



中国认可
国际互认
检测
TESTING
CNAS L0223

XIHARI

No. 170672J

检 验 报 告

Test Report

试品型号:
TYPE

800kV

试品名称:
DESIGNATION

气体绝缘复合套管
Gas Insulation Composite Bushing

委托单位:
CLIENT

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

厦门ABB高压开关有限公司

ABB High Voltage Switchgear (Xiamen) Co., Ltd.

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.

检验类别:
TEST CLASSIFICATION

Type Tests

西安高压电器研究院有限责任公司

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



注意事项 REMARK

- 1、检验报告无“检验报告专用章”及封印无效。The test report will be invalid without the “Special stamp for test report” or the seal.
- 2、仅下述情况不需要本实验室的书面许可：完整的复制本报告；或同时复制结论页及概述页。While without the laboratory permission in writing form, it's only allowed to completely copy this report; or copy these pages--the test conclusion pages and summary pages in the same time.
- 3、检验报告无编写、校核、批准人签字无效。The test report will be invalid without the original signature of edit by, checked by and approval by.
- 4、检验报告涂改无效。The test report will be invalid with alter of any character or data.
- 5、对检验报告若有异议，应于收到报告之日起二十五天内向本实验室提出。Any dissensions to this test report should be formally submitted to the laboratory within 25 days from the receiving date.
- 6、本检验报告仅适用于被试品，任何采用相同设计的同型号产品与被试品的一致性由制造单位负责。This test report is only for the tested object. It's manufacturer's duty to keep the uniformity of any products of the same type using the same design and the test object.
- 7、本检验报告的产品和相关内容可能涉及专利，本实验室不承担识别这些专利以及由此引起的任何责任。Tested object, report and relevant contents may relate to patent. The laboratory is not responsible for identifying these patents and any others.
- 8、本检验报告封面、目录、概述及检验结论页面为防伪页。The page ‘cover’, ‘contents’, ‘summary’ and ‘test conclusion’ contain the anti-fake label.

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

目录 Contents

内 容/Contents	页 次/Page
封面/Front cover	
目录/Contents	1
概述/Summary	2
检验结论/Test conclusion	3-4
局部放电测量 Partial Discharge Measurement	5-6, 34-35
工频湿耐受电压试验 Wet power-frequency voltage withstand test	7-8
雷电冲击干耐受电压试验 Dry lightning impulse voltage withstand test	9-12
操作冲击湿耐受电压试验 Wet switching impulse withstand voltage test	13-15
电磁兼容试验 (EMC) Electromagnetic compatibility test	16-18
温升试验 Temperature rise test	19-22
热短时电流耐受试验 Verification of thermal short-time current withstand	23
悬臂负荷耐受试验 Cantilever load withstand test	24-25
工频干耐受电压试验 Dry Power-frequency Voltage Withstand Test	26-27
套管的内压力试验 Internal Pressure Test	28, 32
套管的密封试验 Tightness Test	29-30
外观检查和尺寸检查 Visual inspection and dimensional check	31
尺寸检查 Verification of the dimensions	33
附录 Appendix	36-37

XIHARI

检验报告 Test Report

No. 170672J

Page 2 of 37

概述 Summary

试品型号及名称		800kV 气体绝缘复合套管	
Test object		800kV Gas Insulation Composite Bushing	
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	
	名称 Name	厦门ABB高压开关有限公司 ABB High Voltage Switchgear (Xiamen) Co., Ltd.	
	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	800	
	额定电流/Nominal current A	5000	
	雷电冲击干耐受电压/Dry lightning impulse withstand voltage kV	2400	
	操作冲击湿耐受电压/Wet switching impulse withstand voltage kV	1640	
	工频耐受电压 (干/湿) /Power-frequency withstand Voltage (Dry/Wet) kV	1005/1005	
	额定频率/Rated frequency Hz	50	
	长度/Length mm	8100	
	爬电距离/Creepage distance mm	29760	
悬臂弯曲负荷/Bending load N		8000	
委托单位提供的技术资料 The tested object is guaranteed by the manufacturer		SM/QJ6110-A 800kV气体绝缘复合套管型式试验大纲/ 800kV Gas Insulation Composite Bushing Type Testing Schedule. 17SM310303.1 800kV气体绝缘复合套管产品图样/ 800kV Gas Insulation Composite Bushing Drawing.	
委托单位声明 Note			
委试方代表 Representation of client		王亮 Wang Liang	
试品到达日期 Reception date		/	
试验日期 Date of tests		起 From 2017-10-24 止 To 2017-10-30	
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.
厦门ABB高压开关有限公司
ABB High Voltage Switchgear (Xiamen) Co., Ltd.

试品型号及名称: 800kV
气体绝缘复合套管
800kV
Test object: Gas Insulation Composite Bushing

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 :

型式试验/Type test: 局部放电测量
Measurement of partial discharge quantity
工频湿耐受电压试验
Wet power-frequency voltage withstand 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
工频湿耐受电压试验
Wet power-frequency voltage withstand test
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
套管的内压力试验
Internal Pressure Test
尺寸检查
Verification of the dimensions
局部放电测量
Measurement of partial discharge quantity

