tyco Electronics

Energy Division
http://energy.tycoelectronics.com

Bowthorpe EMP

Test Report

Type	**OCP2- M**
PPR Number	**PPR-2227**
Test Specification	Insulation withstand tests on the arrester housing IEC 60099-4 (2004-05)

Test Information:

Laboratory	CESI
Date	19/10/2005
External Test Ref	A5/049798
Report Prepared by	M. Gregori
Test Verified by	R. Malgesini
Test Approved by	M. de Nigris

Tyco Approvals:

R&D Manager Brendan Normoyle	Signature		Date	10/01/2006
Product Manager Brian McGowan	Signature		Date	10/01/2006

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Client	TYCO Electronics Energy Division – Shannon (IRL)
Tested equipment	Housing for polymer housed metal-oxide surge arrester type OCP2
Tests carried out	Insulation withstand tests
Standards/Specifications	IEC 60099-4 (2004-05)
Test date	**from** October 19, 2005 **to** October 19, 2005

No. of pages	13	**No. of pages annexed**	5
Issue date	October 19, 2005		
Prepared	BU PeC - M. Gregori		
Verified	BU PeC - R. Malgesini		
Approved	BU PeC - M. de Nigris		

CESI
CENTRO ELETTROTECNICO SPERIMENTALE ITALIANO
Business Unit
Prove e Componenti
Il Responsabile del Laboratorio

Tests witnessed by:------

Identification of the object:

The Manufacturer guarantees that the tested object is manufactured according to the submitted drawing.
CESI checked that this drawing adequately represents in shape and dimensions the essential details and the parts of the tested object.
This drawing, identified by CESI and numbered A5049800, is annexed to this document.

The data necessary to permit repetition of the tests are contained in the document marked: ---

- dielectric tests with impulse voltage	: **peak voltage: ± 3 %; time parameters: ± 10 %**
- dielectric tests with impulse current	: **peak value: ± 3 %; time parameters: ± 10 %**
- dielectric tests with alternating voltage	: **voltage (rms): ± 3 %**
dielectric tests with direct voltage	: **voltage: ± 3 %**

The measurement uncertainties are estimated at the level of twice the standard deviation (corresponding, in the case of normal distribution, to confidence level of about 95%) and have to be considered as maximum values

Laboratory information

Receipt date of the sample	October 10, 2004
Test location	CESI – Via Rubattino 54 – Milan
CESI testing team	Mr L. Podavitte , Mr I. Guacci, Mr M. Gregori
Test laboratory	P180
Activity code	41652U

Rated characteristics of the tested object assigned by the Client

Metal-oxide surge arrester	
Manufacturer	**TYCO Electronics Energy division - Shannon (IRL)**
Year of manufacture	2005

Electrical characteristics	
Nominal discharge current (I_r)	10 kA
Line discharge class	2
Rated voltage (U_r)	51,25 kV
Continuous operating voltage (U_c)	41 kV
High short circuit	40 kA
Low short circuit	600 A
Rated frequency	50 Hz

Geometrical characteristics	
Total height	533 mm
Number of sheds	n.8 large – n.7 small
Shed diameter	137mm large – 107 mm small
Shed spacing	41 mm
Arcing distance	418 mm
Creepage (leakage)distance	1279 mm

