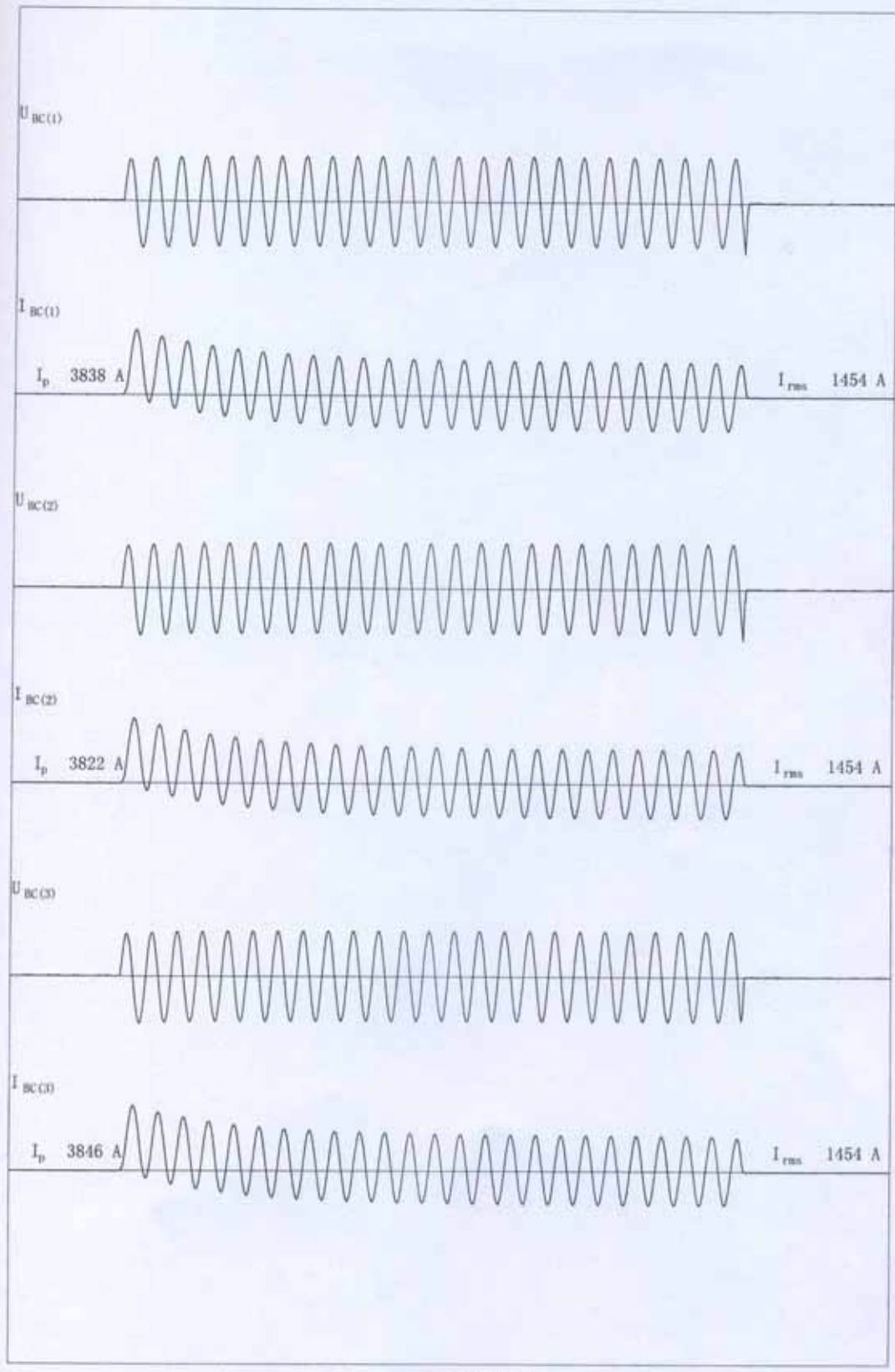


Report.

70555001-TDT 05-51684A

05-06-22

Routine, type and special tests on a dry type power transformer 2000 kVA, manufacturer Hangzhou Qiantang River Electric Group Co., Ltd.

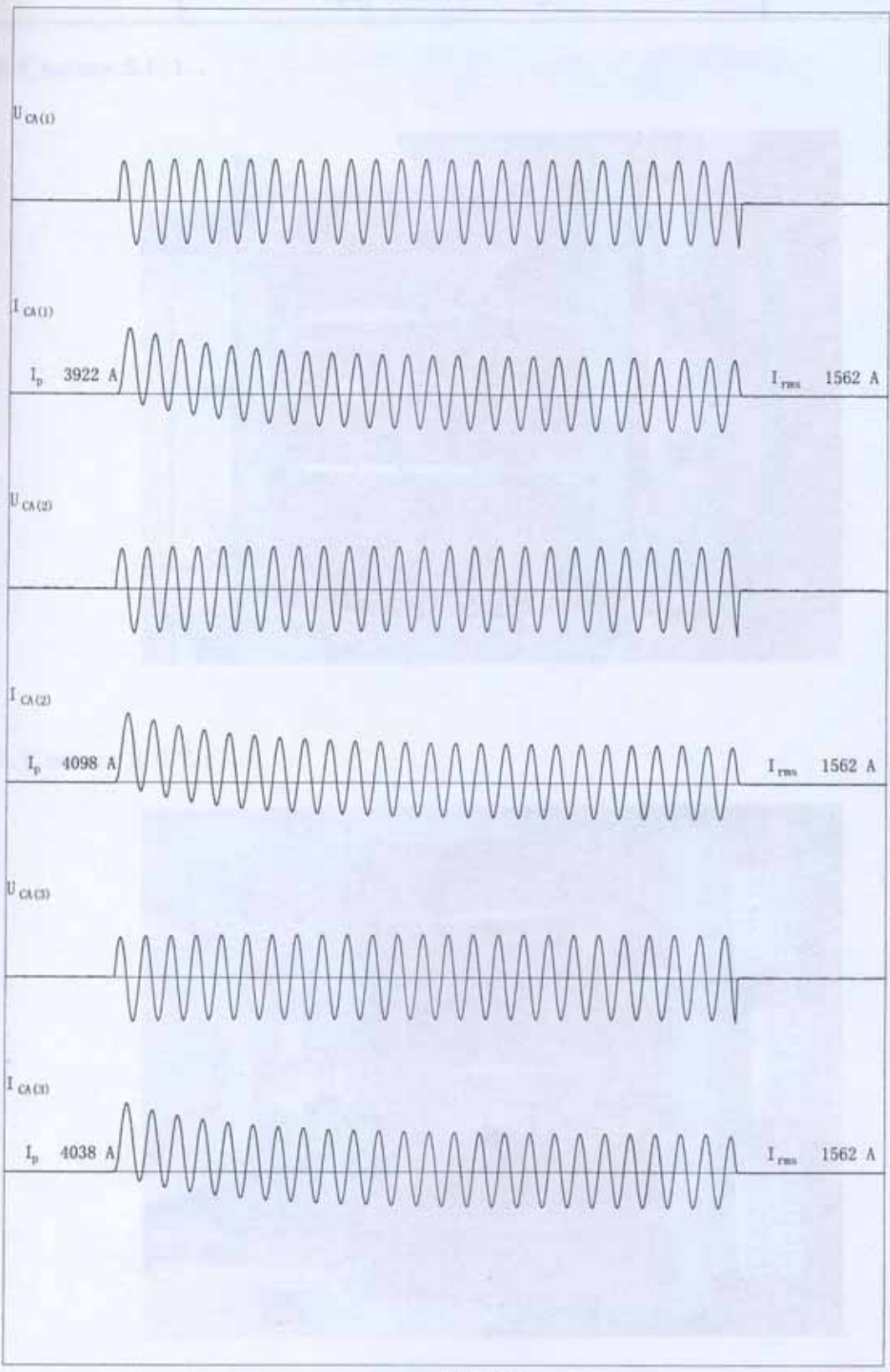


B05096-S02

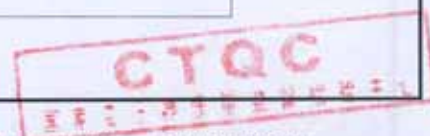


王成松

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| Test Report | China National Transformer Quality Supervision Testing Center | No: CTQC/B-05.096 Total 25 Page 23 |
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B05096-S03



王致松

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| <p>Test Report</p> | <p>China National Transformer Quality Supervision Testing Center</p> | <p>No: CTQC/B-05. 096 Total 25 Page 24</p> |
|--------------------|--|--|

H. V. before S. C. T. :



L. V. before S. C. T. :



CTQC

王成松

| | | |
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| <p>Test Report</p> | <p>China National Transformer Quality Supervision Testing Center</p> | <p>No: CTQC/B-05.096 Total 25 Page 25</p> |
|--------------------|--|---|

H. V. after S. C. T. :



L. V. after S. C. T. :



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Annex 1

Rating plate



RATING PLATE PHOTO

No: CTQC/B-05.096

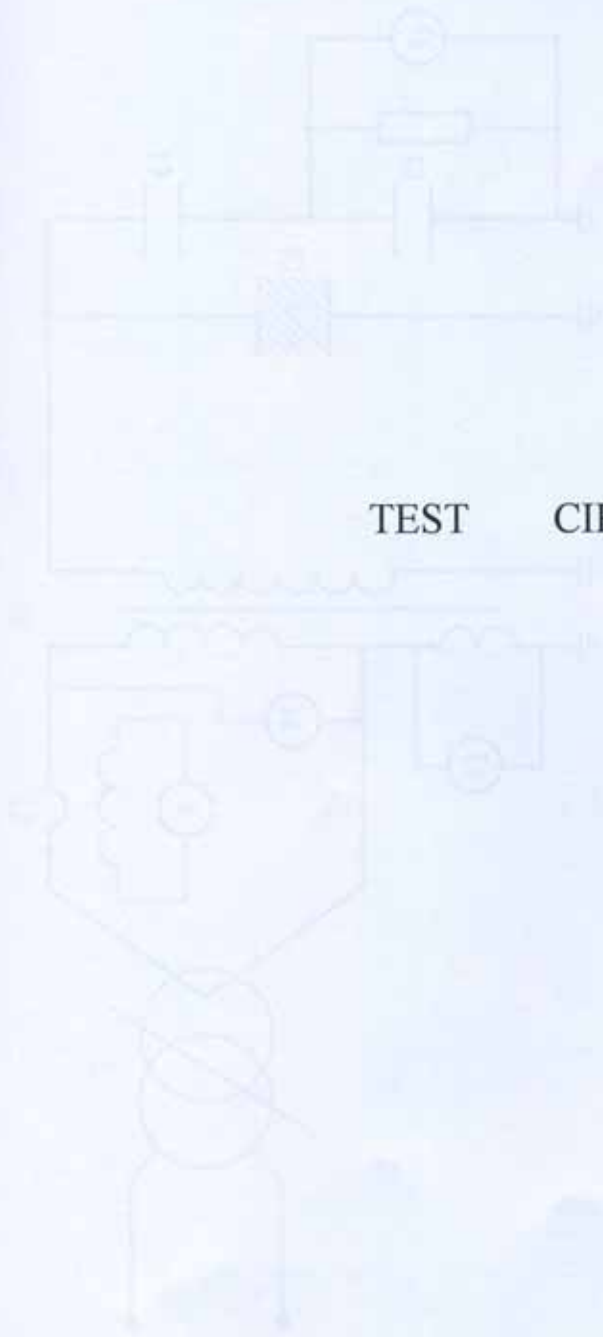
Rating plate:



CTQC

01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20

TEST CIRCUITS

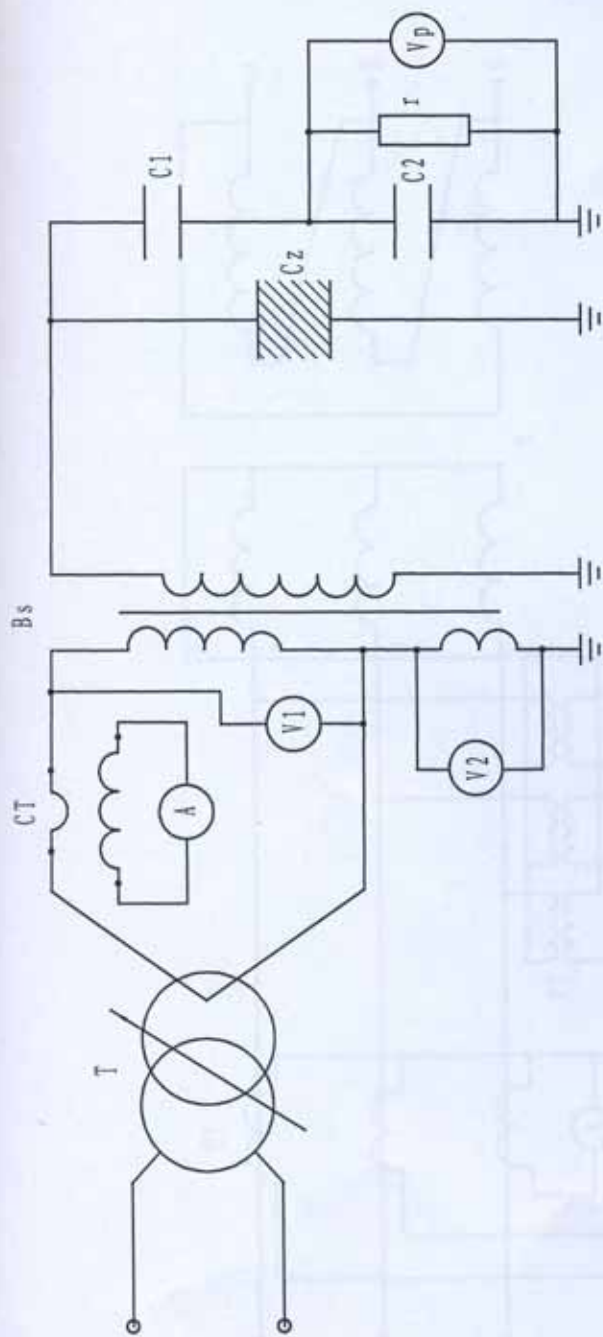


MEASUREMENT

Procedure: Connect the circuit as shown.

- 1. Switch S1 is closed. Measure the primary current I₁ and the primary voltage V₁.
- 2. Switch S2 is closed. Measure the secondary current I₂ and the secondary voltage V₂.
- 3. Switch S2 is opened. Measure the secondary voltage V₂ with the voltmeter.
- 4. Switch S1 is opened. Measure the secondary voltage V₂ with the voltmeter.

ANNEX 2

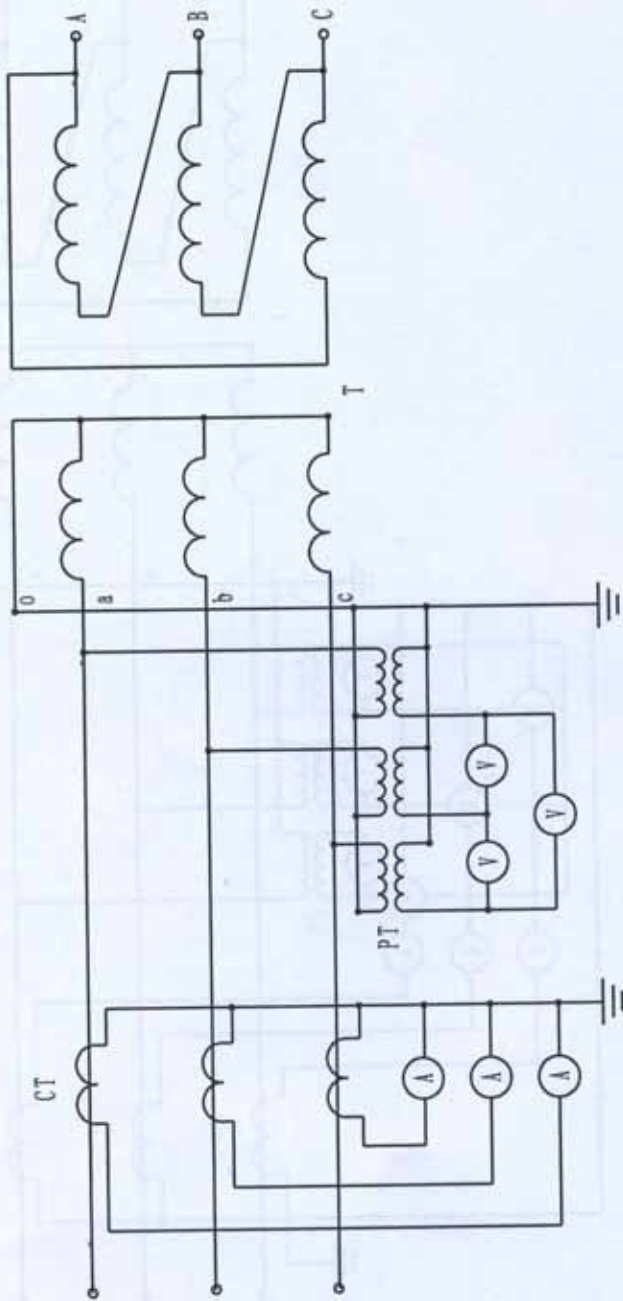


外施耐压试验线路图

Separate-source voltage withstand diagram

- T-调压器 Regulator
- CT-电流互感器 Current transformer
- C1, C2-分压电容 Capacitive divider
- r-放电电阻 Discharge resistance
- A-电流表 Amperemeter
- V1, V2-电压表 Voltmeter
- Cz-试品 Sample
- Vp-峰值电压表 Peak value voltmeter
- Bs-试验变压器 Testing transformer

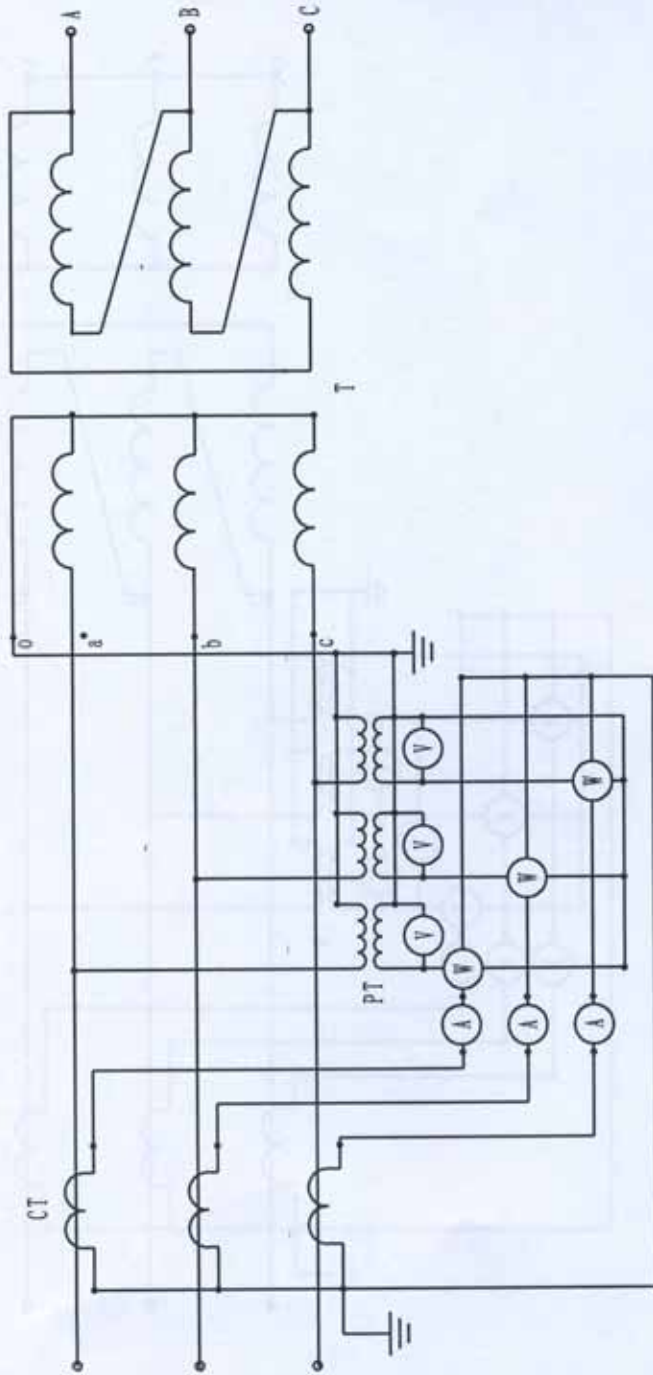




感应耐压试验线路图
Induced overvoltage withstand test circuit

- T-被试变压器 Sample
- CT-电流互感器 Current transformer
- PT-电压互感器 Voltage transformer
- A-电流表 Amperemeter
- V-电压表 Voltmeter



