



中国认可
国际互认
检测
TESTING
CNAS L0699



TEST REPORT

CEPRI-EETC03-2019-0826 (E)

Client: Siemens Transformer (Wuhan) Co., Ltd.

Object: Power Transformer

Type: SFZ11-100000/110

Test Category: Routine test, type test and special test



POWER INDUSTRY QUALITY INSPECTION AND
TEST CENTER FOR ELECTRIC EQUIPMENT

NOTICE

1. This report will enter into effect with seals of test center.
2. This report is legally made available accompany with compiled, checked, verified and approved signatures.
3. Alter the report is invalid.
4. This report only takes responsibility to the test object.
5. Part of copy is invalid.
6. Any objections in the report should be posed within 15 days once the report is received.
7. The inspection and testing management system of China Electric Power Research Institute includes the following institutes:

National Wind Power Integration Research and Test Center

☆**Power Industry Quality Inspection and Test Center for Electric Equipment**

Power Industry Quality Inspection & Test Center for Electric Power Equipment and Instruments

Power Industry Quality Inspection & Test Center for Electrical Material and Components

Power Industry Quality Inspection & Test Center for Automation Equipment

Power Industry Quality Inspection & Test Center for Communication Equipment

Power Industry Quality Inspection & Test Center for Concrete Power and Communication Poles

Power System Electromagnetic Compatibility and Electromagnetic Environmental Research and Monitoring Center

Address: NO.143, Luoyu Road, Hongshan District, Wuhan, Hubei Province, 430074.

Fax: 86-27-5937-8488 Service line: 400-656-5689 Supervision hotline: 010-82813498

E-mail: eetc@epri.sgcc.com.cn

Website: <http://www.epri.sgcc.com.cn>

Catalogue

1. Catalogue.....	1
2. Signature Page.....	2
3. Test Results.....	3
4. Content	7
5. Appendix A Object Parameters	22
6. Appendix B The Main Test Devices	24
7. Appendix C Lightning Impulse Test Waveforms	26

Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment		CEPRI-EETC03-2019-0826(E) Total 32 Page 2
Client	Siemens Transformer(Wuhan) Co., Ltd.	Manufacturer	Siemens Transformer(Wuhan) Co., Ltd.
Object	Power Transformer 检测报告 专用章	Type	SFZ11-100000/110
		Serial No.	V143101
Test Category	Routine test, type test and special test	Test Date	2019.08.08~2019.08.12
Requirements	<p>IEC 60076-1:2011 Power Transformers Part 1: General</p> <p>IEC 60076-2:2011 Power Transformers Part 2: Temperature rise for liquid-immersed transformers</p> <p>IEC 60076-3:2013 Power Transformers Part 3: Insulation levels, dielectric tests and external clearances in air</p> <p>IEC 60076-10:2016 Power transformers Part 10: Determination of sound levels</p> <p>V143101 Technical data of SFZ11-100000/110 Power Transformer</p>		
Conclusion	<p>According to IEC 60076-1:2011 and other standards, routine test, lightning impulse test, temperature-rise test, determination of sound levels, measurement of the harmonics of the no-load current, winding hot-spot temperature-rise measurement, measurement of no-load excitation characteristic, measurement of zero-sequence impedance(s) on three-phase transformers, measurement of the power taken by the fan and pump motors and measurement of frequency response were performed on SFZ11-100000/110 Power Transformer which was provided by Siemens Transformer(Wuhan) Co., Ltd. All the results were in accordance with the requirements.</p>		
Note	In the event of any difference in meanings, the Chinese report shall take priority over the English version.		
Compiled by: 任晓红 任晓红 杨国泰 杨国泰			
Checked by: 张锦 张锦 Verified by: 应斯 应斯			
Approved by: 付超 付超 Date of issue: 2019-09-27			

Test Report		Power Industry Quality Inspection and Test Center for Electric Equipment		CEPRI-EETC03-2019-0826(E) Total 32 Page 3	
Test Results					
No.	Item	Requirements	Results		Evaluation
1	Measurement of d.c. Insulation Resistance between Each Winding to Earth and between Windings (Routine Test)	Provide the measured values	HV—LV & earth: 22500MΩ LV—HV & earth: 21100MΩ HV & LV— earth: 21200MΩ		/
2	Measurement of Absorption Ratio (Routine Test)	Provide the measured values	See Content 1		/
3	Check of Core and Frame Insulation (Routine Test)	Core: d.c. 2500V 60s Frame: d.c. 2500V 60s Core — frame: d.c. 2500V 60s	d.c. 2500V 60s Without breakdown d.c. 2500V 60s Without breakdown d.c. 2500V 60s Without breakdown		Passed
4	Determination of Capacitances Windings-to-earth and between Windings (Routine Test)	Provide the measured values	See Content 5		/
5	Measurement of Dissipation Factor (tan δ) of the Insulation System Capacitances (Routine Test)	Dissipation Factor tan δ(%): ≤0.5	HV—LV & earth: 0.125 LV—HV & earth: 0.175 HV & LV— earth: 0.184		Passed
6	Measurement of Winding Resistance (Routine Test)	Unbalance rate between three phases: ≤2%(Phase) ≤1%(Line)	Maximum unbalance rate HV winding: 0.75%(Phase) LV winding: 0.06% (Line)		Passed
7	Measurement of Voltage Ratio and Check of Phase Displacement (Routine Test)	Ratio tolerance (%): -0.5~+0.5 Connection Symbol: YNd11	(-0.14~+0.05) % YNd11		Passed
8	Measurement of No-load Loss and Current (Routine Test)	No-load loss P ₀ (kW): ≤59.0(1+15%) No-load current I ₀ (%): ≤0.3	47.98kW 0.07%		Passed
9	Measurement of No-load Loss and Current at 90% and 110% of Rated Voltage (Routine Test)	Test voltage: 90%Ur、 110%Ur No-load loss P ₀ (kW): —— No-load current I ₀ (%): ——	90%Ur 35.36kW 0.05%	110%Ur 78.69kW 0.73%	/

Test Report		Power Industry Quality Inspection and Test Center for Electric Equipment		CEPRI-EETC03-2019-0826(E) Total 32 Page 4	
Test Results(continued)					
No.	Item		Requirements	Results	Evaluation
10	Check of the Ratio and Polarity of Built-in Current Transformers (Routine Test)		Ratio should be consistent with the nameplate. Negative polarity	Ratio was consistent with the nameplate. Negative polarity	Passed
11	Measurement of Short-circuit Impedance and Load Loss (Routine Test)		Load loss at 75°C $P_{k75^{\circ}\text{C}}$ (kW): $\leq 328(1+15\%)$ Short-circuit impedance at 75°C $Z_{k75^{\circ}\text{C}}$ (%): $14(1\pm 5\%)$ $Z_{k75^{\circ}\text{C}}$ (Ω /phase): —	348.17kW 13.57% 16.42 Ω /phase	Passed
12	Leak Testing with Pressure (Routine Test)		Pressure (kPa): 30 Duration (h): 24 No leakage and no damage	30kPa 24h No leakage and no damage	Passed
13	Tests on On-load Tap-Changers (Routine Test)		The operation test on on-load tap-changers should be performed without failure. Collapse of the test voltage of auxiliary circuits shouldn't occur.	The operation test on on-load tap-changers was performed without failure. No collapse of the test voltage of auxiliary circuits occurred.	Passed
14	Lightning Impulse Test	Full wave for the line terminals (Routine Test)	HV (kV) : $-480(1\pm 3\%)$ LV (kV) : $-200(1\pm 3\%)$	$(-477.27 \sim -482.63)\text{kV}$ $(-199.00 \sim -199.73)\text{kV}$	Passed
		Full wave for the neutral terminal (Type Test)	HVN (kV) : $-325(1\pm 3\%)$	$(-321.12 \sim -323.28)\text{kV}$	Passed
		Chopped wave for the line terminals (Type Test)	HV (kV) : $-530(1\pm 3\%)$ LV (kV) : $-220(1\pm 3\%)$	$(-525.09 \sim -527.25)\text{kV}$ $(-218.57 \sim -219.23)\text{kV}$	Passed
15	Applied Voltage Test (Routine Test)		HV neutral: 140kV 60s LV winding: 85kV 60s	140kV 60s No collapse 85kV 60s No collapse	Passed
16	Line Terminal AC Withstand Test (Routine Test)		Test voltage(kV): 200 Frequency(Hz): >50 Duration (s): $15\leq t\leq 60$ No collapse	200kV 200Hz 30s No collapse	Passed

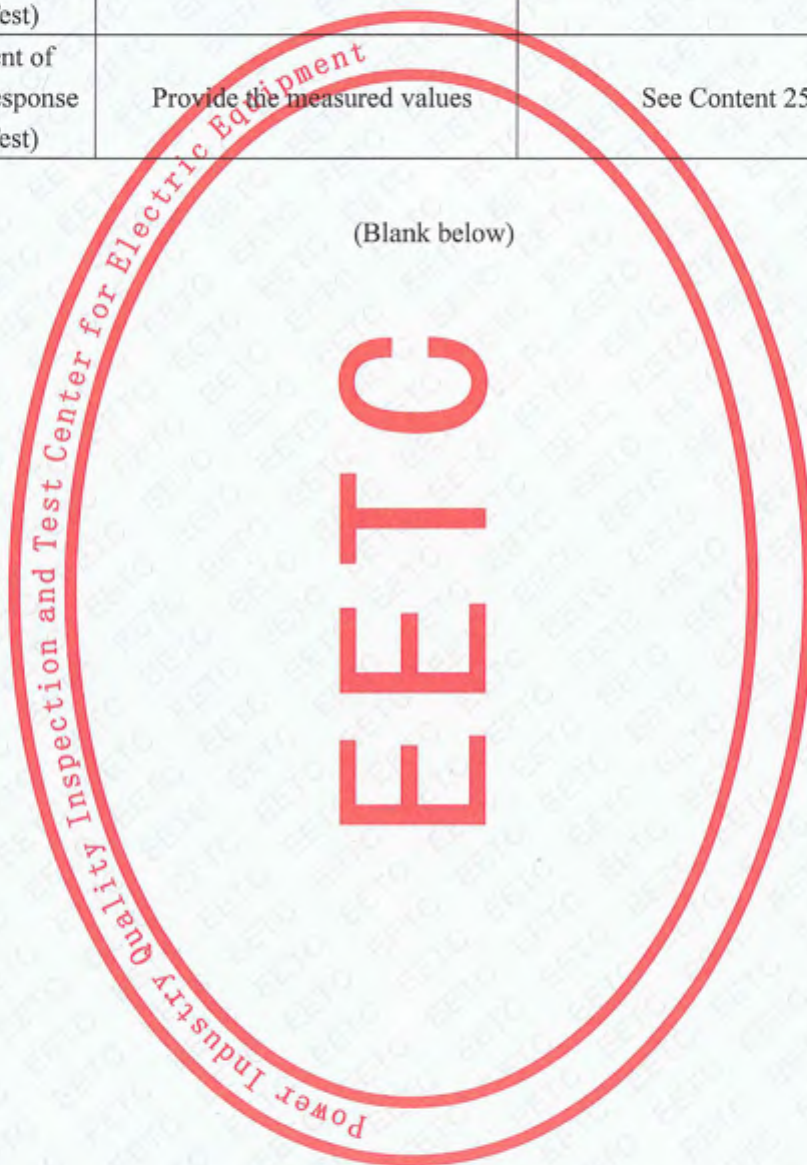
Test Report		Power Industry Quality Inspection and Test Center for Electric Equipment		CEPRI-EETC03-2019-0826(E) Total 32 Page 5	
Test Results(continued)					
No.	Item	Requirements	Results		Evaluation
17	Induced Voltage Withstand Test with Partial Discharge (Routine Test)	Frequency(Hz): >50 Pre-applied voltage $2.0U_r/\sqrt{3}$ Duration (s): $15\leq t\leq 60$ Measured voltage $1.58U_r/\sqrt{3}$ Duration (min): 60 Partial discharge quantity(pC): ≤ 100	200Hz 127kV 30s 100kV 60min A:13pC B:20pC C:20pC		Passed
18	Insulation Oil Test (Routine Test)	Breakdown voltage (kV): ≥ 65 $\tan \delta$ 90°C(%): ≤ 0.5 Water content (mg/L): <10	69.4kV 0.12% 2.8mg/ L		Passed
19	Measurement of Dissolved Gasses in Oil (Special Test)	No obviously change before and after the test.	No obviously change before and after the test.		Passed
20	Temperature-rise Test (Type Test)	Cooling type Top oil temperature rise (K): ≤ 55 Average winding temperature rise: HV winding (K): ≤ 60 LV winding (K): ≤ 60	ONAN 44.9K 45.5K 46.1K	ONAF 46.9K 47.4K 47.4K	Passed
21	Winding Hot-spot Temperature-rise Measurement (Special Test)	Hot-spot winding temperature rise: HV winding (K): ≤ 78 LV winding (K): ≤ 78	59.1K 59.8K	68.0K 68.1K	Passed
22	Determination of Sound Levels (Type Test)	Cooling device state $\overline{L_{PA}}$ [dB(A)]: ≤ 67 L_{WA} [dB(A)]: ——	On service 62dB (A) 82dB (A)	Out of service 65dB (A) 88 dB (A)	Passed
23	Measurement of the Power Taken by the Fan and Pump Motors (Type Test)	Provide the measured values	See content 21		/
24	Measurement of Zero-sequence Impedance on Three-phase Transformers (Special Test)	Provide the measured values	See Content 22		/
25	Measurement of the Harmonics of the No-load Current (Special Test)	Provide the measured values	a: 53.9% b: 40.5% c: 37.9%		/

Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC03-2019-0826(E) Total 32 Page 6
-------------	---	--

Test Results(continued)

No.	Item	Requirements	Results	Evaluation
26	Measurement of No-load Excitation Characteristic (Special Test)	Provide the measured values	See Content 24	/
27	Measurement of Frequency Response (Special Test)	Provide the measured values	See Content 25	/

(Blank below)



Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment		CEPRI-EETC03-2019-0826(E) Total 32 Page 7			
Content						
1. Measurement of d.c. Insulation Resistance between Each Winding to Earth and between Windings, Absorption Ratio (Routine Test):						
Oil temperature: 27.8°C, Relative humidity: 70.0%						
Position	R ₁₅ (MΩ)	R ₆₀ (MΩ)	R ₆₀ /R ₁₅			
HV—LV & earth	10700	22500	2.10			
LV—HV & earth	8860	21100	2.38			
HV & LV—earth	8450	21200	2.51			
2. Check of Core and Frame Insulation (Routine Test):						
Oil temperature: 27.8°C, Relative humidity: 70.0%						
Position	Applied d.c. voltage (V)	Duration (s)	Test result	R ₆₀ (MΩ)(20°C)		
Core—Frame & earth	2500	60	Without breakdown	16821		
Frame—Core & earth			Without breakdown	15476		
Core—frame			Without breakdown	19688		
3. Measurement of Winding Resistance (Routine Test):						
Oil temperature: 28.1°C						
Winding	Tapping position	Resistance (Ω)			Maximum unbalance rate (%)	Specified value (%)
HV	—	A-0	B-0	C-0	0.75	≤2
	1	0.2173	0.2180	0.2187		
	2	0.2148	0.2155	0.2162		
	3	0.2123	0.2130	0.2138		
	4	0.2099	0.2106	0.2113		
	5	0.2076	0.2082	0.2091		
	6	0.2051	0.2058	0.2065		
	7	0.2092	0.2035	0.2043		
	8	0.2003	0.2011	0.2018		
	9	0.1971	0.1974	0.1978		
	10	0.2001	0.2008	0.2014		
	11	0.2025	0.2032	0.2049		
	12	0.2049	0.2056	0.2063		
	13	0.2075	0.2082	0.2089		
	14	0.2098	0.2106	0.2112		
	15	0.2125	0.2131	0.2038		
	16	0.2148	0.2156	0.2161		
17	0.2174	0.2183	0.2187			
LV	—	a-b	b-c	c-a	0.06	≤1
		0.03231	0.03233	0.03232		

Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC03-2019-0826(E) Total 32 Page 8
-------------	---	--

4. Measurement of Voltage Ratio and Check of Phase Displacement (Routine Test):

Position	Tapping position	Calculated voltage ratio	Measured deviation of voltage ratio (%)			Specified value (%)	Connection symbol
			AB / ab	BC / bc	CA / ca		
HV to LV	1	3.143	-0.02	+0.05	+0.03	-0.5~+0.5	YNd11
	2	3.107	-0.05	+0.04	+0.04		
	3	3.071	-0.04	+0.05	+0.02		
	4	3.036	-0.08	+0.04	+0.00		
	5	3.000	-0.09	+0.04	+0.01		
	6	2.964	-0.08	+0.03	-0.02		
	7	2.929	-0.09	+0.02	-0.00		
	8	2.893	-0.09	+0.02	-0.03		
	9	2.857	-0.12	+0.02	-0.01		
	10	2.821	-0.11	+0.01	-0.02		
	11	2.786	-0.10	+0.01	-0.03		
	12	2.750	-0.12	+0.02	-0.04		
	13	2.714	-0.12	+0.02	-0.02		
	14	2.679	-0.13	+0.01	-0.02		
	15	2.643	-0.14	+0.01	-0.04		
	16	2.607	-0.14	+0.01	-0.04		
	17	2.571	-0.13	+0.00	-0.05		

5. Determination of Capacitances Windings-to-earth and between Windings, Measurement of Dissipation Factor ($\tan \delta$) of the Insulation System Capacitances (Routine Test):

Oil temperature: 28.1°C Relative humidity: 74.7%

Position	Dissipation factor $\tan \delta$ (%)	Capacitance C_x (nF)
HV—LV & earth	0.125	11.23
LV —HV & earth	0.175	16.27
HV & LV— earth	0.184	14.13

6. Measurement of No-load Loss and Current (Routine Test):

U/U _r	Applied voltage (kV)		Measured current (A)	Measured loss (kW)	No-load loss P_0 (kW)	No-load current I_0		Specified value	
	avg	rms				(A)	(%)	P_0 (kW)	I_0 (%)
100%	38.499	38.741	1.10	48.28	47.98	1.10	0.07	≤ 59.0 (1+15%)	≤ 0.3

7. Measurement of No-load Loss and Current at 90% and 110% of Rated Voltage (Routine Test):

U/U _r	Applied voltage (kV)		Measured current (A)	Measured loss (kW)	No-load loss P_0 (kW)	No-load current I_0		Specified value	
	avg	rms				(A)	(%)	P_0 (kW)	I_0 (%)
90%	34.643	34.683	0.688	35.40	35.36	0.688	0.05	—	—
110%	42.347	45.357	10.94	84.71	78.69	10.94	0.73		

Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC03-2019-0826(E) Total 32 Page 9
-------------	---	--

8. Measurement of Short-circuit Impedance and Load Loss (Routine Test):

8.1 Under 100% Sr

Oil temperature: 29.2°C

Winding	Tapping position	Applied current (A)	Measured voltage (kV)	Measured loss (kW)	Load loss P _{k75°C} (kW)	Short-impedance		Specified value	
						Z _{k75°C} (%)	Z _{k75°C} (Ω/phase)	P _{k75°C} (kW)	Z _{k75°C} (%)
HV—LV	1	300.32	10.708	116.68	334.19	14.06	20.59	—	—
	9	320.23	9.1081	113.74	348.17	13.57	16.42	≤328 (1±15%)	14(1±5%)
	17	357.50	8.0900	137.82	419.47	13.33	13.07	—	—

8.2 Under 70% Sr

Winding	Tapping position	Applied current (A)	Measured voltage (kV)	Measured loss (kW)	Load loss P _{k75°C} (kW)	Short-impedance		Specified value	
						Z _{k75°C} (%)	Z _{k75°C} (Ω/phase)	P _{k75°C} (kW)	Z _{k75°C} (%)
HV—LV	1	300.32	10.708	116.68	163.75	9.84	20.59	—	—
	9	320.23	9.1081	113.74	170.60	9.50	16.42	—	—
	17	357.50	8.0900	137.82	205.54	9.33	13.07	—	—

9. Tests on On-load Tap-changers (Routine Test):

9.1 Operation test on on-load tap-changers:

Test method	Test result
1. With the transformer un-energized, eight complete cycles of operation. 2. With the transformer un-energized and with the auxiliary voltage reduced to 85% of its rated value, one complete cycle of operation. 3. With the transformer energized at rated voltage and frequency at no load, one complete cycle of operation. 4. With one winding short-circuited and, rated current in the tapped winding, 10 tap-change operations across the range of two steps on each side from where a coarse or reversing changeover selector operates.	Without failure

9.2 Auxiliary circuits insulation test on on-load tap-changers:

Applied position	Test voltage (kV)	Duration (s)	Test result
Auxiliary circuits	2	60	No collapse
Current transformer secondary winding circuits	2.5	60	No collapse

10. Check of the Ratio and Polarity of Built-in Current Transformers (Routine Test):

Nameplate ratio	Checked ratio	A	B	C	0	Polarity
1S1-1S2	600/5	600/5	600/5	600/5	—	Negative polarity
2S1-2S2	600/5	600/5	600/5	600/5	—	
3S1-3S2	600/5	600/5	600/5	600/5	—	
4S1-4S2	640/2	—	640/2	—	—	
1S1-1S2	300/5	—	—	—	300/5	

Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC03-2019-0826(E) Total 32 Page 10
-------------	---	---

11. Insulation Oil Test (Routine Test):

Breakdown voltage (kV)		DDF at 90°C (%)		Water content (mg/L)	
Measured value	Specified value	Measured value	Specified value	Measured value	Specified value
69.4	≥65	0.12	≤0.5	2.8	<10

12. Measurement of Dissolved Gases in Oil (Routine Test): (μL/L)

Test state	H ₂	CO	CO ₂	CH ₄	C ₂ H ₆	C ₂ H ₄	C ₂ H ₂	Total hydrocarbon
Before test	3.04	1.63	51.26	0.08	0	0	0	0.08
After insulation test	3.96	2.07	83.72	0.14	0	0	0	0.14
After temperature-rise test	5.92	6.74	89.43	0.32	0	0	0	0.32

13. Lightning Impulse Test (LI) (Routine Test, Type Test):

Temperature: 29.4°C, Relative humidity: 59.0%, Atmospheric pressure: 99.4kPa

Line terminal test sequence: One full wave reference impulse at (50~75)% of the full wave test voltage;

One full wave impulse at the full wave test voltage;

Two chopped wave impulses at the chopped wave test voltage;

Two full wave impulses at the full wave test voltage.

Neutral test sequence:

One full wave reference impulse at (50~75)% of the full wave test voltage;

Three full wave impulses at the full wave test voltage.

Test result: (Oscillograms of the test voltage and the current see Appendix C)

Applied terminal	Tapping position	Full wave test voltage value (kV)					Chopped wave test voltage value (kV)		
		(50~70)%	100%	100%	100%	Specified	100%	100%	Specified
A	1	-251.70	-479.83	-479.73	-479.21	-480 (1±3%)	-527.25	-526.86	-530 (1±3%)
B	9	-251.12	-479.10	-478.10	-477.98		-525.09	-526.12	
C	17	-247.83	-482.63	-477.27	-478.32		-525.12	-526.67	
0	1	-168.17	-321.12	-323.28	-322.08	-325 (1±3%)	—	—	—
a	—	-102.48	-199.31	-199.56	-199.73	-200 (1±3%)	-219.23	-218.98	-220 (1±3%)
b	—	-104.73	-199.08	-199.30	-199.58		-218.77	-218.66	
c	—	-104.53	-199.23	-199.00	-199.18		-218.57	-218.57	

14. Applied Voltage Test (AV) (Routine Test):

Applied position	Test voltage (kV)	Duration (s)	Test result
HV neutral	140	60	No collapse
LV winding	85	60	No collapse

Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC03-2019-0826(E) Total 32 Page 11
-------------	--	---

15. Line Terminal AC Withstand Test (LTAC) (Routine Test):

Terminal	Tap	HV voltage (kV)	Frequency (Hz)	During time (s)	Testing results
A	5	200	200	30	No collapse
B	5	200	200	30	No collapse
C	5	200	200	30	No collapse

16. Induced Voltage Withstand Test with Partial Discharge (IVPD) (Routine Test):

Tap position: 9, power frequency: 200Hz

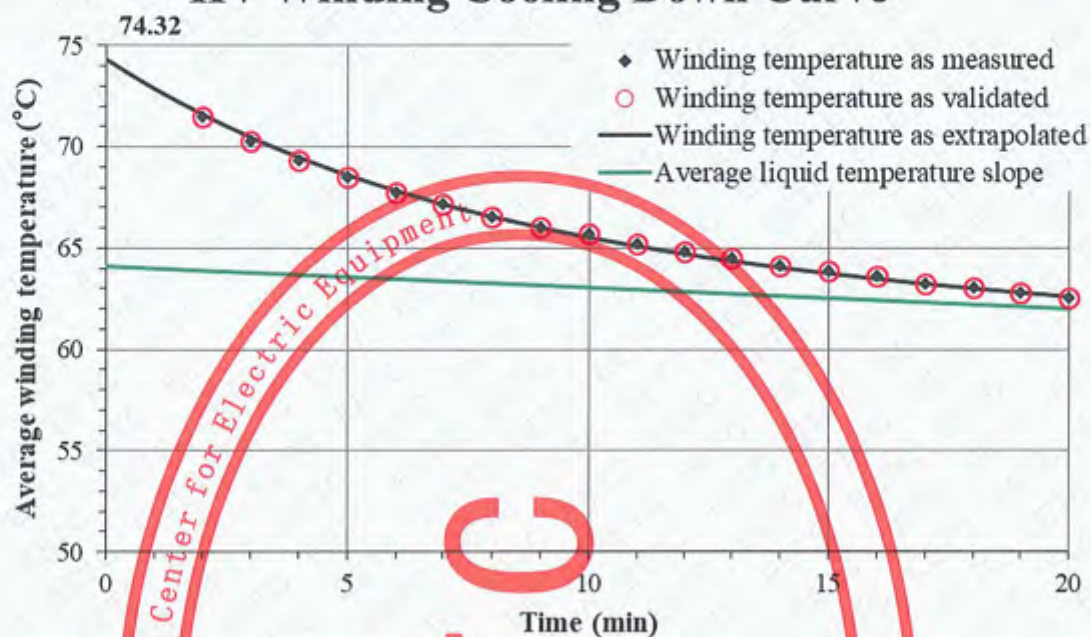
Applied voltage (kV)	Duration	Partial discharge quantity (pC)		
		A	B	C
$0.4 U_r/\sqrt{3}$	25.4	----	13	13
$1.2 U_r/\sqrt{3}$	76.2	1 min	13	13
$1.58 U_r/\sqrt{3}$	100	5 min	13	13
$1.8 U_r/\sqrt{3}$	127	30 s	-----	-----
$1.58 U_r/\sqrt{3}$	100	5 min	13	13
	10 min	13	13	13
	15 min	13	13	13
	20 min	13	13	13
	25 min	13	13	13
	30 min	13	13	13
	35 min	13	13	13
	40 min	13	13	13
	45 min	13	13	13
	50 min	13	13	20
	55 min	13	20	20
	60 min	13	20	20
$1.2 U_r/\sqrt{3}$	76.2	1 min	13	20
$0.4 U_r/\sqrt{3}$	25.4	---	13	20