Other characteristics	
Housing material	silicone
Housing color	grey

Name and signature of Client's witness: _____

Photograph of the test object

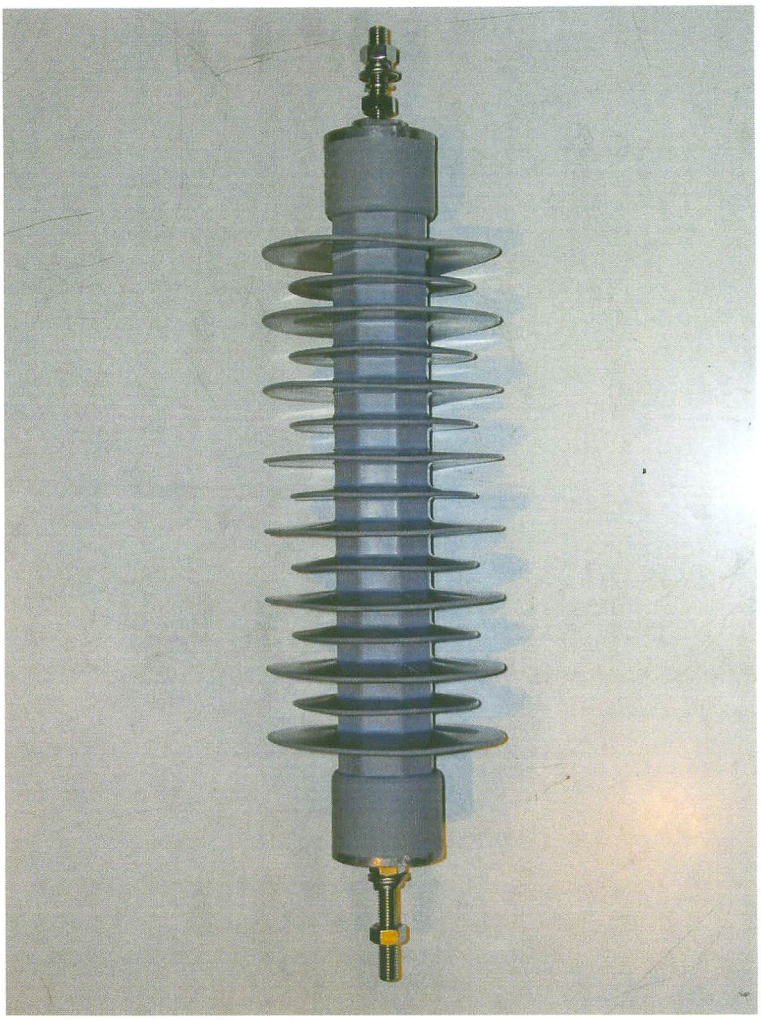


Photo no. 1

Test setting for dielettric tests

Photo no. 2

Reference Standard

IEC 60099-4 (2004-05): "Metal-oxide surge arrester without gaps for a.c. system", clause 8.2

Test carried out and identification of the test objects

Test carried out	Number of test objects	Test object identification
Dry lightning impulse withstand tests	1	IWT1
Wet power frequency withstand tests		

Test procedure

Dry lightning impulse withstand test

The test sample has been submitted to fifteen voltage impulses for each polarity having waweshape 1,2/50 μs and peak value equal to 250 kVpeak . The test has been performed in dry condition (as defined by IEC st. 60060-1) .

Wet power frequency withstand test

The power frequency voltage has been applied for 60 second on the sample at the value equal to 122 kVrms.
The test has been performed in wet condition (as defined by IEC st. 60060-1) .

Summary of test results

Dry lightning impulse withstand test
No flashover occurred during any of the impulse application

Wet power frequency withstand test
Non flashover occurred

The test result positive

Dry lightning impulse withstand voltage test

Test No.: 1

Test object: Housing for polymer housed metal-oxide surge arrester
Test circuit: A0002
Arrangement: see photograph pag n.6

Atmospheric conditions and correction factor			
b	t_d/t_w	h	K_t
kPa	°C	g / m^3	
101,03	15,5 (12,0)	8,70	0,996

Date: October 19, 2005

test condition	polarity	impulse generator charging voltage	voltage Required U	voltage applied U x K_t															
		kV	kV_{peak}	kV_{peak}	A: (o) withstand (x) flashover B: oscillogram No. C: peak voltage [kV] D: time to discharge (µs)														
IWT1	NEG	64	250	249	A	o	o	o	o	o	o	o	o	o	o	o	o	o	o
					B	03													
					C	248	249	248	248	249	249	249	249	249	250	248	249	249	249	249
					D														
IWT1	POS.	64	250	249	A	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
					B	04													
					C	250	249	249	250	249	249	249	250	249	249	249	249	249	249	249
					D														

continued

Wet power frequency withstand voltage test

Test No.: 2

Test object: Housing for polymer housed metal-oxide surge arrester
Test circuit: A0058-A0059
Arrangement: see photograph pag n.6

Atmospheric conditions and correction factor			
b	t_d/t_w	h	K_t
kPa	°C	g / m^3	
101,03	15,5 (12,0)	8,70	1,00

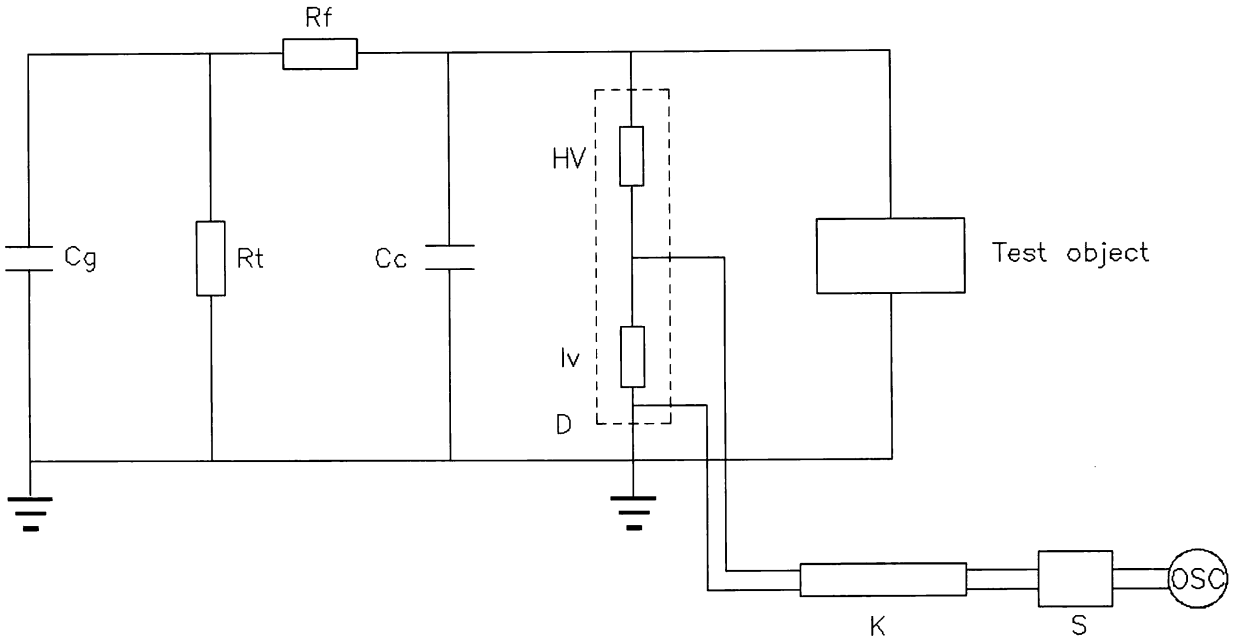
	Precipitation conditions				
	Precipitation rate (mm/min)			Water temperature	Water resistivity
	top	center	bottom	°C	Ω * m
vertical	1,2	1,2	1,2	11	100
horizontal	1,2	1,2	1,2		

