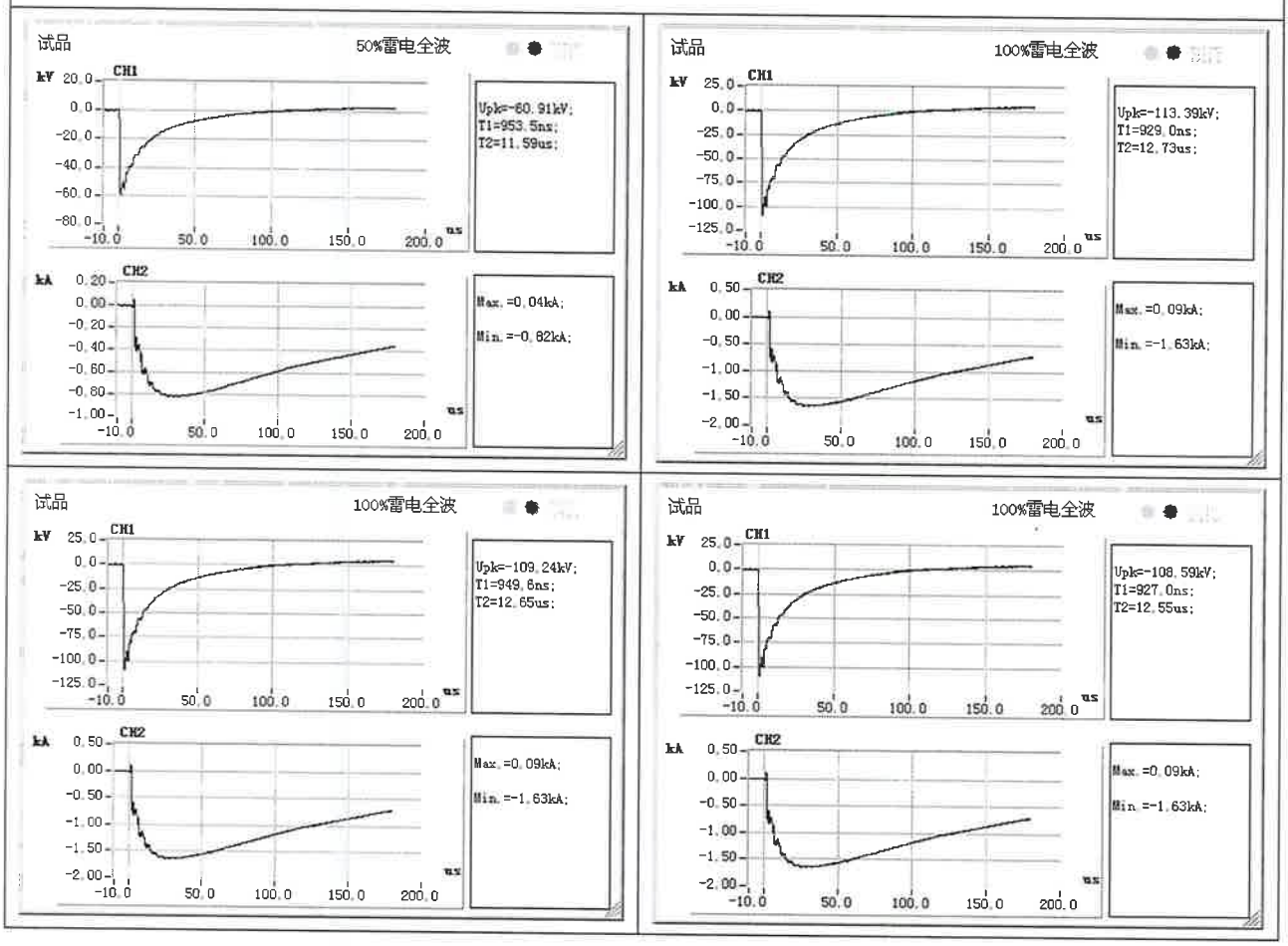
KEMA Laboratories

O 相

试验极性：负;

通道 1：电压波;

通道 2：中性点电流波



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Richard Houtepen

Date: 28/10/2015

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