List of Test Participants

Representatives of the Test Committee:

Mr. G. Heit	PEHLA-Testing Laboratory Mannheim, Germany
Mr. K. Hauck	PEHLA-Testing Laboratory Ratingen, Germany

Test Engineer:

Mr. K. Hauck	PEHLA-Testing Laboratory Ratingen, Germany

Representatives of the Client:

Mr. S. Magoni	ABB T&D SpA, Division SACE T.M.S., Italy
Mr. C. Manzoni	ABB T&D SpA, Division SACE T.M.S., Italy

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker

Ratings assigned by the manufacturer

Test Object: Vacuum circuit-breaker
Type: VD4.17.12.32
Manufacturer:
Circuit-breaker: ABB T&D SpA, Divisione Sace T.M.S, Via Friuli, 4 – 24044 Dalmine (BG), Italy
Pole parts including vacuum interrupters: ABB Calor Emag Mittelspannung GmbH, Oberhausener Str. 33, 40472 Ratingen, Germany
Serial-No.: AC00043879 **Year of manufacture:** 2002
Drawing No.: see sheet 7
Vacuum interrupter: Type: VG4S L1: No. 3690, L2: No. 3559, L3: No. 5133
Drawing No.: see sheet 7

Rated voltage	17.5 kV
Rated lightning impulse withstand voltage	95 kV
Rated switching impulse withstand voltage	- kV
Rated power frequency withstand voltage	38 kV
Rated frequency	50 Hz
Rated normal current	1250 A
Rated peak withstand current	80 kA
Rated short-time withstand current	31.5 kA
Rated duration of short-circuit	3 s
Rated short-circuit breaking current at 17.5 kV	31.5 kA
D.C. component	30 %
Rated short-circuit making current at 17.5 kV	80 kA
Rated transient recovery voltage:	
Peak value	30 kV
Rate of rise	0.42 kV/µs
First-pole-to-clear-factor	1.5
Rated operating sequence	O-0.3s-CO-3min-CO
Arc extinguishing medium	vacuum
Number of poles	3
Number of units per pole	1
Rated opening time	≥ 45 ms
Rated closing time	approx. 60 ms
Rated voltage of trip coil	220 V-DC
Rated voltage of closing coil	220 V-DC
Rated supply voltage	220 V-DC
Rated frequency of supply voltage	- Hz

Essential characteristics:
Motor Drive Type 701 921/804, Serial No. CA 6DC L02 D (EL1)

Date of receipt of test object: 11th November 2002

ВЯРНО С ОРИГИНАЛА

List of Drawings

The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. PEHLA has verified that these drawings adequately represent the equipment tested. These drawings have been stamped and signed by PEHLA representatives and are kept

☒ with the test documents at the test laboratory.

☐ at the client.

The drawings contained in this document are identical with the checked, stamped and signed drawings.

Drawing-No.	Revision	Title	Additional remarks
TN. 7405	M5234	VACUUM CIRCUIT BREAKER TYPE VD4 12-17.5kV 630-1250A	Included in this Test Report
GCE7003979R0131	00	pole complete VD4P 12kV 1250A 31,5kA	Included in this Test Report
510507	50535	OPERATING MECHANISM ASSEMBLY	Included in this Test Report
510564	50535	CLOSING SPRINGS ASSEMBLY	-
Parts list			-
510564		Ass. molle di ch. com. EL1	-
510507		Assieme commando EL1	-
GCE7003979R0131		Pol vst. 40,7 3150N H205 12/171231 VG4S	-

ВЯРНО С ОРИГИНАЛА

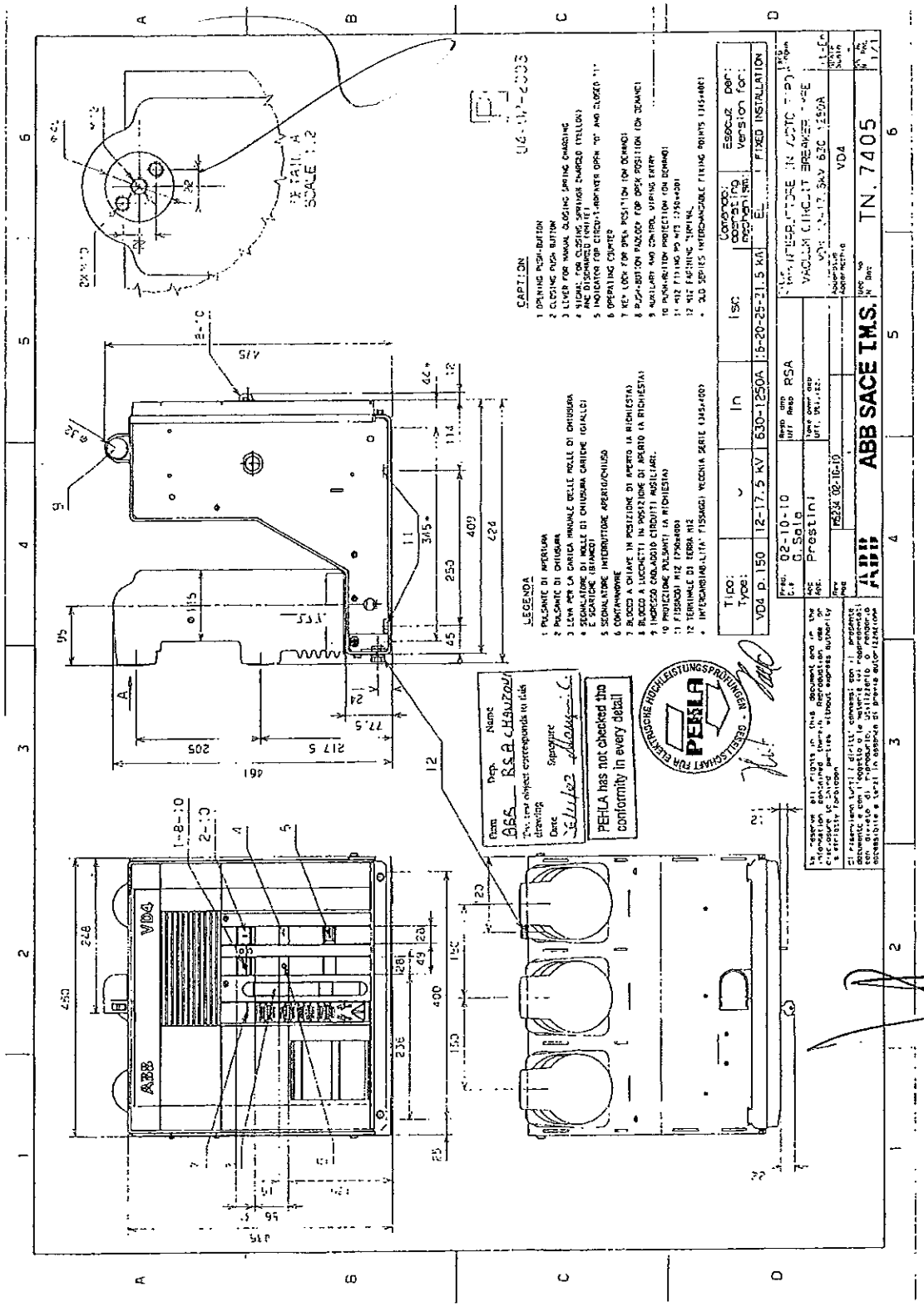
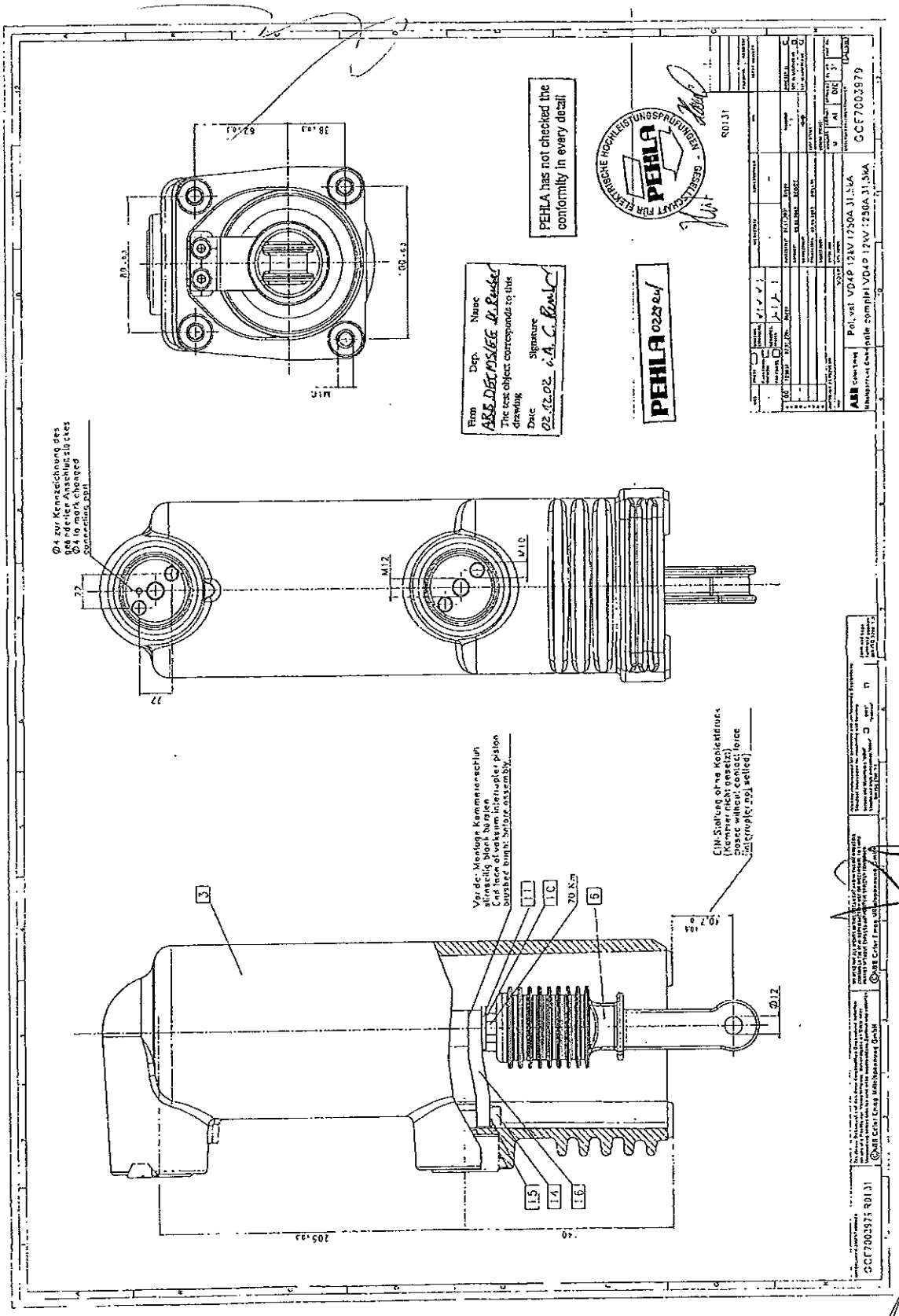


ABB SACE T.M.S.
TN. 7405
VD4 p.150
12-17.5 kV
630-1250A
16-20-25-31.5 kA
1 FIXED INSTALLATION
VACUUM CIRCUIT BREAKER
PEHLA has not checked the conformity in every detail
ВЯРНО С ОРИГИНАЛА



ВЯРНО С ОРИГИНАЛА

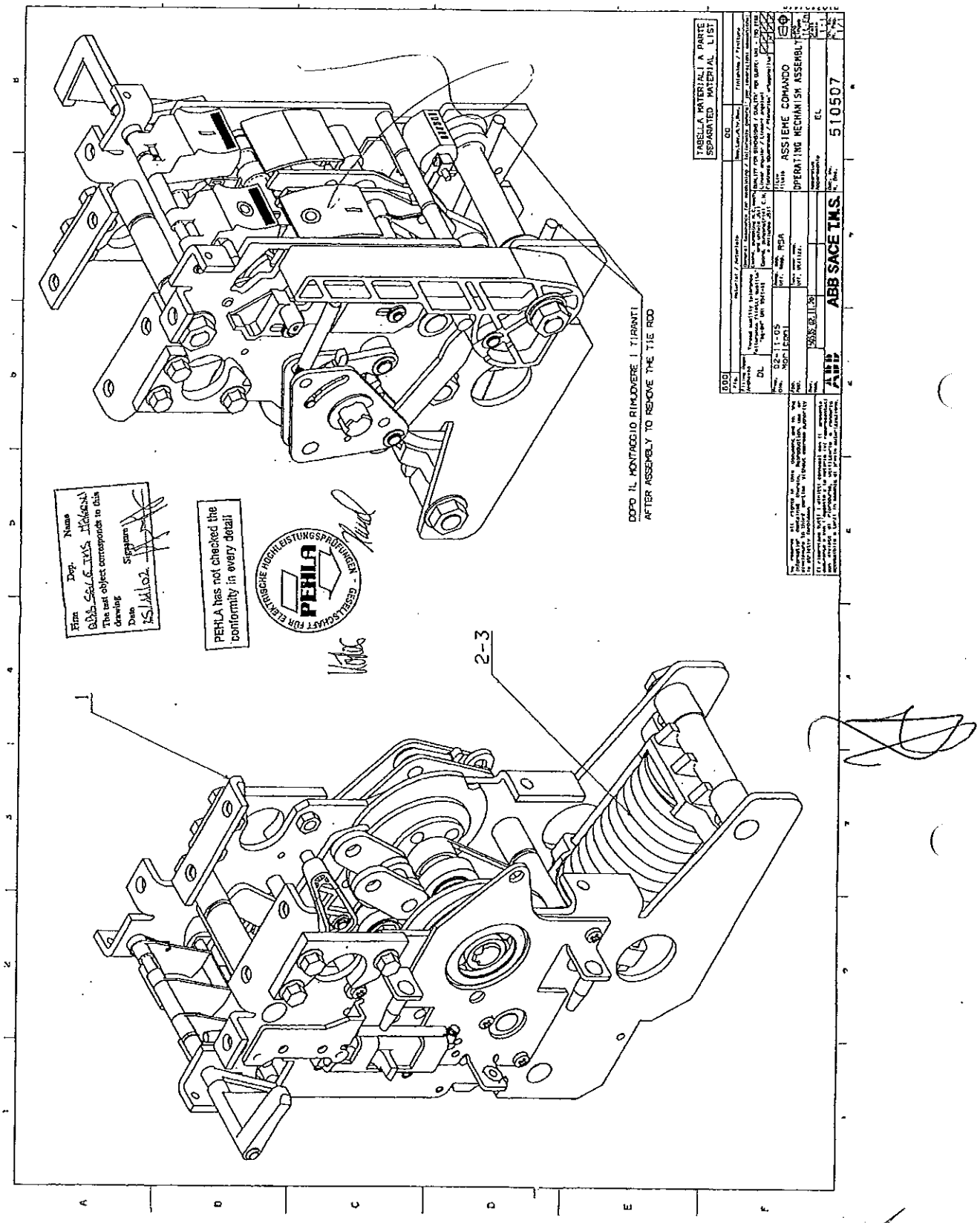


TABELLA MATERIALI A PARTE
SEPARATED MATERIAL LIST
DOPO IL MONTAGGIO RIMUOVERE I TIRANTI
AFTER ASSEMBLY TO REMOVE THE TIE ROD
ASSIEME COMANDO
OPERATING MECHANISM ASSEMBLY
ABB SACE T.M.S.
510507
PEHLA has not checked the conformity in every detail
GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
PEHLA
2-3
1

Technical Data of Test Circuits

Test	Basic Short-Circuit Test-Duty		T60		T100	
Test No.		0231Ra	06 – 08		09 - 24	
Number of phases		(test circuit)	3		3	
Rated voltage		kV	17.5		17.5	
Number of poles or phases		(test object)	3		3	
Voltage distribution		%	-		-	
Power frequency		Hz	50		50	
Power factor		cos φ	≤ 0.15		≤ 0.15	
Earthing conditions	Generator / System Transformer Short-circuit point		earthed via 5 kΩ not earthed earthed		earthed via 5 kΩ not earthed earthed	
Short-circuit breaking current		kA	18.9		31.5	
Test frequency		Hz	-		-	
Crest value of injected current		kA	-		-	
Corresponding test frequency		Hz	-		-	
Transient Recovery Voltage			required values	actual values	required values	actual values
TRV peak value u_c		kV	32.0	37.3	30.0	29.6
Time t_2 or t_3		µs	31.0	36.0	71.0	64.0
Time delay t_d		µs	-	-	-	-
Rate-of-rise u_1 / t_1 or u_c / t_3		kV/µs	1.04	1.04	0.42	0.46
Voltage u_1		kV	-	-	-	-
Time t_1		µs	-	-	-	-
First peak u_L		kV	-	-	-	-
Time t_L		µs	-	-	-	-
Rate of rise u_L/t_L		kV/µs	-	-	-	-
Surge impedance Z_L		Ω	-	-	-	-
Time Delay t_{dL}		µs	-	-	-	-
Crest value u_T		kV	-	-	-	-
Crest value u_c		kV	-	-	-	-
		-				
		-				
Voltage measurements			- -	Dividers 4.5 MΩ / 10 kΩ	- -	Dividers 4.5 MΩ / 10 kΩ
Current measurements			- -	Shunts 37.6 µΩ	- -	Shunts 37.6 µΩ

Remarks: -

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Circuits

Test Basic Short-Circuit Test		T10		T30	
Test No.	0231Ra	25 – 27		28 - 31	
Number of phases	(test circuit)	3		3	
Rated voltage	kV	17.5		17.5	
Number of poles or phases	(test object)	3		3	
Voltage distribution	%	-		-	
Power frequency	Hz	50		50	
Power factor	cos φ	≤ 0.15		≤ 0.15	
Earthing conditions	Generator / System Transformer Short-circuit point	earthed via 5 kΩ not earthed earthed		earthed via 5 kΩ not earthed earthed	
Short-circuit breaking current	kA	3.15		9.45	
Test frequency	Hz	-		-	
Crest value of injected current	kA	-		-	
Corresponding test frequency	Hz	-		-	
Transient Recovery Voltage		required values	actual values	required values	actual values
TRV peak value u_c	kV	32.0	35.0	32.0	35.4
Time t_2 or t_3	µs	15.0	56.5 *1	15.0	49.0 *1
Time delay t_d	µs	-	-	-	-
Rate-of-rise u_1 / t_1 or u_c / t_3	kV/µs	2.14	0.62	2.14	0.72
Voltage u_1	kV	-	-	-	-
Time t_1	µs	-	-	-	-
First peak u_L	kV	-	-	-	-
Time t_L	µs	-	-	-	-
Rate of rise u_L/t_L	kV/µs	-	-	-	-
Surge impedance Z_L	Ω	-	-	-	-
Time Delay t_{dL}	µs	-	-	-	-
Crest value u_T	kV	-	-	-	-
Crest value u_c	kV	-	-	-	-
	-				
	-				
Voltage measurements		- -	Dividers 4.5 MΩ / 10 kΩ	- -	Dividers 4.5 MΩ / 10 kΩ
Current measurements		- -	Shunts 37.6 µΩ	- -	Shunts 37.6 µΩ

Remarks:

*1 Due to limitations of the test plant, the length of time t_3 of the TRV is greater than the rated value.

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Circuits

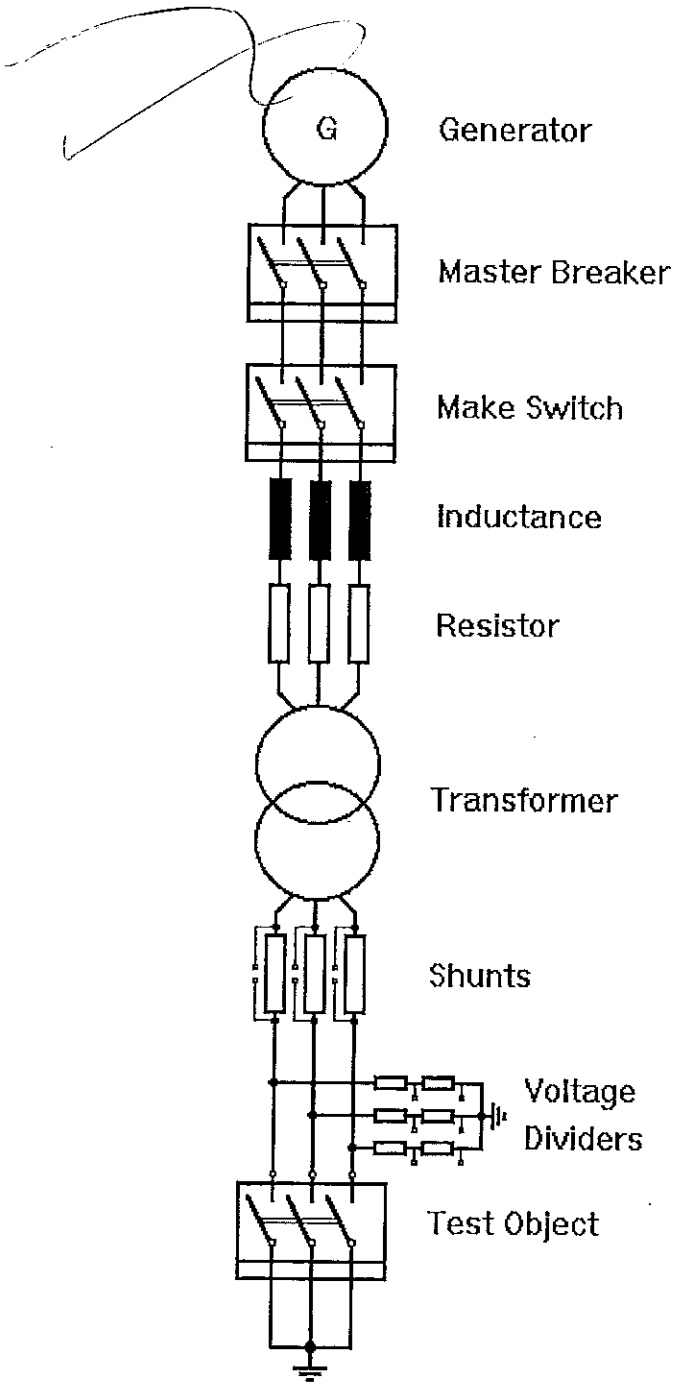
Test	Basic Short-Circuit Test		Double earth fault test		-	
Test No.		0231Ra	35		-	
Number of phases	(test circuit)		2		-	
Rated voltage		kV	17.5		-	
Number of poles or phases	(test object)		1		-	
Voltage distribution		%	-		-	
Power frequency		Hz	50		-	
Power factor		cos φ	≤ 0.15		-	
Earthing conditions	Generator / System Transformer Short-circuit point		earthed via 5 kΩ not earthed earthed		- - -	
Short-circuit breaking current		kA	27.4		-	
Test frequency		Hz	-		-	
Crest value of injected current		kA	-		-	
Corresponding test frequency		Hz	-		-	
Transient Recovery Voltage			required values	actual values	required values	actual values
TRV peak value u_c		kV	34.6	34.1	-	-
Time t_2 or t_3		µs	81.9	77.5	-	-
Time delay t_d		µs	-	-	-	-
Rate-of-rise u_1 / t_1 or u_c / t_3		kV/µs	0.42	0.44	-	-
Voltage u_1		kV	-	-	-	-
Time t_1		µs	-	-	-	-
First peak u_L		kV	-	-	-	-
Time t_L		µs	-	-	-	-
Rate of rise u_L/t_L		kV/µs	-	-	-	-
Surge impedance Z_L		Ω	-	-	-	-
Time Delay t_{dL}		µs	-	-	-	-
Crest value u_T		kV	-	-	-	-
Crest value u_c		kV	-	-	-	-
		-				
		-				
Voltage measurements			- -	Dividers 4.5 MΩ / 10 kΩ	- -	- -
Current measurements			- -	Shunts 37.6 µΩ	- -	- -

Remarks: -

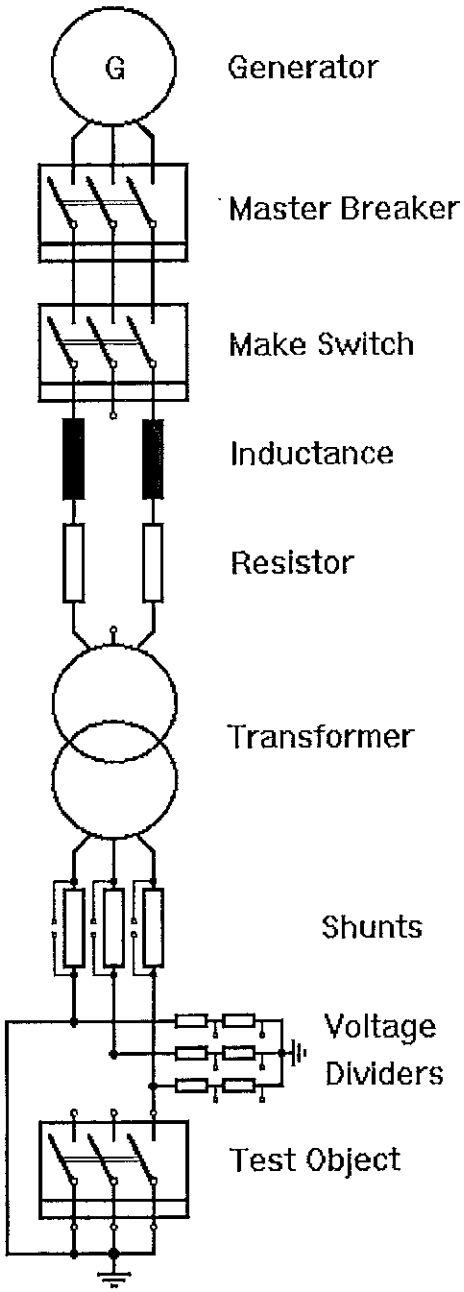
ВЯРНО С ОРИГИНАЛА

Principle Diagram of Three-phase Test Circuits

Basic Short-circuit Test-Duties T10 – T100



Principle Diagram of Single-phase Test Circuit



ВЯРНО С ОРИГИНАЛА

Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: T60

Date of test: 19th December 2002

Condition of test object before test: Factory new.

Connections to test object: By means of copper bars to the upper terminals of the circuit-breaker. Lower terminals of the circuit-breaker short-circuited and earthed

Arc extinguishing medium: Vacuum

Test No. PEHLA 0231Ra				06		07	08
Operating sequence				O – 0.3s – CO – 3min – CO – 8min – CO			
Applied voltage		kV		-	18.4	17.4	18.4
Short-circuit making current		kA	L1	-	44.3	34.1	35.2
			L2	-	32.9	46.5	47.4
			L3	-	49.6	50.7	52.2
Short-circuit breaking current	Short-circuit current	kA	L1	19.1	18.5	18.4	18.9
			L2	19.0	19.0	18.9	19.4
			L3	19.3	18.6	18.8	19.3
	Average value	kA		19.1	18.7	18.7	19.2
	d.c. component	%	L1	< 20	< 20	< 20	< 20
			L2	< 20	< 20	< 20	< 20
			L3	< 20	< 20	< 20	< 20
Recovery voltage		kV	L1	10.6	10.2	10.4	10.4
			L2	10.6	10.2	10.4	10.6
			L3	10.4	10.3	10.4	10.4
Average value (phase-to-phase)		kV	-	18.0	17.7	18.0	18.2
Transient Recovery Voltage (TRV), first-pole-to-clear		kV		- 31.8	- 31.3	- 38.3	- 38.8
Arcing time		ms	L1	9.1	7.0	2.4	1.8
			L2	4.6	2.0	7.2	7.0
			L3	9.3	6.8	7.0	6.8
Closing time		ms		-	62.9	65.3	65.5
Opening time		ms		62.9	66.4	65.0	65.7
Result				P	P	P	P

Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

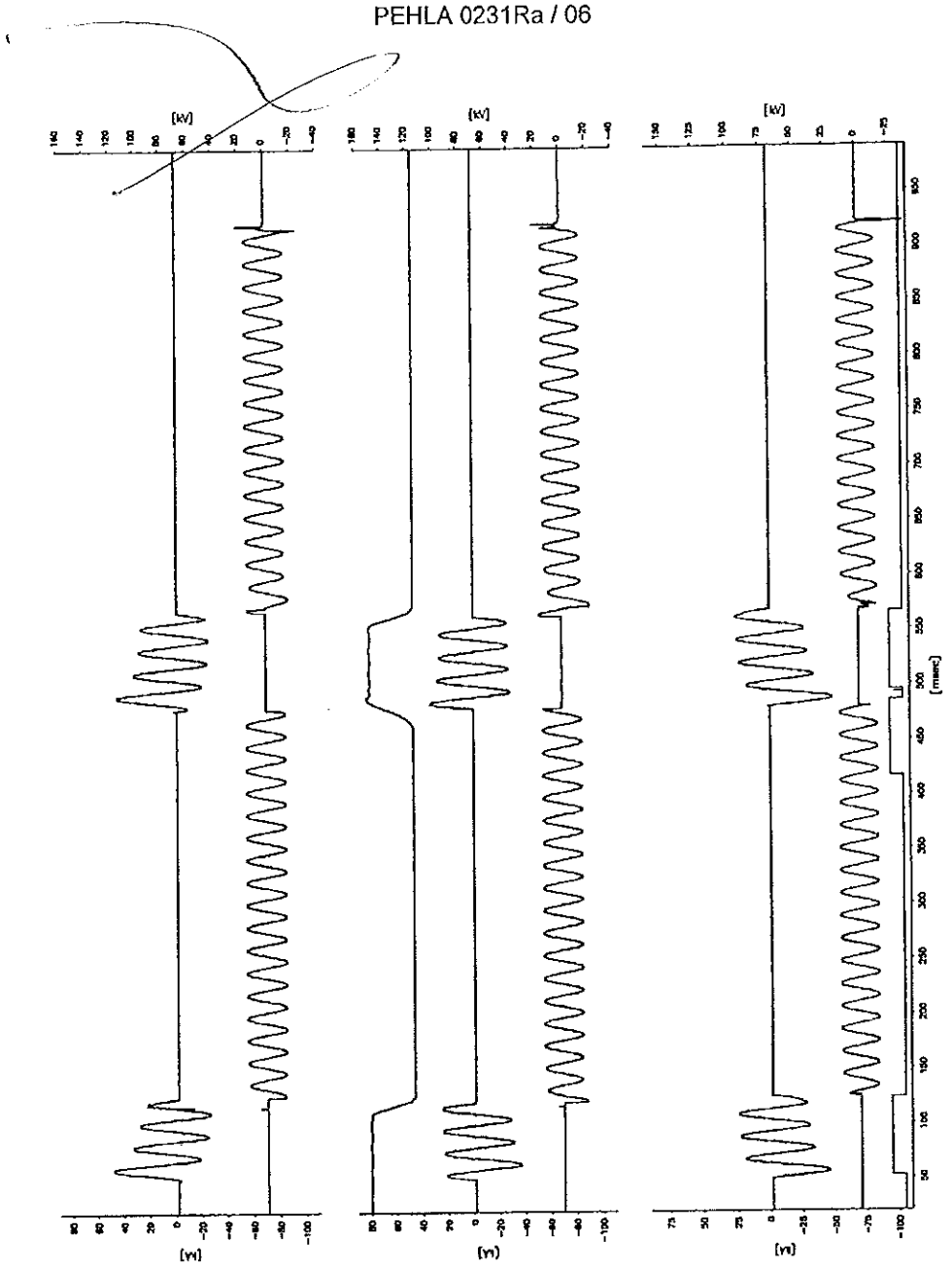
Remarks:

PEHLA 0231Ra / 01:	Current calibration
PEHLA 0231Ra / 02:	No-load operation
PEHLA 0231Ra / 03:	Voltage calibration
PEHLA 0231Ra / 04 and 05:	Tests with reduced values
PEHLA 0231Ra / 06 to 08:	The operating devices are supplied at their minimum voltage.

Condition of test object after test: Circuit-breaker without functional or visible change.

