

# Report.

70550460-TDT 06-59784A

28-08-2006

Type testing concerning metal-oxide surge arrester without gaps, complete type series YH 10W-3-42 kV, manufacturer Wenzhou Cantor H.V. Electric Manufacturing Co. Ltd., Zhejiang China

**Result**

The test results fulfilled the requirements

**3.1.3 STEEP CURRENT**

One steep current impulse with a waveform of  $1/10 \mu\text{s}$  and a peak value of 10 kA was applied to each of the three sections. The maximum value of the residual voltage was recorded.

The results of this test are summarised in annex B.

The acceptance criterion is:

- the equivalent residual voltage of the arrester at nominal discharge current should be below the specified steep current impulse residual voltage in kV.

**Result**

The test results fulfilled the requirements.

**3.2 Long duration current impulse withstand test**

The long duration current impulse withstand test was carried out on three arrester sections. The rated voltage of one section is 3 kV and consisted of one metal-oxide block. The line discharge class is 1.

Before this test the lightning impulse residual voltage at nominal discharge current and the switching impulse residual voltage at 125 A was measured. The latter was used for calculating the energy, which should be injected into the sample during every long duration impulse. This energy was determined as 2,98 kJ. The duration of the impulse is 2000  $\mu\text{s}$ .

Each sample was tested with 18 long duration impulses divided in 6 groups. Between each impulse there is a pause of 50 to 60 s and between each group the samples are cooled down to ambient.

Following the test and after the samples are cooled down to ambient the lightning impulse residual voltage at nominal discharge current was measured.

The results of this test are summarised in annex B.

The acceptance criteria are:

- no evidence of puncture, flashover or other significant damage
- change of residual voltage should be less than 5%.

## Result

The test results fulfilled the requirements.

### 3.3 Operating duty test

The operating duty test was carried out on three arrester sections. The rated voltage of one section is 3 kV and consisted of one metal-oxide block. Successively the following three tests were carried out.

#### 3.3.4 ACCELERATED AGEING TEST

This test is designed to determine the elevated test voltages and to decide whether new or aged samples shall be used in the operating duty test.

The three samples were subjected to a long duration test with a corrected  $U_{cov}$  of 2,56 kV during 1000 hours. During the whole test duration the resistor power losses are measured. Taken into account the results of these loss measurements and using the calculation method described in the IEC standard the choice between aged and new samples for the following tests has to be made.

#### 3.3.5 CONDITIONING

The conditioning test was made on three new samples. Before the conditioning test the lightning impulse residual voltage at nominal discharge current was determined. Following this the three samples were exposed to 20 lightning current impulses of 8/20  $\mu$ s with nominal discharge current. The impulses were applied while the sample was energized at  $1,2 \times U_{cov}$ . The 20 impulses are applied in four groups of 5 impulses. The interval between each impulse was 50-60 s and between each group 25-30 min.

#### 3.3.3 HIGH CURRENT IMPULSE OPERATING DUTY TEST, APPLICATION OF IMPULSES

The operating duty test is made on the same samples as during conditioning, above. The samples were placed in a housing, which is thermal equivalent to the housing of a complete arrester.

All three samples were tested with two high current impulses of 100 kA, 4/10  $\mu$ s. Before the application of the second impulse the samples were pre heated to a temperature of 60 °C.

Immediately after the second application of the high current impulse, a power frequency of  $U_r$  during 10 s and  $U_{cov}$  during 30 min. was applied. During these 30 min. the power dissipation of the sample was measured.

Following this and after the samples are cooled down to ambient the lightning impulse residual voltage at nominal discharge current was measured.

The results of this test are summarised in annex B.

The acceptance criteria is:

- the measurement of the losses during the voltage application did not show thermal instability
- change of residual voltage should be less than 5%
- no evidence of puncture, flashover or other significant damage.

### **Result**

The test results fulfilled the requirements.

## INSPECTION REPORT

Report no. 70550460-TDT 06-59784A  
Client Wenzhou Cantor H.V. Electric Manufacturing Co. Ltd  
Zhejiang, China  
Reference -  
Concerning type testing  
Date March 21, 2006 to June 7, 2006  
Place Xi'an, China  
Object metal-oxide surge arrester without gaps  
Type Complete type series YH 10W-3-42 kV  
Manufacturer Wenzhou Cantor H.V. Electric Manufacturing Co. Ltd  
Zhejiang, China

### REQUIREMENTS

As per IEC 60099-4 Second Edition (2004-05).