检验结论 Test Conclusion

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: 刘子新

日期 Date: 2017-11-17

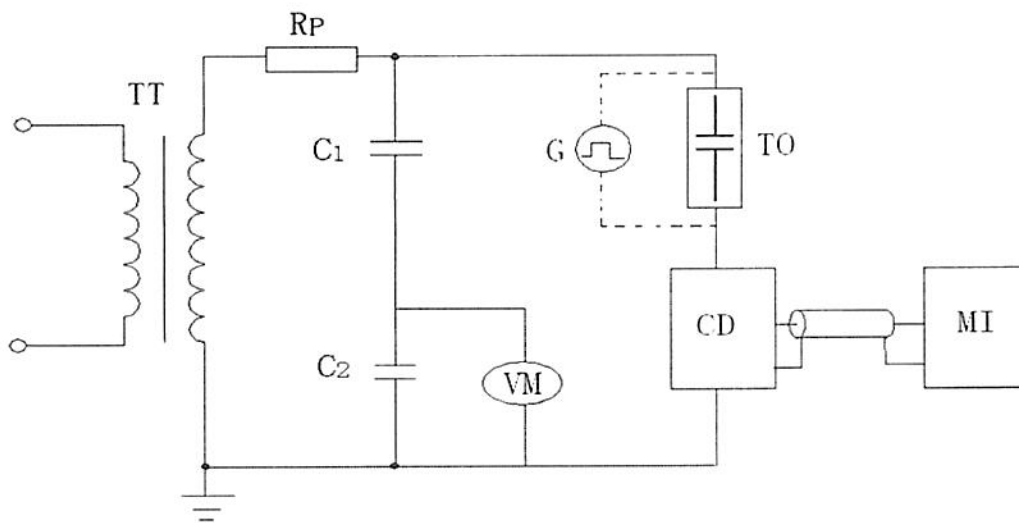
校核 Checked by: 何远平

日期 Date: 2017-11-17

批准 Approved by: 2017-11-20

日期 Date: 2017-11-20



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)

Rp---保护电阻(Protection resistance)

C₁---高压臂电容(H.V arm capacitance)C₂---低压臂电容(L.V arm capacitance)

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 (kΩ)	C ₁ (pF)	C ₂ (μF)
1200/4800	50	8	500	5.0

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

XIHARI

检验报告 Test Report

No. 170672J

Page 6 of 37

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

试验日期/Date: 2017-10-24

 $t = 20.9^{\circ}\text{C}$, $\text{RH} = 59\%$, $P = 101.9\text{kPa}$ 试验前采用10pC校准源对回路进行校准, 背景噪音为 $\leq 2.1\text{pC}$ 。Step voltage generator: 10pC. Background noise $\leq 2.1\text{pC}$.

预加电压为1005kV, 持续1min, 在693kV和555kV的测量电压下进行局部放电测量, 要求的局部放电量693kV下最大值为10pC, 要求的局部放电量555kV下最大值为5pC。

The applied voltage is 1005kV for 1 min. Partial discharge is measured on 693kV and 555kV. and allowed partial discharge is 10pC max. under 693kV. and allowed partial discharge is 5pC max. under 555kV.

套管充以0.35MPa压力。

The pressure of SF_6 is 0.35MPa.

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	693.7	5	≤ 4.7
	556.2	5	≤ 2.6

符合检验依据规定, 合格。

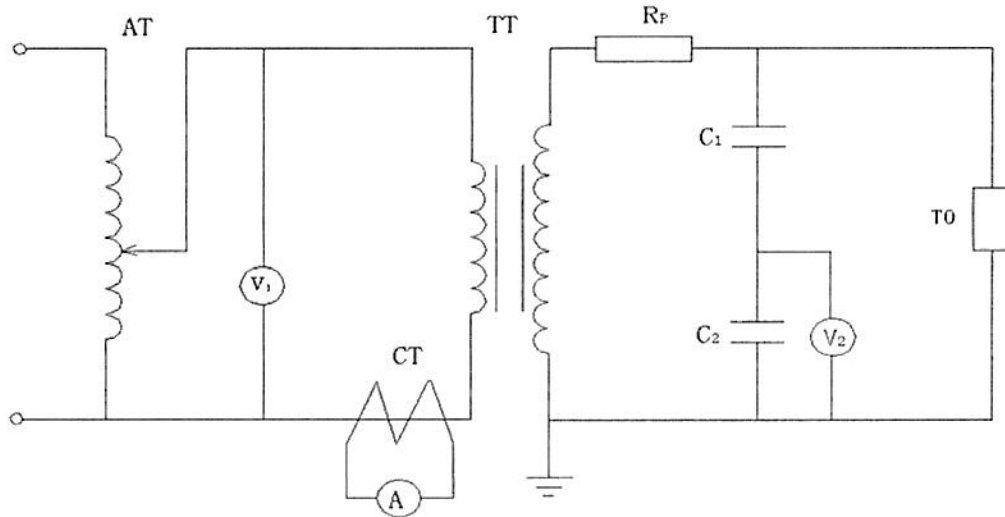
The result met test standard and the technical specifications.



PDZP170672J-001

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)

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)
1200/4800	50	8	500	5.0
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: 2017-10-25

 $t=21.2^{\circ}\text{C}$, $\text{RH}=54\%$, $P=101.7\text{kPa}$

雨水温度 $t_{\text{water}}=20.3^{\circ}\text{C}$, 实测雨水电导率/Conductivity of water $\sigma=101.2\mu\text{S/cm}$

降雨量/Precipitation rate: 水平分量为/Horizontal component is 1.4mm/min , 垂直分量为/vertical component is 1.6mm/min .

规定值/Specifications: 1005kV .

套管充以 0.35MPa 压力。

The pressure of SF_6 is 0.35MPa .