17. Leak Testing with Pressure (Routine Test):

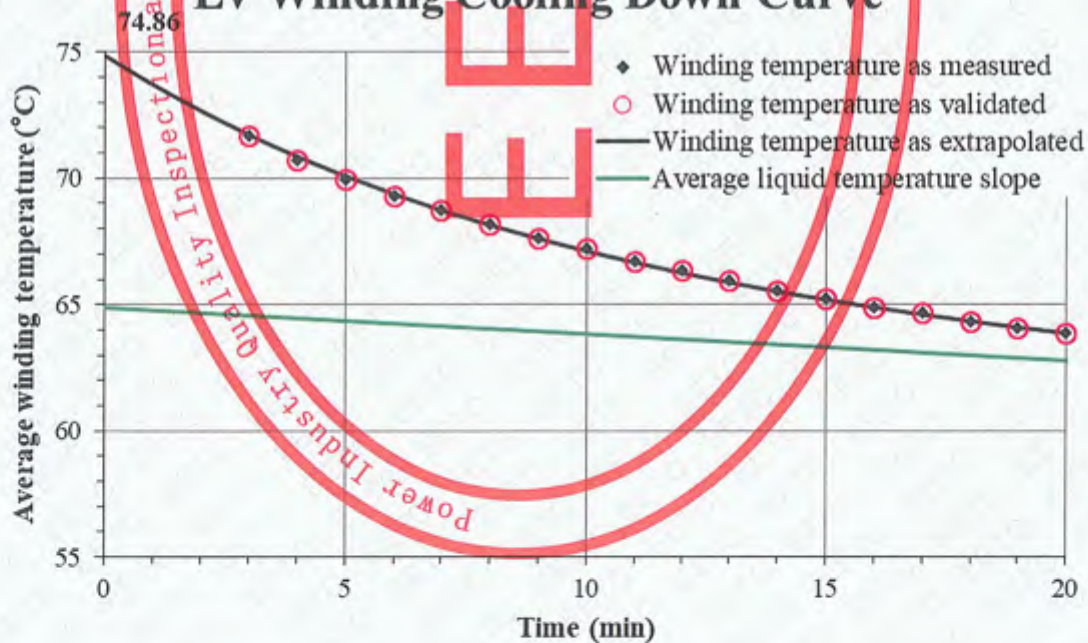
Applied pressure (kPa)	Duration (h)	Test result
30	24	No leakage and no damage

Test Report		Power Industry Quality Inspection and Test Center for Electric Equipment				CEPRI-EETC03-2019-0826(E) Total 32 Page 12				
18. Temperature-rise Test (Type Test):										
18.1 70%Sr (ONAN)										
18.1.1 Test details:										
Test method: Short-circuit method.										
1) Testing step of total loss injection:										
Tapping position	Power supply winding	Shorted winding	Rated capacity (kVA)	Total loss (kW)	Test loss (kW)	Stable time (h)	Duration (h)	Cooling type		
17	HV	LV	70000	253.52	252.6	3	8	ONAN		
2) Testing step of rated current injection:										
Tapping position	Power supply winding	Shorted winding	Rated capacity (kVA)	Specified current (A)	Test current (A)	Measured winding at shutdown instant	Duration (h)	Cooling type		
17	HV	LV	70000	408.24	408.42	HV, LV	1	ONAN		
18.1.2 Measured temperature records: (°C)										
Test state				Top oil temperature		Bottom oil temperature		Ambient temperature		
Under total loss				75.3		54.8		30.6		
Under specified current	HV winding	At shutdown instant		73.1		53.6		31.0		
		At measurement end		71.5		51.0		—		
	LV winding	At shutdown instant		73.1		53.6		31.0		
		At measurement end		71.5		51.0		—		
18.1.3 Measured reference winding resistance under cold state:										
Test winding			Cold state oil temperature (°C)			Cold state resistance (mΩ)				
HV winding			28.4			217.0				
LV winding			28.4			32.20				
18.1.4 Measured winding resistance varied with time as the winding cooled down: (mΩ)										
Time	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'
HV winding	—	252.5	251.5	250.7	250.0	249.4	248.9	248.4	248.0	247.7
LV winding	—	—	37.49	37.37	37.28	37.20	37.13	37.06	36.99	36.94
Time	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'
HV winding	247.3	247.0	246.7	246.4	246.2	246.0	245.7	245.5	245.3	245.1
LV winding	36.88	36.84	36.79	36.74	36.70	36.66	36.63	36.59	36.56	36.53
18.1.5 Test result:										
Top oil temperature rise (K)	Test winding			Average winding temperature at shutdown instant (°C)		Average winding temperature rise (K)		Hot-spot winding temperature rise (K)		
44.9	HV winding			74.32		45.5		59.1		
	LV winding			74.86		46.1		59.8		

HV Winding Cooling Down Curve

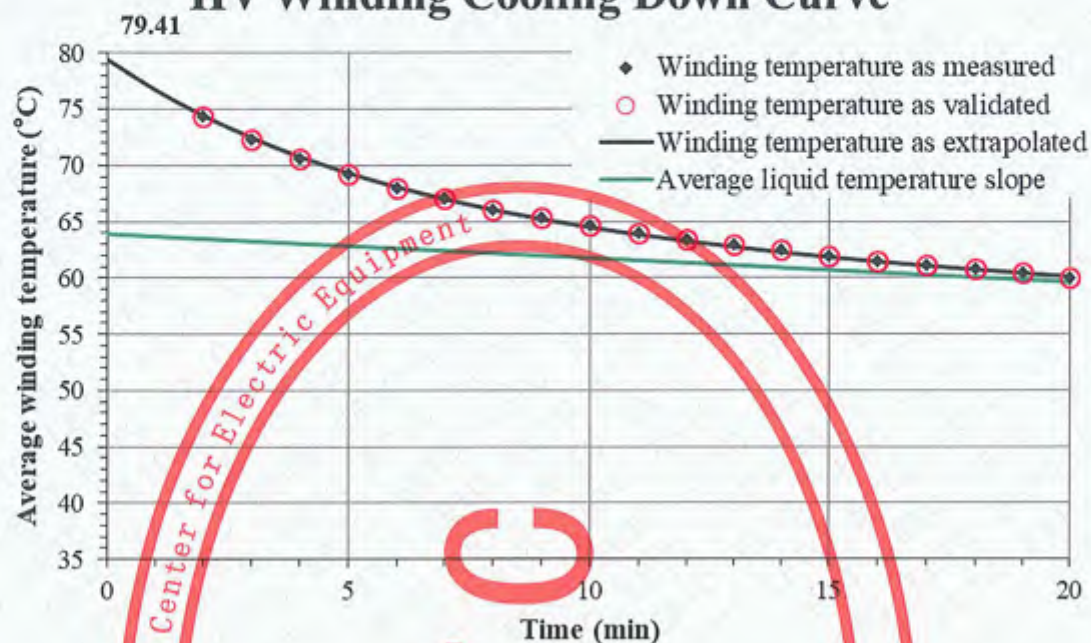


LV Winding Cooling Down Curve

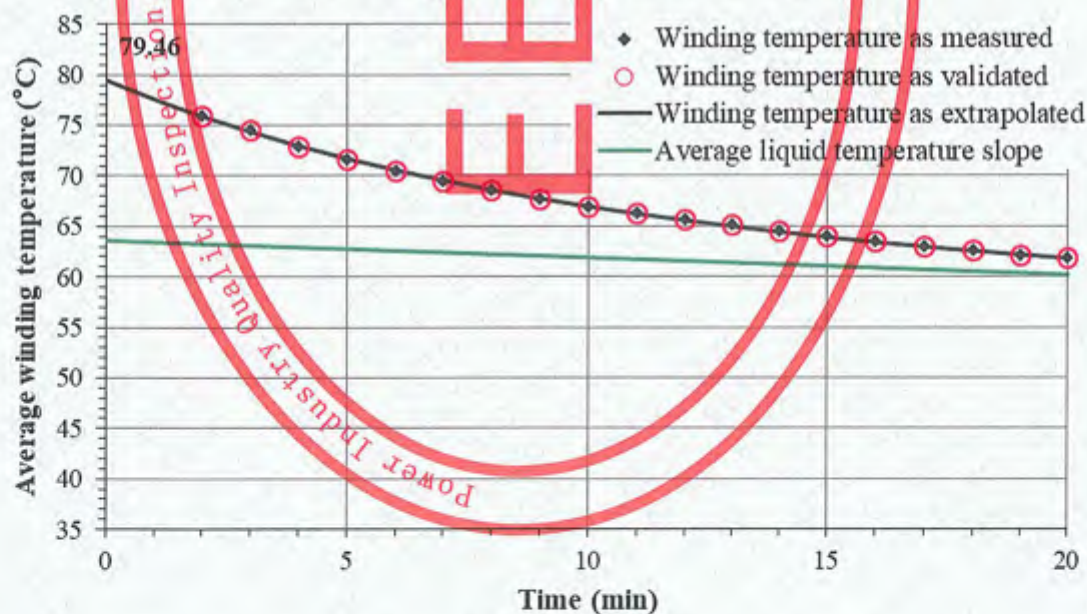


Test Report		Power Industry Quality Inspection and Test Center for Electric Equipment				CEPRI-EETC03-2019-0826(E) Total 32 Page 14				
18.2 100%Sr (ONAF)										
18.2.1 Test details:										
Test method: Short-circuit method.										
1) Testing step of total loss injection:										
Tapping position	Power supply winding	Shorted winding	Rated capacity (kVA)	Total loss (kW)	Test loss (kW)	Stable time (h)	Duration (h)	Cooling type		
17	HV	LV	100000	467.45	467.00	3	4.5	ONAF		
2) Testing step of rated current injection:										
Tapping position	Power supply winding	Shorted winding	Rated capacity (kVA)	Specified current (A)	Test current (A)	Measured winding at shutdown instant	Duration (h)	Cooling type		
17	HV	LV	100000	583.2	583.19	HV、LV	1	ONAF		
18.2.2 Measured temperature records: (°C)										
Test state				Top oil temperature		Bottom oil temperature		Ambient temperature		
Under total loss				80.0		48.5		33.1		
Under specified current	HV winding	At shutdown instant		78.5		47.9		33.6		
		At measurement end		75.8		43.8		—		
	LV winding	At shutdown instant		78.5		47.9		33.6		
		At measurement end		75.8		43.8		—		
18.2.3 Measured reference winding resistance under cold state:										
Test winding			Cold state oil temperature (°C)			Cold state resistance (mΩ)				
HV winding			28.4			217.0				
LV winding			28.4			32.20				
18.2.4 Measured winding resistance varied with time as the winding cooled down: (mΩ)										
Time	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'
HV winding	—	254.8	253.1	251.7	250.6	249.6	248.8	248.0	247.4	246.8
LV winding	—	38.00	37.83	37.64	37.48	37.34	37.21	37.10	37.00	36.91
Time	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'
HV winding	246.3	245.8	245.4	245.0	244.6	244.2	243.9	243.6	243.3	243.0
LV winding	36.83	36.75	36.68	36.61	36.55	36.49	36.43	36.38	36.32	36.28
18.2.5 Test result:										
Top oil temperature rise (K)	Test winding		Average winding temperature at shutdown instant (°C)		Average winding temperature rise (K)		Hot-spot winding temperature rise (K)			
46.9	HV winding		79.41		47.4		68.0			
	LV winding		79.46		47.4		68.1			

HV Winding Cooling Down Curve



LV Winding Cooling Down Curve



19. Winding Hot-spot Temperature-rise Measurement (Special Test): (See content 18)

Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC03-2019-0826(E) Total 32 Page 16
-------------	--	---