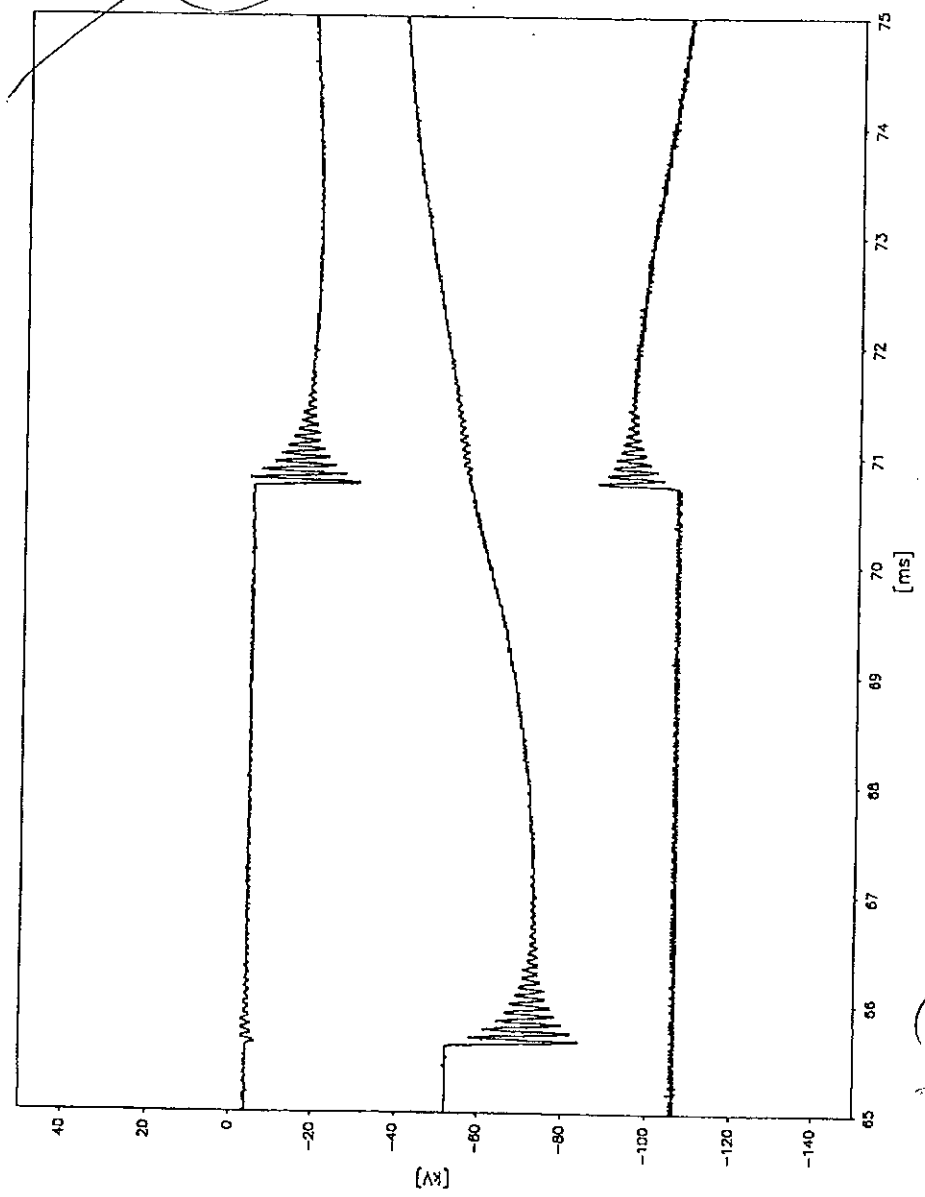
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 06



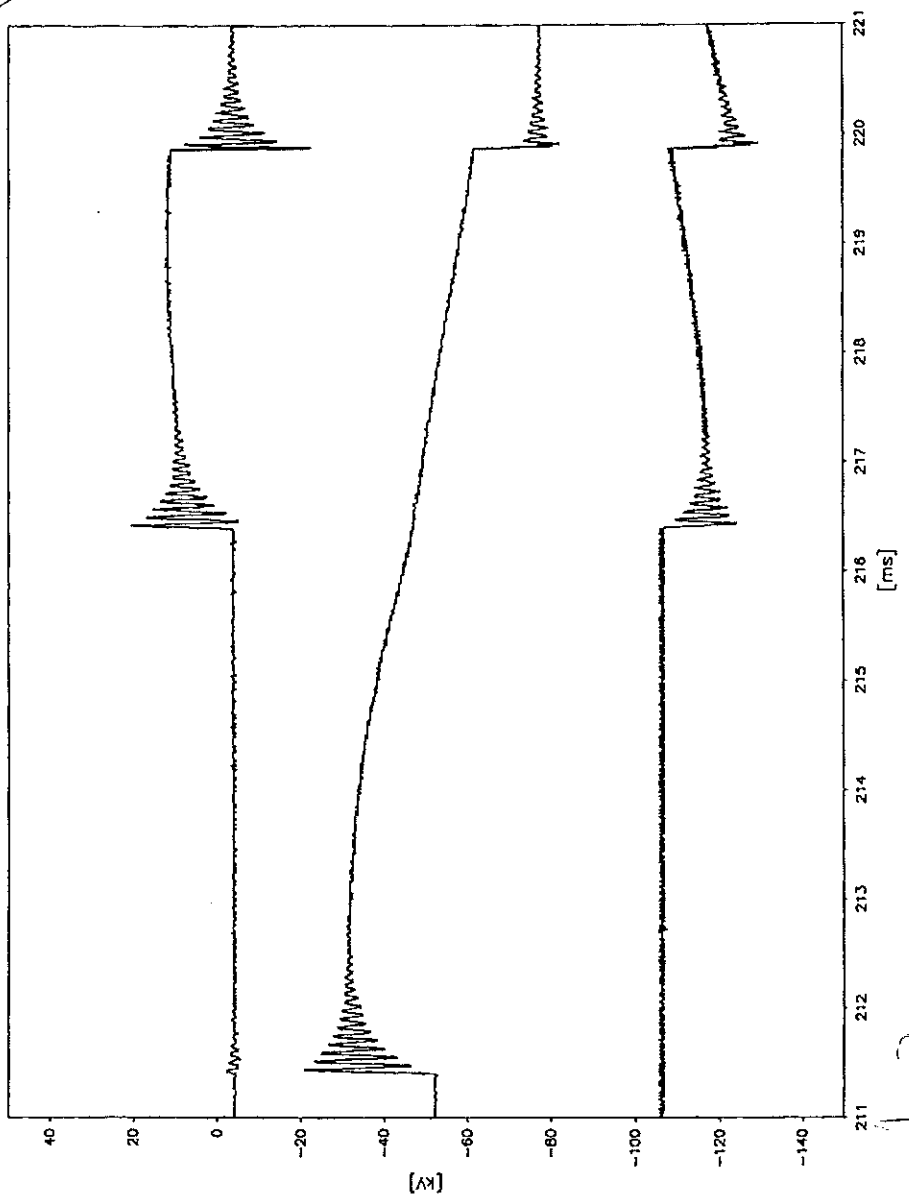
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 06
Transient Recovery Voltage, First O

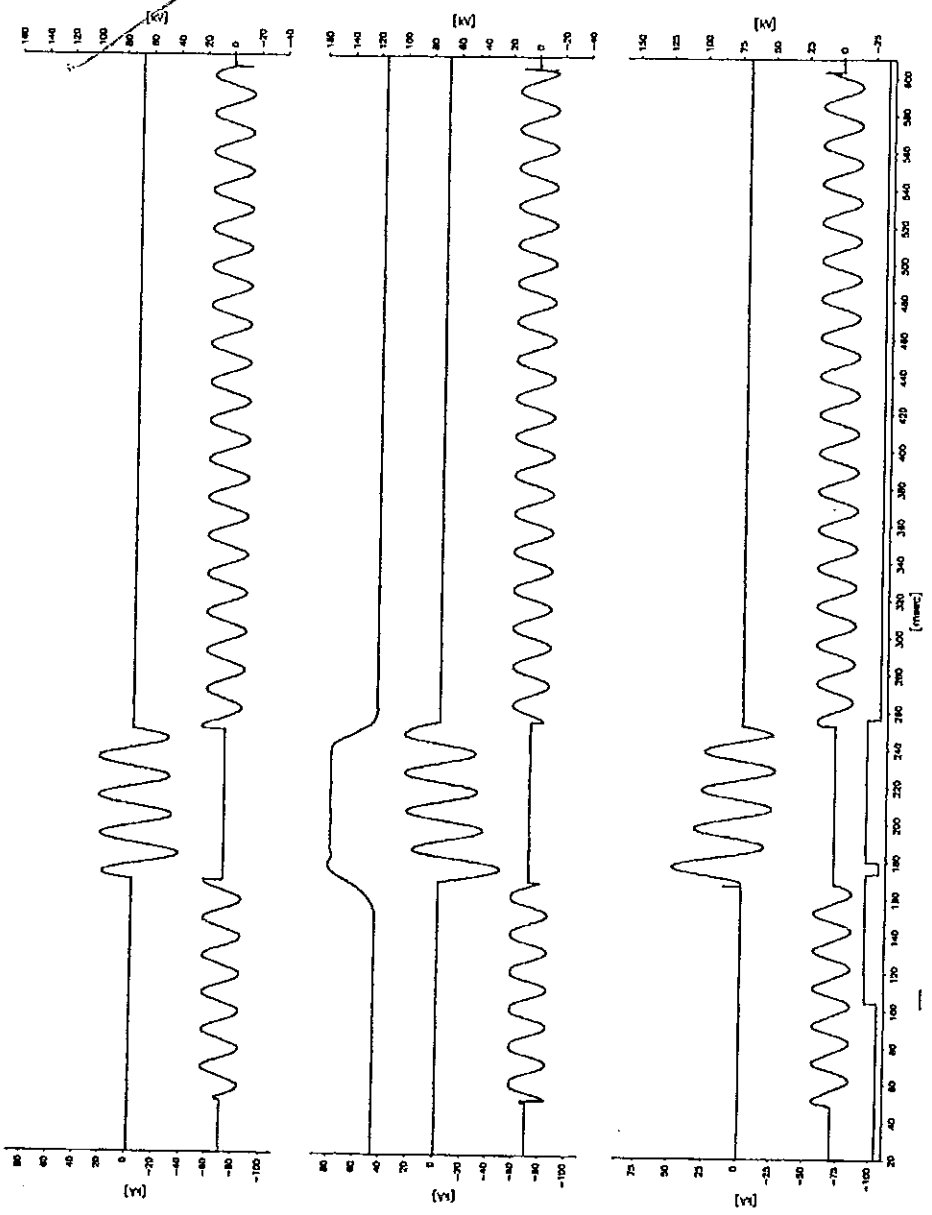


ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 06
Transient Recovery Voltage, Second O

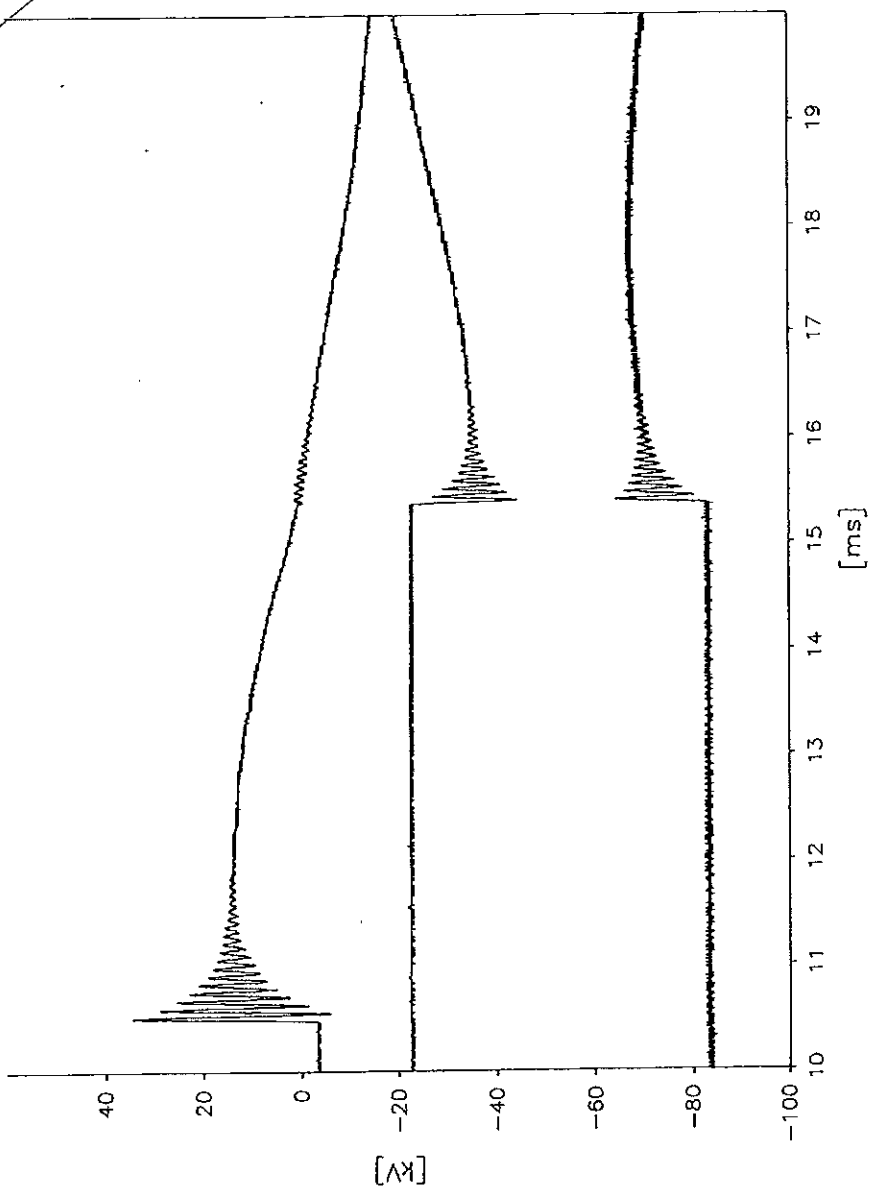


Test no.
PEHLA 0231Ra / 07



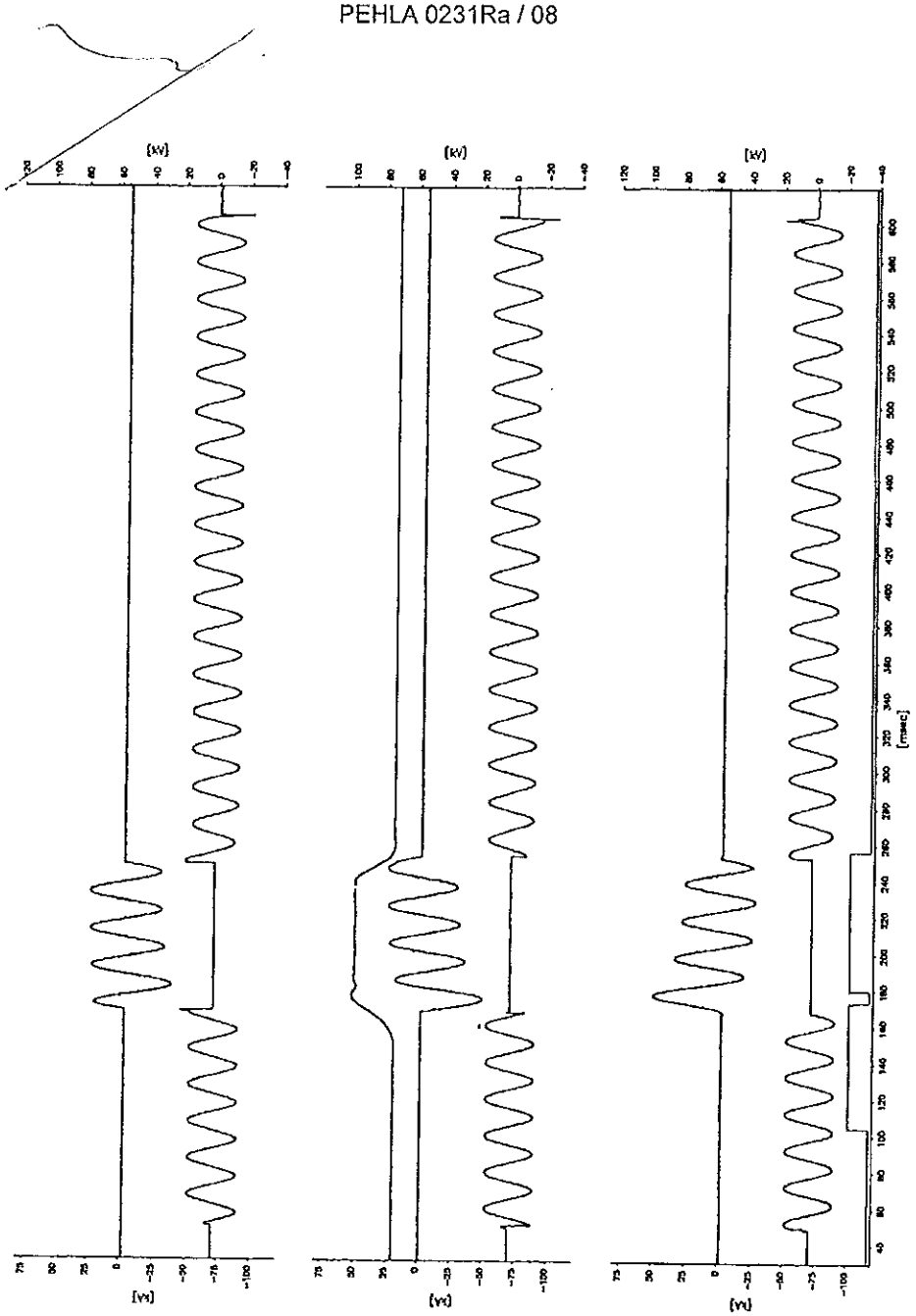
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 07
Transient Recovery Voltage



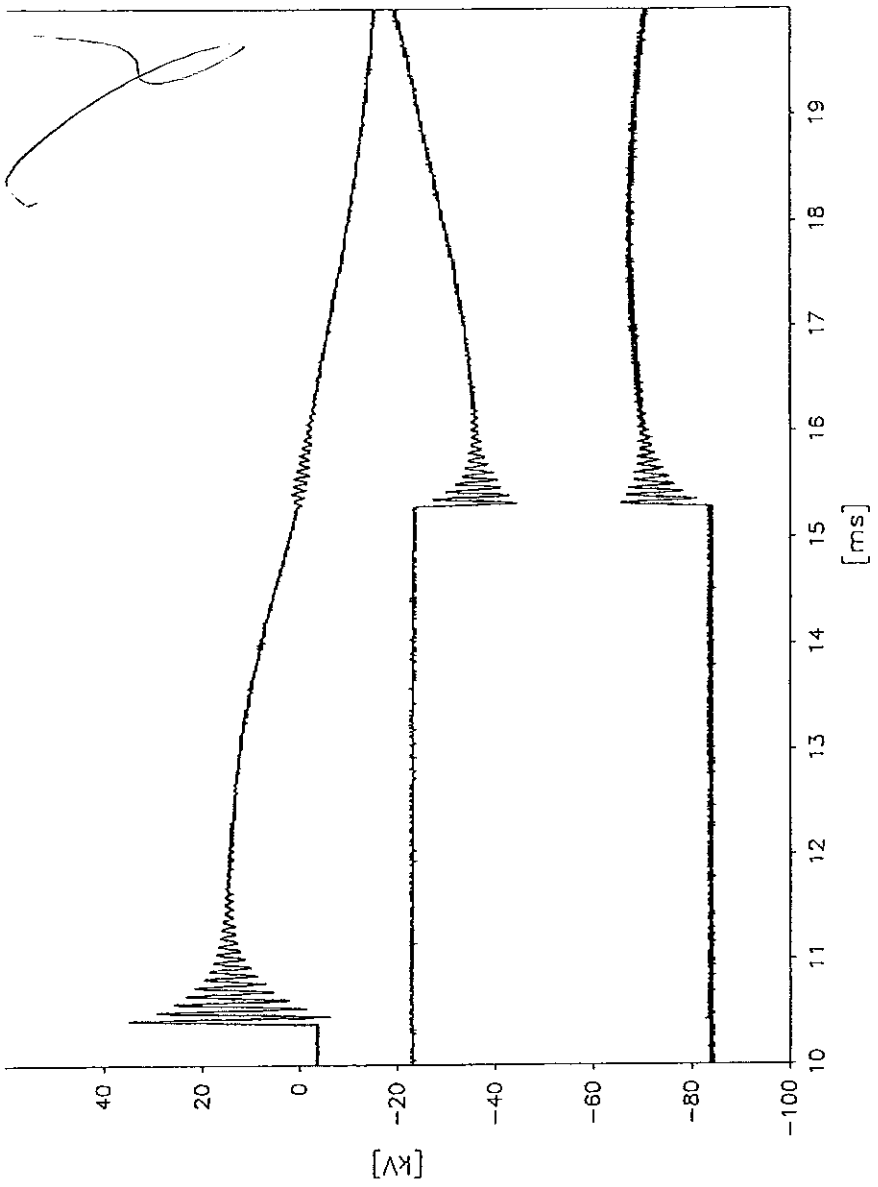
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 08



ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 08
Transient Recovery Voltage



ВЯРНО С ОРИГИНАЛА

Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: T100s

Date of test: 19th December 2002

Condition of test object before test: As after test PEHLA 0231Ra / 08.

Connections to test object: By means of copper bars to the upper terminals of the circuit-breaker. Lower terminals of the circuit-breaker short-circuited and earthed.

Arc extinguishing medium: Vacuum

Test No. PEHLA 0231Ra				10	11
Operating sequence				O – 0.3s – CO – 3min – CO	
Applied voltage		kV		-	20.1	19.9
Short-circuit making current			L1	-	65.7	61.0
		kA	L2	-	79.6	76.8
			L3	-	84.5	87.1
Short-circuit breaking current	Short-circuit current	kA	L1	32.4	31.6	30.9
			L2	32.7	32.5	31.8
			L3	32.8	31.9	32.0
	Average value	kA		32.6	32.0	31.6
	d.c. component	%	L1	< 20	< 20	< 20
			L2	< 20	< 20	< 20
			L3	< 20	< 20	< 20
Recovery voltage			L1	10.5	10.0	11.0
		kV	L2	11.0	10.2	11.6
			L3	10.7	10.3	11.3
Average value (phase-to-phase)		kV	-	18.6	17.6	19.5
Transient Recovery Voltage (TRV), first-pole-to-clear		kV		- 32.2	- 35.2	- 32.6
Arcing time			L1	9.4	1.8	1.6
		ms	L2	4.2	7.1	6.6
			L3	9.4	6.8	6.8
Closing time		ms		-	62.0	65.6
Opening time		ms		63.4	66.4	67.4
Result				P	P	P

Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

Remarks:

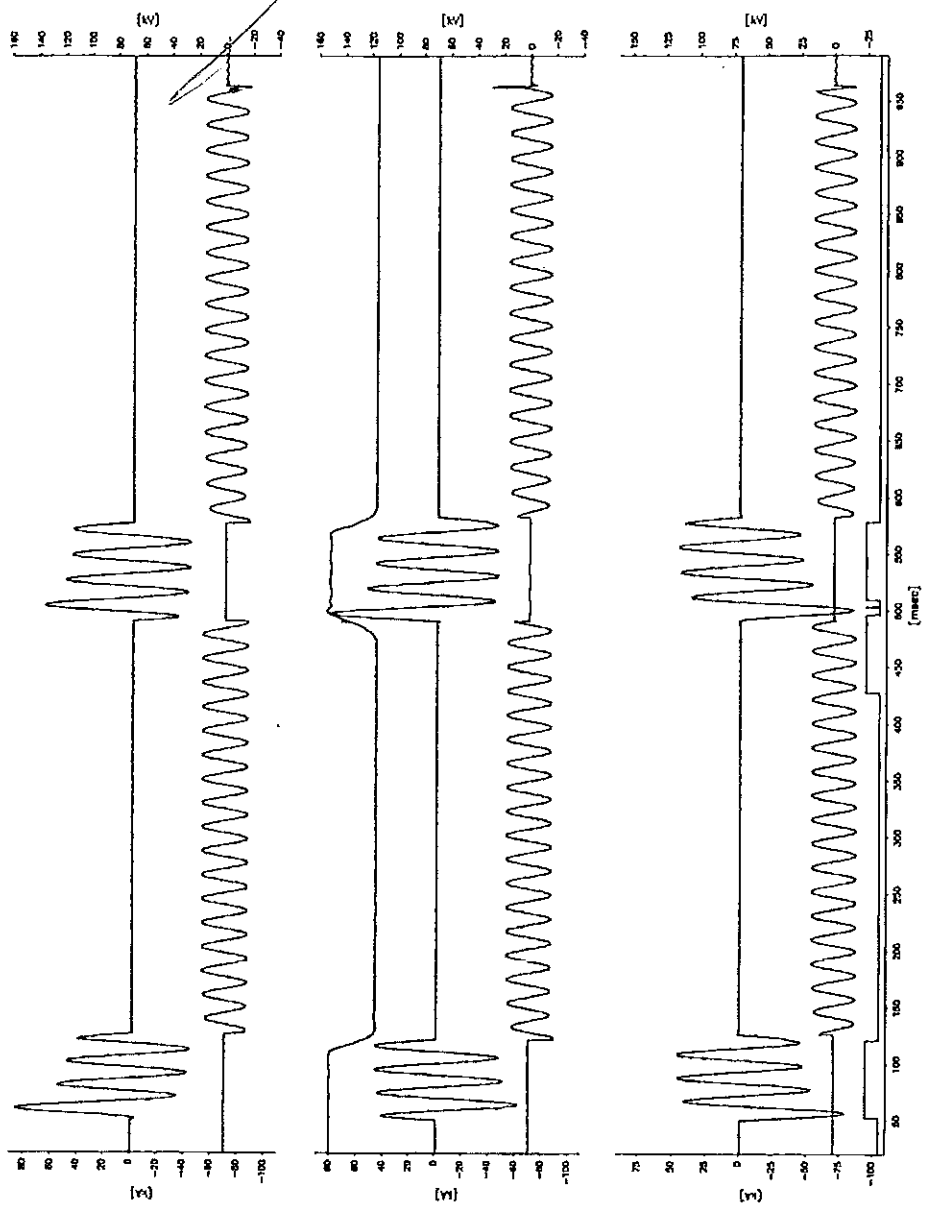
PEHLA 0231Ra / 09: Test with reduced values

PEHLA 0231Ra / 10 and 11: The operating devices are supplied at their minimum voltage

Condition of test object after test: Circuit-breaker without functional or visible change.

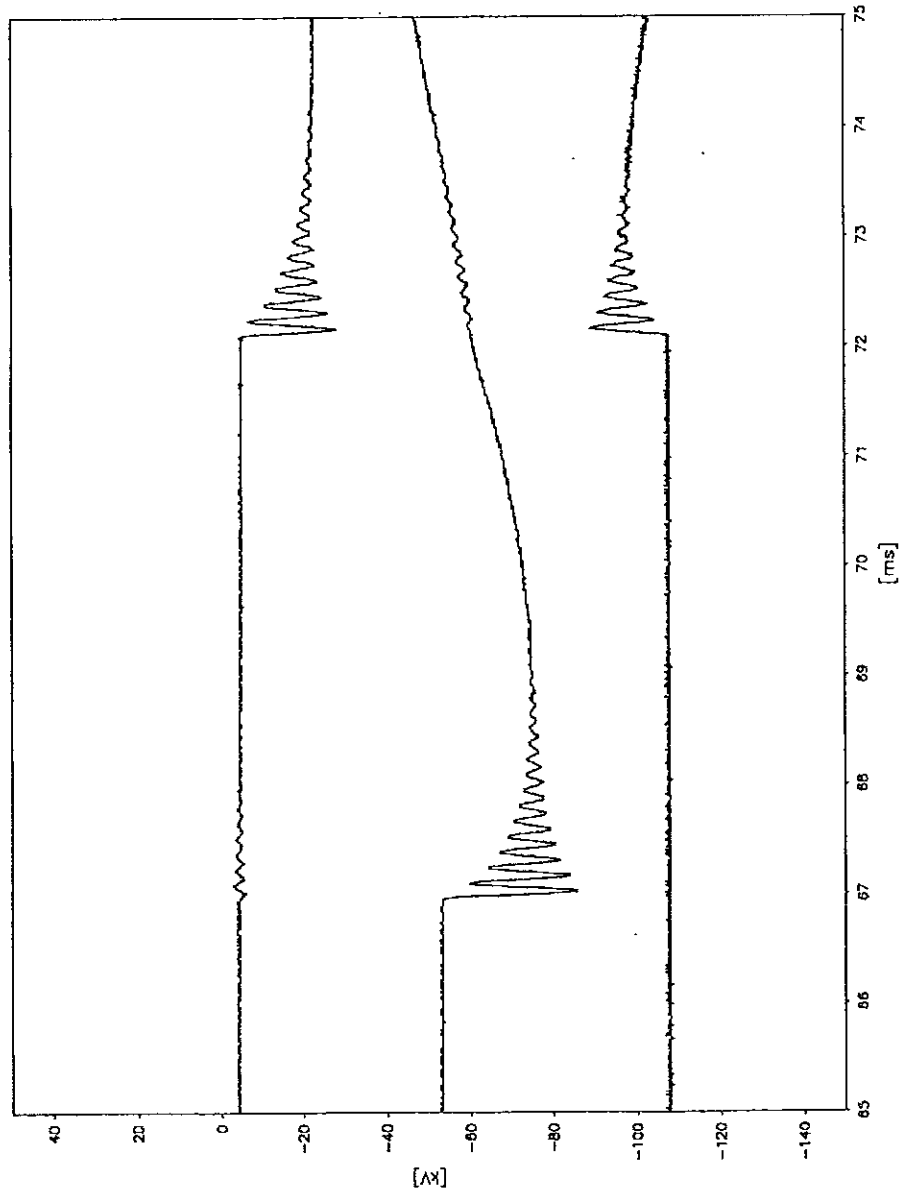
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 10



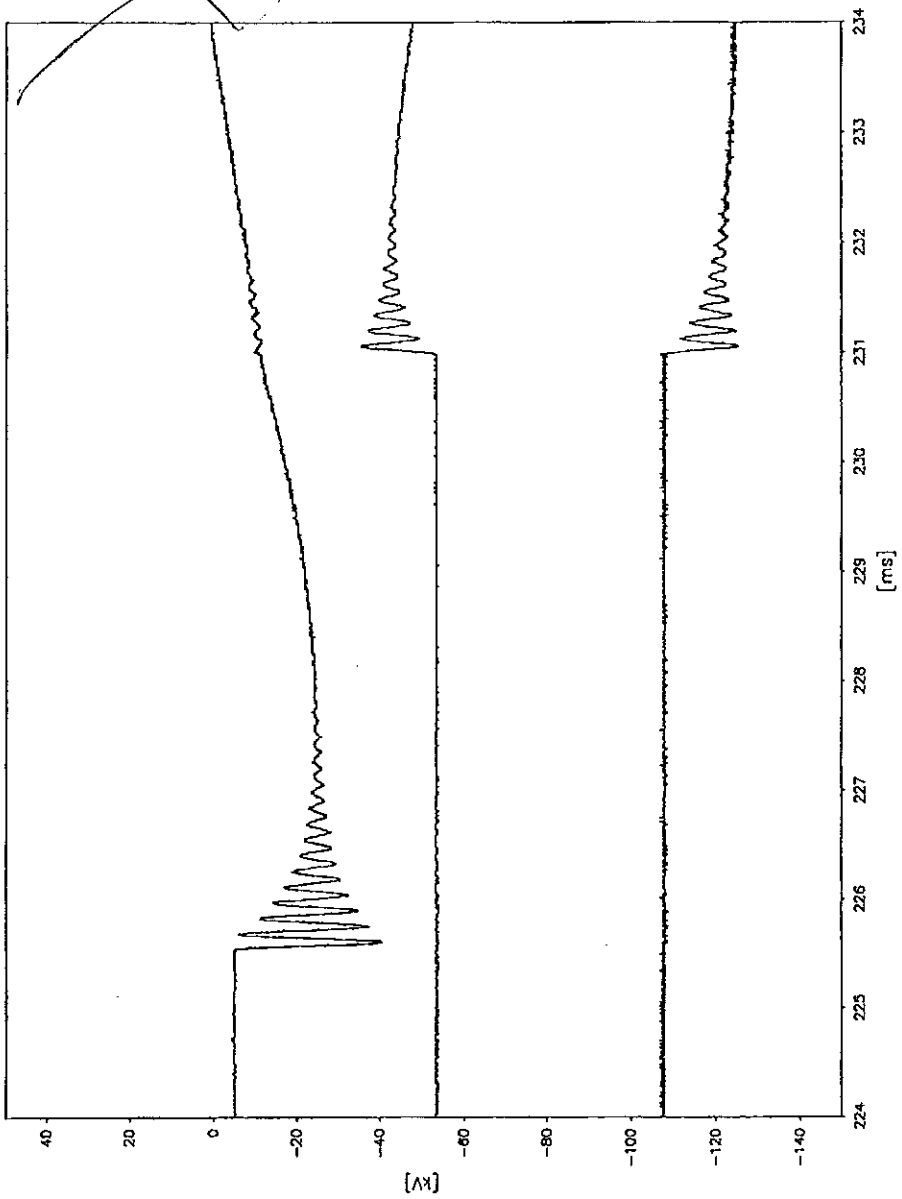
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 10
Transient Recovery Voltage, First O



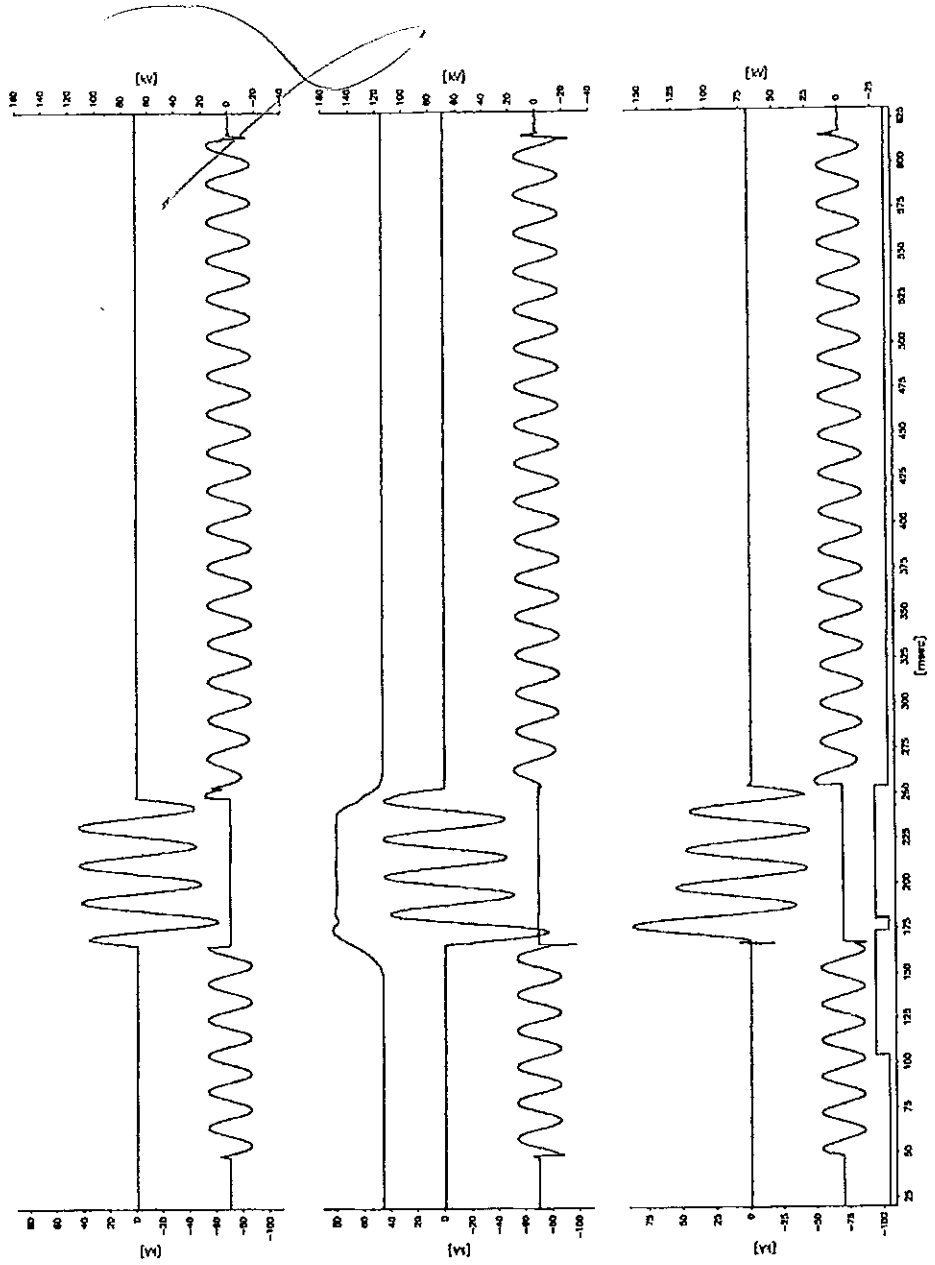
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 10
Transient Recovery Voltage, Second O

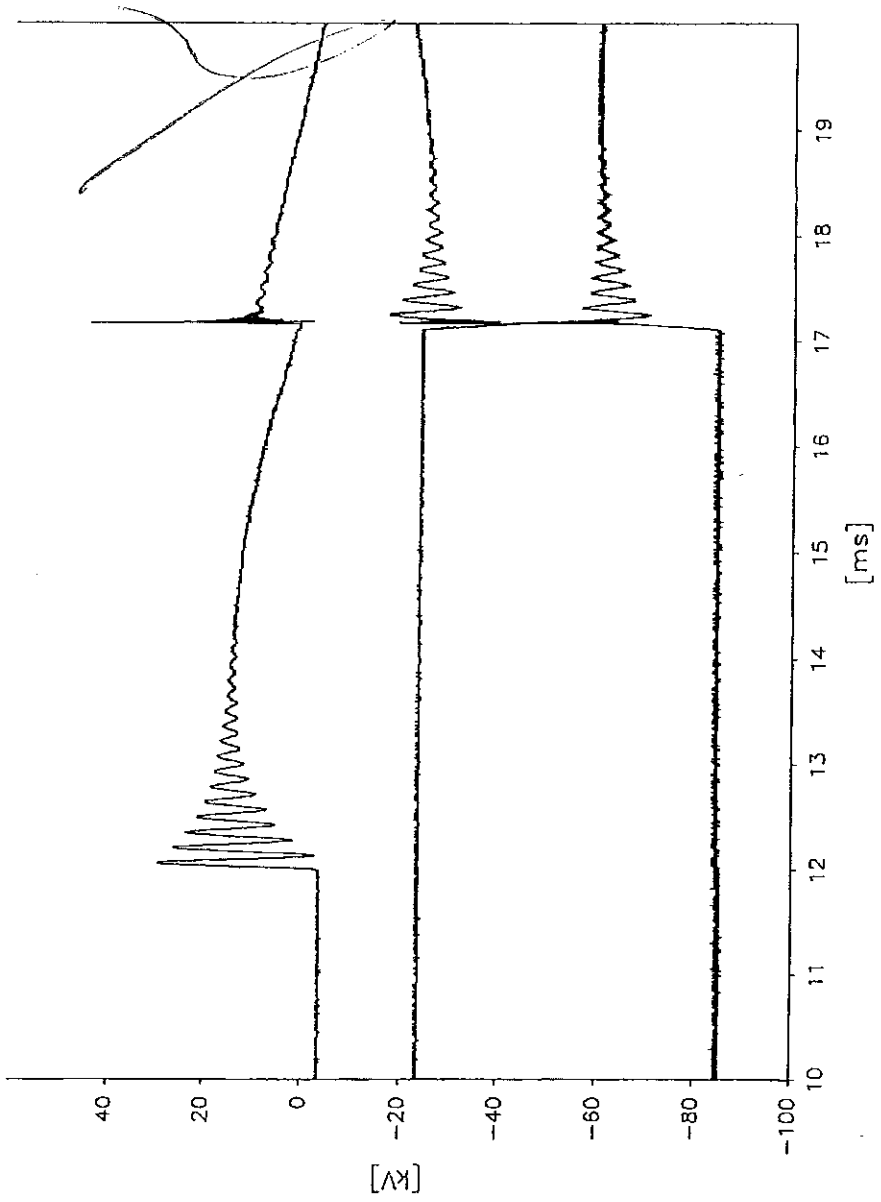


ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 11



Test no.
PEHLA 0231Ra / 11
Transient Recovery Voltage



ВЯРНО С ОРИГИНАЛА

Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: T100a

Date of test: 19th December 2002

Condition of test object before test: As after test PEHLA 0231Ra / 11.

Connections to test object: By means of copper bars to the upper terminals of the circuit-breaker. Lower terminals of the circuit-breaker short-circuited and earthed.

