HEAT RUN TEST ON

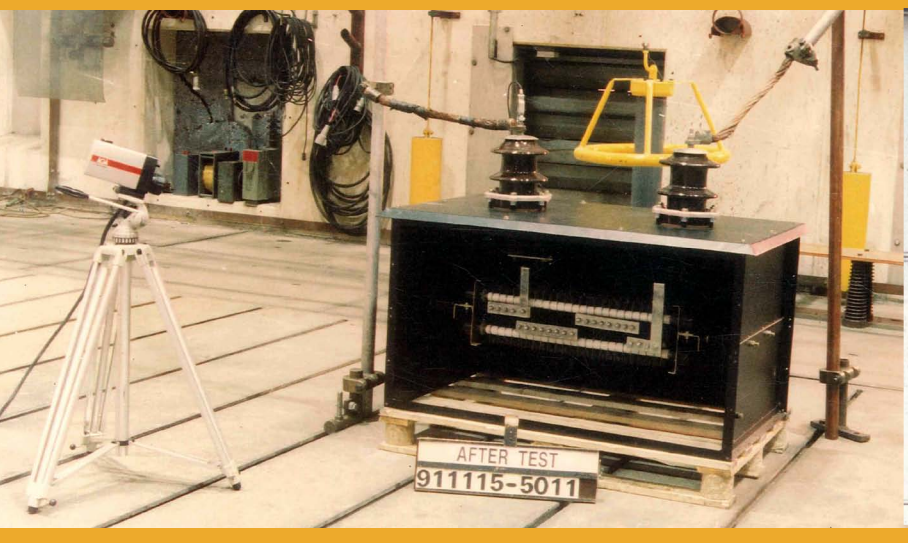
Neutral Grounding Resistor (NGR)

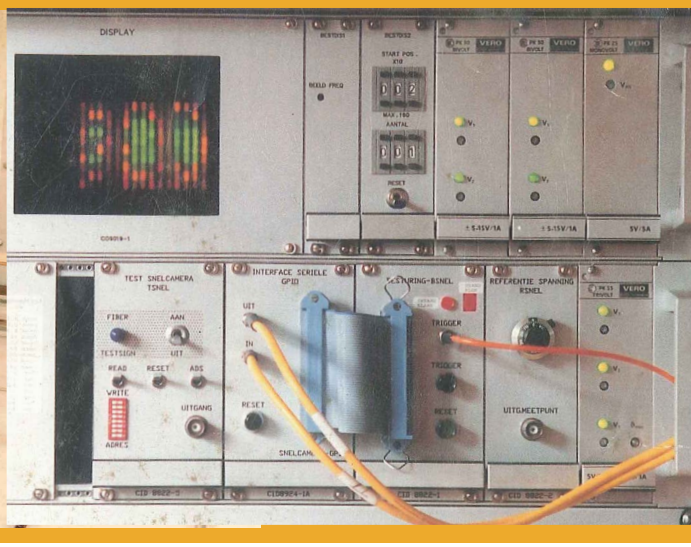
BSI REGISTERED
UKAS QUALITY MANAGEMENT 003
ANAB ACCREDITED
Certificate No.: FM 523854
ISO 9001 - 2008

USC

NATIONAL SWITCHGEARS

Heat run test is an essential test for the continuous satisfactory performance of the Electrical equipments.





If the equipment is having any hidden quality problems the test reveals the defect by abnormal temperature rise. Most of the Electrical equipments and components undergo Temperature rise test specified by the Electrical standards and specifications.

In a laboratory or an industry injecting rated current to the equipment is always a challenge. Measurement of temperature rise is to be very accurate and appropriate measuring instruments should be also available.

The limitation of conducting the test, therefore, rests on the availability of source voltage and power to drive the required current. It is not feasible to conduct the test if adequate source is not available with testing Agency.