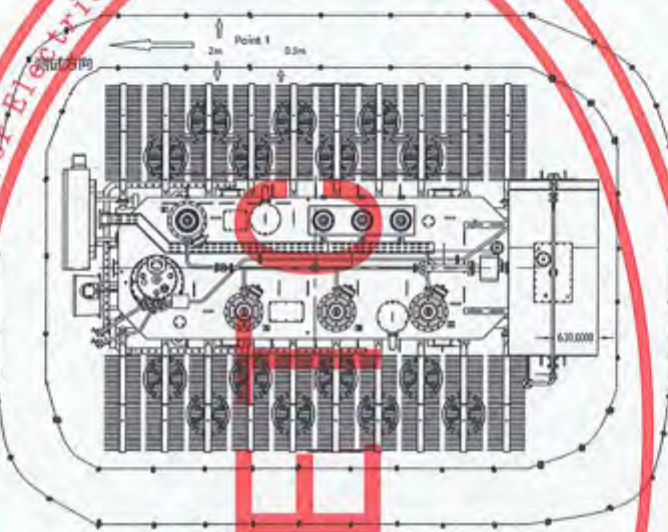
20. Determination of Sound Levels (Type Test):

20.1 70%Sr, cooling device out of service:

20.1.1 Test condition:

State	Frequency (Hz)	Tapping position	LV excitation voltage (kV)	X (m)	I _m (m)	h (m)	Measuring height (m)	
							1/3h	2/3h
No-load	50	9	38.5	0.3	26.5	3.19	1.06	2.13

State	Frequency (Hz)	Tapping position	HV Current (A)	X (m)	I _m (m)	h (m)	Measuring height (m)	
							1/3h	2/3h
Load	50	9	367.4	0.3	26.5	3.19	1.06	2.13



20.1.2 Measured A-weighted sound levels

20.1.2.1 No-load sound pressure levels of the background noise: [dB(A)]

No.		1	2	3	4	5	6	7	8	9	10	Average
Initial	1/3h	39.7	39.2	39.2	39.2	39.7	40.7	41.7	41.7	41.4	39.8	40.5
	2/3h	39.4	39.9	39.6	40.2	40.2	41.2	41.8	42.2	41.7	39.9	
Final	1/3h	39.5	39.1	39.4	39.4	39.9	38.9	38.6	39.4	39.9	40.4	39.5
	2/3h	38.6	39.7	39.2	38.7	39.7	39.7	39.2	39.6	40.1	40.2	

20.1.2.2 Sound pressure levels under no-load condition: [dB(A)]

No.	1	2	3	4	5	6	7	8	9	10
1/3h	69.2	64.5	62.6	63.5	64.5	63.9	68.3	63.7	68.0	62.8
2/3h	62.0	62.0	65.0	65.1	61.3	65.1	62.6	63.8	62.1	60.5
No.	11	12	13	14	15	16	17	18	19	20
1/3h	66.6	68.1	69.0	65.5	65.0	62.0	62.6	62.3	63.6	62.8
2/3h	61.2	60.6	64.1	63.6	63.5	61.5	63.9	61.0	65.3	63.8
No.	21	22	23	24	25	26	27	28	29	30
1/3h	65.1	63.6	65.0	62.5	65.4	61.8	61.1	64.6	61.5	64.2
2/3h	64.5	66.9	61.6	62.6	63.1	62.1	62.6	61.6	66.1	61.3
Average						64.3				

Test Report		Power Industry Quality Inspection and Test Center for Electric Equipment						CEPRI-EETC03-2019-0826(E) Total 32 Page 17				
20.1.2.3 Load sound pressure levels of the background noise: [dB(A)]												
No.		1	2	3	4	5	6	7	8	9	10	Average
Initial	1/3h	38.7	38.4	38.2	38.9	38.5	38.6	39.5	39.6	40.3	40.0	39.2
	2/3h	38.7	38.1	38.7	38.5	39.1	38.7	39.2	40.1	40.2	40.2	
Final	1/3h	38.5	38.2	39.5	39.7	38.5	38.7	38.5	38.9	40.1	40.2	39.1
	2/3h	38.6	38.3	39.3	39.5	38.5	38.4	38.3	38.6	40.0	40.1	
20.1.2.4 Sound pressure levels under load condition: [dB(A)]												
No.		1	2	3	4	5	6	7	8	9	10	
1/3h		42.5	48.3	44.6	44.6	50.0	55.1	47.5	45.3	43.8	44.9	
2/3h		46.1	48.6	44.4	45.8	47.8	52.4	48.7	46.3	43.0	44.1	
No.		11	12	13	14	15	16	17	18	19	20	
1/3h		48.1	45.3	44.7	47.4	47.1	44.4	45.0	44.9	45.3	49.3	
2/3h		45.4	45.3	42.9	48.3	46.3	42.2	43.2	44.1	48.9	48.0	
No.		21	22	23	24	25	26	27	28	29	30	
1/3h		47.6	49.9	51.4	45.8	49.7	47.3	46.4	45.4	44.9	48.1	
2/3h		47.1	49.3	46.4	47.1	48.5	48.2	42.5	44.6	44.9	44.8	
Average									47.4			
20.2 100%Sr, cooling device on service:												
State	Frequency (Hz)	Tapping position	LV excitation voltage (kV)	X (m)	l _m (m)	h (m)	Measuring height (m)					
							1/3h	2/3h				
No-load	50	9	38.5	2.0	37.0	3.19	1.06	2.13				
State	Frequency (Hz)	Tapping position	HV Current (A)	X (m)	l _m (m)	h (m)	Measuring height (m)					
							1/3h	2/3h				
Load	50	9	367.4	2.0	37.0	3.19	1.06	2.13				
20.2.1.1 No-load sound pressure levels of the background noise: [dB(A)]												
No.		1	2	3	4	5	6	7	8	9	10	Average
Initial	1/3h	40.2	40.6	39.7	40.1	38.2	37.1	38.4	38.7	40.8	41.2	39.9
	2/3h	38.7	41.6	41.9	39.2	39.5	38.1	39.0	38.9	41.1	41.5	
Final	1/3h	38.4	39.1	37.9	37.4	38.6	39.2	38.6	38.5	39.6	39.2	38.7
	2/3h	39.7	38.9	37.9	38.1	37.1	38.2	38.9	39.8	39.1	38.9	
20.2.1.2 Sound pressure levels under no-load condition: [dB(A)]												
No.		1	2	3	4	5	6	7	8	9	10	
1/3h		67.6	66.2	67.1	66.2	67.0	66.6	66.1	66.5	67.5	66.1	
2/3h		66.0	67.4	68.5	66.6	68.1	67.5	67.1	68.0	66.7	68.4	
No.		11	12	13	14	15	16	17	18	19	20	
1/3h		66.3	67.1	67.6	66.8	66.2	64.5	65.5	65.2	63.8	65.1	
2/3h		67.3	68.8	67.0	68.2	68.1	66.3	65.0	65.2	64.5	64.8	

Test Report		Power Industry Quality Inspection and Test Center for Electric Equipment						CEPRI-EETC03-2019-0826(E) Total 32 Page 18				
No.	21	22	23	24	25	26	27	28	29	30		
1/3h	65.9	65.6	64.3	66.0	67.0	66.5	64.2	63.3	65.6	65.1		
2/3h	66.1	67.1	65.5	65.8	66.3	66.3	65.6	64.5	64.1	66.5		
No.	31	32	33	34	35	36	37	38	—	Average		
1/3h	67.5	66.1	64.1	66.5	63.0	63.9	65.8	64.9	—	66.3		
2/3h	67.6	65.0	65.0	67.3	63.1	64.1	67.8	65.3	—			
20.2.1.3 Load sound pressure levels of the background noise: [dB(A)]												
No.		1	2	3	4	5	6	7	8	9	10	Average
Initial	1/3h	38.2	38.9	38.9	38.2	39.1	38.1	39.1	38.9	38.9	40.7	38.9
	2/3h	38.1	39.2	38.5	38.5	39.0	38.2	38.7	39.0	39.1	40.1	
Final	1/3h	38.3	38.5	38.9	38.2	39.1	38.5	39.1	38.9	38.5	40.0	38.7
	2/3h	38.1	38.2	38.3	38.2	39.0	38.3	39.0	38.5	38.2	39.8	
20.2.1.4 Sound pressure levels under load condition: [dB(A)]												
No.	1	2	3	4	5	6	7	8	9	10		
1/3h	67.0	64.4	64.3	64.1	64.0	64.6	64.8	64.7	65.0	65.2		
2/3h	65.1	64.0	64.5	64.5	63.8	64.0	64.5	64.5	65.3	64.0		
No.	11	12	13	14	15	16	17	18	19	20		
1/3h	64.8	66.0	66.0	66.3	65.9	65.3	65.3	64.6	63.5	63.0		
2/3h	64.2	64.2	64.8	65.0	65.3	64.6	64.1	63.9	63.4	62.5		
No.	21	22	23	24	25	26	27	28	29	30		
1/3h	62.3	62.3	61.6	61.6	62.0	62.3	63.8	64.1	63.8	64.4		
2/3h	62.5	62.0	61.6	61.8	61.8	62.1	63.8	63.3	63.1	64.0		
No.	31	32	33	34	35	36	37	38	—	Average		
1/3h	65.3	64.7	64.1	62.8	61.8	62.4	61.3	62.3	—	63.9		
2/3h	63.8	63.7	63.6	62.5	62.0	61.6	61.6	61.8	—			
20.3 Test Result:												
Cooling device state	Mean sound absorption coefficient α	Surface area of test room S_V (m ²)		Sound absorption A (m ²)		Area of the effective surfaces S (m ²)		Correction factor of ambient K (dB)				
Out of service	0.25	2388		597		105.7		2.3				
On service						192.0		3.6				
Cooling device state	Test condition	Sound pressure level $\overline{L_{PA}}$ [dB(A)]	Sound power level L_{WA} [dB(A)]	Synthetic Sound power level [dB(A)]	Synthetic Sound pressure level [dB(A)]	Guarantee Sound pressure level [dB(A)]						
Out of service	No-load	62.0	82.2	82.3	62	67						
	Load	44.4	64.6									
Out of service	No-load	62.7	85.5	87.5	65	67						
	Load	60.3	83.1									
20.4 Determination of sound levels evaluation: Passed												

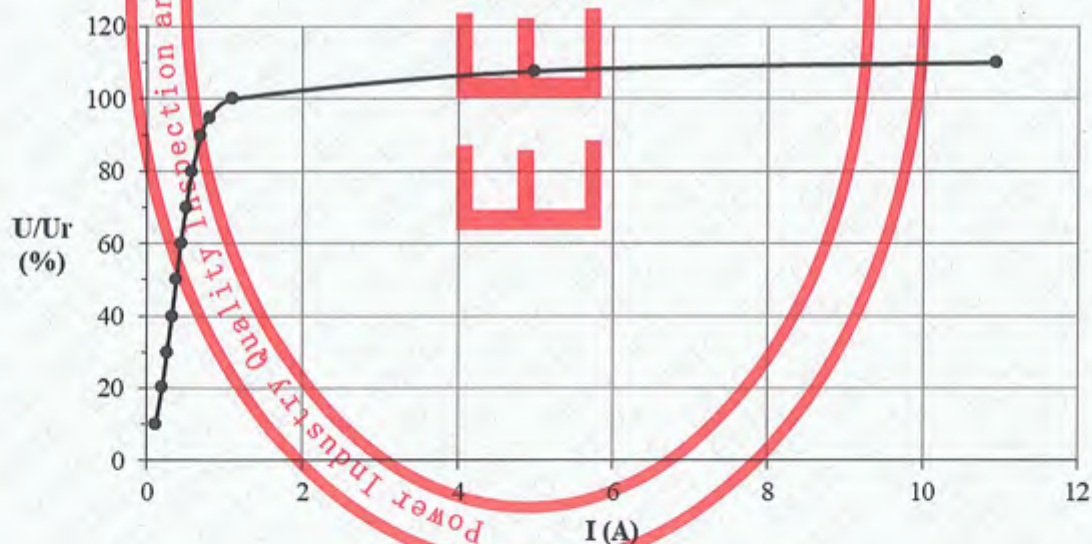
Test Report		Power Industry Quality Inspection and Test Center for Electric Equipment		CEPRI-EETC03-2019-0826(E) Total 32 Page 19	
21. Measurement of the Power Taken by the Fan and Pump Motors (Type Test):					
Motor type	Factory number	Applied voltage (V)	Current (A)	Power (W)	
Fan motor	57208090-1	380.3	1.011	529.98	
	57208090-2	379.9	1.017	530.84	
	57208090-3	379.8	1.012	528.24	
	57208090-4	379.9	1.015	528.36	
	57208090-5	379.9	1.031	534.36	
	57208090-6	379.8	1.052	534.52	
	57208090-7	379.9	0.998	526.66	
	57208090-8	379.9	1.010	530.75	
	57208090-9	380.0	1.024	535.27	
	57208090-10	379.9	1.006	526.84	
	57208090-11	380.2	1.004	517.29	
	57208090-12	379.9	1.007	523.71	
	57208090-13	379.8	1.006	525.56	
	57208090-14	379.9	1.015	530.45	
	57208090-15(backup)	380.0	1.010	528.39	
Total power (W)		7158.0 (contain backups)			
22. Measurement of Zero-sequence Impedance on Three-phase Transformers (Special Test):					
Applied voltage terminals	Tap	Applied current (A)	Measuring voltage (V)	Zero-sequence Impedance (Ω/phase)	
ABC-0	9	172.05	891.08	15.538	
23. Measurement of the Harmonics of the No-load Current (Special Test):					
Applied voltage (kV)	Applied current (A)	Harmonics of the No-load Current (%)			
		Phase a	Phase b	Phase c	
38.499	1.10	53.9	40.5	37.9	
Harmonic frequency	I (%)				
	Phase a	Phase b	Phase c		
1	100.000	100.000	100.000		
3	33.3	23.4	9.8		
5	35.6	28.0	31.4		
7	21.9	16.1	18.3		
9	4.5	4.4	0.7		
11	4.2	5.6	4.2		
13	2.6	1.5	1.8		
Σ	53.9	40.5	37.9		