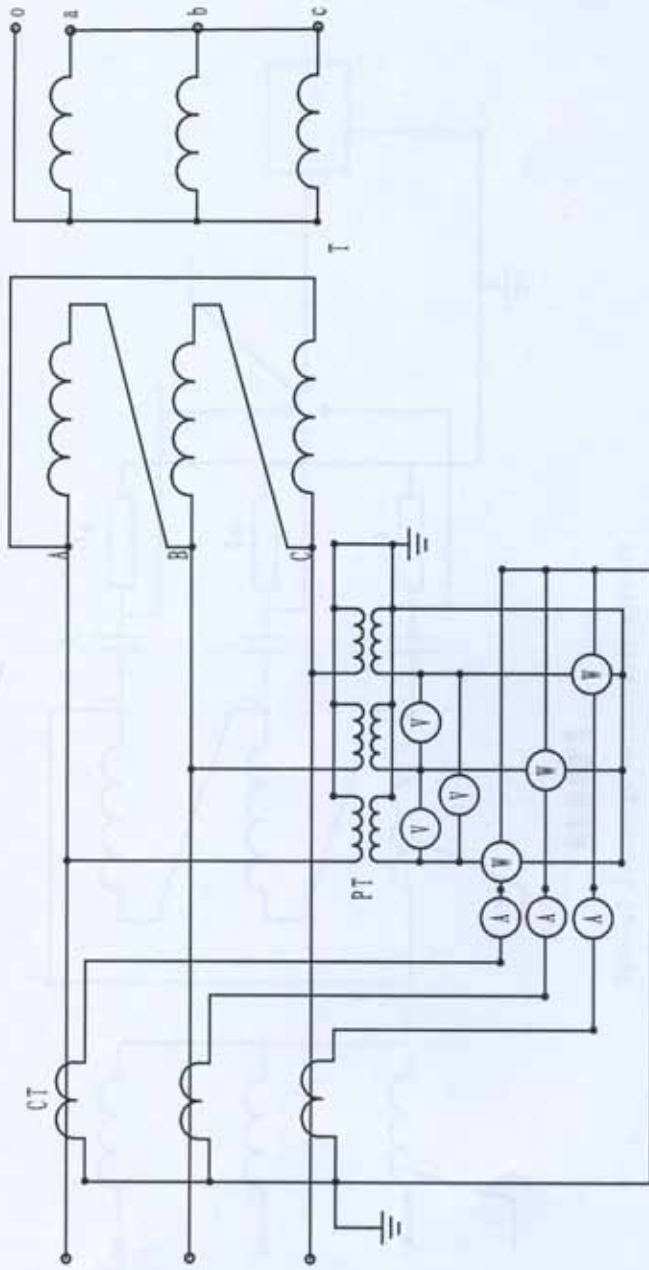


空载损耗及空载电流测量线路图

No-load loss and current measurement circuit

- T-被试变压器 Sample
- CT-电流互感器 Current transformer
- PT-电压互感器 Voltage transformer
- A-电流表 Amperemeter
- W-瓦特表 Wattmeter
- V-电压表 Voltmeter





短路阻抗及负载损耗测量线路图

Short circuit impedance and on load loss measurement circuit

T-被试变压器 Sample

A-电流表 Amperemeter

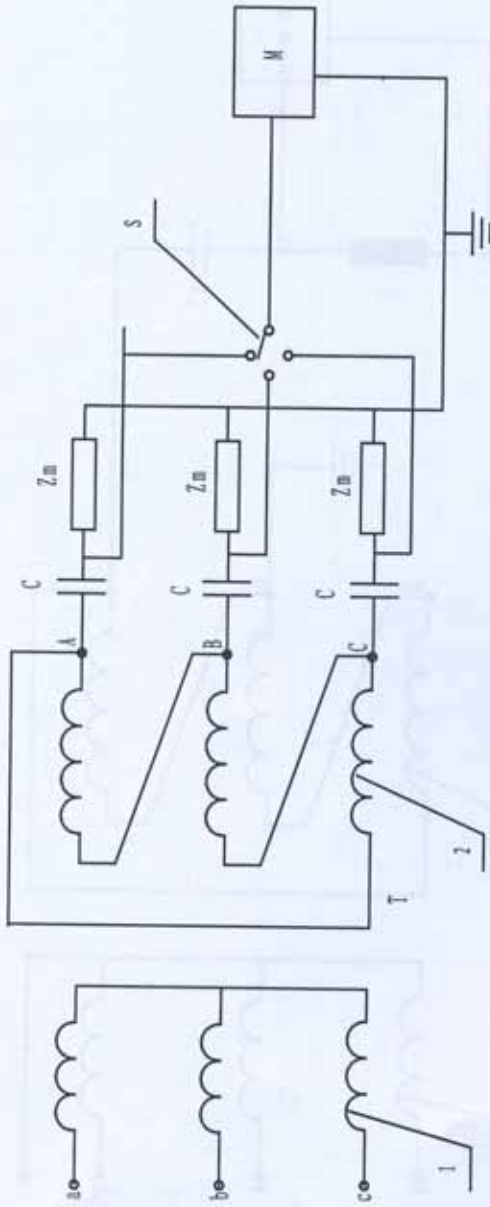
W-瓦特表 Wattmeter

CT-电流互感器 Current transformer

PT-电压互感器 Voltage transformer

V-电压表 Voltmeter

CTQC



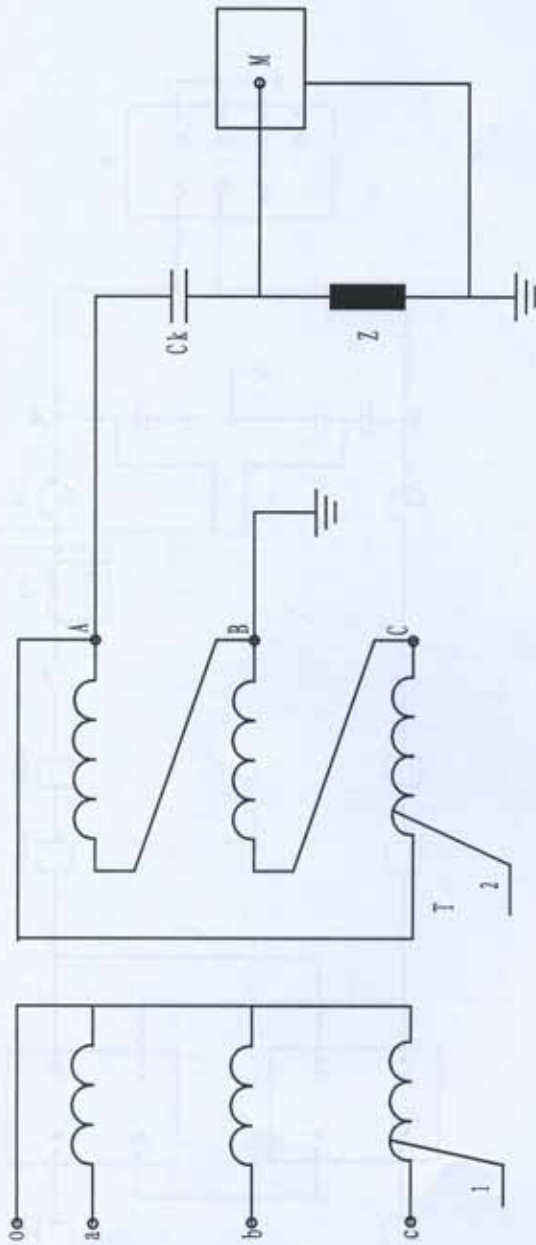
局部放电测量

Partial discharge measurement circuit
(three phase measurement)

1-低压绕组 Low voltage winding 2-高压绕组 High winding, delta or star connected.

M-测量装置 Measuring instrument S-转换开关 Switch

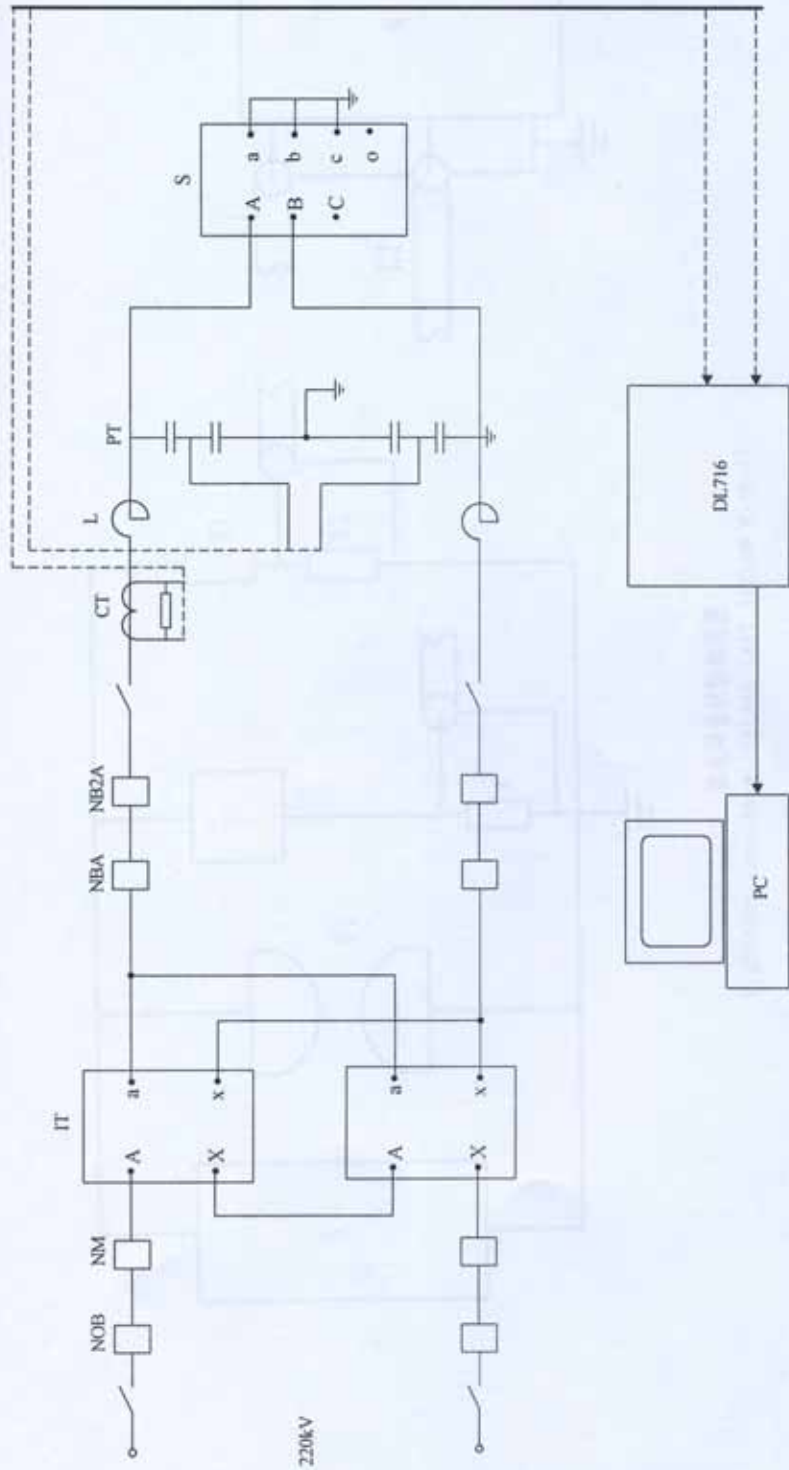




局部放电测量

Partial discharge measurement circuit
(single phase measurement)

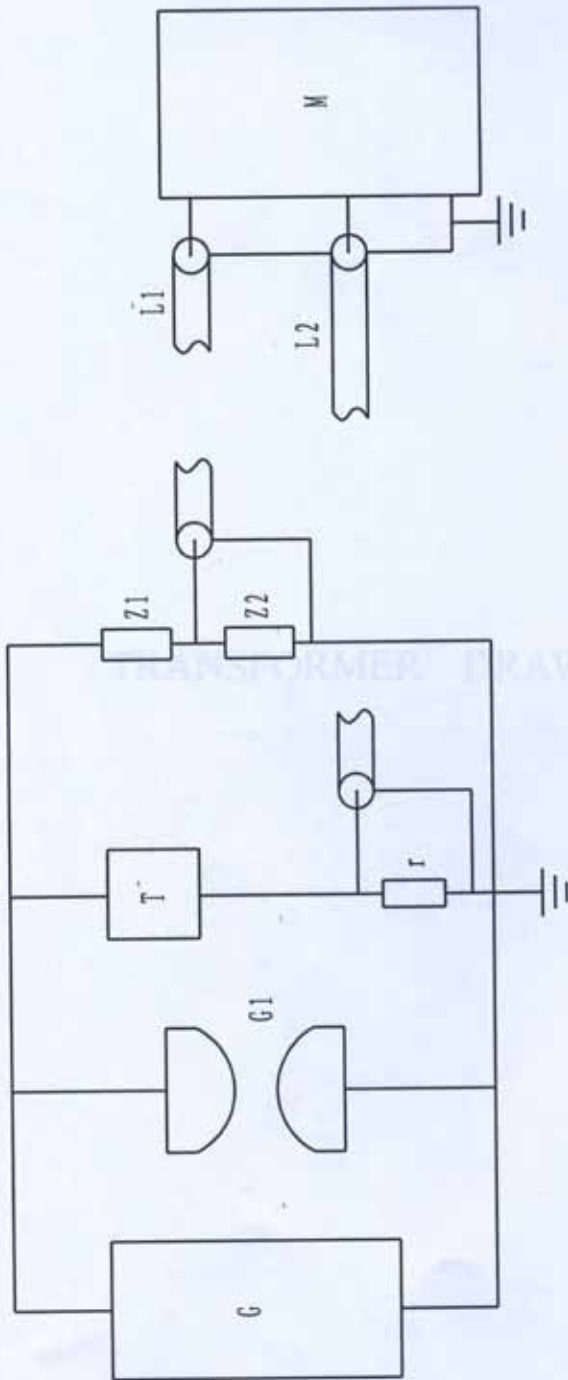
1-低压绕组 Low voltage winding 2-高压绕组 High winding, delta or star connected
M-测量装置 Measuring instrument



短路试验线路图 Short circuit tests of transformer:

- IT: 中间变压器 Intermediate transformer CT: 电流互感器 Standard current transformer PC: 计算机 Computer
 L: 限流电抗器 Reactors PT: 电容分压器 Voltage divider DL716: 瞬态记录仪 16 channels analyzer
 S: 被试变压器 Sample NOB, NM, NB, NB2: SF6断路器 SF6 switchgear

CTQC

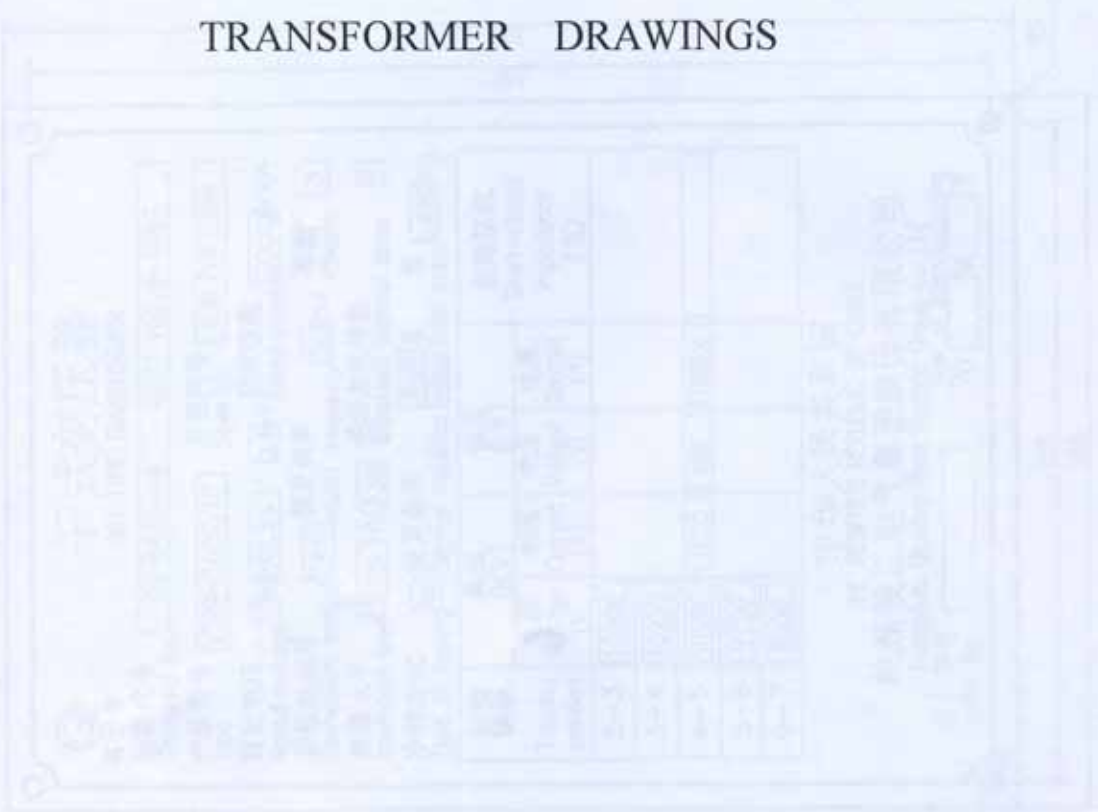


雷电冲击试验线路图
Lightning impulse withstand test system circuit

- G-冲击电压发生器 Impulse generator
- Z1, Z2-阻容分压器 Voltage divider
- L1, L2-高频传输电缆 High frequency transmission cable
- r-分流器 Shunt
- G1-截断装置 Chopping device
- M-测量仪器 Measurement instrument
- T-试品 Sample



TRANSFORMER DRAWINGS



| Part No. | Description | Quantity | Material |
|----------|----------------------|----------|----------|
| 1 | Core | 1 | Steel |
| 2 | Winding | 1 | Copper |
| 3 | Insulation | 1 | Oil |
| 4 | Tap Changer | 1 | Steel |
| 5 | Oil Level Indicator | 1 | Glass |
| 6 | Breather | 1 | Steel |
| 7 | Conservator | 1 | Steel |
| 8 | Terminal Box | 1 | Steel |
| 9 | Supporting Structure | 1 | Steel |