Arc extinguishing medium: Vacuum

Test No. PEHLA 0231Ra				21	22	23	24
Operating sequence				O	O	O	O
Applied voltage		kV		-	-	-	-
Short-circuit making current			L1	-	-	-	-
		kA	L2	-	-	-	-
			L3	-	-	-	-
Short-circuit breaking current	Short-circuit current	kA	L1	33.0	32.6	32.3	32.2
			L2	33.2	33.7	33.5	33.4
			L3	33.7	33.1	33.0	33.6
	Average value	kA		33.3	33.1	33.0	33.1
	d.c. component	%	L1	< 20	24.7	23.7	28.8
			L2	30.3	< 20	< 20	27.6
			L3	26.6	27.9	26.7	< 20
Δt1			L1	-	-	-	12.0
		ms	L2	12.3	-	-	-
			L3	-	12.0	12.0	-
Peak last loop			L1	-	-	-	57.1
		kA	L2	58.8	-	-	-
			L3		56.8	56.8	-
Recovery voltage			L1	10.8	11.2	11.3	11.0
		kV	L2	11.3	11.2	11.1	10.7
			L3	11.2	11.2	10.9	10.6
Average value (phase-to-phase)		kV	-	19.2	19.4	19.2	18.7
Transient Recovery Voltage (TRV), first-pole-to-clear		kV		- 34.1	- 31.3	- 31.7	- 31.8
Arcing time			L1	5.4	2.2	12.5	9.6
		ms	L2	10.1	7.0	12.9	9.4
			L3	10.9	7.2	8.4	4.6
Opening time		ms		43.2	42.8	43.1	43.3
Result				P	P	P	P

Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

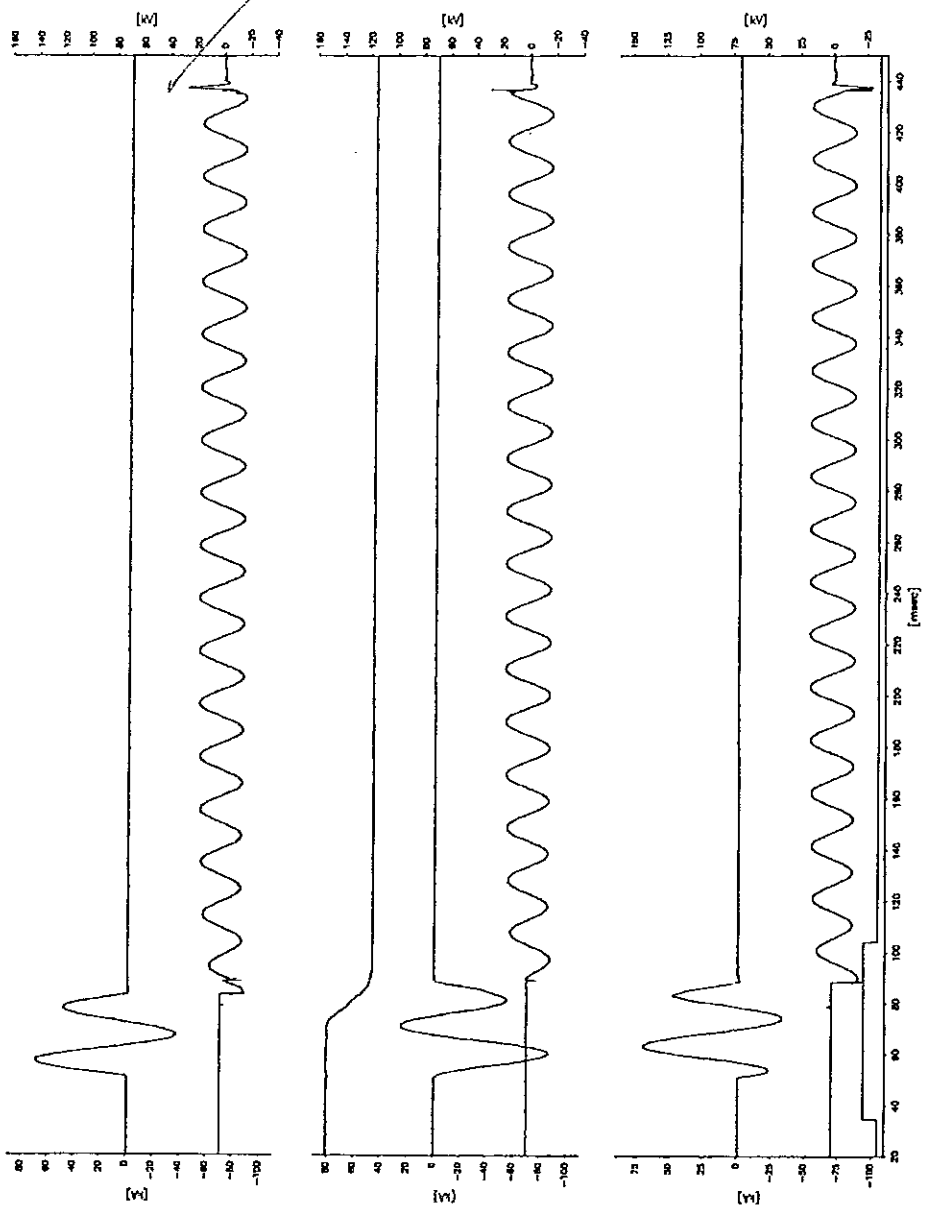
Remarks:

PEHLA 0231Ra / 12 to 16: Tests with reduced values
PEHLA 0231Ra / 17 to 20: Tests for determination of prospective dc components
PEHLA 0231Ra / 21 to 24: The operating devices are supplied at their maximum voltage

Condition of test object after test: Circuit-breaker without functional or visible change.

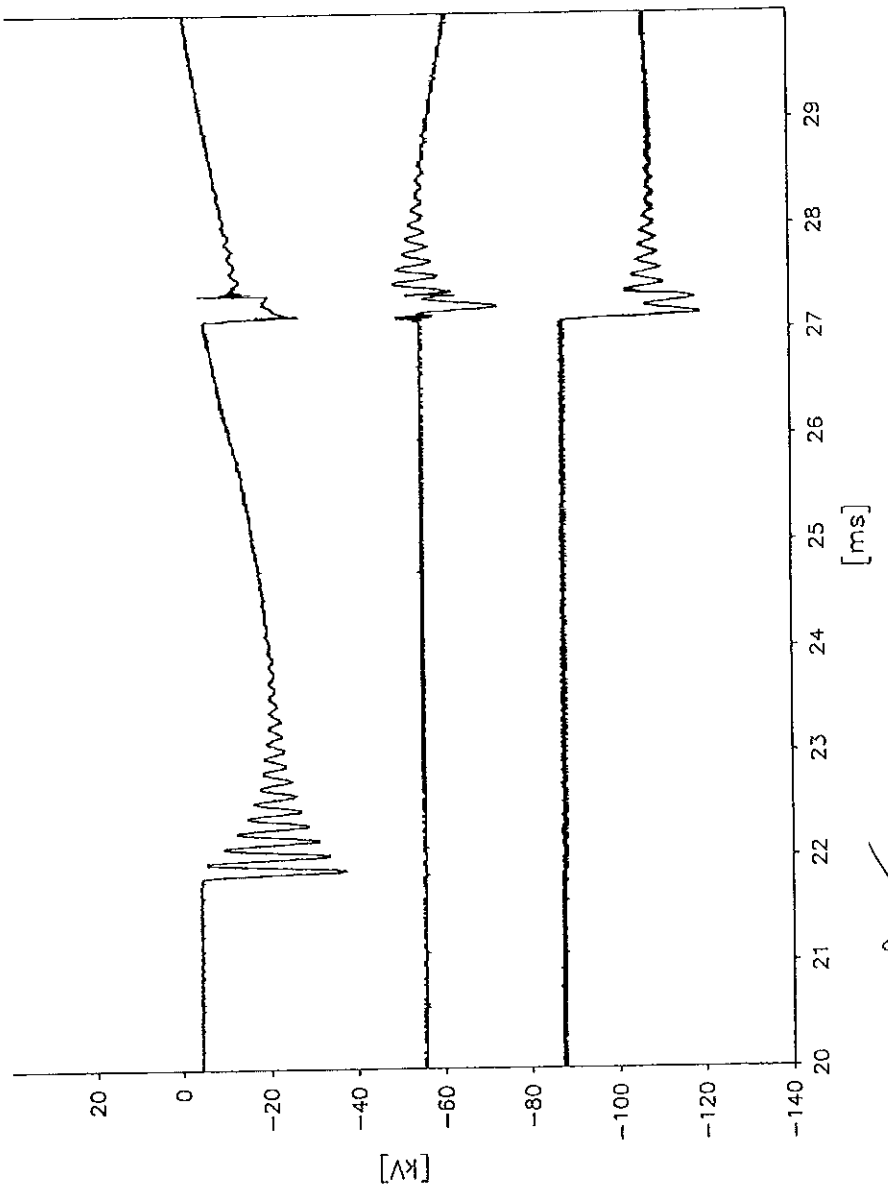
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 21



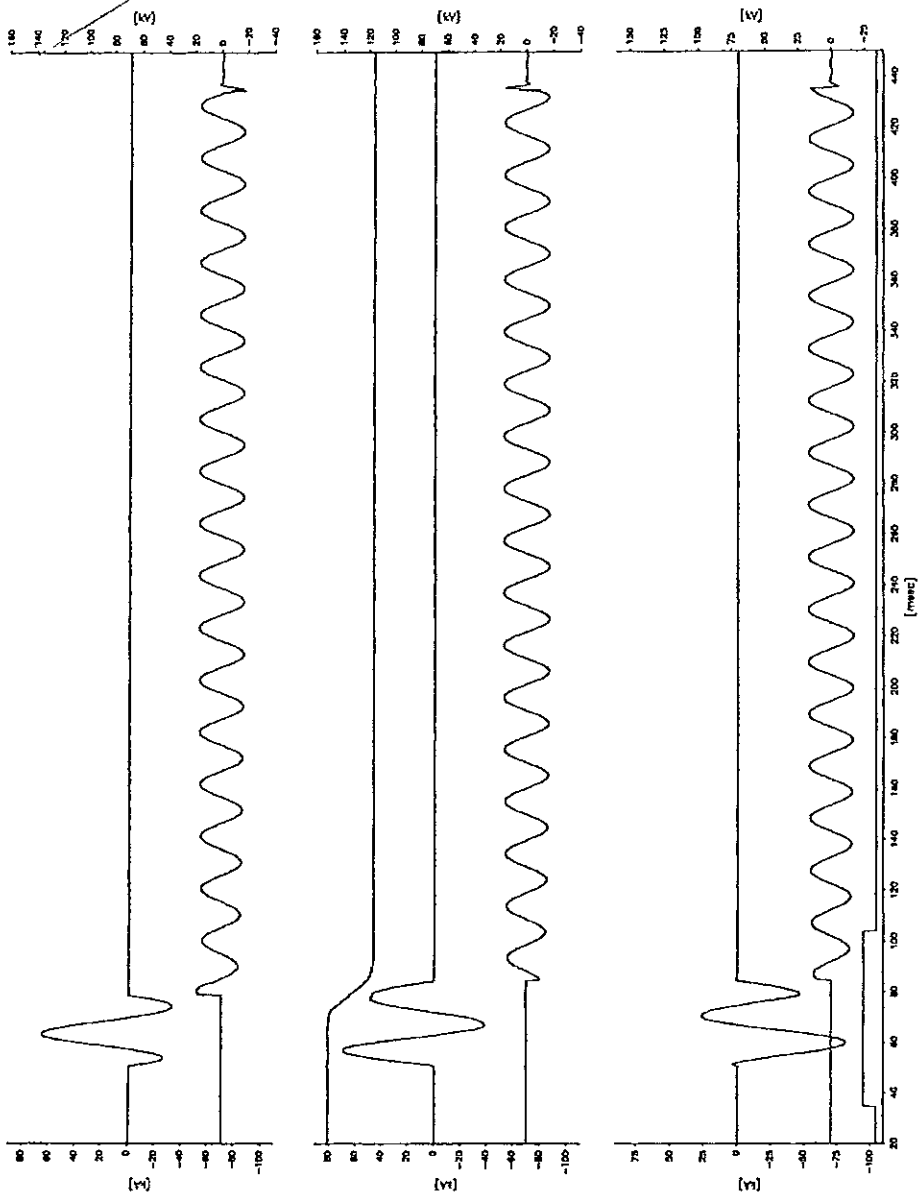
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 21
Transient Recovery Voltage

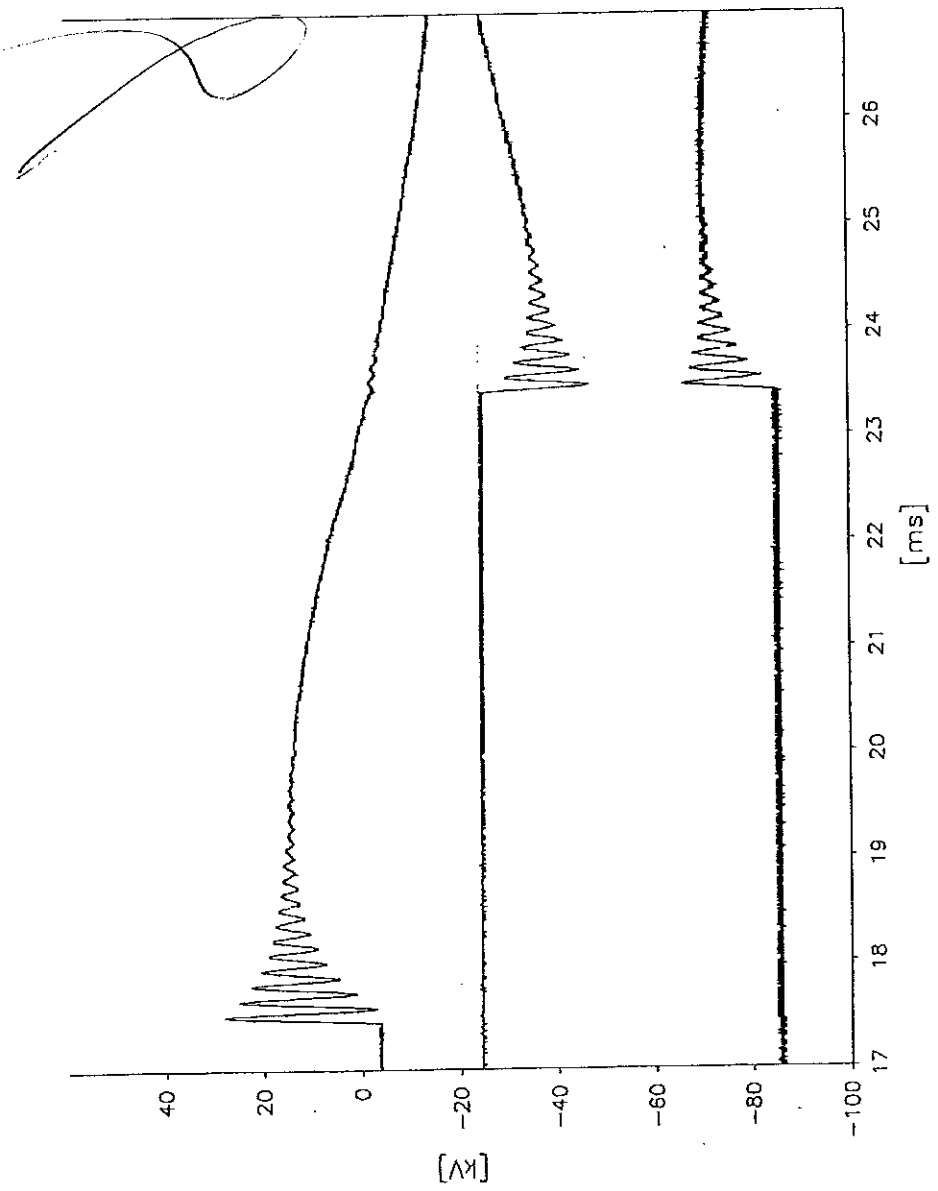


ВЯРНО С ОРИГИНАЛА

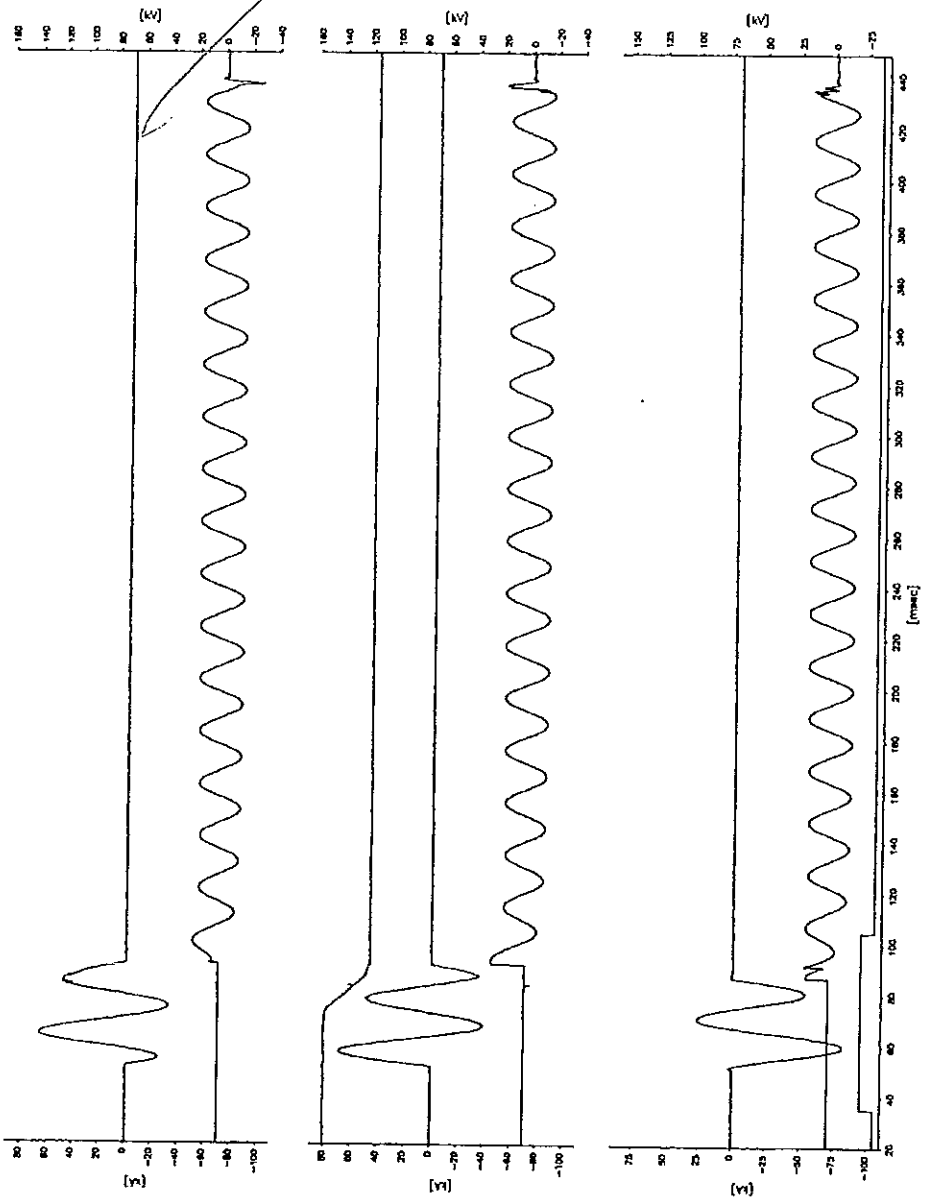
Test no.
PEHLA 0231Ra / 22

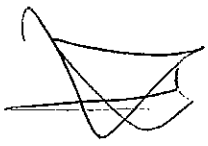


Test no.
PEHLA 0231Ra / 22
Transient Recovery Voltage



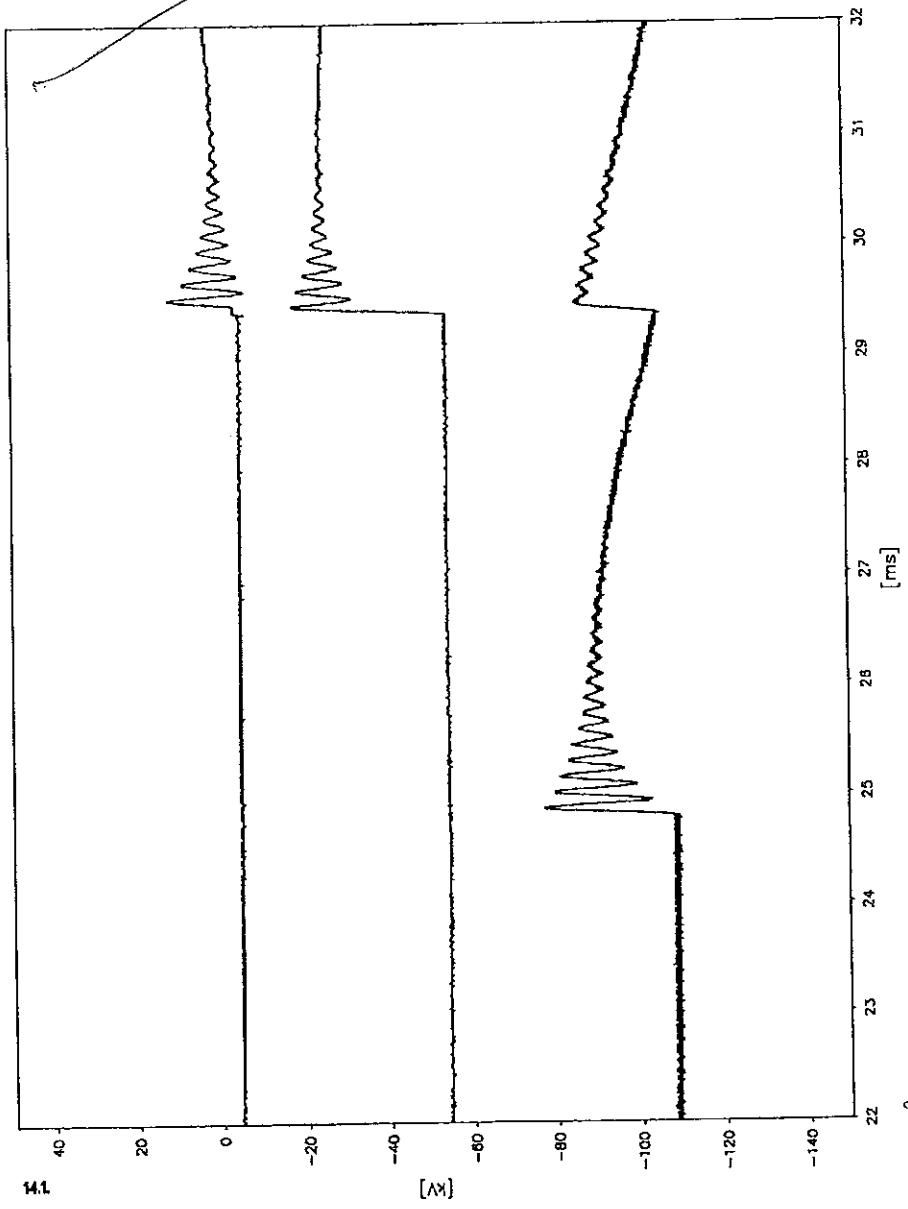
Test no.
PEHLA 0231Ra / 23





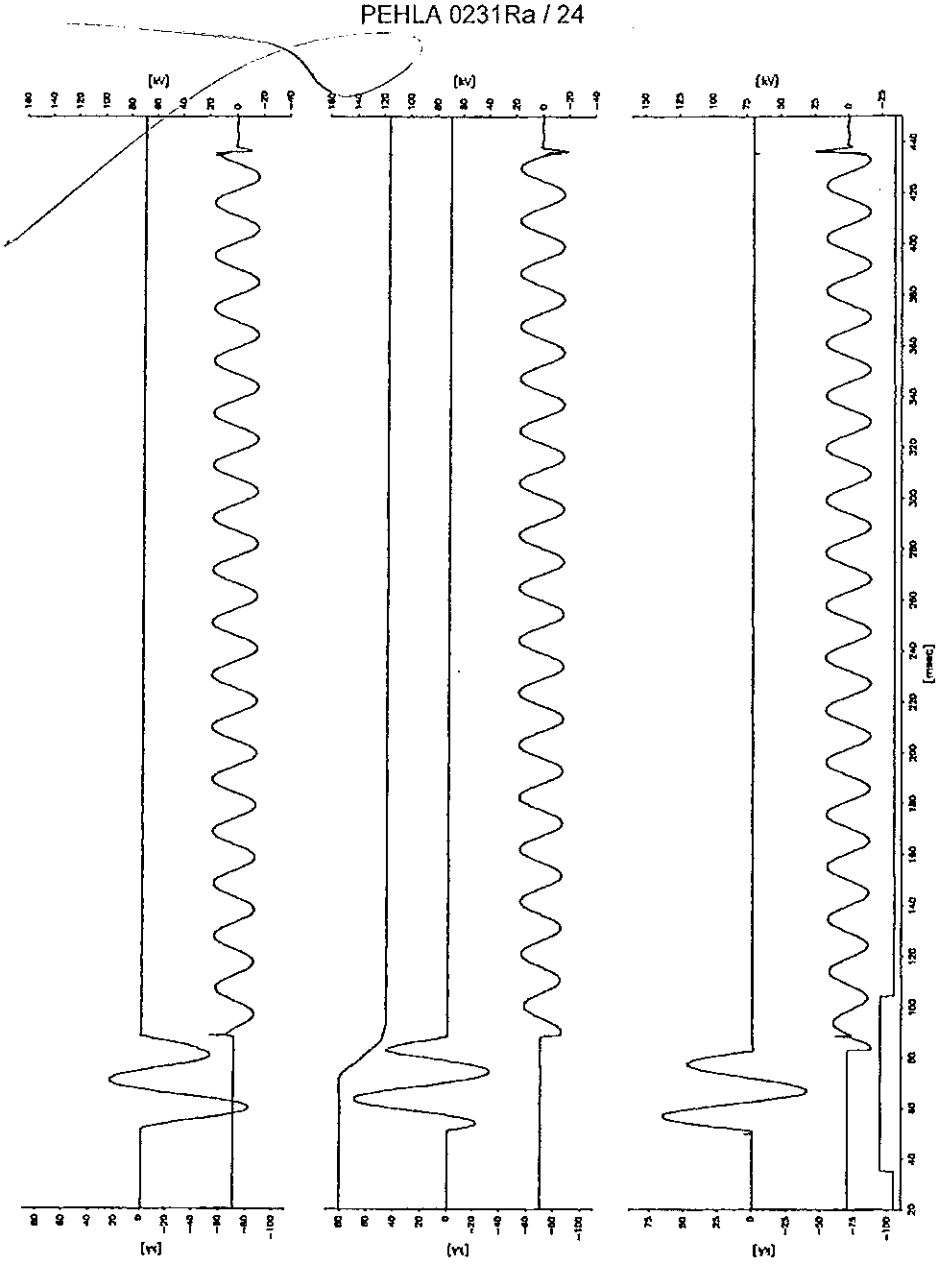
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 23
Transient Recovery Voltage



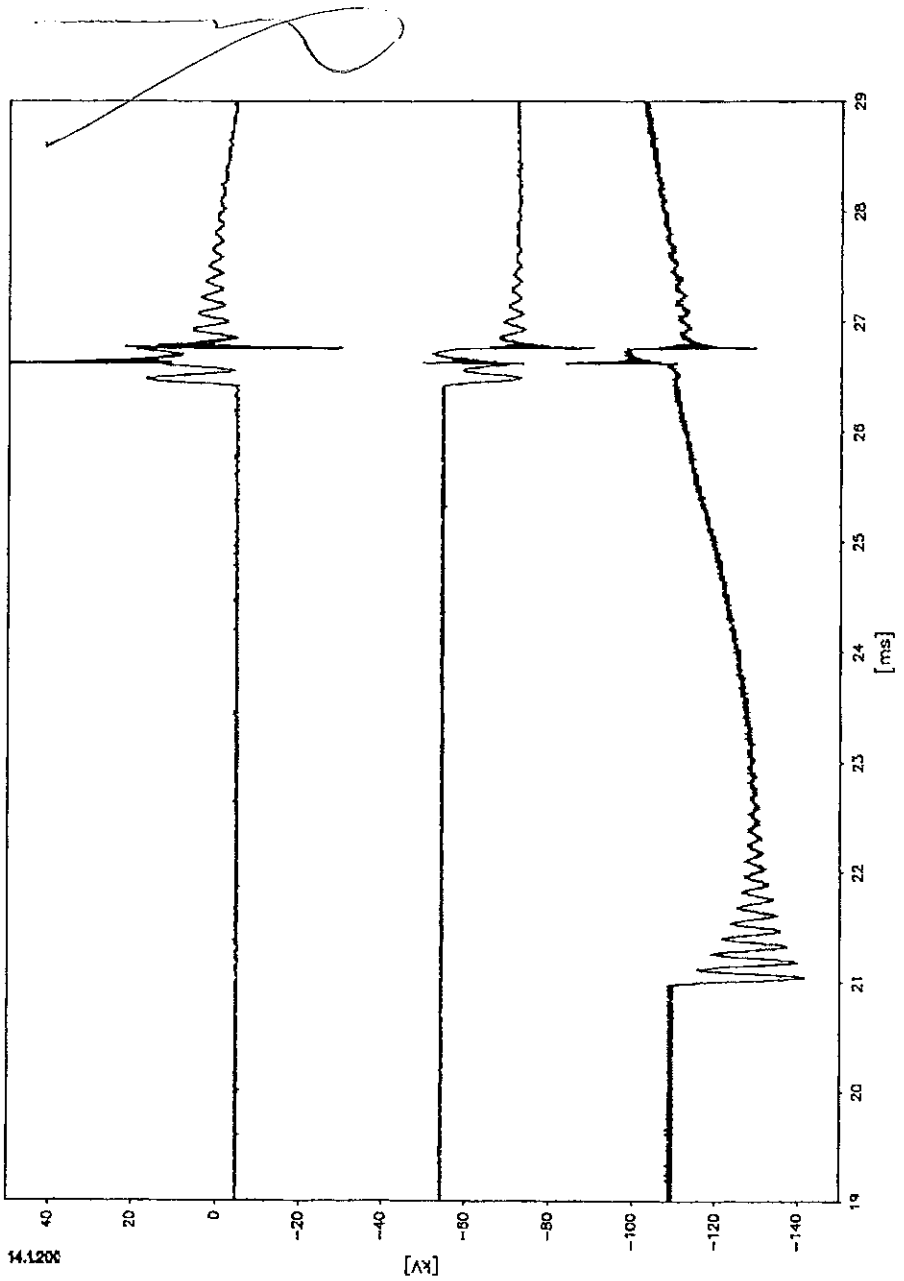
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 24



ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 24
Transient Recovery Voltage



Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: T10

Date of test: 19th December 2002

Condition of test object before test: As after test no. PEHLA 0231Ra / 24.

Connections to test object: By means of copper bars to the upper terminals of the circuit-breaker. Lower terminals of the circuit-breaker short-circuited and earthed.

Arc extinguishing medium: Vacuum

Test No. PEHLA 0231Ra				25	26	27
Operating sequence				O – 0.3s – CO - 3min – CO – 5min – CO		
Applied voltage		kV		-	18.6	17.0	17.7
Short-circuit making current		kA	L1	-	8.50	7.20	6.60
			L2	-	6.80	5.50	6.90
			L3	-	6.20	8.10	8.40
Short-circuit breaking current	Short-circuit current	kA	L1	3.42	3.47	3.48	3.48
			L2	3.35	3.46	3.40	3.40
			L3	3.40	3.46	3.37	3.40
	Average value	kA		3.39	3.46	3.41	3.43
	d.c. component	%	L1	< 20	< 20	< 20	< 20
			L2	< 20	< 20	< 20	< 20
			L3	< 20	< 20	< 20	< 20
Recovery voltage		kV	L1	10.8	9.92	10.9	9.69
			L2	10.7	9.80	10.7	10.6
			L3	10.8	10.6	10.8	10.5
Average value (phase-to-phase)		kV		18.7	17.5	18.7	17.8
Transient Recovery Voltage (TRV), first-pole-to-clear		kV		- n.e.*	- n.e.*	- n.e.*	- 35.5
Arcing time		ms	L1	3.2	6.0	7.4	8.6
			L2	7.4	2.0	7.0	8.2
			L3	8.2	6.0	2.6	3.4
Closing time		ms		-	66.9	66.8	66.0
Opening time		ms		60.5	63.5	63.5	62.6
Result				P	P	P	P

Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

Remarks:

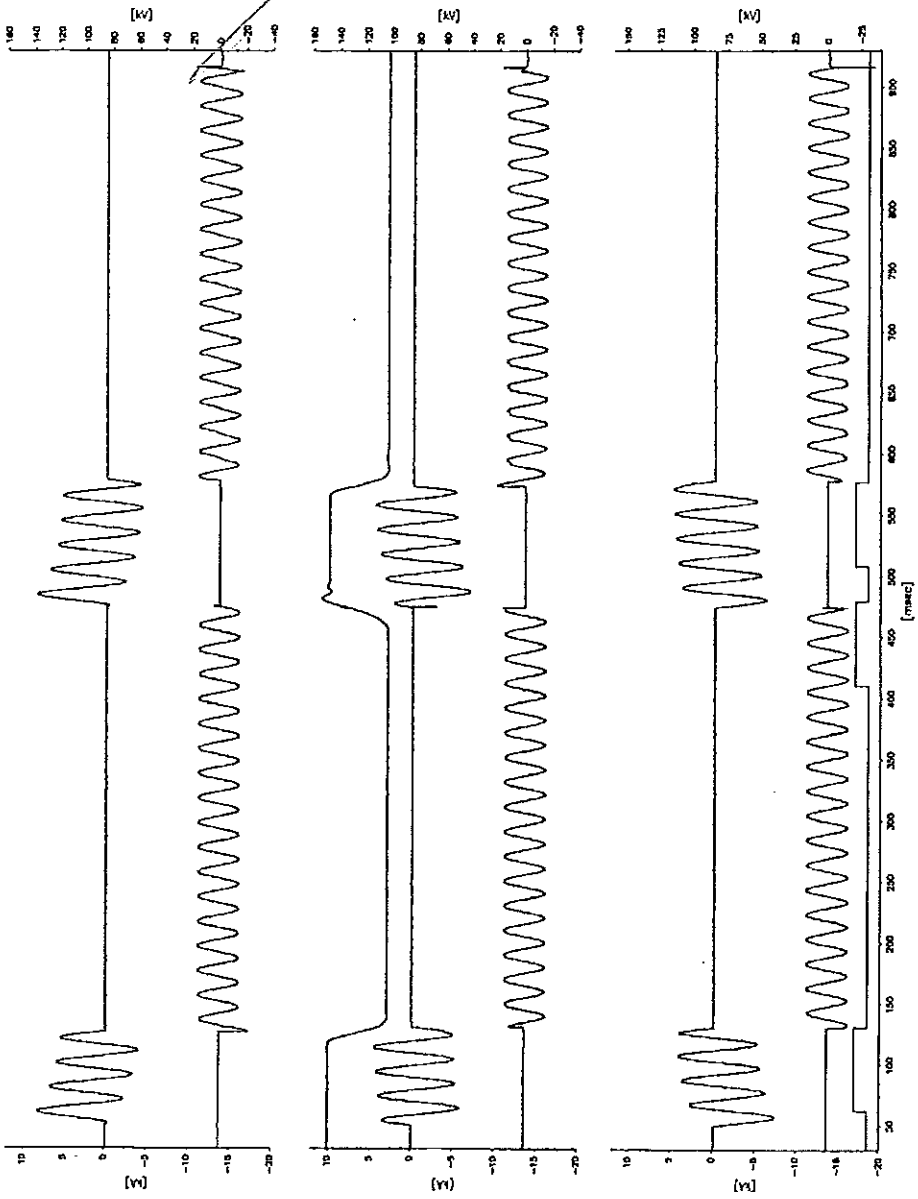
PEHLA 0231Ra / 25 to 27: The operating devices are supplied at their minimum voltage

* n.e. = Due to a failure of the recorder the TRV could not be evaluated.

Condition of test object after test: Circuit-breaker and without functional or visible change.

