



Zkušebnictví, a. s.

zkratovna

HIGH
POWER
LABORATORY

06 - 042

zkratovna
Zkušebnictví, a. s.

Podnikatelská 547, 190 11 Praha 9, Běchovice, Czech Republic

TEST REPORT
No. 06 - 042

Test object : NEUTRAL GROUNDING RESISTOR
Type : G-11-1000-10-S-HV-SF-TC
Serial No. : O NE 05 07 012-3 / 019

Ratings
Rated voltage : $11/\sqrt{3}$ kV
Rated current : 1000 A

Manufacturer : M. S. RESISTANCES
Rue du Crêt de la Perdrix, Zone Industrielle du Coin
42400 St CHAMOND, France

Test performed : Temperature-rise test

Customer : M. S. RESISTANCES
Rue du Crêt de la Perdrix, Zone Industrielle du Coin
42400 St CHAMOND, France

Date of test : 24.04. 2006

THIS TEST REPORT IS CONFIDENTIAL AND SHALL NOT BE PASSED OVER OR TRANSFERRED TO ANY THIRD PARTY WITHOUT WRITTEN APPROVAL OF THE CUSTOMER.

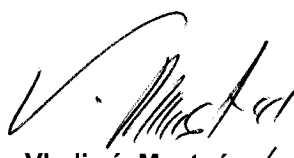
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Number of issued copies: 3
Praha 9, Běchovice

26.5.2006
Tested by:


Martin Vaniš




Vladimír Mastný
Head of the Laboratory



Copy No.: 1

Description of the test object

Neutral grounding resistor for the purpose of controlling the ground of an alternating current system.
The test object was identified according to the drawings:

E0205/AMT/COM/00301/C Neutral Earthing Resistor: $11/\sqrt{3}$ kV-1000A/10s
E0205/AMT/COM/00302/D Neutral Earthing Resistor: $11/\sqrt{3}$ kV-1000A/10s

layout drawing
single line&cabling
details

Routine tests report No. ORT 05 07 012-24

Date of the test: 21.03.2006

Ratings assigned by the manufacturer

Type : G-11-1000-10-S-HV-SF-TC
Serial No. : O NE 05 07 012-3 / 019
Rated voltage : $11/\sqrt{3}$ kV
Rated current : 1000 A
Rated time : 10 s
Resistance at 40 °C : $6,35 \Omega \pm 10\%$
Temperature-rise : 350 K
Temperature coefficient of resistance : $1,45 \times 10^{-3} K^{-1}$
Rated energy : 44,5 MJ
Rated insulation level : 28 kV (AC-1 min), 75 kV (BIL)
Outline dimensions : 1610 × 1820 × 1720 mm
Weight : 480 kg
Installation : outdoor

Test specification

The tests were carried out according to the customer's instructions. The test procedures, parameters and test assessment criteria are based on the IEEE-32 (1972).

Test parameters

Test voltage : 6,35 kV
Duration of the test current : 10 s

Summary

All the tests were carried out as required by the test specification.

More details of the tests performed are given in the enclosed tables and graphs.

Test conditions

Working frequency

$f = 42,5 \text{ Hz} \pm 49,5 \text{ Hz}$

The temperature-rise test was performed in a single phase test circuit with a value of the supply no-load voltage of ca 6,6 kV. The tests were carried out in a test cell.

The values of the voltage and current were recorded for the purpose of calculation of the temperature-rise. Furthermore the temperature was measured by means of 4 thermocouples welded to resistor's active parts. The temperature measurement started approximately 20 s after the temperature-rise test.

The measurement of the resistance was carried out before and after the tests.

The test circuit, including measurement points, is illustrated in the diagram Sch. 1.

The connection of the test object to the test circuit is documented by the photograph in Fig. 1.

The thermocouples positions during the temperature measurement are marked in the drawing No. E0205/AMT/COM/00301/C.