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OK

干式变压器

DRY TYPE TRANSFORMER



标准代号 Standard No. GB 6450-86 GB/T 10228-1997
 产品型号 Type SCB9-2000/10 产品代号 Style No. 1QB.710.2368
 额定电压 Rated voltage 10±2X2.5% / 0.4kV 额定容量 Rated power 2000kVA
 联接组标号 Connection symbol Dyn11 额定频率 Rated frequency 50Hz 相数 Phases 3
 绝缘水平 Insulation level Ⅱ 75 AQ35 绝缘耐热等级 Withstand thermal class E
 冷却方式 Type of cooling AN 使用条件 Service condition 户内 总重 Total mass 5490kg

| 分接 位置 Tapping position | 高压 (H.V.) | | 低压 (L.V.) | | 短路阻抗 Short-circuit Impedance (%) |
|---------------------------------|----------------------|----------------------|----------------------|----------------------|---|
| | 电压 Voltage (V) | 电流 Current (A) | 电压 Voltage (V) | 电流 Current (A) | |
| 2-3 | 10500 | | | | |
| 3-4 | 10250 | | | | |
| 4-5 | 10000 | 115.5 | 400 | 2886.8 | |
| 5-6 | 9750 | | | | |
| 6-7 | 9500 | | | | |

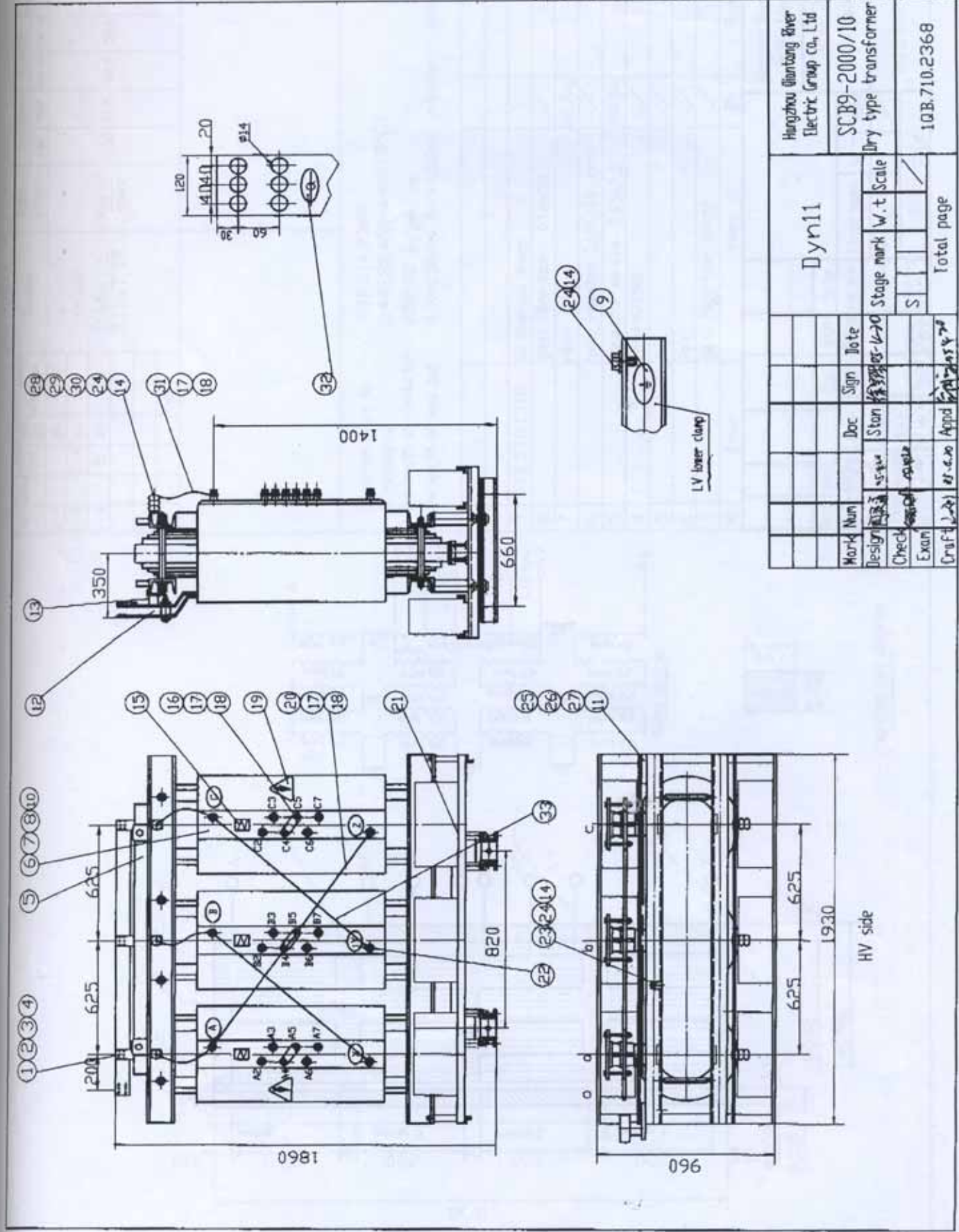
中华人民共和国
 THE PEOPLE'S REPUBLIC OF CHINA
 杭州钱江电气集团股份有限公司
 Hangzhou Qianting River Electric Group Co., Ltd.
 出厂序号 Serial No. _____ 20__年__月__日

| | | | | | | |
|---------------|---------|------|------|---------|------------------------|--------------|
| Mark | Num | DOC | Sign | Date | 1.0 Stainless steel | Scale 1:1 |
| Design | 05.4.20 | Ston | | 05.4.20 | | |
| Check | 05.4.20 | | | | | |
| Exam | | | | | | |
| Appd | | | | | Total Page | |
| Date: 05.4.20 | | | | | 1QB.710.2368MF | |

杭州钱江电气集团股份有限公司
 Hangzhou Qianting River Electric Group Co., Ltd.
 SCB9-2000/10
 名 牌
 Rolling plate



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| | | | | | | | |
|----------|------|------|------------|-----------|------------|-----|--------------|
| Mark Num | | Doc | Sign | Date | Stage mark | W.t | Scale |
| Design | | Stan | | | | | |
| Check | Exam | Appd | Total page | | S | | |
| Draft | | 1:1 | 2015.4.20 | 2015.4.20 | | | 10B.710.2368 |

Dyn11

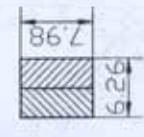
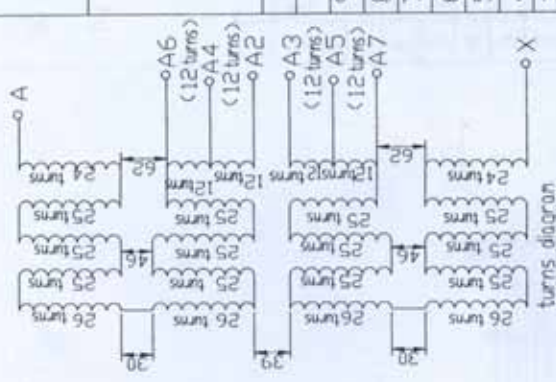
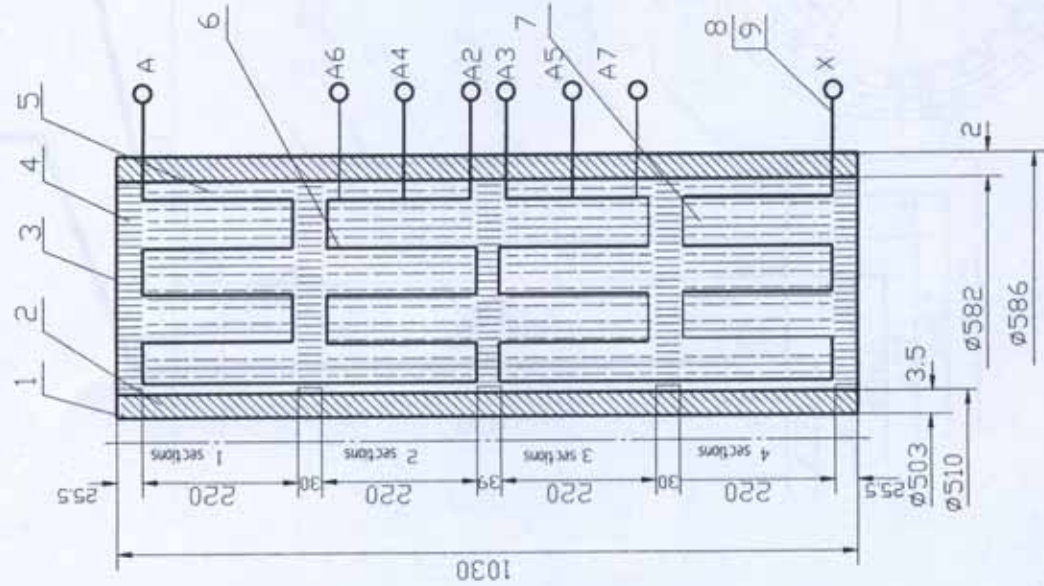
Hangzhou Qiantang River Electric Group Co., Ltd

SCB9-2000/10

Dry type transformer

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CTQC



parallel coil diagram

| No. | Section | Layer | Winding | Turns | Material | Weight (kg) | Division | Dimension | Material | Weight (kg) | Dimension | Material | Weight (kg) |
|---|---------|-------|----------------------------------|-------|-------------------------------------|-------------|----------|-----------|----------|-------------|-----------|----------|-------------|
| 1-4 | 1 | 26 | | 2 | | | | | | | | | |
| 1-4 | 2-4 | 25 | | | | | | | | | | | |
| 1-4 | 5 | 24 | | | | | | | | | | | |
| | | | | | | 500 | | | | | | | |
| <p>Calculation sheet No. : 0QB.214.2368 DC resistance : 0.4288 Ω/phase (75°C) The length of conductor : 858.70 m/phase The length of lead out : A, X=150mm A6=450mm others 300mm</p> | | | | | | | | | | | | | |
| 9 | | | HV lead-out device | | 1 | | | | | | | | |
| 8 | | | glass fibre tape 0.14x50 | | <input checked="" type="checkbox"/> | | | | | | | | |
| 7 | | | resin | | 162.7kg | | | | | | | | |
| 6 | | | layer insulation 0.13X260 circle | | <input checked="" type="checkbox"/> | | | | | | | | |
| 5 | | | conductor SB-04B 2.65x7.5 | | 904.1kg | | | | | | | | |
| 4 | | | end insulation | | <input checked="" type="checkbox"/> | | | | | | | | |
| 3 | | | felt | | <input checked="" type="checkbox"/> | | | | | | | | |
| 2 | | | felt | | <input checked="" type="checkbox"/> | | | | | | | | |
| 1 | | | glass fibre tape 0.3x50 | | <input checked="" type="checkbox"/> | | | | | | | | |
| <p>NO. Code Name Qty Remarks</p> | | | | | | | | | | | | | |
| <p>Hangzhou Wantang River Electric Group co. Ltd</p> | | | | | | | | | | | | | |
| <p>SCB9-2000/10 HV winding</p> | | | | | | | | | | | | | |
| <p>60B.602.2368.1</p> | | | | | | | | | | | | | |



王成林

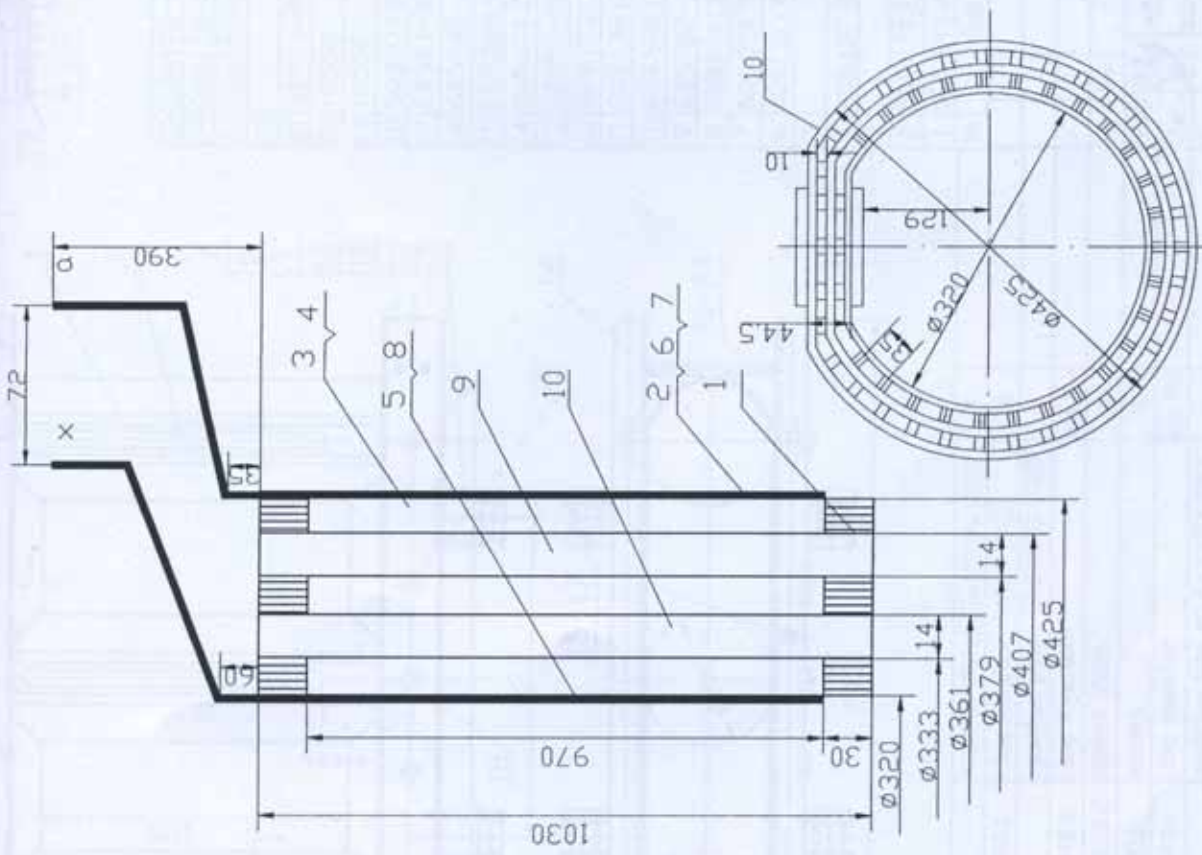
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|------------|-----|-------|
| S | | |

Total page

| Mark Num | Doc | Sign | Date |
|----------|-----|------|------|
| 101 | 101 | 101 | 101 |

| Design | Check | Exam | Craft |
|--------|-------|------|-------|
| 101 | 101 | 101 | 101 |

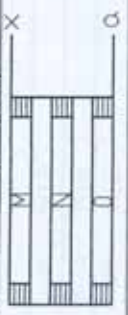
| Appd | of | Date |
|------|-----|------|
| 101 | 101 | 101 |



王敏书



| No. | Section | layer | Qty | Unit | Dimension | Weight (KG) | Material |
|-----|---------|-------|-----|------|-----------|-------------|--|
| M | 1 | 3 | 1 | 1 | | | Support sticks |
| N | 1 | 4 | 1 | 1 | | | DMD epoxy pre-dipped cloth 0.16X150X1030 |
| O | 1 | 4 | 1 | 1 | | | PTC device |
| | | | | | | | bus bar |
| | | | | | | | bus bar |
| | | | | | | | copper foil 1.7X970 |
| | | | | | | | layer insulation 0.16X1030 circle |
| | | | | | | | DMD epoxy pre-dipped cloth 0.16x50 |
| | | | | | | | end insulation 0.16x30 circle |
| | | | | | | 565.98 | |



Calculation sheet No. : 0QB.214.2368.1-4

DC resistance : $1.6347 \times 10^{-4} \Omega/\text{phase}(75^\circ\text{C})$

The length of conductor : 12.855m

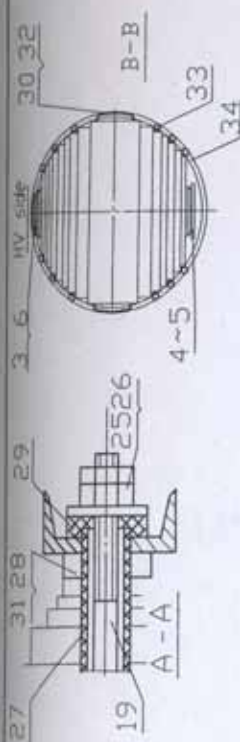
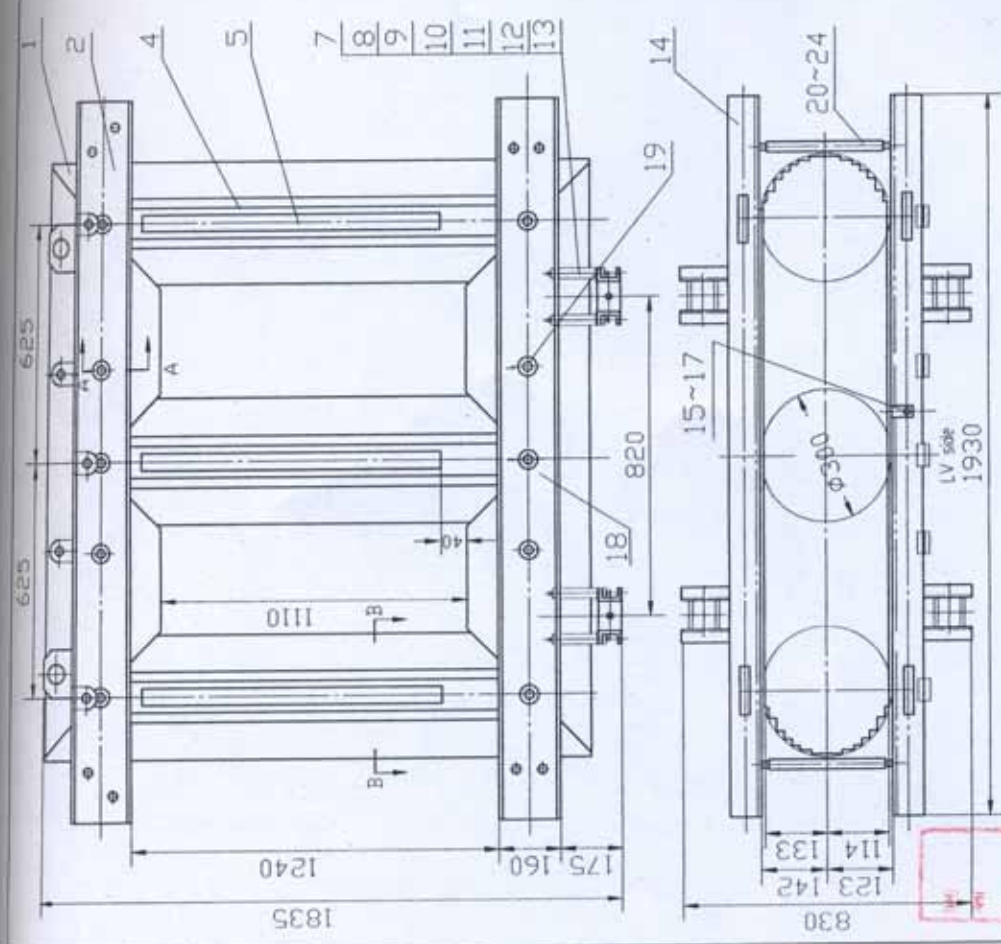
| No. | Code | Name | Qty | Remarks |
|-----|----------------|--|----------|---------|
| 10 | | | | |
| 9 | 8QB.132.2368 | Support sticks | 186 | |
| 8 | | DMD epoxy pre-dipped cloth 0.16X150X1030 | 28 | |
| 7 | 8QB.421.1312 | PTC device | 3 | |
| 6 | 8QB.511.2368.2 | bus bar | 3 | |
| 5 | 8QB.511.2368.1 | bus bar | 3 | |
| 4 | | copper foil 1.7X970 | 565.98kg | |
| 3 | | layer insulation 0.16X1030 circle | ✓ | |
| 2 | | DMD epoxy pre-dipped cloth 0.16x50 | ✓ | |
| 1 | | end insulation 0.16x30 circle | ✓ | |

| Mark Num | Doc | Sign | Date | Stage mark | W.t | Scale |
|----------|-----|------|------|------------|-----|-------|
| Design | | | | | | |
| Check | | | | S | | ✓ |
| Exam | | | | | | |
| Draft | | | | | | |
| | | | | Total page | | |