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	1005	1006	72	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。

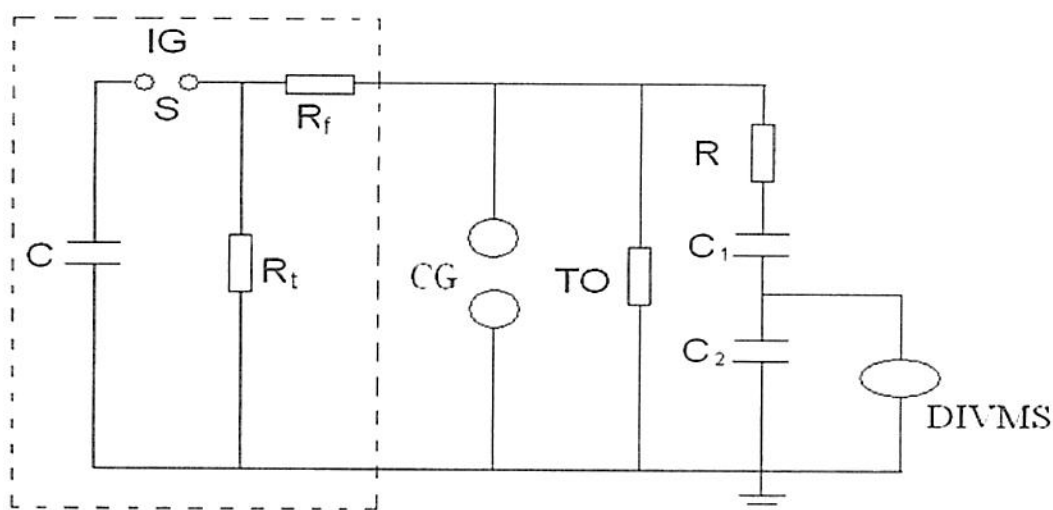
The result met test standard and the technical specifications.



PFVZP170672J -001

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)

CG——截波球隙(Chopping 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)	$R_f(\Omega)$	$R_t(\Omega)$	C_1 (pF)	$C_2(\mu$ F)
4800	0.0417	322	1560	479.39	2.07
扩展不确定度(Expanded uncertainty): $U < 2\%$, ($k=2$).					

XIHARI

检验报告 Test Report

No. 170672J

Page 10 of 37

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: 2017-10-25

 $t = 21.2^{\circ}\text{C}$, RH = 54%, P = 101.7kPa

规定值/Specifications: 2400kV.

套管充以0.35MPa压力。

The pressure of SF₆ is 0.35MPa.

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	正极性全波 Positive polarity full wave	2380 ~ 2418	15	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	正极性全波 Positive polarity full wave	2400	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	2418	1	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性全波 Negative polarity full wave	2400	1	不应闪络或击穿 No flashover or No puncture
1	负极性截波 Negative polarity chopped wave	2597 ~ 2658	5	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性截波 Negative polarity chopped wave	2640	5	不应闪络或击穿 No flashover or No puncture
1	负极性全波 Negative polarity full wave	2388 ~ 2421	14	未闪络、未击穿 No flashover, No puncture
规定值 Specifications	负极性全波 Negative polarity full wave	2400	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.

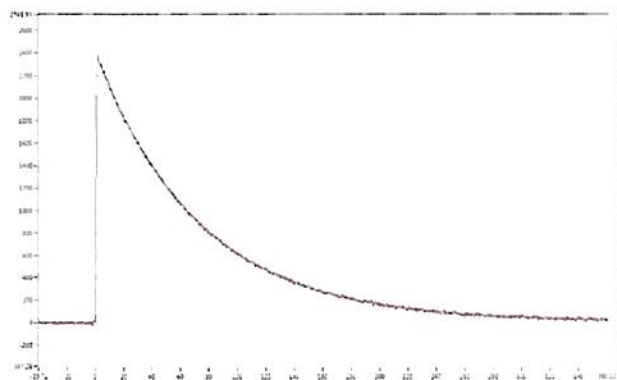
雷电冲击干耐受电压试验 (型式)
Dry Lightning Impulse Voltage Withstand Test (Type Test)



IPVZP170672J-001

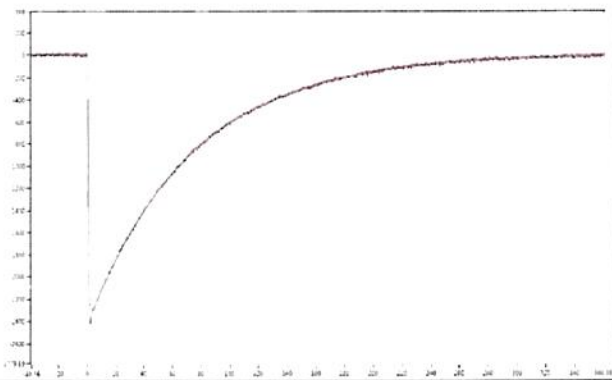
雷电冲击干耐受电压试验 (型式) Dry Lightning Impulse Voltage Withstand Test (Type Test)

典型示波图/Typical oscillogram



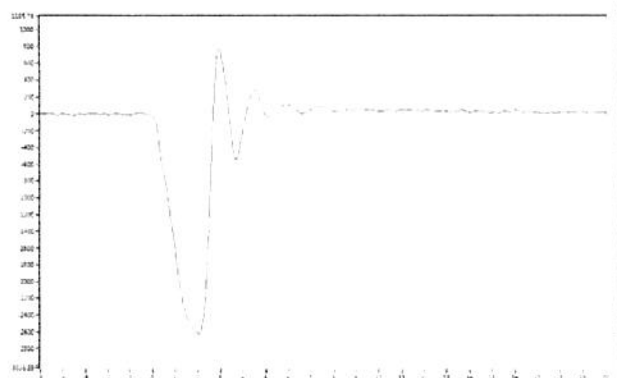
0659
Upk=2380.52 kV,T1=1.423 μs,T2=51.90 μs