The tests were witnessed by

Hakam ELASSAD, M. S. RESISTANCES, France

Mohammed Khalid Raza, Federal Electricity & Water Authority, United Arab Emirates

Samson Allace, Federal Electricity & Water Authority, United Arab Emirates

Notice:

The test results relate only to the tests given in this Test Report. No documents of administrative, business or other character can be substituted by this Test Report.

List of symbols

a) Used in the table of test results

I_1	-	test current at the beginning of the test ($t \pm 0,05$ s)
I_2	-	test current at the middle of the test ($t \pm 0,5 t_i$)
I_3	-	test current at the end of the test ($t \pm 0,99 t_i$)
U_1	-	test voltage at the beginning of the test ($t \pm 0,05$ s)
U_2	-	test voltage at the middle of the test ($t \pm 0,5 t_i$)
U_3	-	test voltage at the end of the test ($t \pm 0,99 t_i$)
R_1	-	resistance at the beginning of the test
R_2	-	resistance at the middle of the test
R_3	-	resistance at the end of the test
W	-	total injected energy
W_r	-	rated energy
t_i	-	duration of test current
$\Delta\theta$	-	temperature-rise
$\Delta\theta_c$	-	corrected temperature-rise
α	-	temperature coefficient of resistance
I_{ss}	-	DC current
U_{ss}	-	DC voltage
R	-	resistance
R_{40}	-	resistance recalculated to 40 °C
θ_1	-	temperature on top of the active part (more closely to control panel)
θ_2	-	temperature on top of the active part (along from control panel)
θ_3	-	temperature in middle of the active part
θ_4	-	temperature on bottom of the active part
θ_a	-	ambient air temperature
t	-	time

b) Used in the oscillograms

I	-	current course
U	-	voltage course
t	-	time

c) Used in the graph

θ_1	-	temperature on top of the active part (more closely to control panel)
θ_2	-	temperature on top of the active part (along from control panel)
θ_3	-	temperature in middle of the active part
θ_4	-	temperature on bottom of the active part
t	-	time

The Test Report contains: **16** sheets i.e.:

- 1 introductory sheet
- 1 title sheet
- 3 text sheets
- 4 table sheets
- 1 test circuit diagram
- 3 photos
- 1 graph
- 2 oscillograms

1. Table of test results: Temperature-rise test

Test circuit diagram: Sch. 1

File denomination: resi24ds

Measured values

Test No.	I ₁ (A)	I ₂ (A)	I ₃ (A)	U ₁ (kV)	U ₂ (kV)	U ₃ (kV)	W (MJ)	t _i (s)	Observation
004	985	740	638	6,46	6,53	6,55	50,3	10,07	white smoke

Temperature-rise calculation

- calculation of the resistance variation during the test

Test No.	R ₁ (Ω)	R ₂ (Ω)	R ₃ (Ω)
004	6,558	8,824	10,27

- calculation of the temperature-rise

$$\Delta\theta = \frac{\frac{R_3}{R_1} - 1}{\alpha} \Rightarrow \Delta\theta = 390 \text{ K}$$

- correction to the injected energy

$$\frac{W}{W_r} = \frac{\Delta\theta}{\Delta\theta_c} \Rightarrow \Delta\theta_c = 345 \text{ K}$$

2. Table of test results: Temperature measurement after temperature-rise test

Ambient air temperature: 23 °C

t (min)	θ ₁ (°C)	θ ₂ (°C)	θ ₃ (°C)	θ ₄ (°C)
0,3	143,4	162,3	166,3	70,7
1,0	150,7	172,7	173,7	68,5
2,0	165,3	191,7	194,4	65,2
3,0	176,2	205,8	205,2	62,8
4,0	188,0	216,4	213,4	61,2
5,0	197,4	224,4	219,5	61,1
6,0	206,1	229,3	222,8	60,5
7,0	212,4	232,8	224,0	60,2
8,0	217,8	234,8	224,3	60,5
9,0	221,0	235,9	223,4	60,3
10,0	223,7	236,0	221,7	60,2
11,0	225,4	235,9	219,9	60,8
12,0	225,8	234,7	217,1	60,6
13,0	226,4	233,4	214,8	61,1
14,0	225,9	231,8	211,8	60,9
15,0	224,9	230,0	209,2	60,9