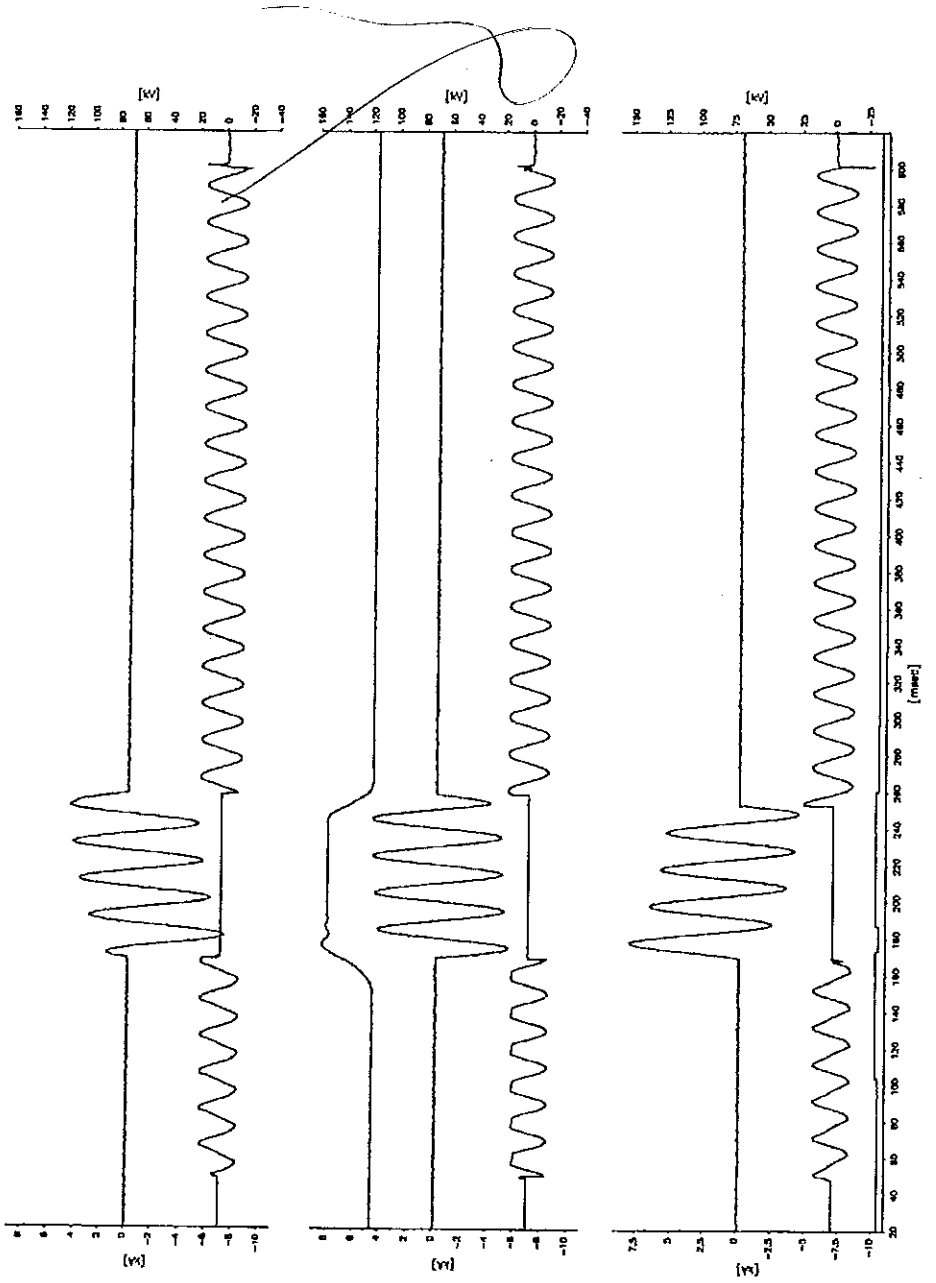
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 25



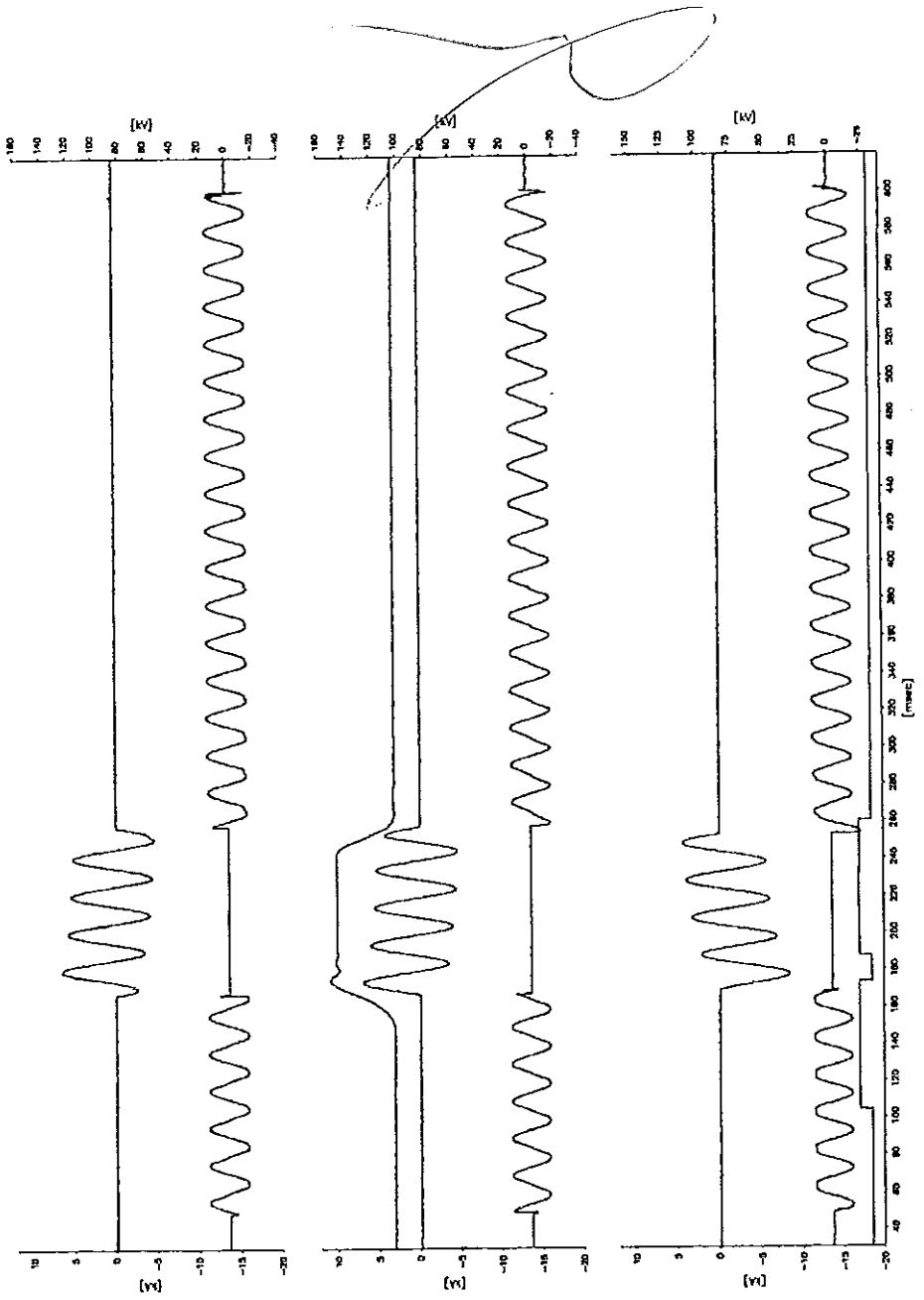
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 26



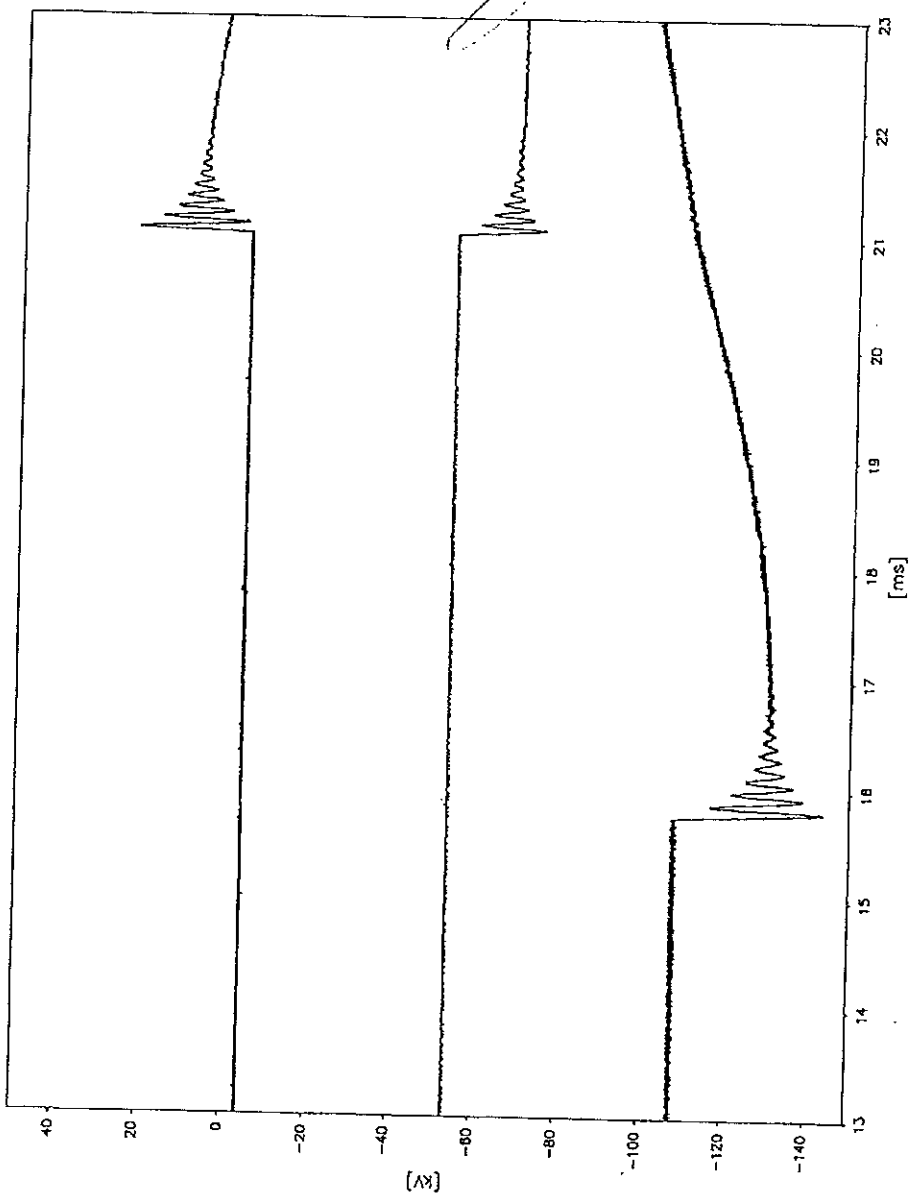
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 27



ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 27
Transient Recovery Voltage



ВЯРНО С ОРИГИНАЛА

Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: T30

Date of test: 19th December 2002

Condition of test object before test: As after test PEHLA 0231Ra / 27.

Connections to test object: By means of copper bars to the upper terminals of the circuit-breaker. Lower terminals of the circuit-breaker short-circuited and earthed.

Arc extinguishing medium: Vacuum

Test No. PEHLA 0231Ra				30		31
Operating sequence				O - 0.3s - CO - 3min - CO		
Applied voltage		kV		-	18.8	17.7
Short-circuit making current		kA	L1	-	24.2	19.4
			L2	-	18.0	19.3
			L3	-	20.7	25.6
Short-circuit breaking current	Short-circuit current	kA	L1	9.60	9.69	9.86
			L2	9.71	9.87	9.99
			L3	9.74	9.00	9.94
	Average value	kA		9.69	9.81	9.93
	d.c. component	%	L1	< 20	< 20	< 20
			L2	< 20	< 20	< 20
			L3	< 20	< 20	< 20
Recovery voltage		kV	L1	10.9	11.0	11.1
			L2	10.9	10.6	11.0
			L3	10.8	10.9	11.0
Average value (phase-to-phase)		kV	-	18.8	18.7	19.1
Transient Recovery Voltage (TRV), first-pole-to-clear		kV		- 34.4	- 47.3	- 34.4
Arcing time		ms	L1	6.2	2.0	6.6
			L2	6.6	7.0	6.4
			L3	1.6	6.8	2.4
Closing time		ms		-	64.9	66.4
Opening time		ms		58.8	60.4	64.4
Result				P	P	P

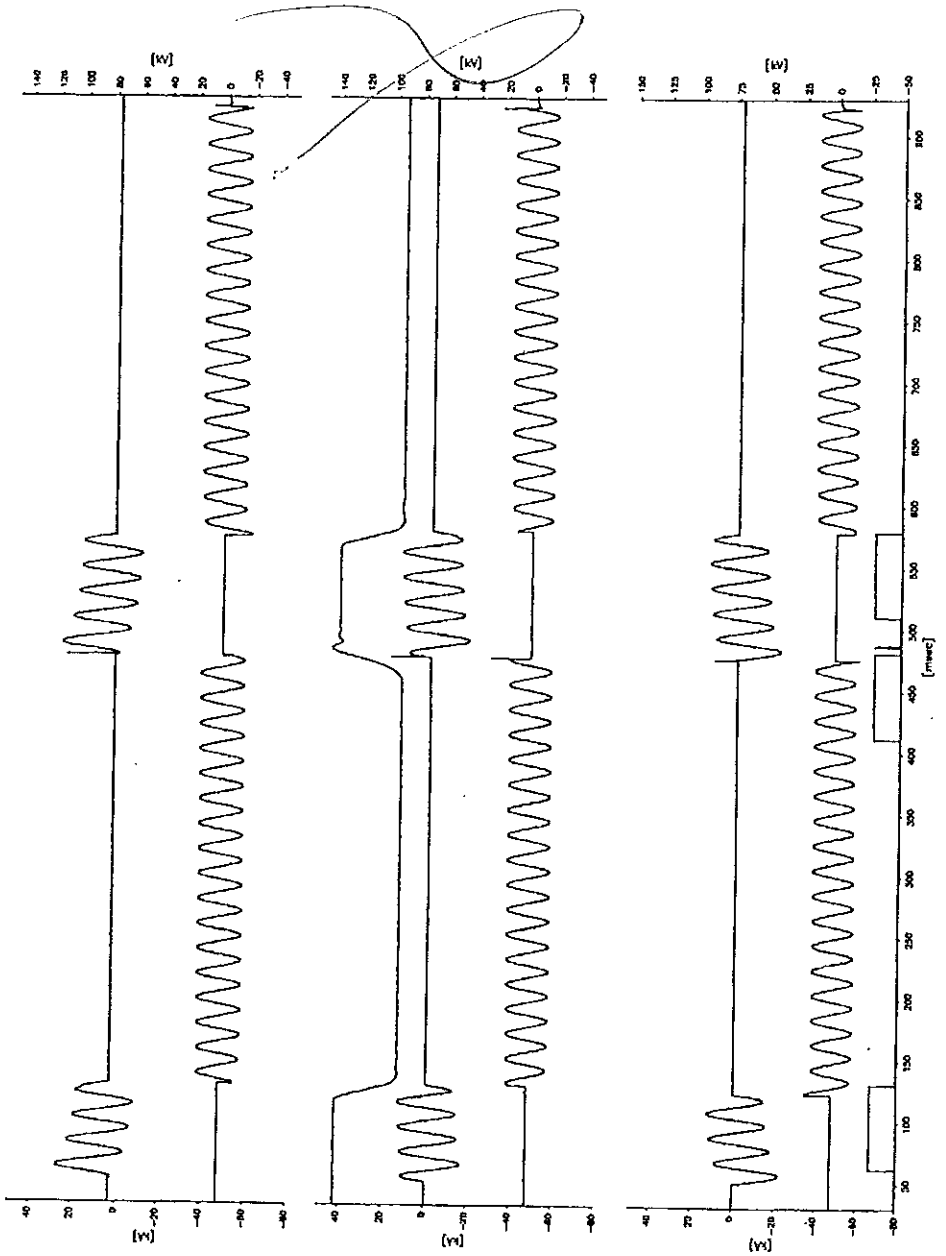
Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

Remarks:
PEHLA 0231Ra / 28 and 29: Tests with reduced values
PEHLA 0231Ra / 30 and 31: The operating devices are supplied at their minimum voltage

Condition of test object after test: Circuit-breaker without functional or visible change.

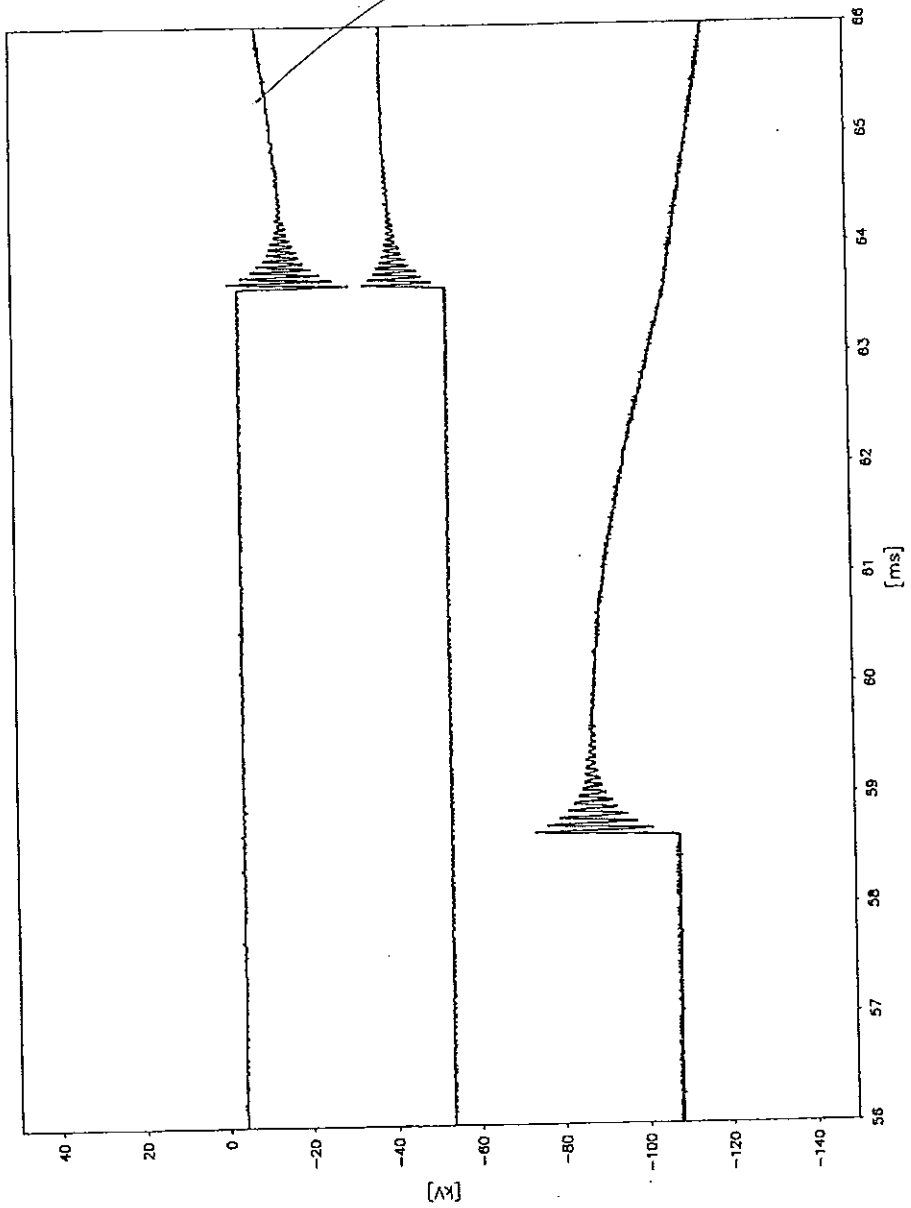
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 30



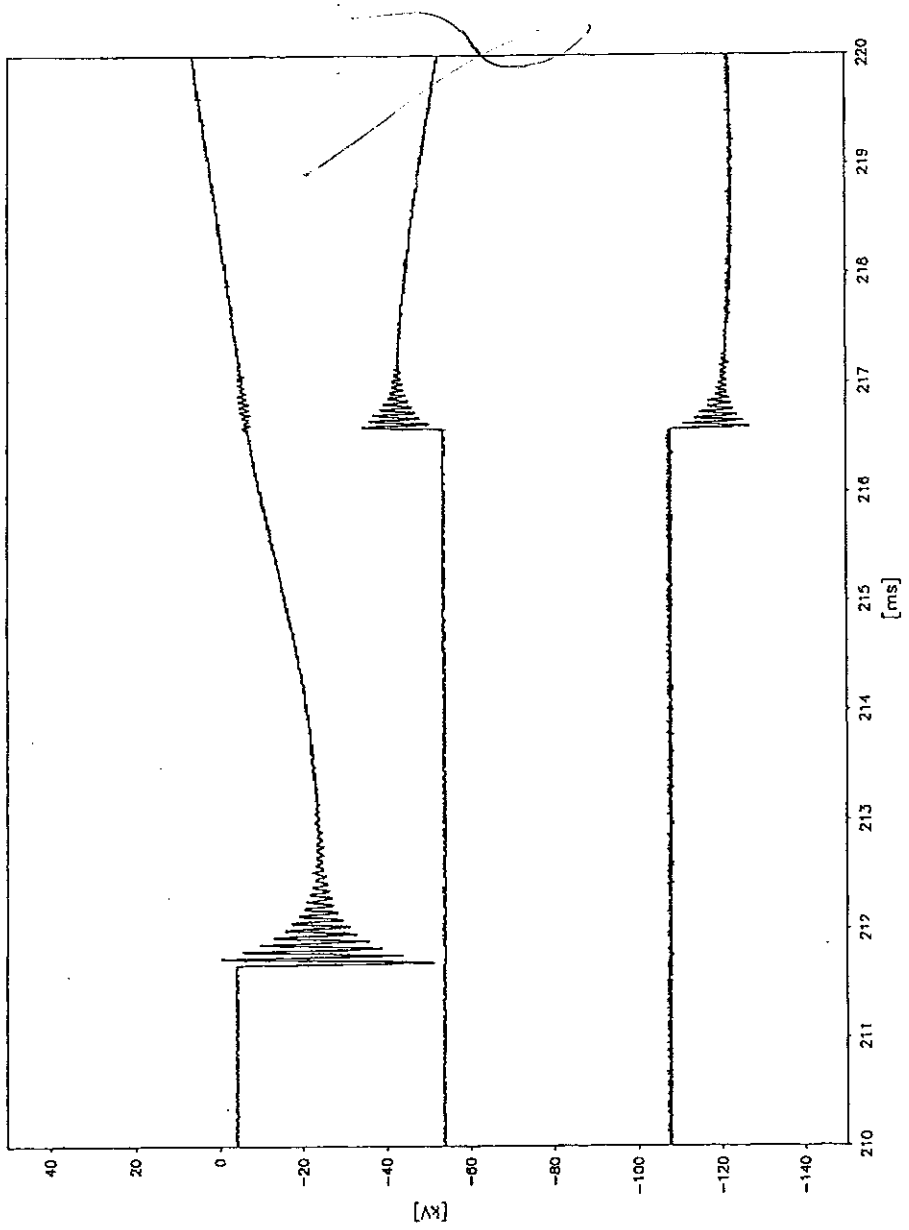
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 30
Transient Recovery Voltage, First O



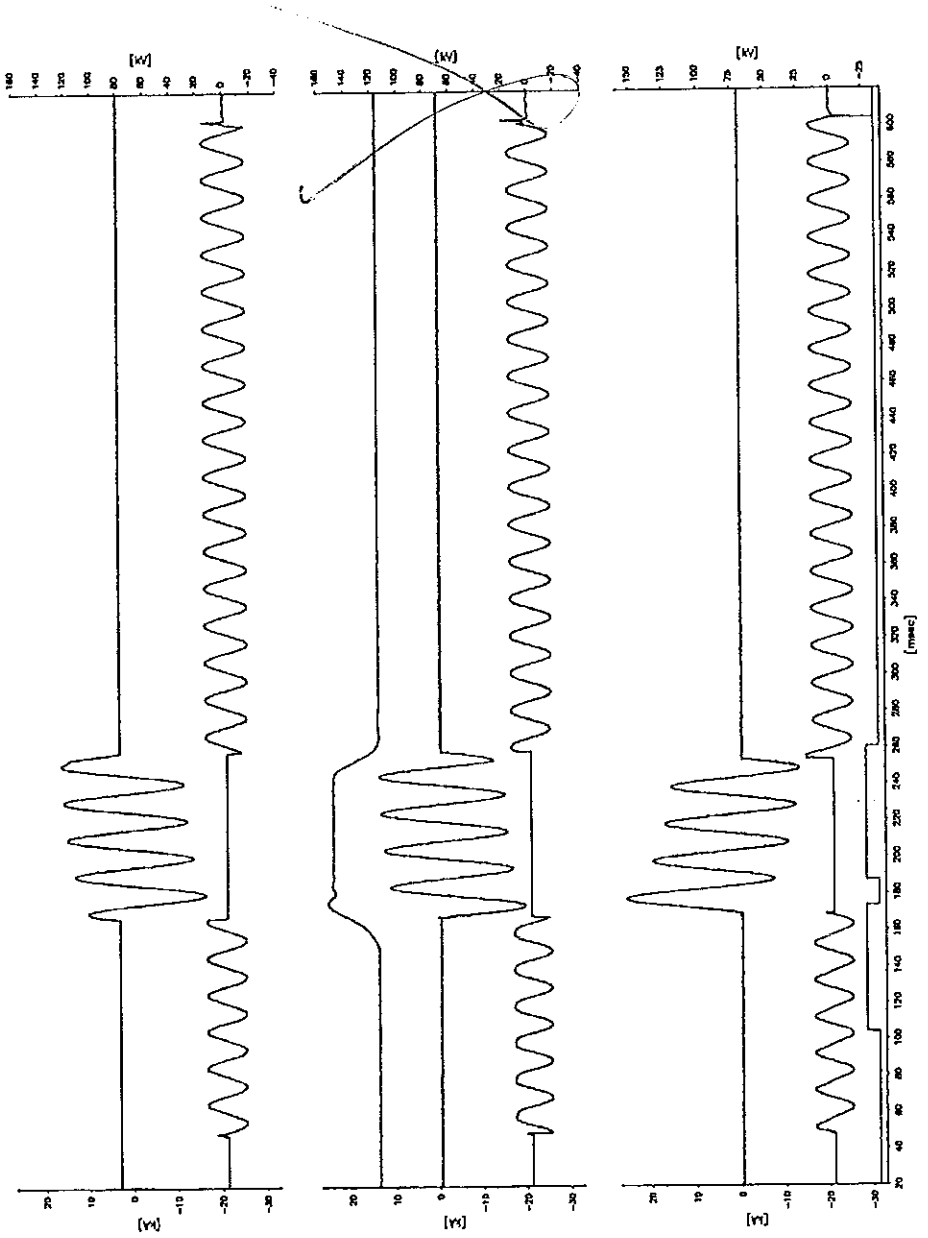
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 30
Transient Recovery Voltage, Second O



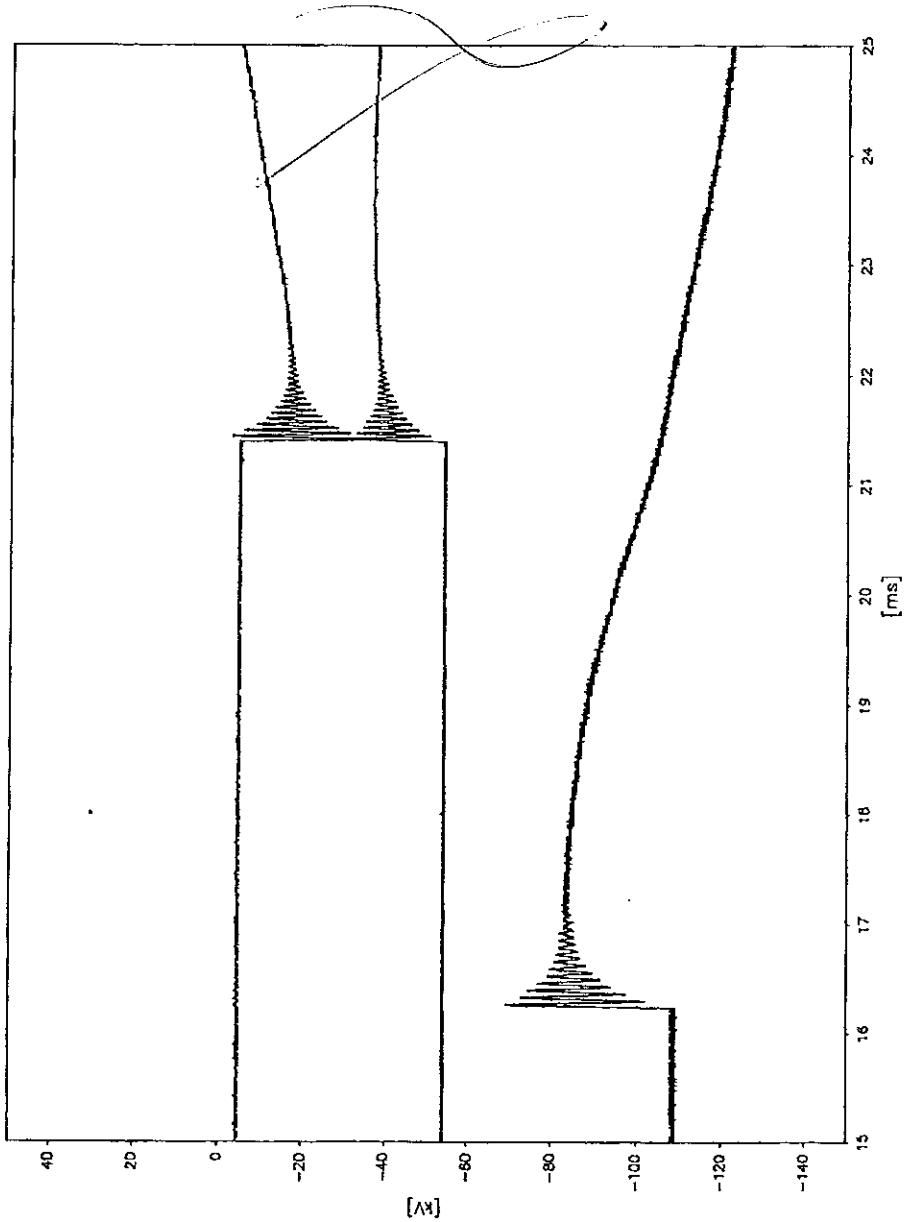
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 31



ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 31
Transient Recovery Voltage



ВЕРНО С ОРИГИНАЛА

Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: Double earth fault test

Date of test: 19th December 2002

Condition of test object before test: As after test PEHLA 0231Ra / 31

Connections to test object: Phase L3 of the laboratory by means of a copper bar to the upper terminal of phase L3 of the circuit-breaker, lower terminal of phase L3 of the circuit-breaker connected to phase L1 of the laboratory.

Arc extinguishing medium: Vacuum

Test No. PEHLA 0231Ra				35	-	-
Operating sequence				O	-	-
Applied voltage			kV	-	-	-
Short-circuit making current			L1	-	-	-
			kA L2	-	-	-
			L3	-	-	-
Short-circuit breaking current	Short-circuit current		L1	-	-	-
			kA L2	-	-	-
			L3	28.8	-	-
	Average value		kA	-	-	-
	d.c. component		L1	-	-	-
		%	L2	-	-	-
			L3	< 20	-	-
Recovery voltage			L1	-	-	-
			kV L2	-	-	-
			L3	-	-	-
Average value (phase-to-phase)			kV	18.5	-	-
Transient Recovery Voltage (TRV), first-pole-to-clear			kV	- 32.9	- -	- -
Arcing time			L1	-	-	-
			ms L2	-	-	-
			L3	9.4	-	-
Opening time			ms	44.6	-	-
Result				P	-	-

Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

Remarks:

PEHLA 0231Ra / 32: No-load operations
PEHLA 0231Ra / 33 and 34: Tests with reduced values
PEHLA 0231Ra / 35: The operating devices are supplied at their maximum voltage
PEHLA 0231Ra / 36: No-load operations

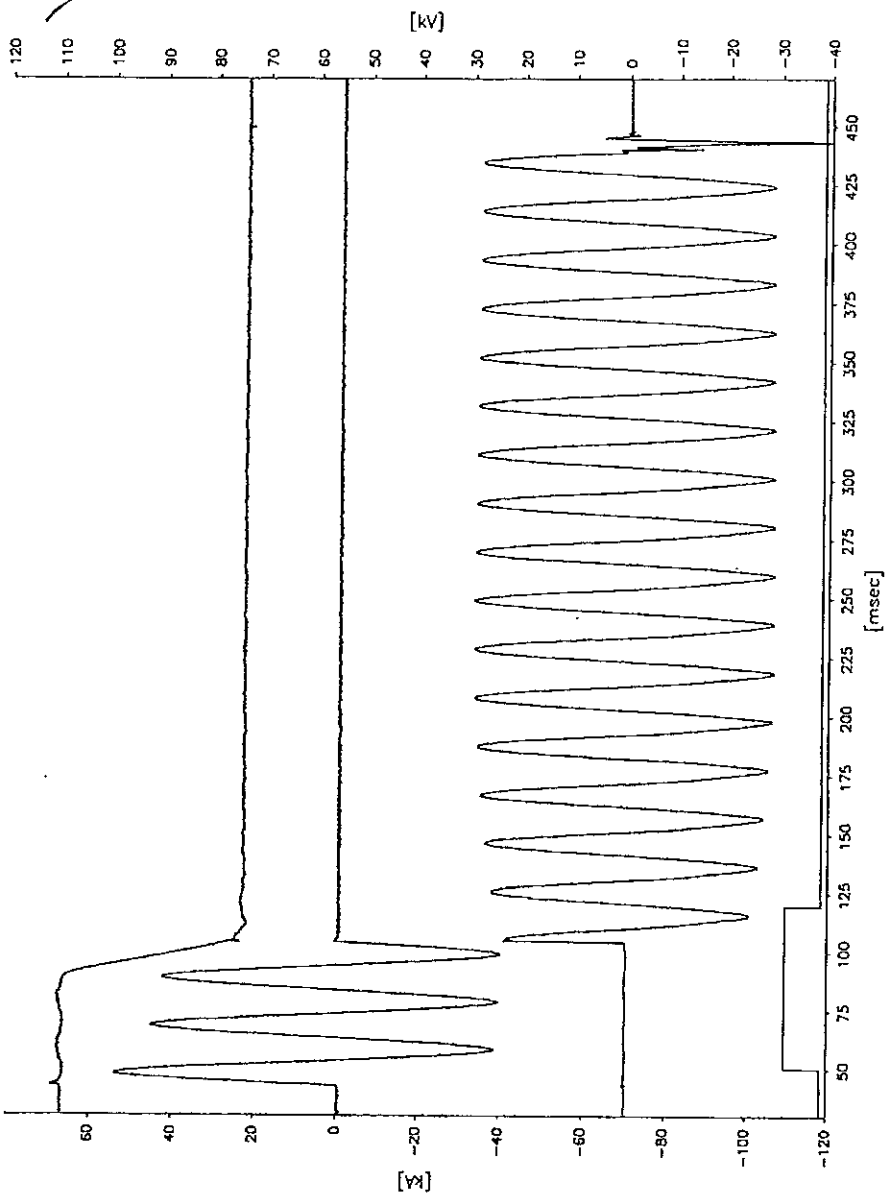
Condition of test object after test: Circuit-breaker without functional or visible change.

Power frequency withstand voltage test at 38 kV – 1 min passed.

The deviations from the reference mechanical travel characteristic are in the allowable limits.