IPVBT170672J-001



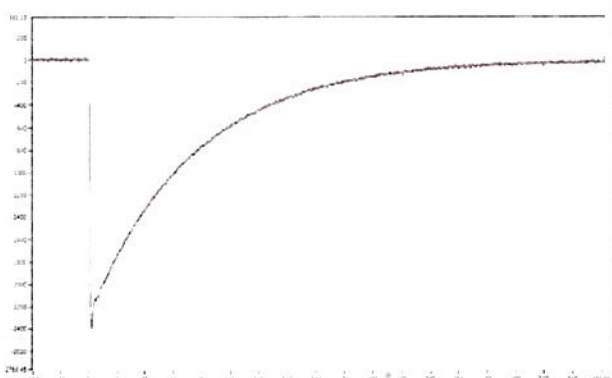
0674
Upk=2418.42 kV,T1=1.426 μs,T2=50.80 μs

IPVBT170672J-002



0676
Upk=2658.51 kV,T1=1.53 μs,Tc=2.08 μs,Oz=0.31

IPVBT170672J-003

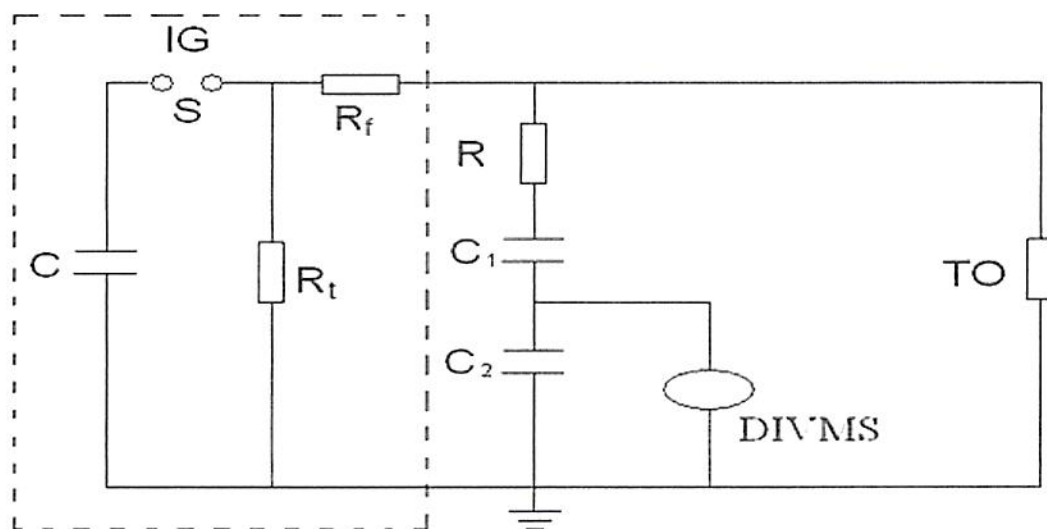


0680
Upk=2404.53 kV,T1=1.527 μs,T2=47.29 μs

IPVBT170672J-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)	$C(\mu F)$	$R_f(k\Omega)$	$R_t(k\Omega)$	$C_1(pF)$	$C_2(\mu F)$
3000	0.0417	48	134.4	479.39	2.07
扩展不确定度(Expanded uncertainty): $U < 2\%$, ($k=2$)。					

XIHARI

检验报告 Test Report

No. 170672J

Page 14 of 37

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: 2017-10-25

干球温度 $t=21.2^{\circ}\text{C}$, 相对湿度 $\text{RH}=54\%$, 大气压 $P=101.7\text{kPa}$ 雨水温度 $t_{\text{water}}=20.3^{\circ}\text{C}$, 实测雨水电导率/Conductivity of water $\sigma=101.2\mu\text{S/cm}$ 降雨量/Precipitation rate: 水平分量为/Horizontal component is 1.4mm/min , 垂直分量为/vertical component is 1.6mm/min .规定值/Specifications: 1640kV .套管充以 0.35MPa 压力。The pressure of SF_6 is 0.35MPa .

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	1633 ~ 1648	均未闪络 No flashover
	负极性15次 Negative polarity 15 shots	1652 ~ 1657	均未闪络 No flashover
规定值 Specifications	15	1640	闪络次数 ≤ 2 Flashover less than 2 shots

符合检验依据规定, 合格。

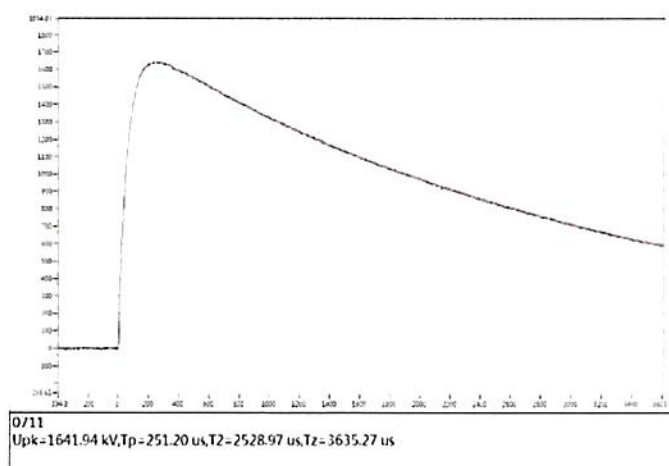
The result met test standard and the technical specifications.