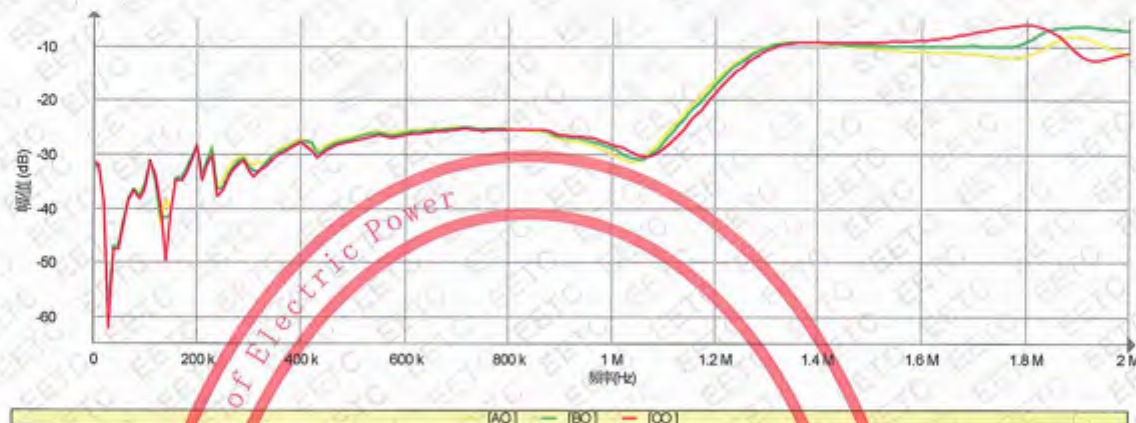
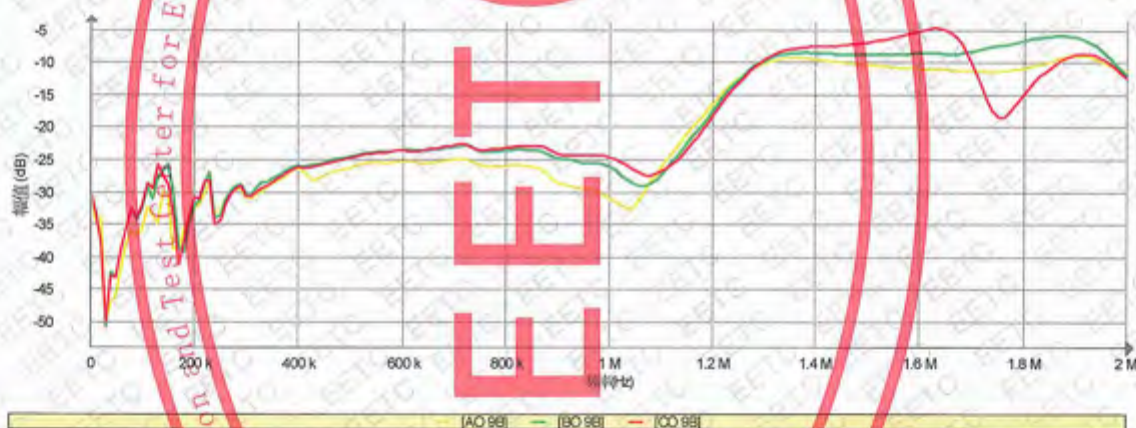
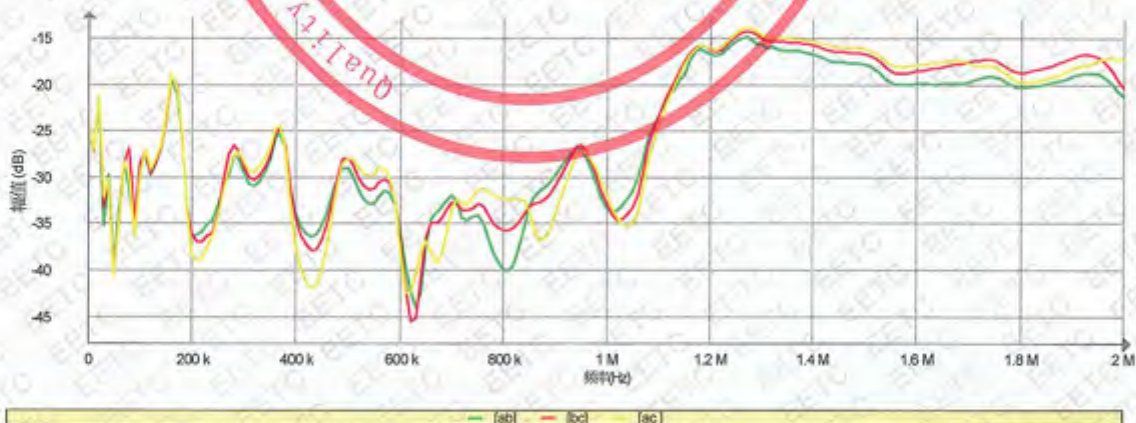
Test Report	Power Industry Quality Inspection and Test Center for Electric Equipment	CEPRI-EETC03-2019-0826(E) Total 32 Page 20
-------------	--	---

24. Measurement of No-load Excitation Characteristic (Special Test):

U/Ur (%)	Applied voltage (kV)		Measuring current (A)	Measuring loss (kW)
	avg	rms		
10	3.8663	3.8615	0.109	0.54
20	7.7684	7.7663	0.192	2.04
30	11.586	11.581	0.256	4.28
40	15.361	15.354	0.315	7.22
50	19.265	19.261	0.373	11.00
60	23.086	23.079	0.43	15.41
70	26.971	26.975	0.496	20.76
80	30.794	30.799	0.573	27.13
90	34.643	34.683	0.688	35.40
95	36.571	36.657	0.798	40.81
100	38.499	38.741	1.10	48.28
105	41.429	43.026	4.97	71.54
110	42.347	45.357	10.94	84.71

No-load Excitation Characteristic Curve



25. Measurement of Frequency Response (Special Test):**25.1 HV winding Frequency Response Characteristic curve (Tapping 1):****25.2 HV winding Frequency Response Characteristic curve (Tapping 9):****25.3 LV winding Frequency Response Characteristic curve:**

Appendix A Object Parameters

A.1 Normal Information of Sample

Rated power: 100000/100000 kVA

Rated frequency: 50Hz

Rated voltages: $(110 \pm 8 \times 1.25\%) / 38.5\text{kV}$

Connection symbol: YNd11

Rated currents: 524.9/1499.6A

Application conditions: Outdoor

Type of cooling: ONAN/ONAF (70%/100%)

Total weight: 101300kg

Date of manufacture: August 2019

Insulation levels:

HV

 $U_m/LI/LIC/AC$

126/480/530/200kV

HVN

 $U_m/LI/AC$

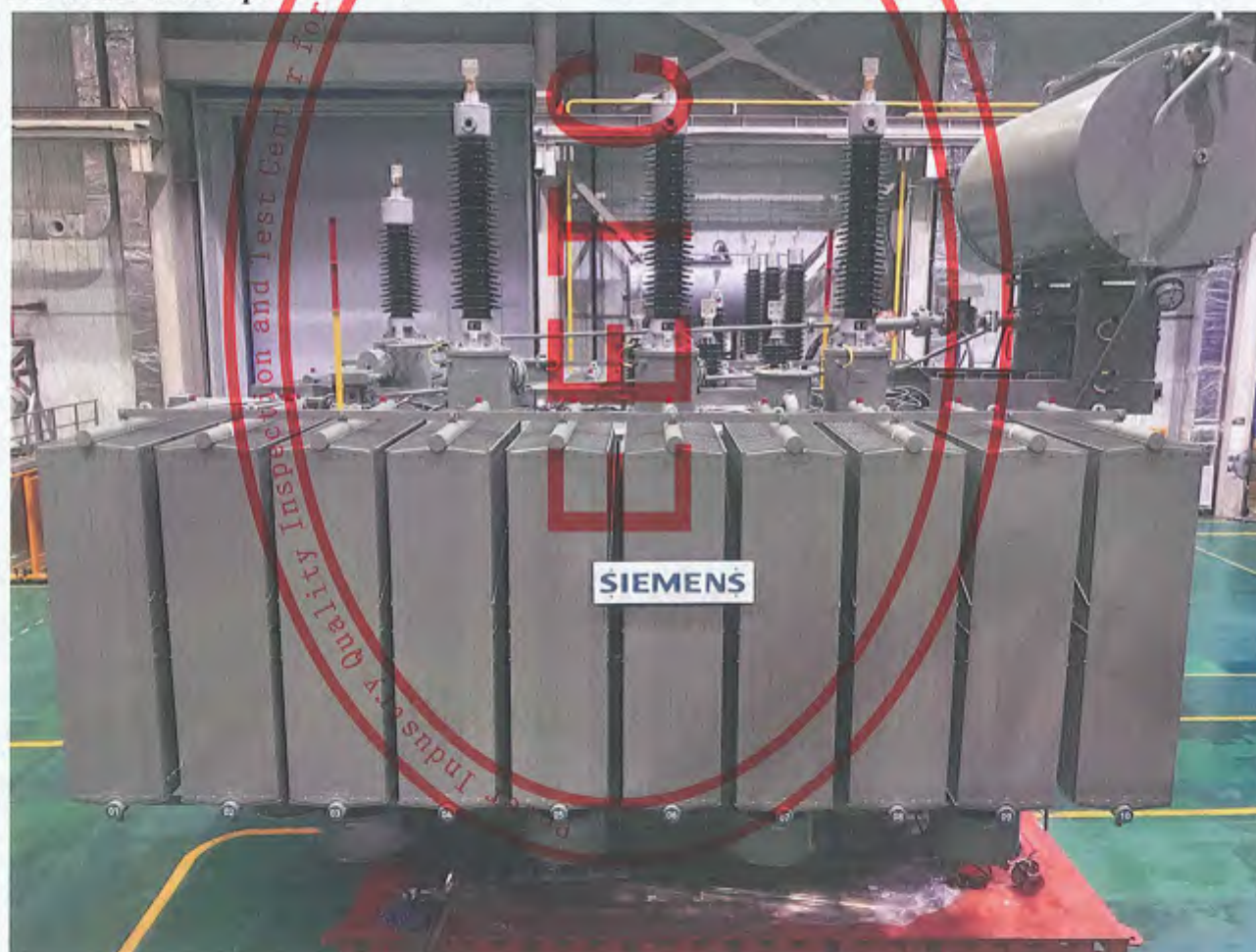
72.5/325/140kV

LV

 $U_m/LI/LIC/AC$

40.5/200/220/85kV

A.2 Photo of Sample



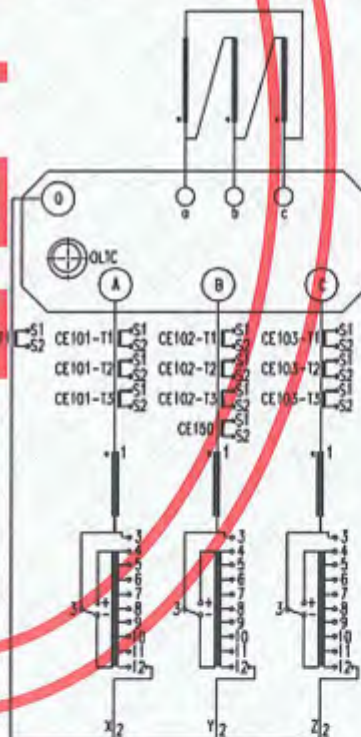
SIEMENS

型号	SFZ11-100000/110	出厂序号	Y143101	制造年月	年 月	标准代号	GB1984	
额定容量	100000kVA	额定电压	0.4kV/10kV(70%/100%)	绝缘水平 (kV)	L1480 AC200—L1325 AC140/L1200 AC85			
额定电流	YkA110	交流耐压值	设计风冷式全绝缘电压器		额定频率	50Hz	相数	3 相
—	电压 (kV)	电流 (A)	短路容量 (MVA)		冷却容量 (MW)	绝缘材料类别		3s
位置	海拔	海拔	海拔	海拔	海拔——海拔	海拔——海拔	最高环境温度	45℃
1	121.000	38.500	477.1	1499.6			最高油温(K)	55
9	110.000	38.500	524.9	1499.6			绕组平均温升(K)	65
17	99.000	38.500	583.2	1499.6			使用条件	户内
供货范围	名	厂家、绝缘油牌号、油桶	中石油，交货时供25年，可质保		设备重量	95.8t		
设备重量	kg	绝缘油重量			1	设备重量	2.0t	
开关型号	MS II 650r-72.5/C-1D19.3t				绝缘油品牌	BP		
噪声声压级	67dB(A)	绝缘纸厚度	VM 厚度		总重量	101.3t		