### INSPECTION PROGRAMME

The programme was specified by KEMA Nederland B.V.  
For the programme we refer to page 3.

### SUMMARY AND CONCLUSION

The results obtained relate only to the work ordered and to the material inspected.  
The arrester withstood all type tests as per inspection program of page 3.

Author André W. van Boetelaer

KEMA Nederland B.V.

This B-report consists of:  
11 pages  
2 annexes (42 pages)

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

Arnhem, August 28, 2006

**MATERIAL DATA**

**Metal-oxide surge arrester without gaps**

Type		Series YH 10W-3-42 kV
Manufacturer		Wenzhou Cantor H.V. Electric Manufacturing Co. Ltd Zhejiang, China
Housing material		polymer
Rated voltage $U_r$	kV	3-42
Reference voltage (1 mA)	kV	$\geq 3-42$
Rated frequency	Hz	50
Nominal discharge current	kA	10
Continuous operating voltage $U_{cov}$	kV	2,4-33,6
Residual voltage at		
- nominal discharge current 8/20 $\mu$ s	kV	$\leq 8,5-119$
- switching current 30/60 $\mu$ s	kV	$\leq 7,3-102,2$
- steep current 1/10 $\mu$ s	kV	$\leq 9,8-137,2$
Line discharge class		1
Housing insulation level		
- lightning impulse	kV	12-160
- power frequency	kV	7-80
Arrester mechanical load		
- torsional	Nm	50
- cantilever	N	147
Block dimensions		
- diameter	mm	53
- height	mm	22
Number of metal-oxide blocks		1-14
Rated short-circuit withstand current	kA	-

The exact data of each type of arrester from this series as well the drawings are summarized in annex A, page 1 to 18.

## INSPECTION PROGRAM

The inspection program was specified by KEMA. All measurements and tests are in accordance with IEC 60099-4 (2004-05).

	Kind of test	Standard	Clause
1	COMPLETE ARRESTER		
1.1	Reference voltage measurement	IEC 60099-4	7.2
1.2	Internal partial discharge test	IEC 60099-4	8.8
1.3	Mechanical tests	IEC 60099-4	
1.3.1	Moisture ingress test	IEC 60099-4	10.8.13
1.3.2	Weather ageing test	IEC 60099-4	10.8.14
2	ARRESTER HOUSING		
2.1	Lightning impulse voltage test	IEC 60099-4	8.2.6
2.2	Power frequency voltage test, wet	IEC 60099-4	8.2.8
3	ARRESTER SECTION		
3.1	Residual voltage test	IEC 60099-4	
3.1.1	Lightning impulse	IEC 60099-4	8.3.2
3.1.2	Switching impulse	IEC 60099-4	8.3.3
3.1.3	Steep current	IEC 60099-4	8.3.1
3.2	Long duration current impulse withstand test	IEC 60099-4	8.4.3
3.3	Operating duty test	IEC 60099-4	
3.3.1	Accelerated ageing test	IEC 60099-4	8.5.2
3.3.2	Conditioning	IEC 60099-4	8.5.4.1
3.3.3	High current impulse surge operating duty test, application of impulses	IEC 60099-4	8.5.4.2

**PERSONS ATTENDING THE INSPECTION**

Mr Xiao'ou Zheng

Wenzhou Cantor H.V. Electric Manufacturing Co. Ltd

**THE INSPECTION WAS CARRIED OUT BY**

Mr André W. van Boetelaer

KEMA Nederland B.V.

**PURPOSE OF THE INSPECTION**

Purpose of the inspection was to verify whether the arrester complies with the specified requirements.



## DESCRIPTION AND RESULTS OF THE TEST

### 0 INSPECTION OF THE TEST SET-UP

The tests were carried out in the laboratory of China National Centre for Quality Supervision and Test of Insulators and Surge Arresters in Xi'an, China, who is therefore jointly responsible for the correctness of the results obtained. The measuring devices and the test set-up were checked by KEMA and where necessary calibrated.

#### **Result**

The inspection results did not give rise to remarks.

### 1 COMPLETE ARRESTER

#### 1.1 Reference voltage measurement

The reference voltage of the arrester is defined as the power frequency voltage applied to the arrester when the resistive component of the current flowing through the arrester is 1 mA<sub>peak</sub>. The reference voltage should be greater than the value as stated in the material data. The reference voltage measurement was carried out on three complete arresters of the 42 kV type which is representative for the whole series. The results of this measurement are summarised in annex B.