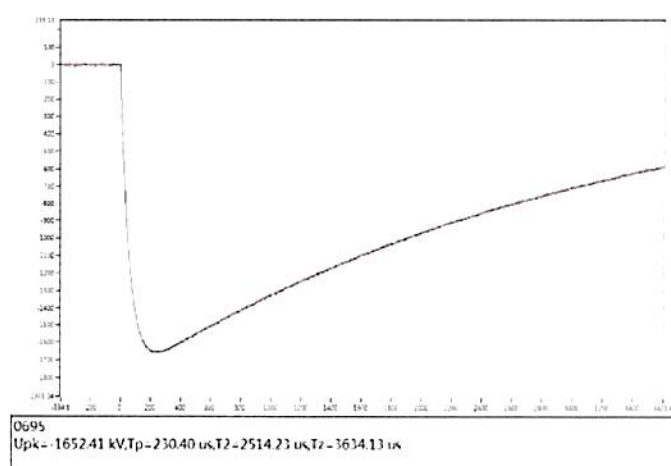
IPVZP170672J-002

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

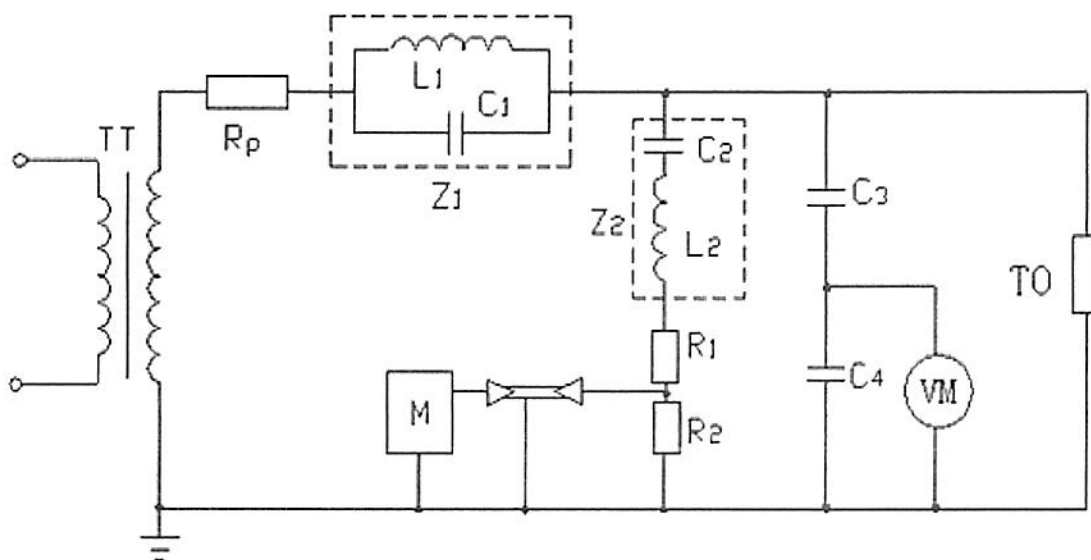
典型示波图/Typical oscillogram



IPVBT170672J-005



IPVBT170672J-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)
1200/4800	50	8	500	5.00
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: 2017-10-25

 $t=21.2^{\circ}\text{C}$, $\text{RH}=54\%$, $P=101.7\text{kPa}$

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22.6dB, 背景噪音为31.3dB。

Test frequency: 1.0MHz. Using 60dB signal source to determine attenuation coefficient, attenuation coefficient was 22.6dB. Background noise level was 31.3dB.

套管充以0.35MPa压力。

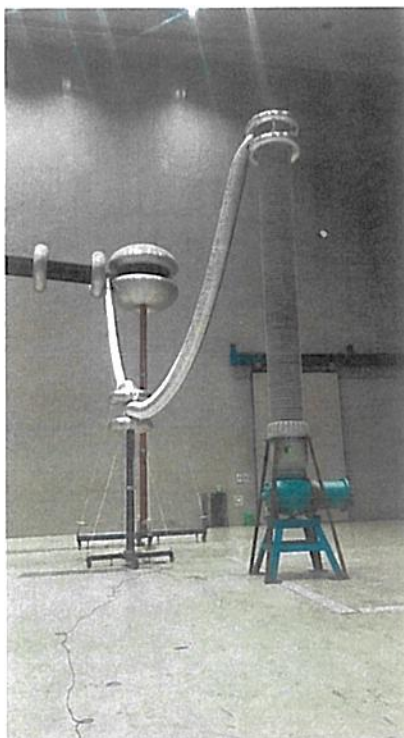
The pressure of SF_6 is 0.35MPa.

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.

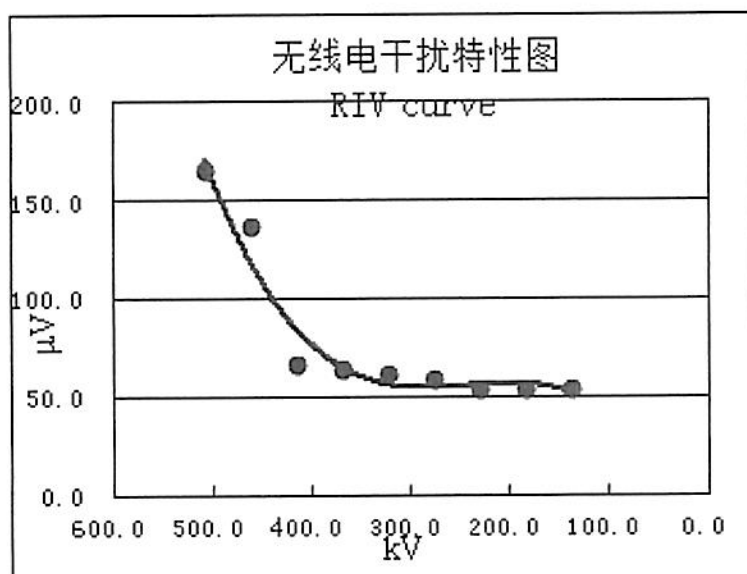
样品编号 Specimen No.	施加电压 Voltage applied kV	测量结果 Result	
		dB	μV
1	509.2	44.4	166.0
规定值 Specifications	508	/	≤ 500

