KEMA
DE ZOETEN LABORATORIUM
Utrechtseweg 310 – 6812 AR Arnhem – The Netherlands

REPORT OF PERFORMANCE 485–91

CLIENT	National Switchgears, Ambattur, Madras, India
MANUFACTURER	National Switchgears, Ambattur, Madras, India
APPARATUS	Punched stainless steel resistor
SERIAL No.	K/071

RATINGS ASSIGNED BY THE MANUFACTURER

Resistance	5.34	Ω
Voltage	66	kV(1)
Thermal current	200	A
Duration	10	s
Frequency	50	Hz

(1) Total voltage of 3 units in series.

The tests have been carried out in accordance with the client's instructions.
Test procedure and test parameters were based on ANSI/IEEE Std. 32.

Date of tests 14th and 15th November 1991

The performance of the apparatus tested and the observations made during the tests have been recorded in the tables with test results and the oscillograms.

THIS REPORT CONSISTS OF:

Sheets	5
Circuit diagrams	1
Electromagnetic oscillograms	1
Photographs	2
Report no.	1429-91
Information sheet	B70E

N.V. KEMA

H.W. Kemper

Arnhem, 9th December 1991

KEMA

TYPE OF TEST	LOCATION	TEST DATE	OBSERVER	SHEET
Dielectric tests	High-Voltage Laboratory	14th November 1991	W.J.W.M. Sloot	Report 1429-91
10 s temperature-rise test	De Zoeten Laboratorium	15th November 1991	M. Lusing	3 and 4

The tests were witnessed by :

Name	**Company**
Samy, R. P.	National Switchgears, Ambattur, Madras, India

Photographs

141303
141304

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REPORT 485-91	TABLE WITH TEST CIRCUITS				SHEET 2	
TEST CIRCUIT No.	S01					
Number of phases	1					
Power frequency Hz	50					
Generator neutral	not earthed					
Transformer connections	single phase					
Short-circuit point	earthed					
Circuit impedance Ω	94					
Power factor	< 0.1					
TRV control elements added: Capacitance in parallel C_1 µF						
TRV control elements added: Resistance in series R_1 Ω						
TRV control elements added: Resistance in parallel R_1 Ω						
TRV control elements added: Inductance in parallel with R_1 L_1 mH						
TRV control elements added: Time delay Capacitance C_d nF						
TRV control elements added:						
TRV control elements added:						
Prospective TRV: TRV peak value u_c kV						
Prospective TRV: Time co-ordinate t_3 µs						
Prospective TRV: Time delay t_d µs						
Prospective TRV: Based on kVrms						
Prospective TRV: Depression						
Prospective TRV: Rate-of-rise kV / µs						
Prospective TRV:						
Prospective TRV:						

EU1E

871001

TABLE WITH TEST RESULTS

REPORT 485-91 | TYPE OF TESTS REQUESTED: Short-time withstand current test | TEST CIRCUIT S01 | SHEET 3

Condition before tests: Resistor new. Photograph 141303.
Top connections made by means of flexible connectors.
Ambient temperature: 8 °C.

Before the temperature-rise test a power-frequency voltage withstand test and a lightning-impulse voltage withstand test was carried out at our High-Voltage Laboratory.
See report no. 1429-91 (included).

Date and test	Test quantities: Peak value of current (A)	Symmetrical current: Beginning (A)	Middle (A)	End (A)	Average (A)	Duration (s)	Voltage: Beginning (kV)	Middle (kV)	End (kV)	Maximum temperature (1) (°C)						Physical behaviour: Emission of: Flame	Gas		Remarks
																none	none		
911115 5006		204	206	206	205	10.1	1078	1276	1461	467									No visible disturbance.

Condition after tests: Externally no visible change.
Porcelain intact.
Photograph 141304.

(1) During the test an infra-red temperature measurement was carried out to detect the hottest spot in the resistor.
(See next sheet).