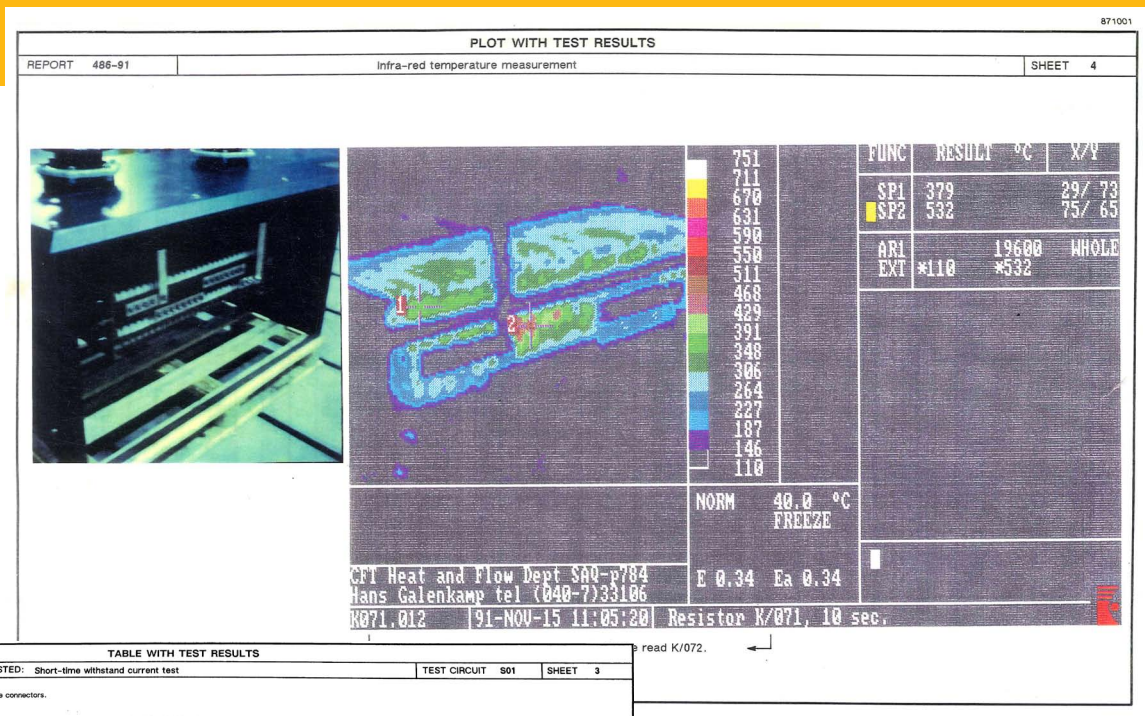
The issue is much more complicated in the case of short time rated equipments like Neutral Grounding Resistors. The NGR is usually rated for 5/10 /30 sec. The current and resistance values are normally very high. Finding a source for injecting high current to high resistance load for a short duration has many impediments. The problem is further more compounded in measuring the temperature rise for duration as low as 5 or 30 sec. Conventional measuring instruments like Thermocouple may not reveal the actual temperature within a short duration of 30 sec due to thermal inertia.

Hence, most of the renowned laboratories in the world do not undertake the Temperature rise test on NGR. We have approached KEMA, ASTA, PEHLA (Germany), CPRI(India), etc and enclosed our queries and their replies are in Annexure-I. They have categorically stated that it is not possible for them.

The NGR is designed and constructed in accordance with standard IEEE-32. Heat run test for NGR has been omitted in the standard which calls for only Routine Tests and they are:-

(a) Measurement of Ohmic value

(b) Dielectric test, excluding Impulse test



PLOT WITH TEST RESULTS

REPORT 486-91 | Infra-red temperature measurement | SHEET 4

TABLE WITH TEST RESULTS

REPORT 486-91 | TYPE OF TESTS REQUESTED: Short-time withstand current test | TEST CIRCUIT S01 | SHEET 3

Condition before tests: Resistor new. Photograph 141305.
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. 1430-91 (included).

Date and test	Test quantities: Peak value of current	Symmetrical current: Begin-ning	Middle	End	Average	Duration	Voltage: Begin-ning	Middle	End	Maximum temperature (1)					Physical behaviour: Emission of: Flame	Gas	Remarks
	A	A	A	A	A	s	kV	kV	kV	°C							
911115 5011		2090	2090	2090	2090	10.1	49	57	63	532					none	none	No visible disturbance.

Condition after tests: Externally no visible change.
Porcelain intact.
Photograph 141306.

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

Figure-1

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	Symmetrical current: Begin-ning	Middle	End	Average	Duration	Voltage: Begin-ning	Middle	End	Maximum temperature (1)					Physical behaviour: Emission of: Flame	Gas	Remarks
	A	A	A	A	A	s	kV	kV	kV	°C							
911115 5006		204	206	206	205	10.1	1078	1276	1461	467					none	none	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).

KEMA

Testing at KEMA on our NGR

National Switchgears have done pioneering work in validation of design procedure for selecting resistive elements for different current ratings and duration. The tests conducted by us at KEMA are neither Type test nor Routine test. It is only to validate our design and to fix other parameters for NGR.

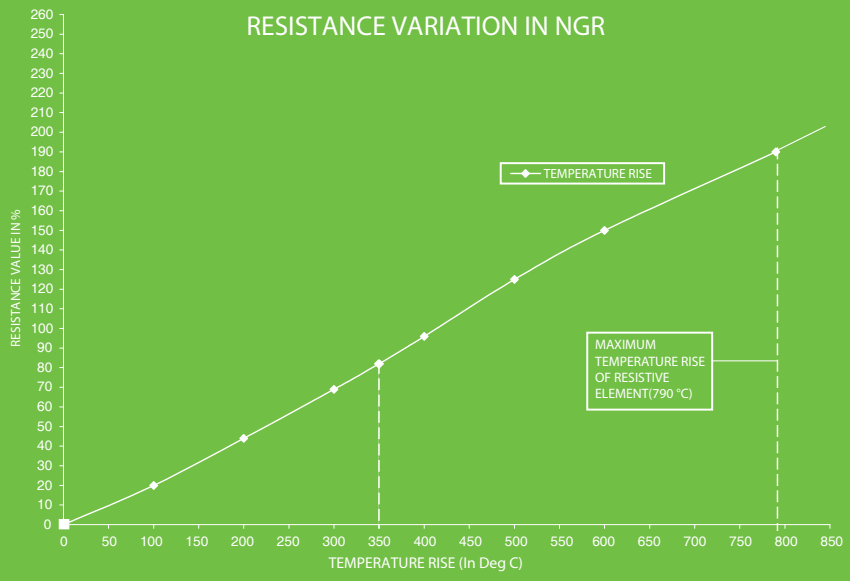
The NGR will normally have many elements connected in series and the total assembly of resistive elements will be housed in an enclosure . As stated earlier it is not possible to inject the rated current to the entire assembly for want of source. Hence one element out of the lot will be housed in a proportionate enclosure as explained in Annexure-II. This arrangement will reduce the source voltage.