符合检验依据规定, 合格。



RIVZP170672J-001

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



RIVCV170672J-001

XIHARI

检 验 报 告 Test Report

No. 170672J

Page 19 of 37

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

试验日期/Date: 2017-10-27

1、温升试验/Temperature Rise Test

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	试验连接母线/Test connection bus	86.6	/
2	接线端子/The connecting terminal	39.3	≤50
3	导体上部/The top of conductor	28.1	/
4	导体中部/The middle of conductor	49.1	/
5	导体下部/The bottom of conductor	38.4	/
6	螺栓连接处/Bolt connection	33.2	≤75
7	螺栓连接处/Bolt connection	27.8	≤75
8	外壳/The shell	0.7	≤30
9	试验连接母线/Test connection bus	8.8	≤30
10	套管绝缘外套/Bushing insulator wrap	13.9	≤30
11	法兰/The flange	12.8	≤30
12	试验连接母线/Test connection bus	55.5	/
13	SF ₆	16.1	/
14	接线端子/The connecting terminal	44.9	≤65

环境温度为18.9℃，施加电流5500A。

Ambient air temperature: 18.9℃. The current is 5500A.

套管充以0.35MPa压力。

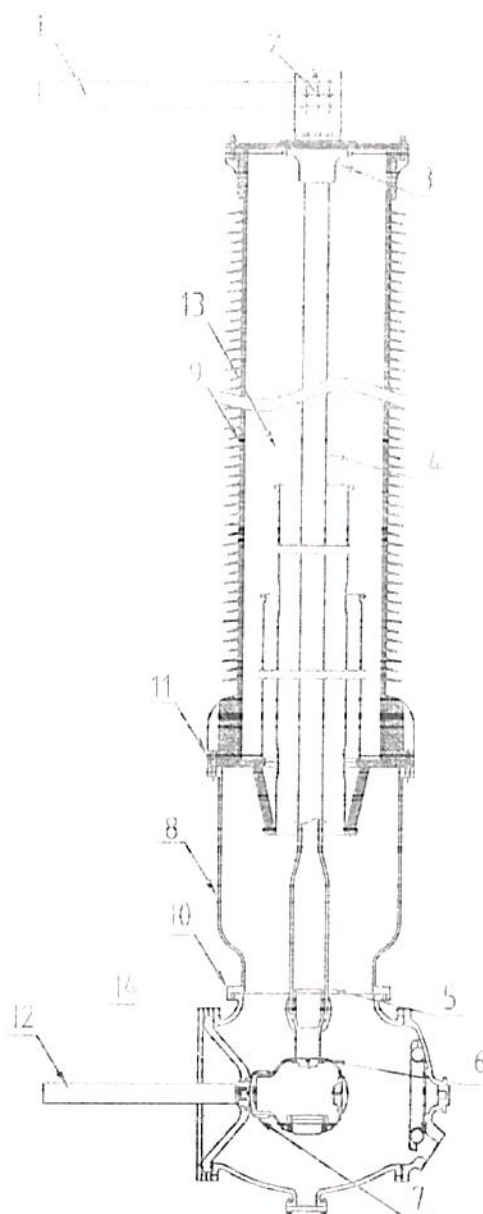
The pressure of SF₆ is 0.35MPa.

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)

XIHARI

检验报告 Test Report

No. 160584J

Page 21 of 42

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

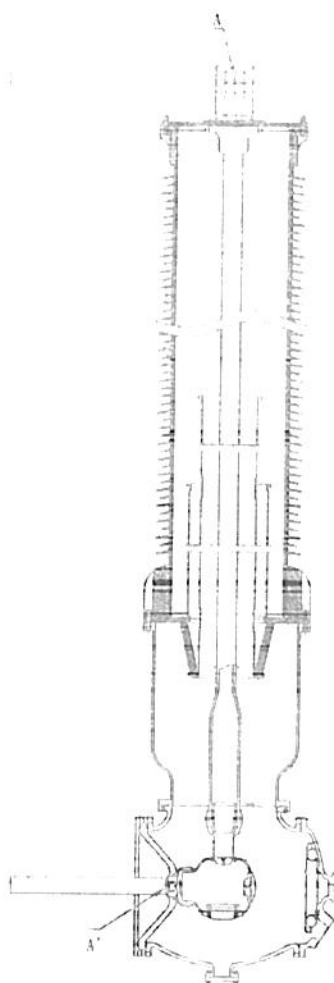
试验日期/Date: 2017-10-27 ~ 2017-10-28

2、主回路电阻测量/Measurement of The Resistance of Circuit

样品编号 No.	温升前回路电阻 Resistance of circuits (before the temperature- rise test) $\mu\Omega$	温升后回路电阻 Resistance of circuits(after the temperature-rise test) $\mu\Omega$	温升前后回路电阻差值 Max.difference %
1	51.1	55.0	7.6
规定值 Specifications	/	/	≤ 20

符合检验依据规定, 合格。

The result met test standard and the technical specifications.



回路电阻测量示意图

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



温升试验整体 Photograph 1



温升试验表压 Photograph 2

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 —铝为/for aluminum is $1.8 (\text{K/s})/(\text{kA}/\text{cm}^2)^2$;

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 .

$$S_f = 59.07 \text{ cm}^2;$$

$$S_e = 98.91 \text{ cm}^2;$$

$$\theta_0 (\text{max}) = 115^\circ\text{C};$$

$$I_{th} = 100 \text{ kA};$$

$$t_{th} = 1 \text{ s};$$

$$\theta_f = 115 + 1.8 \times 100^2 \times 1 \div (59.07 \times 98.91) = 118.08 (^\circ\text{C});$$

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: 2017-10-28

试验时套管内部充0.9MPa（表压）的SF₆气体。
The pressure of SF₆ is 0.9MPa.