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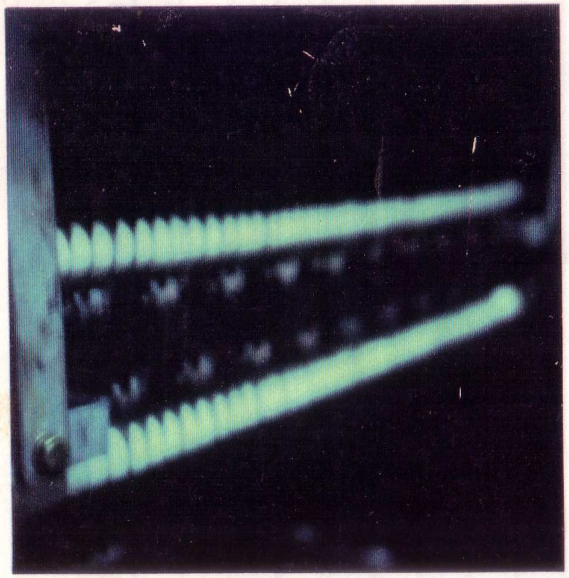
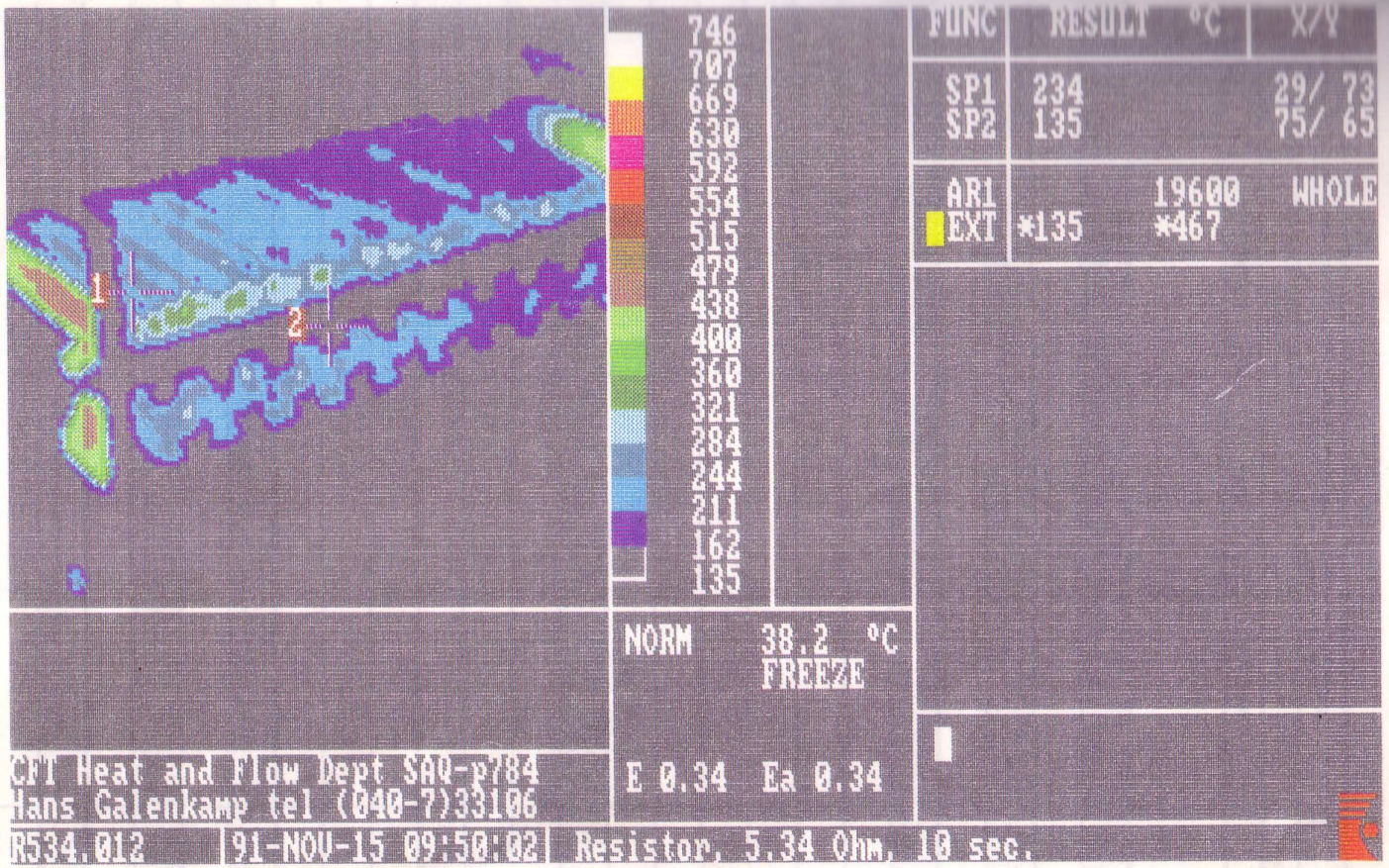
PLOT WITH TEST RESULTS

REPORT 485-91 | infra-red temperature measurement | SHEET 1





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REPORT 485-91	CALIBRATION OF ELECTROMAGNETIC OSCILLOGRAM	SHEET 5

Time marking ▶		100 ms	ms	ms	ms	ms
		Test	Test	Test	Test	Test
Trace ▼	Phase ▼	911115 5006				
CURRENT OPENING COIL momentary A/mm						
CURRENT CLOSING COIL momentary A/mm						
VOLTAGE momentary kV/mm						
1		0.44				
CURRENT momentary A/mm						
2		16.0				
AMPLIFIED VOLTAGE momentary V/mm						
AMPLIFIED CURRENT momentary A/mm						
I^2t $10^3 \times A^2$ s/mm						
POWER MW/mm						
ENERGY MJ/mm						
PRESSURE bar/mm						

☞ Trace No. 1 is indicated on each oscillogram. Traces are numbered from top to bottom except for travel recorders. ☜
For practical reasons travel recorder traces bear no number.