Hangzhou Qiantang River Electric Group Co., Ltd

SCB9-2000/10
LV winding

6QB.602.2368.2



| No. | Code | Name | Qty | Remarks |
|-----|------------------|--|----------|---------|
| 25 | GB6170-86 | nuts M12 | 8 | D.Zn |
| 24 | GB6172-86 | nuts M16 | 16 | D.Zn |
| 23 | GB6170-86 | nuts M16 | 16 | D.Zn |
| 22 | | insulation tube $\phi 18/\phi 22 \times 261$ | 8 | |
| 21 | GB97.1-88 | washers 16 | 16 | |
| 20 | r8552 | screw rods M16X350/60-60 | 8 | D.Zn |
| 19 | r8552 | screw rods M12X350/60-60 | 4 | D.Zn |
| 18 | 50B.070.2368.3 | HV. & LV. lower clamp | each one | |
| 17 | GB97.1-88 | washers 10 | 1 | |
| 16 | GB5782-86 | screw bolts M10X20 | 1 | D.Zn |
| 15 | 80B.588.902.1 | conductor sheet | 1 | |
| 14 | 50B.070.2368.1 | HV. upper clamp | 1 | |
| 13 | GB853-88 | washers 16 | 16 | |
| 12 | 80B.123.1318 | support plate | 2 | |
| 11 | 80B.132.1318.1 | support plate | 8 | |
| 10 | 80B.920.1318 | screw bolts M16 | 4 | |
| 9 | GB5782-86 | screw bolts M16X30 | 16 | D.Zn |
| 8 | 80B.750.1318.3-4 | insulation plate | 2 | |
| 7 | 50B.022.2348 | underlay | 2 | |
| 6 | 80B.132.1318.2 | support sticks | 3 | |
| 5 | | insulation plate 5.0X130X1100 | 3 | |
| 4 | 80B.137.2348 | drawplate | 6 | |
| 3 | | insulation plate 5.0X60X1020 | 3 | |
| 2 | 50B.070.2368.2 | LV. upper clamp | 1 | |
| 1 | 50B.640.2348.1 | core | 1 | |

| No. | Code | Name | Qty | Remarks |
|-----|----------------|--|-----------|---------|
| 34 | | insulation plate 0.5x1029x1000 | 3 | |
| 33 | 80B.132.2368.1 | insulation stick $\phi 12 \times 1030$ | 36 | |
| 32 | | insulation plate 2.0X60X1020 | 6 | |
| 31 | 80B.750.2348.2 | clamp insulation | each four | |
| 30 | 80B.132.1318.2 | support sticks | 6 | |
| 29 | 80B.710.1312 | washers | 8 | |
| 28 | 80B.750.2348.1 | clamp insulation | each four | |
| 27 | | insulation tube $\phi 14/\phi 18 \times 284$ | 4 | |
| 26 | GB6172-86 | nuts M12 | 8 | D.Zn |

Hangzhou Wantong River Electric Group Co., Ltd

SCB9-2000/10 CORE

50B.640.2368

CTCC

11月12日

11月12日

LIST OF INSTRUMENTS AND METERS USED

| ID No. | Instrument / Instrument | Precision | Serial No. | Acquisition Date | Manufacturer |
|--------|----------------------------------|-----------|-------------------|------------------|--|
| D52-W | Wattmeter | 0.5 | YB-10317314136 | 2005.09.13 | Shanghai Second Institute of Metrology |
| D52-W | Wattmeter | 0.5 | YB1031730140338 | 2005.09.13 | Shanghai Second Institute of Metrology |
| D52-W | Wattmeter | 0.5 | YB-1031730141171 | 2005.09.13 | Shanghai Second Institute of Metrology |
| Y19-A | Acoustic-volta | 0.5 | YB1031730141170 | 2005.09.13 | Shanghai Second Institute of Metrology |
| Y19-A | Acoustic-volta | 0.5 | YB1031730141170 | 2005.09.13 | Shanghai Second Institute of Metrology |
| Y19-G | Amperemeter | 0.5 | YB-10317301411738 | 2005.09.13 | Shanghai Second Institute of Metrology |
| Y19-G | Voltmeter | 1.0 | YB-30201010080 | 2005.07.15 | Shanghai Second Institute of Metrology |
| Y19-V | Voltmeter | 0.5 | YB-1030201109027 | 2005.07.15 | Shanghai Second Institute of Metrology |
| Y19-V | Wattmeter | 0.5 | YB-702008100100 | 2005.07.15 | Shanghai Second Institute of Metrology |
| A5504 | Voltage ratio bridge | 0.2 | YB-3070090014106 | 2006.01.24 | Shenyang Zhongyuan Measurement Instruments Co., Ltd. |
| A5004 | Voltage ratio bridge | 0.2 | YB4070090014104 | 2005.11.02 | Shenyang Zhongyuan Measurement Instruments Co., Ltd. |
| B391 | Direct current resistance bridge | 0.2 | YB-100219100172 | 2006.05.14 | Beijing Shitai Electric Power Instrument Co., Ltd. |
| B391 | Direct current resistance bridge | 0.2 | YB-1002090015013 | 2006.05.14 | Beijing Shitai Electric Power Instrument Co., Ltd. |

| Type | Instrument name | Precision | Serial No | Available date | Manufacturer |
|---------|-------------------------------------|-----------|-------------------|----------------|--|
| D52-W | Wattmeter | 0.5 | YB-103173/148.8 | 2005.09.13 | Shanghai second ammeter works |
| D52-W | Wattmeter | 0.5 | YB103174/148.26 | 2005.09.12 | Shanghai second ammeter works |
| D52-W | Wattmeter | 0.5 | YB-103175/442.71 | 2005.09.12 | Shanghai second ammeter works |
| T19-A | Ampere-meter | 0.5 | YB101166/317.92 | 2005.09.09 | Shanghai second ammeter works |
| T19-A | Ampere-meter | 0.5 | YB101167/317.12 | 2005.07.18 | Shanghai second ammeter works |
| T19-A | Ampere-meter | 0.5 | YB-101168/317.24 | 2005.09.09 | Shanghai second ammeter works |
| L2 | Voltmeter | 1.0 | YB-102010/1008.2 | 2005.07.18 | Shanghai second ammeter works |
| D26/1-V | Voltmeter | 0.5 | YB-102020/1004.27 | 2005.07.18 | Shanghai second ammeter works |
| T15-V | Voltmeter | 0.5 | YB-202408/3441 | 2005.07.18 | Tianjin zhonhuan meter factory |
| ASQJ-I | Voltage ratio bridge | 0.2 | YB-107049/014186 | 2006.01.24 | Shenyang Zhongchuan measurement technic Co., Ltd. |
| ASQJ-I | Voltage ratio bridge | 0.2 | YB-107198/024035 | 2005.11.02 | Shengyang Zhongchuan measurement technics Co., Ltd. |
| 3391 | Direct current resistance bridge | 0.2 | YB-107191/675 | 2006.03.14 | Baoding Shiri electric power instrument Co., Ltd. |
| 3391 | Direct current resistance bridge | 0.2 | YB-107050/RS232 | 2006.03.14 | Baoding Shiri electric power instrument Co., Ltd. |

| Type | Instrument name | Precision | Serial No | Available date | Manufacturer |
|--------|----------------------------------|-----------|-------------------|----------------|---|
| QJ24 | Direct current resistance bridge | 0.2-0.2 | YB-307739 | 2005.09.10 | Shanghai ammeter works |
| HL28 | Current transformer | 0.05 | YB-109184/920045 | 2007.04.27 | Dandong Zhenan precision instrument transformer works |
| HL28 | Current transformer | 0.05 | YB-109073/99922 | 2005.12.15 | Dandong instrument transformer |
| HL28 | Current transformer | 0.05 | YB-109185/920046 | 2007.04.27 | Dandong Zhenan precision instrument transformer works |
| HJ12 | Voltage transformer | 0.1 | YB-110183/92072 | 2006.10.04 | Dandong Zhenan precision instrument transformer works |
| HJ12 | Voltage transformer | 0.1 | YB-110188/99921 | 2007.04.27 | Dandong precision instrument transformer works |
| HJ12 | Voltage transformer | 0.1 | YB-110182/92073 | 2006.10.04 | Dandong Zhenan precision transformer works |
| L2/1-V | Voltmeter | 0.5 | YB-102011/1008.6 | 2005.09.09 | Shanghai second ammeter Co., Ltd. |
| T24-AV | Voltage-ampere meter | 0.2 | YB-105035/717.2 | 2005.11.03 | Shanghai second ammeter Co., Ltd. |
| T24-AV | Voltage-ampere meter | 0.2 | YB-105037/114.12 | 2005.07.18 | Shanghai second ammeter Co., Ltd. |
| D52-W | Wattmeter | 0.5 | YB-103024/1059.9 | 2005.09.12 | Shanghai second ammeter works |
| D52-W | Wattmeter | 0.5 | YB-103027/711.36 | 2006.03.07 | Shanghai second ammeter works |
| D52-W | Wattmeter | 0.5 | YB-103028/1059.11 | 2006.03.07 | Shanghai second ammeter works |



| Type | Instrument name | Precision | Serial No | Available date | Manufacturer |
|--------|---------------------|-----------|-------------------|----------------|---|
| HJ12 | Voltage transformer | 0.05 | YB-110086/200084 | 2005.11.14 | Dandong Zhenan instrument transformer works |
| HJ12 | Voltage transformer | 0.05 | YB-110087/200085 | 2005.11.14 | Dandong Zhenan instrument transformer works |
| HJ12 | Voltage transformer | 0.05 | YB-110088/200086 | 2005.11.14 | Dandong Zhenan instrument transformer works |
| HJ12 | Voltage transformer | 0.05 | YB-110089/200052 | 2005.10.14 | Dandong Zhenan instrument transformer works |
| HJ12 | Voltage transformer | 0.05 | YB-110090/200053 | 2005.11.14 | Dandong Zhenan instrument transformer works |
| HJ12 | Voltage transformer | 0.05 | YB-110091/200054 | 2005.11.14 | Dandong Zhenan instrument transformer works |
| HL28 | Current transformer | 0.05 | YB-109070/200074 | 2006.09.15 | Dandong Zhenan instrument transformer works |
| HL28 | Current transformer | 0.05 | YB-109071/200075 | 2006.09.17 | Dandong Zhenan instrument transformer works |
| HL28 | Current transformer | 0.05 | YB-109073/99922 | 2005.12.15 | Dandong Zhenan instrument transformer works |
| BLY-1 | Voltage transformer | 0.05 | YB-110084/9505011 | 2007.04.27 | Shanyang Zhongchuan technics Co.,Ltd |
| PK2003 | Peak voltmeter | 0.5 | YB-102217/0301 | 2005.07.19 | Shenyang transformer Co.,Ltd. |
| K2000 | Digital multi-meter | 0.2 | YB-106039/0770678 | 2005.07.20 | America |

| Type | Instrument name | Precision | Serial No | Available date | Manufacturer |
|---------|------------------------------|-----------|-------------------|----------------|---|
| D26/1-V | Voltmeter | 0.5 | YB-102018/1117.52 | 2005.07.18 | Shanghai Liangbiao intelligence interface Co., Ltd. |
| L2-V | Voltmeter | 1.0 | YB-102021/624.8 | 2005.09.09 | Shanghai second ammeter works |
| T63-A | Ampere-meter | 0.5 | YB-101002/84215 | 2005.09.19 | Haerbing ammeter instrument works |
| T63-A | Ampere-meter | 0.5 | YB-101003/84315 | 2005.09.19 | Haerbing ammeter instrument works |
| T63-A | Ampere-meter | 0.5 | YB-101001/84306 | 2005.09.19 | Haerbing ammeter instrument works |
| D52-W | Wattmeter | 0.5 | YB-103023/943.13 | 2005.07.20 | Shanghai second ammeter works |
| D52-W | Wattmeter | 0.5 | YB-103026/1129.16 | 2006.01.19 | Shanghai second ammeter works |
| D52-W | Wattmeter | 0.5 | YB-103029/1129.24 | 2006.03.07 | Shanghai second ammeter works |
| D52-W | Wattmeter | 0.5 | YB-203411/632.6 | 2005.07.20 | Shanghai second ammeter works |
| HL28 | Current transformer | 0.05 | YB-109065/2082 | 2007.04.28 | Dandong Zhenan instrument transformer works |
| HL28 | Current transformer | 0.05 | YB-109066/2083 | 2007.04.28 | Dandong Zhenan instrument transformer works |
| HL28 | Current transformer | 0.05 | YB-109067/2084 | 2007.04.28 | Dandong Zhenan instrument transformer works |
| BLY-1 | Voltage transformer | 0.05 | YB-110083/9505010 | 2007.04.27 | Shanyang Zhongchuan technics Co.,Ltd |
| JFD-2B | Partial discharge instrument | / | YB-114151/991201 | 2005.07.26 | Wuhan high voltage institute |

| Type | Instrument name | Precision | Serial No | Available date | Manufacturer |
|----------------------|------------------------------------|-----------|---------------------|----------------|---|
| BLY-1 | Voltage transformer | 0.05 | YB-110085/9505012 | 2007.04.27 | Shanyang Zhongchuan technics Co.,Ltd |
| HS5660A | Sound level instrument | / | YB-114205/08002127 | 2005.09.27 | Jiangxi Hongsheng instrument works |
| D6000 | Wide band power analyzer | / | YB-114150/M832541RR | 2005.09.27 | LEM |
| DXC-1 | Electric power harmonic instrument | / | YB-114149 | 2005.06.03 | Wuhan high voltage institute |
| GWC250-0.0004/0.0008 | Capacitor divider | / | SB-110834/2008006 | 2008.08.21 | Jiangu institute |
| YL250-100 | Standard capacitor | / | YB-116132/99-12 | 2005.09.14 | Guilin electric power capacitor works |
| JD2705 | Jindi digital megohmmeter | 1.5 | YB-104034/200114 | 2006.01.19 | Jindi instrument Co.,Ltd. |
| ATS-4 | Impulse measuring systems | / | YB-112130/ATS | 2005.09.09 | Jianga institute |
| CT106 | Transformer voltage Tester | 1.0 | YB-114140/2014 | 2005.06.29 | Shenyang Zhongchuan measurement technic Co., Ltd. |
| HESD | Transformer checkout meter | 0.5 | YB-114138/3099 | 2006.03.04 | Shenyang Zhongchuan |

| Type | Instrument name | Precision | Serial No | Available date | Manufacturer |
|----------------------|---|-----------|------------------|----------------|---|
| 6801 | Insulation Oil Dielectric Strength Tester | 1.5 | YB-117160/911012 | 2005.07.04 | Baoding Jiantong electric instrument Co.Ltd |
| QS40 | Capacitance tan δ bridge | 0.01 | YB-117161/702 | 2005.09.16 | Mudanjiang electric meter factory |
| 0-0.25MPa Φ 100 | Pressure meter | 1.5 | 89.12.1-1502 | 2005.08.01 | Shenyang Gongqi meter factory |
| 0-0.25MPa Φ 100 | Pressure meter | 1.5 | 88.5-97641 | 2005.08.01 | Shenyang pressure meter No.1 factory |
| 0-0.25MPa Φ 100 | Pressure meter | 1.5 | 8610-2420 | 2005.08.01 | Shenyang pressure meter No.1 factory |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |



Instruments for short circuit test

7

| Instrument name | Type | Serial No. | Ratio | Precision | Manufacturer | Available date |
|-------------------------------|------------|------------|--------------|-----------|--|----------------|
| Current transformer | LRBT-220 | YB-309786 | 1250-2500/1 | 0.5 | Shenyang instrument transformer Co.,Ltd. | 2005.11.7 |
| Current transformer | LRBT-220 | YB-309787 | 1250-2500/1 | 0.5 | Shenyang instrument transformer Co.,Ltd. | 2005.09.12 |
| Current transformer | LRBT-220 | YB-309788 | 1250-2500/1 | 0.5 | Shenyang instrument transformer Co.,Ltd. | 2005.09.12 |
| Current transformer | LRB-220 | YB-309790 | 500-50/1 | 0.5 | Shenyang instrument transformer Co.,Ltd. | 2005.11.07 |
| Current transformer | LMZC-10 | YB-309781 | 1000/5 | 0.5 | Shenyang special instrument transformer works | 2005.11.07 |
| Current transformer | LMZC-10 | YB-309780 | 1000/5 | 0.5 | Shenyang special instrument transformer works | 2005.11.07 |
| Current transformer | LMZC-10 | YB-309779 | 1000/5 | 0.5 | Shenyang special instrument transformer works | 2007.03.28 |
| Current transformer | LV-330 | YB-309782 | 5000/1 | 0.5 | Dalian second instrument transformer works | 2005.11.12 |
| Voltage transformer | JDZJ-10 | YB-310722 | 10000/100/√3 | 0.5 | Dalian second instrument transformer works | 2005.12.23 |
| Voltage transformer | JDZJ-10 | YB-310721 | 10000/100/√3 | 0.5 | Dalian second instrument transformer works | 2005.12.23 |
| Voltage transformer | JDZJ-10 | YB-310723 | 10000/100/√3 | 0.5 | Dalian second instrument transformer works | 2005.12.23 |
| Standard resistance | FL-27 | 1# | 0.9780 Ω | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.03.06 |
| Standard resistance | FL-27 | 2# | 0.985 | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.04.25 |
| Standard resistance | FL-27 | 3# | 0.009974 | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.03.06 |
| Standard resistance | FL-27 | 4# | 0.009967 | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.03.06 |
| Standard resistance | FL-27 | 5# | 0.009967 | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.03.06 |
| Standard resistance | FL-27 | 6# | 0.979 | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.04.25 |
| Standard resistance | FL-27 | 7# | 0.9765 | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.03.06 |
| Standard resistance | FL-27 | 8# | 0.977 | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.04.25 |
| Standard resistance | FL-2/1000 | YB-316786 | 0.503 | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.04.25 |
| Standard resistance | FL-10/1000 | YB-316782 | 0.10003 | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.04.25 |
| Standard resistance | FL-10/1000 | YB-316783 | 0.09990 | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.03.06 |
| Standard resistance | FL-10/1000 | YB-316784 | 0.1000 | 0.2 | Shenyang Guangming electrician apparatus facto | 2006.04.25 |
| 16CH digital scope | DL716 | YB-312729 | | 0.5 | YOKOGAWA in Japan | 2005.07.11 |
| 16CH digital scope | DL716 | YB-312730 | | 0.5 | YOKOGAWA in Japan | 2005.09.03 |
| Precision inductance analyzer | YY2816 | YB-314735 | | 0.2 | Tianjin radio sixth works | 2006.04.25 |
| Precision inductance analyzer | YY2816 | YB-314734 | | 0.2 | Tianjin radio sixth works | 2005.09.05 |

注 意 事 项

1. 检验报告无“检验专用章”和检验单位公章无效。
2. 检验报告无编制、审核、批准人签字无效。
3. 对检验报告若有异议,应在收到报告后及时向检验单位提出。
4. 检验(监试)仅对样品负责。
5. 未经实验室书面批准,不得复制证书或检验报告(完整复制除外)。

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INSPECTION REPORT

Report number 70555001-TDT 05- 51684A
Client SVET.CTQC
Shenyang Hunnan New & High-Tech. Industrial
Development Zone
Shenyang 110179
China
Reference Trust testing
Concerning routine, type and special tests
Date between May 12 and May 20, 2005
Place Shenyang, China
Object Dry Type Power Transformer 2000 kVA
Manufacturer Hangzhou Qiantang River Electric Group Co., Ltd

REQUIREMENTS

Requirements as specified in the standards IEC 60076-11, IEC 60076-1, IEC 60076-3, IEC 60076-5 and IEC 60076-10.