Date: October 19, 2005

test condition	voltage		test voltage				test duration	Test result	Notes
	required U	applied U x K_t	V_1	$V_{AT} = k_1 V_1$ (k_1 = 3500)	V_2	$V_{AT} = k_2 V_2$ (k_2 = ---)			
	kV_{rms}	kV_{rms}	V_{rms}	kV_{rms}	V_{rms}	kV_{rms}	s		
IWT1	122	122	34,85	122	---	---	60	withstand	

continued

Circuit A0002



Impulse generator

No. of stages: 4
C_g: 125 nF
R_t: 280 Ω (140 x 2)
R_f: 320 Ω (140+60+40+80)
C_C: 0,6 nF

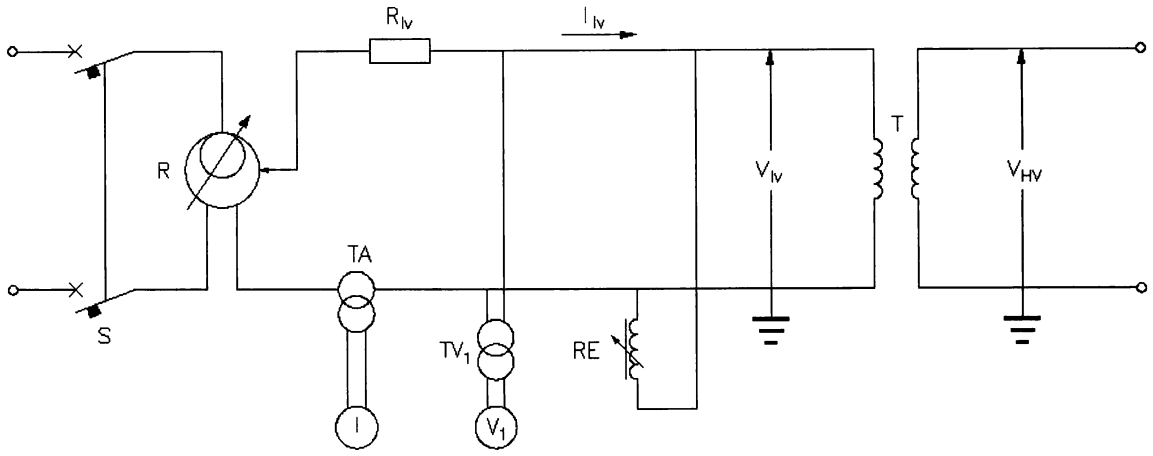
Voltage measuring system CESI No. 9792

D - divider PASSONI & VILLA type RC series CESI No. 6700; scale factor 25662,7
HV - high voltage capacitance 600 pF
lv - low voltage unit CESI No. 6704
K - coaxial cable
S - attenuation and termination unit CESI No. 14924
OSC - digital oscilloscope type TEKTRONIX TDS 430A CESI No. 14232

	Measured waveshape		
	polarity	time	oscillogram
		µs	No.
front	negative	1,15	01
tail		55,0	02

	Check of the test circuit		
	Charging voltage V_c	Measured voltage V_m	η $V_m / (V_c \cdot n_{stages})$
polarity	kV/stage	kV	
negative		195,6	0,978

Circuit A0058



Power frequency test circuit

R - regulation group PIVI composed by:
- single-phase voltage converter PIVI; power 210 kVA; voltage 380 V/0÷610 V
- booster transformer PIVI; power 200 kVA; voltage 600 V /6 kV