TEST-CIRCUIT DIAGRAM

REPORT No. 485-91		TEST CIRCUIT No. S01

CIRCUIT COMPONENTS

G = Generator
MB = Master breaker
MS = Make switch
PT = Power transformer

R = Resistor
C = Capacitor
L = Inductance

TO = Test object
AL = Artificial line

AB = Auxiliary breaker
OP = Overvoltage protection

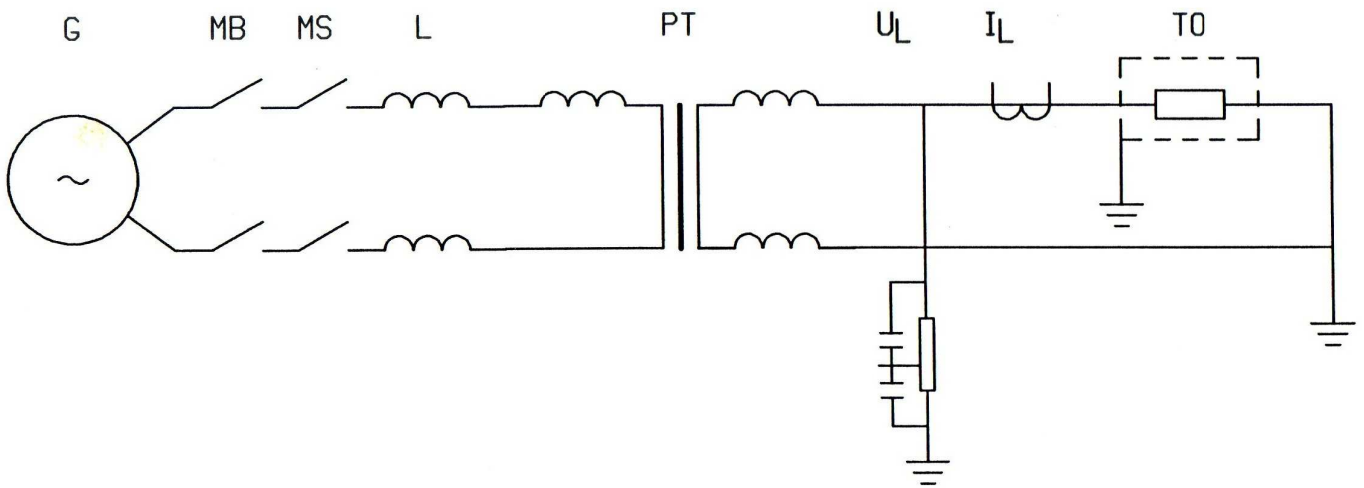
MEASUREMENTS

U = Voltage measurement
I = Current measurement

Suffix of U and I

L = Low-frequency recording instrument
H = High-frequency recording instrument

LD = Differential measurement with L
HD = Differential measurement with H



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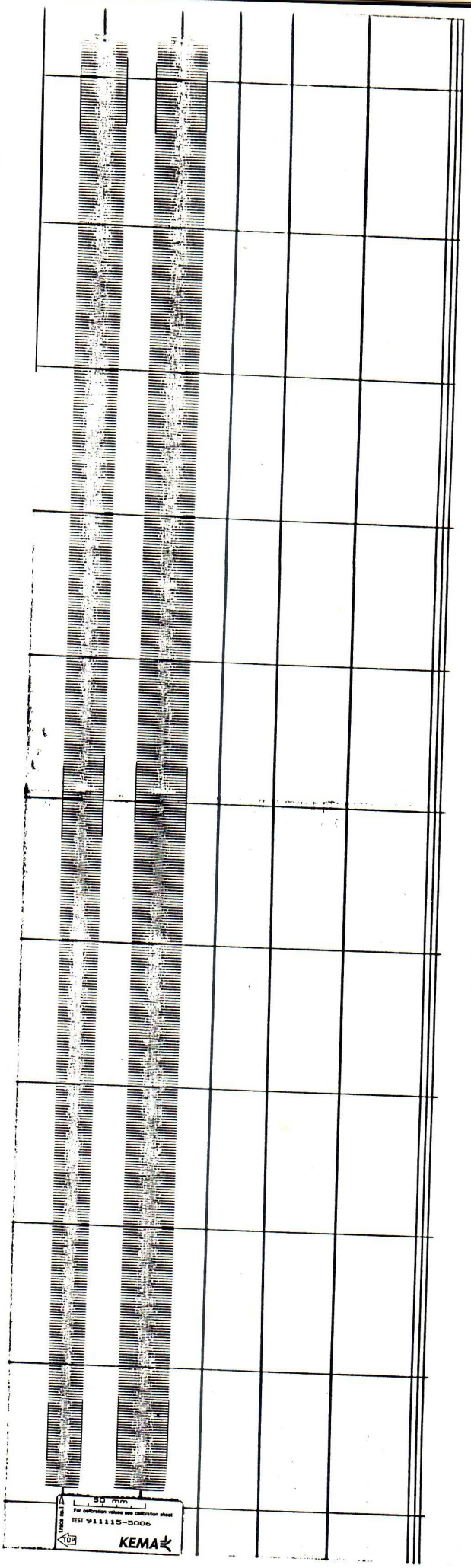
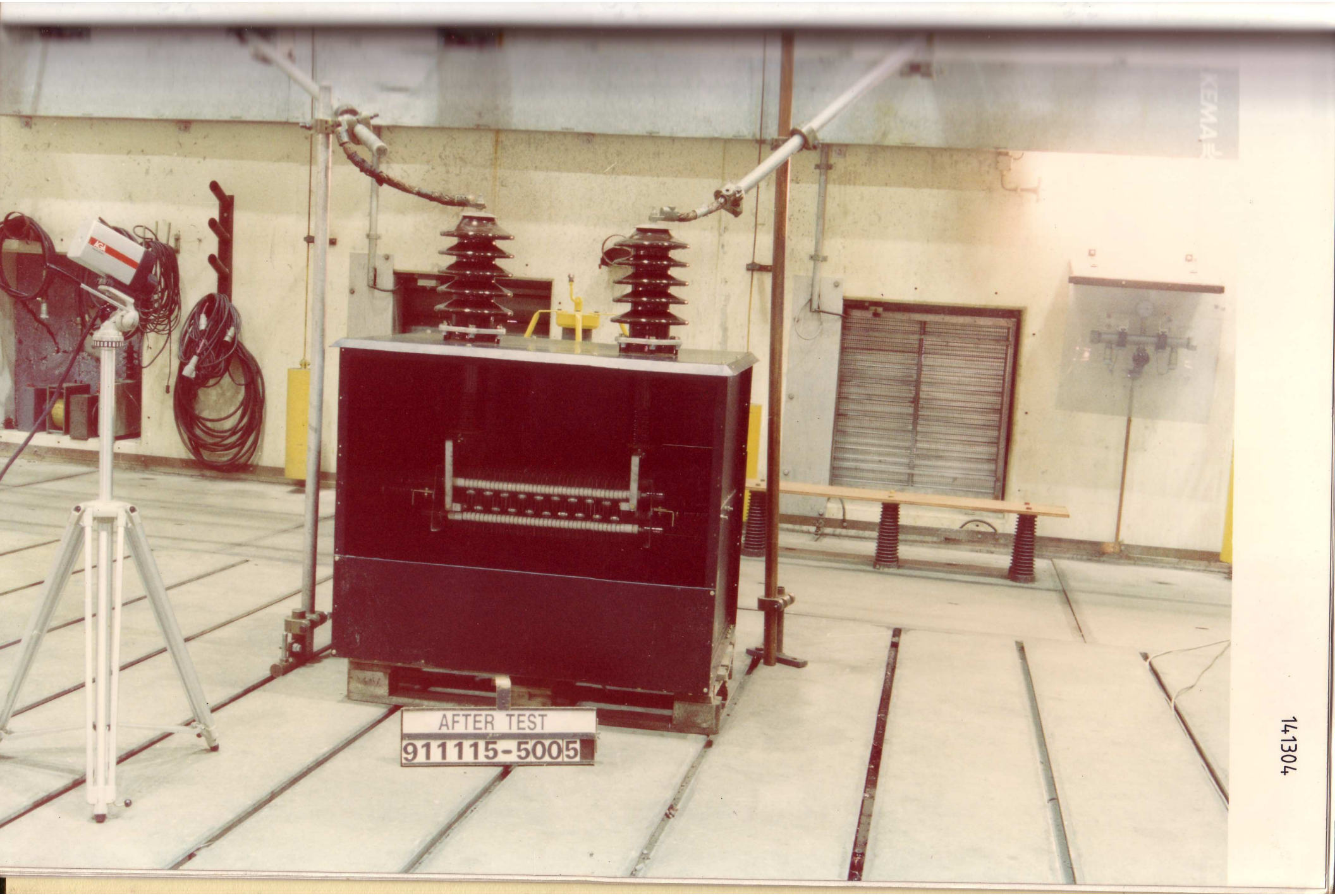

50 mm
For calibration values see calibration sheet
TEST 911115-5006
KEMA


AFTER TEST
911115-5005
141304

141303

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CLIENT
National Switchgears, Madras, India

Order no. 1366500

Client's reference: Mr. R.P. Samy

Report no. 1429-91

Test report concerning a power frequency voltage withstand test and a lightning impulse voltage withstand test on a neutral grounding resistor unit with serial number K/071

Date and place of test:
November 14, 1991, in the High-Voltage Laboratory of N.V. KEMA, Arnhem, the Netherlands

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Author: W.J.W.M. Sloot

SUMMARY AND CONCLUSION
The test programme was specified by the client.
The tests were passed successfully.

N.V. KEMA
KEMA HIGH-POWER/HIGH-VOLTAGE LABORATORIES
High-Voltage Laboratory

p.o.

N. van Schaik

To this report belong:
4 pages
2 appendices
7 oscillograms
1 drawing

- 5 DEC. 1991

Utrechtseweg 310, 6812 AR Arnhem. P.O. box 9035, 6800 ET Arnhem, The Netherlands.
Telephone (085) 56 91 11. Telex 45016 kema nl. Telefax (085) 51 56 06.