TEST PROGRAMME

The programme was specified by the client.
For the programme we refer to page 3.

SUMMARY AND CONCLUSION

The results obtained relate only to the work ordered and to the material tested.
On the points examined, the requirements specified for the material tested were met.

Author G.J. Veldscholten

This B-report consists of:
20 pages
4 annexes
1 appendix (25 pages)

KEMA Nederland B.V.


P.G.A. Bus
KEMA T&D Testing Services
Managing Director

Arnhem, June 22, 2005

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MATERIAL DATA

| | |
|---------------------------------|---|
| Manufacturer | Hangzhou Qiantang River Electric Group Co., Ltd |
| Type | SCB9-2000/10 |
| Serial number | 052368002 |
| Rated power | 2000 kVA |
| Rated voltages | 10 / 0.4 kV |
| Rated current | 115.5/2886.8 A |
| Rated frequency | 50 Hz |
| Number of phases | 3 |
| Tapping range | +5%, -5% |
| Number of steps/ tapping step | 5 / 2.5% |
| Vector group | Dyn11 |
| Cooling method | AN |
| Temperature class of insulation | F |
| Insulation levels | H.V. LI/AC – 75 / 35 kV L.V. AC – 3 kV |
| Short-circuit impedance | 6.0% |
| Total mass | 5490 kg |

TEST OBJECT IDENTIFICATION

The test object was identified by checking the rating plate and the serial number.

The test object was checked with the drawings enclosed in the SVET.CTQC report number CTQC/B-05.096.

The SVET.CTQC test report regarding tests, oscillograms, curves, lists of test equipments, test circuits and manufacturer drawings are enclosed in this report as appendix A.

TEST PROGRAMME

| | | kind of test * | standard/ specification | clause |
|-------|---|----------------|-------------------------|--------|
| 0 | INSPECTION OF THE TEST SET-UP | | | |
| 1 | ROUTINE-, SPECIAL- AND TYPE TESTS BEFORE SHORT-CIRCUIT TEST | | | |
| 1.1 | Separate source AC withstand voltage test | R | IEC 60076-3 | 5,11 |
| 1.2 | Short-duration induced AC withstand voltage test | R | IEC 60076-3 | 5,12 |
| 1.3 | Measurement of insulation resistances | S | IEC 60076-1 | 10.1 |
| 1.4 | Measurement of winding resistance | R | IEC 60076-1 | 10.2 |
| 1.5 | Measurement of voltage ratio and check of voltage vector relationship | R | IEC 60076-1 | 10.3 |
| 1.6 | Measurement of no-load loss and current | R | IEC 60076-1 | 10.5 |
| 1.7 | Measurement of load loss and short-circuit impedance | R | IEC 60076-1 | 10.4 |
| 1.8 | Temperature-rise test | T | IEC 60076-11 | 23 |
| 1.9 | Partial discharge measurement | | | |
| 1.9.1 | Partial discharge measurement – routine | R | IEC 60076-11 | 22 |
| 1.9.2 | Partial discharge measurement – special | S | IEC 60076-11 | 22 |
| 2 | SHORT-CIRCUIT TEST | S | IEC 60076-5 | |
| 3 | REPEAT OF ROUTINE TESTS, SPECIAL- AND TYPE TESTS | | | |
| 3.1 | Separate source AC withstand voltage test | R | IEC 60076-3 | 5, 11 |
| 3.2 | Short-duration induced AC withstand voltage test | R | IEC 60076-3 | 5, 12 |
| 3.3 | Measurement of insulation resistances | S | IEC 60076-1 | 10.1 |
| 3.4 | Measurement of winding resistance | R | IEC 60076-1 | 10.2 |
| 3.5 | Measurement of voltage ratio and check of voltage vector relationship | R | IEC 60076-1 | 10.3 |
| 3.6 | Measurement of no load loss and current | R | IEC 60076-1 | 10.5 |
| 3.7 | Measurement of load loss and impedance | R | IEC 60076-1 | 10.4 |
| 3.8 | Lightning Impulse test | T | IEC 60076-3 | 13 |
| 3.9 | Partial discharge measurement | R | IEC 60076-11 | 22 |
| 3.10 | Determination of sound levels | S | IEC 60076-10 | |
| 3.11 | Inspection of the active part | S | IEC 60076-5 | 4.2 |

R = routine test T = type test S = special test

PERSONS ATTENDING THE TEST

| | |
|-----------------|-----------|
| Mr Chen Kui | SVET.CTQC |
| Mr Tian Wenge | SVET.CTQC |
| Mr Wang Maosong | SVET.CTQC |

THE INSPECTION WAS CARRIED OUT BY

| | |
|---------------------|---------------------|
| Mr G.J Veldscholten | KEMA Nederland B.V. |
|---------------------|---------------------|

PURPOSE OF THE TEST

Purpose of the test was to verify whether the material, regarding the routine-, type- and special tests in accordance with the test programme, complies with the specified requirements.

DESCRIPTION AND RESULTS OF THE TESTS PERFORMED

0 INSPECTION OF THE TEST SET-UP

The tests were carried out in the laboratory of SVET, who is therefore jointly responsible for the correctness of the results obtained. The measuring devices and the test set-up were checked by us and where necessary calibrated.

Results

The inspection did not give rise to remarks.

1 ROUTINE-, TYPE- AND SPECIAL TESTS BEFORE SHORT-CIRCUIT TEST

1.1 Separate source AC withstand voltage test

The tests were carried in accordance with IEC 60076-3 clause 11.
The high voltage winding was tested with 35 kV, 50 Hz for 5 minutes. The low voltage winding was tested with 3 kV, 50 Hz for 5 minutes.

Results

Values of the applied voltages and the durations are higher than the IEC standard. No collapse of the test voltages occurred.

1.2 Short-duration induced AC withstand voltage test

The test was carried out in accordance with IEC 60076-3 clause 12.

A three-phase power-frequency voltage of 200 Hz was applied to the low-voltage winding during 30 seconds in order to induce 200% U_n . The tapping position during the test was 3 (10000/400 V).

Results

No collapse of the test voltages occurred.

1.3 Measurement of insulation resistances

Measured was the insulation resistance between the mutual windings and between the winding and ground with a d.c. voltage of 5 kV. The measured values are shown in annex 1.

Results

The measured values do not give rise to remarks.

1.4 Measurement of winding resistance

The measurement was carried out in accordance with IEC 60076-1 clause 10.2.

The d.c. resistance of the windings was determined with equipment, measuring voltages and currents and calculating the measured resistance. The resistances of the h.v. winding were measured in all positions of the tap-changer. The results of the measurements are represented in annex 1.

Results

The measured values do not give rise to remarks.

1.5 Measurement of voltage ratio and check of voltage vector relationship

The measurement was carried out in accordance with IEC 60076-1, clause 10.3.

The voltage ratio was measured using a bridge circuit at low voltage.

The measurements took place for all tapping positions.

The connection symbol was checked together with the determination of the voltage ratio. Balance of the bridge can be attained only if the voltages connected to the bridge from the primary and secondary side have the same phase and sense.

The measured values in comparison with the specified ones are given in annex 1.

Results

The deviations with respect to the rated values are within the specified tolerances.

1.6 Measurement of no-load loss and current

The measurement was carried out in accordance with IEC 60076-1, clause 10.5.

The no-load loss and no-load currents were measured with supply at the low voltage side with rated voltage. The results in comparison with the specified values are given in annex 1.

Results

The measured values were within the specified tolerance.

1.7 Measurement of load loss and short-circuit impedance

The measurement was carried out in accordance with IEC 60076-1 clause 10.4. The load loss and the short-circuit impedance were measured with a three phase supply. The measurements took place in all tapping positions. The l.v. winding was short-circuited. The measuring results were recalculated to 120 °C winding temperature and are given in annex 1.

Results

The measured values were within the specified tolerance.

1.8 Temperature-rise test

The temperature-rise test was carried out in accordance with IEC 60076-11, clause 11 (simulated load method). The transformer was subjected to two tests. One test with its no-load losses at rated voltage and one test with its load losses at rated current. The measured values, compared with the guaranteed values, are given in annex 2.

Results

The measured temperature-rise values are within the specified values.

1.9 Partial discharge measurement

1.9.1 PARTIAL DISCHARGE MEASUREMENT - ROUTINE

The partial discharge measurement was carried out in accordance with IEC 60076-11, clause 22.4.1.1. The routine test is a 3-phase test. After the pre-stress voltage of 1.8 U_r during 30 seconds, the PD level was measured during 3 minutes at a voltage of 1.3 U_r in every phase. The maximum PD acceptance level was 10 pC.

Results

The measured values were within the specified limits.

1.9.2 PARTIAL DISCHARGE MEASUREMENT - SPECIAL

The partial discharge measurement was carried out in accordance with IEC 60076-11, clause 22.4.1.2. The special test is a single-phase test in which one line terminal will be earthed. After a phase to phase voltage of 1.5 U_m for 30 seconds, the PD level was measured during 3 minutes at a voltage of 1.1 U_m . This test is repeated for every phase.

The maximum PD acceptance level was 10 pC.

Results

Values of the induced voltages are higher than the IEC standard requires. The measured values were within the specified limits.

2 SHORT-CIRCUIT TEST

The short-circuit test was carried out in accordance with IEC 60076-5. The transformer is of category 1.

Calculations of the short-circuit current were made with a short-circuit rating of 500 MVA and a system voltage of 10 kV.

The test was performed according to the single-phase method. The single-phase supply is provided between the two corners of the delta. The secondary windings were short-circuited.

The primary currents were measured.

After each test the reactance of the windings were measured at the primary side.

The measured and calculated values of currents and reactance are given in the SVET.CTQC report, see appendix A.

Results

During the test no visible damage could be detected.

The reactance deviations were within the tolerance.

The currents and peak currents were within the tolerances.

3 REPEAT OF ROUTINE TEST, SPECIAL- AND TYPE TESTS

3.1 Separate source AC withstand voltage test

The tests were carried out in accordance with IEC 60076-3 clause 11.

The high voltage winding was tested with 35 kV, 50 Hz for 5 minutes. The low voltage winding was tested with 3 kV, 50 Hz for 5 minutes.

Results

Values of the applied voltages and the durations are higher than the IEC standard. No collapse of the test voltages occurred.

3.2 Short-duration induced AC withstand voltage test

The test was carried out in accordance with IEC 60076-3 clause 12.

A three-phase power-frequency voltage of 200 Hz was applied to the low-voltage winding during 30 seconds in order to induce 200% U_n . The tapping position during the test was 3 (10000/400 V).

Results

No collapse of the test voltages occurred.

3.3 Measurement of insulation resistances

Measured was the insulation resistance between the mutual windings and between the winding and ground with a d.c. voltage of 5 kV. The measured values are shown in annex 4.

Results

The measured values do not give rise to remarks.

3.4 Measurement of winding resistance

The measurement was carried out in accordance with IEC 60076-1 clause 10.2.

The d.c. resistance of the windings was determined with equipment, measuring voltages and currents and calculating the measured resistance. The resistances of the h.v. winding were measured in all positions of the tap-changer. The results of the measurements are represented in annex 4.

Results

The measured values do not give rise to remarks.

3.5 Measurement of voltage ratio and check of voltage vector relationship

The measurement was carried out in accordance with IEC 60076-1, clause 10.3.

The voltage ratio was measured using a bridge circuit at low voltage.

The measurements took place for all tapping positions.

The connection symbol was checked together with the determination of the voltage ratio. Balance of the bridge can be attained only if the voltages connected to the bridge from the primary and secondary side have the same phase and sense.

The measured values in comparison with the specified ones are given in annex 4.

Results

The deviations with respect to the rated values are within the specified tolerances.

3.6 Measurement of no-load loss and current

The measurement was carried out in accordance with IEC 60076-1, clause 10.5.

The no-load loss and no-load currents were measured with supply at the low voltage side with rated voltage. The results in comparison with the specified values are given in annex 4.

Results

The measured values were within the specified tolerance.

3.7 Measurement of load loss and short-circuit impedance

The measurement was carried out in accordance with IEC 60076-1 clause 10.4. The load loss and the short-circuit impedance were measured with a three phase supply. The measurements took place in tap 3. The l.v. winding was short-circuited. The measuring results were recalculated to 120 °C winding temperature and are given in annex 4.

Results

The measured values were within the specified tolerance.

3.8 Lightning impulse test

The test was carried out in tapping position 3 in accordance with IEC 60076-3, clause 13. The lightning impulse test voltage was 75 kV. The three phases of the high voltage windings were each tested with a sequence consisting of a reduced full wave and three full waves, all of negative polarity. The results are given in the SVET.CTQC report, see appendix A.

Results

The transformer passed the test successfully.

3.9 Partial discharge measurement

The partial discharge measurement was carried out in accordance with IEC 60076, clause 22. After the pre-stress voltage of 1.8 Ur during 30 seconds, the PD level was measured during 3 minutes at a voltage of 1.3 Ur. The maximum PD acceptance level was 10 pC.

Results

The measured values were within the specified limits.

3.10 Determination of sound levels

The sound level test was carried out in accordance with IEC 60076-10.

Sound level measurement was carried out at 100% of the rated voltage. The measurement was carried out indoor. The measured values are given in annex 3.

Results

The measured values, compared with the guaranteed values, don't give rise to remarks.

3.11 Inspection of the active part

After the short-circuit test the transformer was inspected.

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

The drawings and photos made before and after short-circuit test can be found in the SVET.CTQC report, see appendix A.

Results

The transformer complies with IEC 60076-5, sub-clause 4.2.7.

Results of routine tests before the short-circuit tests

Transformer number: 052368002

Insulation impedance

| Humidity: 73%, ambient temperature 15.2 °C | |
|--|----------------------------|
| Measurement position | Insulation resistance (GΩ) |
| H.V. – L.V. & tank to earth | 36.4 |
| L.V. – H.V. & tank to earth | 29.4 |
| H.V. & L.V. – tank to earth | 31.9 |

Winding resistances

| Resistance at 15.2 °C | H.V. (Ω) | | | | | L.V. (mΩ) |
|-----------------------|----------|--------|--------|--------|--------|-----------|
| | Tap 1 | Tap 2 | Tap 3 | Tap 4 | Tap 5 | |
| AB/ab | 0.2468 | 0.2405 | 0.2343 | 0.2281 | 0.2220 | 0.2929 |
| BC/bc | 0.2477 | 0.2411 | 0.2346 | 0.2285 | 0.2223 | 0.2919 |
| CA/ca | 0.2469 | 0.2407 | 0.2344 | 0.2282 | 0.2221 | 0.2985 |

Ratio and connection group

| H.V. | | L.V. | Ratio | Measured deviation (%) | | | Connection Group |
|--------------|--------------|--------------|--------|------------------------|-------|-------|------------------|
| Tap position | Voltage (kV) | Voltage (kV) | | AB/ab | BC/bc | CA/ca | |
| 1 | 10.50 | 0.40 | 26.250 | 0.02 | -0.01 | 0.01 | Dyn11 |
| 2 | 10.25 | | 25.625 | -0.01 | -0.01 | -0.01 | |
| 3 | 10.00 | | 25.000 | -0.07 | -0.07 | -0.06 | |
| 4 | 9.75 | | 24.375 | -0.04 | -0.07 | -0.05 | |
| 5 | 9.50 | | 23.750 | -0.07 | -0.09 | -0.07 | |

No-load loss

| Rated no-load voltage (V) | Average current (A) | Average current %/ guaranteed (%) | No-load loss (W)/ guaranteed (W) |
|---------------------------|---------------------|-----------------------------------|----------------------------------|
| 400 | 6.31 | 0.22 / 1.2 | 3150/ 3740 |

Load loss and short-circuit impedance

| Values calculated to 120 °C | Tap 1 | Tap 3 | Tap 5 |
|------------------------------|------------|-----------------|-----------|
| Load loss (W)/ guaranteed | 12890 - | 13170/ 15300 | 13590 |
| Impedance (Ω) | 3.37 | 3.03 | 2.72 |
| Impedance (%)/ guaranteed | 6.11 - | 6.06/ 6.00 | 6.02 - |

Results of the temperature rise test

Transformer number: 052368002

| Temperature rise test (simulated method) | | |
|---|-----|--------------------------|
| General | | Dry Type |
| Power | kVA | 2000 |
| Cooling | | AN |
| Position of tap changer | | 3 |
| Ratio | kV | 10/ 0.4 |
| Results no-load loss measurement | | |
| h.v. winding | K | 4.3 |
| l.v. winding | K | 18.3 |
| Results load loss measurement | | |
| High voltage windings | K | 97.0 |
| Low voltage windings | K | 86.3 |
| Total temperature rise | | Calculated/limits |
| High voltage windings | K | 98.6/100 |
| Low voltage windings | K | 96.1/100 |

Measurement of sound levels

Transformer number: 052368002

| | | |
|-----------------------------|------------------|--------|
| Location | | Indoor |
| Excitation | % U _n | 100 |
| Cooling method | | AN |
| Number of measuring points | | |
| At 1/2 height | | 14 |
| Measuring distance | m | 1.0 |
| Logarithmic mean of: | | |
| Measured value | dB _A | 53.9 |
| Corrected measuring result | dB _A | 53.0 |
| Sound power | dB _A | 68.0 |
| Guaranteed sound power | dB _A | 77 |

Results of routine tests after the short-circuit tests

Transformer number: 052368002

Insulation impedance

| Humidity: 65%, ambient temperature 20.8 °C | |
|--|----------------------------|
| Measurement position | Insulation resistance (GΩ) |
| H.V. – L.V. & tank to earth | >100 |
| L.V. – H.V. & tank to earth | 52.4 |
| H.V. & L.V. – tank to earth | 67.8 |

Winding resistances

| Resistance at 20.8 °C | H.V. (Ω) | | | | | L.V. (mΩ) |
|-----------------------|----------|--------|--------|--------|--------|-----------|
| | Tap 1 | Tap 2 | Tap 3 | Tap 4 | Tap 5 | |
| AB/ab | 0.2528 | 0.2463 | 0.2399 | 0.2336 | 0.2273 | 0.3006 |
| BC/bc | 0.2532 | 0.2467 | 0.2403 | 0.2340 | 0.2276 | 0.3007 |
| CA/ca | 0.2528 | 0.2464 | 0.2399 | 0.2337 | 0.2273 | 0.3070 |

Ratio and connection group

| H.V. | | L.V. | Ratio | Measured deviation (%) | | | Connection Group |
|--------------|--------------|--------------|--------|------------------------|-------|-------|------------------|
| Tap position | Voltage (kV) | Voltage (kV) | | AB/ab | BC/bc | CA/ca | |
| 1 | 10.50 | 0.40 | 26.250 | 0.03 | 0.03 | 0.02 | Dyn11 |
| 2 | 10.25 | | 25.625 | -0.01 | -0.01 | -0.01 | |
| 3 | 10.00 | | 25.000 | -0.01 | -0.05 | -0.02 | |
| 4 | 9.75 | | 24.375 | -0.07 | -0.05 | -0.05 | |
| 5 | 9.50 | | 23.750 | -0.09 | -0.08 | -0.07 | |

No-load loss

| Rated no-load voltage | Average current (A) | Average current %/ guaranteed (%) | No-load loss (W)/ Guaranteed |
|-----------------------|---------------------|-----------------------------------|------------------------------|
| 400 V | 6.27 | 0.22 / 1.2 | 3120/ 3740 |