3. Table of test results: Resistance measurement at ambient air temperature

Before test				After test			
I_{ss} (A)	U_{ss} (V)	R (Ω)	θ_a ($^{\circ}\text{C}$)	I_{ss} (A)	U_{ss} (V)	R (Ω)	θ_a ($^{\circ}\text{C}$)
1,00	6,412	6,412	17,1	1,010	6,447	6,383	16,5
Correction to 40 $^{\circ}\text{C}$							
$R_{40} = 6,624 \Omega$				$R_{40} = 6,601 \Omega$			

Meteorological conditions

Test No.	Date (dd.mm.yy)	Time (hh:mm)	Relative humidity (%)	Atmospheric pressure (hPa)
004	24.04.06	14:22	53	988

Test circuit parameters

Direct tests

File denomination		resi24ds
Test No.		004
Test circuit diagram		Sch. 1
Generator		J
Rated (phase to phase) voltage	(kV)	8
Phases connected		R, T
Inductance per phase	(mH)	0,133
Inductance of reactors per phase	(mH)	1,58
Resistance of resistors per phase	(Ω)	---
Short-circuit transformer		---
Connection		---
Transf. ratio		---
Inductance per phase	(mH)	---
High-current transformer - Connection		---
Transf. ratio		---
Inductance per phase	(mH)	---
Total inductance per phase of supply circuit	(mH)	1,71
Power factor		0,95
Capacity in parallel	(μ F)	---
Resistance in series	(Ω)	---
Neutral point of supply circuit		---
Short-circuit point		earthed
Load transformer		---
Connection		---
Transf. ratio		---
Resistance of load resistors	(Ω)	---
Inductance of load reactors	(mH)	---
Capacity of load capacitors	(μ F)	---
Neutral point of load circuit		---

Measuring devices used

Test circuit diagram: Sch. 1

File denomination: resi24ds.001, 004

Measurand	Sensor	Sensor parameters	Serial No.	Calibration resi24ds.001	
				Calibration value	Evaluated value
I	cage shunt	5 kA / 2 V	006/95	1000 A	1002 A
U	resistance voltage divider	125 kV /150 V	DR 001/78	8,333 kV	8,353 kV

Recording devices:

- Measuring system with digital optoelectronic transmission (type TR-01M)

Optoelectronic transmissions:

- MAC

Temperature measurement

Multichannel thermometer Microtherm, serial No. 8252002454

Multichannel thermometer Microtherm, serial No. 8252002451

Thermocouple, type K

Mercury thermometer Exatherm, type glass, serial No. T01/04

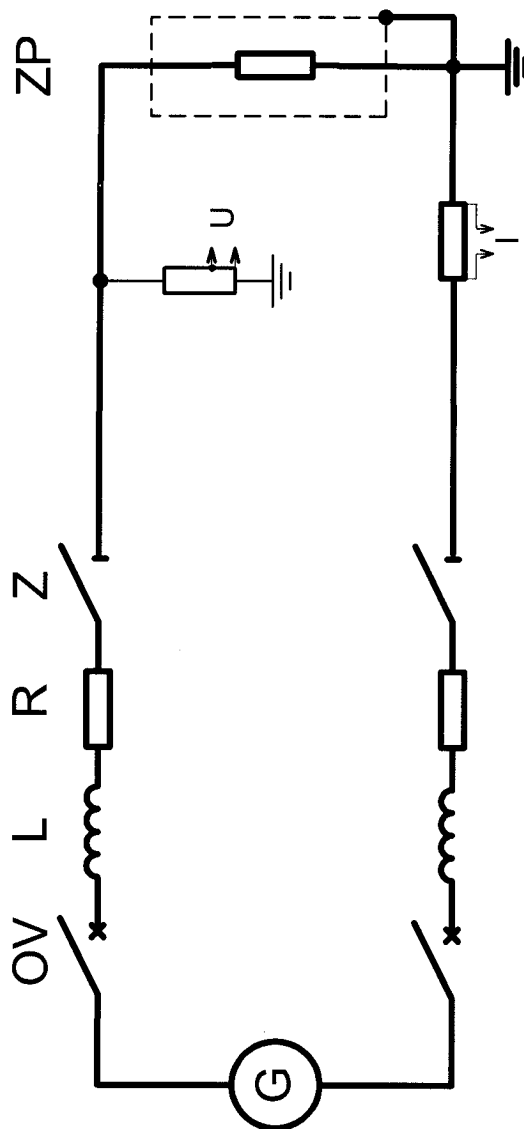
Resistance measurement

Digital multimeter METEX, type M-4660A, serial No. EB290286

Digital multimeter METEX, type M-4660A, serial No. EB289901

Meteorological conditions measurement

Meteorological station, type Vantage Pro 2, serial No. 3788-6312



- G - Short-circuit generator
- OV - Master breaker
- L, R - Reactors and resistors
- Z - Make switch
- ZP - Test object
- I, U - Current and voltage measurement