MATERIAL TESTED

Neutral grounding resistor unit

Manufacture	: National Switchgears, Madras, India
Quantity	: 1
Serial number	: K/071
Year of construction	: 1991
System voltage	: 66000 V, 50 Hz, when 3 units in series, 22000 V, 50 Hz, per unit
Fault current	: 200 A
Duration	: 10 s
Total resistance	: 5.34 Ω ± 10% (20°)
Material of element	: stainless steel (punched)

See also drawing no. 1 for construction and dimensions.

PURPOSE OF THE TESTS

Purpose of the testing was to verify whether the material complies with the requirements set by the client.

TEST PROGRAMME

The test programme was specified by the client and was as follows:

1 power frequency voltage withstand test with reference to IEC 694, clause 6.1.7
requirement: no flashover
no breakdown

2 lightning impulse voltage withstand test with reference to IEC 694, clause 6.1.6
requirement: no flashover
no breakdown.

DATE AND PLACE OF THE TESTS

November 14, 1991, in the High-Voltage Laboratory of KEMA, Arnhem, the Netherlands.

PERSONS ATTENDING THE TESTS

Mr. R.P. Samy (National Switchgears).

THE TESTS WERE CARRIED OUT BY

Mr. W.J.W.M. Sloot and Mr. J.F.W. Scheefhals.

DESCRIPTION AND RESULTS OF THE TESTS

1 Power frequency voltage withstand test

The neutral grounding resistor unit was subjected to a power frequency voltage withstand test with the test voltage as per clause 4.2.1, table 1 of IEC 694.
The unit was placed on the laboratory floor.
A voltage of 38 kV was applied for 1 minute to the interconnected terminals of the unit, the enclosure being earthed. The voltage was measured by using a resistive divider.
The atmospheric conditions were taken into account according to clause 6.1.1 of IEC 694.
Neither flashover nor breakdown occurred.
The results are represented in appendix 1.
The results do not give rise to remarks.

2 Lightning impulse voltage withstand test

The neutral grounding resistor unit was subjected to a lightning impulse voltage withstand test with the test voltage as per clause 4.2.1, table 1, list 1 of IEC 694.

The unit was placed on the laboratory floor. A lightning impulse with a crest value of 75 kV was applied to the interconnected terminals of the unit, the enclosure being earthed.
The wave shape was determined at 50% of the test voltage and was 1.17/46 µs.
The voltage was measured by using a resistive divider.
The atmospheric conditions were taken into account according to clause 6.1.1 of IEC 694.
Neither flashover nor breakdown occurred.
The results are represented in appendix 2.
The results do not give rise to remarks.

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Report no.: 1429-91
Test date : 1991-11-14

Appendix: 1
Page no.: 1

Results of the power frequency voltage withstand test.
Test object: neutral grounding resistor unit, serial no. K/071

Atmospheric conditions

Ambient temperature (t) : 19.5 °C Ambient air pressure (p) : 993 mbar
Temperature of the test object : 19.5 °C Humidity (h) : 8.5 g H_2O/m^3

number	voltage applied between	voltage and duration kV	s	results	remarks
1	interconnected terminals and enclosure	38	60	no flashover no breakdown	none

RESULTS OF THE LIGHTNING IMPULSE VOLTAGE TEST.

Testobject: Neutral Grounding Resistor Unit, serial no. K/071

Atmospheric conditions
Ambient temperature (T) : 19.5 °C
Temperature of the testobject: 19.5 °C
Ambient air pressure (b) : 993 mbar
Humidity (h) : 8.5 g H_2O/m^3

Requirement: IEC 694, clause 6.1.6, used as a guide

Fig. no.	Number of impulses	Remarks	Date	Time
1	1	Waveshape: 1.17/46 µs	911411	11:56
2	5	positive impulses nos. 1 - 5	911411	12:01
3	5	positive impulses nos. 6 - 10	911411	12:03
4	5	positive impulses nos. 11 - 15	911411	12:05
5	5	negative impulses nos. 1 - 5	911411	12:09
6	5	negative impulses nos. 6 - 10	911411	12:12
7	5	negative impulses nos. 11 - 15	911411	12:14

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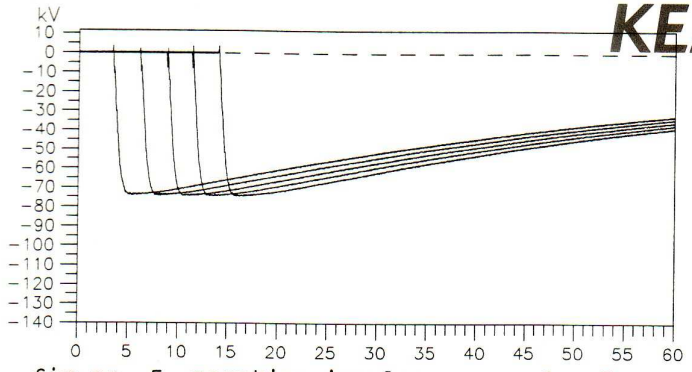
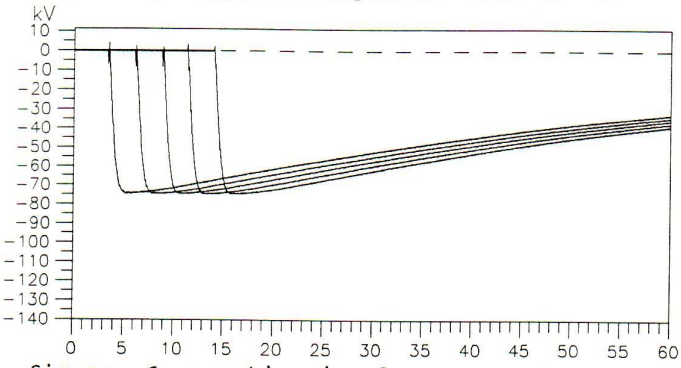