R_{lv} - protection resistor TELEMA; R= 2 Ω

TA - current transformer type CGS; ratio 50 A/5 A; CESI No. 03399

I - direct reading digital amperometer

TV_1 - voltage transformer type ALSTOM; ratio 6 kV/100 V

V_1 - digital voltmeter AGILENT 34401A; CESI No. 23082

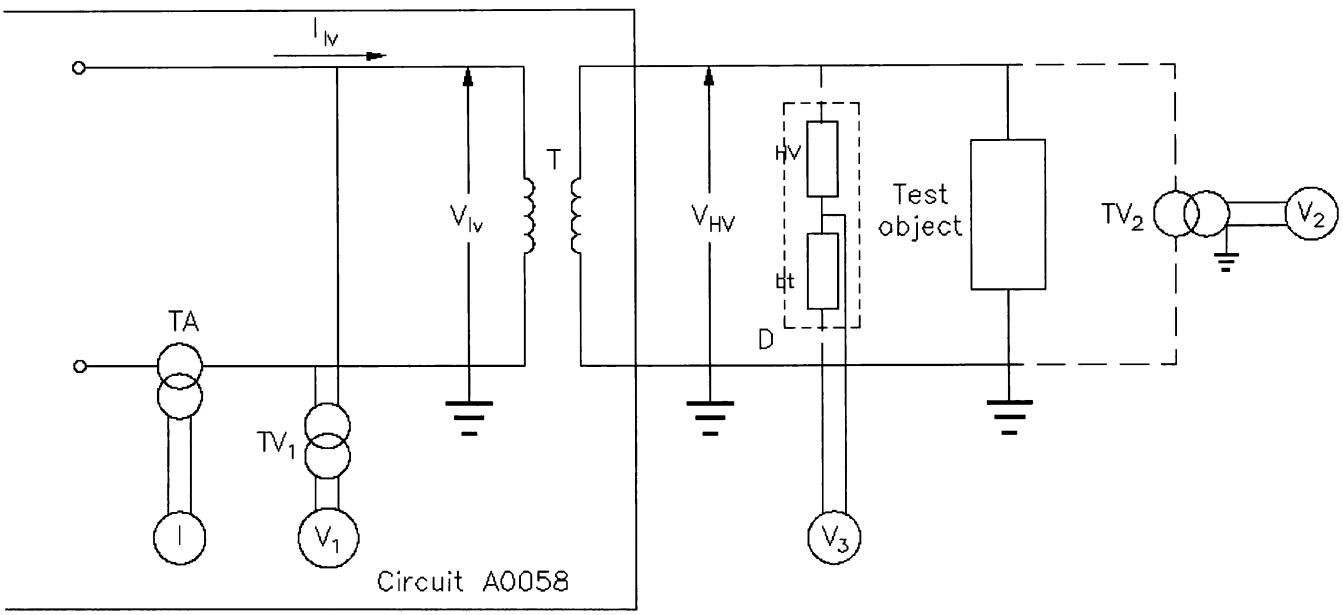
T - booster transformer CGE mod. KOC; secondary winding power 700 kVA; voltage 6 kV /350 kV; No. of units 1; ratio /

RE - variable reactor PIVI; power 600 kVA; voltage / kV; No. of units /

Tripping of the circuit breaker S

I_N	k_{TA}	instantaneous tripping			time delayed tripping		
		setting			setting		
		s_1	s_1 3 I_N	t_1	s_2	s_2 3 I_N	t_2
5	10	1	5	0,05	0,5	2,5	0,05

Circuit A0059



Power frequency measuring circuit

TA - current transformer type CGS; ratio 50 A/5 A; CESI No. 03399
I - direct reading digital amperometer
TV_1 - voltage transformer type ALSTOM; ratio 6 kV/100 V
V_1 - digital voltmeter AGILENT 34401A CESI No. 23082