Annex 4 page 2

Load loss and short-circuit impedance

| Values calculated to 120 °C | Tap 1 | Tap 3 | Tap 5 |
|------------------------------|-------|----------------|-------|
| Load loss (W)/ guaranteed | | 13210 15300 | |
| Impedance (Ω) | | 3.02 | |
| Impedance (%)/ guaranteed | | 6.05/ 6.00 | |

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No. L0681



国质监认字 080 号



(2000)量认(国)字(A0394)号



机检电(2000)07号

TEST REPORT

No: CTQC/H-05.096

Apparatus: Dry-type power transformer

Manufacturer: HANGZHOU QIANTANG RIVER
ELECTRIC GROUP CO., LTD

Kind of testing: TRUST TESTING

CHINA NATIONAL TRANSFORMER QUALITY
SUPERVISION TESTING CENTER

李明智



Test Report

No: CTQC/B-05.096

Total 25 Page 1

| | | | |
|--|--|--------------------------|--|
| Test object name | Dry-type power transformer | Test object type | SCB9-2000/10 |
| | | Brand | / |
| Entrusted by | Hangzhou Qiantang River Electric Group Co;Ltd | Kind of testing | Trust testing |
| Manufacturer | Hangzhou Qiantang River Electric Group Co;Ltd | Sampling date | May. 11,2004 |
| Address | QianTang River Electric Science & Technology Industrial Zone XiaoShan District, Hangzhou China | Serial No | 052368002 |
| Standards | IEC60076-11:2004 Contract requirements | Test items | Routine tests; Type tests; Special tests: Partial discharge measurement (single phase measurement) Sound level measurement Short-circuit withstand test |
| Results | The test results of routine tests, type tests, partial discharge measurement(single phase measurement), sound level measurement, short-circuit withstand test of SCB9-2000/10 are in accordance with standards and contract requirements. The sample passed the above tests. | | |
| | | Signing and issuing date | May 23, 2004 |
| KEMA T&D TESTING SERVICES INSPECTORS: Mr. G.J. Veldscholten | | | |

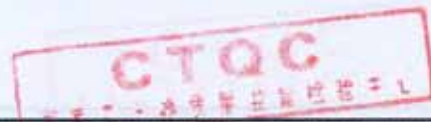
Approved by: 李明智 Checked by: 李世斌 Compiled by: 李秋

- Statement :
1. Testing report is invalid without test special seal or CTQC seal.
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| | | |
|-------------|--|--------------------|
| Test Report | China National Transformer Quality Supervision Testing Center | No.: CTQC/B-05.096 |
| | | Total 25 Page 2 |

Test results

| No | Test items | Specified values | Measured values | | Conclu- sions |
|----|--|---|---|---|------------------|
| | | Standards (Technical contract) | Before S.C.T. | After S.C.T. | |
| 1 | Measurement of insulation resistance | Providing insulation resistance (GΩ) | H-L.E: 36.4 L-H.E: 29.4 H.L-E: 31.9 | H-L.E: >100 L-H.E: 52.4 H.L-E: 67.8 | Passed |
| 2 | Measurement of voltage ratio and check of connection group | The tolerances of voltage ratio : ±0.5% Connection group: Dyn11 | -0.07%~-0.06% Dyn11 | -0.05%~-0.01% Dyn11 | Passed |
| 3 | Measurement of winding resistance | Providing winding resistance (Ω) | See 4.3 | See 4.11.5.3 | Passed |
| 4 | Separate-source AC withstand voltage test | H.V.: 35kV; 300s L.V.: 3kV; 300s | 35kV; 300s 3kV; 300s | 35kV; 300s 3kV; 300s | Passed |
| 5 | Induced AC withstand voltage test | Applied voltage (kV): 2Ur Induced voltage (kV): 20 Duration (s): 120 (f _n /f) Frequency (Hz): f>50 | 0.8 20 30 200 | 0.8 20 30 200 | Passed |
| 6 | Measurement of no-load loss and current | I ₀ %: 1.2 +30% P ₀ (kW): 3.74 +15% | 0.22 3.15 | 0.22 3.12 | Passed |
| 7 | Measurement of short-circuit impedance and load loss | t: 120°C Z%: 6.0 ±10% P _k (kW): 15.3 +15% P ₀ +P _k (kW): 19.04 +10% | 6.06 13.17 16.32 | 6.05 13.21 16.33 | Passed |
| 8 | Partial discharge measurement | Three phase measurement: Applied voltage (kV) : 1.3Ur Duration(min): 3 Partial discharge level(pC): ≤ (10) | 13 3 <5 | 13 3 <10 | Passed |
| | | Single phase measurement: Applied voltage (kV) : 1.1Um Duration(min): 3 Partial discharge level(pC): ≤ (10) | 13.2 3 <10 | | |



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| | | |
|-------------|--|-------------------|
| Test Report | China National Transformer Quality Supervision Testing Center | No: CTQC/B-05.096 |
| | | Total 25 Page 3 |

Test results

| № | Test items | Specified values | Measured values | Conclu- sions |
|----|---------------------------------|--|--|------------------|
| | | Standards (Technical contract) | | |
| 9 | Temperature-rise test | Winding temp. -rise limit (K): 100 | H.V.: 98.6 L.V.: 96.1 | Passed |
| 10 | Measurement of Sound levels | Sound power level $L_{WA,SN}$ dB (A): ≤ 77 | 68 | Passed |
| 11 | Short-circuit withstand test | Three times each phase Duration (s): $0.5 \pm 10\%$ Test waveshapes have no distortion Deviation of reactance before and after S.C.T. $\leq 2\%$ The visual inspection shows no apparent defects Successfully repeat routine test | 3 0.50 No distortion 0.33% No apparent defects. See 4.11.4 Passed | Passed |
| 12 | Lightning impulse test | Full wave (kV) : 75 $\pm 3\%$ | 74.7~75.8 | Passed |

Annex 1: Rating plate photo (Total page 1)

Annex 2: Test circuits (Total pages 8)

Annex 3: Transformer drawings (Total pages 5)

№ 1 Rating plate 1QB.710.2368MP

№ 2 Outline dimensions 1QB.710.2368

№ 3 H.V. winding 6QB.602.2368.1

№ 4 L.V. winding 6QB.602.2368.2

№ 5 Core assemble 5QB.640.2368

Annex 4: List of instruments and meters used (Total pages 7)



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Test Report

China National Transformer Quality
Supervision Testing Center

No: CTQC/B-05.096

Total 25 Page 4

1. Test object parameters

Rated power: 2000 kVA

Rated voltage: 10/0.4 kV

Rated current: 115.5/2886.9 A

Rated frequency: 50 Hz

Number of phases: 3

Tap range: $(10 \pm 2 \times 2.5\%) / 0.4$ kV

Connection group: Dyn11

Cooling method: AN

Temperature class of insulation: F

Insulation level: h.v. line terminal LI/AC 75/35 kV

l.v. line terminal AC 3 kV

2. Sample condition description

- (1) Sample exterior construction and major dimensions(length, width, height) are in compliance with drawing. Measured values: length:1930mm; width:960mm, height:1860mm.
- (2) The design, performance data , specifications of sample rating plate are in compliance with drawing.
- (3) The marking of the phase sequence on high voltage and low voltage side of the sample is clear and right.
- (4)The surface of the sample has no collision and damage.

3. Standards

IEC60076-11:2004 《Dry-type transformers》

Contract requirements



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4. Test items and conclusions:

4.1 Measurement of insulation resistance

Test date: May.12,2005

Humidity: 73% Ambient temperature: 15.2°C

| Measurement position | Insulation resistance (GΩ) |
|----------------------|----------------------------|
| H.V.—L.V.&E | 36.4 |
| L.V.—H.V. &E | 29.4 |
| H.V.&L.V.—E | 31.9 |

4.2 Measurement of voltage ratio and check of connection group

Test date: May.12,2005

| H.V. | | L.V. | | Ratio | Measured deviation (%) | | | Conne- tion group |
|-----------------|-----------------|-----------------|-----------------|--------|------------------------|-------|-------|-------------------------|
| Tap position | Voltage (kV) | Tap position | Voltage (kV) | | AB/ab | BC/bc | CA/ca | |
| 1 | 10.50 | / | 0.4 | 26.250 | 0.02 | -0.01 | 0.01 | Dyn11 |
| 2 | 10.25 | | | 25.625 | -0.01 | -0.01 | -0.01 | |
| 3 | 10.00 | | | 25.000 | -0.07 | -0.07 | -0.06 | |
| 4 | 9.75 | | | 24.375 | -0.04 | -0.07 | -0.05 | |
| 5 | 9.50 | | | 23.750 | -0.07 | -0.09 | -0.07 | |

4.3 Measurement of winding resistance

Test date: May.12,2005

Ambient temperature: 15.2°C

| Winding | Tap position | Measured values (Ω) | | | Unbalancedness (%) |
|---------|--------------|---------------------|------------|------------|-----------------------|
| | | A~B a~b | B~C b~c | C~A c~a | |
| H.V. | 1 | 0.2468 | 0.2477 | 0.2469 | 0.36 |
| | 2 | 0.2405 | 0.2411 | 0.2407 | 0.25 |
| | 3 | 0.2343 | 0.2346 | 0.2344 | 0.13 |
| | 4 | 0.2281 | 0.2285 | 0.2282 | 0.18 |
| | 5 | 0.2220 | 0.2223 | 0.2221 | 0.14 |
| L.V. | / | 0.0002929 | 0.0002919 | 0.0002985 | 2.24 |

4.4 Separate-source AC withstand voltage test

Test date: May.12,2005

Test circuit is given in Annex2-a

Humidity: 73%; Ambient temperature: 15.2°C; Atmospheric pressure: 100.2kPa

| Position | Applied voltage (kV) | Duration (s) | Results |
|-------------|----------------------|--------------|---------|
| H.V.—L.V.&E | 35 | 300 | Passed |
| L.V.—H.V.&E | 3 | 300 | |



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| <h2 style="margin: 0;">Test Report</h2> | China National Transformer Quality Supervision Testing Center | No: CTQC/B-05.096 Total 25 Page 6 |
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4.5 Induced AC withstand voltage test Test date: May.12,2005
 Test circuit is given in Annex2-b

Humidity: 73%; Ambient temperature: 15.2°C; Atmospheric pressure: 100.2kPa

| Tap position | Applied voltage (kV) | Induced voltage (kV) | Induced over-voltage factor | Frequency (Hz) | Duration (s) | Results |
|--------------|----------------------|----------------------|-----------------------------|----------------|--------------|---------|
| | L.V. | H.V. | | | | |
| 3 | 0.8 | 20 | 2 | 200 | 30 | Passed |

4.6 Measurement of no-load loss and current Test date: May.12,2005
 Test circuit is given in Annex2-c

| R.M.S. value voltage (kV) | | No-load current | | No-load loss (kW) | |
|---------------------------------|-----------------------------------|-----------------|------|-------------------|-----------------|
| Reading of mean value voltmeter | Reading of R.M.S. value voltmeter | (A) | (%) | Measured value | Corrected value |
| 0.400 | 0.400 | 6.31 | 0.22 | 3.15 | 3.15 |

Note: The reading tolerance between R.M.S value voltmeter and mean value voltmeter is less than 3%.

4.7 Measurement of short-circuit impedance and load loss Test date: May.12,2005
 Test circuit is given in Annex2-d

Ambient temperature: 15.2°C

| Winding | Tap position | Applied current I | | Measured voltage (kV) | Short-circuit impedance (Each phase) | | Load loss (kW) | Total loss (kW) |
|-------------------|--------------|-------------------|----------|-----------------------|--------------------------------------|-----------------|-----------------|-----------------|
| | | (A) | I/Ir (%) | | H.V. impedance (Ω) | (%) | Corrected value | Corrected value |
| | | | | | t=120°C I=Ir | t=120°C I=Ir | t=120°C I=Ir | t=120°C I=Ir |
| H.V. L.V. | 1 | 107.6 | 88.5 | 0.626 | 3.37 | 6.11 | 12.89 | 16.04 |
| | 3 | 113.3 | 98.0 | 0.592 | 3.03 | 6.06 | 13.17 | 16.32 |
| | 5 | 118.9 | 108.0 | 0.558 | 2.72 | 6.02 | 13.59 | 16.74 |



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4.8 Partial discharge measurement Test date: May.12,2005

4.8.1 Three phase measurement:

Test circuit is given in Annex2-e.

| Applied voltage | | Duration | Partial discharge level(pC) | | |
|-----------------|----------|----------|-----------------------------|----|----|
| (kV) | Multiple | | A | B | C |
| 18.0 | 1.8Ur | 30s | / | / | / |
| 13.0 | 1.3Ur | 3min | <5 | <5 | <5 |

Note: Background partial discharge level is < 2.0pC before and after test.

4.8.2 Single phase measurement:

Test circuit is given in Annex2-f.

| Applied voltage | | Duration | Partial discharge level(pC) | | |
|-----------------|----------|----------|-----------------------------|-----|-----|
| (kV) | Multiple | | A | B | C |
| 18.0 | 1.5Um | 30s | / | / | / |
| 13.2 | 1.1Um | 3min | <10 | <10 | <10 |

Note: Background sound level is <1.0pC before and after test.

4.9 Temperature-rise test Test date: May.16,2005

The test is conducted by means of simulated load method, the test duration is 13h, Applied voltage under the condition of no-load is 0.4kV, Specified current is 115.5A under the condition of on load, injected current is 115.5A during test, Tap 3.

Test results of no-load

| Winding | Measured values (Ω) | | Ambient temperature (°C) | | Winding temp.-rise (K) |
|---------|------------------------|-----------|--------------------------|--------|---------------------------|
| | Hot R | Cold R | Hot R | Cold R | |
| H.V. | 0.2409 | 0.2344 | 17.6 | 15.0 | 4.3 |
| L.V. | 0.0003161 | 0.0002917 | | | 18.3 |

Test results of on-load

| Winding | Measured values (Ω) | | Ambient temperature (°C) | | Winding temp.-rise (K) |
|---------|------------------------|-----------|--------------------------|--------|---------------------------|
| | Hot R | Cold R | Hot R | Cold R | |
| H.V. | 0.3301 | 0.2344 | 20.1 | 15.0 | 97.0 |
| L.V. | 0.0003983 | 0.0002917 | | | 86.3 |

Results of temperature-rise test

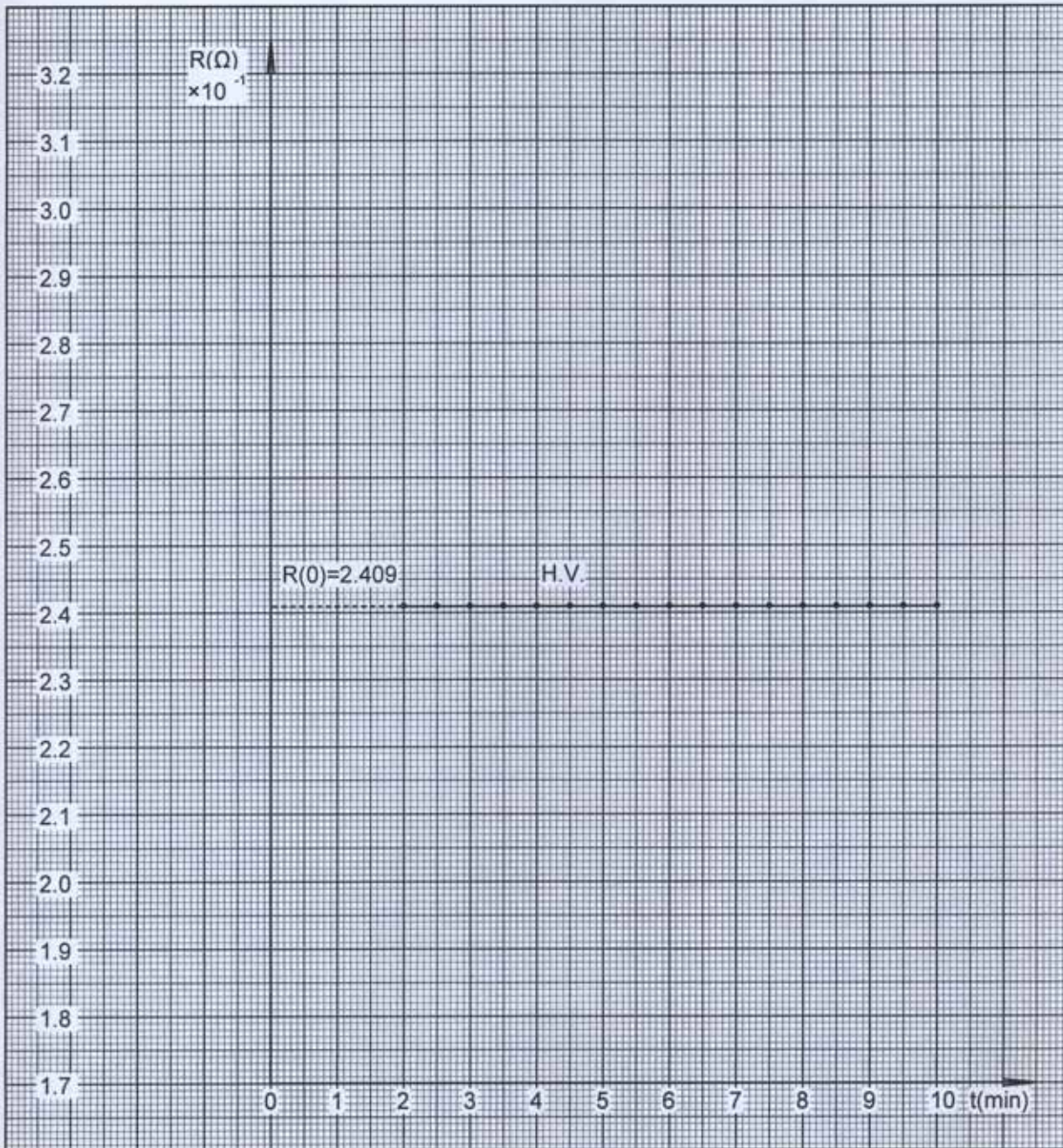
| Winding temp.-rise (K) | H.V. | 98.6 |
|------------------------|------|------|
| | L.V. | 96.1 |

