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CNAS L0223

XIHARI

No. 170066J

检 验 报 告

Test Report

试品型号: BRFDLW-252/1250-4
TYPE

试品名称: 复合油纸绝缘电容型变压器套管
DESIGNATION Composite Oiled Paper Insulation Transformer Bushing for Capacitance

委托单位: 江苏神马电力股份有限公司如皋分公司
CLIENT Jiangsu Shemar (Rugao) Electric Co., Ltd.

制造单位: 江苏神马电力股份有限公司如皋分公司
MANUFACTURER Jiangsu Shemar (Rugao) Electric Co., Ltd.

检验类别: 型式试验
TEST CLASSIFICATION Type I

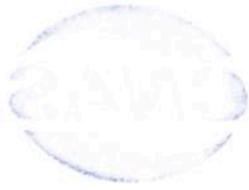


西安高压电器研究院有限责任公司

XI'AN HIGH VOLTAGE APPARATUS RESEARCH INSTITUTE CO., LTD.

国家绝缘子避雷器质量监督检验中心

NATIONAL QUALITY SUPERVISION & INSPECTION CENTER
FOR INSULATOR & SURGE ARRESTER



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地址：西安高压电器研究院有限责任公司陕西省西安市西二环北段 18 号

Address: Xi'an High Voltage Apparatus Research Institute Co., Ltd. No.18 North Section of Xi'erhuan, Shaanxi, China

邮政编码 Zip : 710077

电话 Tel. : (029)84225675 (029)84221456

传真 Fax. : (029)84225680

电子邮箱 E-mail: lab@xihari.com

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概述 Summary

试品型号及名称 Test object		BRFDLW-252/1250-4 复合油纸绝缘电容型变压器套管 BRFDLW-252/1250-4 Composite Oiled Paper Insulation Transformer Bushing for Capacitance	
委托单位 Client	名称 Name	江苏神马电力股份有限公司如皋分公司 Jiangsu Shemar (Rugao) Electric Co., Ltd.	
	联系方式 Connection	江苏省如皋市神马电力工业园 (226500) 电话: 0513-80575246 传真: 0513-80579581 Rucheng Town, Rugao, Nantong, Jiangsu Province, P. R. China Postal code: 226500 Tel:+86 513 80575246 Fax: +86 513 80579581	
制造单位 Manufacturer		江苏神马电力股份有限公司如皋分公司 Jiangsu Shemar (Rugao) Electric Co., Ltd.	
出厂日期 Manufacture date		/	
产品编号 Serial No.		1#	
制造单位规定的试品主要技术参数 Rated value assigned by the client	额定电压/Rated voltage kV	252	
	额定电流/Nominal current A	1250	
	雷电冲击干耐受电压/Dry lightning impulse withstand voltage kV	1050	
	操作冲击湿耐受电压/Wet switching impulse withstand voltage kV	850	
	工频耐受电压(干/湿)/Power-frequency withstand Voltage (Dry/Wet) kV	505/505	
	额定频率/Rated frequency Hz	50	
	长度/Length mm	4400	
	爬电距离/Creepage distance mm	7812	
	悬臂弯曲负荷/Bending load-N	4000	
委托单位提供的技术资料 The tested object is guaranteed by the manufacturer	0SM.116.132.3 252kV复合油纸绝缘电容型变压器套管试验大纲/ 252kV Composite Oiled Paper Insulation Transformer Bushing for Capacitance Testing Schedule. 0SM.132.323.1 252kV复合油纸绝缘电容型变压器套管产品图样/ 252kV Composite Oiled Paper Insulation Transformer Bushing for Capacitance Drawing.		
委托单位声明 Note			
委试方代表 Representation of client	朱兴祥 Zhu Xingxiang		
试品到达日期 Reception date	/		
试验日期 Date of tests	起 From 2017-03-01		止 To 2017-03-27
试验地址 Test address	/		

检验结论 Test Conclusion

委托单位: 江苏神马电力股份有限公司如皋分公司
Client: Jiangsu Shemar (Rugao) Electric Co., Ltd.

试品型号及名称: BRFDLW-252/1250-4
复合油纸绝缘电容型变压器套管
Test object: BRFDLW-252/1250-4
Composite Oiled Paper Insulation Transformer Bushing for Capacitance

制造单位: 江苏神马电力股份有限公司如皋分公司
Manufacturer: Jiangsu Shemar (Rugao) Electric Co., Ltd.

检验类别: 型式试验
Test classification: Type Tests

实施的检验项目/Tests have been performed :

逐个试验/Routine Test 介质损耗因数和电容量测量
Measurement of dielectric dissipation factor and capacitance
工频干耐受电压试验
Dry power-frequency voltage withstand test
雷电冲击干耐受电压试验
Dry lightning impulse voltage withstand test
局部放电量测量
Measurement of partial discharge quantity
抽头绝缘试验
Tests of tap insulation
充液体、充混合物以及液体绝缘套管的密封试验
Tightness test on liquid-filled, compound-filled and liquid-insulated bushings
法兰和其他紧固件上的密封试验
Tightness test at the flange or other fixing device
外观检查和尺寸检查
Visual inspection and dimensional check

型式试验/Type test: 介质损耗因数和电容量测量
Measurement of dielectric dissipation factor and capacitance
局部放电量测量
Measurement of partial discharge quantity
工频湿耐受电压试验
Wet power-frequency voltage withstand test
长时间工频耐受电压试验
Long-duration power-frequency withstand voltage test
雷电冲击干耐受电压试验
Dry lightning impulse voltage withstand test
操作冲击湿耐受电压试验
Wet switching impulse withstand voltage test

检验结论 Test Conclusion

电磁兼容试验 (EMC)
Electromagnetic compatibility test

温升试验
Temperature rise test

热短时电流耐受试验
Verification of thermal short-time current withstand

悬臂负荷耐受试验
Cantilever load withstand test

充液体、充混合物以及液体绝缘套管的密封试验
Tightness test on liquid-filled, compound-filled and liquid-insulated bushings

尺寸检查
Dimensional check

局部放电测量
Measurement of partial discharge quantity

介质损耗因数和电容量测量
Measurement of dielectric dissipation factor and capacitance

检验依据/Applied standards:

GB/T 4109-2008 交流电压高于1000V的绝缘套管
Insulated bushings for alternating voltage above 1000V (IEC 60137 Ed.6.0,MOD)

检验结论/Conclusion:

按照检验依据规定的逐个试验、型式试验各项全检，其结果均符合检验依据和技术资料的规定；型式试验合格。

All the items of routine test and type tests as specified by the standard were tested, the results met the requirements of the standards and technical specifications.

The results of the type tests met the requirements of the standards and technical specifications .

编写 Edited by:



校核 Checked by:



批准 Approved by:



日期 Date:

2017-05-25

日期 Date:

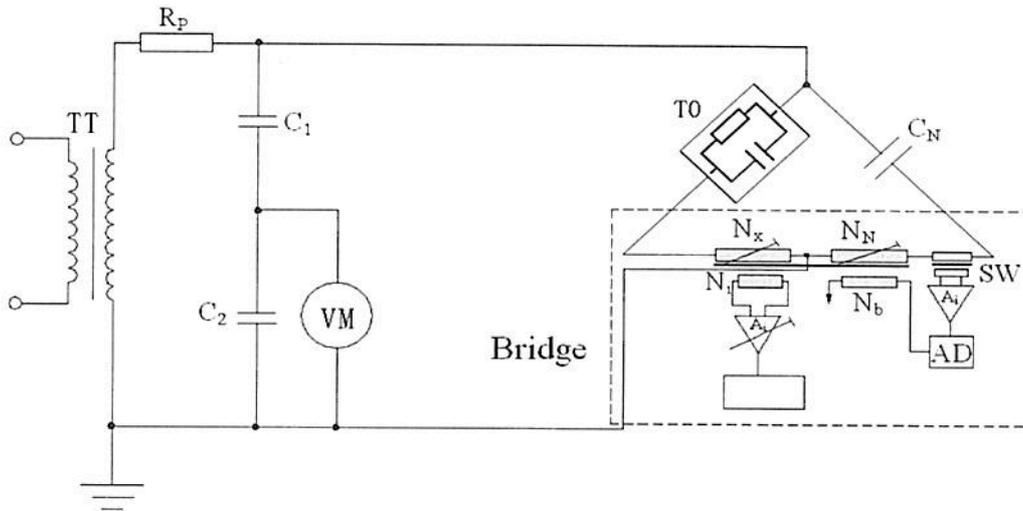
2017-05-25

日期 Date:

2017-05-25

介质损耗因数和电容量测量(逐个) Measurement of Dielectric Dissipation Factor and Capacitance (Routine Test)

介质损耗因数和电容量测量线路图
(Circuit diagram of measurement of dielectric dissipation factor and capacitance)



TT---工频试验变压器(PF transformer)

R_p ---保护电阻(Protection resistance)

C_1 ---高压臂电容(H.V arm capacitance)

C_2 ---低压臂电容(L.V arm capacitance)

C_N ---标准电容器(Standard capacitor)

TO---试品(Test object)

VM---数字测量仪(Voltmeter)

Bridge---测量电桥(Bridge)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{T1} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
550/2200	50	2	500	2.12

扩展不确定度(Expanded uncertainty): $U=2.4pC$, ($k=2$)。

介质损耗因数和电容量测量(逐个) Measurement of Dielectric Dissipation Factor and Capacitance (Routine Test)

试验日期/Date: 2017-03-06

 $t = 8.9^{\circ}\text{C}$, $\text{RH} = 61\%$, $P = 102.2\text{kPa}$

试验分别在153kV、252kV下进行介质损耗因数和电容量测量。要求在153kV、252kV电压下 $\tan \delta$ 最大值为0.4%，测量电压从153kV提高至252kV时， $\tan \delta$ 最大允许增值为0.1%，电容量规定值：390pF ~ 410pF。

The dielectric dissipation factor and capacitance are measured on 153kV and 252kV. The allowed $\tan \delta$ is 0.4% on all test voltages. When the test voltage raises from 153kV to 252kV, the increase of $\tan \delta$ must be less than 0.1%. C_x : 390pF ~ 410pF.

 标准电容 $C_N = 50.12\text{pF}$.

 Standard capacitor $C_N = 50.12\text{pF}$.

样品编号 Specimen No.	测量电压 Voltage applied kV		Cx pF	tan δ %	$\Delta \tan \delta$ %
	应施电压 Expected voltage	实施电压 Measured voltage			
1	153	153.4	399.7	0.318	/
	252	252.6	399.5	0.315	0.003

符合检验依据规定，合格。

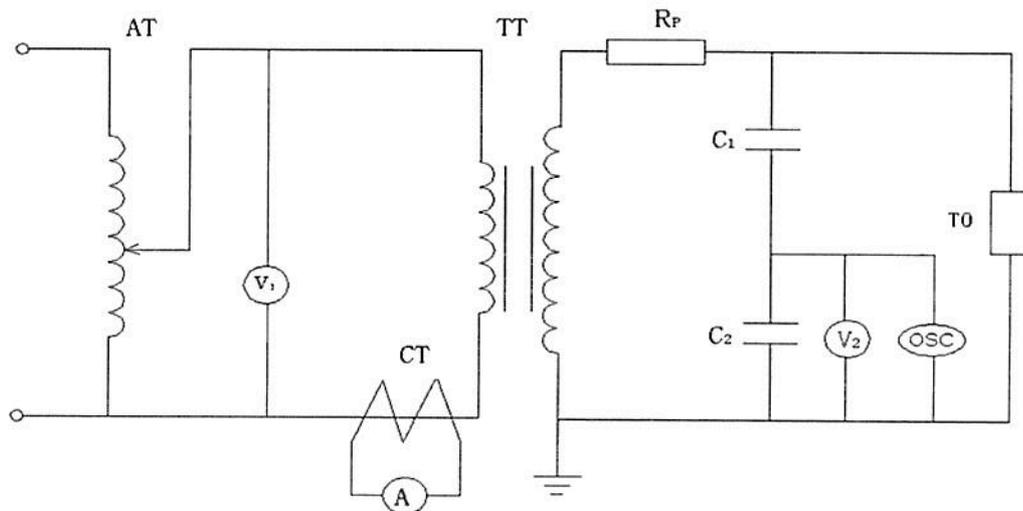
The result met test standard and the technical specifications.



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工频干耐受电压试验 (逐个) Dry Power-frequency Voltage Withstand Test (Routine Test)

工频试验原理接线图
(Diagram of power frequency voltage circuit)



- AT——调压器(Regulator)
- R_p——保护电阻(Protection resistance)
- CT——电流互感器(Current transformer)
- TT——工频试验变压器(PF transformer)
- TO——试品(Test object)
- A——电流表(Current meter)
- C₁——高压臂电容(H.V arm capacitance)
- C₂——低压臂电容(L.V arm capacitance)
- V₂——数字电压表(Voltmeter)
- OSC——数字示波器(Oscilloscope)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f _{TT} (Hz)	R _p (kΩ)	C ₁ (pF)	C ₂ (μF)
2250/2250	50	30	300	3.0

扩展不确定度(Expanded uncertainty): U<2%, (k=2).

工频干耐受电压试验 (逐个) Dry Power-frequency Voltage Withstand Test (Routine Test)

试验日期/Date: 2017-03-06

 $t = 8.9^{\circ}\text{C}$, $\text{RH} = 61\%$, $P = 102.2\text{kPa}$

 规定值/Specifications: 505kV. 电压校正系数/Correction coefficient $K_t = 1.000$

样品编号 No.	应该施加电压值 Expected voltage value kV	实际施加电压值 Measured voltage kV	耐受时间 Duration s	样品状况 Result
1	505	505.6	60	未闪络 No flashover
规定值 Specifications	/	/	60	不应闪络 No flashover

符合检验依据规定, 合格。

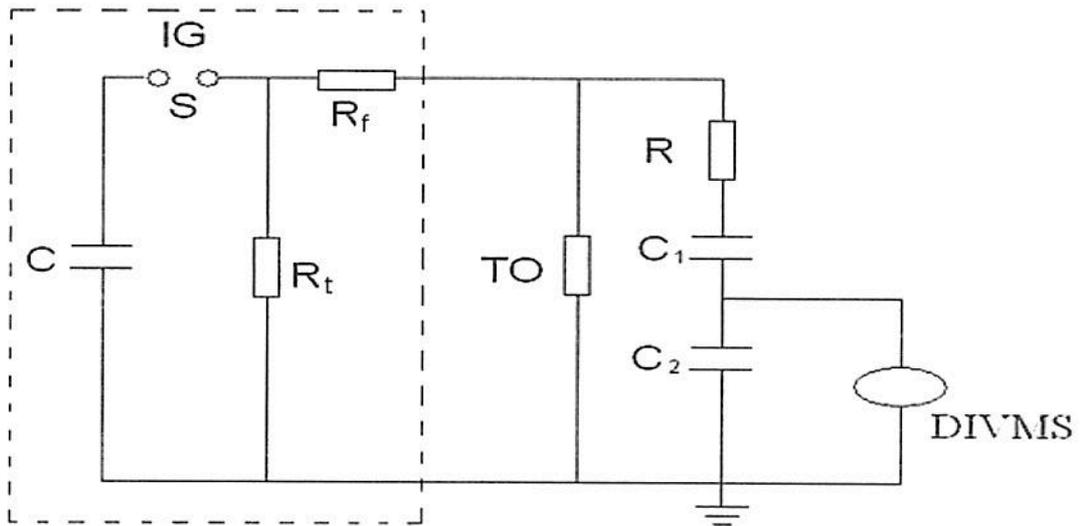
The result met test standard and the technical specifications.



