

CERTIFICATE n° HM 21/22-412

certificate of Temperature rise

Apparatus : NEUTRAL EARTHING RESISTOR

Designation : rated current 1050 A
rated voltage 3.81 kV
rated frequency 50 Hz

Manufacturer : CRESSALL RESISTORS

Applicant for the tests : CRESSALL RESISTORS

Date(s) and place(s) of the tests : 8 July 1994
Les Renardières - L.G.E. - High Power Testing Station

The apparatus, constructed in accordance with the description, drawings and photographs incorporated in this Certificate, has been subjected to the series of proving tests in accordance with ANSI/IEEE 32-1972 (revised 1984) Clauses 10 and 14.

The results are shown in the record of proving tests and the oscillograms attached hereto.

The values obtained and the general performance are considered to comply with the above standard and to justify the ratings assigned by the manufacturer as listed on page 2.

This Certificate and Record of Proving Tests applies only to the specific piece of apparatus tested from the particular place of manufacture. The responsibility for conformity of any apparatus having the same designation with that tested rests with the manufacturer at the place of manufacture of that apparatus.

The documents forming part of this Certificate are :

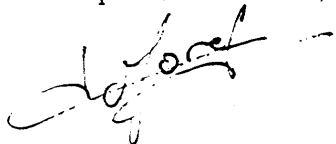
characteristics of the apparatus	: page 2	list of tests performed	: page 3
test conditions	: pages 5 - 6	tables of test results	: pages 6 - 7
oscillograms n°	: 2001	photographs n°	: 1 to 5

This Certificate includes 7 pages and 11 appended sheets.

Reproduction of this Certificate is authorized only in the form of a complete photographic facsimile with the written authorization of the Laboratory and the Applicant.

Executive responsible for the tests,

High Power Testing Manager,



L. MOREL



B. DECLERCK

Les Renardières, le 8 November 1994

CHARACTERISTICS OF THE EQUIPMENT

- Apparatus : Neutral earthing resistor for 6.6 kV network
- System voltage : 6.6 kV \pm 10 %
- Line-neutral voltage : 3.81 kV
- Initial Amps : 1050 A
- Max. Time on : 1 minute
- Resistance at 20°C : 3.63 Ω \pm 10 %
- Resistance at 50°C : 3.64 Ω \pm 10 %
- Approx. Weight : 1050 kg
- Enclosure protection : IP55

LIST OF TEST PERFORMED

Test n°	Test duty	Date	Page
—	Applied potential tests	08/07/94	6
2001	Temperature rise test	08/07/94	7

Accuracy of measurements : unless mentioned otherwise, the guaranteed uncertainty in the results given in this document, is less than 5 %. In the tables of tests results, the measured quantities are generally given in three digits.

Manufacturer representatives : MM. DUNCAN – HARRIS
Customer representatives : MM. DUNCAN – HARRIS
Test engineer : Mr MOREL

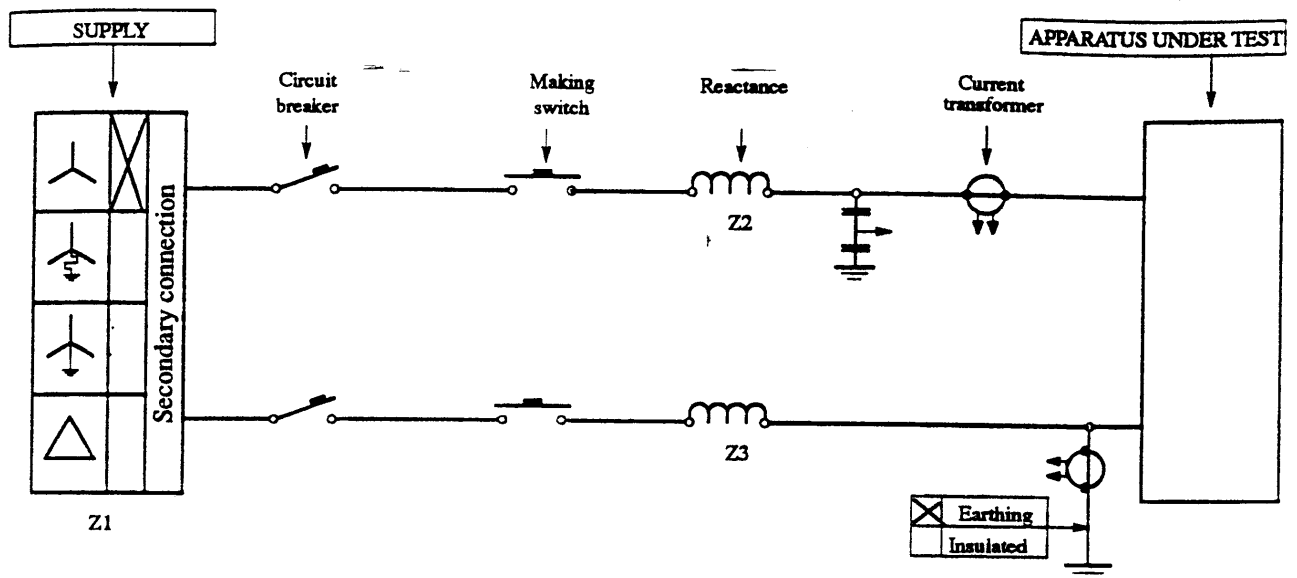
Circulation : 2 copies to Mr DUNCAN (CRESSALL RESISTORS)