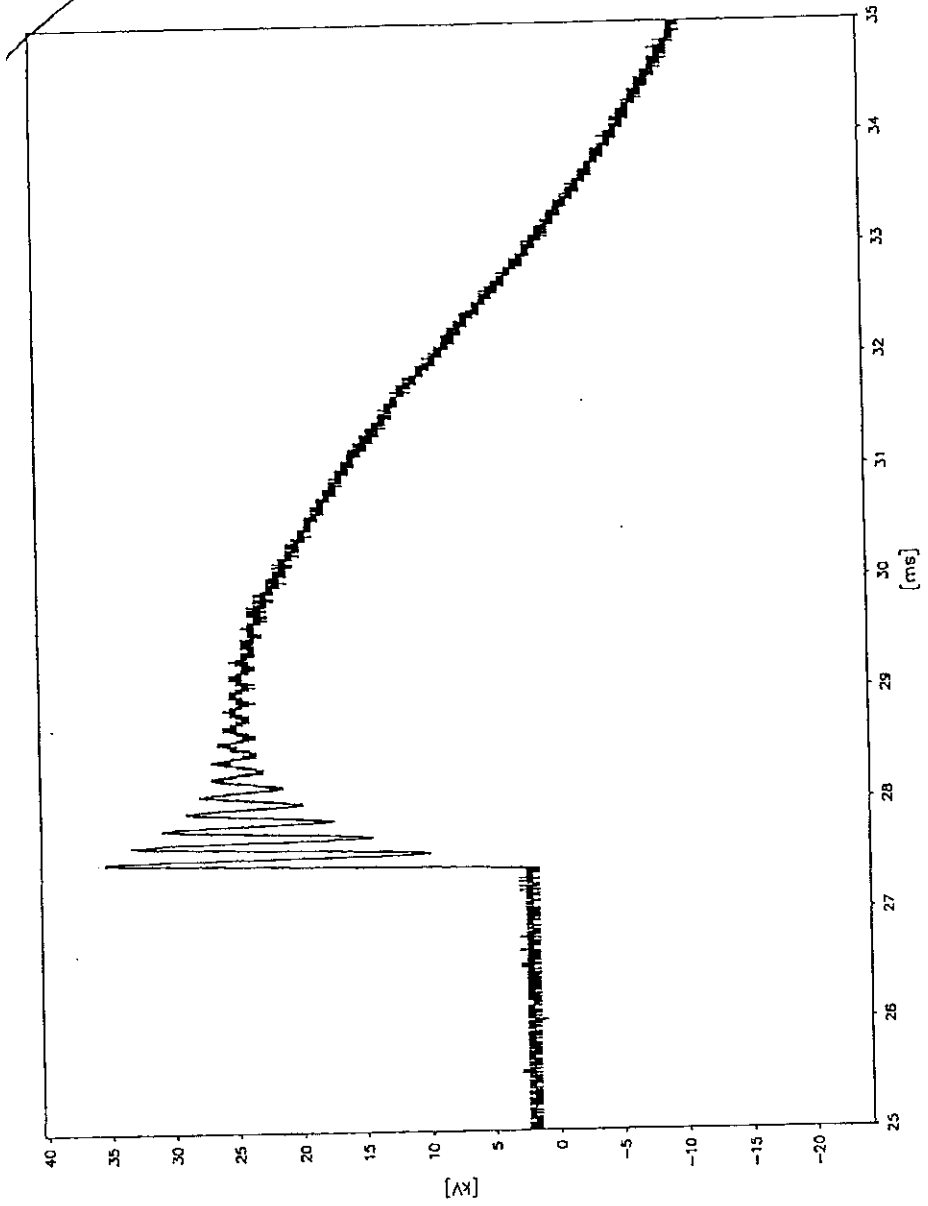
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 35



ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 35
Transient Recovery Voltage



ВЯРНО С ОРИГИНАЛА

Actual Values of No-load Operations

Rated supply voltage of closing coil 220 V DC
Rated supply voltage of opening coil 220 V DC

	Operation	Voltage closing coil V	Closing time ms	Voltage opening coil V	Opening time ms
Before basic short-circuit test duties					
Test 0231Ra / 002	O-	--	--	220	44.5
	CO	220	58.5	220	45.0
Test 0231Ra / 02A	O-	--	--	154	62.4
	CO	187	63.1	154	62.4
Test 0231Ra / 02B	O-	--	--	242	41.8
	CO	242	56.8	242	42.1
After double earth fault test					
Test 0231Ra / 036	O-	--	--	220	43.3
	CO	220	60.1	220	44.3
Test 0231Ra / 36A	O-	--	--	154	60.7
	CO	187	64.7	154	60.5
Test 0231Ra / 036	O-	--	--	242	41.9
	CO	242	57.7	242	42.1

Measurement of the Resistance

Ambient air temperature: ≈ 18 °C

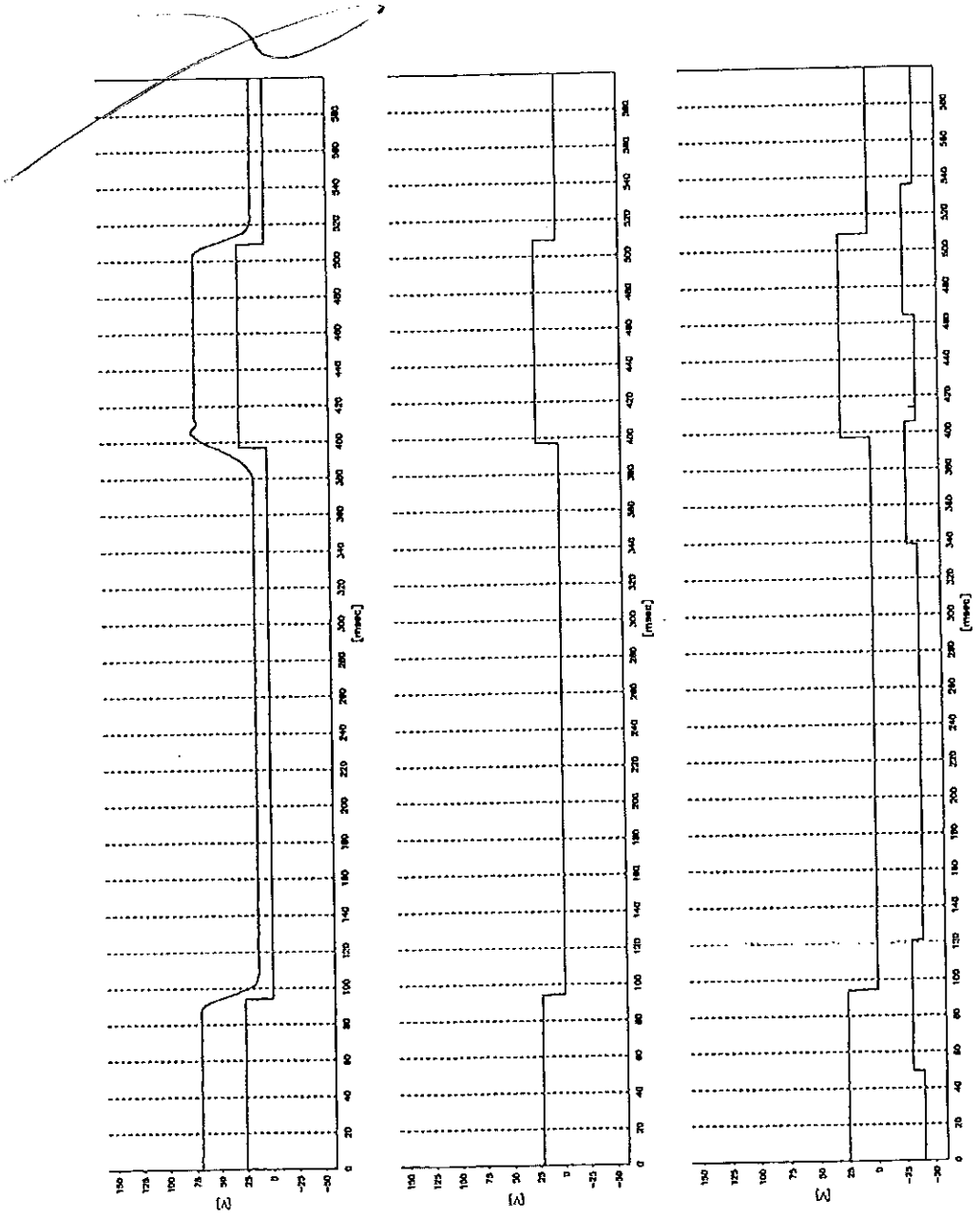
	Resistance of the pole parts μΩ		
	L1	L2	L3
Before test 0231Ra / 002	14.9	15.0	15.7
After test 0231Ra / 035	19.6	21.4	22.9

(The resistance values fulfil the requirements of STL-Guide to IEC56: 4th Edition: 1987, Amendment Slip No. 2).

Remarks:
Resistance measurement at direct current of: 50 A

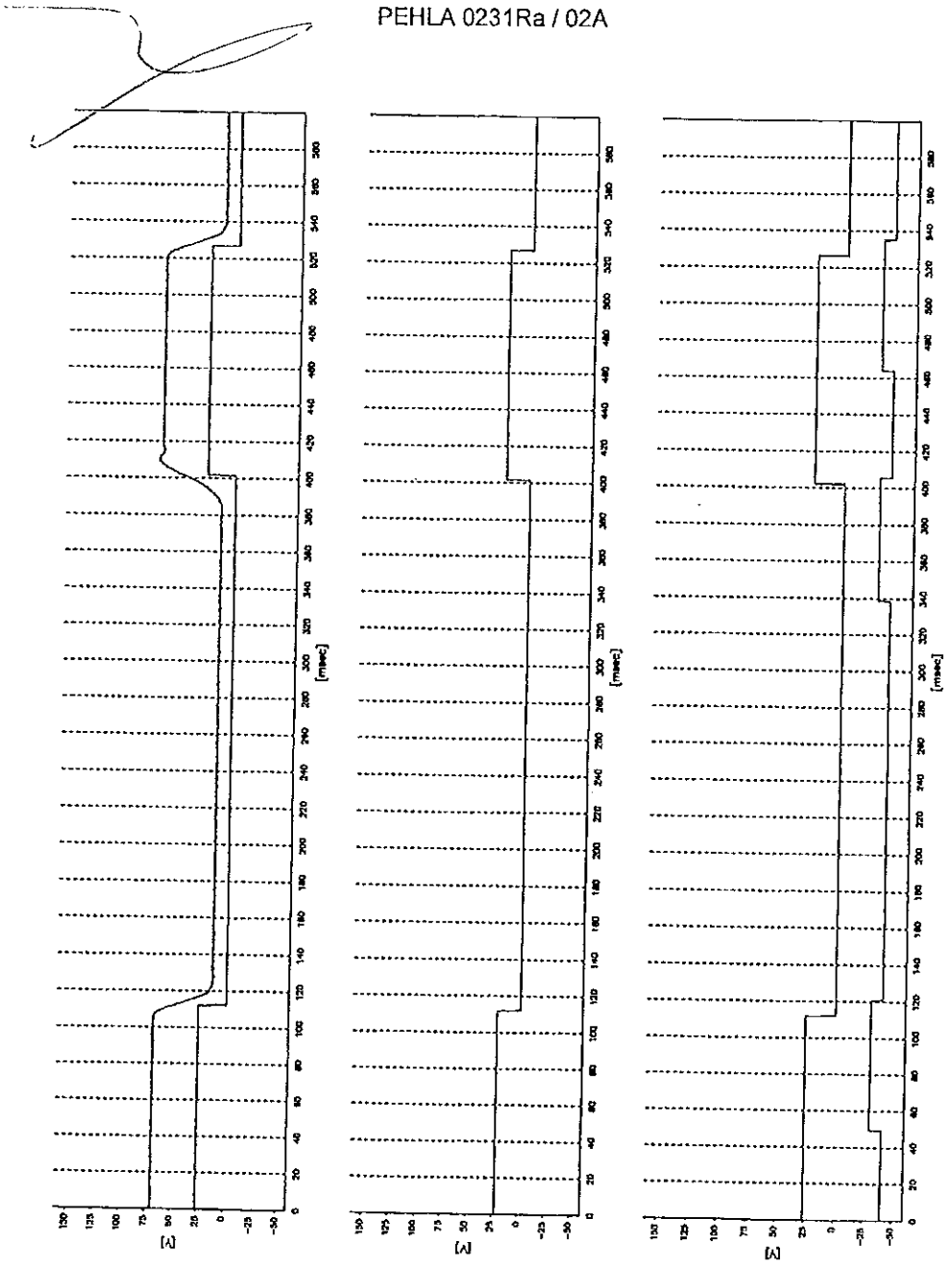
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 02



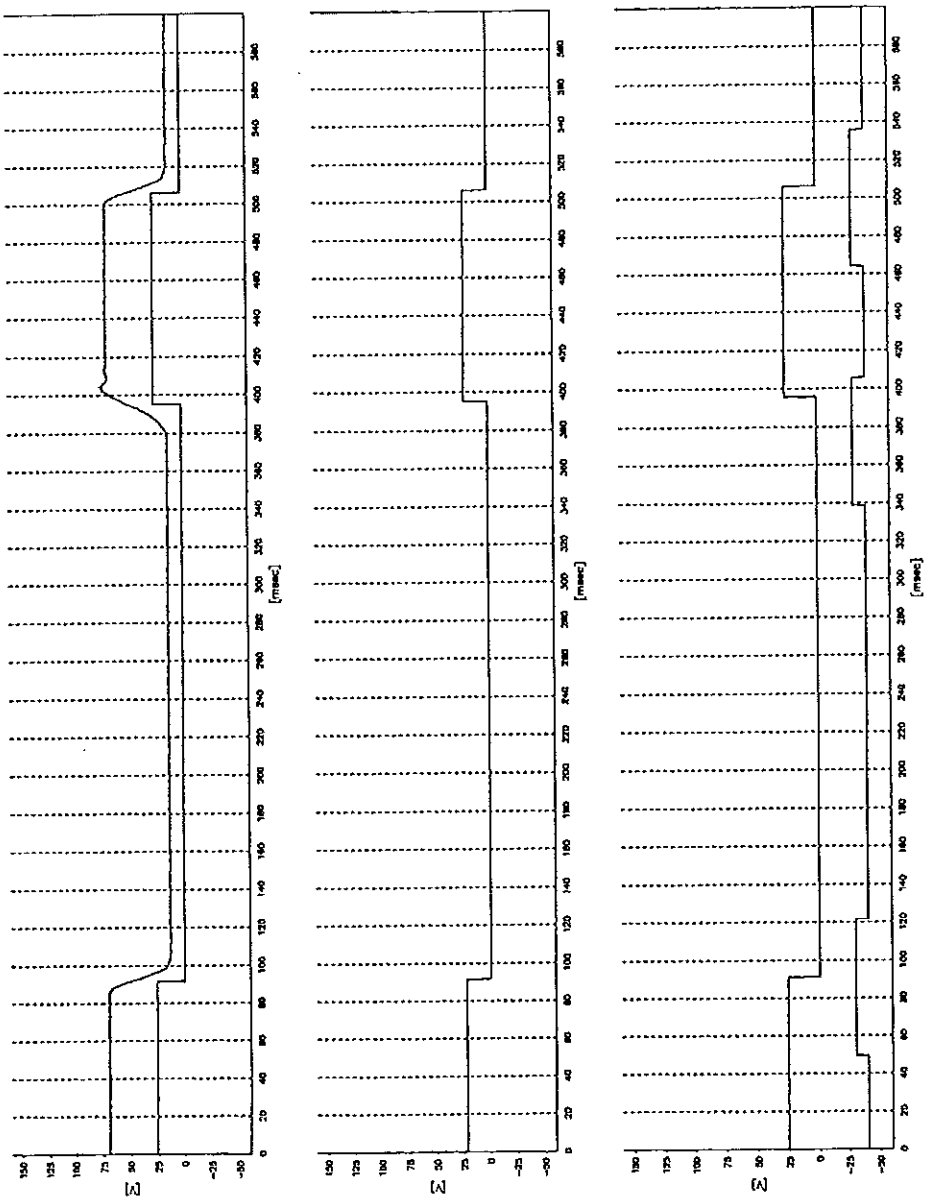
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 02A

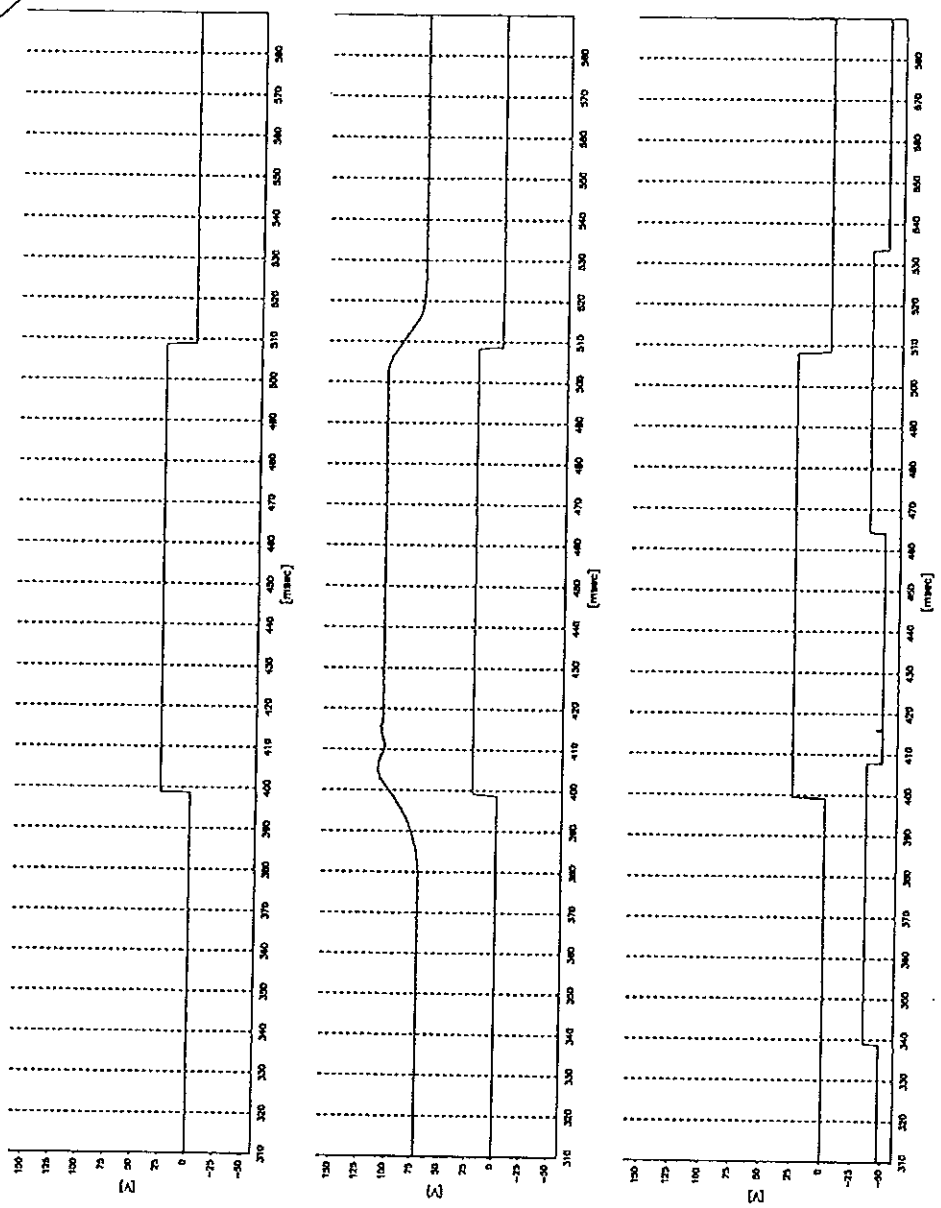


ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 02B

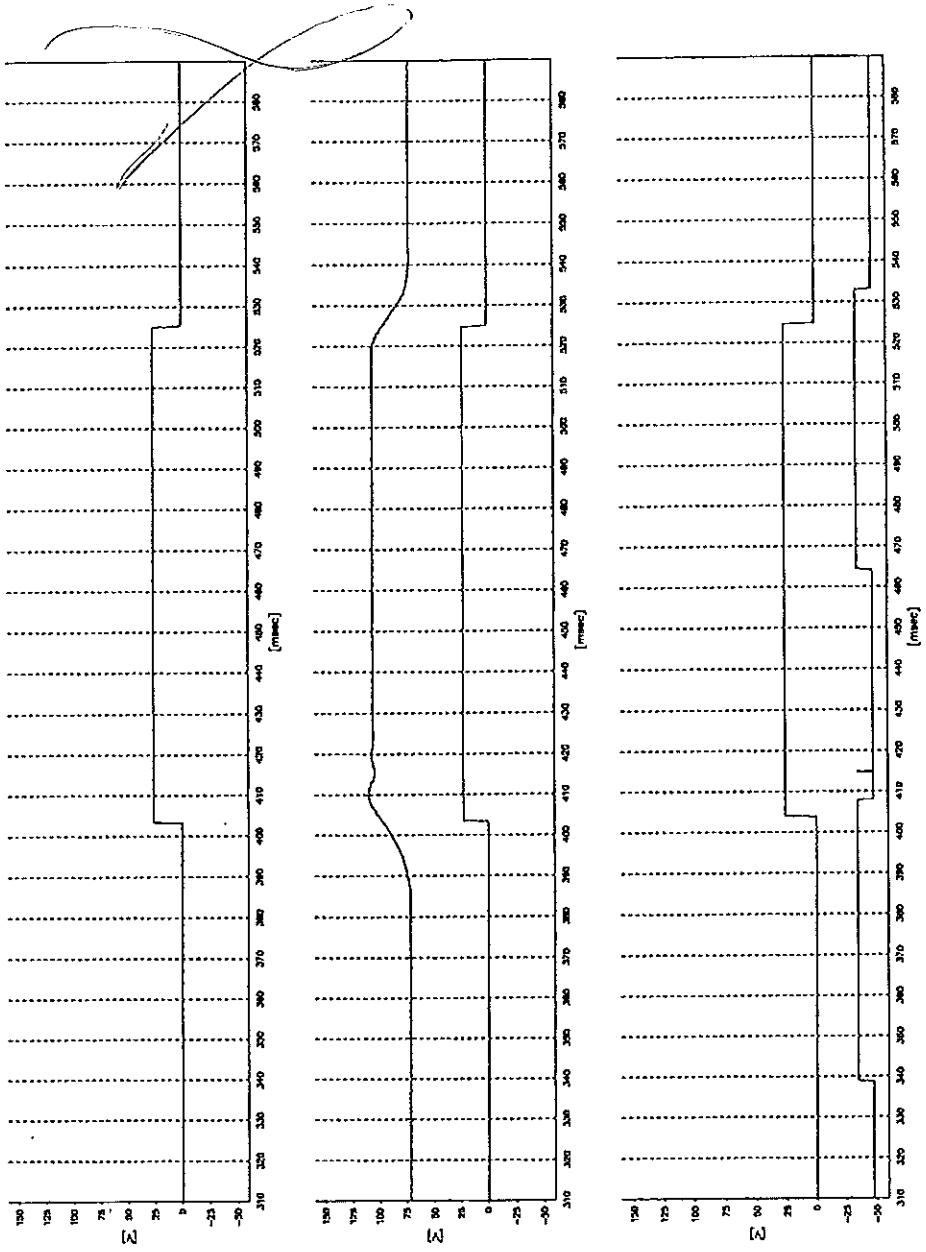


Test no.
PEHLA 0231Ra / 36



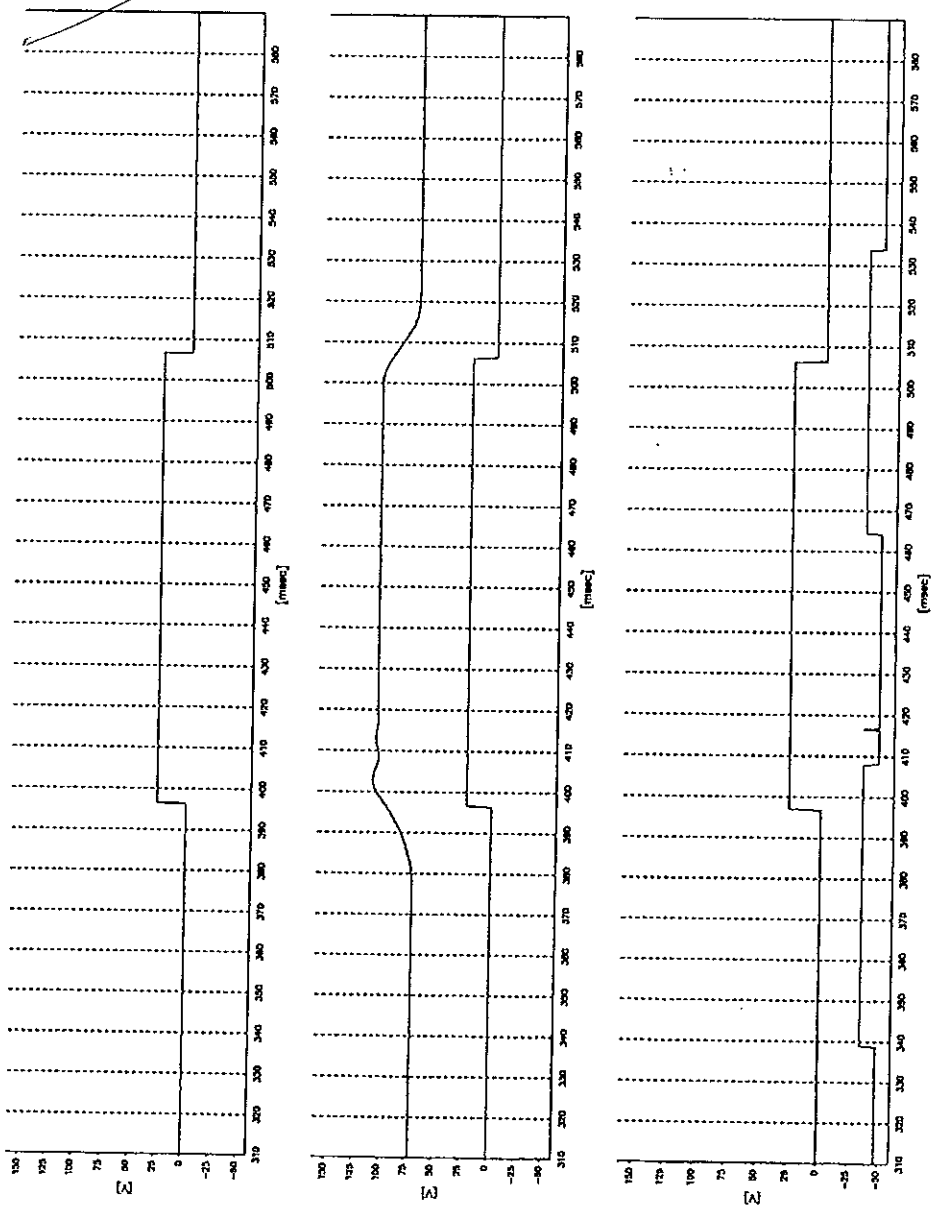
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 36A



ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0231Ra / 36B



ВЯРНО С ОРИГИНАЛА

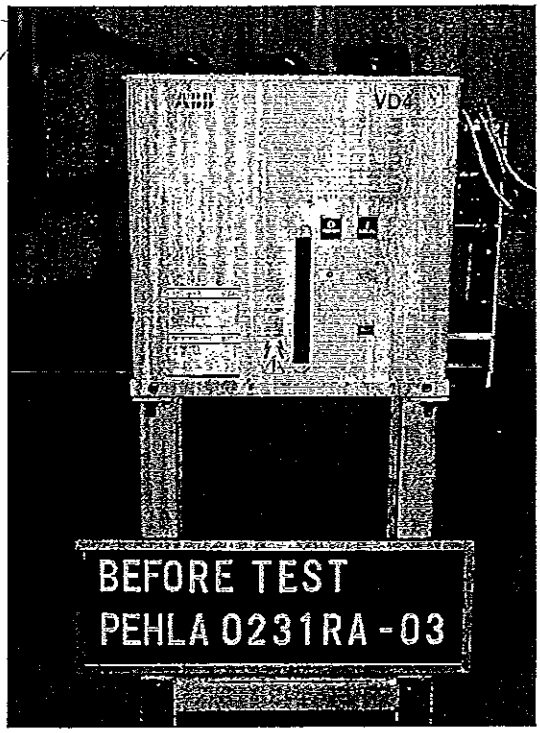


Photo No. 01
Before Test 0231Ra / 03

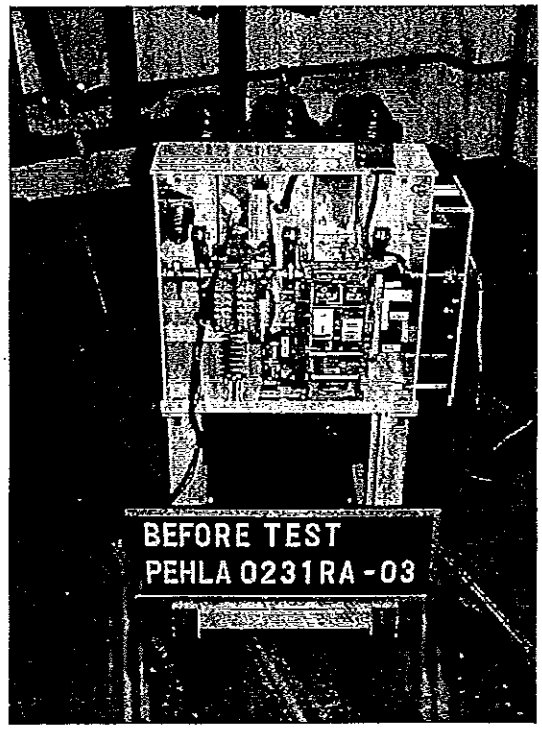


Photo No. 02
Before Test 0231Ra / 03

ВЯРНО С ОРИГИНАЛА

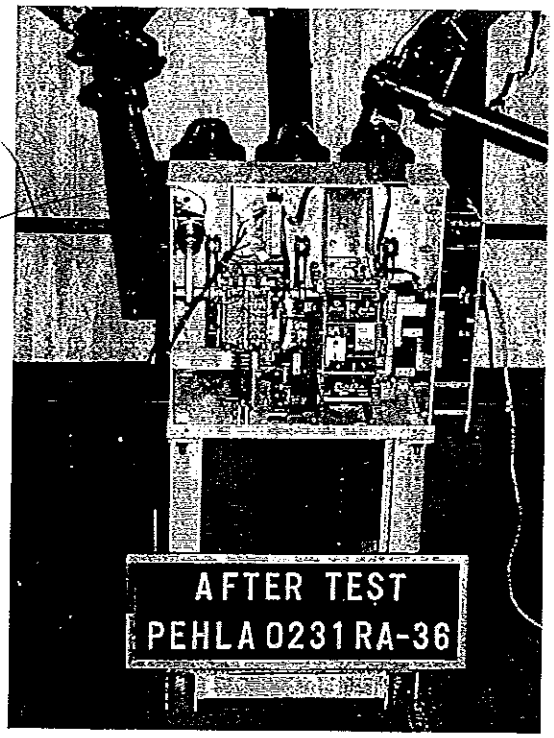


Photo No. 03
After Test 0231Ra / 36

ВЯРНО С ОРИГИНАЛА

Deutscher Akkreditierungs Rat

Reg.-Nr. DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. MZ ZS1 A 03

Sheet 1

Issued by an Accredited Laboratory corresponding to EN 45001

Copy-No. 01e

Test Object

Metal-clad switchgear panel from a 12 kV switchgear type ZS1.2 (T = 650 mm), drawing-no. GCE 8010450 R0101, with withdrawable vacuum circuit-breaker type VD4P 1212-31 drawing-no. GCE 7373263 R1185 on a common truck drawing-no 549003Fig804 and with earthing switch type EK6-1208-150;

Rated voltage	U	12 kV
Rated normal current	I_n	1000 A
Rated frequency	f	50/60 Hz
Rated short-time withstand current	I_{th}	31,5 kA
Rated peak withstand current	I_p	80 kA
Rated duration of short-circuit current	t_{th}	3 s
Rated short-circuit breaking capacity at 12 kV	I_{sc}	31,5 kA

Manufacturer

Switchgear ABB Calor Emag Mittelspannung GmbH 40472 Ratingen / Germany

Common truck ABB EJF, A.S. VIDENSKA 117 Brno 658 67 Czech Republic

Tests performed

Mechanical operation test comprising 50 operations of the vacuum circuit-breaker, 50 operations of the earthing switch type EK6 and 25 manual insertions and withdrawals of the withrawable part. The interlocks of the circuit-breaker, withdrawable part and the earthing switch were tested in the respective position. Test procedure and test parameters were based on IEC 60298/3rd. Ed./1990/Clause 6.102

Test Specification

IEC 60298/3rd. Ed./1990

Test Results

All switching devices and removable parts and the mechanical interlocks passed the mechanical operation test successfully. They were in proper working order and the effort to operate them was practically the same before and after the test.