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8000N 调整为19.6kN。

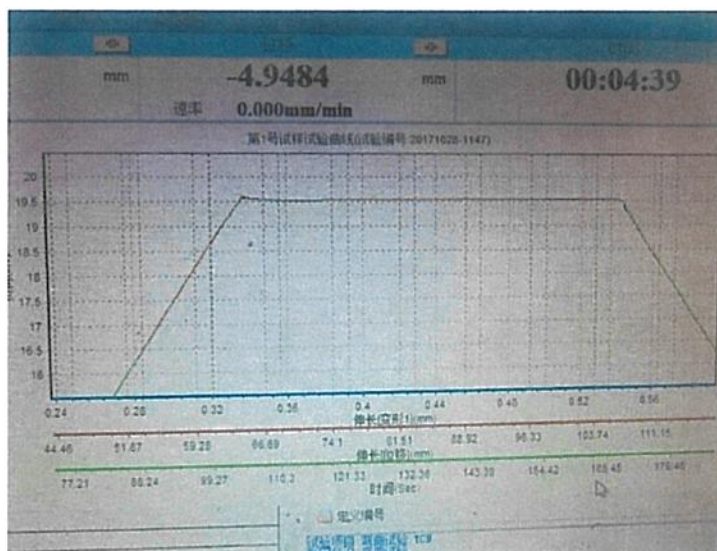
样品编号 No.	施加负荷 Load applied kN	持续时间 Duration s	样品状况 Result
1	19.6	60	未损坏 No damage
规定值 Specifications	19.6	60	不应损坏 No damage

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 Photograph 1

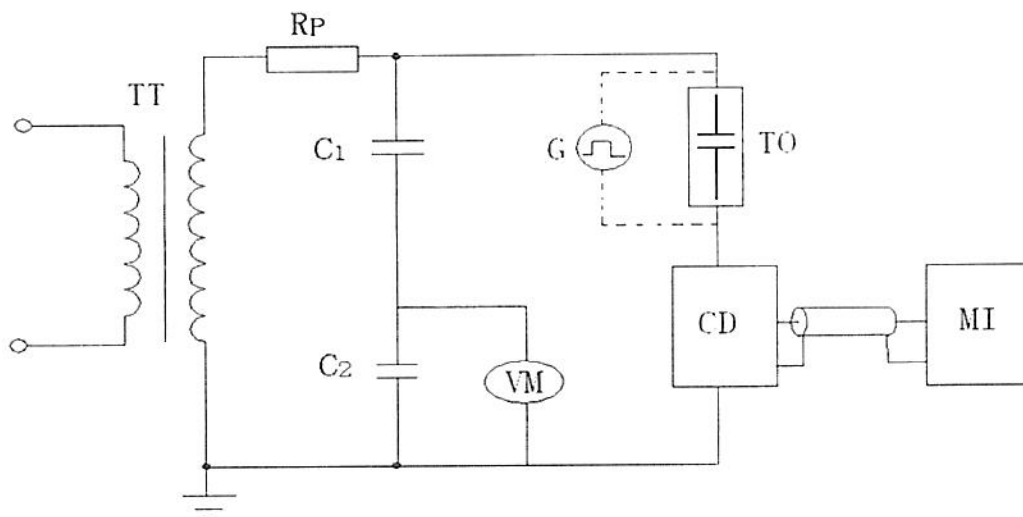
悬臂负荷耐受试验 (型式) Cantilever Load Withstand Test (Type Test)



施加负荷曲线图 Photograph 2



表压 Photograph 3

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)

TT---工频试验变压器(PF transformer)

Rp---保护电阻(Protection resistance)

C₁---高压臂电容(H.V arm capacitance)C₂---低压臂电容(L.V arm capacitance)

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 (kΩ)	C ₁ (pF)	C ₂ (μF)
1200/4800	50	8	500	5.0
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: 2017-10-24

t= 20.9℃, RH= 59%, P= 101.9kPa

规定值/Specifications: 1005kV.

套管充以0.35MPa压力。

The pressure of SF₆ is 0.35MPa.

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	1005	1005	72	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.



PDZP170672J-001

XIHARI

检验报告 Test Report

No. 170672J

Page 28 of 37

套管的内压力试验（悬臂负荷耐受试验后） Internal Pressure Test (After Cantilever Load Withstand Test)

试验日期/Date: 2017-10-28

样品编号 No.	施加压力 Pressure applied MPa	持续时间 Duration min	样品状况 Result
1	1.2	15	未损坏 No damage
规定值 Specifications	1.2	15	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.



内压力试验后试品照片 Photograph 1



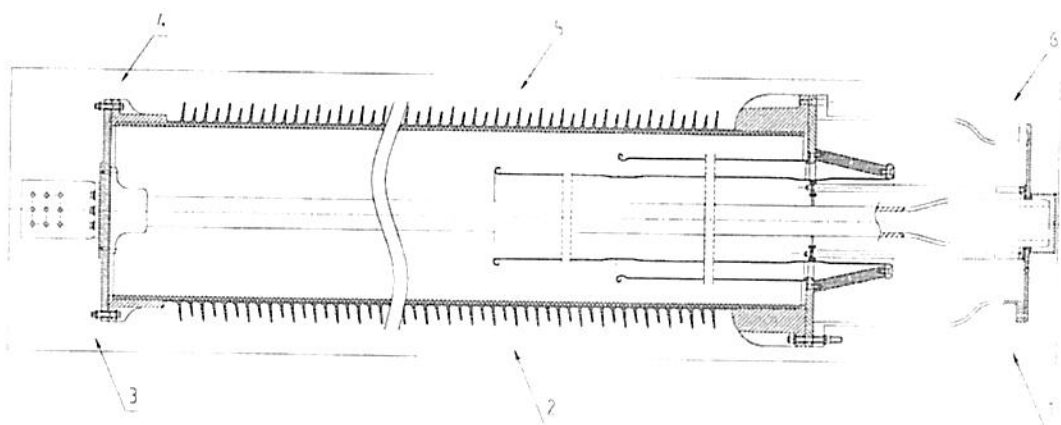
内压力试验表压 Photograph 2

套管的密封试验（悬臂负荷耐受试验后） Tightness Test (After Cantilever Load Withstand Test)