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Hot resistance curve



No-load



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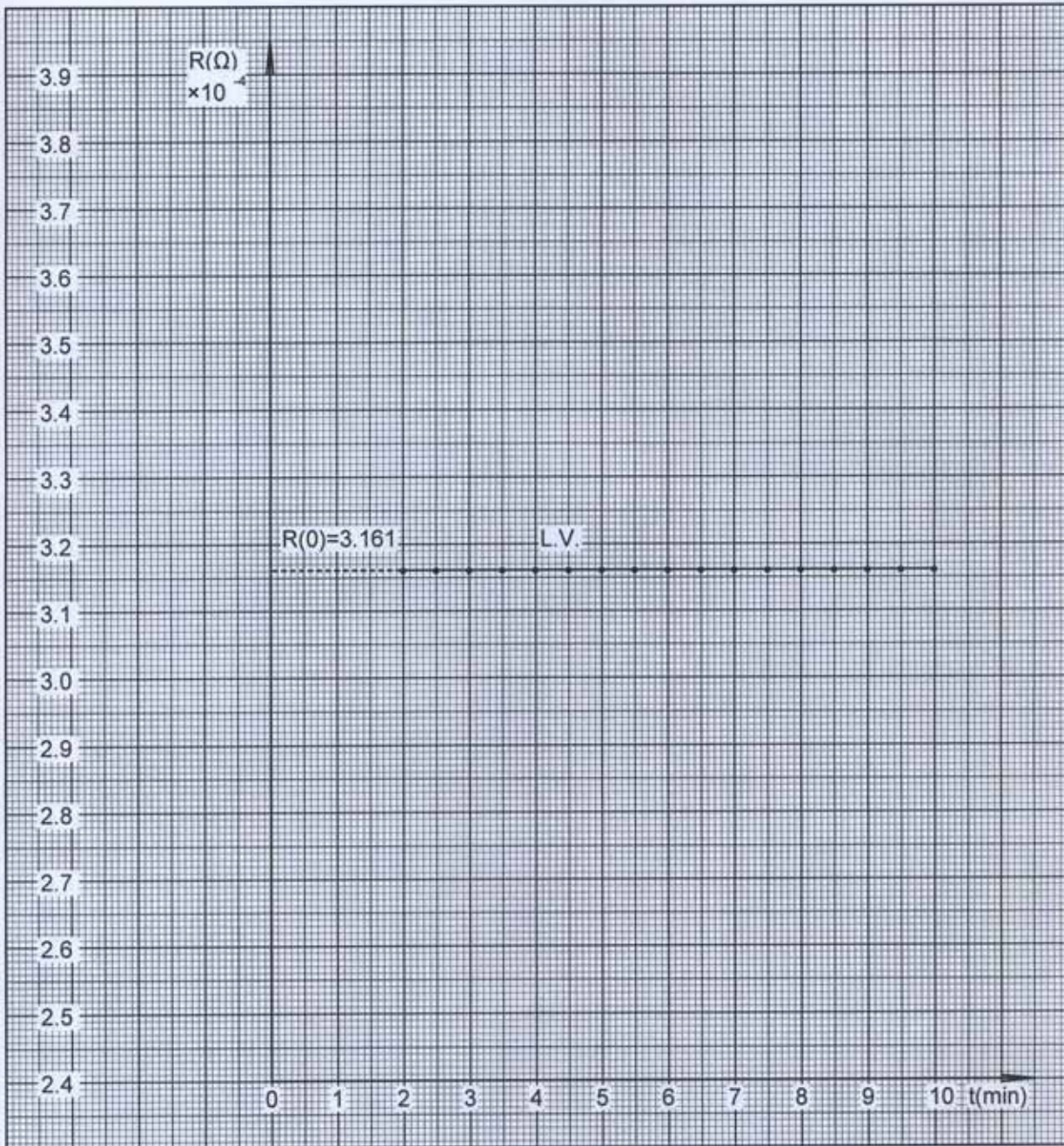
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Hot resistance curve

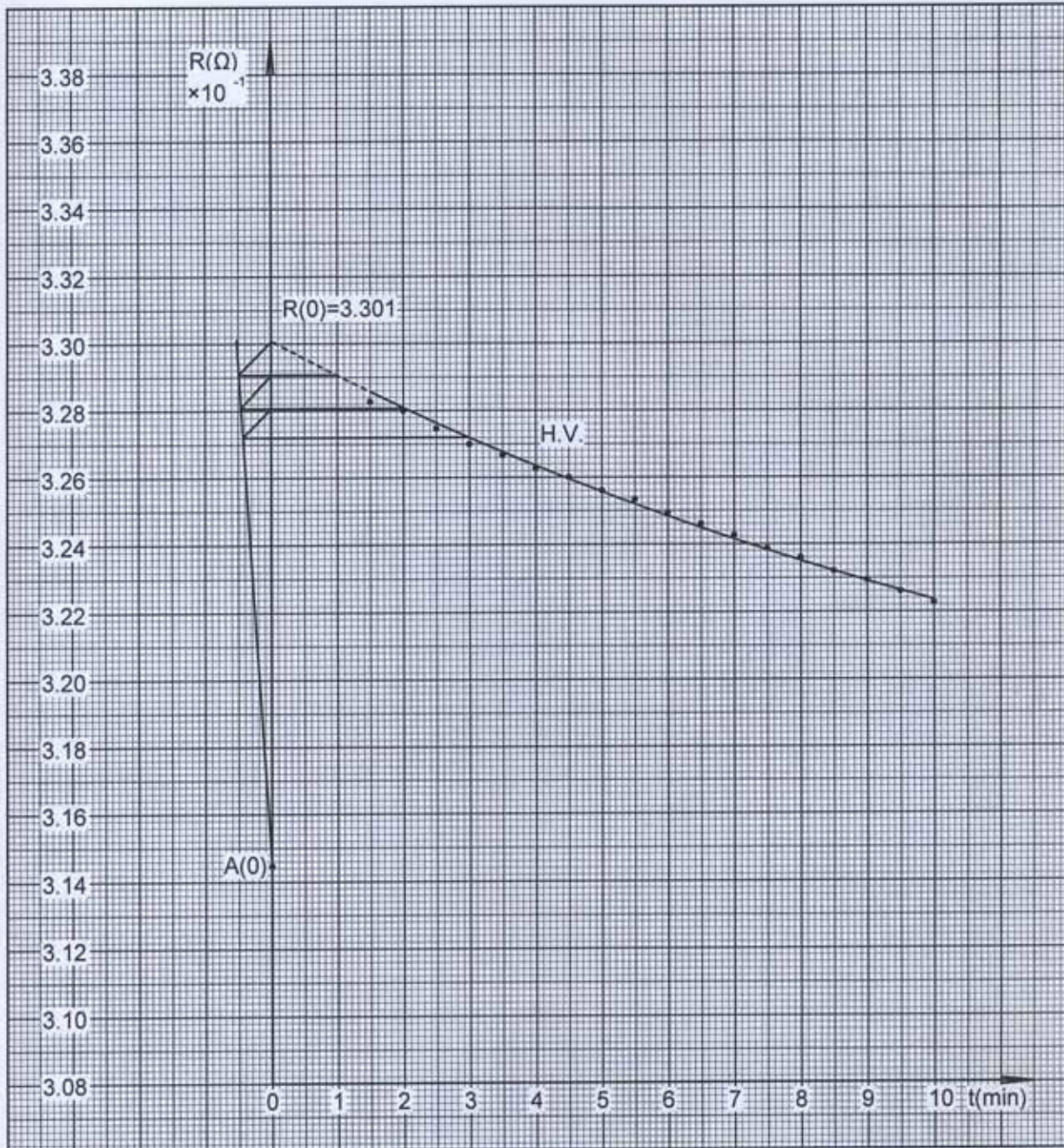


No-load



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Hot resistance curve

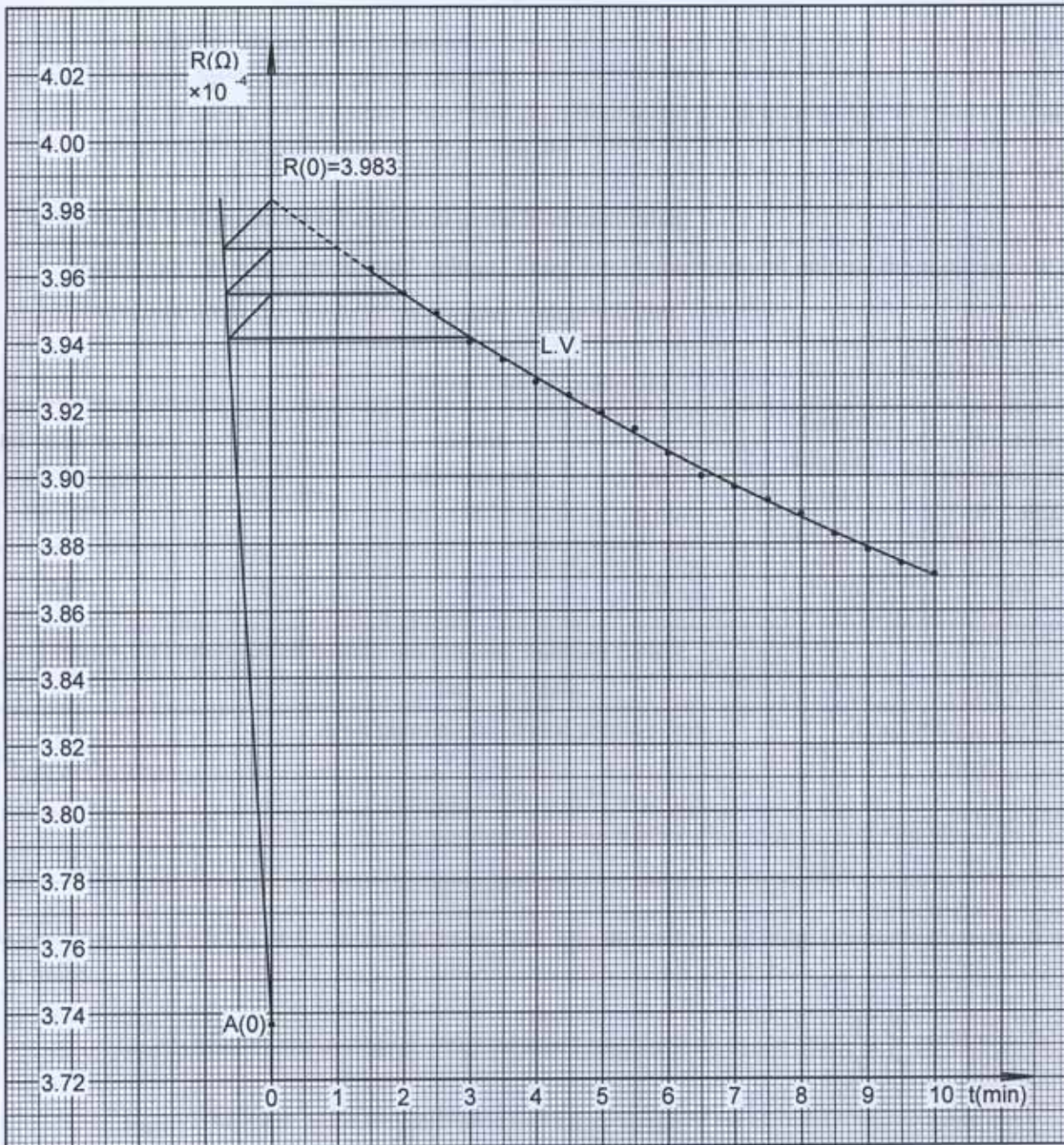


On-load



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Hot resistance curve



On-load



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| | | |
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| <h2 style="margin: 0;">Test Report</h2> | <h3 style="margin: 0;">China National Transformer Quality Supervision Testing Center</h3> | No: CTQC/B-05.096 Total 25 Page 12 |
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4. 10 Measurement of Sound levels Test date: May.20,2005

4. 10. 1 Sound power level calculation under on load current:

Calculation equation: $L_{WA, IN} \approx 39 + 181g \frac{S_r}{S_p} = 44dB (A)$

In which: S_r —Rated power 2.00MVA;
 S_p —Reference power 1.00MVA.

$L_{WA, IN}$ is 44dB (A) , is 33dB lower than guaranteed sound power level limited (77dB (A)) , so load current sound measurements are not appropriate.

4.10.2 Sound level measurement and sound power level calculation

Transformer is energized at rated voltage. There are 14 measurement points, the measurement point interval is 0.78m, the height of measurement points is 0.91m.

Environmental conditions

| Area of the surface of the test room $S_v (m^2)$ | Mean sound absorption coefficient α | Sound absorption A (m^2) | d (m) | Area of effective surface S (m^2) | Environmental correction factor K (dB) |
|--|---|------------------------------------|-------|--|--|
| 3432 | 0.15 | 515 | 1.0 | 30.76 | 0.9 |

d—Distance between specified contour and principal radiating surface.

Test results

dB (A)

| Type of Cooling | A-weighted surface sound pressure level $L_{PA} = 10\lg(10^{0.1L_{PA0}} - 10^{0.1L_{bgA}}) - K$ | A-weighted sound power level $L_{WA, UN} = L_{PA} + 10\lg(S/S_0)$ |
|-----------------|--|---|
| AN | 53 | 68 |

Note: The background noise before measurement is 44.7dB, the background noise after measurement is 44.8dB.

In which:

L_{PA0} —Uncorrected average A-weighted sound pressure level. $L_{PA0} = 10\lg\left(\frac{1}{N} \sum_{i=1}^N 10^{0.1L_{PAi}}\right)$

L_{bgA} —The lower of the two calculated average A-weighted background sound pressure level.

In according to 4.10.1, $L_{WA, SN} = 68dB$



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4.11 Short-circuit withstand test Test date: May.19,2005

Test circuit is given in annex2-g

4.11.1 Calculated short-circuit current

Calculated short-circuit current (Reference temperature 120°C)

| Tap position | Phase peak value(A) | Symmetrical value(A) | | Peak factor (K×√2) |
|--------------|---------------------|----------------------|--------------|--------------------|
| | | Phase current | Line current | |
| 1 | 2382 | 981 | 1699 | 2.428 |
| 3 | 2494 | 1032 | 1788 | 2.417 |
| 5 | 2611 | 1086 | 1880 | 2.404 |

4.11.2 Measurement of short-circuit current

Perform single-phase test, the single-phase supply is provided between one line terminal and the other two line terminals connected together, Test waveshapes have no distortion, Test oscillograms are shown in Page 21-23. The percentage of peak value and symmetrical value is the ratio of applied current to calculated current.
 Corrected value=Measured value/1.5

| Tap position | Applied current terminal | Degree | Current measurement | | | | | | Duration (s) | Serial No. | |
|--------------|--------------------------|---------------------------|---------------------|---------------------|----------------|--------------------|---------------------|----------------|--------------|--------------|--|
| | | | Peak value | | | Symmetrical value | | | | | |
| | | | Measured value (A) | Corrected value (A) | Percentage (%) | Measured value (A) | Corrected value (A) | Percentage (%) | | | |
| 1 | AB | № 1 | 3598 | 2399 | 100.7 | 1404 | 936 | 95.4 | 0.50 | B05096-S01-1 | |
| | | № 2 | 3686 | 2457 | 103.1 | 1404 | 936 | 95.4 | 0.50 | B05096-S01-2 | |
| | | № 3 | 3698 | 2465 | 103.5 | 1404 | 936 | 95.4 | 0.50 | B05096-S01-3 | |
| | | Reactance measured | | | | | | | | | |
| | | phase reactance value (Ω) | | | Deviation (%) | | | | | | |
| | | Degree | A | B | C | A | B | C | | | |
| | | before test | 10.07 | 10.08 | 10.07 | / | / | / | | | |
| | | № 1 | 10.06 | 10.09 | 10.10 | <0.1 | <0.1 | 0.30 | | | |
| | | № 2 | 10.06 | 10.09 | 10.09 | <0.1 | <0.1 | 0.20 | | | |
| | | № 3 | 10.07 | 10.09 | 10.09 | <0.1 | <0.1 | 0.20 | | | |



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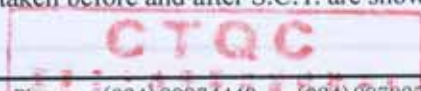
| Tap position | Applied current terminal | Degree | Current measurement | | | | | | | Duration (s) | Serial No. |
|--------------|--------------------------|------------------------------------|---------------------|---------------------|----------------|--------------------|---------------------|----------------|------|--------------|------------|
| | | | Peak value | | | Symmetrical value | | | | | |
| | | | Measured value (A) | Corrected value (A) | Percentage (%) | Measured value (A) | Corrected value (A) | Percentage (%) | | | |
| 3 | BC | No 1 | 3838 | 2559 | 102.6 | 1454 | 969 | 93.9 | 0.50 | B05096-S02-1 | |
| | | No 2 | 3822 | 2548 | 102.2 | 1454 | 969 | 93.9 | 0.50 | B05096-S02-2 | |
| | | No 3 | 3846 | 2564 | 102.8 | 1454 | 969 | 93.9 | 0.50 | B05096-S02-3 | |
| | | Reactance measured | | | | | | | | | |
| | | phase reactance value (Ω) | | | | Deviation (%) | | | | | |
| | | Degree | A | B | C | A | B | C | | | |
| | | before test | 9.02 | 9.04 | 9.10 | / | / | / | | | |
| | | No 1 | 9.02 | 9.03 | 9.11 | <0.1 | -0.11 | 0.11 | | | |
| | | No 2 | 9.04 | 9.04 | 9.07 | 0.22 | <0.1 | -0.33 | | | |
| | | No 3 | 9.01 | 9.06 | 9.10 | -0.11 | 0.22 | <0.1 | | | |

| Tap position | Applied current terminal | Degree | Current measurement | | | | | | | Duration (s) | Serial No. |
|--------------|--------------------------|------------------------------------|---------------------|---------------------|----------------|--------------------|---------------------|----------------|------|--------------|------------|
| | | | Peak value | | | Symmetrical value | | | | | |
| | | | Measured value (A) | Corrected value (A) | Percentage (%) | Measured value (A) | Corrected value (A) | Percentage (%) | | | |
| 5 | CA | No 1 | 3922 | 2615 | 100.2 | 1562 | 1041 | 95.9 | 0.50 | B05096-S03-1 | |
| | | No 2 | 4098 | 2732 | 104.6 | 1562 | 1041 | 95.9 | 0.50 | B05096-S03-2 | |
| | | No 3 | 4038 | 2692 | 103.1 | 1562 | 1041 | 95.9 | 0.50 | B05096-S03-3 | |
| | | Reactance measured | | | | | | | | | |
| | | phase reactance value (Ω) | | | | Deviation (%) | | | | | |
| | | Degree | A | B | C | A | B | C | | | |
| | | before test | 8.12 | 8.11 | 8.18 | / | / | / | | | |
| | | No 1 | 8.11 | 8.11 | 8.16 | -0.12 | <0.1 | -0.24 | | | |
| | | No 2 | 8.10 | 8.11 | 8.19 | -0.25 | <0.1 | 0.12 | | | |
| | | No 3 | 8.12 | 8.11 | 8.17 | <0.1 | <0.1 | -0.12 | | | |

The maximum deviation of short circuit reactance is 0.33%.

4.11.3 The visual inspection

There is no deformation of winding, connection or supporting structures, no traces of electrical discharge was found after S.C.T. The photos of the transformer taken before and after S.C.T. are shown in Page 24 and Page 25.