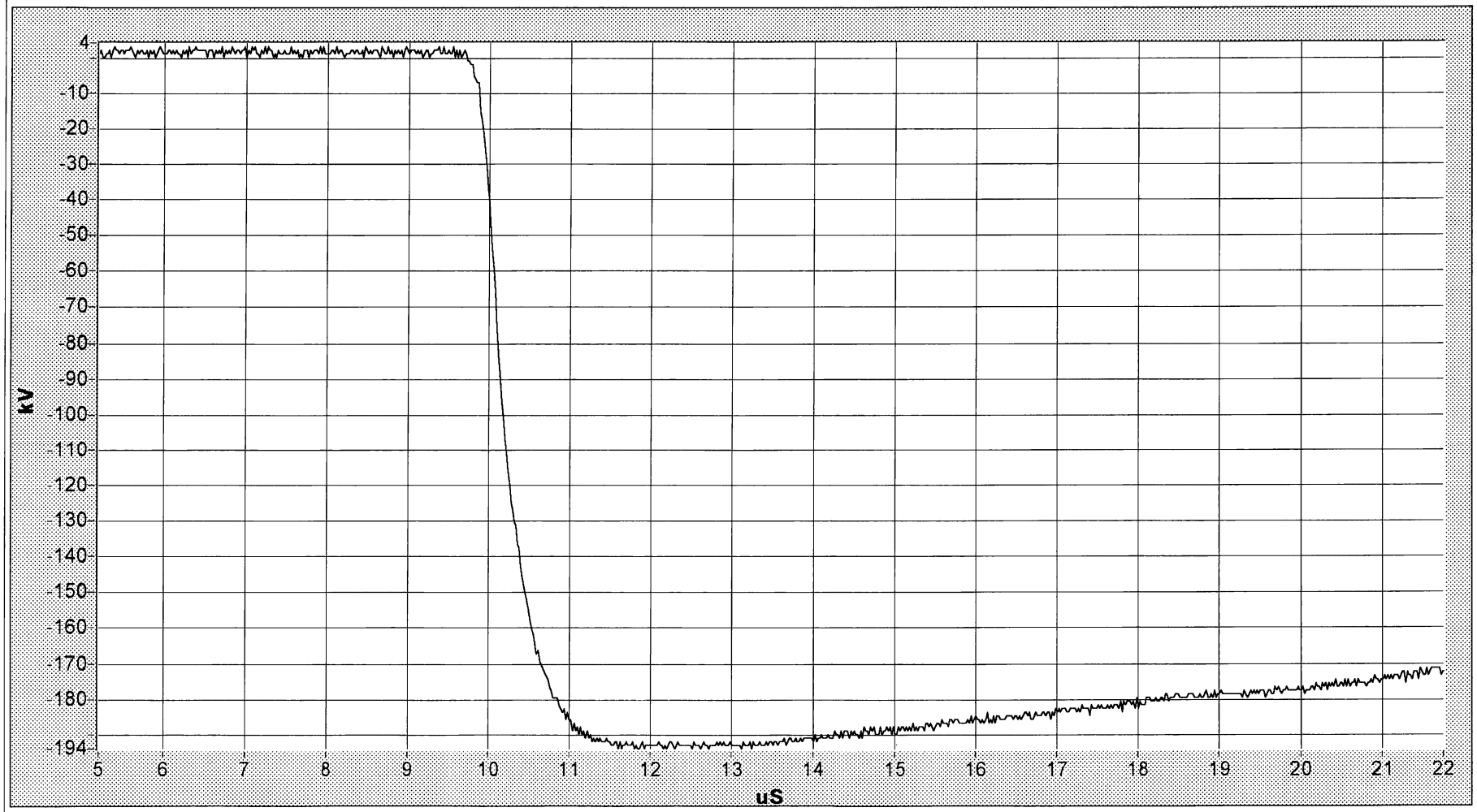
D - voltage divider / type RC series; voltage / kV; HV capacitance / pF; CESI No. /; low voltage arm CESI No. / scale factor /
V_3 - voltmeter CESI No. Not used

TV_2 - voltage transformer type SCARPA & MAGNANO; ratio 130/100 V; CESI No.5133
V_2 - digital voltmeter AGILENT 34401A CESI No. 23083

Functional check of the test circuit Date: October 19, 2005

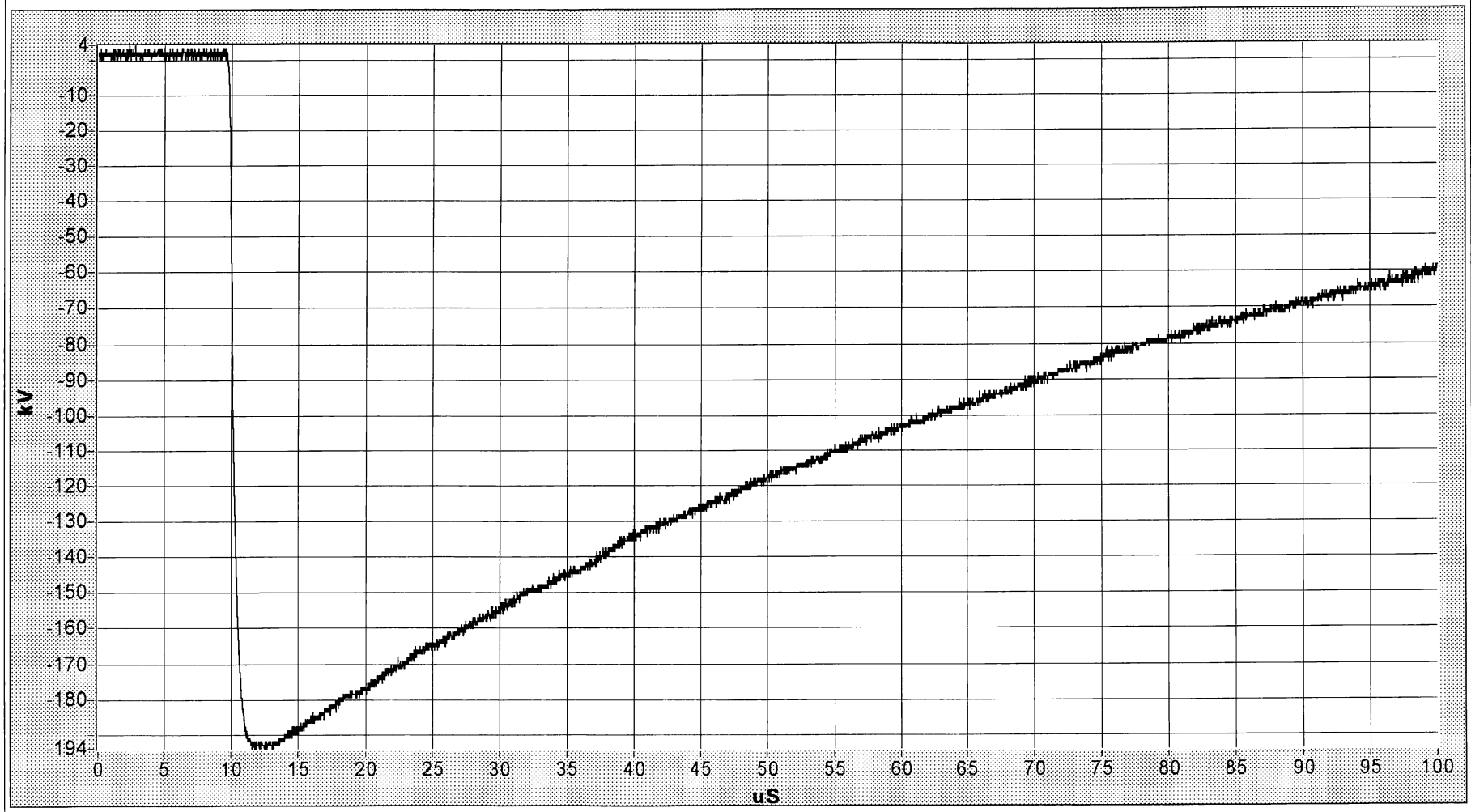
Low voltage				High voltage				k_t
				k_2 = 1300		k_3 =		
V_1	V_{lv}	I	I_{lv}	V_2	V_{HV}	V_3	V_{HV}	V_{HV} / V_1
V	V	A	A	V	kV	V	kV	3500
14,27	856,2	--	1,0	38,34	48,83	-	-	3492