PDZP170066J-001

雷电冲击干耐受电压试验 (逐个) Dry Lightning Impulse Voltage Withstand Test (Routine Test)

冲击试验原理接线图
(Diagram of impulse voltage circuit)



- C——冲击发生器主电容(IG capacitance)
- R_f ——波头电阻(front resistance)
- R_t ——波尾电阻(Tail resistance)
- R——阻尼电阻(Damping resistance)
- S——冲击点火球隙(Sphere gap)
- C_1 ——高压臂电容(H.V arm capacitance)
- C_2 ——低压臂电容(L.V arm capacitance)
- TO——试品(Test object)
- DIVMS——数字冲击电压测量系统(Impulse voltage measuring systems)

试验所用设备主要参数

(Main parameters of testing equipment)

U(kV)	C(μ F)	R_f (Ω)	R_t (Ω)	C_1 (pF)	C_2 (μ F)
2400	0.09	220	770	300	0.9

扩展不确定度(Expanded uncertainty): $U < 2\%$, ($k=2$).

雷电冲击干耐受电压试验 (逐个) Dry Lightning Impulse Voltage Withstand Test (Routine Test)

试验日期/Date: 2017-03-06

 $t = 8.9^{\circ}\text{C}$, $\text{RH} = 61\%$, $P = 102.2\text{kPa}$

规定值/Specifications: 1050kV.

 电压校正系数/Correction coefficient $K_t = 0.998$

 实际试验时取 $K_t = 1.000$

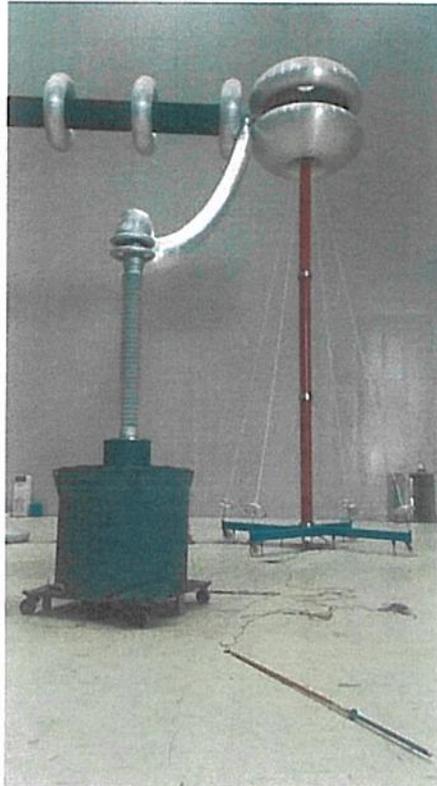
 Choosing $K_t = 1.000$ during test

样品编号 Specimen No.	极性 & 波形 Polarity and wave	实际施加电压值 Voltage applied kV	加压次数 Times	样品状况 Result
1	负极性全波 Negative polarity full wave	1050 ~ 1061	5	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性全波 Negative polarity full wave	1050	5	不应闪络或击穿 No flashover or No puncture
1	负极性截波 Negative polarity chopped wave	1186 ~ 1204	2	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性截波 Negative polarity chopped wave	1175	2	不应闪络或击穿 No flashover or No puncture
1	负极性全波 Negative polarity full wave	1051 ~ 1063	2	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性全波 Negative polarity full wave	1050	2	不应闪络或击穿 No flashover or No puncture

符合检验依据规定, 合格。

The result met test standard and the technical specifications.

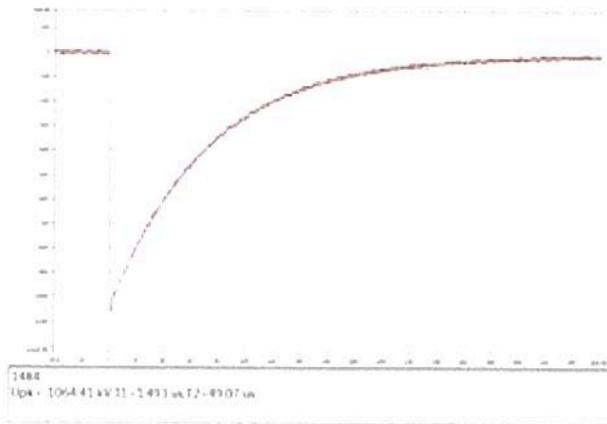
雷电冲击干耐受电压试验 (逐个)
Dry Lightning Impulse Voltage Withstand Test (Routine Test)



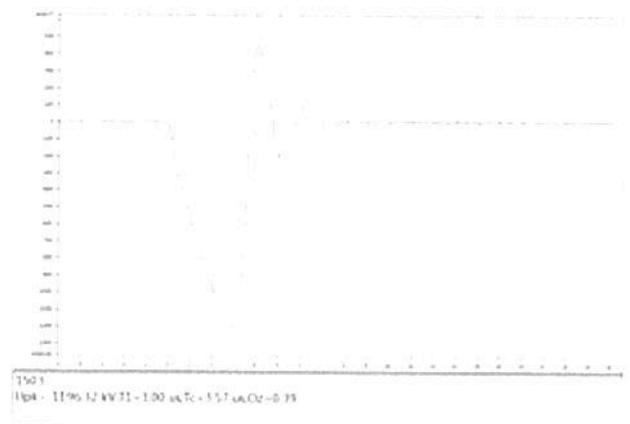
IPVZP170066J-001

雷电冲击干耐受电压试验 (逐个) Dry Lightning Impulse Voltage Withstand Test (After Cantilever Load Withstand Test)

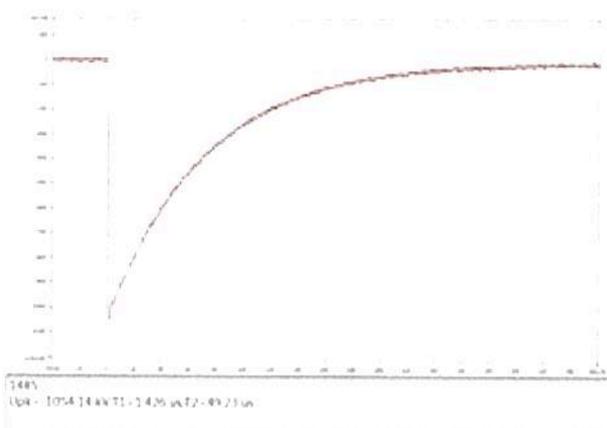
典型示波图/Typical oscillogram



IPVBT170066J-001



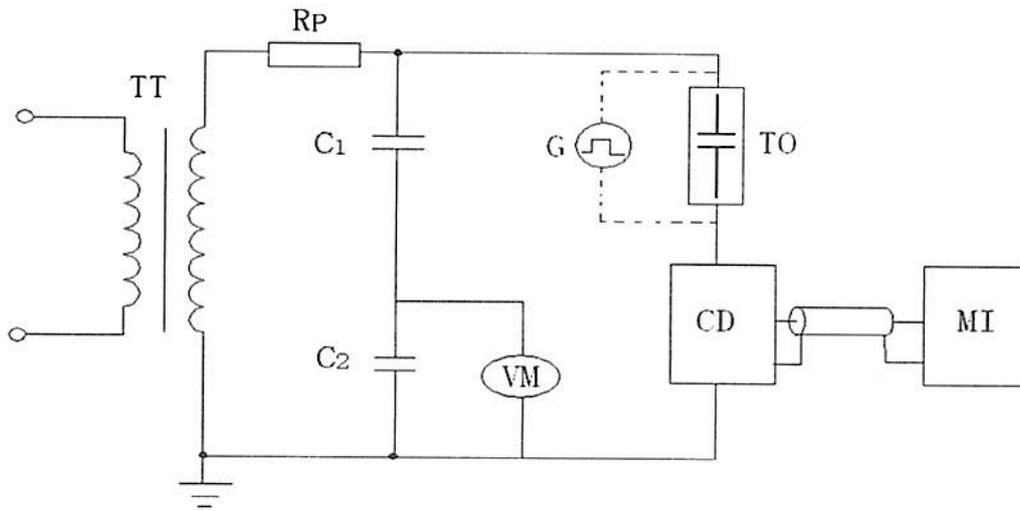
IPVBT170066J-002



IPVBT170066J-003

局部放电测量(逐个) Partial Discharge Measurement (Routine Test)

局部放电测量线路图 (AC)
(Circuit diagram of partial discharge measurement, AC)



TT---工频试验变压器(PF transformer)

R_p ---保护电阻(Protection resistance)

C_1 ---高压臂电容(H.V arm capacitor)

C_2 ---低压臂电容(L.V arm capacitor)

CD---耦合装置(Coupling device)

TO---试品(Test object)

VM---数字电压表(Voltmeter)

G---方波校准器(Step voltage generator)

MI---局放测量仪(Measuring instrument)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
550/2200	50	2	500	2.12

扩展不确定度(Expanded uncertainty): $U=2.4pC$, ($k=2$).

局部放电测量(逐个) Partial Discharge Measurement (Routine Test)

试验日期/Date: 2017-03-06

t= 8.9℃, RH= 61%, P= 102.2kPa

试验前采用5pC校准源对回路进行校准, 背景噪音为 ≤2.5pC.

Step voltage generator: 5pC. Background noise ≤ 2.5pC.

预加电压为505kV, 持续1min, 在252kV、220kV和160kV的测量电压下进行局部放电测量, 要求的局部放电量252kV、220kV和160kV下最大值为5pC.

The applied voltage is 505kV for 1 min. Partial discharge is measured on 252kV, 220kV and 160kV. and allowed partial discharge is 5pC max..

样品编号 Specimen No.	实施电压 Voltage applied kV	持续时间 Duration min	局部放电量 Partial discharge pC
1	252.5	5	≤ 4.2
	220.3	5	≤ 4.0
	160.4	5	≤ 4.0

符合检验依据规定, 合格。

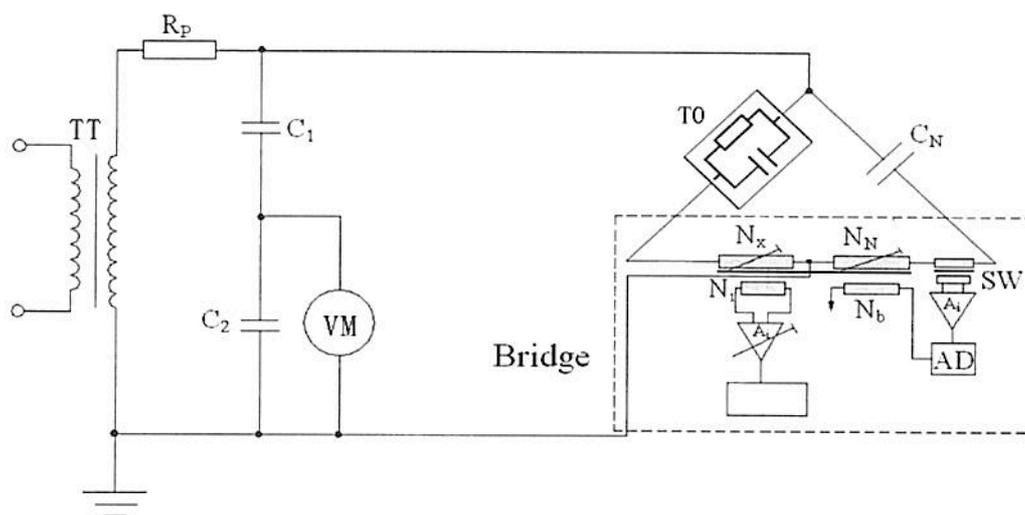
The result met test standard and the technical specifications.



PDZP170066J-001

介质损耗因数和电容量测量(逐个) Measurement of Dielectric Dissipation Factor and Capacitance (Routine Test)

介质损耗因数和电容量测量线路图
(Circuit diagram of measurement of dielectric dissipation factor and capacitance)



TT---工频试验变压器(PF transformer)

R_p ---保护电阻(Protection resistance)

C_1 ---高压臂电容(H.V arm capacitance)

C_2 ---低压臂电容(L.V arm capacitance)

C_N ---标准电容器(Standard capacitor)

TO---试品(Test object)

VM---数字测量仪(Voltmeter)

Bridge---测量电桥(Bridge)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
550/2200	50	2	500	2.12

扩展不确定度(Expanded uncertainty): $U=2.4pC$, ($k=2$).

介质损耗因数和电容量测量(逐个) Measurement of Dielectric Dissipation Factor and Capacitance (Routine Test)

试验日期/Date: 2017-03-06

 $t = 8.9^{\circ}\text{C}$, $\text{RH} = 61\%$, $P = 102.2\text{kPa}$

试验分别在153kV、252kV下进行介质损耗因数和电容量测量。要求在153kV、252kV电压下 $\tan \delta$ 最大值为0.4%，测量电压从153kV提高至252kV时， $\tan \delta$ 最大允许增值为0.1%，电容量规定值：390pF ~ 410pF。

The dielectric dissipation factor and capacitance are measured on 153kV and 252kV. The allowed $\tan \delta$ is 0.4% on all test voltages. When the test voltage raises from 153kV to 252kV, the increase of $\tan \delta$ must be less than 0.1%. C_x : 390pF ~ 410pF.

 标准电容 $C_N = 50.12\text{pF}$ 。

 Standard capacitor $C_N = 50.12\text{pF}$ 。

样品编号 Specimen No.	测量电压 Voltage applied kV		Cx pF	tanδ %	Δ tanδ %
	应施电压 Expected voltage	实施电压 Measured voltage			
1	153	153.4	399.5	0.308	/
	252	252.1	399.6	0.316	0.008

符合检验依据规定，合格。

The result met test standard and the technical specifications.



DLCZP170066J-002

抽头绝缘试验(逐个) Tests of Tap Insulation (Routine Test)

试验日期/Date: 2017-03-06

1 对地耐压试验/The ground pressure test

P=102.2kPa t=8.9℃ RH=61%

样品编号 Specimen No.	实施电压 Voltage applied kV	持续时间 Duration min	样品状况 Result
1	3	1	未闪络、未击穿 No flashover、No puncture
规定值 Specifications	3	1	未闪络、未击穿 No flashover or puncture

符合检验依据规定，合格。

The result meets test standard and the technical specifications.

2 介质损耗因数和电容量测量/Measurement of dielectric dissipation factor and capacitance

2.1 试验要求/The test requirement

试验在1kV电压下进行介质损耗因数和电容量测量，要求tanδ最大值为5%，电容量≤5000pF，对地绝缘≥1000MΩ。

Measure the dielectril loss factor and capacitance under the test voltage of 1kV. tanδ≤5%. Cx≤5000pF. grounding insulation ≥1000MΩ.

2.2 试验结果/The test result

样品编号 Specimen No.	实施电压 Voltage applied kV	Cx pF	tanδ %
1	1	796.1	0.592
规定值 Specifications	1	≤5000	≤5

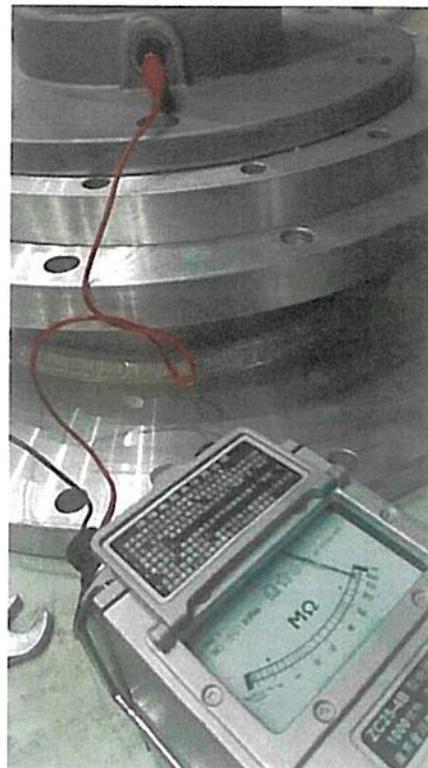
符合检验依据规定，合格。

The result meets test standard and the technical specifications.