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4.11.4. Repeated routine tests after short-circuit withstand test

4.11.4.1 Measurement of insulation resistance Test date: May.20,2005
 Humidity: 65% Ambient temperature: 20.8°C

| Measurement position | Insulation resistance (GΩ) |
|----------------------|----------------------------|
| H.V.—L.V.&E | >100 |
| L.V.—H.V. &E | 52.4 |
| H.V.&L.V.—E | 67.8 |

4.11.4.2 Measurement of voltage ratio and check of connection group Test date: May.20,2005

| H.V. | | L.V. | | Ratio | Measured deviation (%) | | | Connec- tion group |
|--------------|--------------|--------------|--------------|--------|------------------------|-------|-------|--------------------------|
| Tap position | Voltage (kV) | Tap position | Voltage (kV) | | AB/ab | BC/bc | CA/ca | |
| 1 | 10.50 | / | 0.4 | 26.250 | 0.03 | 0.03 | 0.02 | Dyn11 |
| 2 | 10.25 | | | 25.625 | -0.01 | -0.01 | -0.01 | |
| 3 | 10.00 | | | 25.000 | -0.01 | -0.05 | -0.02 | |
| 4 | 9.75 | | | 24.375 | -0.07 | -0.05 | -0.05 | |
| 5 | 9.50 | | | 23.750 | -0.09 | -0.08 | -0.07 | |

4.11.4.3 Measurement of winding resistance Test date: May.20,2005
 Ambient temperature: 20.8°C

| Winding | Tap position | Measured values (Ω) | | | Unbalancedness (%) |
|---------|--------------|---------------------|------------|------------|--------------------|
| | | A~B a~b | B~C b~c | C~A c~a | |
| H.V. | 1 | 0.2528 | 0.2532 | 0.2528 | 0.16 |
| | 2 | 0.2463 | 0.2467 | 0.2464 | 0.16 |
| | 3 | 0.2399 | 0.2403 | 0.2399 | 0.17 |
| | 4 | 0.2336 | 0.2340 | 0.2337 | 0.17 |
| | 5 | 0.2273 | 0.2276 | 0.2273 | 0.13 |
| L.V. | / | 0.0003006 | 0.0003007 | 0.0003070 | 2.11 |

4.11.4.4 Separate-source AC withstand voltage test Test date: May.20,2005
 Humidity: 65%; Ambient temperature: 20.8°C; Atmospheric pressure: 101.2kPa

| Position | Applied voltage (kV) | Duration (s) | Results |
|-------------|----------------------|--------------|---------|
| H.V.—L.V.&E | 35 | 300 | Passed |
| L.V.—H.V.&E | 3 | 300 | |



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4.11.5.5 Induced AC withstand voltage test Test date: May.20,2005
 Humidity: 65%; Ambient temperature: 20.8°C; Atmospheric pressure: 101.2kPa

| Tap position | Applied voltage (kV) | Induced voltage (kV) | Induced over-voltage factor | Frequency (Hz) | Duration (s) | Results |
|--------------|----------------------|----------------------|-----------------------------|----------------|--------------|---------|
| | L.V. | H.V. | | | | |
| 3 | 0.8 | 20 | 2 | 200 | 30 | Passed |

4.11.5.6 Measurement of no-load loss and current Test date: May.20,2005

| R.M.S. value voltage (kV) | | No-load current | | No-load loss (kW) | |
|---------------------------------|-----------------------------------|-----------------|------|-------------------|-----------------|
| Reading of mean value voltmeter | Reading of R.M.S. value voltmeter | (A) | (%) | Measured value | Corrected value |
| 0.400 | 0.400 | 6.27 | 0.22 | 3.12 | 3.12 |

Note: The reading tolerance between R.M.S value voltmeter and mean value voltmeter is less than 3%.

4.11.5.7 Measurement of short-circuit impedance and load loss Test date: May.20,2005
 Ambient temperature: 20.8°C

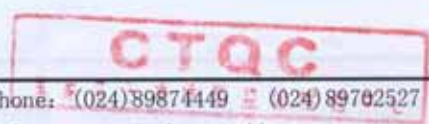
| Winding | Tap position | Applied current I | | Measured voltage (kV) | Short-circuit impedance (Each phase) | | Load loss (kW) | Total loss (kW) |
|-------------------|--------------|-------------------|----------------------|-----------------------|--------------------------------------|-----------------------------|-----------------------------|-----------------------------|
| | | (A) | I/I _r (%) | | H.V. impedance (Ω) | (%) | Corrected value | Corrected value |
| | | | | | t=120°C I=I _r | t=120°C I=I _r | t=120°C I=I _r | t=120°C I=I _r |
| H.V. L.V. | 3 | 113.5 | 98.3 | 0.590 | 3.02 | 6.05 | 13.21 | 16.33 |

4.11.5.8 Partial discharge measurement Test date: May.12,2005

Three phase measurement:

| Applied voltage (kV) | | Duration | Partial discharge level (pC) | | |
|----------------------|-------|----------|------------------------------|-----|-----|
| Multiple | | | A | B | C |
| 18.0 | 1.8Ur | 30s | / | / | / |
| 13.0 | 1.3Ur | 3min | <10 | <10 | <10 |

Note: Background sound level is < 1pC before and after test.



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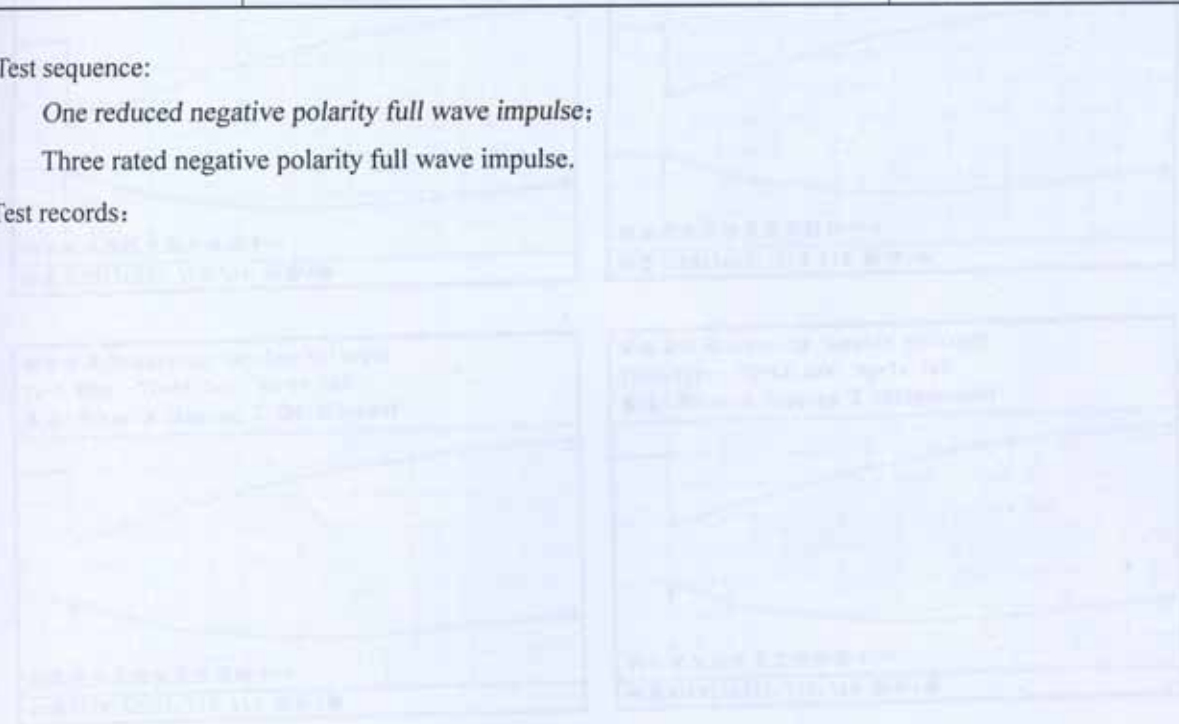
4. 12 Lightning impulse test Test date: May.20,2005
 Test circuit is given in Annex2-h
 Humidity: 37%; Ambient temperature: 20.5°C; Atmospheric pressure: 101.2kPa

Test items and voltage:

| Tested terminals | Rated withstand full wave voltage (kV) | Tap position |
|------------------|--|--------------|
| A, B, C | 75 | 3 |

Test sequence:
 One reduced negative polarity full wave impulse;
 Three rated negative polarity full wave impulse.

Test records:



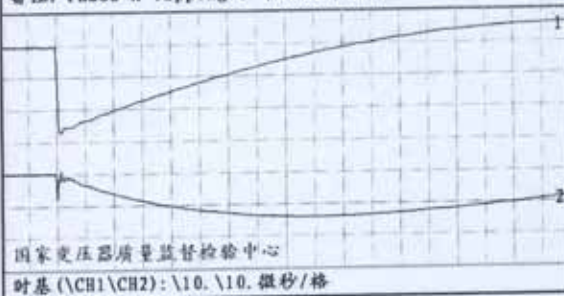
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Tested terminal: A Test polarity: Negative CH1.Voltage records CH2. Neutral current records

雷电全波 (Lightning Impulse Voltage)

T1=1.12us T2=44.6us Up=38.0kV

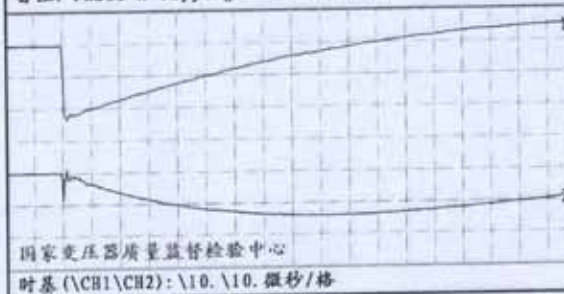
备注: Phase A Tapping 3 (B05096-L01)



雷电全波 (Lightning Impulse Voltage)

T1=1.09us T2=44.5us Up=75.8kV

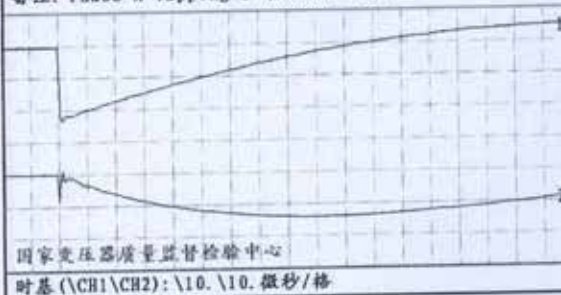
备注: Phase A Tapping 3 (B05096-L02)



雷电全波 (Lightning Impulse Voltage)

T1=1.09us T2=44.5us Up=75.5kV

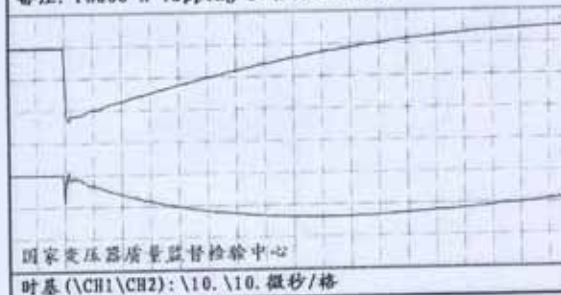
备注: Phase A Tapping 3 (B05096-L03)



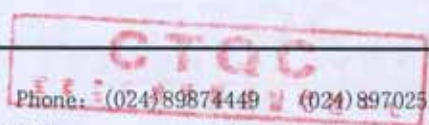
雷电全波 (Lightning Impulse Voltage)

T1=1.11us T2=44.5us Up=74.7kV

备注: Phase A Tapping 3 (B05096-L04)

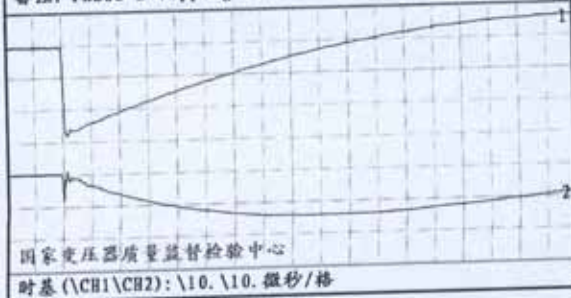


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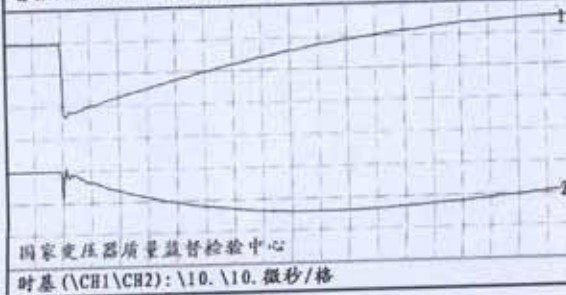


Tested terminal: B Test polarity: Negative CH1.Voltage records CH2. Neutral current records

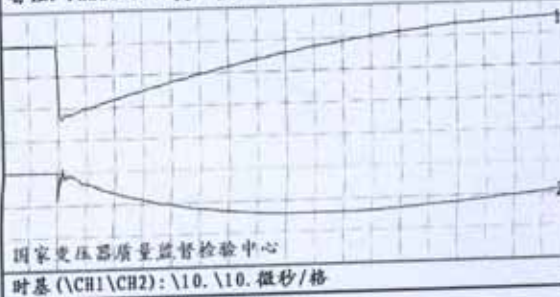
雷电全波 (Lightning Impulse Voltage)
T1=1.09us T2=44.4us Up=38.8kV
备注: Phase B Tapping 3 (B05096-L05)



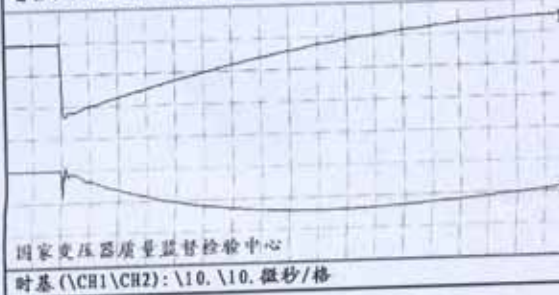
雷电全波 (Lightning Impulse Voltage)
T1=1.04us T2=44.6us Up=74.9kV
备注: Phase B Tapping 3 (B05096-L06)



雷电全波 (Lightning Impulse Voltage)
T1=1.06us T2=44.4us Up=75.7kV
备注: Phase B Tapping 3 (B05096-L07)



雷电全波 (Lightning Impulse Voltage)
T1=1.02us T2=44.4us Up=74.8kV
备注: Phase B Tapping 3 (B05096-L08)



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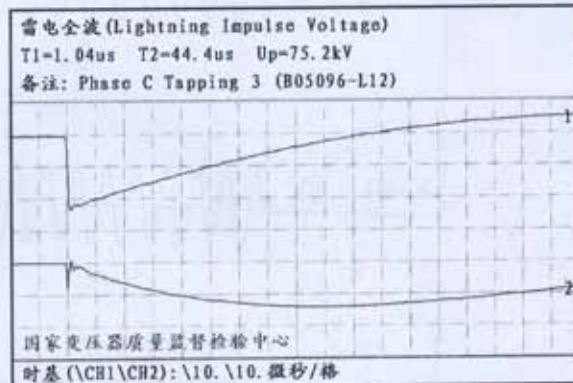
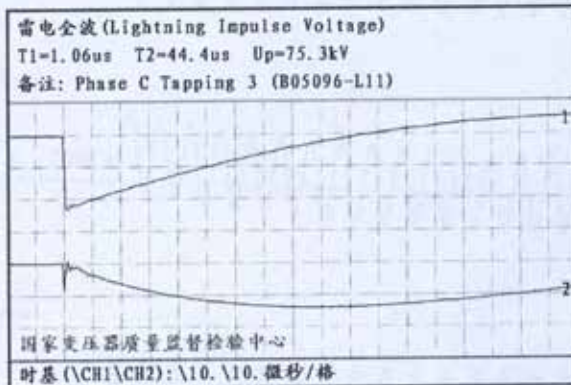
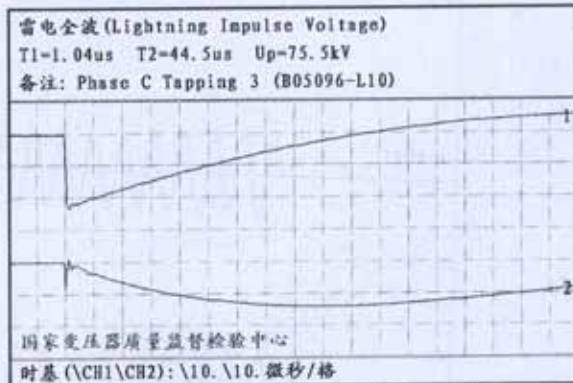
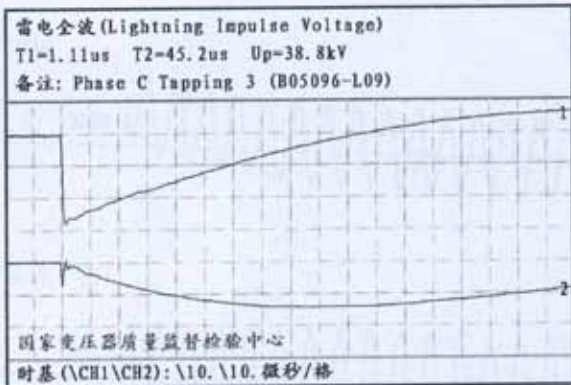
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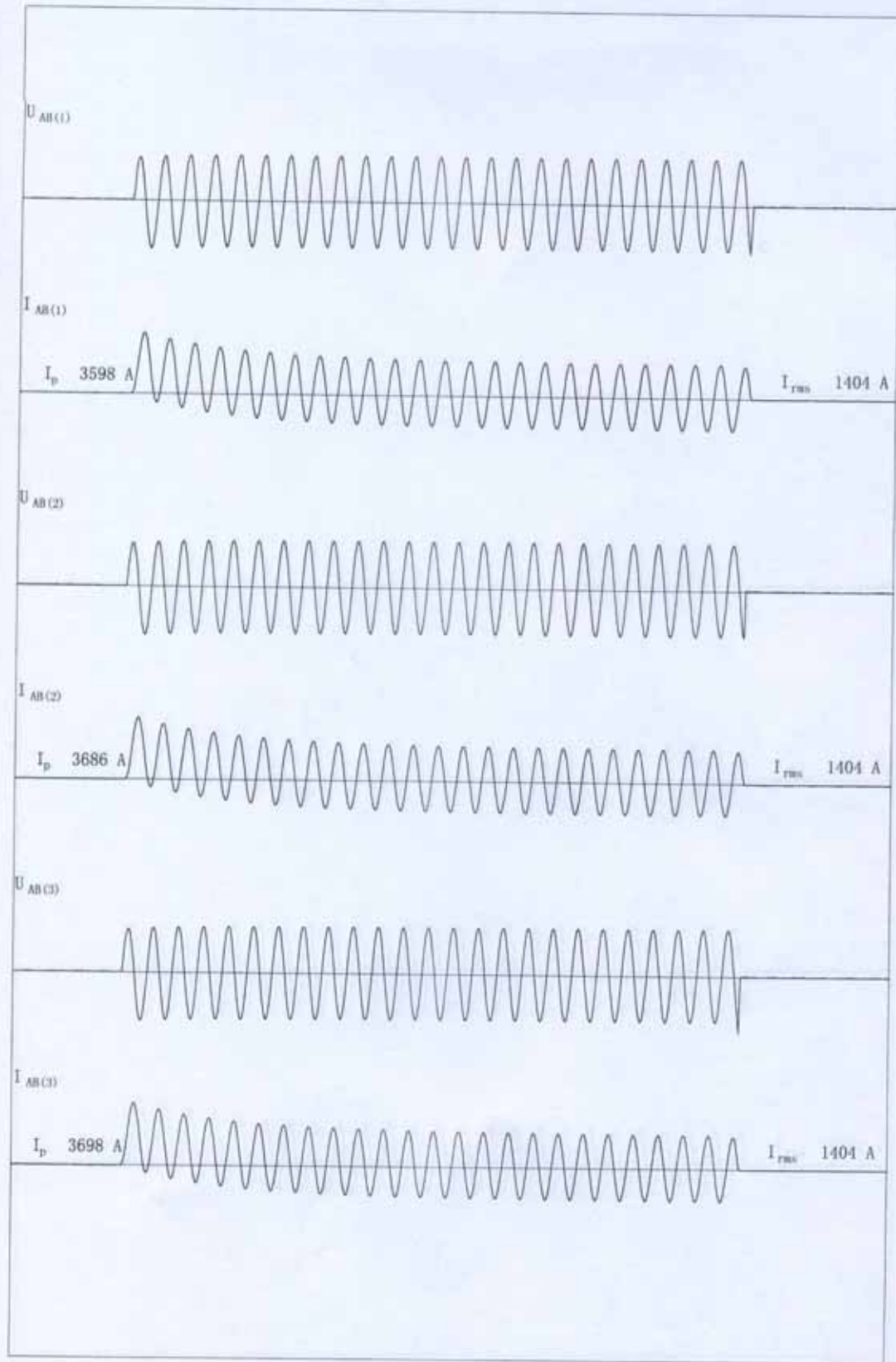
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Tested terminal: C Test polarity: Negative CH1.Voltage records CH2. Neutral current records

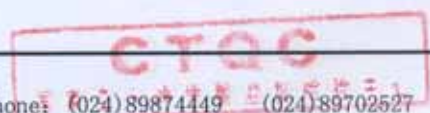


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