CESI A5/049798, n.1



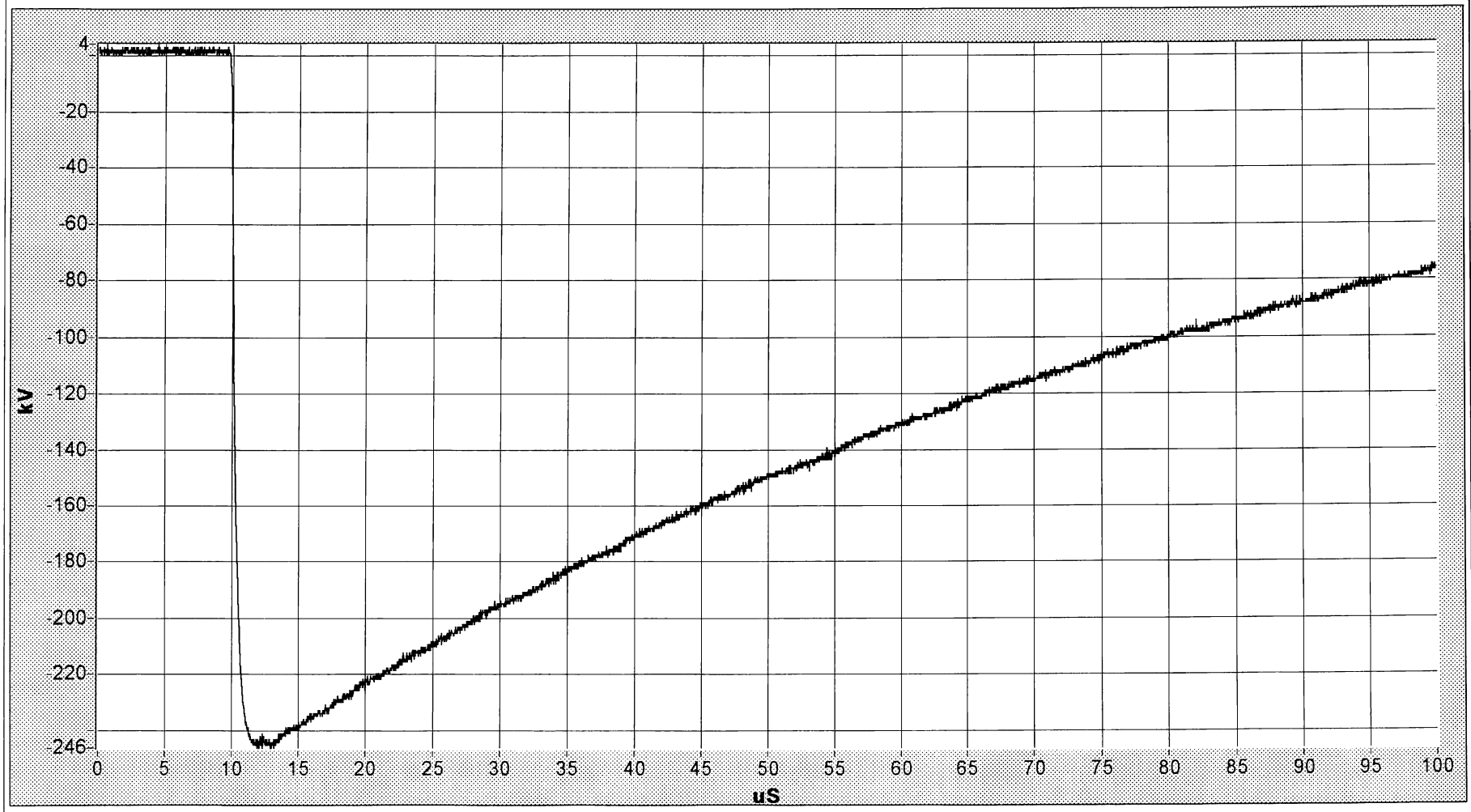
Vp[kV]	T1/Tp[us]	T2/Tc[us]
-195.567	1.154	55.225