抽头绝缘试验(逐个)
Tests of Tap Insulation (Routine Test)



TTIZP 170066J-001



TTIZP 170066J-002

充液体、充混合物以及液体绝缘套管的密封试验（逐个） Tightness Test on Liquid-filled, Compound-filled and Liquid-insulated Bushings (Routine Test)

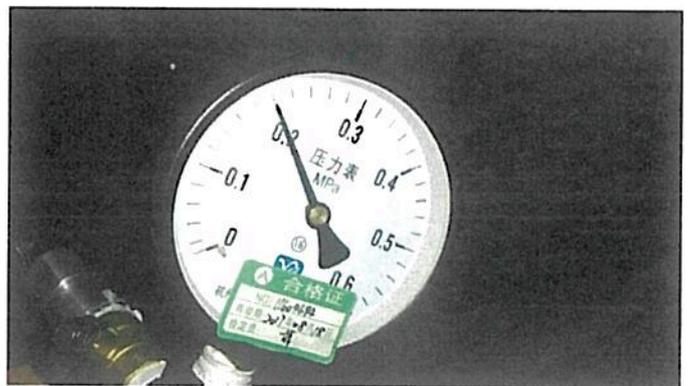
试验日期/Date: 2017-03-09

样品编号 Specimen No.	施加压力值 The pressure value MPa	持续时间 Duration h	试验温度 Test temperature ℃	样品状况 Result
1	0.20	12	60	无泄漏、未损坏 No leakage, no damage
规定值 Specifications	0.20	12	60	不应泄漏或损坏 No leakage or damage

符合检验依据规定，合格。
The result met test standard and the technical specifications.



试验整体



密封表压

法兰和其他固定装置的密封试验 (逐个) Tightness Test at the Flange or Other Fixing Device (Routine Test)

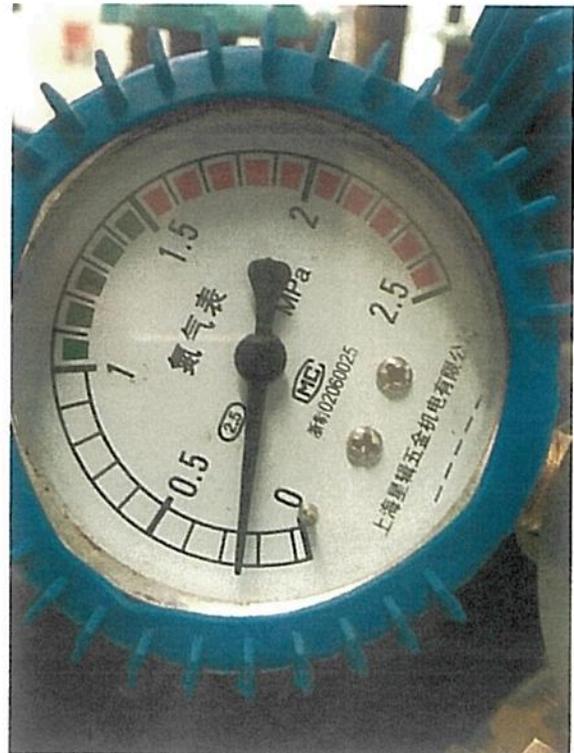
试验日期/Date: 2017-03-09

样品编号 No.	施加压力值 The pressure value MPa	持续时间 Duration min	样品状况 Result
1	0.25	15	无泄漏、未损坏 No leakage, no damage
规定值 Specifications	0.25	15	不应泄漏或损坏 No leakage or damage

符合检验依据规定, 合格。
The result met test standard and the technical specifications.



试验整体



密封表压

外观检查和尺寸检查 (逐个)
Visual Inspection and Dimensional Check (Routine Test)

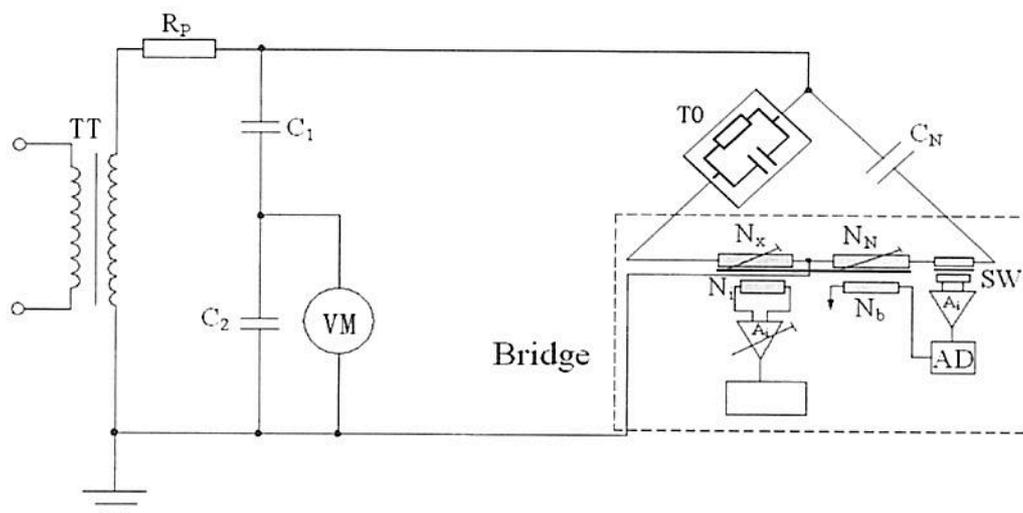
试验日期/Date: 2017-03-08

试品外观表面无缺陷, 套管尺寸符合相关图纸, 套管整体长度为4402mm, 满足 (4400±10) mm; 油中端长度为1227mm, 满足 (1227±5) mm; 爬电距离为7901mm, 满足 > 7812mm。符合检验依据规定, 合格。

The outside surface has no vice, the dimension of bushing conforms to the drawing, the total length is 4402mm, met the requirement of (4400±10) mm. the length of oil side is 1227mm, met the requirement of (1227±5) mm. creepage distance is 7901mm. met the requirement of more than 7812mm. The result met test standard and the technical specifications.

介质损耗因数和电容量测量(型式) Measurement of Dielectric Dissipation Factor and Capacitance (Type Test)

介质损耗因数和电容量测量线路图
(Circuit diagram of measurement of dielectric dissipation factor and capacitance)



TT---工频试验变压器(PF transformer)

R_p ---保护电阻(Protection resistance)

C_1 ---高压臂电容(H.V arm capacitance)

C_2 ---低压臂电容(L.V arm capacitance)

C_N ---标准电容器(Standard capacitor)

TO---试品(Test object)

VM---数字测量仪(Voltmeter)

Bridge---测量电桥(Bridge)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
550/2200	50	2	500	2.12

扩展不确定度(Expanded uncertainty): $U=2.4pC$, ($k=2$).

介质损耗因数和电容量测量(型式) Measurement of Dielectric Dissipation Factor and Capacitance (Type Test)

试验日期/Date: 2017-03-08

 $t = 8.0^{\circ}\text{C}$, $\text{RH} = 71\%$, $P = 102.1\text{kPa}$

试验分别在153kV、252kV下进行介质损耗因数和电容量测量。要求在153kV、252kV电压下 $\tan \delta$ 最大值为0.4%，测量电压从153kV提高至252kV时， $\tan \delta$ 最大允许增值为0.1%，电容量规定值：390pF ~ 410pF。

The dielectric dissipation factor and capacitance are measured on 153kV and 252kV. The allowed $\tan \delta$ is 0.4% on all test voltages. When the test voltage raises from 153kV to 252kV, the increase of $\tan \delta$ must be less than 0.1%. C_x : 390pF ~ 410pF.

 标准电容 $C_N = 50.12\text{pF}$.

 Standard capacitor $C_N = 50.12\text{pF}$.

样品编号 Specimen No.	测量电压 Voltage applied kV		Cx pF	tanδ %	Δ tanδ %
	应施电压 Expected voltage	实施电压 Measured voltage			
1	153	153.2	399.6	0.320	/
	252	252.3	399.7	0.318	0.002

符合检验依据规定，合格。

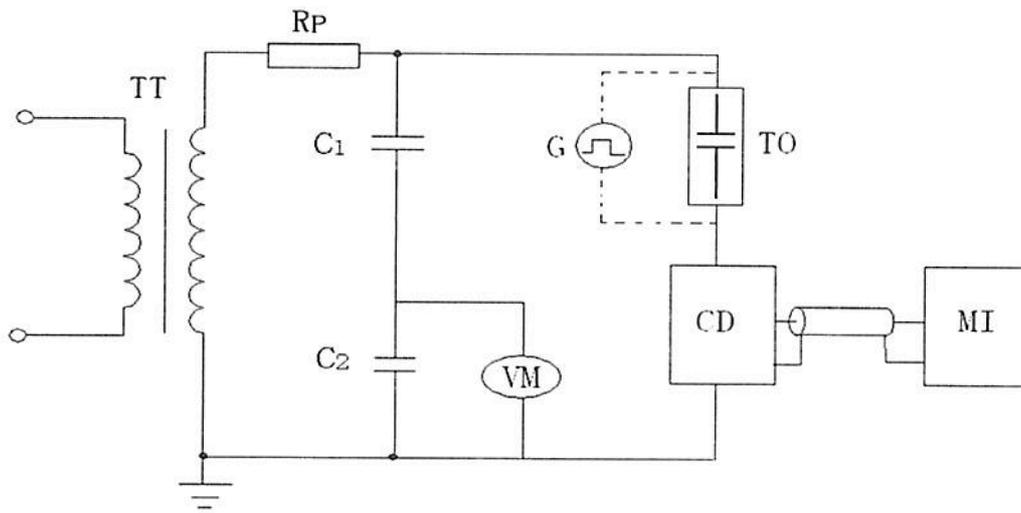
The result met test standard and the technical specifications.



DLCZP170066J-003

局部放电测量(型式) Partial Discharge Measurement (Type Test)

局部放电测量线路图 (AC)
(Circuit diagram of partial discharge measurement, AC)



TT---工频试验变压器(PF transformer)

R_p ---保护电阻(Protection resistance)

C_1 ---高压臂电容(H.V arm capacitor)

C_2 ---低压臂电容(L.V arm capacitor)

CD---耦合装置(Coupling device)

TO---试品(Test object)

VM---数字电压表(Voltmeter)

G---方波校准器(Step voltage generator)

MI---局放测量仪(Measuring instrument)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
550/2200	50	2	500	2.12

扩展不确定度(Expanded uncertainty): $U=2.4pC$, ($k=2$)。

局部放电测量(型式) Partial Discharge Measurement (Type Test)

试验日期/Date: 2017-03-08

t= 8.0℃, RH= 71%, P= 102.1kPa

试验前采用5pC校准源对回路进行校准, 背景噪音为 ≤2.5pC.

Step voltage generator: 5pC. Background noise ≤2.5pC.

预加电压为505kV, 持续1min, 在252kV、220kV和160kV的测量电压下进行局部放电测量, 要求的局部放电量252kV、220kV和160kV下最大值为5pC.

The applied voltage is 505kV for 1 min. Partial discharge is measured on 252kV, 220kV and 160kV. and allowed partial discharge is 5pC max..

样品编号 Specimen No.	实施电压 Voltage applied kV	持续时间 Duration min	局部放电量 Partial discharge pC
1	252.6	5	≤3.7
	220.7	5	≤3.6
	160.5	5	≤3.6

符合检验依据规定, 合格。

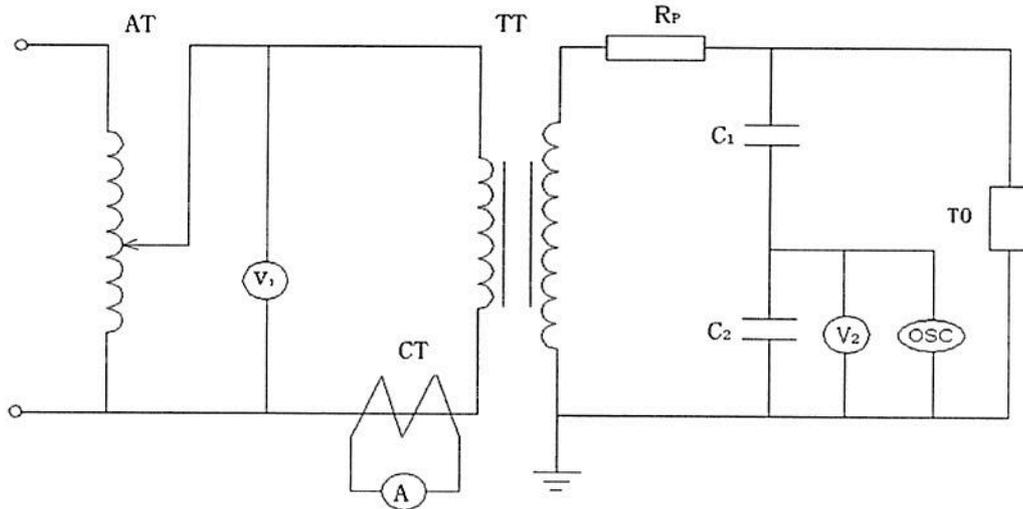
The result met test standard and the technical specifications.



PDZP170066J-004

工频湿耐受电压试验 (型式) Wet Power-frequency Voltage Withstand Test (Type Test)

工频试验原理接线图
(Diagram of power frequency voltage circuit)



- AT——调压器(Regulator)
- R_p ——保护电阻(Protection resistance)
- CT——电流互感器(Current transformer)
- TT——工频试验变压器(PF transformer)
- TO——试品(Test object)
- A——电流表(Current meter)
- C_1 ——高压臂电容(H.V arm capacitance)
- C_2 ——低压臂电容(L.V arm capacitance)
- V_2 ——数字电压表(Voltmeter)
- OSC——数字示波器(Oscilloscope)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
2250/2250	50	30	300	3.0
扩展不确定度(Expanded uncertainty): $U < 2\%$, ($k=2$).				

工频湿耐受电压试验 (型式) Wet Power-frequency Voltage Withstand Test (Type Test)

试验日期/Date: 2017-03-08

 $t=11.0^{\circ}\text{C}$, $\text{RH}=52\%$, $P=102.1\text{kPa}$

 雨水温度 $t_{\text{water}}=9.4^{\circ}\text{C}$, 实测雨水电导率/Conductivity of water $\sigma=105.1\mu\text{S/cm}$

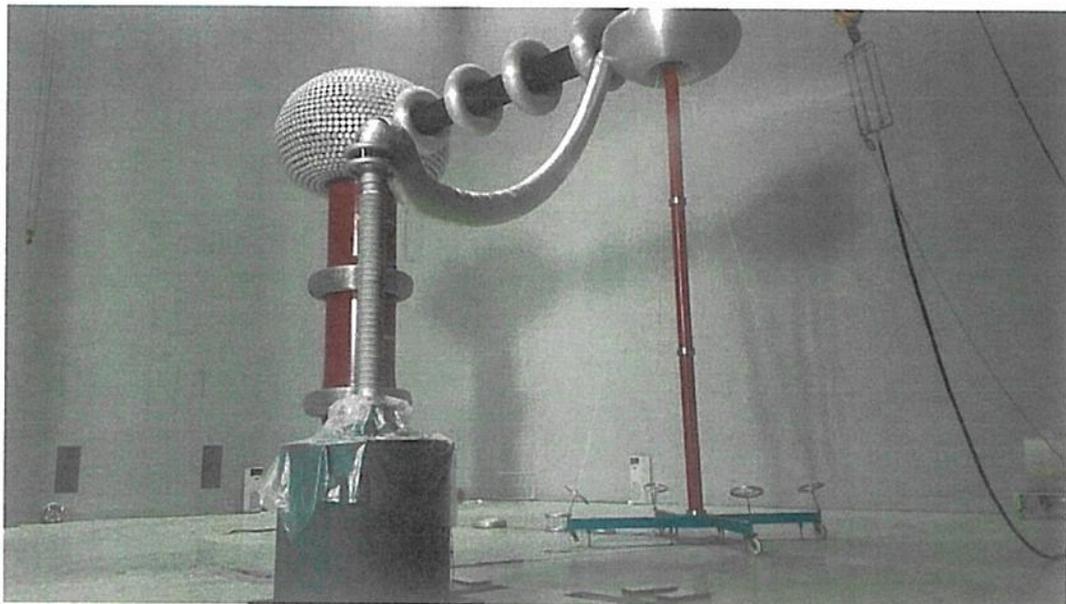
 降雨量/Precipitation rate: 水平分量为/Horizontal component is 1.2mm/min , 垂直分量为/vertical component is 1.2mm/min .