#### **Result**

The test results fulfilled the requirements.

#### 1.2 Internal partial discharge test

The internal partial discharges were measured when applying a power frequency voltage to the arrester. The voltage was first raised to the rated voltage, held for 10 s and then decreased to 1,05 times the continuous operating voltage at which level the partial discharges were measured. The partial discharge level should be below 10 pC. The reference voltage measurement was carried out on three complete arresters of the 42 kV type which is representative for the whole series. The results of this measurement are summarised in annex B.

## Result

The test results fulfilled the requirements.

### 1.3 Mechanical tests

#### 1.3.1 MOISTURE INGRESS TEST

One sample of a complete arrester of the 42 kV type which is representative for the whole series was submitted to the following test sequence:

- initial measurements: partial discharge-, watt losses- and residual voltage measurement
- terminal torque test at rated torque
- thermo mechanical test in four directions with rated cantilever load at temperatures of respectively +60 °C, -25 °C, +45 °C and -40 °C
- water immersion test in boiling water with NaCl for 42 hours
- visual inspection of the sample
- verification tests: partial discharge -, watt losses- and residual voltage measurement.

The results of this test are summarised in annex B.

The acceptance criteria are:

- no mechanical change
- increase of watt losses should be less than 20%
- partial discharges < 10 pC at  $1,05 U_{cov}$
- change of residual voltage should be less than 5%.

## Result

The test results fulfilled the requirements.

#### 1.3.2 WEATHER AGEING TEST

One ratio arrester with an U, of 15 kV and an equivalent creepage distance was specially prepared for this test. This sample was submitted to the following test sequence:

- initial measurements: reference voltage- and partial discharge measurement
- test series A: 1000 hours at a constant power frequency voltage of  $U_{cov}$  (12 kV) in a climate room sprayed with salt water and a flow rate of  $0,4 \pm 0,1$  l/h/m<sup>3</sup>
- verification tests: reference voltage- and partial discharge measurement.

The results of this test are summarised in annex B.

The acceptance criteria are:

- change of reference voltage should be less than 5%
- partial discharges  $< 10$  pC at  $1,05 U_{cov}$ .

### **Result**

The test results fulfilled the requirements.

## **2 ARRESTER HOUSING**

### **2.1 Lightning impulse voltage test**

One empty housing of the 42 kV type which is representative for the whole series was subjected to a standard lightning impulse voltage dry test with 15 impulses of positive polarity and 15 impulses of negative polarity and a crest value of 160 kV.

The results of this test are summarised in annex B.

The acceptance criterion is:

- not more than two external disruptive discharges per 15 impulses.

### **Result**

The test results fulfilled the requirements.

### **2.2 Power frequency voltage test, wet**

One empty housing of the 42 kV type which is representative for the whole series was tested with a power frequency of 80 kV, 50 Hz during 1 minute under artificial rain in accordance with IEC 60060-1 (1989).

The results of this test are summarised in annex B.

The acceptance criterion is:

- no external disruptive discharge during the test

**Result**

The test results fulfilled the requirements.

**3 ARRESTER SECTION****3.1 Residual voltage test**

All residual voltage tests were carried out on the same three arrester sections. The rated voltage of one section is 3 kV and consisted of one metal-oxide block. By multiplying the measured residual voltage by the number of sections per arrester the equivalent residual voltage of the arrester was calculated.

**3.1.1 LIGHTNING IMPULSE**

Three lightning current impulses with a waveform of 8/20  $\mu$ s with a peak value of respectively 5, 10 and 20 kA, this is respectively 0,5, 1 and 2 times the nominal discharge current, were applied to each of the three sections. The maximum value of the residual voltage was recorded. The results of this test are summarised in annex B.

The acceptance criterion is:

- the equivalent residual voltage of the arrester at nominal discharge current (10 kA) should be below the specified residual voltage in kV.

**Result**

The test results fulfilled the requirements.

**3.1.2 SWITCHING IMPULSE**

One switching impulse with a waveform of 30/60  $\mu$ s and a peak value of 500 A was applied to each of the three sections. The maximum value of the residual voltage was recorded.

The results of this test are summarised in annex B.

The acceptance criterion is:

- the equivalent residual voltage of the arrester should be below the specified switching impulse residual voltage in kV.