代号	电压	电压比/V	额定容量	额定容量/V	使用条件
CE10-103-T1, T2	6	600/5	50 VA	30	S1-S2
CE10-103-T3	3	600/5	0.5	30	S1-S2
CE104-T1	1	300/5	50 VA	30	S1-S2
CE150	1	640/2	ATR3	20	S1-S2

注意：一旦电路开始运行，电流互感器就不允许开路。因为这会产生非常高的电压，可能损坏绝缘并危及人员安全。

		位置	电压(kV)	电流(A)	功率(kW)	备注	
<div>可靠性 Inspection</div> <div>图 10-1-1 A O C B</div>	最大一	1	121,000	477.1	12	5-4 K+	
		2	119,625	482.6	11		
		3	118,250	488.2	10		
		4	116,875	494.0	9		
		5	115,500	499.8	8		
		6	114,125	505.9	7		
		7	112,750	512.1	6		
		8	111,375	518.4	5		
		9A	110,000	524.9	4		
		9B			3		
		9C			12		
		10	108,625	531.5	11		K- 3-12
		11	107,250	538.3	10		
		12	105,875	545.3	9		
		13	104,500	552.5	8		
		14	103,125	559.9	7		
	15	101,750	567.4	6			
最小一	16	100,375	575.2	5			
	17	99,000	583.2	4			
数据	—	38,500	1499.6	—			



西门子变压器(武汉)有限公司

中华人民共和国

武汉制造

Test Report		Power Industry Quality Inspection and Test Center for Electric Equipment			CEPRI-EETC03-2019-0826(E) Total 32 Page 24	
Appendix B The Main Test Devices						
No.	Name / Type / Specification	Serial No.	Measurement Range	Uncertainty / Accuracy class / Maximum Permissible Error	Calibration Institute	Valid Date
1	变压器变比测试仪 Ratio Bridge InstrumentJYT-B	04193365	1-1000	0.1%	Guangzhou GRG Metrology and Test Co., Ltd.	2020.05.22
2	直流电阻仪 Transformer Resistance Test Equipment JYR-40E	01146680	5μΩ~20Ω	Class 0.2	Guangzhou GRG Metrology and Test Co., Ltd.	2019.10.16
3	绝缘电阻测试仪 Digital Megaohm Meter MIT525	101310053	1000GΩ	Class 5.0	Guangzhou GRG Metrology and Test Co., Ltd.	2020.07.11
4	全自动变频抗干扰介 质损耗因数测试仪 Dielectric Dissipation Factor Instrument JYC	0208238	(0.001~100)%	Class 1.0	National Center for High Voltage Measurement	2019.12.26
5	功率分析仪 Precision Power Analyzer NORMA5000	X815863	5A 600V	Class 0.2	Guangzhou GRG Metrology and Test Co., Ltd.	2019.12.06
6	工频电压峰值表 Peak Voltmeter PFPV-2-14	STWH/PT test/006	300kV	Class 3.0	Guangzhou GRG Metrology and Test Co., Ltd.	2020.04.10
7	电容分压器 Capacitive voltage divider GWC-400/350	130716-2	350kV	Class 1.0	National Center for High Voltage Measurement	2020.03.03
8	多通道数字局放仪 Multi-channel Digital PD Integration Analyzer TWPD-2F	1807XY052	(1~100000)pC	Class 10	Guangzhou GRG Metrology and Test Co., Ltd.	2019.09.13
9	声级计 Sound Level Meter HS5670A	19013030	(20~130)dB	Class 2.0	Guangzhou GRG Metrology and Test Co., Ltd.	2019.12.16
10	多路温度巡检仪 Multi-channel Temperature Testing System JYDT2000	11160092	(0~100)℃	Class 0.5	Guangzhou Gaotie Metrology and Test Co., Ltd.	2019.09.18
11	弱阻尼电容分压器 Damping Capacitor Voltage Divider FYI-2000/400	14005-2	2000kV	Class 3.0	National Center for High Voltage Measurement	2020.03.20

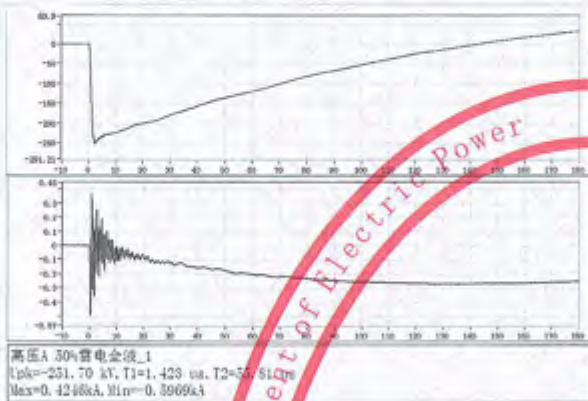
Test Report		Power Industry Quality Inspection and Test Center for Electric Equipment			CEPRI-EETC03-2019-0826(E) Total 32 Page 25	
Appendix B The Main Test Devices						
No.	Name / Type / Specification	Serial No.	Measurement Range	Uncertainty / Accuracy class / Maximum Permissible Error	Calibration Institute	Valid Date
12	气相色谱仪 Chromatogram Analysis 2000B	812018	-----	3.2%	Guangzhou GRG Metrology and Test Co., Ltd.	2020.10.16
13	油介质损耗测试仪 Oil Dielectric Loss Measurement Instrument DTLC	49108	(0~100) %	Class 0.1	National Center for High Voltage Measurement	2020.04.02
14	微量水分测试仪 Water content KFM3000	099603017	(0~200) mg	3.5%	Guangzhou GRG Metrology and Test Co., Ltd.	2019.09.06
15	绝缘油耐压测试仪 Oil AC Withstand Voltage Test Instrument OTS100AF	101567299	(0~100) kV	±1%	National Center for High Voltage Measurement	2019.10.22
16	仪用电流互感器 Current Transformer HL45-0.01/1200	018444 018445 018447	(5~2500)A/5A	Class 0.01	National Center for High Voltage Measurement	2020.10.23
17	电压互感器 Voltage Transformer HJ12	08233 08234 08235	60kV/100V	Class 0.05	National Center for High Voltage Measurement	2021.03.03
18	绕组变形测试仪 Sweep Frequency Response Analyzer FRAX-99	080230	1000kHz	Class 0.2	Guangzhou GRG Metrology and Test Co., Ltd.	2020.07.12
19	压力表 Stainless Steel Pressure Gauges	190722692117	(0~0.1)MPa	±2.5kPa	Guangzhou GRG Metrology and Test Co., Ltd.	2019.11.24
20	电流互感器分析仪 CT Analyzer	QF514Q	10~500	0.05%	Guangzhou GRG Metrology and Test Co., Ltd.	2019.10.21

Appendix C Lightning Impulse Test Waveforms

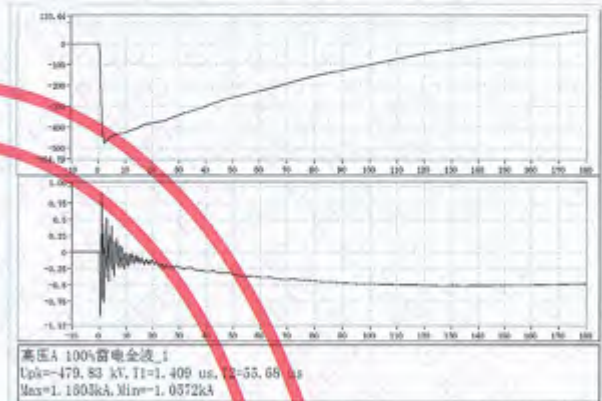
C.1 HV Line Terminal Waveforms

The front time T1: 1.42 μ s、The tail time T2: 55.8 μ s、Time to chopping Tc: 3.76 μ s

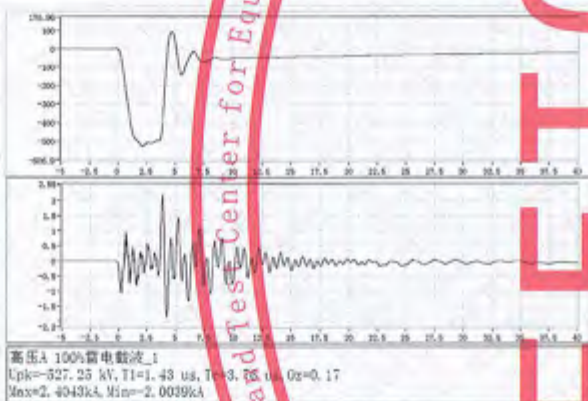
50%~70% Full wave (Terminal A)



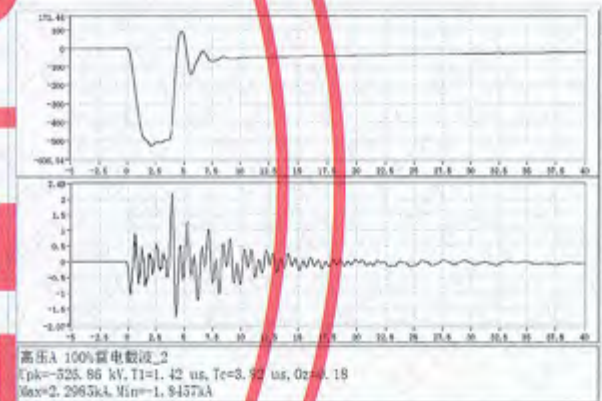
100% Full wave (Terminal A)



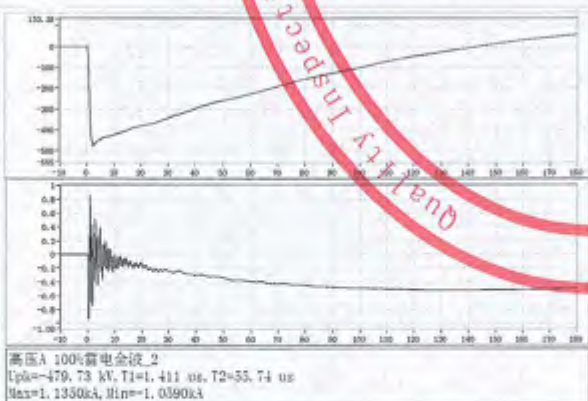
100% Chopped wave (Terminal A)



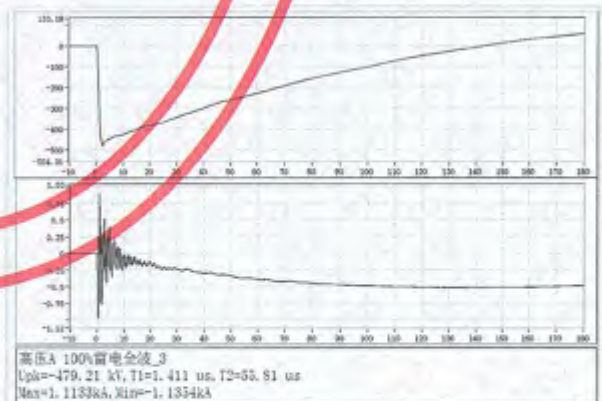
100% Chopped wave (Terminal A)



100% Full wave (Terminal A)

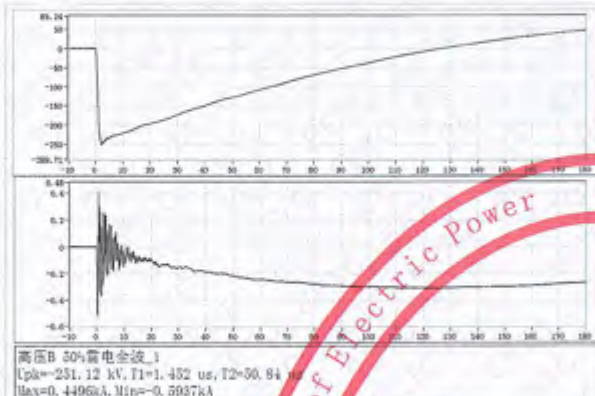


100% Full wave (Terminal A)

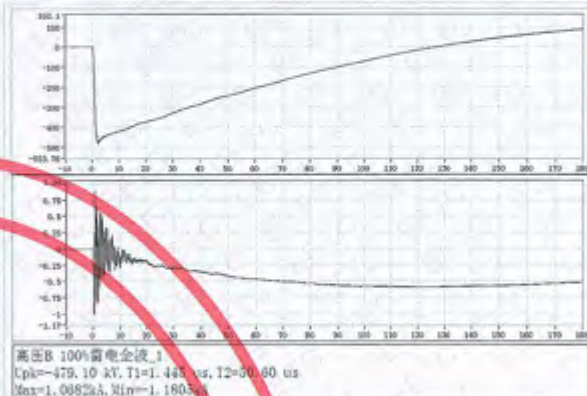


The front time T1: 1.45 μ s、The tail time T2: 50.8 μ s、Time to chopping Tc: 3.82 μ s

50%~70% Full wave (Terminal B)