Test circuit diagram Sch. 1



Fig. 1
Connection of the test object to the test circuit

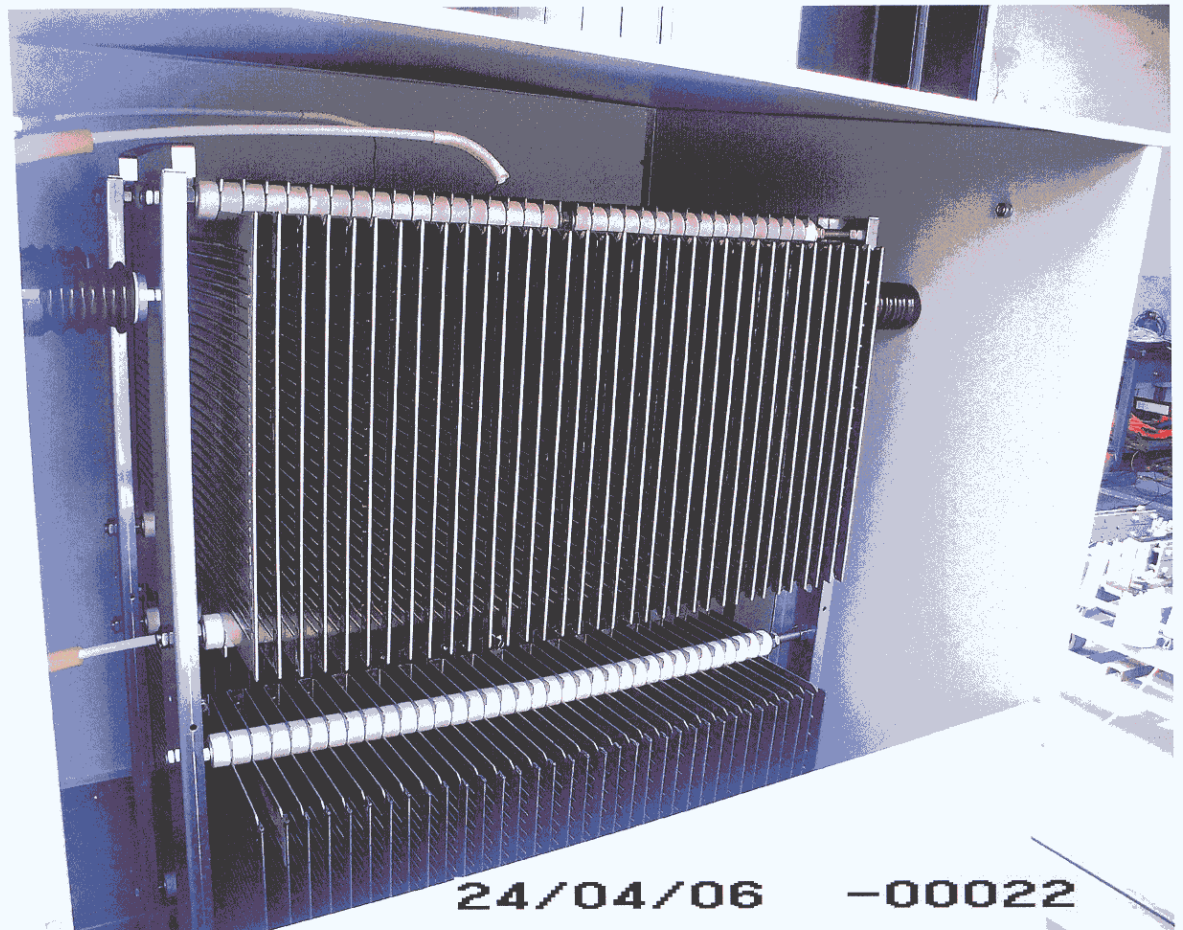


Fig. 2
Test object after the test


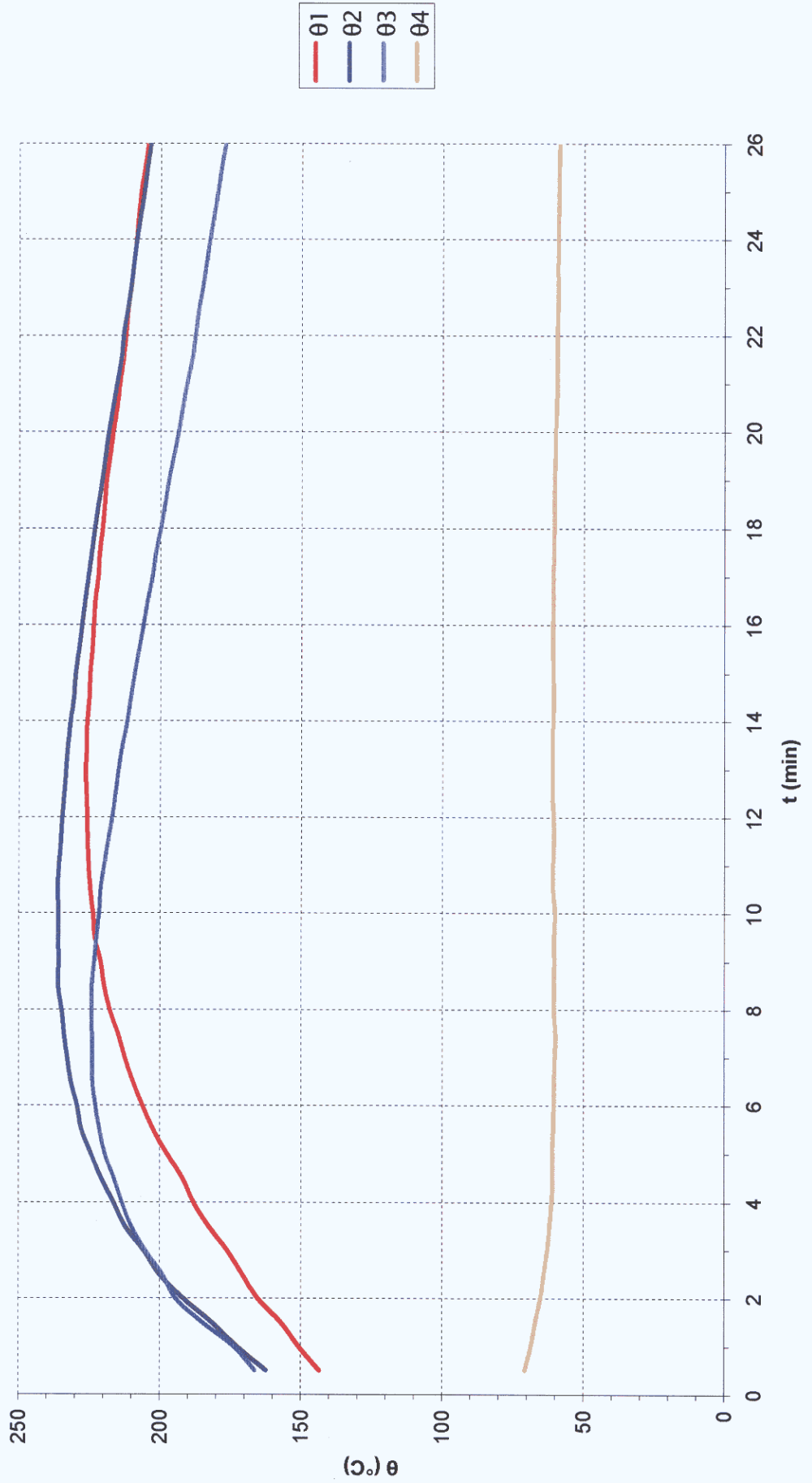
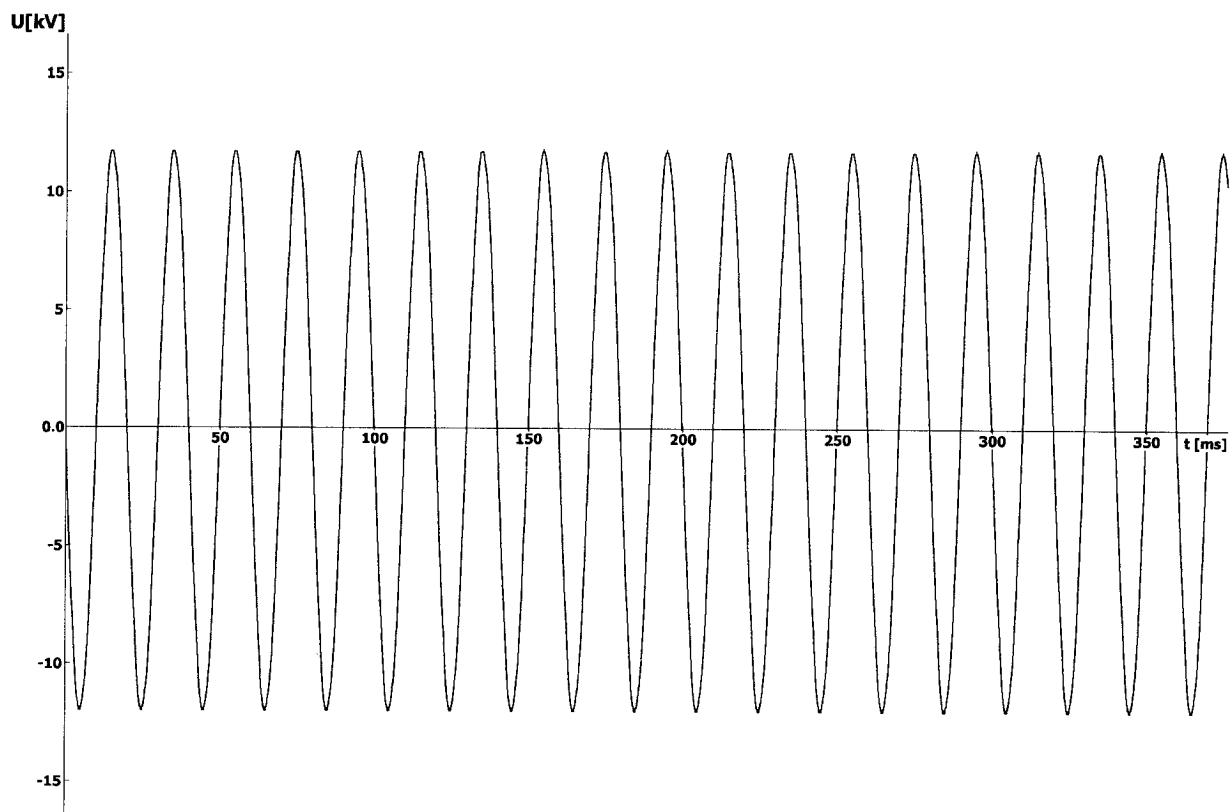
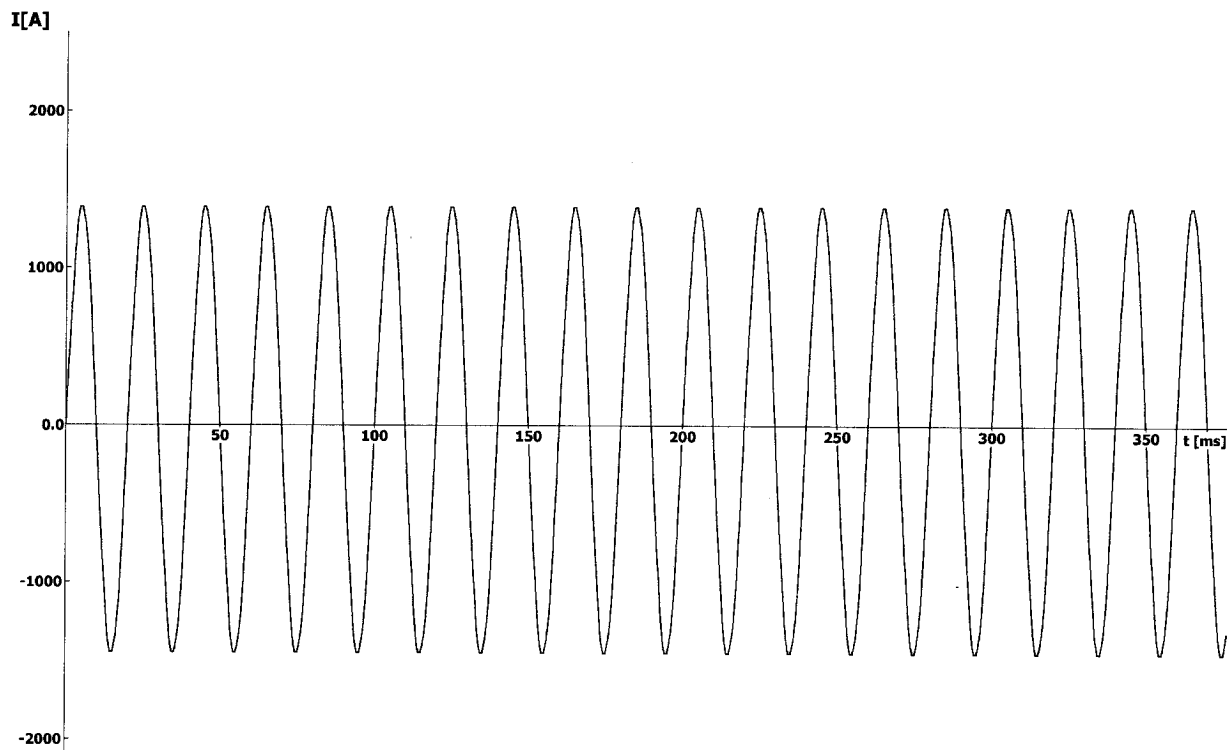
		NEUTRAL EARTHING RESISTOR	
M.S. RESISTANCES Z.I. du Coin 42400 Saint-Chamond / FRANCE		Type	G-11-1000-10-S-HV-SF-TC
		Serial	ONE 05 07 012- 3 / 019
		Tech.	RJ
		Use	OUTDOOR
Date	W49 /05	Nb of Frames / Resistor	1
System Voltage (kV)	11	Rated Voltage (kV)	6.35
		Rated Frequency (Hz)	-
Rated Current (A)	1000	Rated Time (Sec)	10
Add. Current (A)	-	/ (Sec)	-
		Permissible Current (% of Rated Current)	-
Resistance (Ohm)	6.35	at temperature (°c)	40
		Temp. Coefficient (x 0,001 / °c)	1.45
Temp. Rise (°c)	350	Weight / Frame (kG)	480
C.T. : 1200/1/1A - 12kV Disconnecter: 12kV - 1250A/10sec - 31.5kA/3sec c/w 6 N.O. & 6 N.C. each 20MVA - ONAN - HVDT			
<i>Made in France</i>			

Fig. 3
Name plate

Graph: Temperature curves after the temperature-rise test



resi24ds.001



resi24ds.004