 规定值/Specifications: 505kV . 电压校正系数/Correction coefficient $K_t=1.009$

样品编号 Specimen No.	应该施加电压值 Expected voltage value kV	实际施加电压值 Measured voltage kV	耐受时间 Duration s	样品状况 Result
1	510	512.3	60	未闪络 No flashover
规定值 Specifications	/	/	60	不应闪络 No flashover

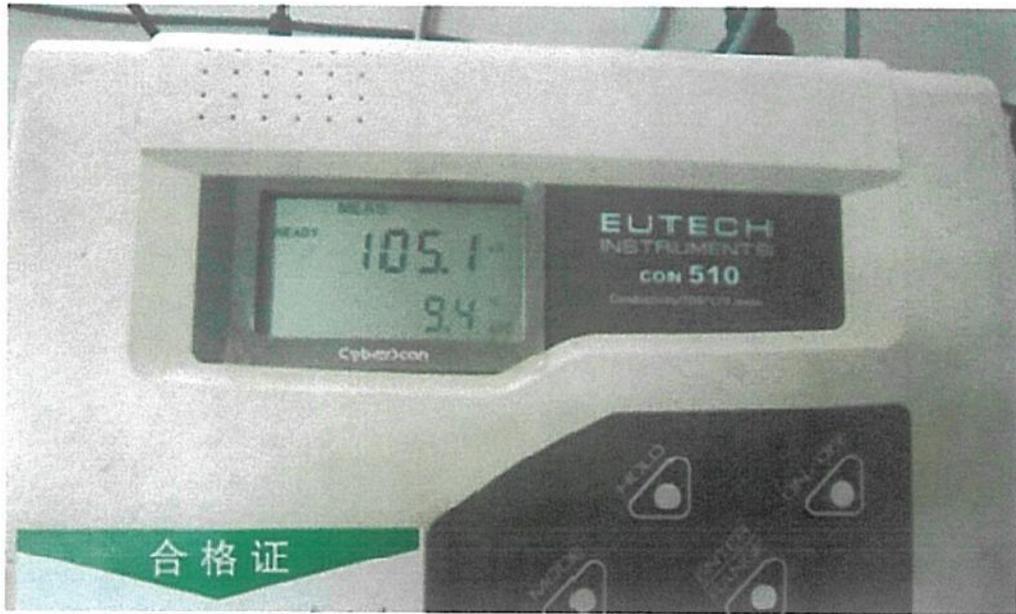
符合检验依据规定, 合格。

The result met test standard and the technical specifications.

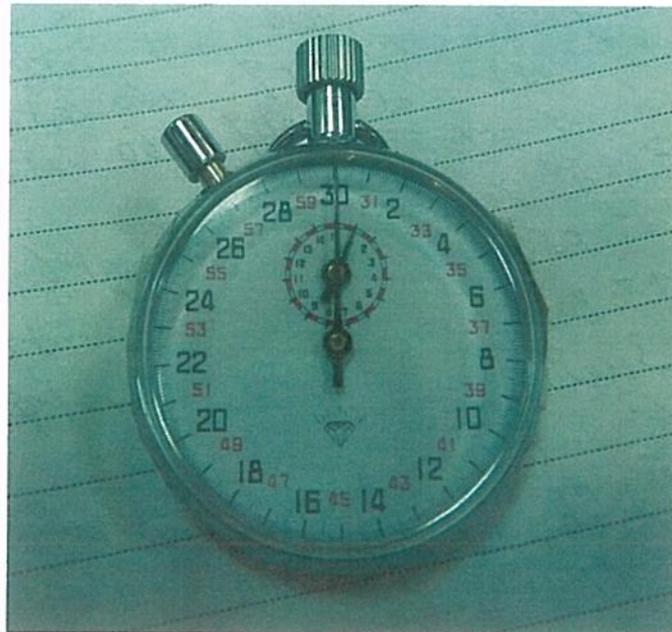


PFVZP170066J-001

工频湿耐受电压试验 (型式)
Wet Power-frequency Voltage Withstand Test (Type Test)



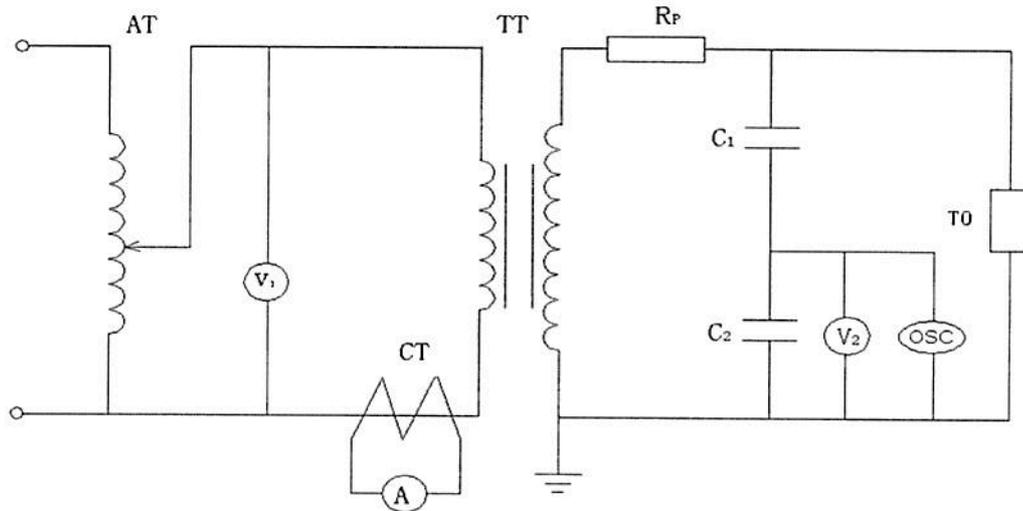
PFVZP170066J-002



PFVZP170066J-003

长时间工频耐受电压试验 (型式) Long-duration Power-frequency Withstand Voltage Test (Type Test)

工频试验原理接线图
(Diagram of power frequency voltage circuit)



- AT——调压器(Regulator)
- R_p ——保护电阻(Protection resistance)
- CT——电流互感器(Current transformer)
- TT——工频试验变压器(PF transformer)
- TO——试品(Test object)
- A——电流表(Current meter)
- C_1 ——高压臂电容(H.V arm capacitance)
- C_2 ——低压臂电容(L.V arm capacitance)
- V_2 ——数字电压表(Voltmeter)
- OSC——数字示波器(Oscilloscope)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
2250/2250	50	30	300	3.0

扩展不确定度(Expanded uncertainty): $U < 2\%$, ($k=2$).

长时间工频耐受电压试验 (型式)
Long-duration Power-frequency Withstand Voltage Test (Type Test)

试验日期/Date: 2017-03-06

t= 8.0℃, RH= 71%, P= 102.1kPa

样品编号 No.	应该施加电压值 Expected voltage value kV	实际施加电压值 Measured voltage kV	耐受时间 Duration min	样品状况 Result
1	160	160.3	5	未闪络 No flashover
	220	220.6	5	未闪络 No flashover
	252	252.8	1	未闪络 No flashover
	220	221.2	30	未闪络 No flashover
	160	160.4	5	未闪络 No flashover
规定值 Specifications	/	/	/	不应闪络 No flashover

符合检验依据规定, 合格。

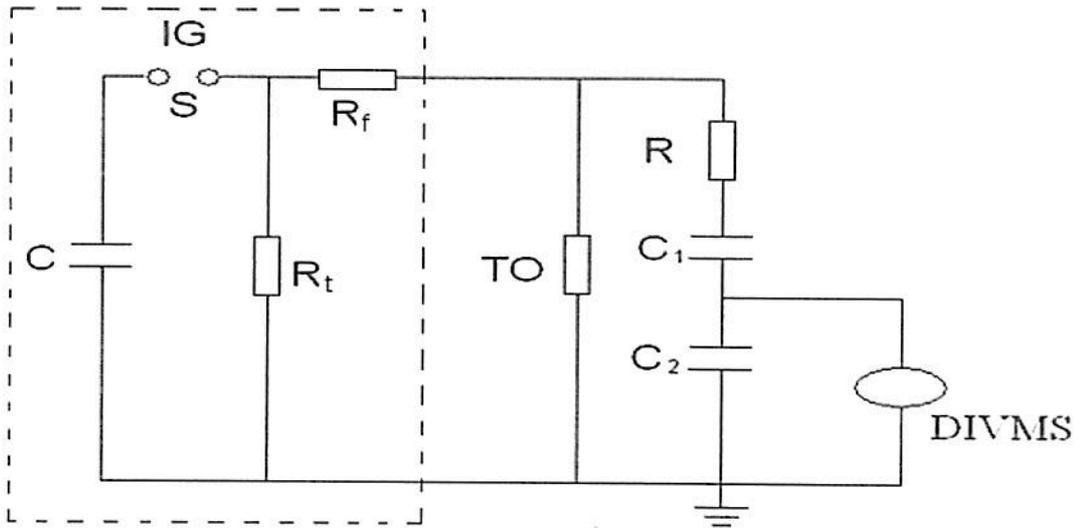
The result met test standard and the technical specifications.



PDZP170066J-004

雷电冲击干耐受电压试验 (型式) Dry Lightning Impulse Voltage Withstand Test (Type Test)

冲击试验原理接线图
(Diagram of impulse voltage circuit)



- C——冲击发生器主电容(IG capacitance)
- R_f ——波头电阻(front resistance)
- R_t ——波尾电阻(Tail resistance)
- R——阻尼电阻(Damping resistance)
- S——冲击点火球隙(Sphere gap)
- C_1 ——高压臂电容(H.V arm capacitance)
- C_2 ——低压臂电容(L.V arm capacitance)
- TO——试品(Test object)
- DIVMS——数字冲击电压测量系统(Impulse voltage measuring systems)

试验所用设备主要参数
(Main parameters of testing equipment)

U(kV)	$C(\mu F)$	$R_f(\Omega)$	$R_t(\Omega)$	$C_1(pF)$	$C_2(\mu F)$
2400	0.09	220	770	300	0.9

扩展不确定度(Expanded uncertainty): $U < 2\%$, ($k=2$).

雷电冲击干耐受电压试验 (型式) Dry Lightning Impulse Voltage Withstand Test (Type Test)

试验日期/Date: 2017-03-08

 $t = 8.0^{\circ}\text{C}$, $\text{RH} = 72\%$, $P = 102.1\text{kPa}$

规定值/Specifications: 1050kV.

 电压校正系数/Correction coefficient $K_t = 0.995$

 实际试验时取 $K_t = 1.000$

 Choosing $K_t = 1.000$ during test

样品编号 Specimen No.	极性及波形 Polarity and wave	实际施加电压值 Voltage applied kV	加压次数 Times	样品状况 Result
1	正极性全波 Positive polarity full wave	1026 ~ 1068	15	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	正极性全波 Positive polarity full wave	1050	15	空气端闪络次数 ≤ 2 不应击穿 Flashover less than 2 shots No puncture
1	负极性全波 Negative polarity full wave	1074	1	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性全波 Negative polarity full wave	1050	1	不应闪络或击穿 No flashover or No puncture
1	负极性截波 Negative polarity chopped wave	1176 ~ 1269	5	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性截波 Negative polarity chopped wave	1175	5	不应闪络或击穿 No flashover or No puncture
1	负极性全波 Negative polarity full wave	1049 ~ 1068	14	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性全波 Negative polarity full wave	1050	14	不应闪络或击穿 No flashover or No puncture

符合检验依据规定, 合格。

The result met test standard and the technical specifications.

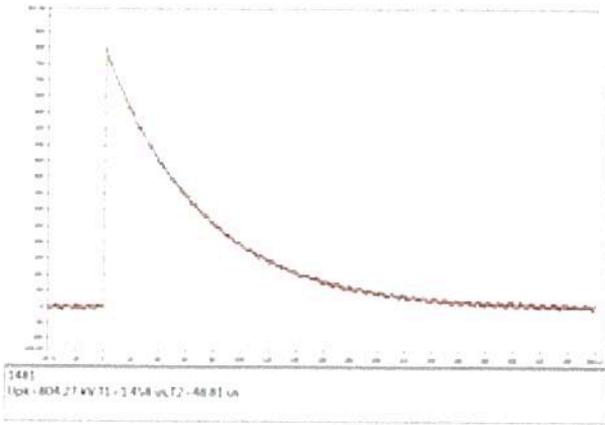
雷电冲击干耐受电压试验 (型式)
Dry Lightning Impulse Voltage Withstand Test (Type Test)



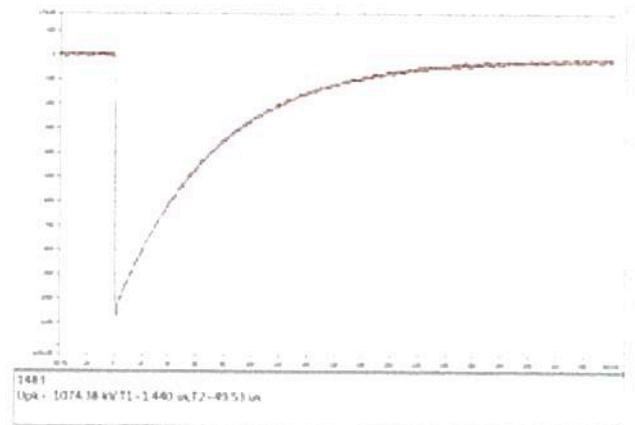
IPVZP170066J-002

雷电冲击干耐受电压试验 (型式) Dry Lightning Impulse Voltage Withstand Test (Type Test)

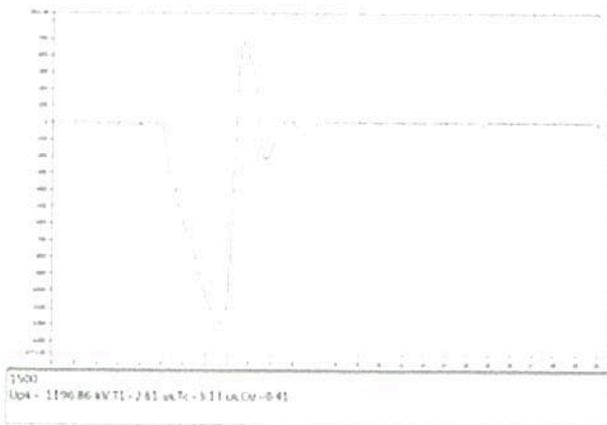
典型示波图/Typical oscillogram



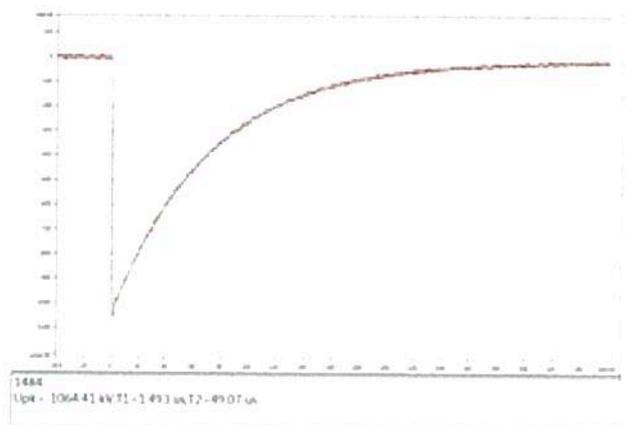
PVBT170066J-001



PVBT170066J-002



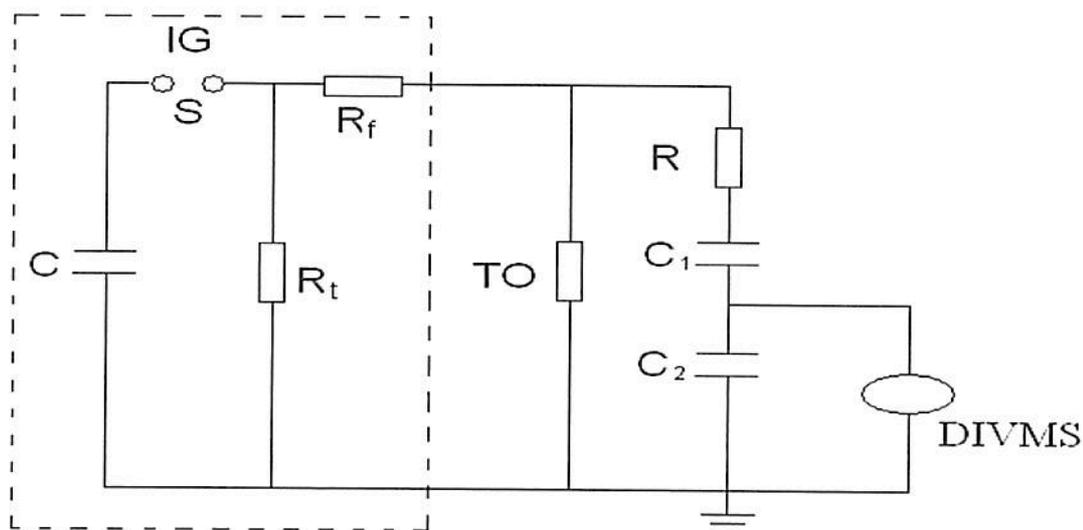
PVBT170066J-003



PVBT170066J-004

操作冲击湿耐受电压试验 (型式) Wet Switching Impulse Withstand Voltage Test (Type Test)