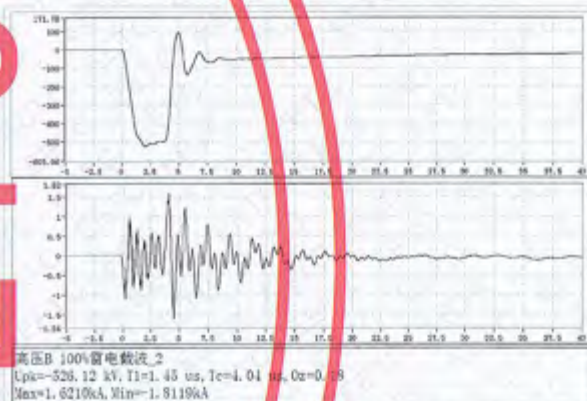
100% Full wave (Terminal B)



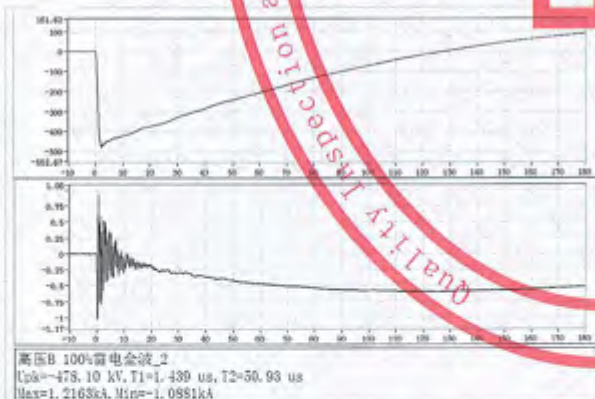
100% Chopped wave (Terminal B)



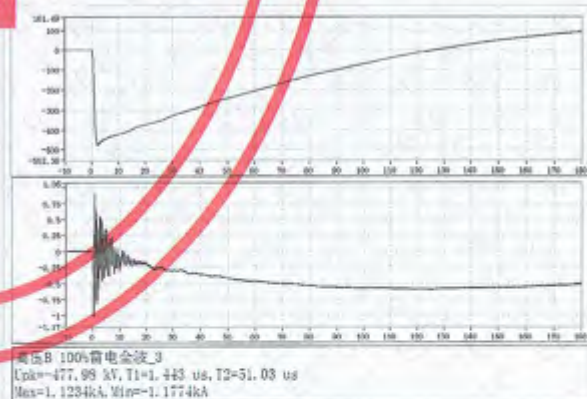
100% Chopped wave (Terminal B)



100% Full wave (Terminal B)

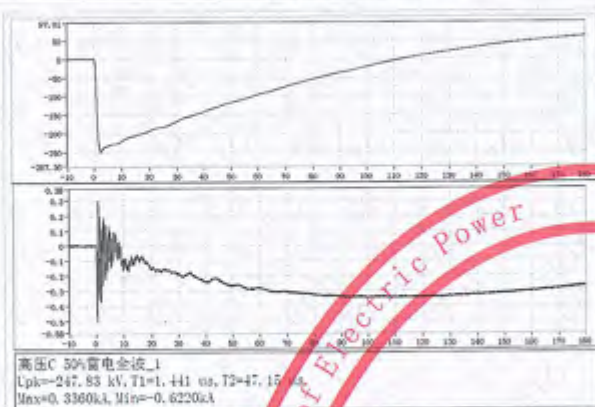


100% Full wave (Terminal B)

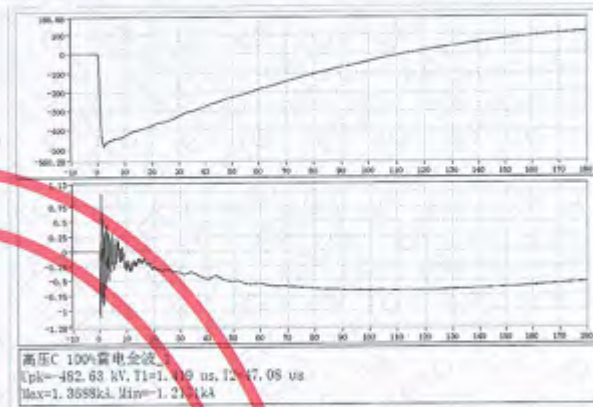


The front time T1: 1.44 μ s、The tail time T2: 47.2 μ s、Time to chopping Tc: 3.80 μ s

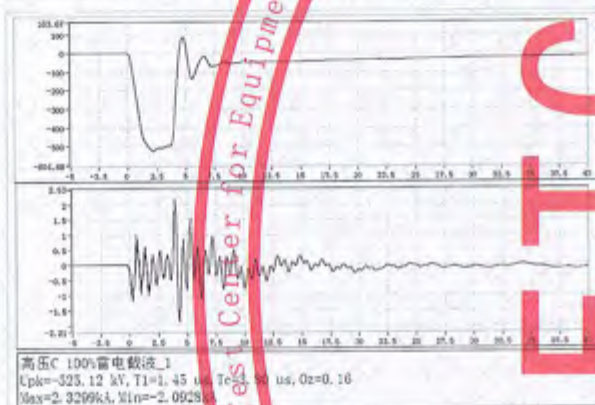
50% ~70% Full wave (Terminal C)



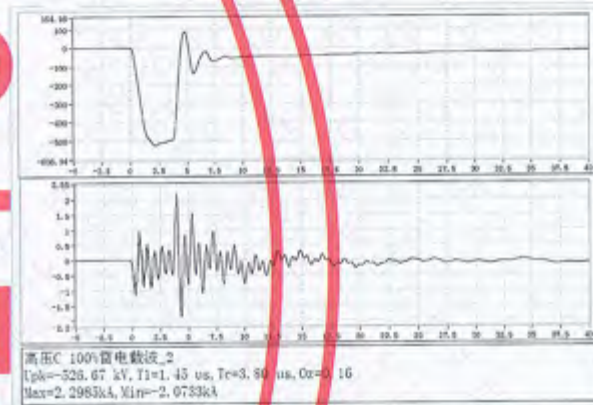
100% Full wave (Terminal C)



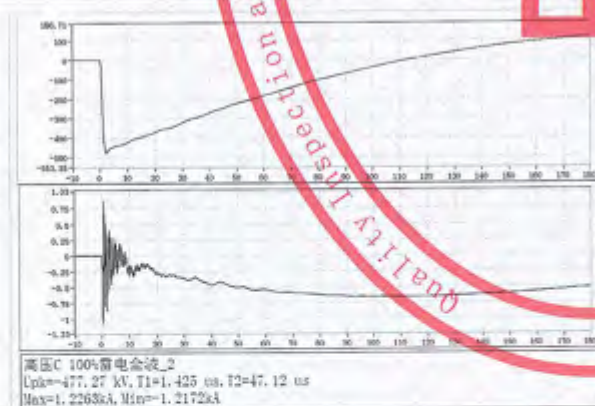
100% Chopped wave (Terminal C)



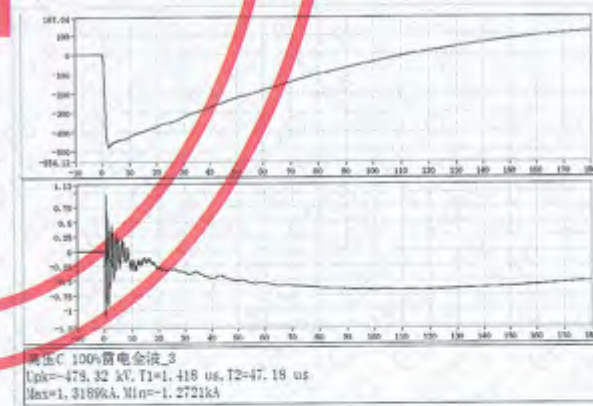
100% Chopped wave (Terminal C)



100% Full wave (Terminal C)



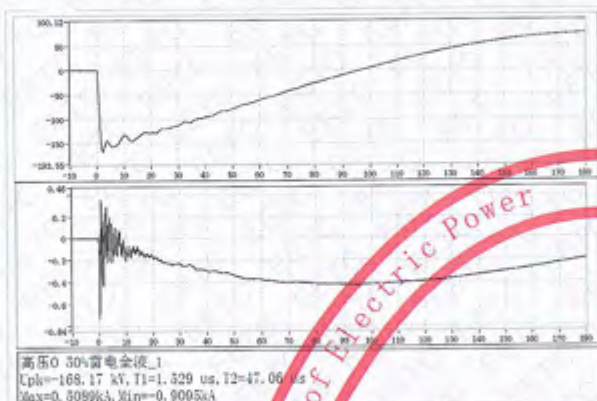
100% Full wave (Terminal C)



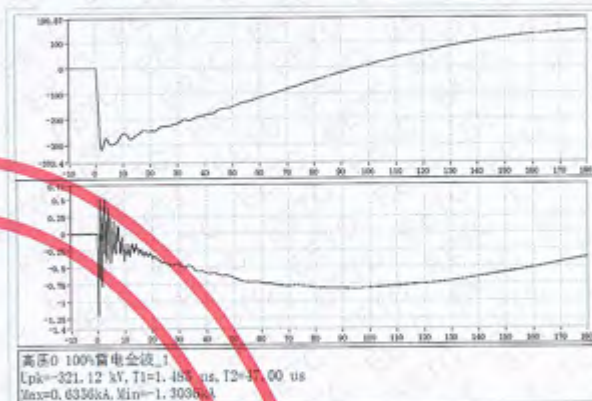
C.2 HV neutral Waveforms

The front time T1: 1.53 μ s、The tail time T2: 47.1 μ s

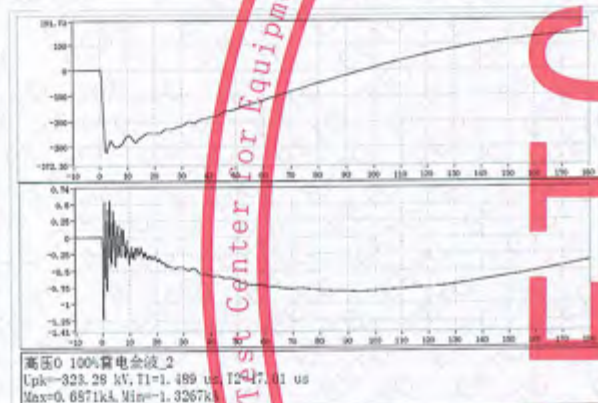
50% ~70% Full wave (Terminal 0)



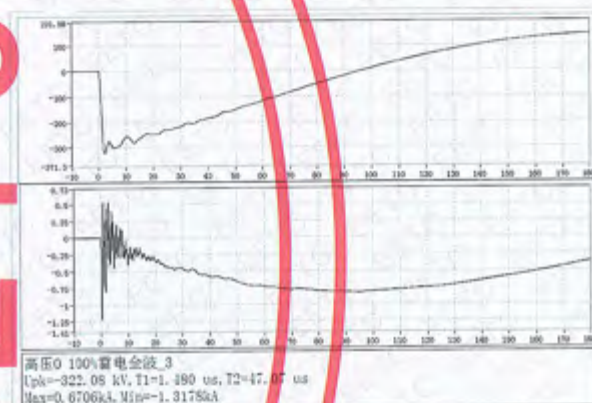
100% Full wave (Terminal 0)



100% Full wave (Terminal 0)



100% Full wave (Terminal 0)

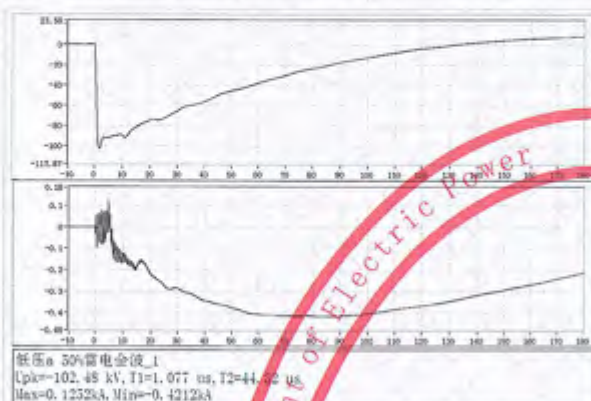


(Blank below)

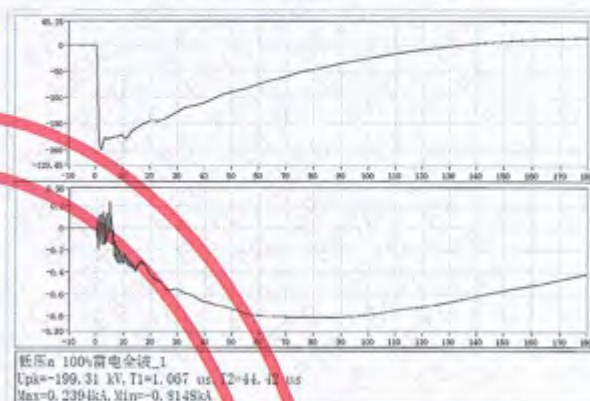
C.3 LV Line Terminal Waveforms

The front time T_1 : 1.08 μ s, The tail time T_2 : 44.3 μ s, Time to chopping T_c : 3.85 μ s