试验日期/Date: 2017-10-28 ~ 2017-10-29

样品编号 No.	施加SF ₆ 压力值 The pressure value of SF ₆ gas MPa	持续时间 Duration h	年漏气率 Leakage rate %/year
1	0.8	24	0.0053
规定值 Specifications	0.8	24	≤ 0.1

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



密封试验图 Photograph 1

XIHARI

检 验 报 告
Test Report

No. 170672J

Page 30 of 37

套管的密封试验（悬臂负荷耐受试验后）
Tightness Test (After Cantilever Load Withstand Test)



密封试验试品状况照片 Photograph 2



密封试验表压 Photograph 2

XIHARI

检 验 报 告
Test Report

No. 170672J

Page 31 of 37

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: 2017-10-30

试品外观表面无缺陷，套管尺寸符合相关图纸规定，套管整体长度为8103mm，干弧距离为7380mm，爬电距离为29790mm。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 8103mm, the arc distance is 7380mm. creepage distance is 29790mm. The result met test standard and the technical specifications.

XIHARI

检 验 报 告
Test Report

No. 170672J

Page 32 of 37

套管的内压力试验(型式)
Internal Pressure Test (Type Test)

符合检验依据，详见本中心WJ-047-2007检验报告。

The result met test standard and the technical specifications. Vide WJ-047-2007 Test Report.

XIHARI

检 验 报 告
Test Report

No. 170672J

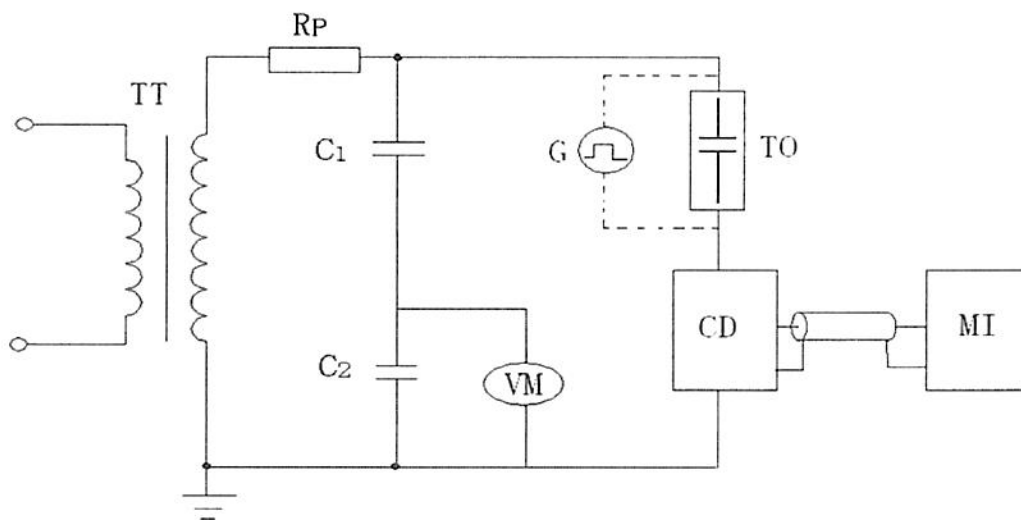
Page 33 of 37

尺寸检查(型式)
Verification of the dimensions (Type Test)

试验日期/Date: 2017-10-30

套管尺寸符合相关图纸规定，套管整体长度为8103mm，干弧距离为7380mm，爬电距离为29790mm。符合检验依据规定，合格。

The dimension of bushing conforms to the drawing. the total length is 8103mm, the arc distance is 7380mm. creepage distance is 29790mm. 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)C₁---高压臂电容(H.V arm capacitance)C₂---低压臂电容(L.V arm capacitance)

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 (kΩ)	C ₁ (pF)	C ₂ (μF)
1200/4800	50	8	500	5.0

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: 2017-10-30

t= 20.4℃, RH= 57%, P= 101.7kPa

试验前采用10pC校准源对回路进行校准, 背景噪音为 ≤2.5pC.

Step voltage generator: 10pC. Background noise ≤ 2.5pC.

预加电压为1005kV, 持续1min, 在693kV和555kV的测量电压下进行局部放电测量, 要求的局部放电量693kV下最大值为10pC, 要求的局部放电量555kV下最大值为5pC.

The applied voltage is 1005kV for 1 min. Partial discharge is measured on 693kV and 555kV. and allowed partial discharge is 10pC max. under 693kV. and allowed partial discharge is 5pC max. under 555kV.

套管充以0.35MPa压力.

The pressure of SF₆ is 0.35MPa.

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	694.6	5	≤ 5.6
	555.8	5	≤ 2.9

符合检验依据规定, 合格。

The result met test standard and the technical specifications.



PDZP170672J-002

XIHARI

检 验 报 告
Test Report

No. 170672J

Page 36 of 37

附录
Appendix

- 1 确认的试品图纸/Drawing
17SM310303.1 (日期/Date: 2017.06.10)
- 2 试品照片/ Photographs
(/)