Test Date

28th March 2000

Client

ABB Calor Emag Mittelspannung GmbH 40472 Ratingen / Germany

ABB Calor Emag Laboratories Ratingen

29th March 2000
Date of Issue

Laboratory Manager

Test Engineer

Total Number of Sheets: 11 Sheets

This test report refers exclusively to the object tested.
ABB Calor Emag Mittelspannung GmbH is certified according to DIN ISO 9001 by DQS under Reg. No. 373-03

ABB Calor Emag Laboratories Ratingen are accredited according to EN 45001 by DATech under Reg.No. DAT - P - 032/93

ABB Calor Emag Mittelspannung GmbH Ratingen
Mechanical Testing Laboratory

Oberhausener Str.33
D - 40472 Ratingen

Phone + 49 (0) 21 02 121371
Fax + 49 (0) 21 02 12 1713

ВЯРНО С ОРИГИНАЛА

Contents

ВЯРНО С ОРИГИНАЛА

1. Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear

Test Object: Metal-clad switchgear panel

Type: ZS1.2

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen/ Germany

Serial-No.: 7550027/2001/00 **Year of manufacture:** 2000

Drawing Nos.: GCE 8010450 R0101

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated normal current busbar	1250	A
Rated normal current circuit	1000	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31,5	kA
Rated duration of short-circuit	3	s

Prospected values under internal-arc conditions:

Peak withstand current	80	kA
Short-time withstand current	31,5	kA
Short-circuit duration	1	s

Date of receipt of test object: 27th March 2000

ВЯРНО С ОРИГИНАЛА

1. Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switching Device

Test Object: Withdrawable vacuum circuit-breaker

Type: VD4P 1212-31

Vacuum interrupter: VG4S

Manufacturer: ABB Calor Emag Mittelspannung GmbH

Serial-No.: 7006579/4002/00 **Year of manufacture:** 2000

Drawing Nos.:

Breaker:	GCE 7373263 R1185
Operating mechanism:	GCE 7179610 R0101
Pole part:	GCE 7003979 R0104
Interrupters:	GCE 7005535 R0101
Pole Centres:	150 mm

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated normal current	1250	A
Rated short-circuit breaking current	31,5	kA
Rated short-circuit making current	80	kA
DC-component		--
Pole factor		--
Rated peak withstand current	80	kA
Rated short-time withstand current	31,5	kA
Rated duration of short-circuit	3	s
Rated operating sequence	O-0,3s-CO-3min-CO	
Rated times of circuit-breaker:		
- opening time	--	ms
- closing time	--	ms
Number of poles	3	
Number of units per pole	1	

Date of receipt of test object: 27th March 2000

Remark: Common truck manufactured by ABB EJF, A.S. VIDENSKA 117 Brno 658 67 Czech Republic

ВЯРНО С ОРИГИНАЛА

1. Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switching Device

Test Object: Earthing switch

Type: EK6-1208-150

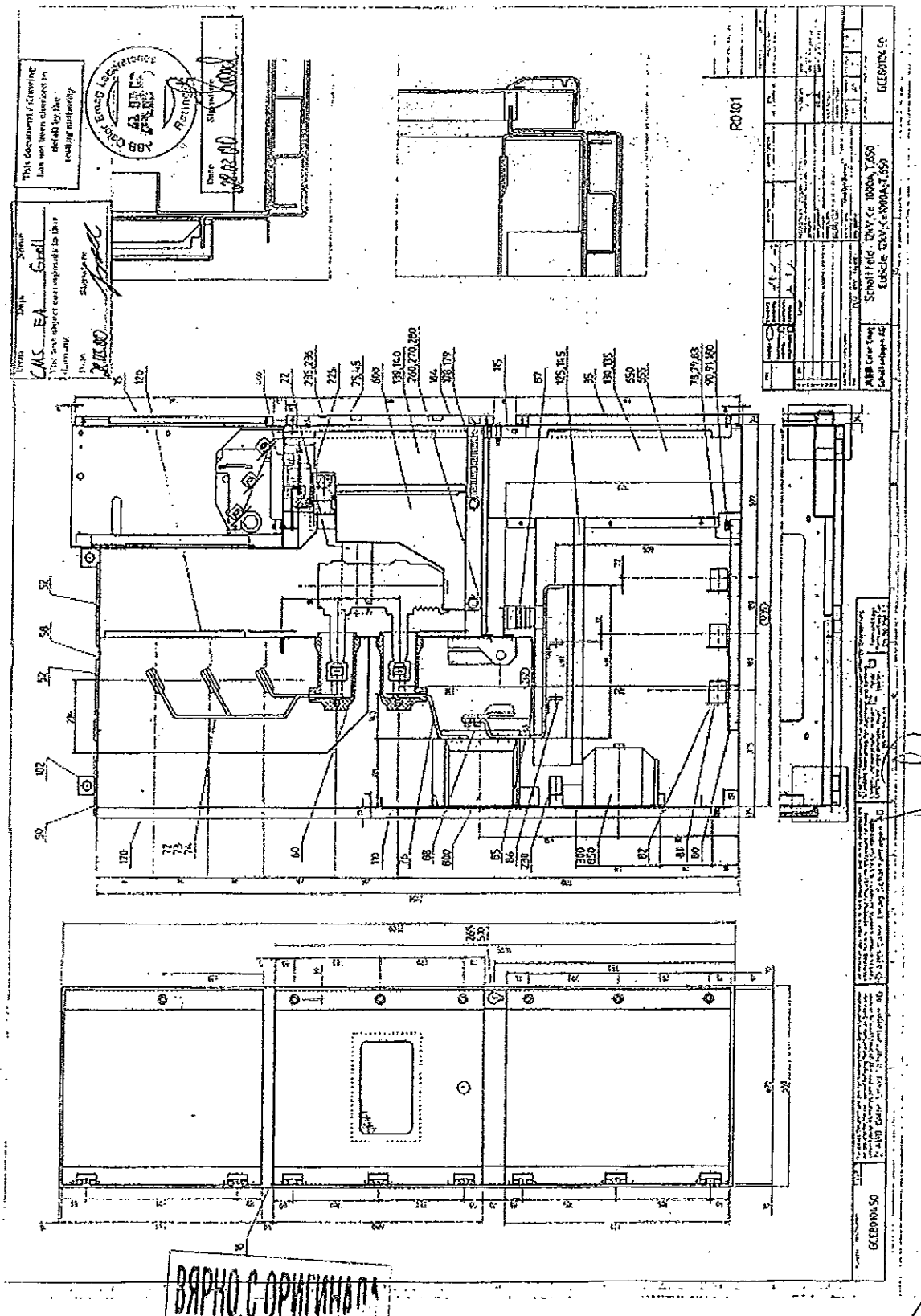
Manufacturer: ABB Calor Emag Mittelspannung GmbH

Serial-No.: 11/357/99 **Year of manufacture:** 1999

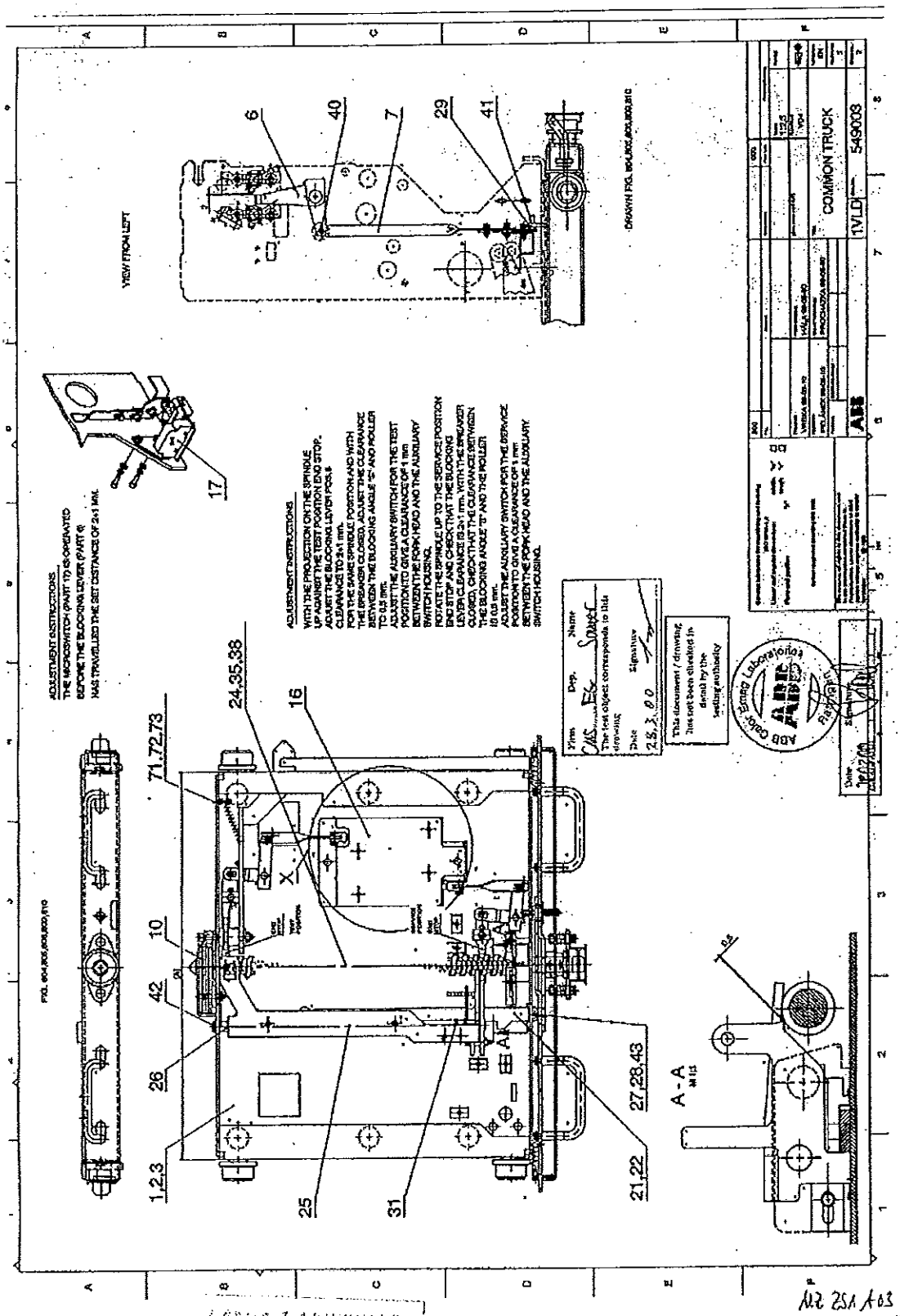
Drawing Nos.:

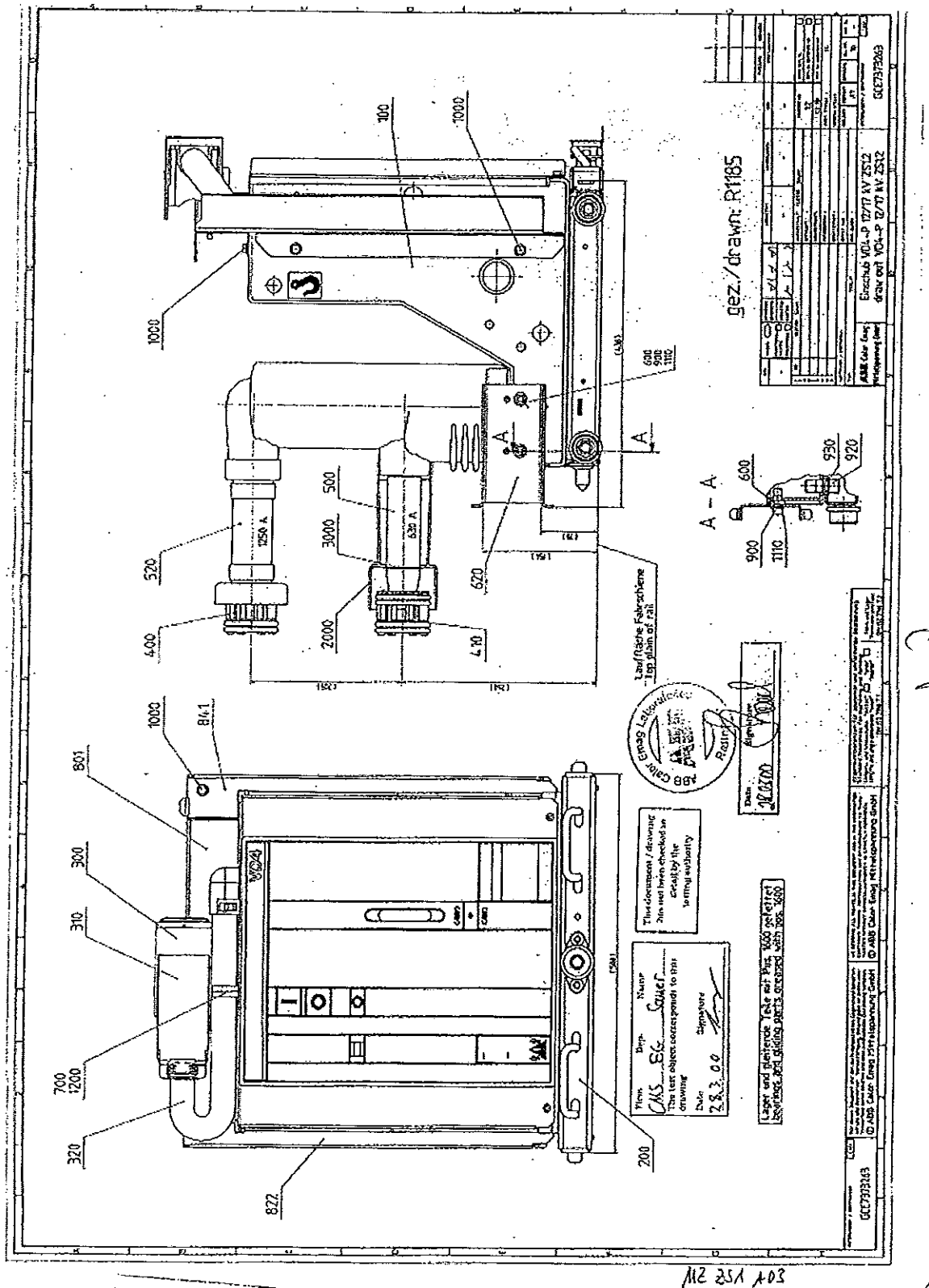
Earthing switch:	GCE 7169312 R 0114	
Pole Centres:	150 mm	
Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated power frequency withstand voltage	28	kV
Rated short-circuit making current	80	kA
Rated peak withstand current	80	kA
Rated short-time withstand current	31,5	kA
Rated duration of short-circuit	3	s

Date of receipt of test object: 27th March 2000

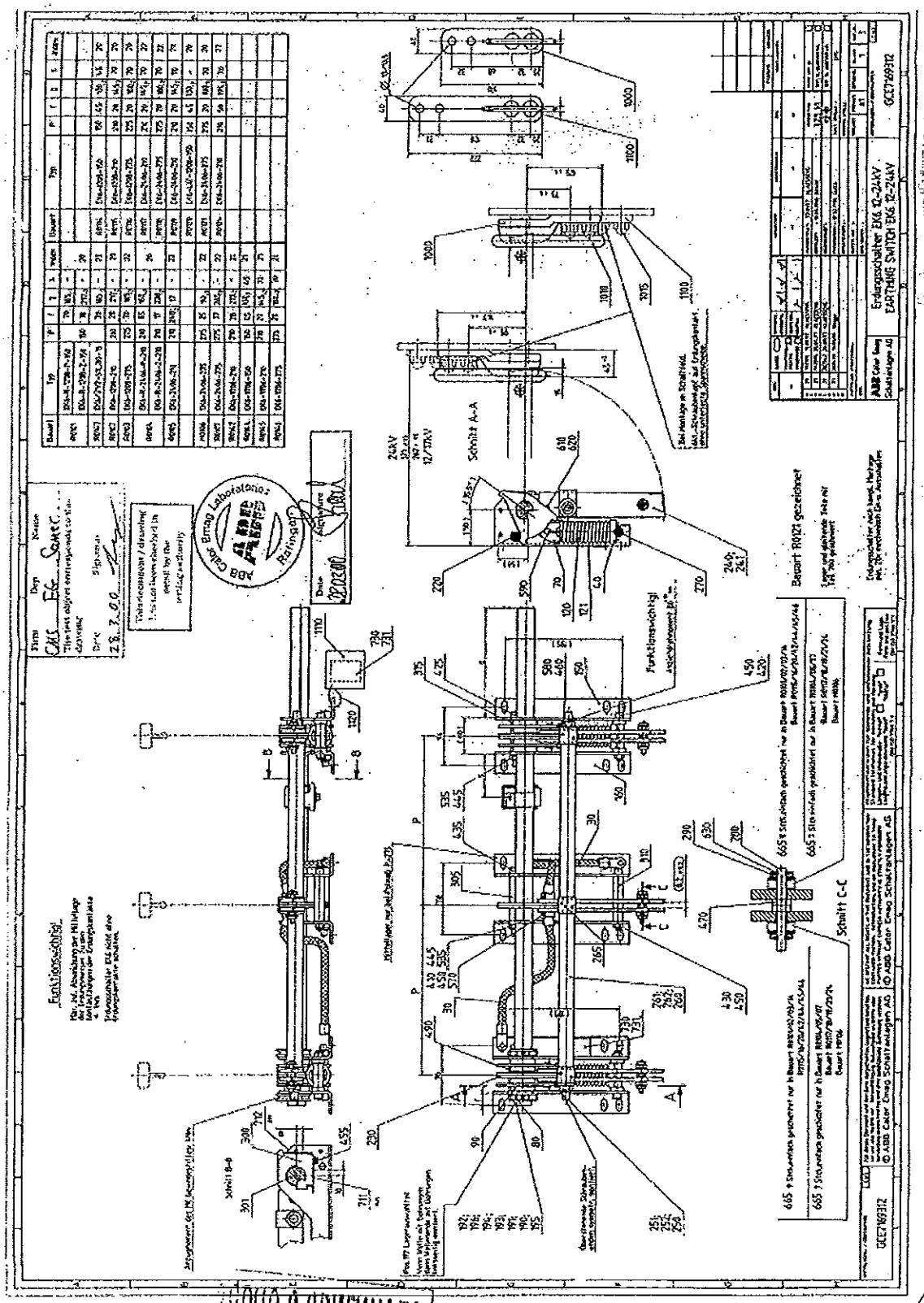


ВЯРНО С ОРИГИНАЛА


6
40
7
29
41
17
24,35,38
16
71,72,73
10
42
26
1,2,3
25
31
27,28,43
21,22
A-A
COMMON TRUCK
549003
1VLD
ABB



ВЯРНО С ОРИГИНАЛА



2. Test Locations and Set-up

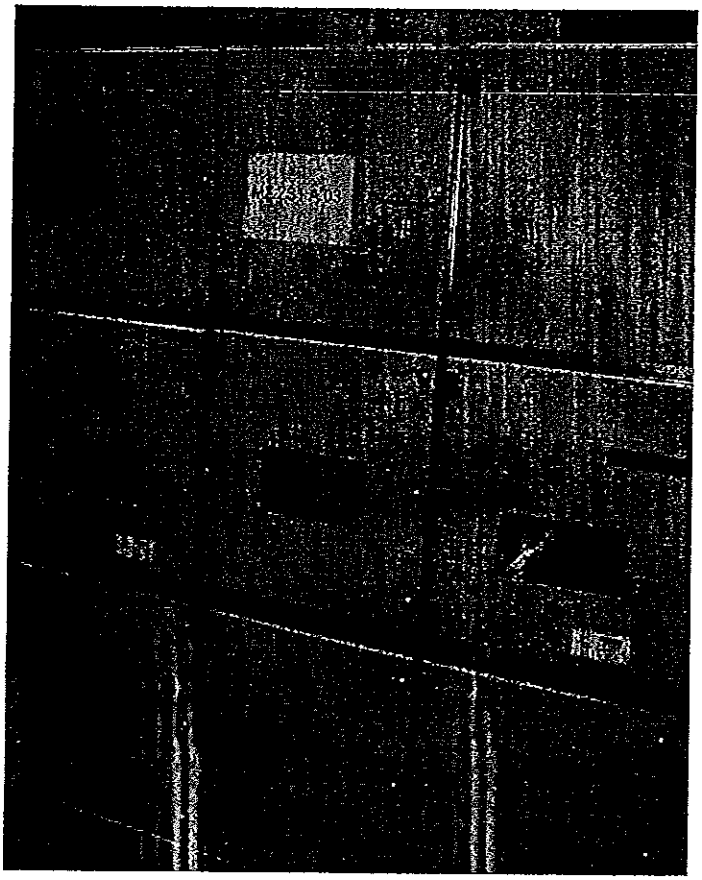
The test was performed in the Mechanical Testing Laboratory

of ABB Calor Emag Mittelspannung GmbH
Dept. LM in Ratingen

at an ambient temperature of approx. 20°C.

Test job no.: 7550030_012A

Test engineer: Koal



3. Mechanical Operation Test

List of interlocks:

1. Withdrawable part in test-position
   - Circuit-breaker ON: prevented to move the withdrawable part in service-position
2. Withdrawable part in service-position
   - Circuit-breaker ON: prevented to move the withdrawable part in test-position
3. Withdrawable part between service and test position:
   prevented to switch ON the circuit-breaker
4. Withdrawable part in test-position
   - Circuit-breaker OFF and earthing switch ON: prevented to move the withdrawable part in service-position
5. Withdrawable part in test-position
   - circuit-breaker ON and earthing switch ON: prevented to move the withdrawable part in service-position
6. Withdrawable part not in test-position
   - prevented to switch ON the earthing switch

All the above mentioned interlocks were checked, for this the circuit-breaker and the earthing switch were operated 50 times and the withdrawable part was inserted and withdrawn 25 times.

Deutscher Akkreditierungs Rat
DAR
Reg. No.
DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. HZ 146 L 02

Sheet 1

Issued by an Accredited Laboratory corresponding to EN 45001

Copy-No. 1

Test Object

Three-panel arrangement of metal-clad, air insulated switchgear type ZS1.2 (650 mm, 1000 mm, 800 mm width) equipped with bushing plates

Rated voltage	U_r	12 kV
Rated normal current	I_r	1000/1600/1600 A
Rated frequency	f_r	50/60 Hz
Rated short-time withstand current	I_k	31.5 kA
Rated peak withstand current	I_p	80 kA
Rated duration of short-circuit current	t_k	3 s

Manufacturer

ABB Calor Emag Mittelspannung GmbH, Oberhausener Str. 33, 40472 Ratingen, Deutschland

Tests performed

Testing of the behaviour of the metal-clad switchgear under conditions of arcing due to internal faults with 31.5 kA - 1.0 s in different compartments of the three panels. For further details see sheet-no. 2 to 5.

Test Specification

The test has been carried out in accordance with the client's instructions. Test procedure and test parameters were based on IEC 60298/3rd Ed/1990-12, Clause 6.108, Annex AA in conjunction with PEHLA-Recommendation No. 4 / 3.1995.
(Accessibility Type A: Metal-enclosed switchgear and controlgear with accessibility restricted to authorized personnel only).

Test Results

The assessment of the test was carried out in accordance with criteria 1 to 6 of the above mentioned test specifications.
For further details see sheet-no. 2 to 5 and 19 to 25.

Test Date

04th to 12th July 2000

Client

ABB Calor Emag Mittelspannung GmbH, Oberhausener Str. 33, 40472 Ratingen, Deutschland

ABB Calor Emag Laboratories ABB Ratingen

12th February 2002
Date of Issue

Dr. Stefan Göttlich
Laboratory Manager

Andreas Brandt
Test Engineer

Total Number of Sheets: 34 Sheets **11 Oszillograms**

This test report refers exclusively to the object tested.
ABB Calor Emag Mittelspannung GmbH is certified according to DIN ISO 9001 by DQS under Reg. No. 373-02

ABB Calor Emag Laboratories Ratingen are accredited according to EN 45001 by DATech under Reg.No. DAT-P-032/93

ABB Calor Emag Mittelspannung GmbH Ratingen
High Power Testing Laboratory
Oberhausener Straße 33
40472 Ratingen, Deutschland
Phone + 49 (0) 21 02 12-1352
Fax + 49 (0) 21 02 12-1713

ВЯРНО С ОРИГИНАЛА

Comments on Test Arrangement and on the Test

The test object was a three-panel arrangement of a metal-clad, air insulated switchgear type ZS1.2 for 12 kV, consisting of a 650 mm width outgoing panel left-handed, of a 1000 mm width incoming panel in centre and a 800 mm width outgoing panel right-handed. The switchgear was installed in a room mock up with a ceiling height of approximately 3 m. The distance between the rear wall of the switchgear and the room mock up was approximately 0.2 m. The pressure relief took place by a top mounted pressure relief duct overcoming 1800 mm at the side wall of the left-handed panel.

Each panel was equipped with a VD4 vacuum circuit-breaker dummy and a common earthing bar of copper 30 x 8 mm^2.

Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

For all tests black cretonne indicators (cotton fabric approximately 150 g/m^2) were placed in front of and on both sides of the switchgear as stated in the relevant test regulations.

During the tests the pressure gauge in the compartment under test was measured and recorded. The tests were filmed with a high-speed video camera with a frequency of 500 frames/s.

The evaluation of the RMS-value of the short-circuit current was made according to the Simpson-Formula.

Test Results:

Test-no.: HZ 146 L 02 / 03 Internal arcing test in the cable compartment of the left-handed panel (650 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm at the cable terminals.

Peak short-circuit current: 72.5 kA
Short-circuit current: 30.6 kA - 1.05 s equivalent to 31.5 kA - 1.02 s

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test-no.: HZ 146 L 02 / 05 Internal arcing test in the cable compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm at the cable terminals.

Peak short-circuit current: 77.3 kA
Short-circuit current: 31.5 kA - 1.05 s equivalent to 31.5 kA - 1.05 s

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test Results:

Test-no.: HZ 146 L 02 / 06 Internal arcing test in the circuit-breaker compartment of the left-handed panel (650 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 across the upper contact arms of the circuit-breaker.

Peak short-circuit current: 79.3 kA
Short-circuit current: 31.5 kA - 1.05 s equivalent to 31.5 kA - 1.05 s

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test-no.: HZ 146 L 02 / 07 Internal arcing test in the busbar compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the busbars.

Peak short-circuit current: 78.8 kA
Short-circuit current: 31.6 kA - 1.05 s equivalent to 31.5 kA - 1.05 s

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test Results:

Test-no.: HZ 146 L 02 / 08 Internal arcing test in the busbar compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 across the busbars.

Peak short-circuit current: 77.3 kA
Short-circuit current: 31.5 kA - 1.05 s equivalent to 31.5 kA - 1.05 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test-no.: HZ 146 L 02 / 09 Internal arcing test in the circuit-breaker compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the lower contact arms of the circuit-breaker.

Peak short-circuit current: 77.2 kA
Short-circuit current: 31.3 kA - 1.05 s equivalent to 31.5 kA - 1.04 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Contents

ВЯРНО С ОРИГИНАЛА

Assessment of the Test

Extraction of IEC 60298/3rd Ed/1990-12, Annex AA

The following criteria allow for the arcing effects.
It is to be observed:

Criterion No. 1

Whether correctly secured doors, covers, etc., do not open.

Criterion No. 2

Whether parts (of the metal-enclosed switchgear and controlgear), which may cause a hazard, do not fly off. This includes large parts or those with sharp edges, for example, inspection windows, pressure relief flaps, cover plates, etc.

Criterion No. 3

Whether arcing does not cause holes to develop in the freely accessible parts of the enclosure as a result of burning or other effects.

Criterion No. 4

Whether the indicators arranged vertically do not ignite. Indicators ignited as a result of paint or stickers burning are excluded from this assessment.

Criterion No. 5

Whether the indicators arranged horizontally do not ignite. Should they start to burn during the test, the assessment criterion may be regarded as having been met, if proof is established of the fact that the ignition was caused by glowing particles rather than hot gases. Pictures taken by high-speed cameras should be produced in evidence.

Criterion No. 6

Whether all earthing connections are still effective.

Remark:

When the PEHLA-Recommendation No. 4 is stated under *Test Specification* in the Test Report the results of each test were assessed by all six criteria.

ВЯРНО С ОРИГИНАЛА

Participants of the Tests

Client:	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland
Representatives of the client:	
Mr. Aufermann	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. EA
Mr. Groll	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. EA
Mr. Martschat	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. EA
Representatives of the laboratory:	
Mr. Dr. Göttlich	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. LL
Test Engineer:	
Mr. Strathmann	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. LL

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear (left-handed)

Test Object: Metal-clad, air insulated switchgear

Type: ZS1.2, 650 mm width

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland

Serial-No.: 7550027/2001/00 **Year of manufacture:** 2000

Drawing Nos.: See sheet-no. 12

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated current (busbar)	2000	A
Rated current (tee-off)	1000	A
Rated short-circuit peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20 ° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	80	kA
Short-time withstand current	31.5	kA
Short-circuit duration	1	s

Additional specifications and data:

- busbars 2 x 80 mm x 10 mm / R 5 mm, Cu, bare
- tee-off bars 1 x 60 mm x 10 mm / R 5 mm, Cu, bare

Date of receipt of test object: 3rd July 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear (centre)

Test Object: Metal-clad, air insulated switchgear

Type: ZS1.2, 1000 mm width

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland

Serial-No.: 7550027/2009/00 **Year of manufacture:** 2000

Drawing Nos.: See sheet-no. 12

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated current (busbar)	2000	A
Rated current (tee-off)	1600	A
Rated short-circuit peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20 ° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	80	kA
Short-time withstand current	31.5	kA
Short-circuit duration	1	s

Additional specifications and data:

- busbars 2 x 80 mm x 10 mm / R 5 mm, Cu, bare
- tee-off bars 2 x 100 mm x 10 mm / R 5 mm, Cu, bare

Date of receipt of test object: 3rd July 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear (right-handed)

Test Object: Metal-clad, air insulated switchgear

Type: ZS1.2, 800 mm width

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland

Serial-No.: 7550027/2005/00 **Year of manufacture:** 2000

Drawing Nos.: See sheet-no. 12

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated current (busbar)	2000	A
Rated current (tee-off)	1600	A
Rated short-circuit peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20 ° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	80	kA
Short-time withstand current	31.5	kA
Short-circuit duration	1	s

Additional specifications and data:

- busbars 2 x 80 mm x 10 mm / R 5 mm, Cu, bare
- tee-off bars 2 x 80 mm x 10 mm / R 5 mm, Cu, bare

Date of receipt of test object: 3rd July 2000

ВЯРНО С ОРИГИНАЛА

Table of Drawings of Test Objects

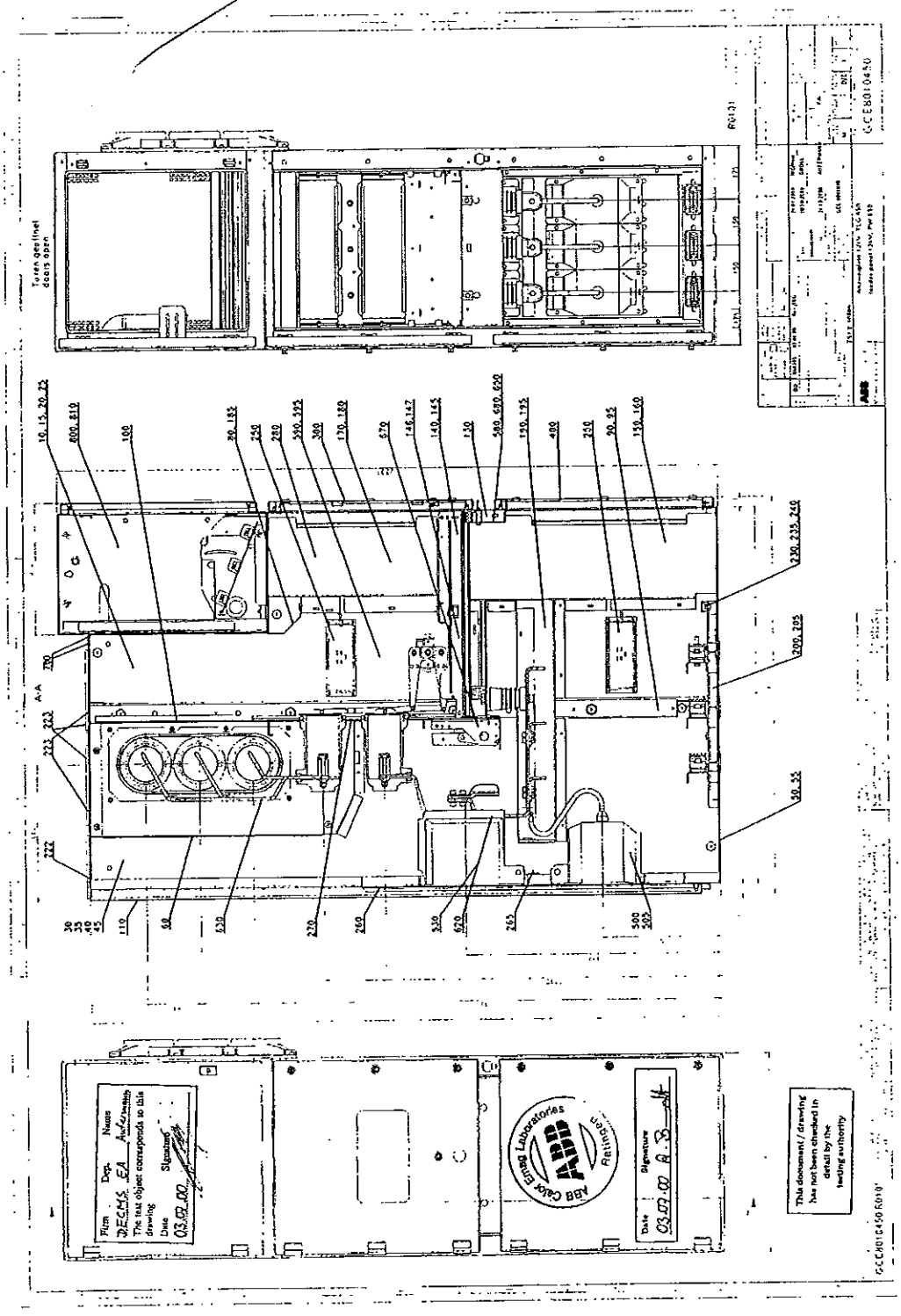
The drawings submitted for identification of the test object were stamped and signed by the test engineer.

The manufacturer/client has guaranteed by signature on the drawings that the equipment submitted for tests has been manufactured in accordance with the given drawings.

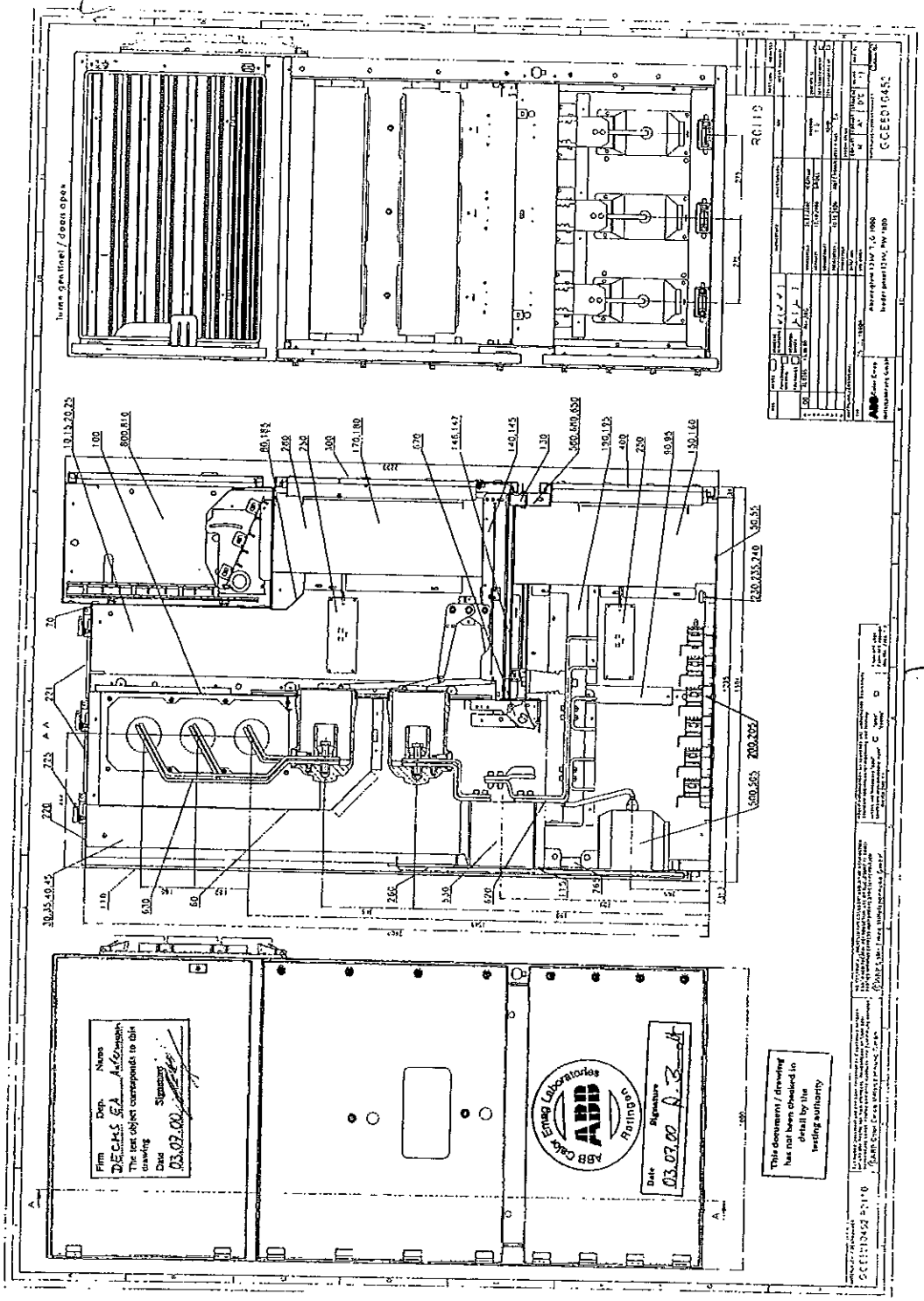
A copy of the following drawing is part of this Test Report:

ZS 1.2, feeder panel 12 kV, PW.650	GCE8010450R0101, sheet 1, index 00,	
ZS 1.2, feeder panel 12 kV, PW.1000	GCE8010452R0110, sheet 19, index 00,	
ZS 1.2, feeder panel 12 kV, PW.800	GCE8010451R0103, sheet 3, index 00,	
Type Test Arrangement (internal fault) ZS1.2 - Panel	GCEP800241	sheet 1, index 00