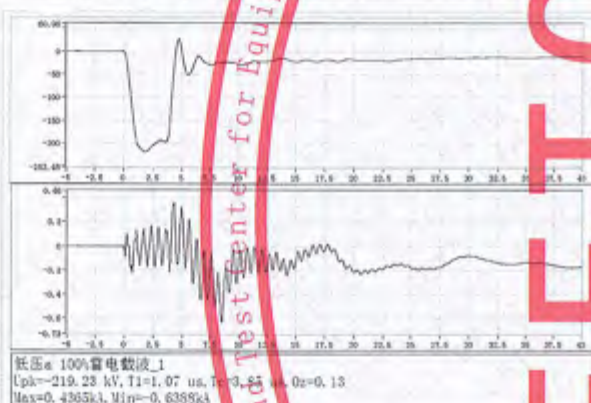
50%~70% Full wave (Terminal a)



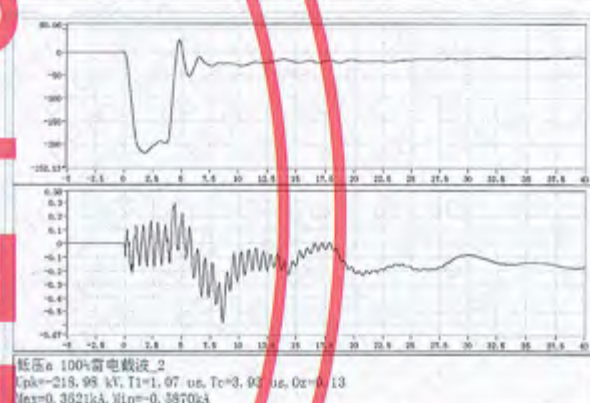
100% Full wave (Terminal a)



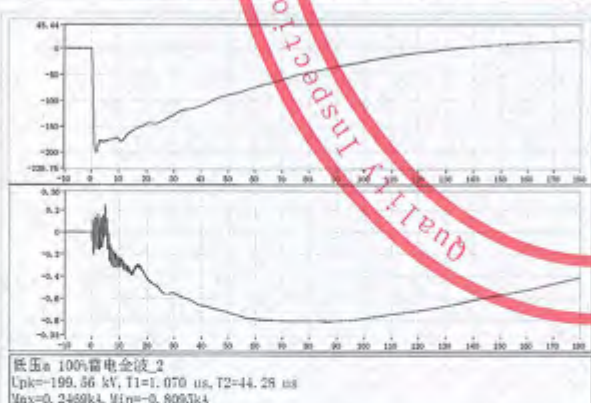
100% Chopped wave (Terminal a)



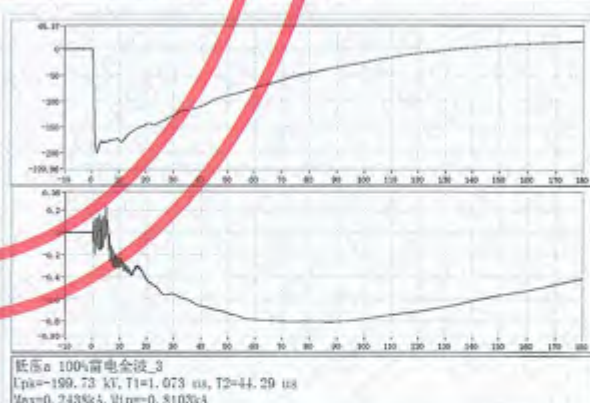
100% Chopped wave (Terminal a)



100% Full wave (Terminal a)

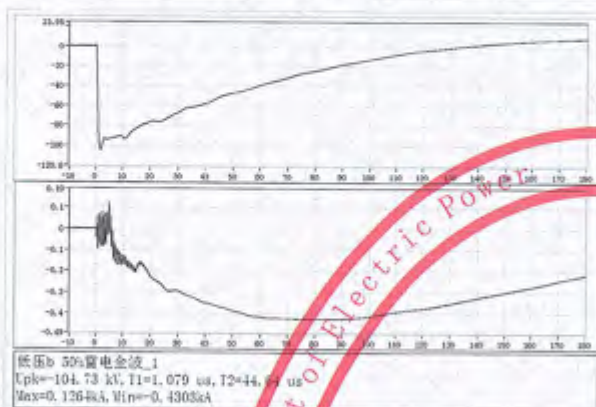


100% Full wave (Terminal a)

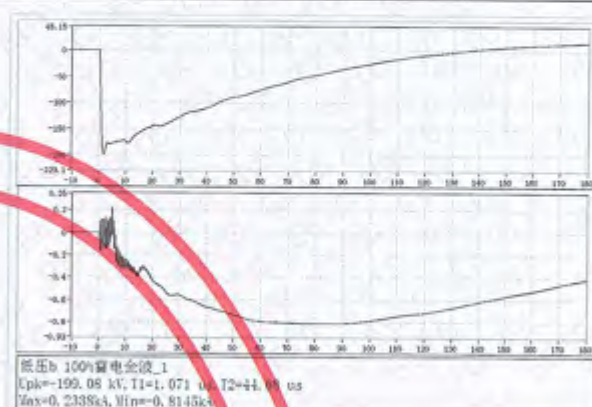


The front time T1: 1.08 μ s、The tail time T2: 44.6 μ s、Time to chopping Tc: 3.90 μ s

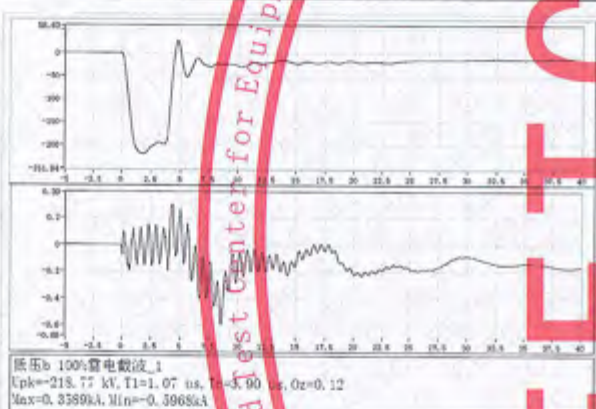
50%~70% Full wave (Terminal b)



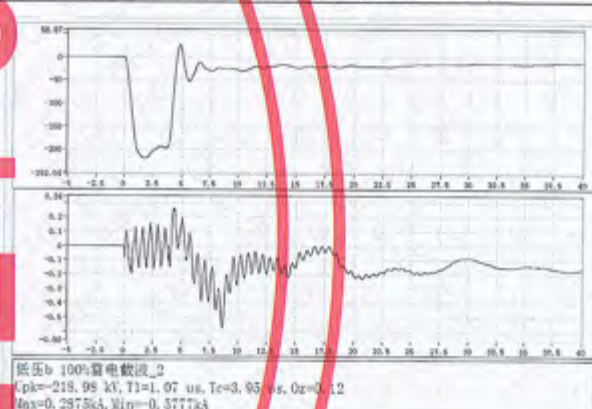
100% Full wave (Terminal b)



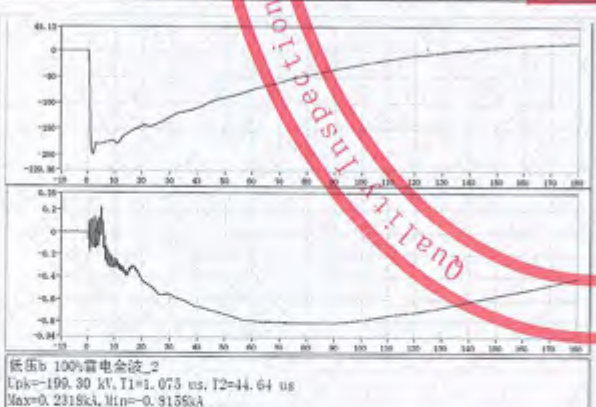
100% Chopped wave (Terminal b)



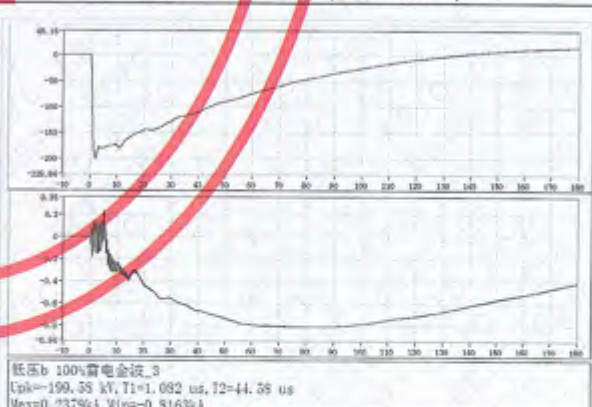
100% Chopped wave (Terminal b)



100% Full wave (Terminal b)

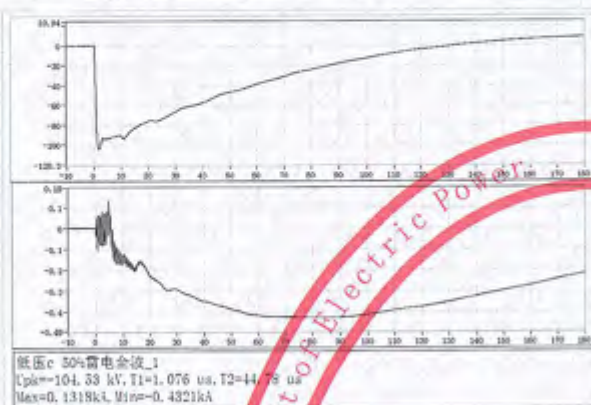


100% Full wave (Terminal b)

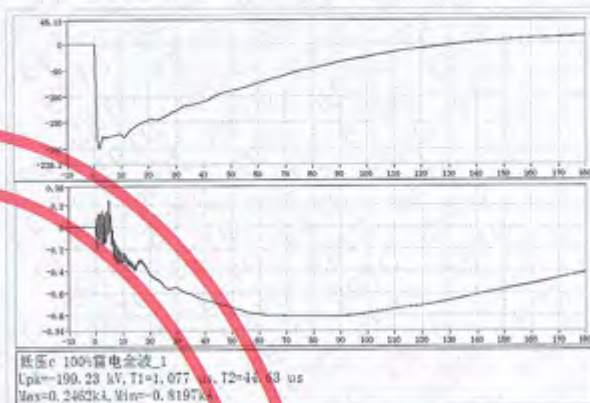


The front time T1: 1.08 μ s、The tail time T2: 44.8 μ s、Time to chopping Tc: 3.92 μ s

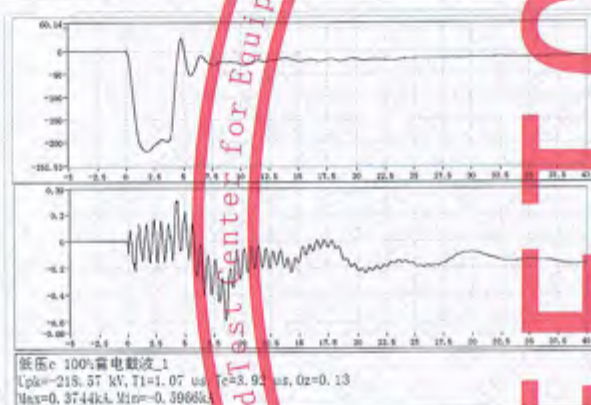
50%~70% Full wave (Terminal c)



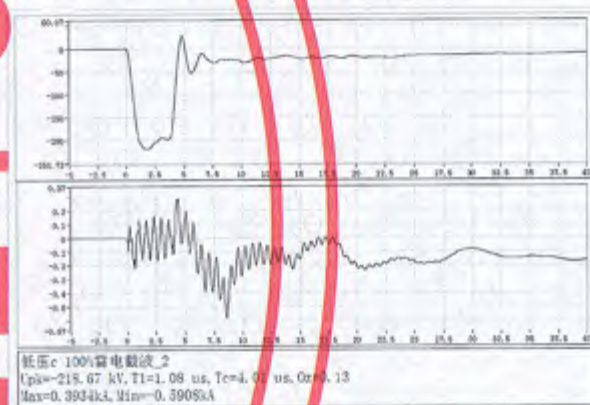
100% Full wave (Terminal c)



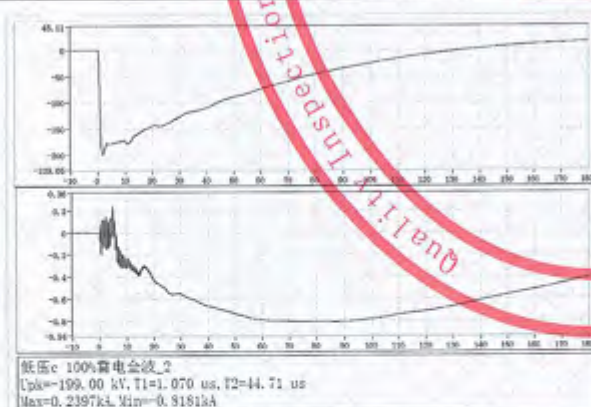
100% Chopped wave (Terminal c)



100% Chopped wave (Terminal c)



100% Full wave (Terminal c)



100% Full wave (Terminal c)