冲击试验原理接线图
(Diagram of impulse voltage circuit)



C——冲击发生器主电容(IG capacitance)

R_f ——波头电阻(front resistance)

R_t ——波尾电阻(Tail resistance)

R——阻尼电阻(Damping resistance)

S——冲击点火球隙(Sphere gap)

C_1 ——高压臂电容(H.V arm capacitance)

C_2 ——低压臂电容(L.V arm capacitance)

TO——试品(Test object)

DIVMS——数字冲击电压测量系统(Impulse voltage measuring systems)

试验所用设备主要参数

(Main parameters of testing equipment)

U(kV)	C(μ F)	R_f (k Ω)	R_t (k Ω)	C_1 (pF)	C_2 (μ F)
3000	0.0417	132	1344	266.9	0.97

扩展不确定度(Expanded uncertainty): $U < 2\%$, ($k=2$).

操作冲击湿耐受电压试验 (型式) Wet Switching Impulse Withstand Voltage Test (Type Test)

试验日期/Date: 2017-03-08

 干球温度 $t=11.0^{\circ}\text{C}$, 相对湿度 $\text{RH}=52\%$, 大气压 $P=102.1\text{kPa}$

 雨水温度 $t_{\text{water}}=9.4^{\circ}\text{C}$, 实测雨水电导率/Conductivity of water $\sigma = 105.1 \mu\text{S/cm}$

 降雨量/Precipitation rate: 水平分量为/Horizontal component is 1.2mm/min , 垂直分量为/vertical component is 1.2mm/min .

 规定值/Specifications: 850kV . 电压校正系数/Correction coefficient $K_t = 1.025$

样品编号 Specimen No.	施加电压次数 Times applied	实际施加电压值 Voltage applied kV	样品状况 Result
1	正极性15次 Positive polarity 15 shots	843.7 ~ 883.4	均未闪络 No flashover
	负极性15次 Negative polarity 15 shots	867.3 ~ 887.5	均未闪络 No flashover
规定值 Specifications	15	871	闪络次数 ≤ 2 Flashover less than 2 shots

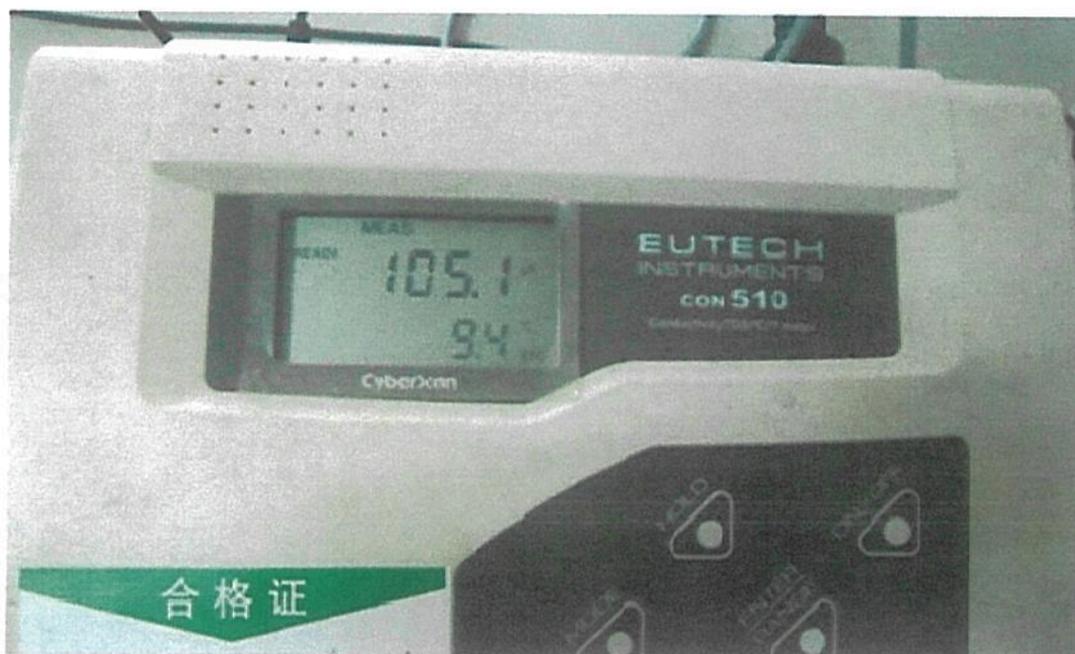
符合检验依据规定, 合格。

The result met test standard and the technical specifications.



IPVZP170066J-003

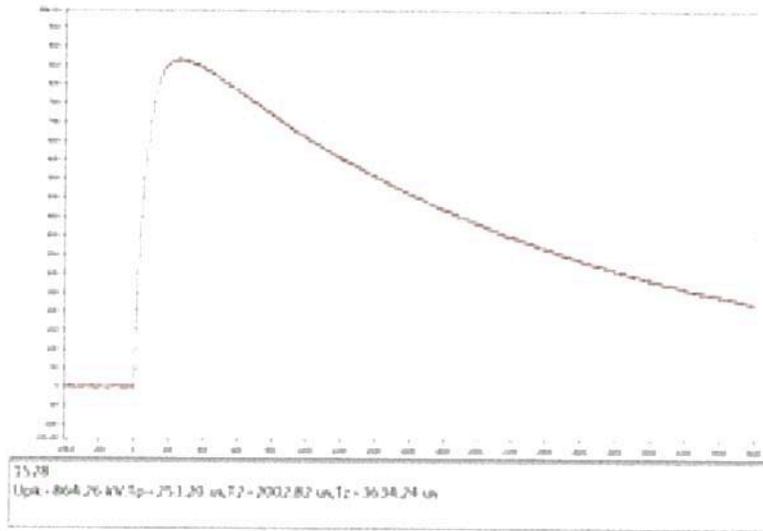
操作冲击湿耐受电压试验 (型式)
Wet Switching Impulse Withstand Voltage Test (Type Test)



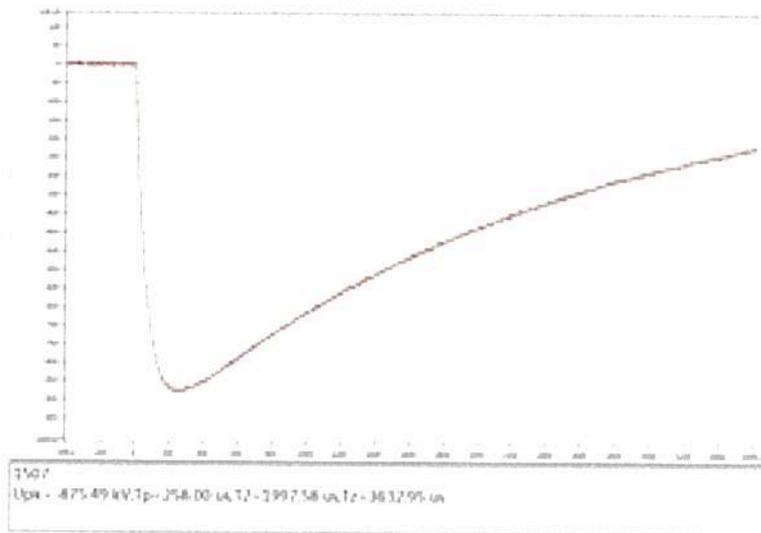
IPVZP170066J-003

操作冲击湿耐受电压试验 (型式) Wet Switching Impulse Withstand Voltage Test (Type Test)

典型示波图/Typical oscillogram



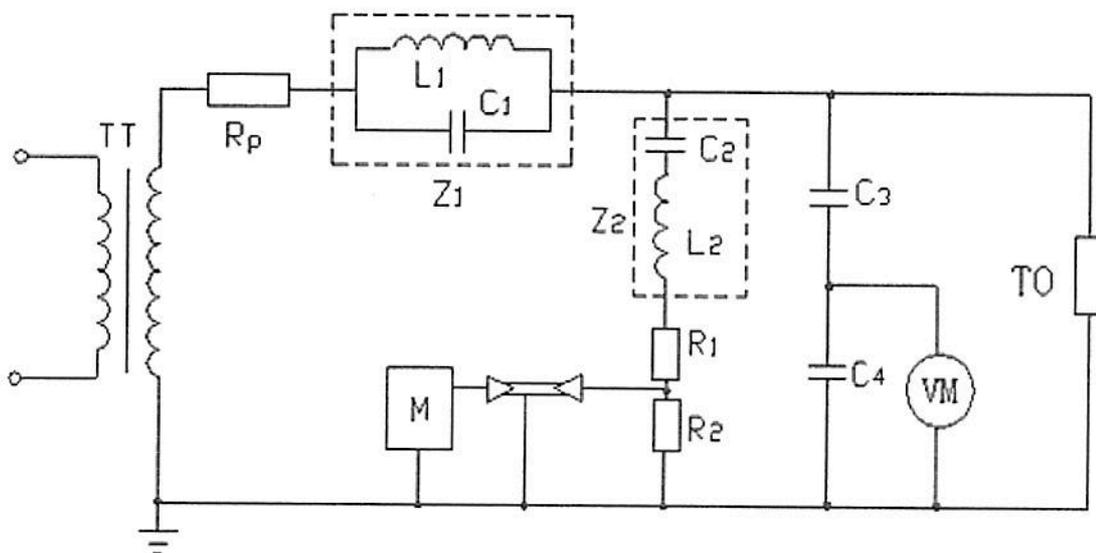
IPVBT170066J-005



IPVBT170066J-006

电磁兼容试验 (EMC) (型式) Electromagnetic Compatibility Test (Type Test)

无线电干扰试验线路图
(Circuit diagram of radio interference voltage testing)



TT---工频试验变压器(PF transformer)

Rp---保护电阻(Protection resistance)

Z₁---阻塞阻抗(Blocking impedance)

Z₂---耦合阻抗(Coupling impedance)

C₃--- 高压臂电容(H.V arm capacitance)

C₄--- 低压臂电容(L.V arm capacitance)

TO——试品(Test object)

VM---数字电压表(Voltmeter)

M--- RIV测量仪(RIV measuring device)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f _{TT} (Hz)	R _p (kΩ)	C ₃ (pF)	C ₄ (μF)
550/2200	50	2	500	2.12

扩展不确定度(Expanded uncertainty): U=2dB, (k=2).

电磁兼容试验 (EMC) (型式) Electromagnetic Compatibility Test (Type Test)

试验日期/Date: 2017-03-27

t= 17.2°C, RH=21%, P=98.1kPa

测量频率: 1.0MHz, 采用60dB信号源对回路衰减系数进行确定, 衰减系数21.6dB, 背景噪音为28.2dB。

Test frequency: 1.0MHz. Using 60dB signal source to determine attenuation coefficient, attenuation coefficient was 21.6dB. Background noise level was 28.2dB.

试验按标准规定的“标准程序”进行, 最后一轮降压过程中规定测量电压下的无线电干扰电压如下:

The test was carried out according to the "standard procedure", RIV obtained during the last decreasing run at the specified test voltage was as follows.

样品编号 Specimen No.	施加电压 Voltage applied kV	测量结果 Result	
		dB	μV
1	160.2	49.8	309.0
规定值 Specifications	160	/	< 500

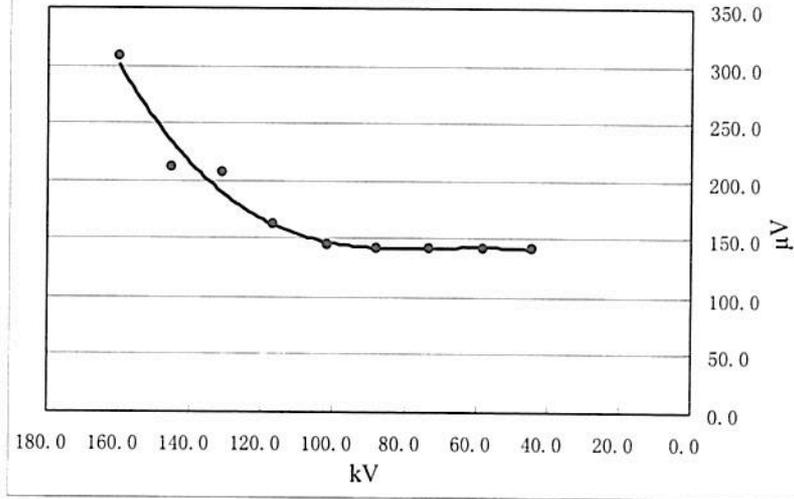
符合检验依据规定, 合格。



RIVZP170066J-001

电磁兼容试验 (EMC) (型式) Electromagnetic Compatibility Test (Type Test)

无线电干扰特性图
RIV curve



RIVCV170066J-001

温升试验 (型式) Temperature Rise Test (Type Test)

试验日期/Date: 2017-03-10

实测温升数据 Measured data of temperature-rise tests

测量部位编号 No.	测量部位名称 Measuring position	实测温升 Temperature rise K	允许温升值 Specifications K
1	铜排一米处/One meter from the copper line	18.8	/
2	接线端子/The connecting terminal	20.2	≤75
3	固定连接/The fixed connection	18.3	≤75
4	固定连接/The fixed connection	14.7	≤75
5	接线帽/The wiring cap	13.3	/
6	油枕/The oil pillow	10.7	/
7	硅橡胶件/The silicon rubber	5.9	/
8	法兰件/The flange	26.4	/
9	螺母/The screw nut	47.9	≤70
10	固定连接/The fixed connection	49.0	≤75
11	接线端子/The connecting terminal	51.5	≤75
12	铜排一米处/One meter from the copper line	50.1	/
13	变压器油/The transformer oil	61.1	60±2

环境温度为23.7℃，施加电流1500A。

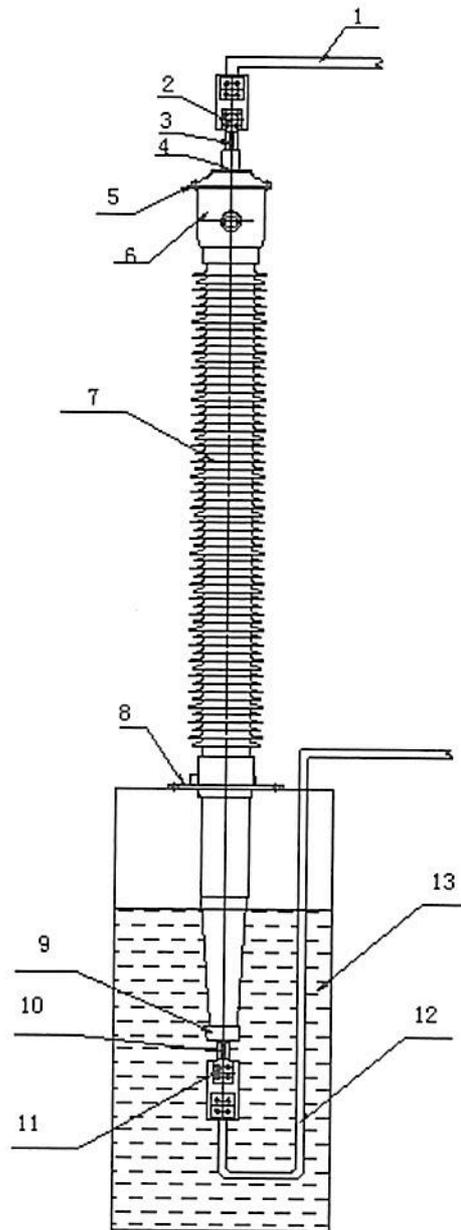
Ambient air temperature: 23.7℃. The current is 1500A.