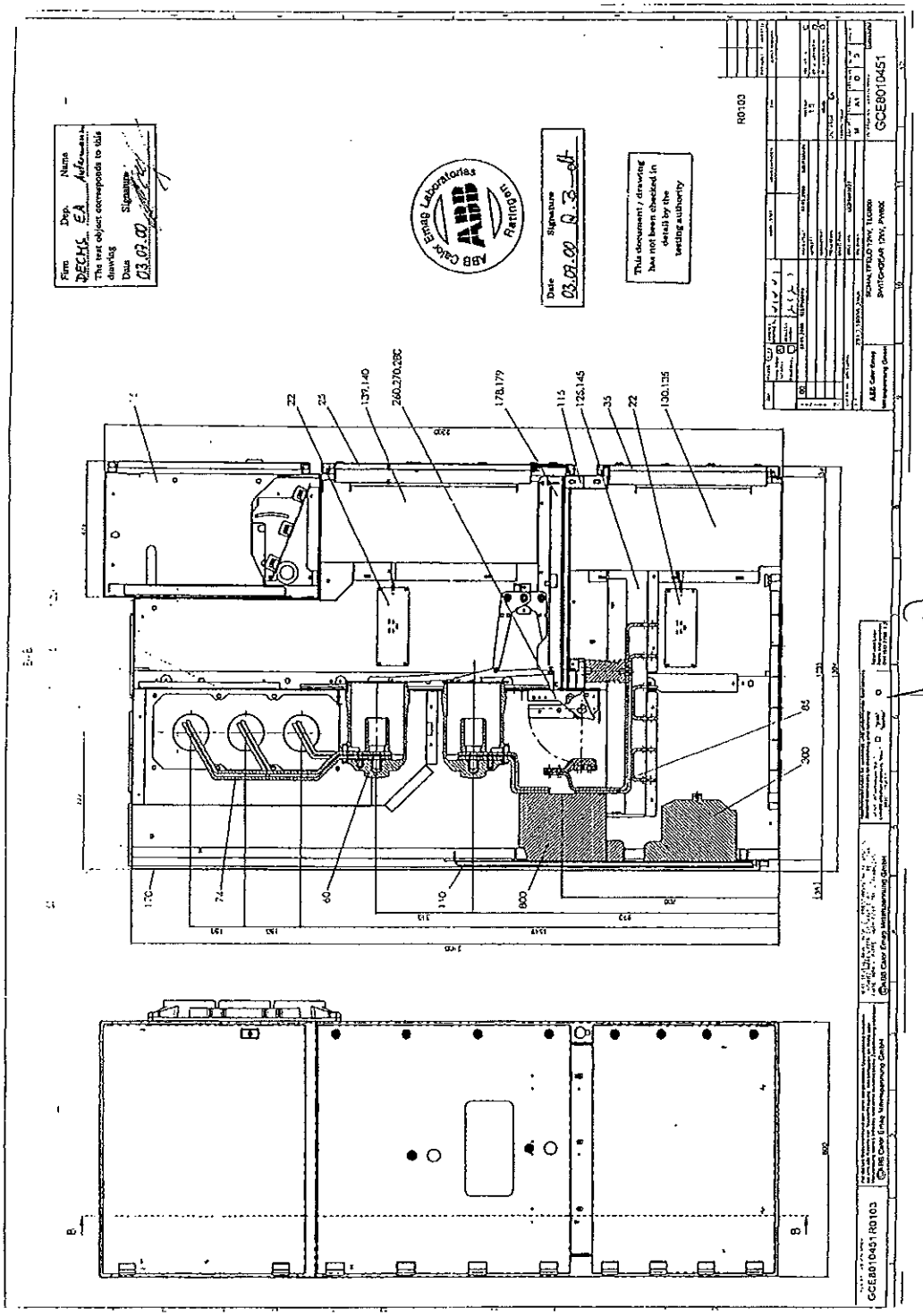
ВЯРНО С ОРИГИНАЛА



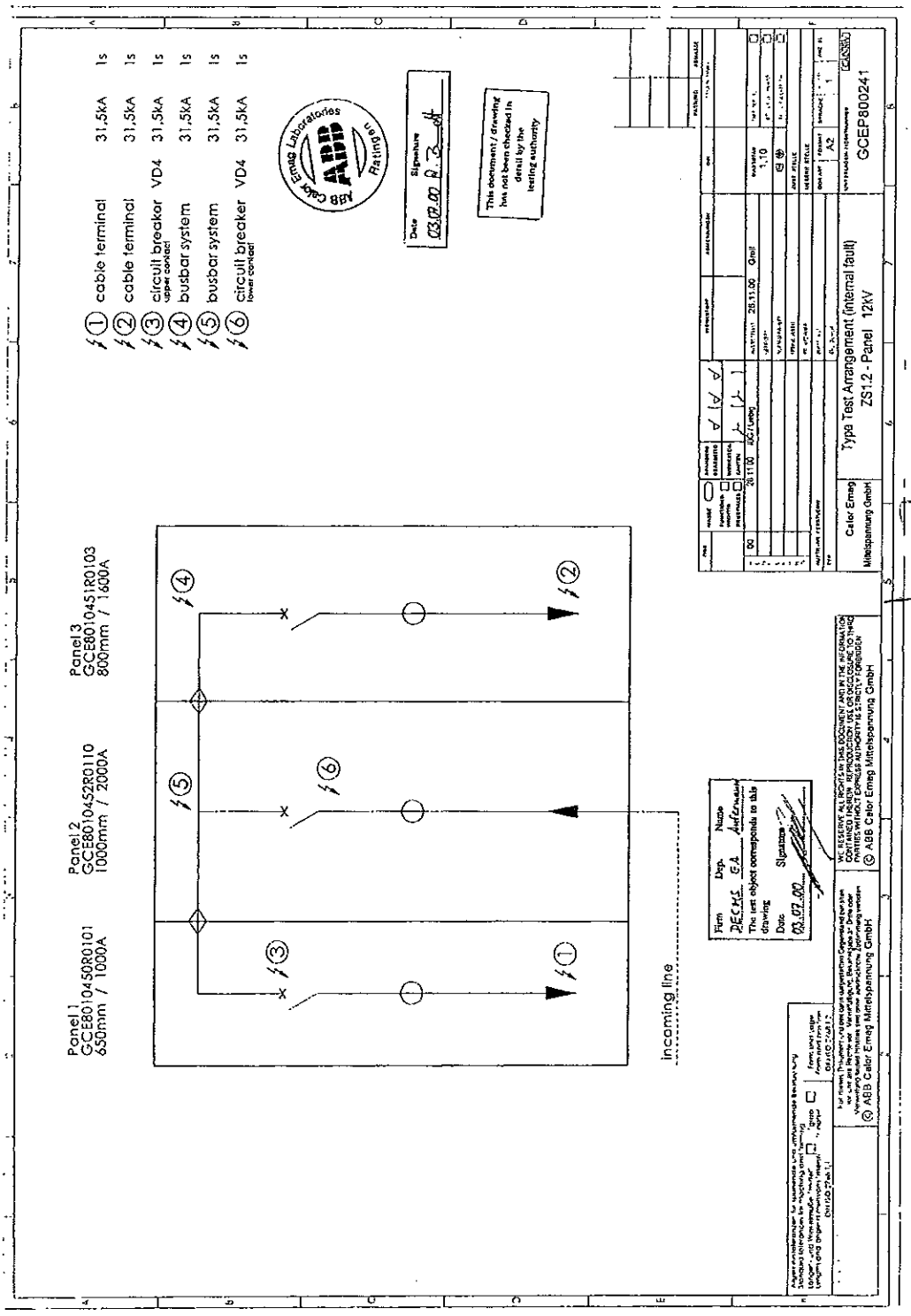
ВЯРНО С ОРИГИНАЛА



ВЯРНО С ОРИГИНАЛА



ВЯРНО С ОРИГИНАЛА



ВЯРНО С ОРИГИНАЛА

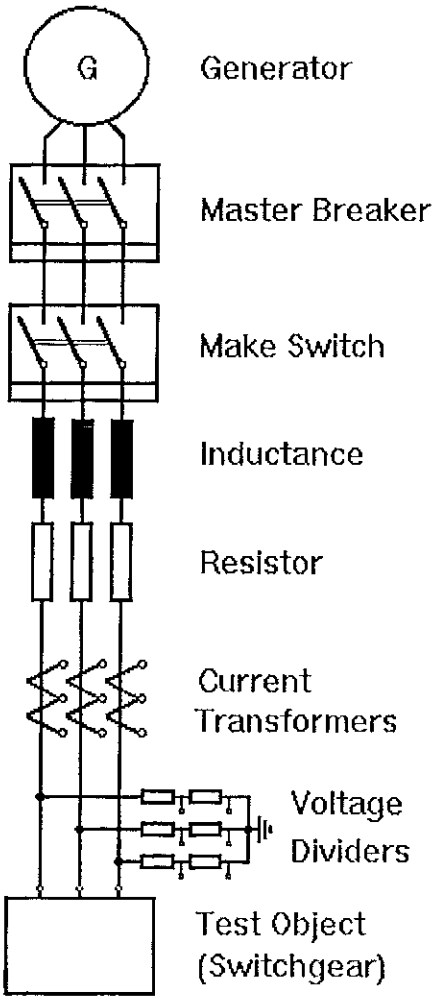
Technical Data of Test Circuit

Test		Internal fault	-	-	-
Oscillogram-No. HZ 146 L 02		02 - 09	-	-	-
Number of phases	(circuit)	3	-	-	-
Number of poles/phases	(test object)	3	-	-	-
Power frequency	Hz	50	-	-	-
Power factor	cos φ	≤ 0.15	-	-	-
Earthing	Generator	earthed via 5 kΩ	-	-	-
	Transformer	not earthed	-	-	-
	Short-circuit point	not earthed	-	-	-
Circuit diagram	Sheet no.:	18	-	-	-
Circuit impedance	mΩ	≈ 120	-	-	-
-		-	-	-	-
TRV control elements		-	-	-	-
Capacitance in parallel	µF	-	-	-	-
Resistance in series	Ω	-	-	-	-
-		-	-	-	-
-		-	-	-	-
Prospective TRV	-	-	-	-	-
TRV peak value u_c	kV	-	-	-	-
Time co-ordinate t_3	µs	-	-	-	-
Time delay t_d	µs	-	-	-	-
Based on	kV	-	-	-	-
Rate-of-rise	kV/µs	-	-	-	-
-		-	-	-	-
-		-	-	-	-
Voltage measurements		Divider 375 kΩ / 2 kΩ	-	-	-
Current measurements		Transformer 50 kA / 5 A	-	-	-

Remarks:
HZ 146 L 02 / 01: Current calibration
HZ 146 L 02 / 04: Pre-test

ВЯРНО С ОРИГИНАЛА

Principle Diagram of Test Circuit



ВЯРНО С ОРИГИНАЛА

Determination of the Prospective Short-Circuit Current

Condition of test object before test: -

Arrangement: See sheet-no. 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

For the determination of the prospective short-circuit current the infeeding busbars of the test plant were short-circuited and earthed outside the switchgear under test.

Test-No.: HZ 146 L 02 / 02		Applied voltage (phase-to-phase) 6.5 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	81.9	37.4	30.0	30.2
L2	27.7	36.4	30.5	30.7
L3	67.2	37.2	29.8	30.0
	Average value	37.0	30.1	30.3
Equivalent duration of short-circuit current 1.01 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks: -

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: Switchgear factory-new.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the cable compartment of the left-handed panel (650 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 mm at the cable terminals.

Test-No.: HZ 146 L 02 / 03		Applied voltage (phase-to-phase) 6.5 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	72.5	37.1	30.4	30.2
L2	27.0	36.0	30.9	31.0
L3	60.7	37.4	30.1	30.6
	Average value	36.9	39.8	30.6
Equivalent duration of short-circuit current 1.02 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 26 to 34. The measured pressure gauge was about 75 kPa.

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Internal Arcing Test

Condition of test object before test: as after test HZ 146 L 02 / 03.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the cable compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm at the cable terminals.

Test-No.: HZ 146 L 02 / 05		Applied voltage (phase-to-phase) 6.65 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	77.3	38.3	30.9	31.4
L2	25.7	36.7	31.2	31.3
L3	60.9	37.7	31.7	31.7
Average value		37.6	31.3	31.5
Equivalent duration of short-circuit current 1.05 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 26 to 34. The measured pressure gauge was about 57 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 146 L 02 / 05.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the circuit-breaker compartment of the left-handed panel (650 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 across the upper contact arms of the circuit-breaker

Test-No.: HZ 146 L 02 / 06		Applied voltage (phase-to-phase) 6.65 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	79.3	38.7	30.3	31.0
L2	26.1	37.1	32.3	31.8
L3	62.6	38.3	32.0	31.6
	Average value	38.0	31.5	31.5
Equivalent duration of short-circuit current 1.05 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 26 to 34. The measured pressure gauge was about 48 kPa.

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Internal Arcing Test

Condition of test object before test: as after test HZ 146 L 02 / 06.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the busbar compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the busbars.

Test-No.: HZ 146 L 02 / 07		Applied voltage (phase-to-phase) 6.65 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	78.8	39.0	32.0	31.8
L2	23.3	36.6	31.4	31.3
L3	60.3	38.4	31.6	31.6
	Average value	38.0	31.7	31.6
Equivalent duration of short-circuit current 1.05 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 26 to 34. The measured pressure gauge was about 27 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 146 L 02 / 07.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the busbar compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 across the busbars.

Test-No.: HZ 146 L 02 / 08		Applied voltage (phase-to-phase) 6.65 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	77.3	38.5	30.8	31.2
L2	25.4	37.4	32.1	32.2
L3	61.4	38.4	31.4	31.2
Average value		38.1	31.4	31.5
Equivalent duration of short-circuit current 1.05 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 26 to 34. The measured pressure gauge was about 23 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Internal Arcing Test

Condition of test object before test: as after test HZ 146 L 02 / 08.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the circuit-breaker compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the lower contact arms of the circuit-breaker.

Test-No.: HZ 146 L 02 / 09		Applied voltage (phase-to-phase) 6.65 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	77.2	38.0	31.4	31.2
L2	27.1	37.0	32.0	31.7
L3	62.1	38.0	30.5	31.0
Average value		37.7	31.3	31.3
Equivalent duration of short-circuit current 1.04 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no 26 to 34.
The measured pressure gauge was about 44 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