The rated current is passed through the element for prescribed duration and the temperature is measured by a thermocouple. The test has several practical disadvantages, but it reveals to some extent the reality.

The disadvantages are :-

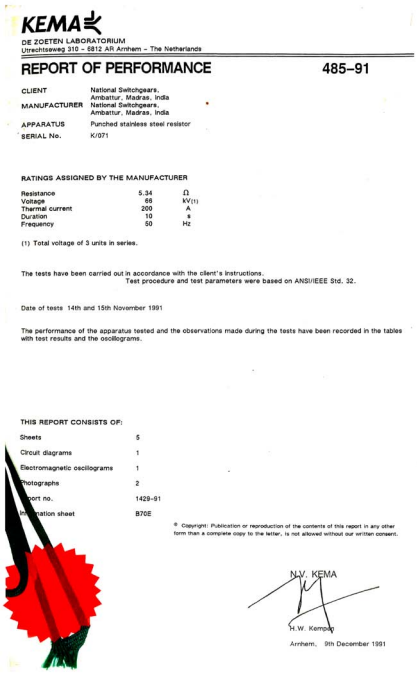
1. The test is again restricted by availability of source
2. When the resistive elements are stacked in actual assembly the heat transfer coefficient is different from a single element .
3. The temperature measurement may not be accurate in view of short duration

Considering all the above factors we have approached KEMA for a Heat run test on a Partial Resistance assembly which is housed in a proportionate enclosure. A study current was arranged to pass through the resistance assembly. Here again we faced a problem. The resistive element is made out of stainless steel grade which is having very poor Temperature coefficient of Resistance, viz, 0.001. Assuming the system voltage as constant, the variation in resistance with respect to temperature rise is given in the following graph.



Testing the resistive element under constant rated current requires variable voltage source which is very difficult to arrange .KEMA have come out with a solution and they have connected high impedance and high current Inductive coil connected in series with the NGR. By this arrangement the constant current is maintained through out the test.

Second task is to measure the temperature in a short period of 10 sec. KEMA with the help of Philips, Netherlands arranged a thermal recorder to detect temperature with an accuracy of 0.1 sec using Nitrogen filled cameras.



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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

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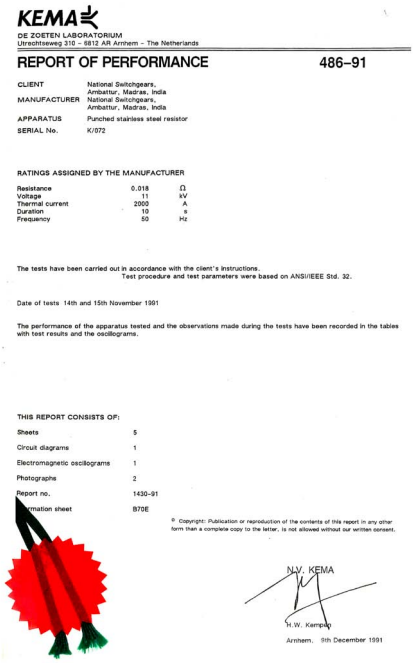
N.V. KEMA
H.W. Kemper
Arnhem, 9th December 1991



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REPORT OF PERFORMANCE 486–91

CLIENT National Switchgears, Ambattur, Madras, India
MANUFACTURER National Switchgears, Ambattur, Madras, India
APPARATUS Punched stainless steel resistor
SERIAL No. K/072

RATINGS ASSIGNED BY THE MANUFACTURER

Resistance	0.018	Ω
Voltage	11	kV
Thermal current	2000	A
Duration	10	s
Frequency	50	Hz

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.

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The above set up was finalized and our NGR was tested. The results are given in Figure-1, and also test certificates can be downloaded from our website. The result was again analyzed by metallurgical methods to double check the temperature rise.

The results are within the parameters prescribed and it also validated our design calculation. The tests are so important as all other coefficients for Heat transfer have been derived accurately.

Our tests find a special place in house magazine of KEMA.

Though the tests were conducted in 1991 the same tests cannot repeated now as it requires elaborate equipments and systems. This is the reason why KEMA and other laboratories have declined to undertake such tests.

National Switchgears have supplied more than 20,000 NGR s all over the world and the design conforms to IEEE-32 and the design parameters have been adopted in all cases.

NATIONAL SWITCHGEARS

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