测量部位编号及热电偶测量部位见示意图。

Measuring position Numbers and measuring position of the thermo cell see diagram.

温升试验 (型式) Temperature Rise Test (Type Test)

测量点示意图/Measuring position diagram



温升测量点示意图
(Measuring position diagram of the temperature-rise test)

温升试验 (型式) Temperature Rise Test (Type Test)



温升试验整体 Photograph 1

热短时电流耐受试验 (型式)

Verification of Thermal Short-time Current Withstand (Type Test)

根据GB/T4109-2008第8.8条的规定, 套管耐受 I_{th} 的能力用下式计算证明, 如果导体的最终温度 θ_f 不超过 180°C , 则认为套管能耐受 I_{th} 标准值。热短时电流耐受试验可以免做。

According to GB/T4109-2008, the ability of the bushing to withstand value I_{th} can be demonstrated by the following calculation, if θ_f does not exceed 180°C the bushing shall be considered to be able to withstand value of I_{th} .

$$\theta_f = \theta_0 + \alpha \times I_{th}^2 \times t_{th} / (S_f \times S_e)$$

式中/Where: θ_f —导体的最终温度/the final temperature of the conductor, $^\circ\text{C}$

θ_0 —在环境温度 40°C 下载 I_r 连续运行时的导体温度/the temperature of the conductor under continuous operation with I_r at an ambient temperature of 40°C , $^\circ\text{C}$;

α —铜为/for copper is $0.8 \text{ (K/s)/(kA/cm}^2\text{)}^2$;

I_{th} —标准规定的热短时电流/the standard value of current as specified, kA;

t_{th} —标准规定的热短时电流的持续时间/the rate duration as specified, s;

S_f —与 I_r 相适应的总截面积/the total cross-section in square centimeters corresponding to I_r , cm^2 ;

S_e —用于计算集肤效应的等效截面积/the equivalent cross-section in square centimeters taking account of skin effect, cm^2 .

$$S_f = 19.625 \text{ cm}^2;$$

$$S_e = 13.86 \text{ cm}^2;$$

$$\theta_0 (\text{max}) = 93 \text{ }^\circ\text{C};$$

$$I_{th} = 37.5 \text{ kA};$$

$$t_{th} = 2 \text{ s};$$

$$\theta_f = 93 + 0.8 \times 37.5^2 \times 2 \div (19.625 \times 13.86) = 101.27 (^\circ\text{C});$$

因为 $\theta_f < 180^\circ\text{C}$, 所以热短时电流耐受试验免做。

The thermal short-time current withstand test can be omitted.

注: 以上计算过程均由客户提供。

Note: the above calculation is provided by customer.

悬臂负荷耐受试验 (型式) Cantilever Load Withstand Test (Type Test)

试验日期/Date: 2017-03-11

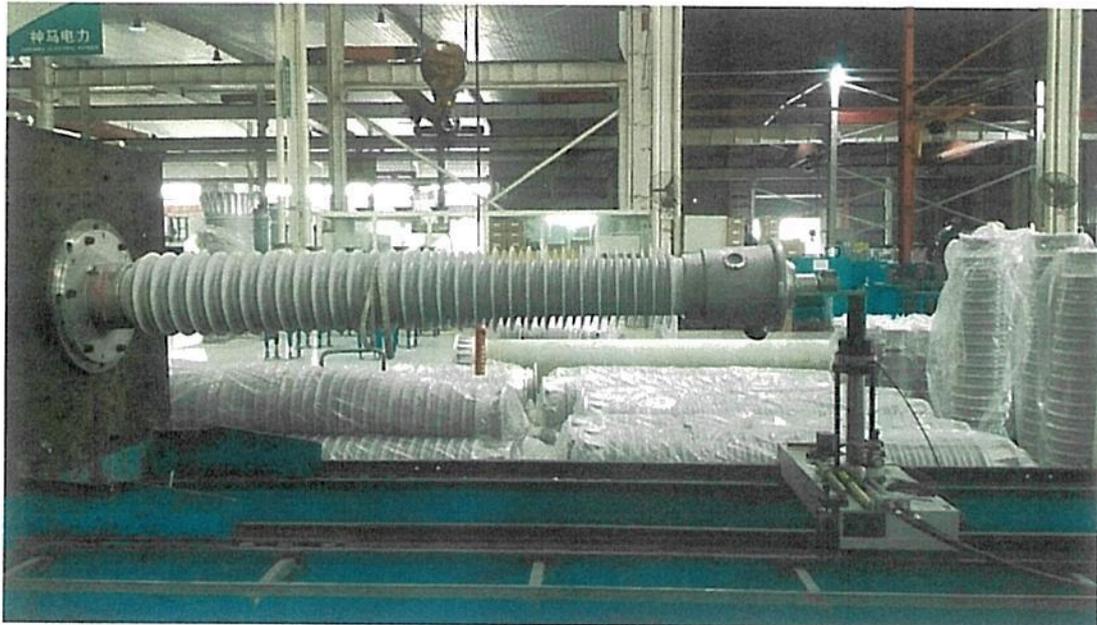
试验时套管内部充0.20MPa (表压) 的SF₆气体、套管中心导管内充0.20MPa (表压) 的SF₆气体。
The pressure of SF₆ is 0.20MPa.

由于产品处于水平放置, 考虑产品自身重量的影响, 故负载由原先4000N 调整为5000N。

样品编号 No.	施加负荷 Load applied N	持续时间 Duration s	样品状况 Result
1	5000	60	未损坏 No damage
规定值 Specifications	5000	60	不应损坏 No damage

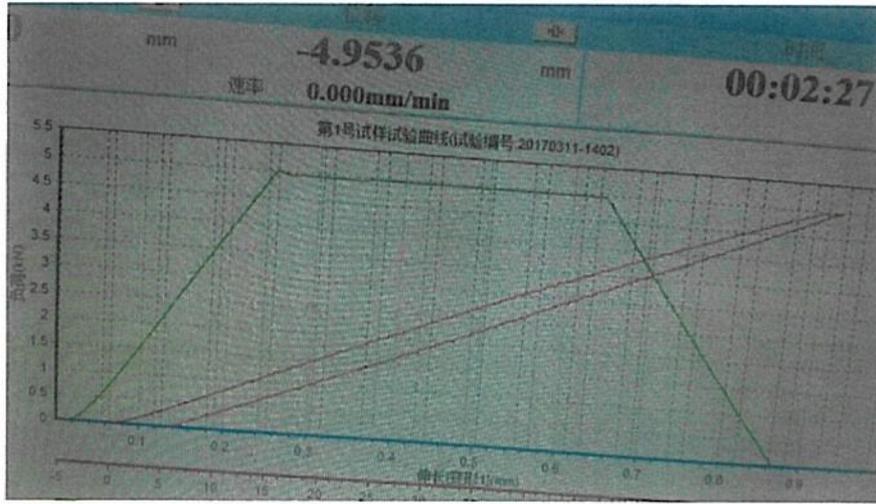
符合检验依据规定, 合格。

The result met test standard and the technical specifications.



套管试验整体

悬臂负荷耐受试验 (型式) Cantilever Load Withstand Test (Type Test)



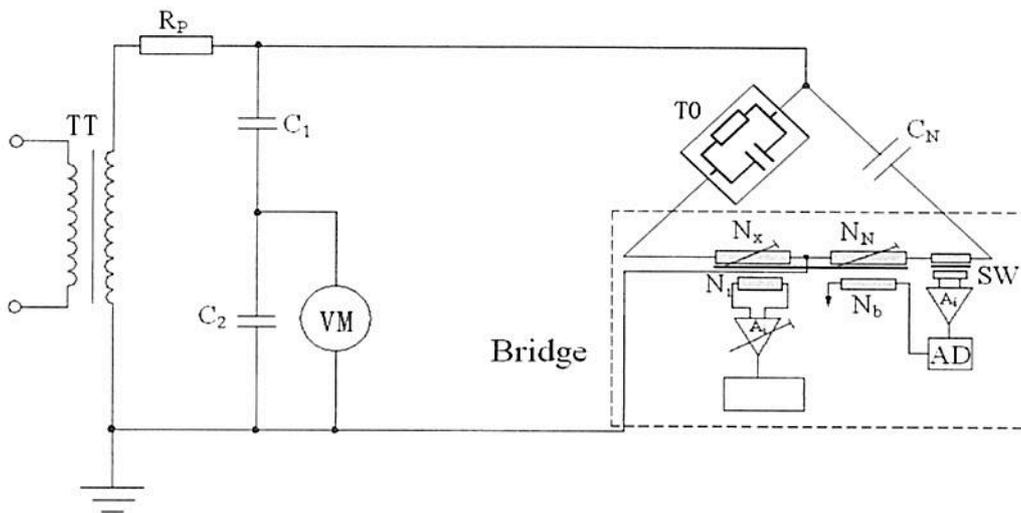
表压



表压

介质损耗因数和电容量测量(悬臂负荷耐受试验后) Measurement of Dielectric Dissipation Factor and Capacitance (After Cantilever Load Withstand Test)

介质损耗因数和电容量测量线路图
(Circuit diagram of measurement of dielectric dissipation factor and capacitance)



TT---工频试验变压器(PF transformer)

R_p ---保护电阻(Protection resistance)

C_1 ---高压臂电容(H.V arm capacitance)

C_2 ---低压臂电容(L.V arm capacitance)

C_N ---标准电容器(Standard capacitor)

TO---试品(Test object)

VM---数字测量仪(Voltmeter)

Bridge---测量电桥(Bridge)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
550/2200	50	2	500	2.12

扩展不确定度(Expanded uncertainty): $U=2.4pC$, ($k=2$).

介质损耗因数和电容量测量(悬臂负荷耐受试验后) Measurement of Dielectric Dissipation Factor and Capacitance (After Cantilever Load Withstand Test)

试验日期/Date: 2017-03-13

 $t = 8.5^{\circ}\text{C}$, $\text{RH} = 64\%$, $P = 101.96\text{kPa}$

试验分别在153kV、252kV下进行介质损耗因数和电容量测量。要求在153kV、252kV电压下 $\tan \delta$ 最大值为0.4%，测量电压从153kV提高至252kV时， $\tan \delta$ 最大允许增值为0.1%，电容量规定值：390pF ~ 410pF。

The dielectric dissipation factor and capacitance are measured on 153kV and 252kV. The allowed $\tan \delta$ is 0.4% on all test voltages. When the test voltage raises from 153kV to 252kV, the increase of $\tan \delta$ must be less than 0.1%. C_x : 390pF ~ 410pF.

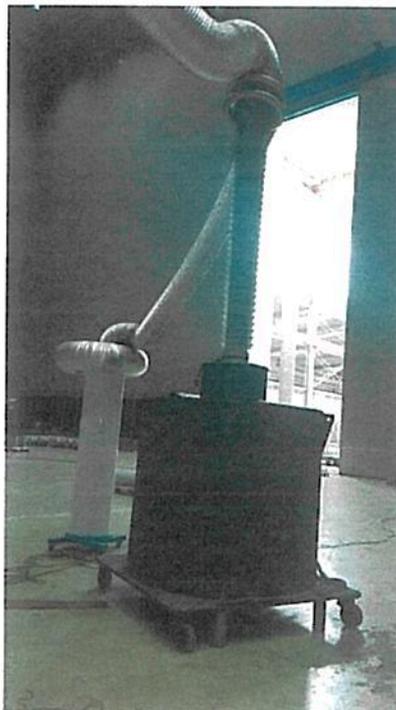
 标准电容 $C_N = 50.12\text{pF}$.

 Standard capacitor $C_N = 50.12\text{pF}$.

样品编号 Specimen No.	测量电压 Voltage applied kV		Cx pF	tan δ %	$\Delta \tan \delta$ %
	应施电压 Expected voltage	实施电压 Measured voltage			
1	153	153.8	399.7	0.317	/
	252	252.6	399.7	0.317	0

符合检验依据规定，合格。

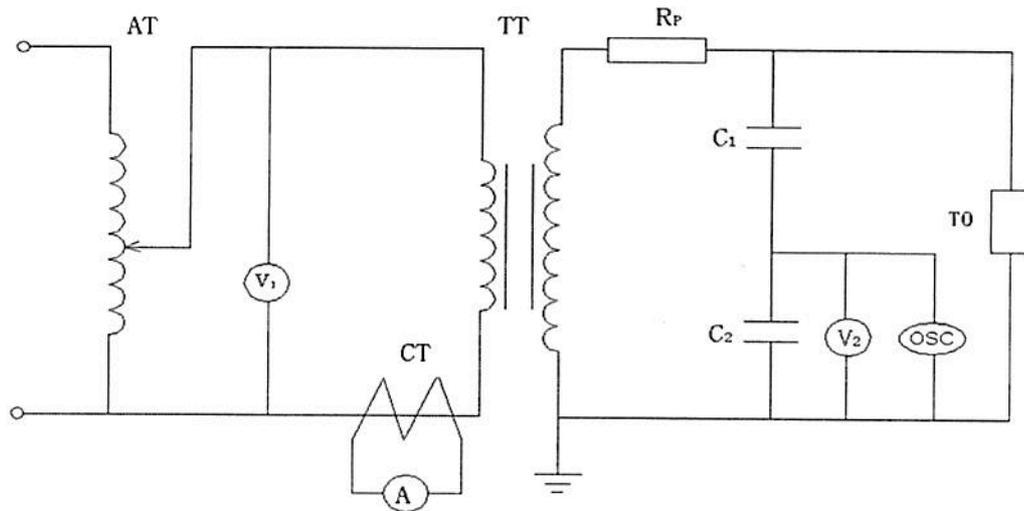
The result met test standard and the technical specifications.



DLCZP170066J-005

工频干耐受电压试验(悬臂负荷耐受试验后) Dry Power-frequency Voltage Withstand Test (After Cantilever Load Withstand Test)

工频试验原理接线图
(Diagram of power frequency voltage circuit)



- AT——调压器(Regulator)
- R_p ——保护电阻(Protection resistance)
- CT——电流互感器(Current transformer)
- TT——工频试验变压器(PF transformer)
- TO——试品(Test object)
- A——电流表(Current meter)
- C_1 ——高压臂电容(H.V arm capacitance)
- C_2 ——低压臂电容(L.V arm capacitance)
- V_2 ——数字电压表(Voltmeter)
- OSC——数字示波器(Oscilloscope)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
2250/2250	50	30	300	3.0
扩展不确定度(Expanded uncertainty): $U < 2\%$, ($k=2$).				