PEAKVALUES:

-74.2 kV
-74.4 kV
-74.5 kV
-74.7 kV
-74.7 kV

Date: 91-14-11
Time: 12:09

fig.no. 5 negative impulses nos. 1 - 5

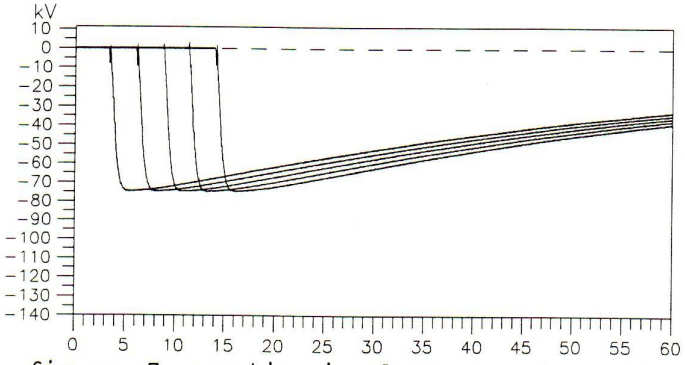


PEAKVALUES:

-74.5 kV
-74.8 kV
-74.8 kV
-74.9 kV
-74.8 kV

Date: 91-14-11
Time: 12:12

fig.no. 6 negative impulses nos. 6 - 10

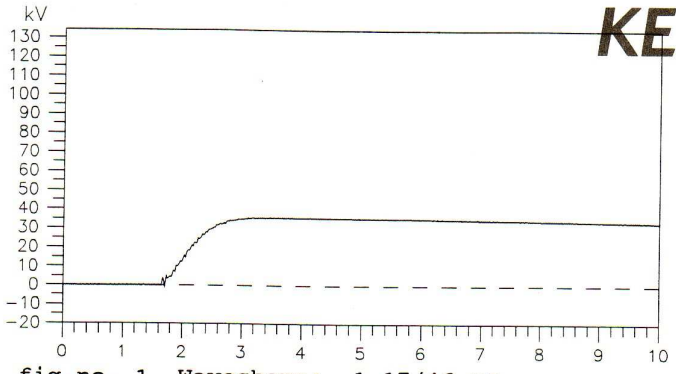


PEAKVALUES:

-74.9 kV
-75.1 kV
-74.9 kV
-75.1 kV
-74.9 kV

Date: 91-14-11
Time: 12:14

fig.no. 7 negative impulses nos. 11 - 15

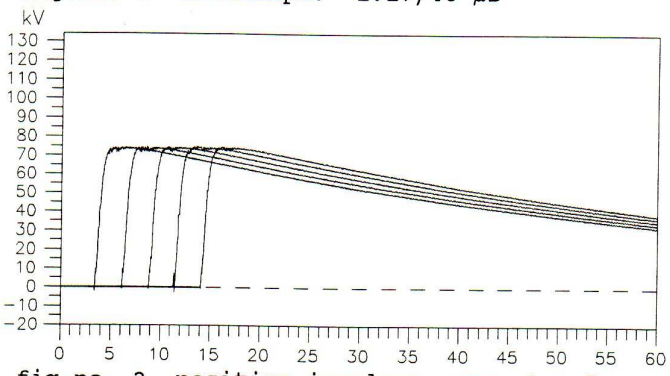


PEAKVALUE:

35.9 kV

Date: 91-14-11
Time: 11:56

fig.no. 1 Waveshape: 1.17/46 µs

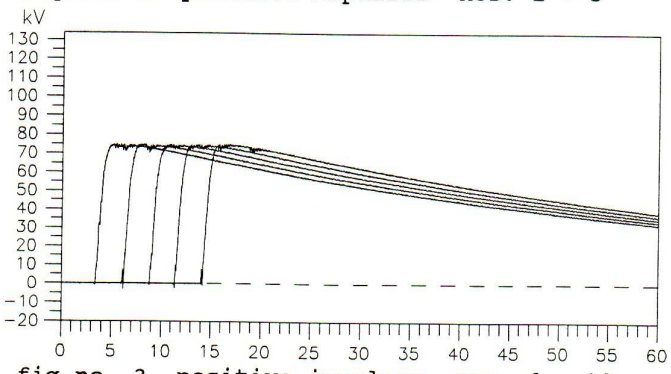


PEAKVALUES:

74.5 kV
74.9 kV
74.8 kV
75.2 kV
74.7 kV

Date: 91-14-11
Time: 12:01

fig.no. 2 positive impulses nos. 1 - 5

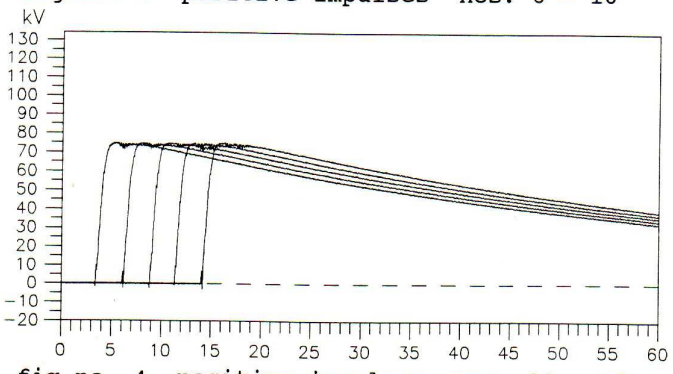


PEAKVALUES:

74.9 kV
74.9 kV
74.9 kV
75.0 kV
75.0 kV

Date: 91-14-11
Time: 12:03

fig.no. 3 positive impulses nos. 6 - 10

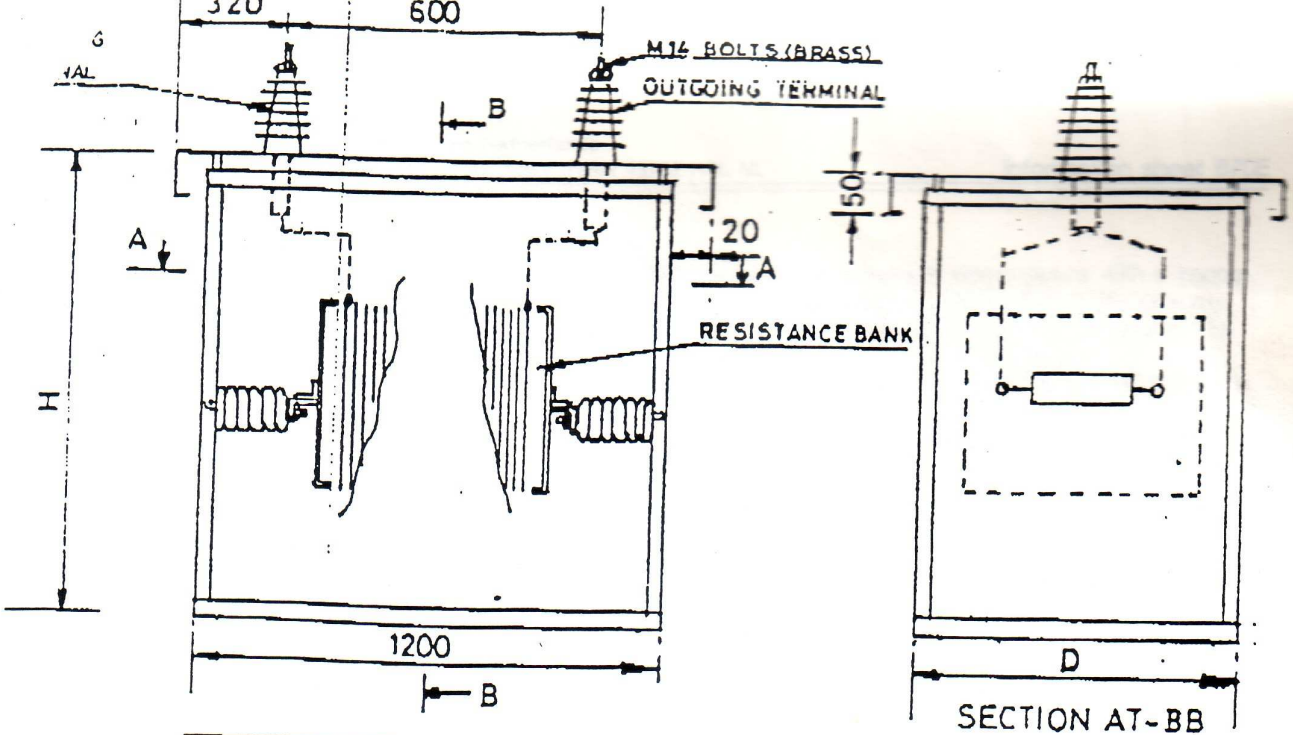


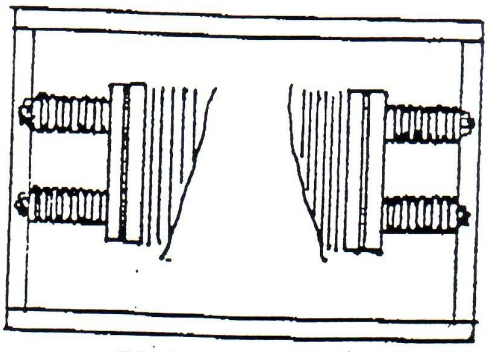
PEAKVALUES:

74.9 kV
74.9 kV
74.9 kV
74.9 kV
75.2 kV

Date: 91-14-11
Time: 12:05

fig.no. 4 positive impulses nos. 11 - 15

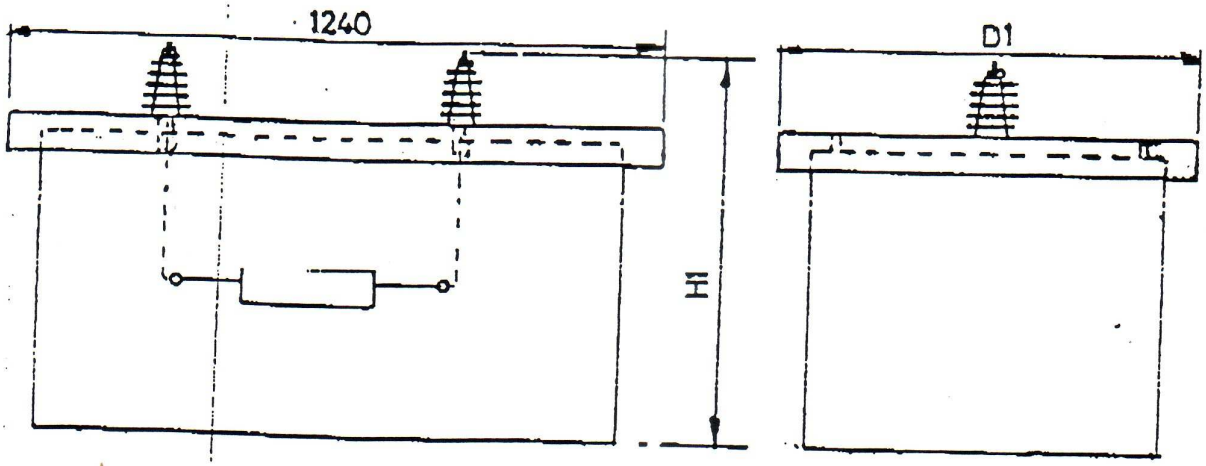




SECTION AT-AA

	66KV	11KV
H	1000	670
H1	1468	958
D	900	700
D1	940	740

NOTE: PERFORATED SHEET TO BE PROVIDED AT BOTTOM RESISTANCE ELEMENT STAINLESS STEEL



NATIONAL SWITCHGEARS			CLIENT:
N	A G S N	TITLE: 11KV & 66KV RESISTANCE BOX	DRG NO: A-778
		SCALE: N.T.S	1-1-91

pg 2 of 2.

KEMA
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1 *Certificate of Compliance*

A Certificate contains a record of a series of type tests carried out strictly in accordance with a recognized standard. The equipment tested has fulfilled the requirements of this standard and the relevant ratings assigned by the manufacturer are endorsed by KEMA. The Certificate is applicable only to the equipment tested. KEMA is responsible for the validity and the contents of the Certificate.
The responsibility for conformity of any apparatus having the same designation as the one tested rests with the manufacturer.
The Certificate contains the essential drawings and a description of the equipment tested. Detailed rules are given in KEMA's Certification procedure.

2 *Report of Performance*

A Report of Performance contains a record of one or more tests which have been carried out according to the client's instructions. These tests are not necessarily in accordance with a recognized standard. The test results do not verify ratings of the test object.
KEMA issues three types of Reports of Performance:

2.1 *The tests have been carried out strictly in accordance with .... . The apparatus has complied with the relevant requirements.*

This sentence will appear on the front page of a Report of Performance if the tests have been performed in accordance with a recognized standard, but the series of tests does not completely fulfill the requirements for a Certificate of Compliance (for example, if the number of test duties is not a complete series of type tests).
The Report contains verified drawings and a description of the equipment tested. Detailed rules are given in KEMA's Certification procedure. The condition of the test object after the tests is assessed and recorded in the Report.

2.2 *The tests have been carried out in accordance with the client's instructions. Test procedure and test parameters were based on ....*

This sentence will appear on the front page of a Report of Performance if the number of tests, the test procedure and the test parameters are based on a recognized standard and related to the ratings assigned by the manufacturer.
Verification of the drawings (if submitted) and assessment of the condition after the tests is only done at the client's request.

2.3 *The tests have been carried out according to the client's instructions.*

This sentence will appear on the front page of a Report of Performance if the tests, test procedure and/or test parameters are not in accordance with a recognized standard.

3 *Standards*

When reference is made to a standard, and the date of issue is not stated, this applies to the latest issue, including amendments which have been officially published prior to the date of the tests.

4 *Accuracy of measurement*

In the table of test results the measured quantities are given in three digits. This method of presentation does not indicate an accuracy. The guaranteed uncertainty in the figures mentioned, taking into account the total measuring system, is less than 5%, unless mentioned otherwise.

5 *Qualified by STERLAB*

The De Zoeten Laboratorium has been entered in the STERLAB register for laboratories under Nr. 20 for the testing services as defined in the Field of Accreditation.
The accreditation is applicable to tests performed in accordance with IEC, ANSI and European standards, recorded in test documents items 1 and 2.1 above.
The accreditation is carried out in accordance with European Standard 45001, based on ISO/IEC Guides 25 and 38.

QUALIFIED BY STERLAB