1. REFERENCE DOCUMENTS

- Test request from CRESSALL RESISTORS, by phone, dated 09/05/94
 - Fax message from EDF/LGE n° 51/1005/LM dated 10/05/94
 - Purchase order from CRESSALL RESISTORS n° 102730 dated 27/05/94
 - Test program n° HM 21/22-412 dated 27/06/94
 - ANSI/IEEE 32-1972 Standard (revised 1984), § 10 and 14
 - Certificat of calibration of the temperature sensitive points by ERC calibration, reference 02082 dated 06/09/94
 - Identification file : the manufacturer has guaranteed that the equipment submitted to the tests has been manufactured in accordance with the following drawings.
 - RE O/P 11232 of 2/02/87 (RP resistor unit/general assembly)
 - 91164 (*) issue E of 16/06/94 (Station Transformer Neutral Earthing Resistor)
 - 91679 issue A of 25/10/94 (RP coil neutral earthing resistor stach)
 - 91677 issue A of 25/10/94 (Characteristics of the resistor)
- (*) this drawing is attached to this Certificate, the other ones are kept in LGE's files.

2. TESTS CONDITIONS

2.1. TEST SCHEME



2.2. CHARACTERISTICS OF THE TEST CIRCUIT

Test n°	Transfo Coupling	Z1 Ω/φ	Z2 Ω/φ	Z3 Ω/φ	I specified A
Potential tests	$\Delta/A3B3$	0.32	2.546	0.856	NA
2001	Y/A1B1	0.07	2.546	0.856	1050

NA : not applicable

2.3. TEST ARRANGEMENT

2.3.1. *Applied-Potential test*

The voltage was applied between the two terminals of the resistor connected together and the frame.

2.3.2. *Temperature rise test*

The testing circuit was connected on the terminals (Neutral and earth) of the resistor by the mean of flexible connexion of 400 mm² (see photograph n° 1).

Temperature sensitive points covering a range of 649 to 843°C, were applied by the manufacturer (see photographs n° 2 and 3).

3. TESTS RESULTS

3.1. APPLIED POTENTIAL TEST

- Preliminary measurement of the resistance : $R = 3,69 \Omega$ at 25°C
- The resistor has submitted a dielectrical test at a voltage of 11 kv during 1 minute, the voltage being applied across the resistor and the frame
- No flashover has been observed.

3.2. TEMPERATURE RISE TEST

Test n°	I A	Voltage kV	Instant of measurement s
2001	1040	3.79	0.5
2001	988	4.02	60

- Determination of the winding temperature by the hot-resistance method
 $R_{(\text{hot})} = 4.11 \Omega$ (see curve n° 1 attached)
- The maximum temperature reached by the sensible points was $\leq 732^\circ\text{C}$ (see photograph n° 4)
(limit authorized by the standard : 760°C)
- Measurements of the resistance after test : $R = 3,69 \Omega$ at 25°C

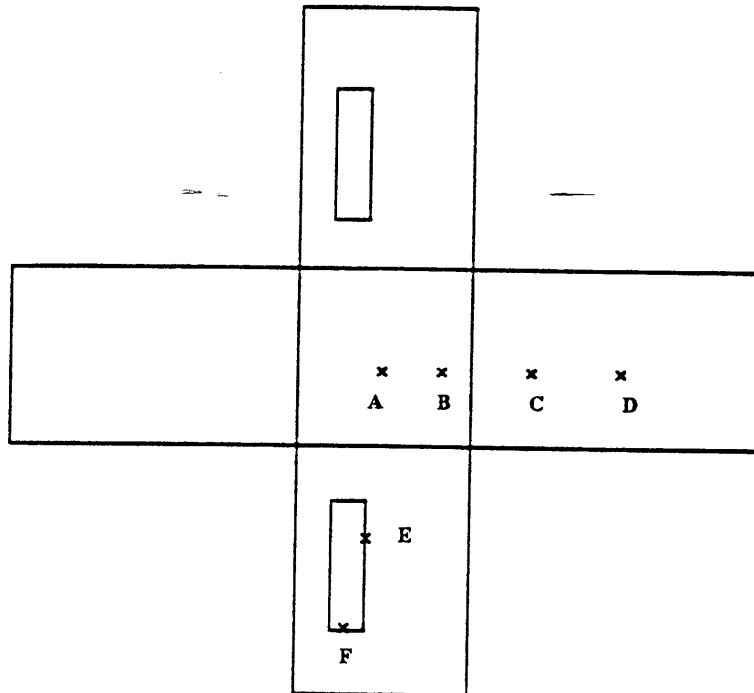
3.3. APPLIED POTENTIAL TEST

The resistor has submitted a dielectrical test (after test 2001) at a voltage of 11 kv during 1 minute, the voltage being applied across the resistor and the frame.

3.4. MEASUREMENT OF THE FRAME TEMPERATURE

- These measurements, realized after the temperature rise test 2001, were done by the mean of thermocouples, installed by the manufacturer, as indicated on the following drawing (see page 7).
- The results are indicated on the following table and graphics (see page 7).

Temperature thermocouples positions



TIME min	POSITION TEMP. °C					
	A	B	C	D	E	F
5	NC	147	210	170	30	33
6	NC	158	220	176	NC	NC
7	160	168	223	182	NC	NC
8	198	186	225	184	NC	NC
9	201	194	227	187	NC	NC
10	203	200	228	187	32	34
15	205	218	221	186	34	32
20	202	221	214	183	NC	NC
25	194	218	206	177	36	39
30	190	214	199	173	37	40
40	178	199	185	162	37	39
60	156	175	162	141	NC	NC
82	145	162	150	131	NC	NC

NC : Not Calculated