工频干耐受电压试验(悬臂负荷耐受试验后)
Dry Power-frequency Voltage Withstand Test (After Cantilever Load Withstand Test)

试验日期/Date: 2017-03-13

t=11.5°C, RH= 71%, P= 102.0Pa

规定值/Specifications: 505kV. 电压校正系数/Correction coefficient $K_t = 0.998$

实际试验时取 $K_t=1.000$

Choosing $K_t=1.000$ during test

样品编号 Specimen No.	应该施加电压值 Expected voltage value kV	实际施加电压值 Measured voltage kV	耐受时间 Duration s	样品状况 Result
1	505	508.1	60	未闪络 No flashover
规定值 Specifications	/	/	60	不应闪络 No flashover

符合检验依据规定, 合格。

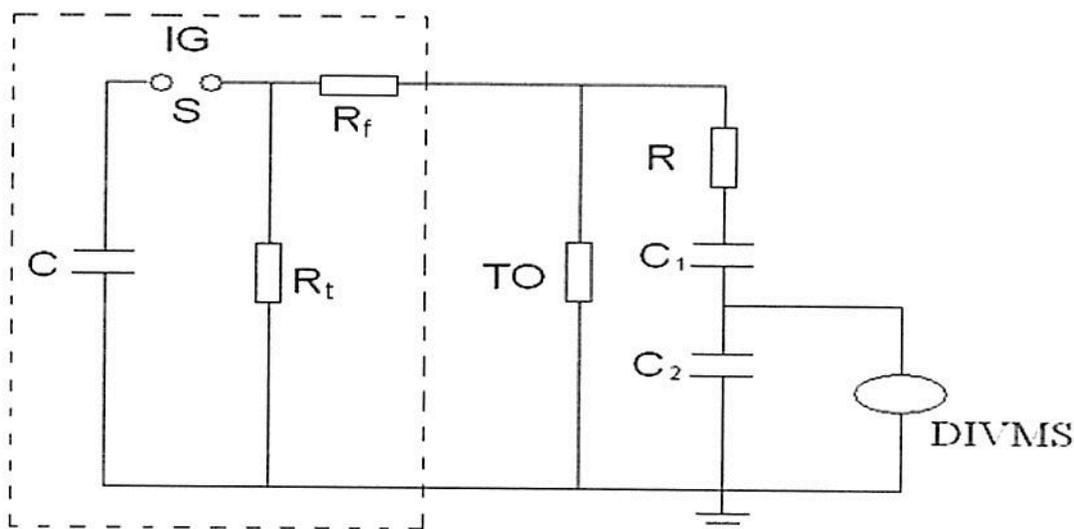
The result met test standard and the technical specifications.



PFVZP170066J-004

雷电冲击干耐受电压试验(悬臂负荷耐受试验后) Dry Lightning Impulse Voltage Withstand Test (After Cantilever Load Withstand Test)

冲击试验原理接线图
(Diagram of impulse voltage circuit)



C——冲击发生器主电容(IG capacitance)

R_f ——波头电阻(front resistance)

R_t ——波尾电阻(Tail resistance)

R——阻尼电阻(Damping resistance)

S——冲击点火球隙(Sphere gap)

C_1 ——高压臂电容(H.V arm capacitance)

C_2 ——低压臂电容(L.V arm capacitance)

TO——试品(Test object)

DIVMS——数字冲击电压测量系统(Impulse voltage measuring systems)

试验所用设备主要参数

(Main parameters of testing equipment)

U(kV)	C(μ F)	R_f (Ω)	R_t (Ω)	C_1 (pF)	C_2 (μ F)
2400	0.09	220	770	300	0.9

扩展不确定度(Expanded uncertainty): $U < 2\%$, ($k=2$).

雷电冲击干耐受电压试验(悬臂负荷耐受试验后) Dry Lightning Impulse Voltage Withstand Test (After Cantilever Load Withstand Test)

试验日期/Date: 2017-03-08

 $t = 11.5^{\circ}\text{C}$, $\text{RH} = 71\%$, $P = 102.0\text{kPa}$

规定值/Specifications: 1050kV.

 电压校正系数/Correction coefficient $K_t = 0.997$

 实际试验时取 $K_t = 1.000$

 Choosing $K_t = 1.000$ during test

样品编号 Specimen No.	极性及波形 Polarity and wave	实际施加电压值 Voltage applied kV	加压次数 Times	样品状况 Result
1	负极性全波 Negative polarity full wave	1049 ~ 1064	5	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性全波 Negative polarity full wave	1050	5	不应闪络或击穿 No flashover or No puncture
1	负极性截波 Negative polarity chopped wave	1196 ~ 1219	2	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性截波 Negative polarity chopped wave	1175	2	不应闪络或击穿 No flashover or No puncture
1	负极性全波 Negative polarity full wave	1054 ~ 1063	2	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性全波 Negative polarity full wave	1050	2	不应闪络或击穿 No flashover or No puncture

符合检验依据规定, 合格。

The result met test standard and the technical specifications.

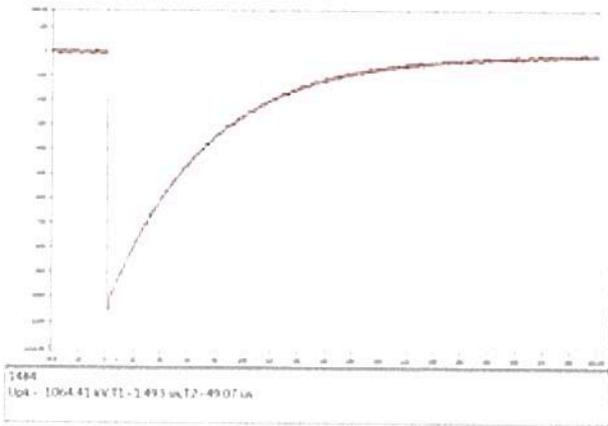
雷电冲击干耐受电压试验(悬臂负荷耐受试验后)
Dry Lightning Impulse Voltage Withstand Test (After Cantilever Load Withstand Test)



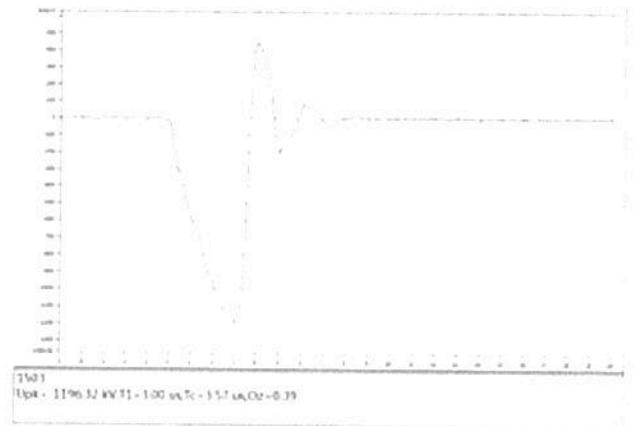
IPVZP170066J-004

雷电冲击干耐受电压试验(悬臂负荷耐受试验后) Dry Lightning Impulse Voltage Withstand Test (After Cantilever Load Withstand Test)

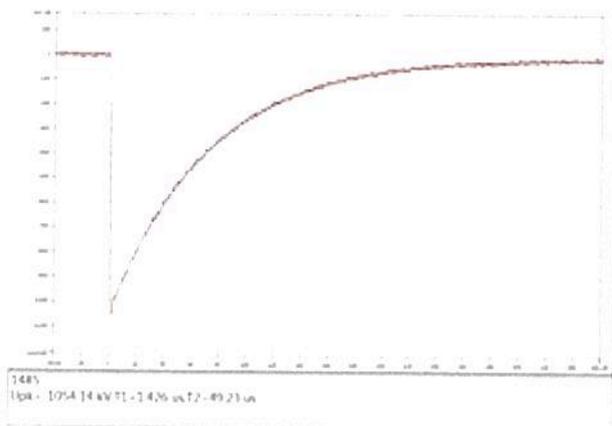
典型示波图/Typical oscillogram



IPVBT170066J-007



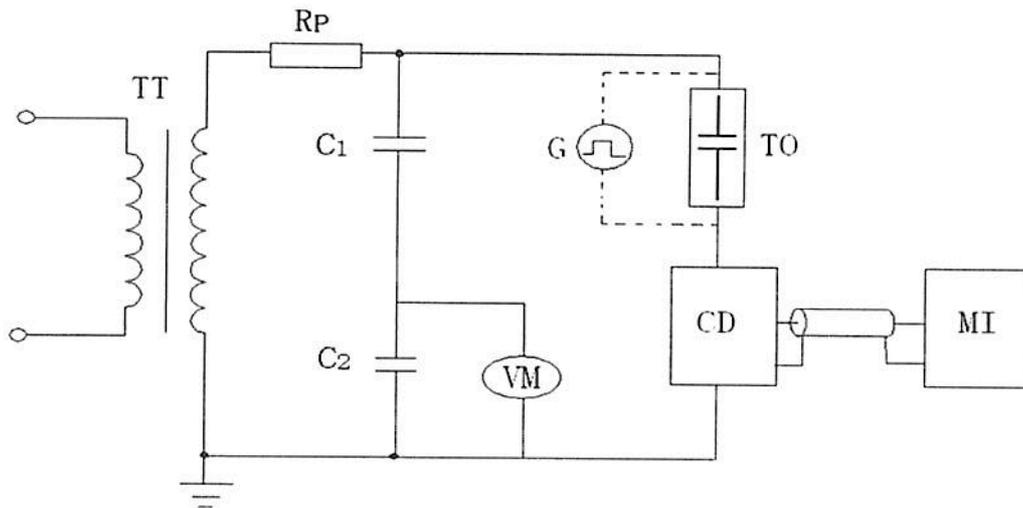
IPVBT170066J-008



IPVBT170066J-009

局部放电测量(悬臂负荷耐受试验后) Partial Discharge Measurement (After Cantilever Load Withstand Test)

局部放电测量线路图 (AC)
(Circuit diagram of partial discharge measurement, AC)



- TT---工频试验变压器(PF transformer)
- R_p ---保护电阻(Protect resistor)
- C_1 ---高压臂电容(H.V arm capacitor)
- C_2 ---低压臂电容(L.V arm capacitor)
- CD---耦合装置(Coupling device)
- TO---试品(Test object)
- VM---数字电压表(Voltmeter)
- G---方波校准器(Step voltage generator)
- MI---局放测量仪(Measuring instrument)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
550/2200	50	2	500	2.12

扩展不确定度(Expanded uncertainty): $U=2.4pC$, ($k=2$).

局部放电测量(悬臂负荷耐受试验后) Partial Discharge Measurement (After Cantilever Load Withstand Test)

试验日期/Date: 2017-03-13

t= 11.5℃, RH= 71%, P= 102.0kPa

试验前采用5pC校准源对回路进行校准, 背景噪音为 < 2.5pC.

Step voltage generator: 5pC. Background noise < 2.5pC.

预加电压为505kV, 持续1min, 在252kV、220kV和160kV的测量电压下进行局部放电测量, 要求的局部放电量252kV、220kV和160kV下最大值为5pC.

The applied voltage is 505kV for 1 min. Partial discharge is measured on 252kV, 220kV and 160kV. and allowed partial discharge is 5pC max..

样品编号 Specimen No.	实施电压 Voltage applied kV	持续时间 Duration min	局部放电量 Partial discharge pC
1	252.9	5	< 3.9
	220.6	5	< 3.8
	161.1	5	< 3.7

符合检验依据规定, 合格。

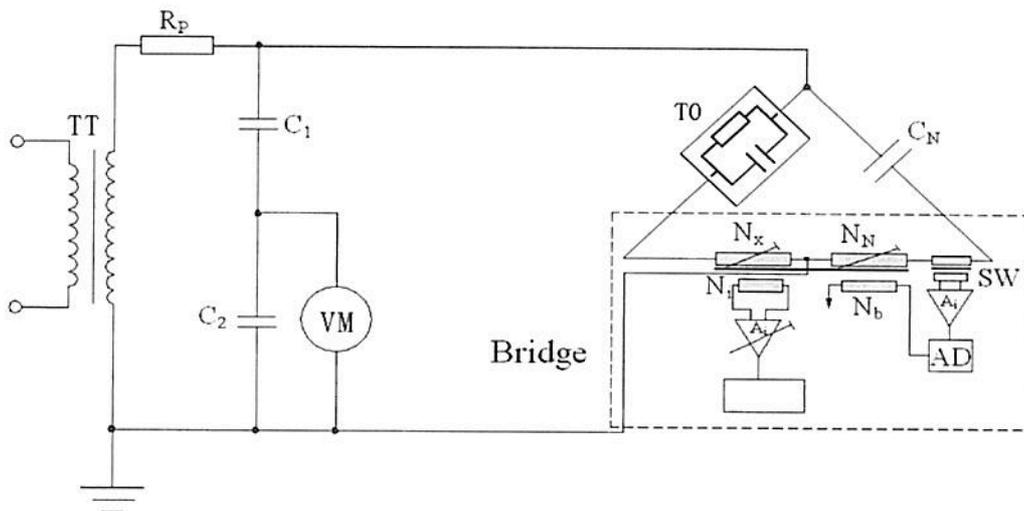
The result met test standard and the technical specifications.



PDZP170066J-010

介质损耗因数和电容量测量(悬臂负荷耐受试验后) Measurement of Dielectric Dissipation Factor and Capacitance (After Cantilever Load Withstand Test)

介质损耗因数和电容量测量线路图
(Circuit diagram of measurement of dielectric dissipation factor and capacitance)



TT---工频试验变压器(PF transformer)

R_p ---保护电阻(Protection resistance)

C_1 ---高压臂电容(H.V arm capacitance)

C_2 ---低压臂电容(L.V arm capacitance)

C_N ---标准电容器(Standard capacitor)

TO---试品(Test object)

VM---数字测量仪(Voltmeter)

Bridge---测量电桥(Bridge)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
550/2200	50	2	500	2.12

扩展不确定度(Expanded uncertainty): $U=2.4pC$, ($k=2$).

介质损耗因数和电容量测量(悬臂负荷耐受试验后)
Measurement of Dielectric Dissipation Factor and Capacitance (After Cantilever Load Withstand Test)

试验日期/Date: 2017-03-13

t= 11.5℃, RH= 71%, P= 102.0kPa

试验分别在153kV、252kV下进行介质损耗因数和电容量测量。要求在153kV、252kV电压下tan δ最大值为0.4%，测量电压从153kV提高至252kV时，tan δ最大允许增值为0.1%，电容量规定值：390pF~410pF。

The dielectric dissipation factor and capacitance are measured on 153kV and 252kV. The allowed tanδ is 0.4% on all test voltages. When the test voltage raises from 153kV to 252kV, the increase of tanδ must be less tan 0.1%. Cx :390pF~410pF.

标准电容 $C_N=50.12\text{pF}$ 。

Standard capacitor $C_N=50.12\text{pF}$.

样品编号 Specimen No.	测量电压 Voltage applied kV		Cx pF	tanδ %	Δ tanδ %
	应施电压 Expected voltage	实施电压 Measured voltage			
1	153	153.1	399.6	0.317	/
	252	252.6	399.6	0.315	0.002

符合检验依据规定，合格。

The result met test standard and the technical specifications.



DLCZP170066J-006

抽头绝缘试验(悬臂负荷耐受试验后) Tests of Tap Insulation (After Cantilever Load Withstand Test)

试验日期/Date: 2017-03-13

1 对地耐压试验/The ground pressure test

P=102.0kPa t=11.5℃ RH=71%

样品编号 Specimen No.	实施电压 Voltage applied kV	持续时间 Duration min	样品状况 Result
1	2	1	未闪络、未击穿 No flashover、No puncture
规定值 Specifications	2	1	未闪络、未击穿 No flashover or puncture

符合检验依据规定, 合格。

The result meets test standard and the technical specifications.

2 介质损耗因数和电容量测量/Measurement of dielectric dissipation factor and capacitance

2.1 试验要求/The test requirement

试验在3kV电压下进行介质损耗因数和电容量测量, 要求tanδ最大值为5%, 电容量 ≤ 5000pF, 对地绝缘 ≥ 1000MΩ。

Measure the dielectril loss factor and capacitance under the test voltage of 3kV. tanδ ≤ 5%. Cx ≤ 5000pF. grounding insulation ≥ 1000MΩ.