CESI A5/049798, n.2



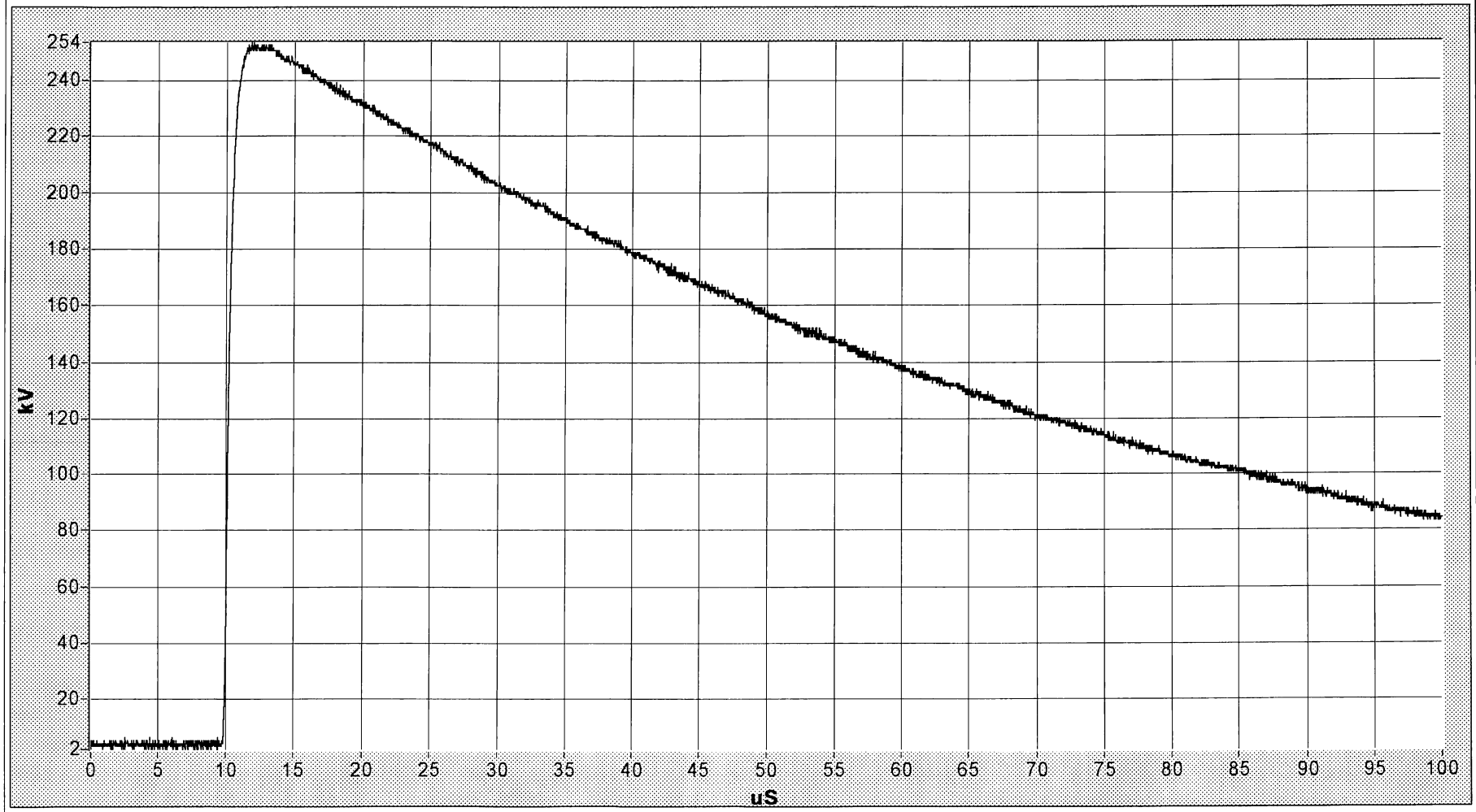
Vp[kV]	T1/Tp[us]	T2/Tc[us]
-195.567	1.154	55.225