2.2 试验结果/The test result

样品编号 Specimen No.	实施电压 Voltage applied kV	Cx pF	tanδ %
1	3	797.0	0.590
规定值 Specifications	3	≤ 5000	≤ 5

符合检验依据规定, 合格。

The result meets test standard and the technical specifications.

抽头绝缘试验(悬臂负荷耐受试验后)
Tests of Tap Insulation (After Cantilever Load Withstand Test)



TTIZP 170066J-004



TTIZP 170066J-005

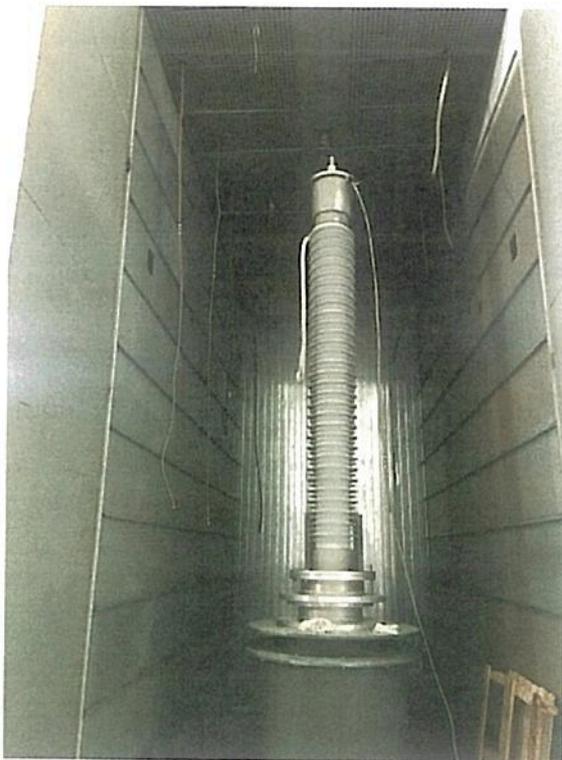
充液体、充混合物以及液体绝缘套管的密封试验(悬臂负荷耐受试验后) Tightness Test on Liquid-filled, Compound-filled and Liquid-insulated Bushings (After Cantilever Load Withstand Test)

试验日期/Date: 2017-03-13

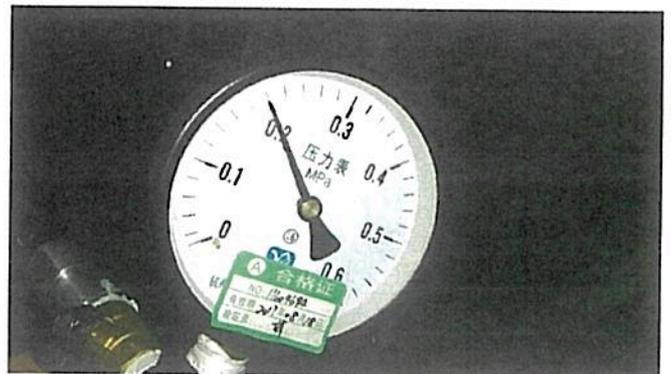
样品编号 Specimen No.	施加压力值 The pressure value MPa	持续时间 Duration h	试验温度 Test temperature ℃	样品状况 Result
1	0.20	12	75	无泄漏、未损坏 No leakage, no damage
规定值 Specifications	0.20	12	75	不应泄漏或损坏 No leakage or damage

符合检验依据规定，合格。

The result met test standard and the technical specifications.



试验整体



密封表压

法兰和其他固定装置的密封试验(悬臂负荷耐受试验后) Tightness Test at the Flange or Other Fixing Device (After Cantilever Load Withstand Test)

试验日期/Date: 2017-03-11

样品编号 No.	施加压力值 The pressure value MPa	持续时间 Duration min	样品状况 Result
1	0.25	15	无泄漏、未损坏 No leakage, no damage
规定值 Specifications	0.25	15	不应泄漏或损坏 No leakage or damage

符合检验依据规定，合格。
The result met test standard and the technical specifications.



试验整体



密封表压

外观检查和尺寸检查（悬臂负荷耐受试验后）
Visual Inspection and Dimensional Check (After Cantilever Load Withstand Test)

试验日期/Date: 2017-03-13

试品外观表面无缺陷，套管尺寸符合相关图纸，套管整体长度为4402mm，满足 (4400 ± 10) mm；油中端长度为1227mm，满足 (1227 ± 5) mm；爬电距离为7901mm，满足 > 7812 mm。符合检验依据规定，合格。
The outside surface has no vice, the dimension of bushing conforms to the drawing. the total length is 4402mm, met the requirement of (4400 ± 10) mm. the length of oil side is 1227mm, met the requirement of (1227 ± 5) mm. creepage distance is 7901mm. met the requirement of more than 7812mm. The result met test standard and the technical specifications.

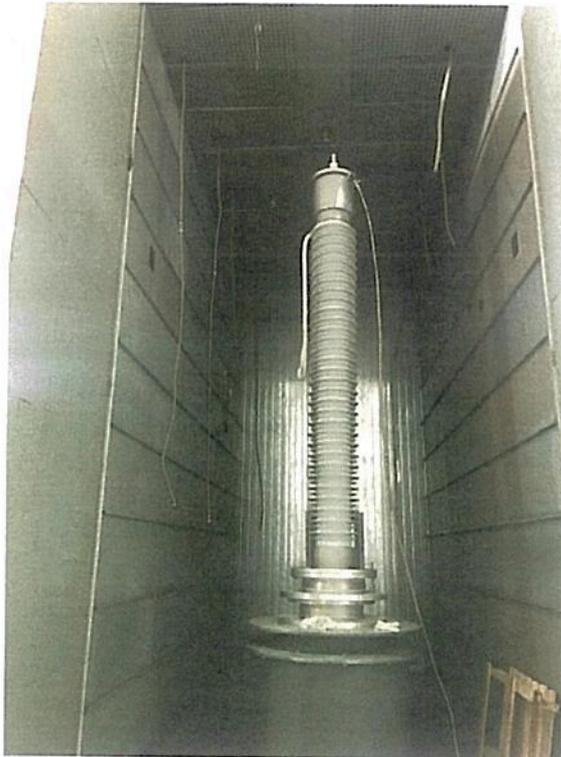
充液体、充混合物以及液体绝缘套管的密封试验(型式) Tightness Test on Liquid-filled, Compound-filled and Liquid-insulated Bushings (Type Test)

试验日期/Date: 2017-03-13

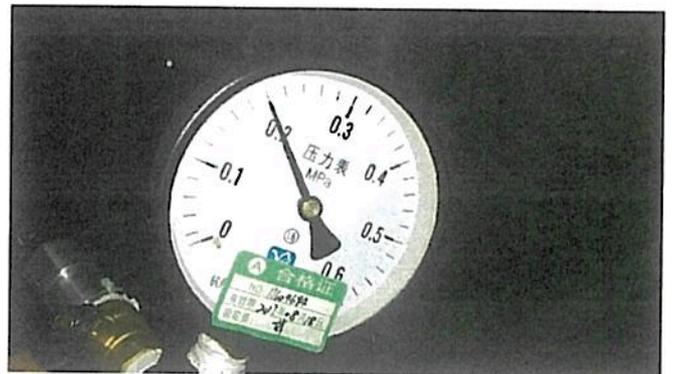
样品编号 Specimen No.	施加压力值 The pressure value MPa	持续时间 Duration h	试验温度 Test temperature °C	样品状况 Result
1	0.20	12	75	无泄漏、未损坏 No leakage, no damage
规定值 Specifications	0.20	12	75	不应泄漏或损坏 No leakage or damage

符合检验依据规定，合格。

The result met test standard and the technical specifications.



试验整体



密封表压

尺寸检查 (型式) Dimensional Check (Type Test)

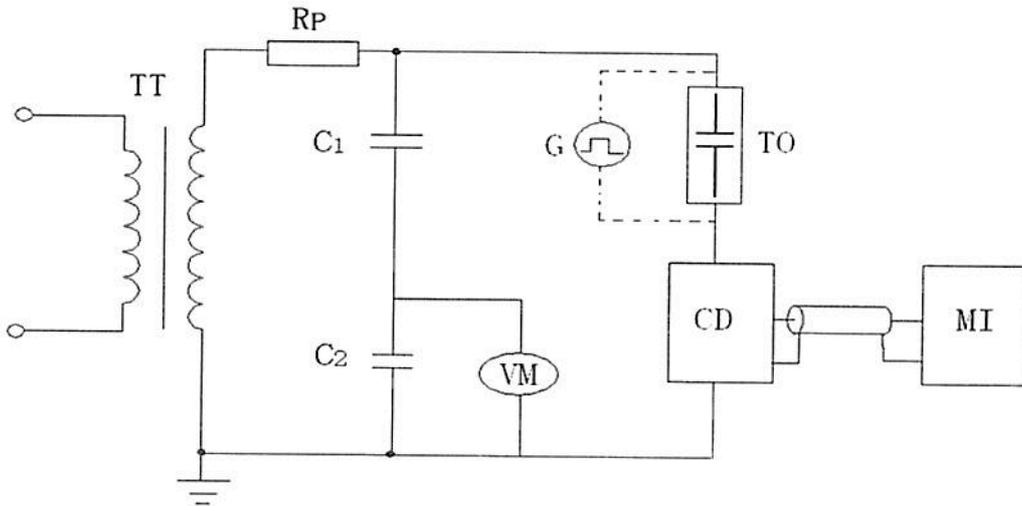
试验日期/Date: 2017-03-08

试品外观表面无缺陷, 套管尺寸符合相关图纸, 套管整体长度为4402mm, 满足 (4400±10) mm; 油中端长度为1227mm, 满足 (1227±5) mm; 爬电距离为7901mm, 满足 > 7812mm。符合检验依据规定, 合格。

The outside surface has no vice, the dimension of bushing conforms to the drawing. the total length is 4402mm, met the requirement of (4400±10) mm. the length of oil side is 1227mm, met the requirement of (1227±5) mm. creepage distance is 7901mm. met the requirement of more than 7812mm. The result met test standard and the technical specifications.

局部放电测量(型式) Partial Discharge Measurement (Type Test)

局部放电测量线路图 (AC)
(Circuit diagram of partial discharge measurement, AC)



TT---工频试验变压器(PF transformer)

R_p ---保护电阻(Protection resistance)

C_1 ---高压臂电容(H.V arm capacitor)

C_2 ---低压臂电容(L.V arm capacitor)

CD---耦合装置(Coupling device)

TO---试品(Test object)

VM---数字电压表(Voltmeter)

G---方波校准器(Step voltage generator)

MI---局放测量仪(Measuring instrument)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
550/2200	50	2	500	2.12

扩展不确定度(Expanded uncertainty): $U=2.4pC$, ($k=2$).

局部放电测量(型式) Partial Discharge Measurement (Type Test)

试验日期/Date: 2017-03-13

t= 11.5℃, RH= 71%, P= 102.0kPa

试验前采用5pC校准源对回路进行校准, 背景噪音为 ≤ 2.5pC.

Step voltage generator: 5pC. Background noise ≤ 2.5pC.

预加电压为505kV, 持续1min, 在252kV、220kV和160kV的测量电压下进行局部放电测量, 要求的局部放电量252kV、220kV和160kV下最大值为5pC.

The applied voltage is 505kV for 1 min. Partial discharge is measured on 252kV, 220kV and 160kV. and allowed partial discharge is 5pC max..

样品编号 Specimen No.	实施电压 Voltage applied kV	持续时间 Duration min	局部放电量 Partial discharge pC
1	252.1	5	≤ 3.8
	220.4	5	≤ 3.7
	160.3	5	≤ 3.5

符合检验依据规定, 合格。

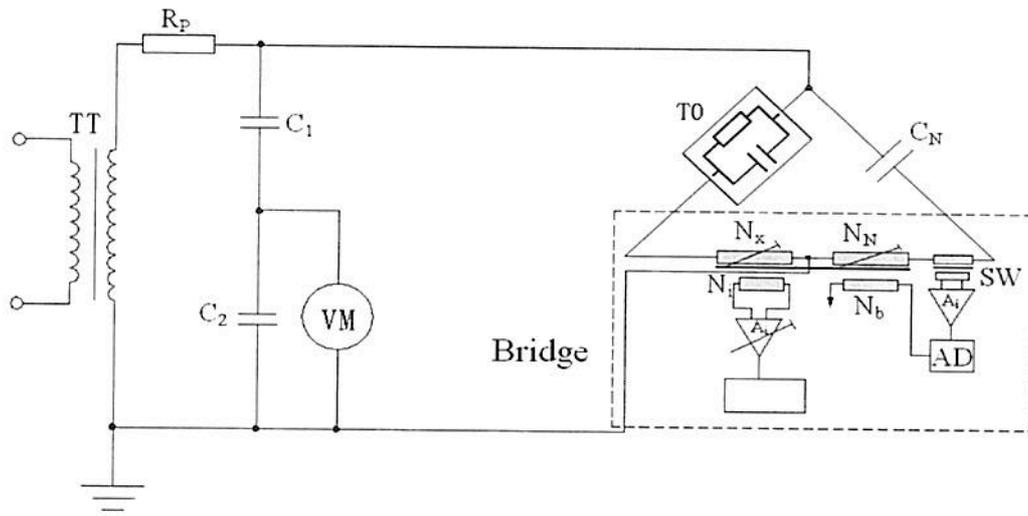
The result met test standard and the technical specifications.



PDZP170066J-013

介质损耗因数和电容量测量(型式) Measurement of Dielectric Dissipation Factor and Capacitance (Type Test)

介质损耗因数和电容量测量线路图
(Circuit diagram of measurement of dielectric dissipation factor and capacitance)



TT---工频试验变压器(PF transformer)

R_p ---保护电阻(Protect resistor)

C_1 ---高压臂电容(H.V arm capacitance)

C_2 ---低压臂电容(L.V arm capacitance)

C_N ---标准电容器(Standard capacitor)

TO---试品(Test object)

VM---数字测量仪(Voltmeter)

Bridge---测量电桥(Bridge)

试验所用设备主要参数

(Main parameters of testing equipment)

U/S(kV/kVA)	f_{TT} (Hz)	R_p (k Ω)	C_1 (pF)	C_2 (μ F)
550/2200	50	2	500	2.12

扩展不确定度(Expanded uncertainty): $U=2.4pC$, ($k=2$).

介质损耗因数和电容量测量(型式) Measurement of Dielectric Dissipation Factor and Capacitance (Type Test)

试验日期/Date: 2017-03-13

 $t = 11.5^{\circ}\text{C}$, $\text{RH} = 71\%$, $P = 102.0\text{kPa}$

试验分别在153kV、252kV下进行介质损耗因数和电容量测量。要求在153kV、252kV电压下 $\tan \delta$ 最大值为0.4%，测量电压从153kV提高至252kV时， $\tan \delta$ 最大允许增值为0.1%，电容量规定值：390pF ~ 410pF。

The dielectric dissipation factor and capacitance are measured on 153kV and 252kV. The allowed $\tan \delta$ is 0.4% on all test voltages. When the test voltage raises from 153kV to 252kV, the increase of $\tan \delta$ must be less than 0.1%. C_x : 390pF ~ 410pF.

 标准电容 $C_N = 50.12\text{pF}$.

 Standard capacitor $C_N = 50.12\text{pF}$.

样品编号 Specimen No.	测量电压 Voltage applied kV		Cx pF	tanδ %	Δ tanδ %
	应施电压 Expected voltage	实施电压 Measured voltage			
1	153	153.3	399.7	0.317	/
	252	252.5	399.7	0.315	0.002

符合检验依据规定，合格。

The result met test standard and the technical specifications.



DLCZP170066J-007

附录 Appendix

1 确认的试品图纸/Drawing

OSM.132.323.1

2 试品照片/ Photographs

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