CESI A5/049798, n.3



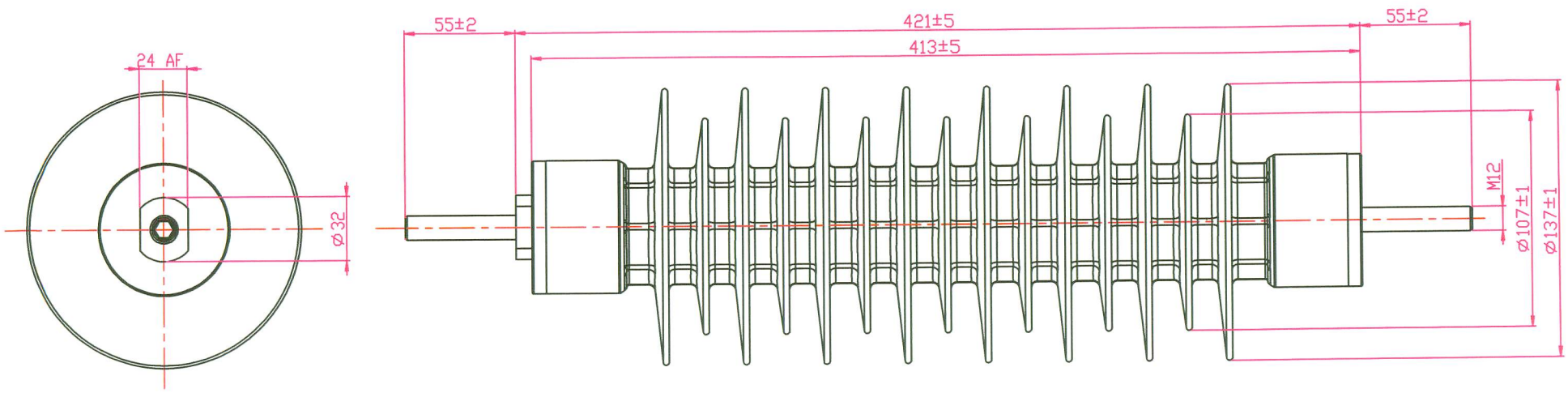
Vp[kV]	T1/Tp[us]	T2/Tc[us]
-247.865	1.112	55.137

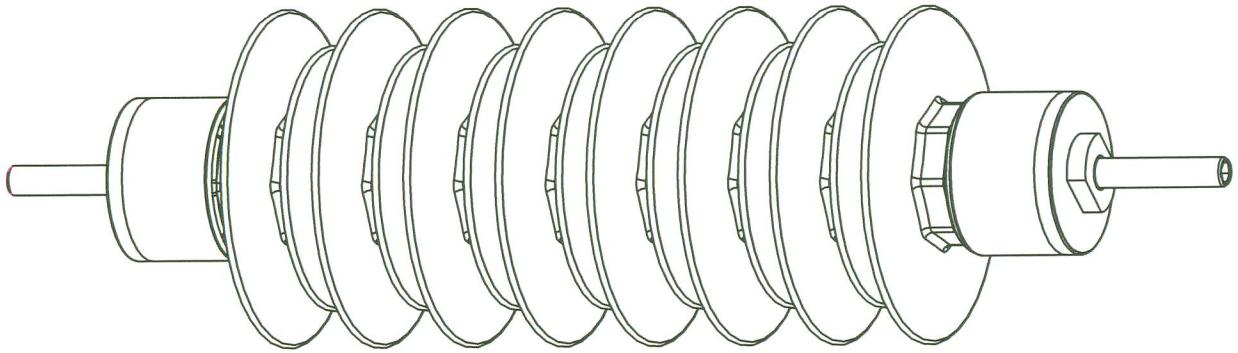
CESI A5/049798, n.4



Vp[kV]	T1/Tp[us]	T2/Tc[us]
249.745	1.146	55.650

SCD





NOTE:-
Uc = 41kV
NOM CREEPAGE = 1279mm
NOM DRY ARC DIST = 418mm
CANT. STRENGTH = 350Nm
TENSILE STREHGTH = 2kN
TORQUE = 50Nm
HIGH SHORT CIRCUIT = 40kA
LOW SHORT CIRCUIT = 600A

REV	DATE	SIGN	MODIFICATION
0	09/05	JM	ORIGINAL ISSUE

CESI
PROTOCOLLO APP.
A 5/ 4 9 8 0 0
DATA 18 OTT. 2005
Firma

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RAYCHEM SHANNON
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SHANNON
CO. CLARE
IRELAND

DRN	J MULLIGAN	09/09/05	
CHECK	B NORMOYLE		
APP	B McGOVAN		
SCALE	1:2		

PCN ******-000
MAT'L

TITLE
41kV 10kA
MV SURGE ARRESTOR
DCP2-41M

DRG NO MV-DCP2-00280-S
SHEET 1 OF 1
REV 0