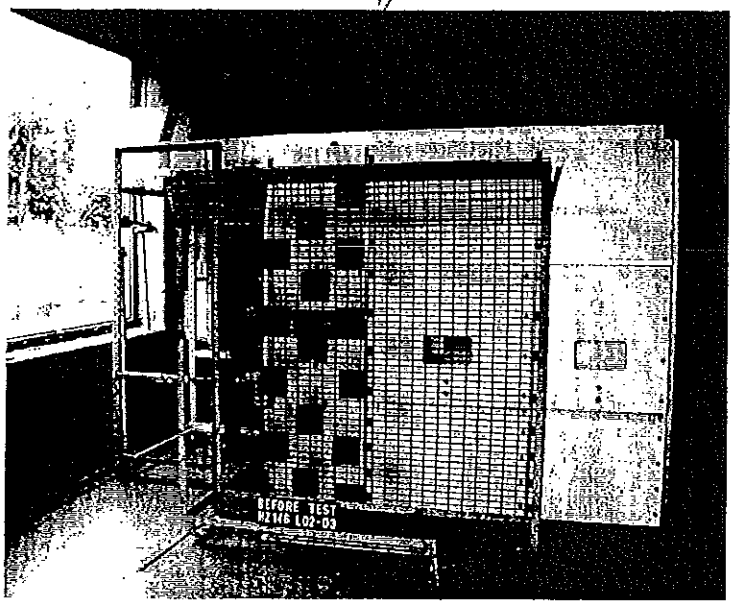


Photo No. 01
Before Test HZ 146 L 02 / 03

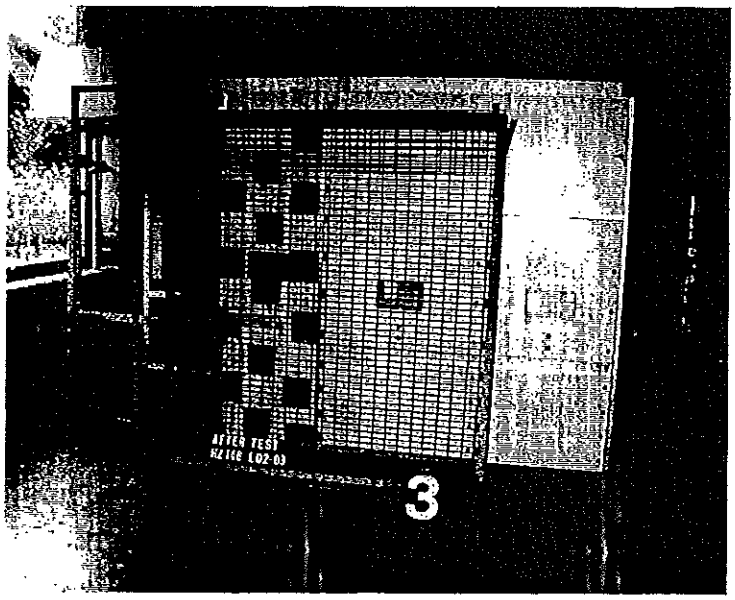


Photo No. 02
After Test HZ 146 L 02 / 03

ВЯРНО С ОРИГИНАЛА

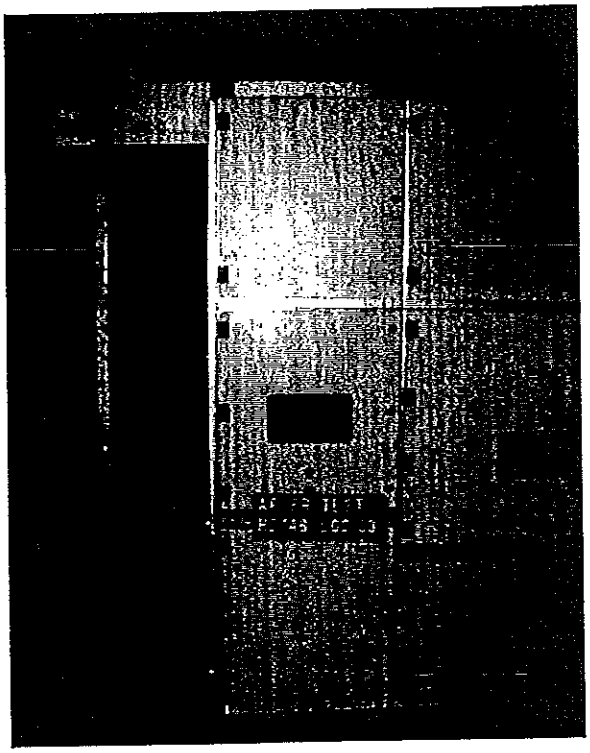


Photo No. 03
After Test HZ 146 L 02 / 03

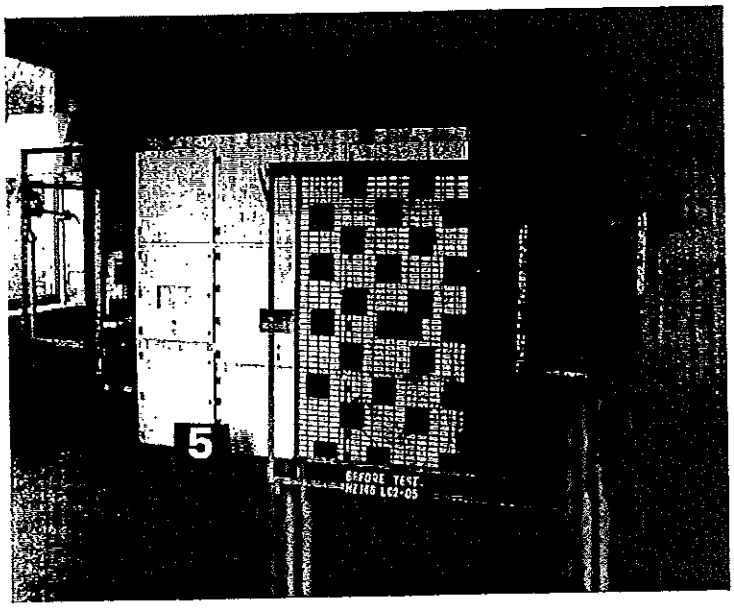


Photo No. 04
Before Test HZ 146 L 02 / 05

ВЯРНО С ОРИГИНАЛА

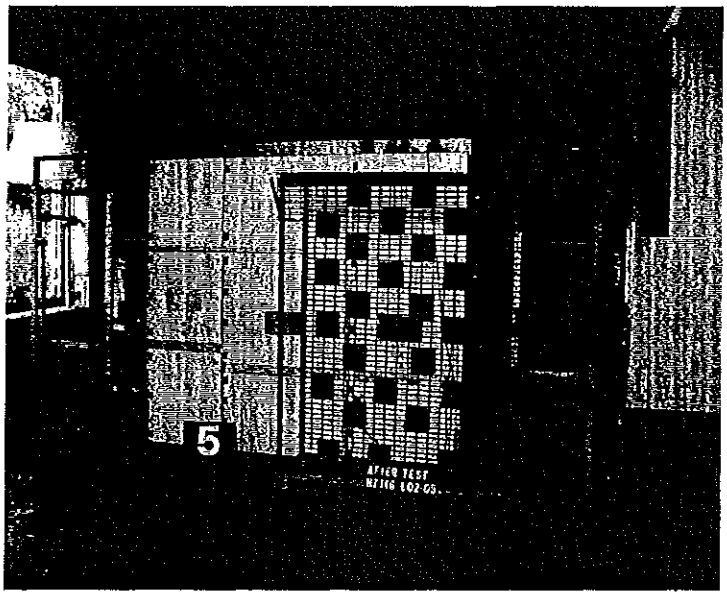


Photo No. 05
After Test HZ 146 L 02 / 05

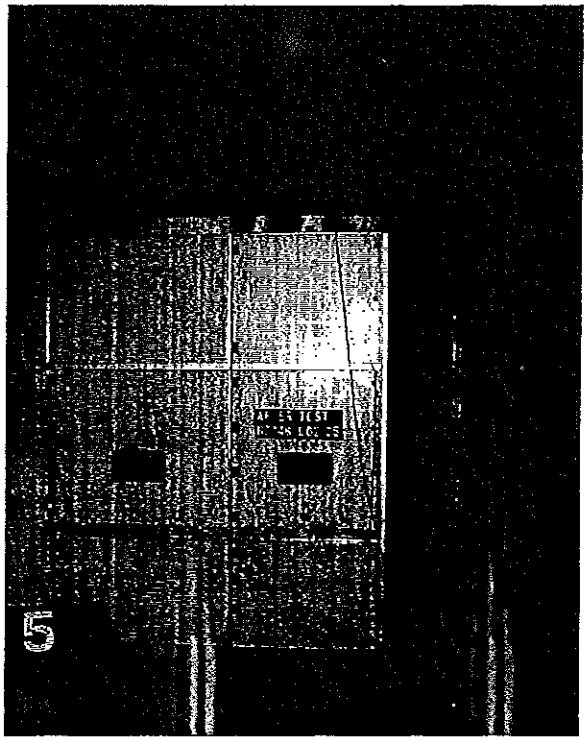


Photo No. 06
After Test HZ 146 L 02 / 05

ВЯРНО С ОРИГИНАЛ

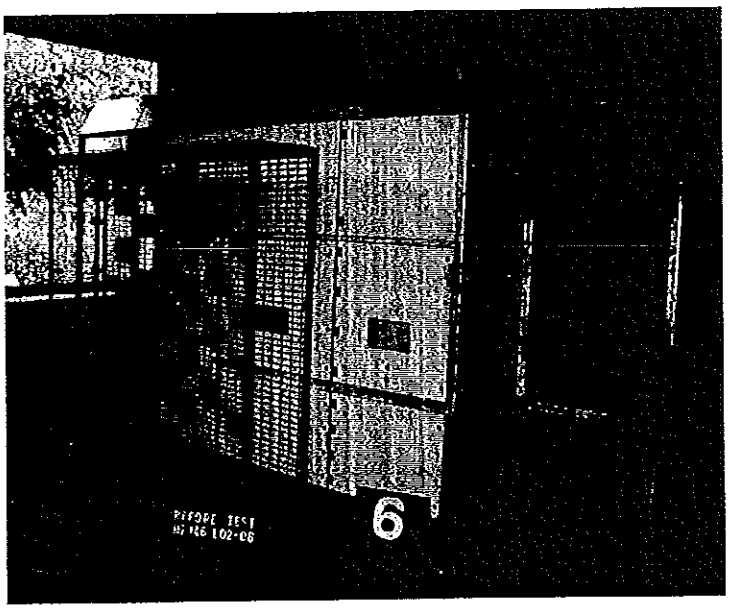


Photo No. 07
Before Test HZ 146 L 02 / 06

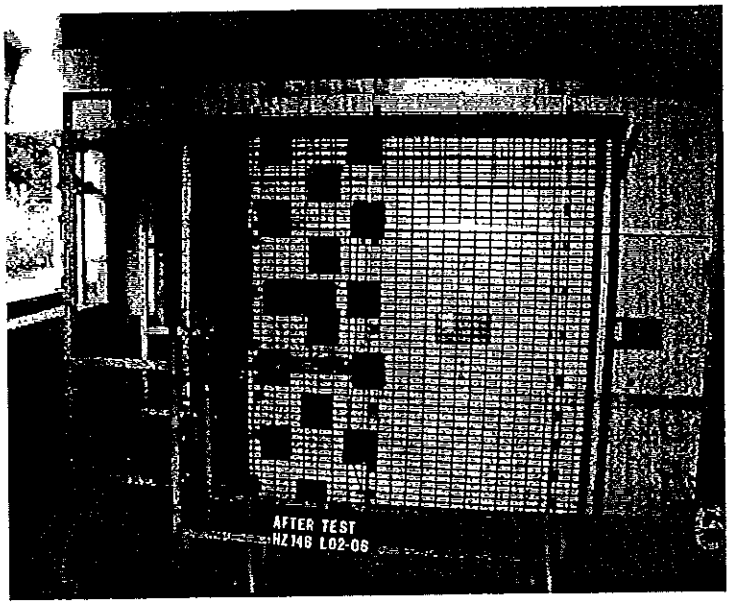


Photo No. 08
After Test HZ 146 L 02 / 06

ВЯРНО С ОРИГИНАЛА

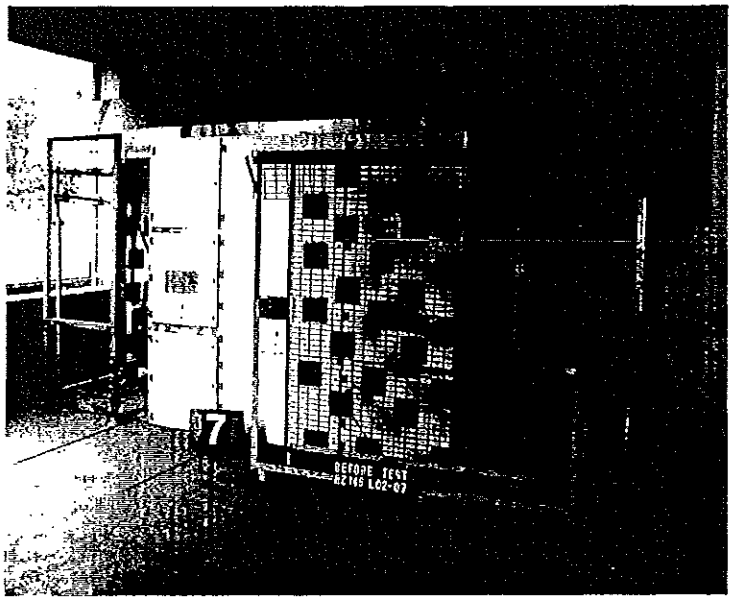


Photo No. 09
Before Test HZ 146 L 02 / 07

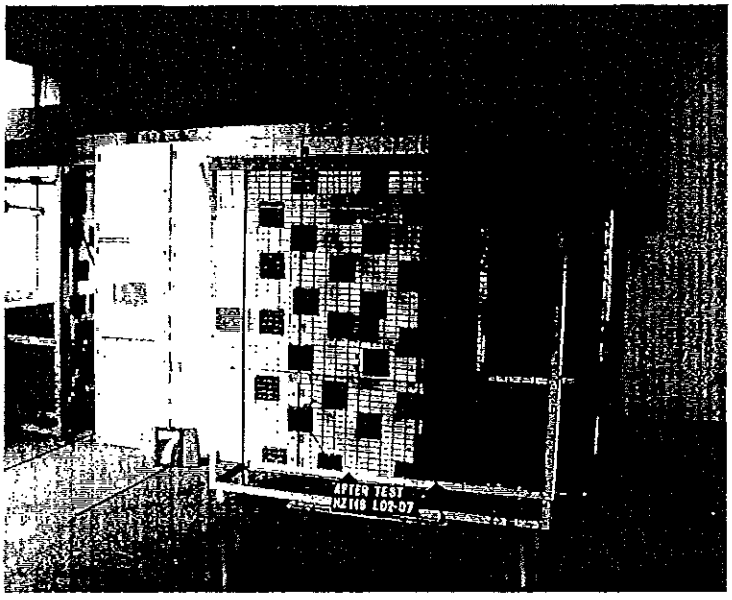


Photo No. 10
After Test HZ 146 L 02 / 07

ВЯРНО С ОРИГИНАЛА

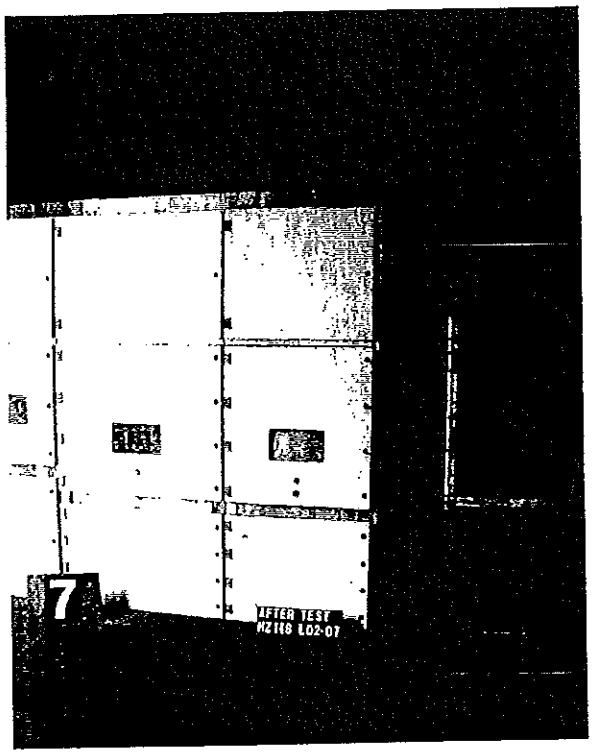


Photo No. 11
After Test HZ 146 L 02 / 07

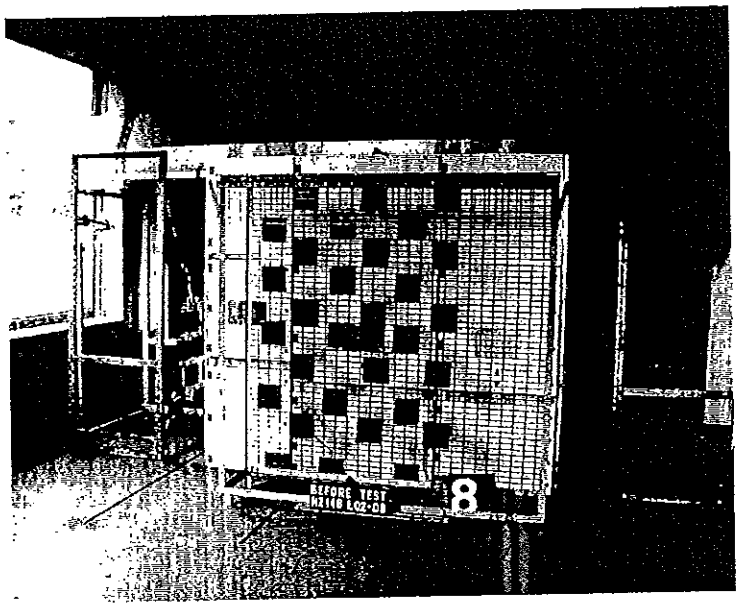


Photo No. 12
Before Test HZ 146 L 02 / 08

ВЯРНО С ОРИГИНАЛА

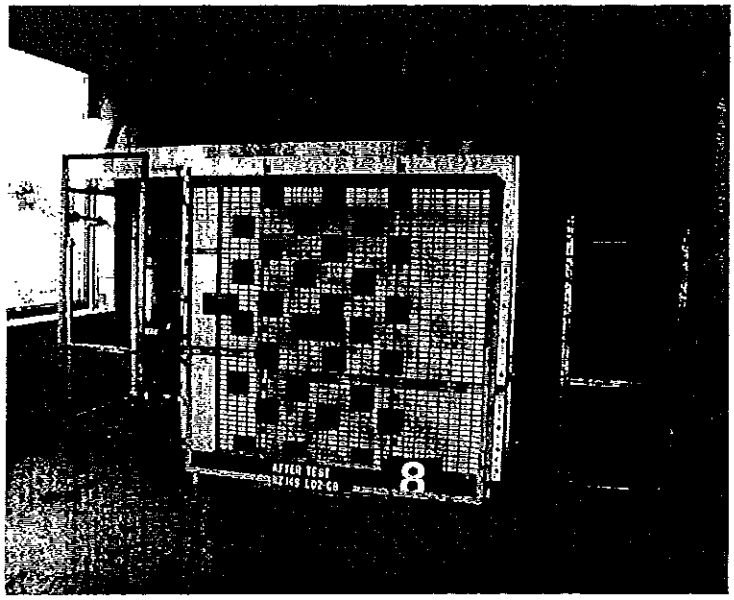


Photo No. 13
After Test HZ 146 L 02 / 08

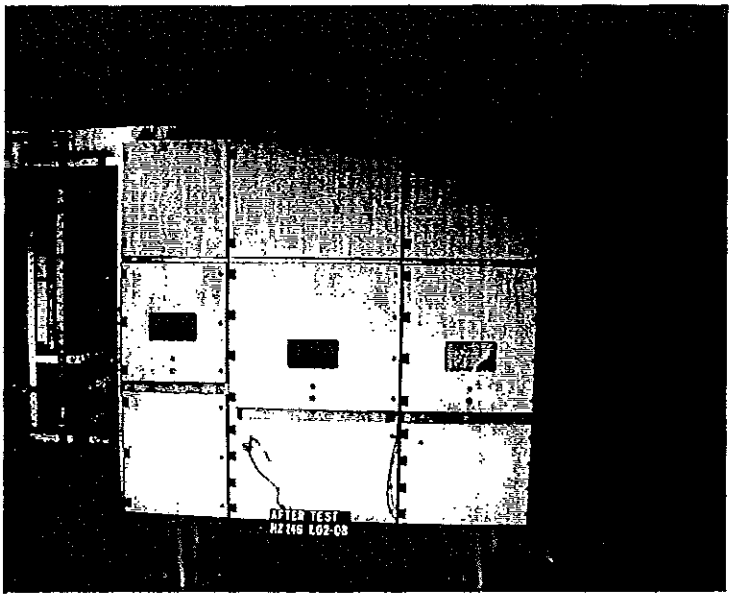


Photo No. 14
After Test HZ 146 L 02 / 08

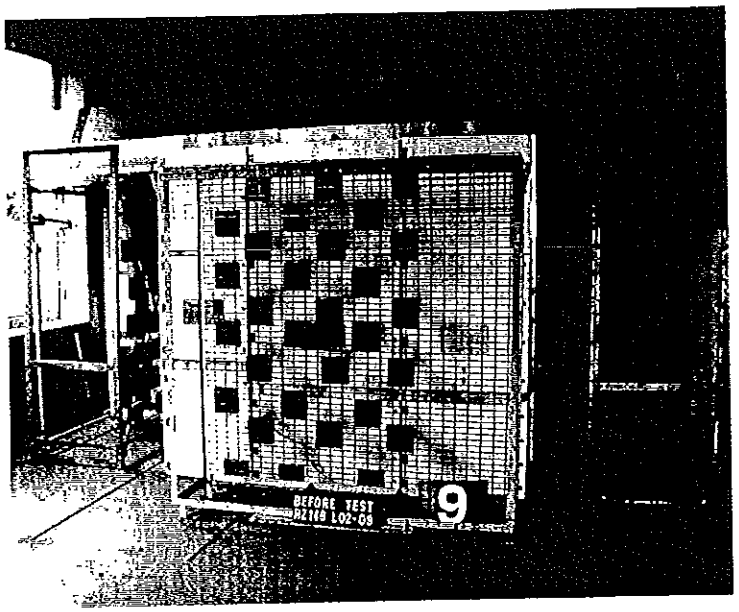


Photo No. 15
Before Test HZ 146 L 02 / 09

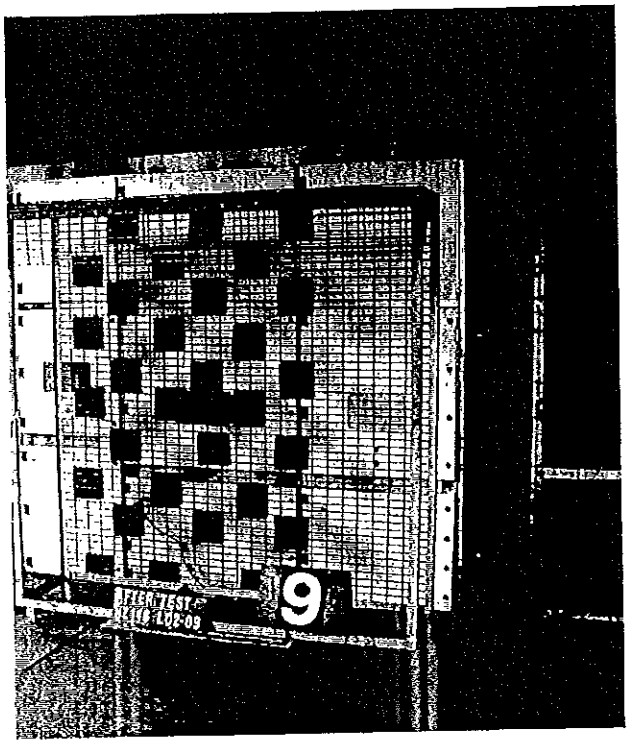


Photo No. 16
After Test HZ 146 L 02 / 09

ВЯРНО С ОРИГИНАЛА

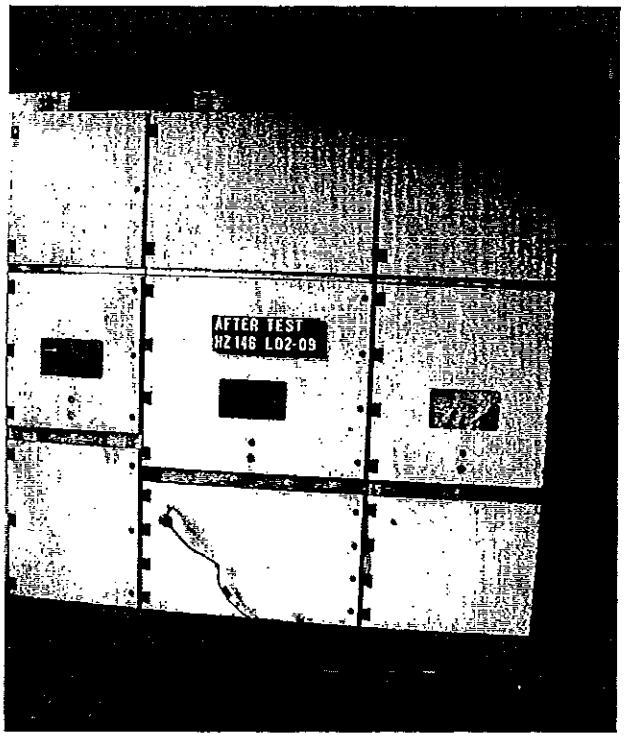
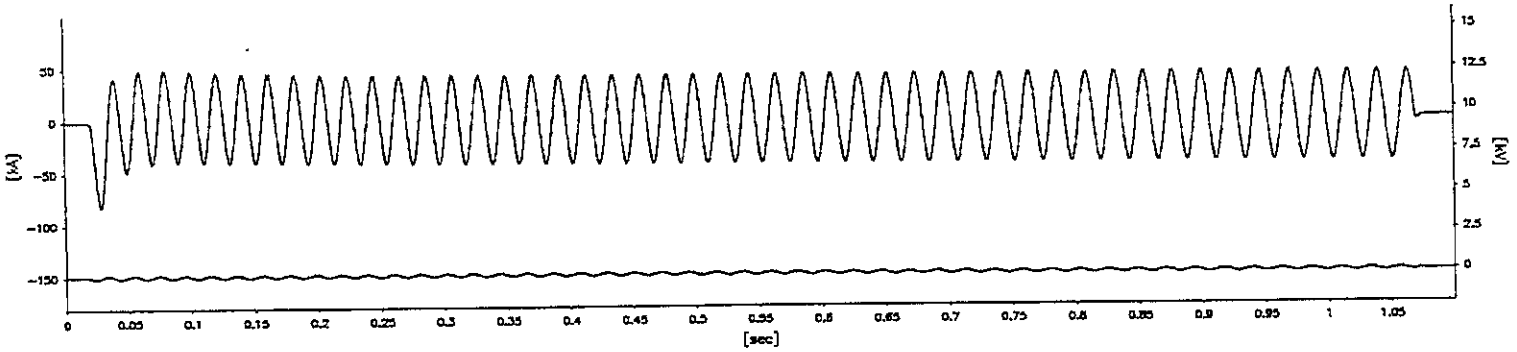
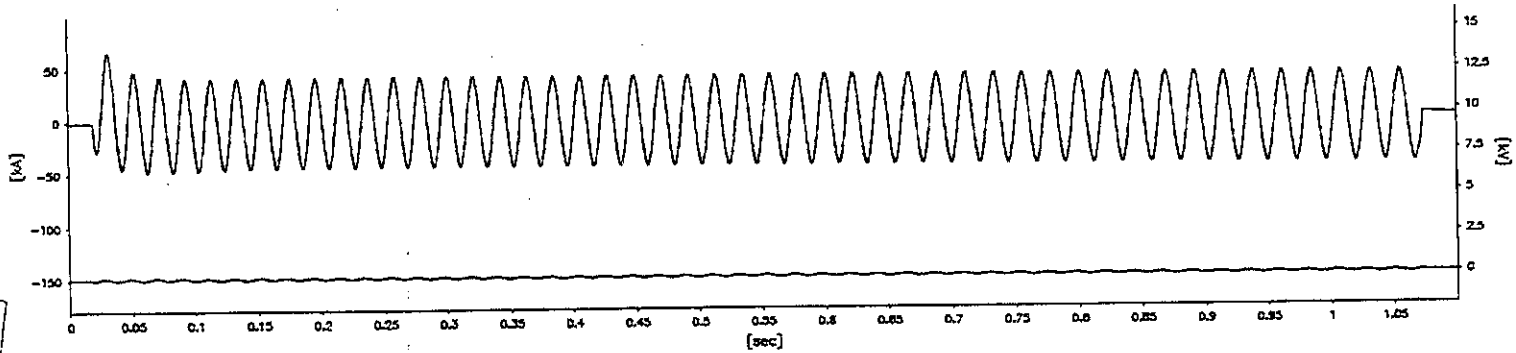
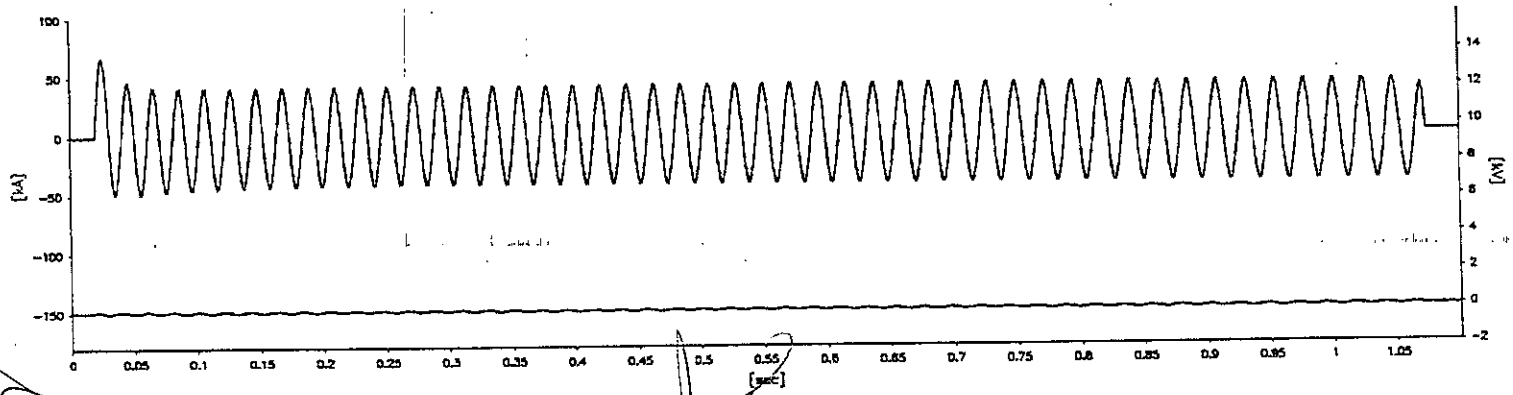


Photo No. 17
After Test HZ 146 L 02 / 09

ВЯРНО С ОРИГИНАЛА







HZ146L02.002

4.7.2000

ВЯРНО С ОРИГИНАЛА

HZ146L02.003

20.2.2002

ВЯРНО С ОРИГИНАЛА

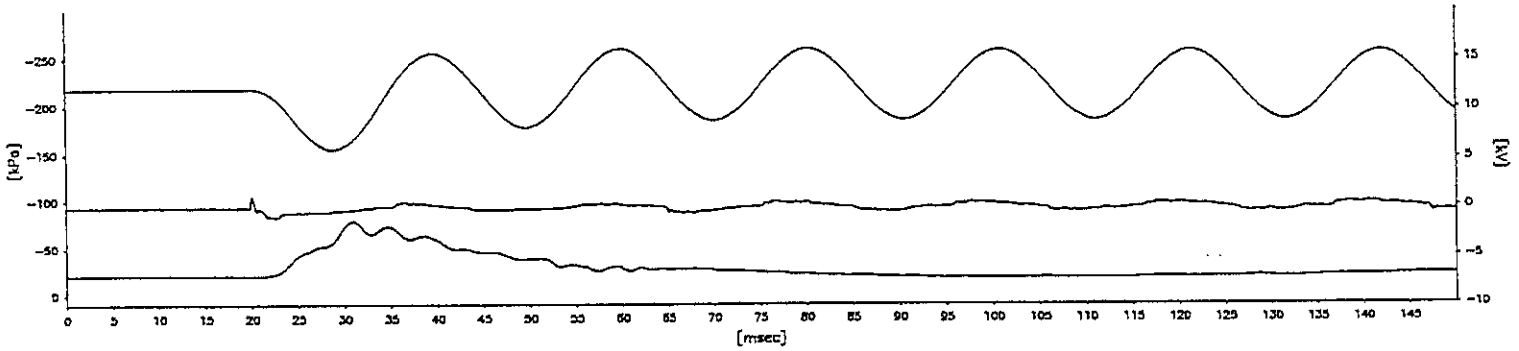
HZ146L02.003

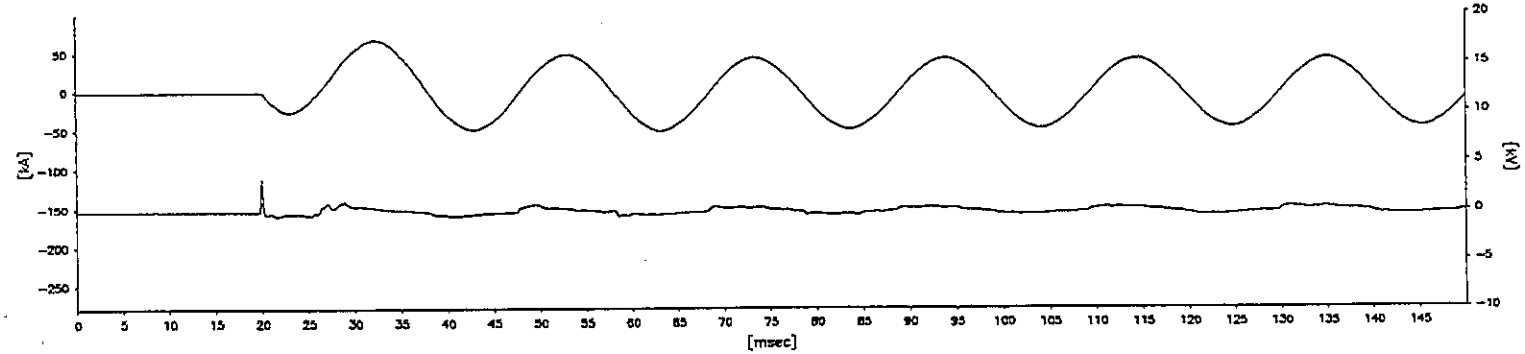
10.7.2000

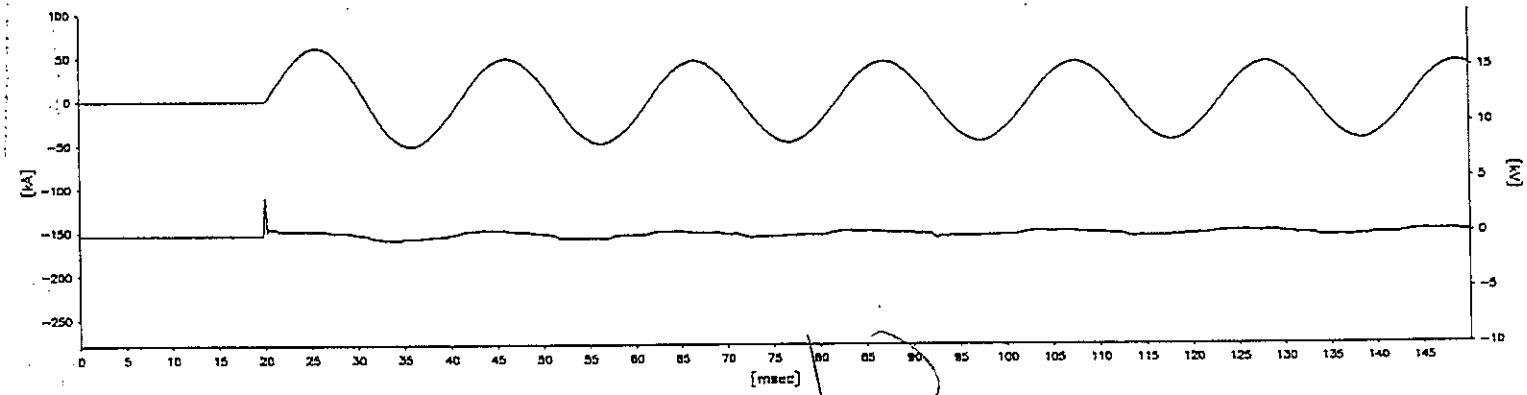
ВЯРНО С ОРИГИНАЛА

HZ146L02.005

20.2.2002

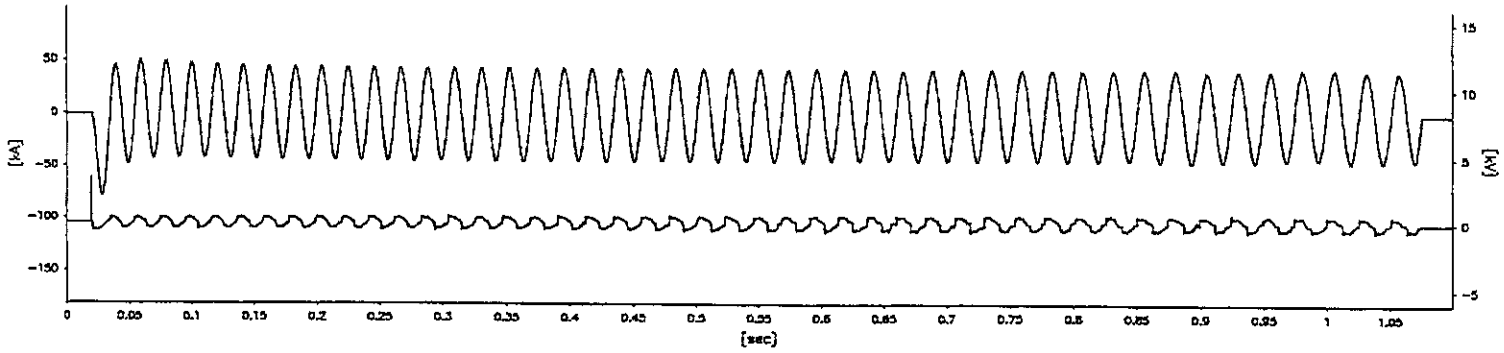


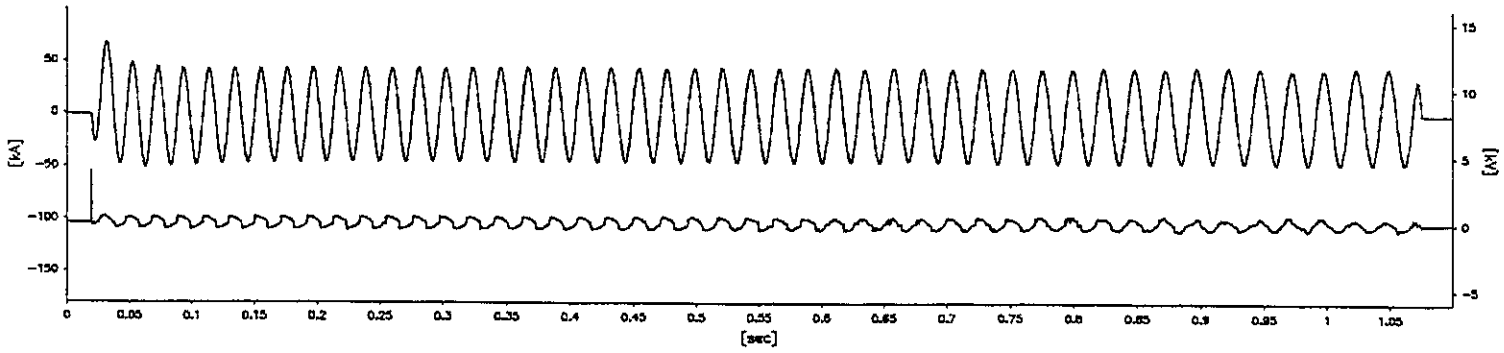


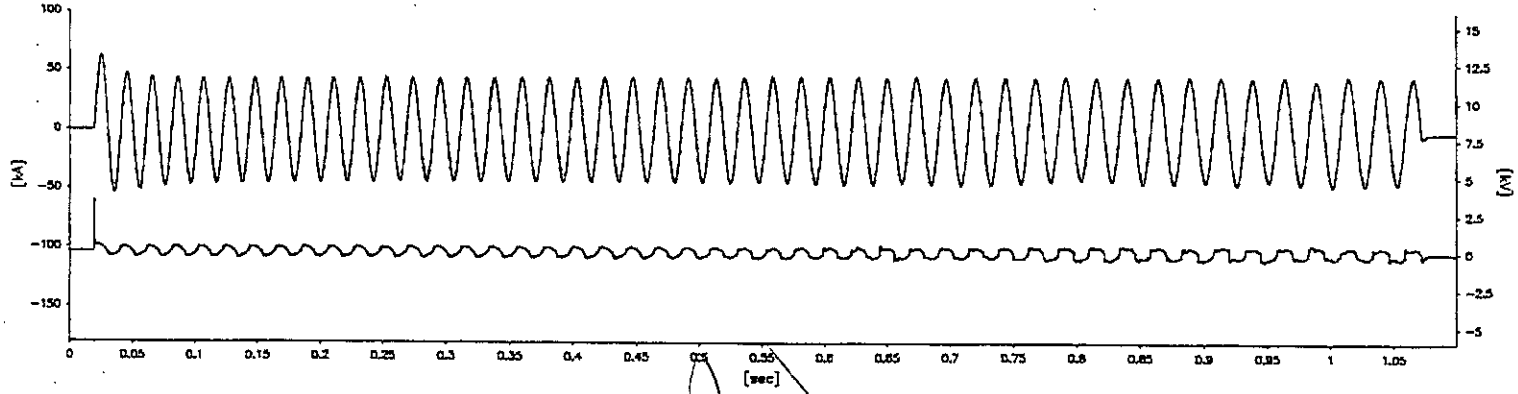


HZ146L02.005

10.7.2000







HZ146L02.006

20.2.2002

ВЯРНО С ОРИГИНАЛА

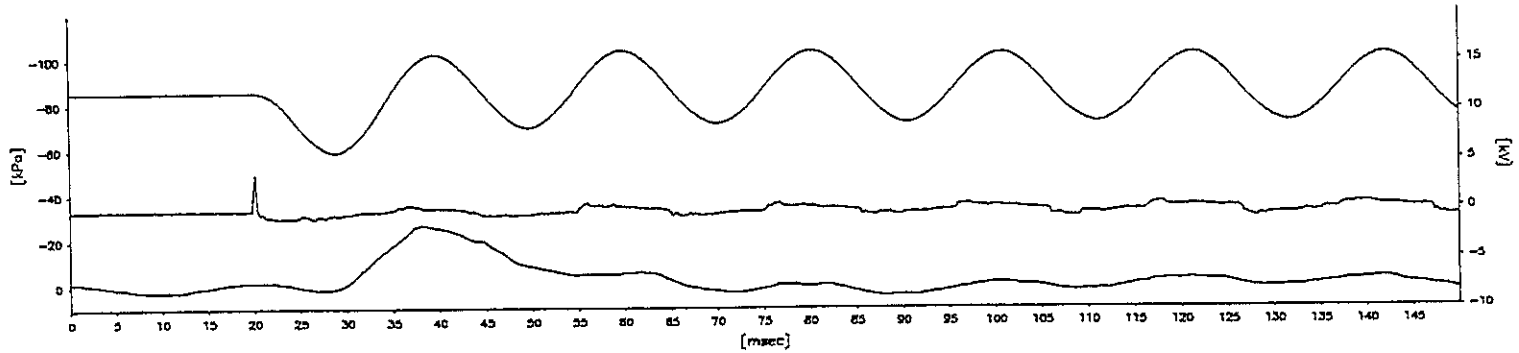
HZ146L02.006

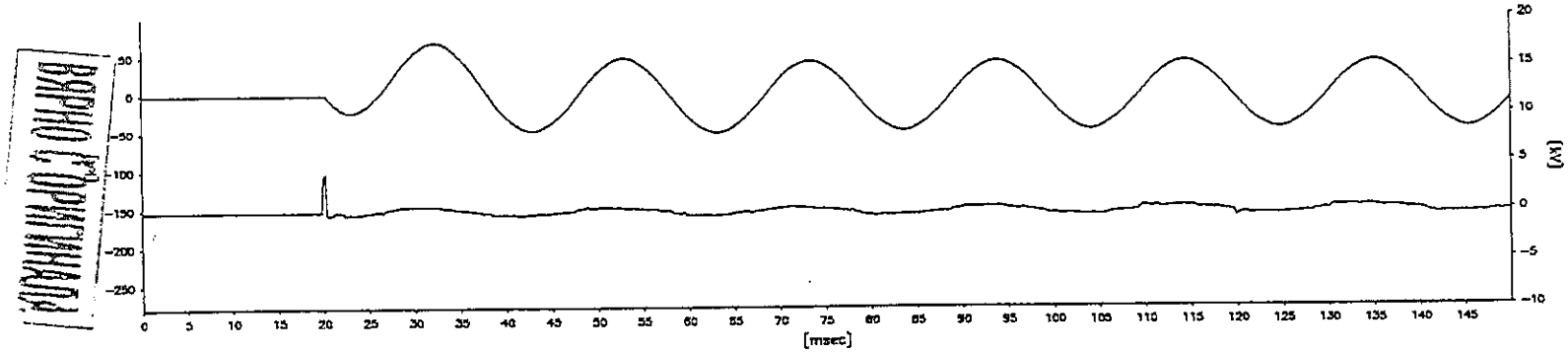
10.7.2000

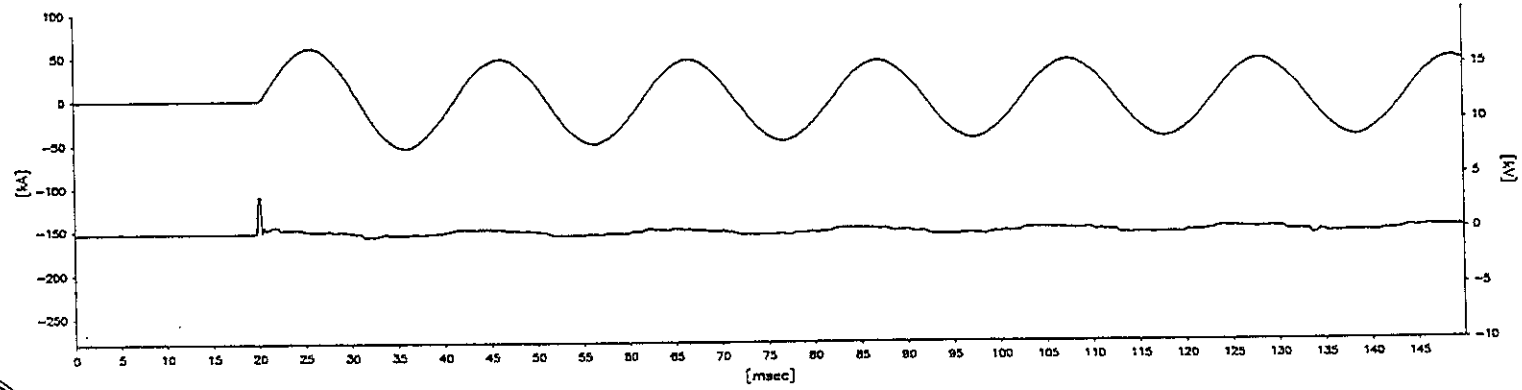
ВЕРНО С ОРИГИНАЛА

HZ146L02.007

20.2.2002







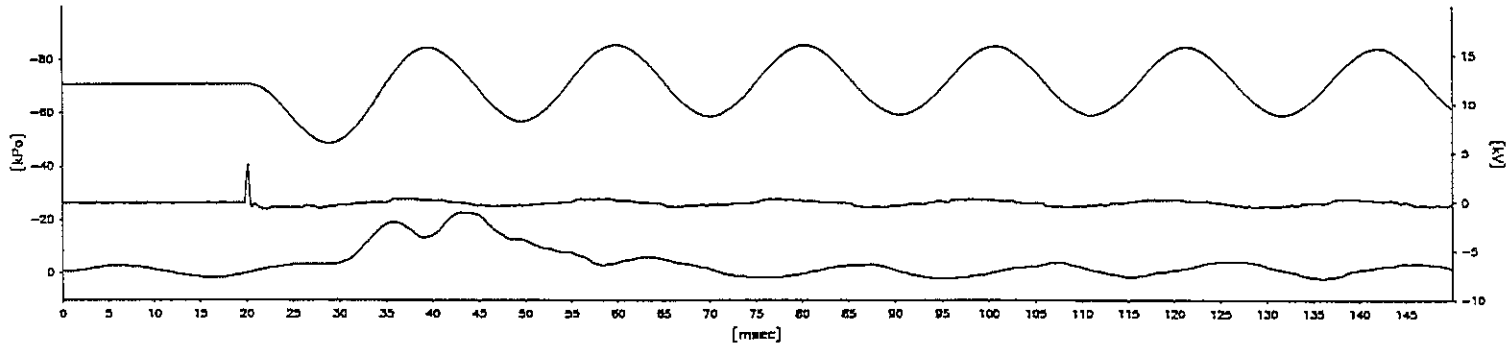
HZ146L02.007

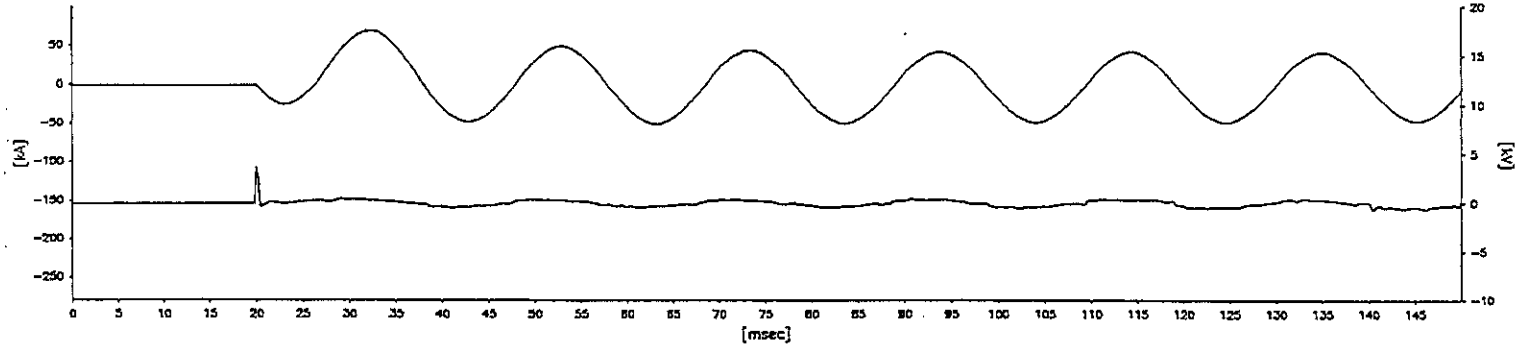
12.7.2000

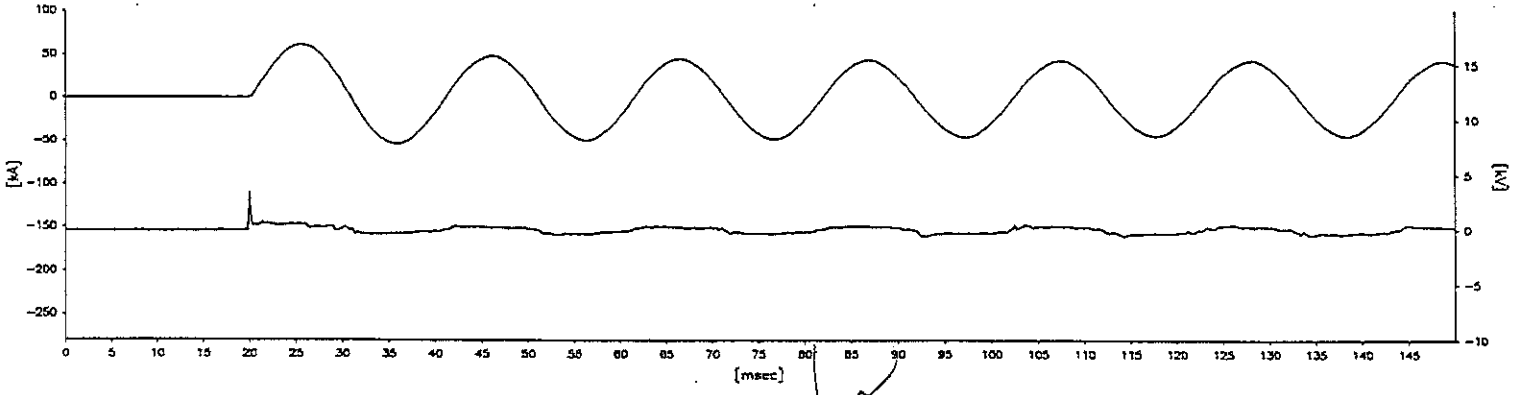
ВЯРНО С ОРИГИНАЛА

HZ146L02.008

20.2.2002







HZ146L02.008

12.7.2000

ВЯРНО С ОРИГИНАЛА

HZ146L02.009

20.2.2002

ВЯРНО С ОРИГИНАЛА

HZ146L02.009

Deutscher Akkreditierungs Rat

DAR

Reg.-Nr.
DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. HZ 144 F 08

Issued by an Accredited Laboratory corresponding to EN 45001

Copy-No. 02e

Test Object

Metal-clad air-insulated switchgear type ZS1.2 consisting of three panels. Center panel equipped with vacuum circuit-breaker type VM1 1212-31.

Rated voltage	U	12 kV
Rated normal current (busbar)	I_n	1250 A
Rated frequency	f	50/60 Hz
Rated short-time withstand current	I_{th}	31.5 kA
Rated peak withstand current	I_p	80 kA
Rated duration of short-circuit current	t_{th}	3 s
Rated short-circuit breaking capacity at 12 kV	I_{sc}	31.5 kA

Manufacturer

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

Tests performed

Peak withstand current test on main circuit of the center panel with vacuum circuit-breaker with 83.1 kA and short-time withstand current test up to 32.3 kA – 3.03 s (equivalent to 32.5 kA – 3 s).

Test Specification

The tests have been carried out in accordance with the client's instructions. Test procedure and test parameters were based on IEC 60694/2nd Ed./1996-05/Clause 6.6, IEC 60298/3rd Ed./1990-12/Clause 6.5, IEC 60056/4th Ed./1987/Clause 6.5.

Test Results

The switchgear with vacuum circuit-breaker passed the tests successfully.

Test Date

23rd of February 2000

Client

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

ABB Calor Emag Laboratories ABB Ratingen

9th of June 2000
Date of Issue

Laboratory Manager

Test Engineer

Total Number of Sheets: 16 Sheets (Test Report) + 4 Sheets (Oscillograms)

ABB Calor Emag Mittelspannung GmbH Ratingen
High-Power Testing Laboratory

Oberhausener Straße 33
D - 40472 Ratingen

Phone + 49 (0) 21 02 12-1736
Fax + 49 (0) 21 02 12-1713

ВЯРНО С ОРИГИНАЛА

Contents

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear

Test Object: Metal-clad air-insulated switchgear

Type: ZS1.2

Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

Serial-No.: 7550027/2001/00 (center panel) **Year of manufacture:** 2000

Drawing Nos.: See sheet-no. 5

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated current	1250	A
Rated short-circuit peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20 ° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	80	kA
Short-time withstand current	31.5	kA
Short-circuit duration	1	s

Additional specifications and data: -

The panel was equipped with current transformers made by ABB, serial-nos. 957058, 957059 and 957060.

Ratio: 1250/5/5 A

Voltage: 12/28/75 kV 50 Hz
E 1999
31.5 kA – 3 s / 125 kA
IEC 60044-1

1S1 – 1S2	15 VA	cl. 0.5
2S1 – 2S2	15 VA	cl. 5P10

Date of receipt of test object: 22nd of February 2000

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switching Device

Test Object: Vacuum circuit-breaker in center panel

Type: VM1 1212-31
Vacuum interrupter: 99G4S00809, 99G4S00825, 99G4S00861

Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen

Serial-No.: 7006082/4002/99 **Year of manufacture:** 1999

Drawing Nos.: See sheet-no. 5

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated normal current	1000	A
Rated short-circuit breaking current	31.5	kA
Rated short-circuit making current	80	kA
DC-component	35	%
Pole factor	1.5	
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Rated operating sequence	O-0.3 s-CO-3 min-CO	
Rated times of circuit-breaker:		
- opening time	≈ 40	ms
- closing time	≈ 55	ms
Number of poles	3	
Number of units per pole	1	
Rated auxiliary voltages:		
- voltage of trip coil	220	V-DC
- voltage of closing coil	220	V-DC
- voltage of motor	-	V-DC

Additional specifications and data: -

Date of receipt of test object: 22nd of February 2000

ВЯРНО С ОРИГИНАЛА

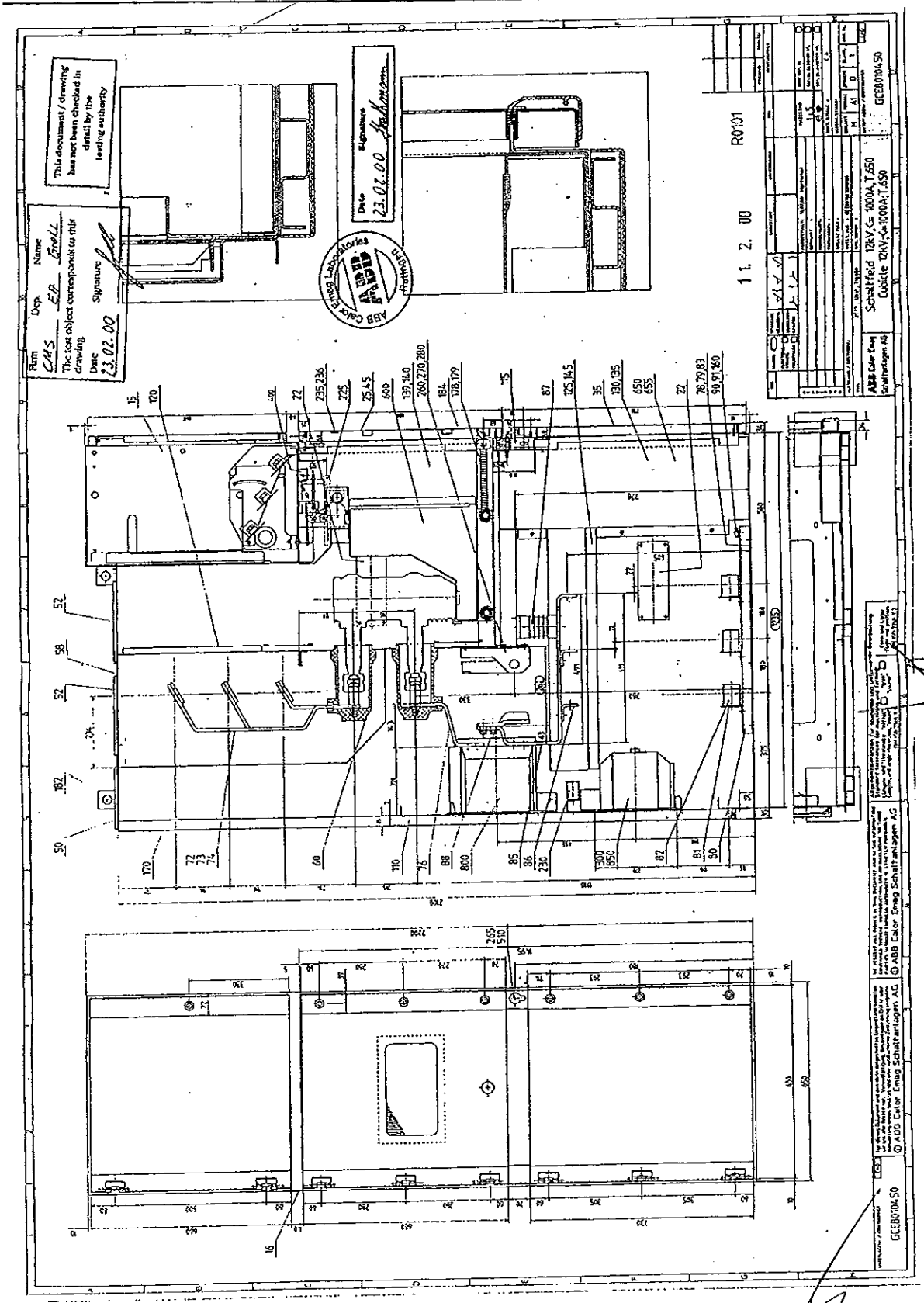
Table of Drawings of the Test Object

The drawing submitted for identification of the test object were stamped and signed by the test engineer. The manufacturer/client has guaranteed by signature on the drawings that the equipment submitted for tests has been manufactured in accordance with the given drawings.

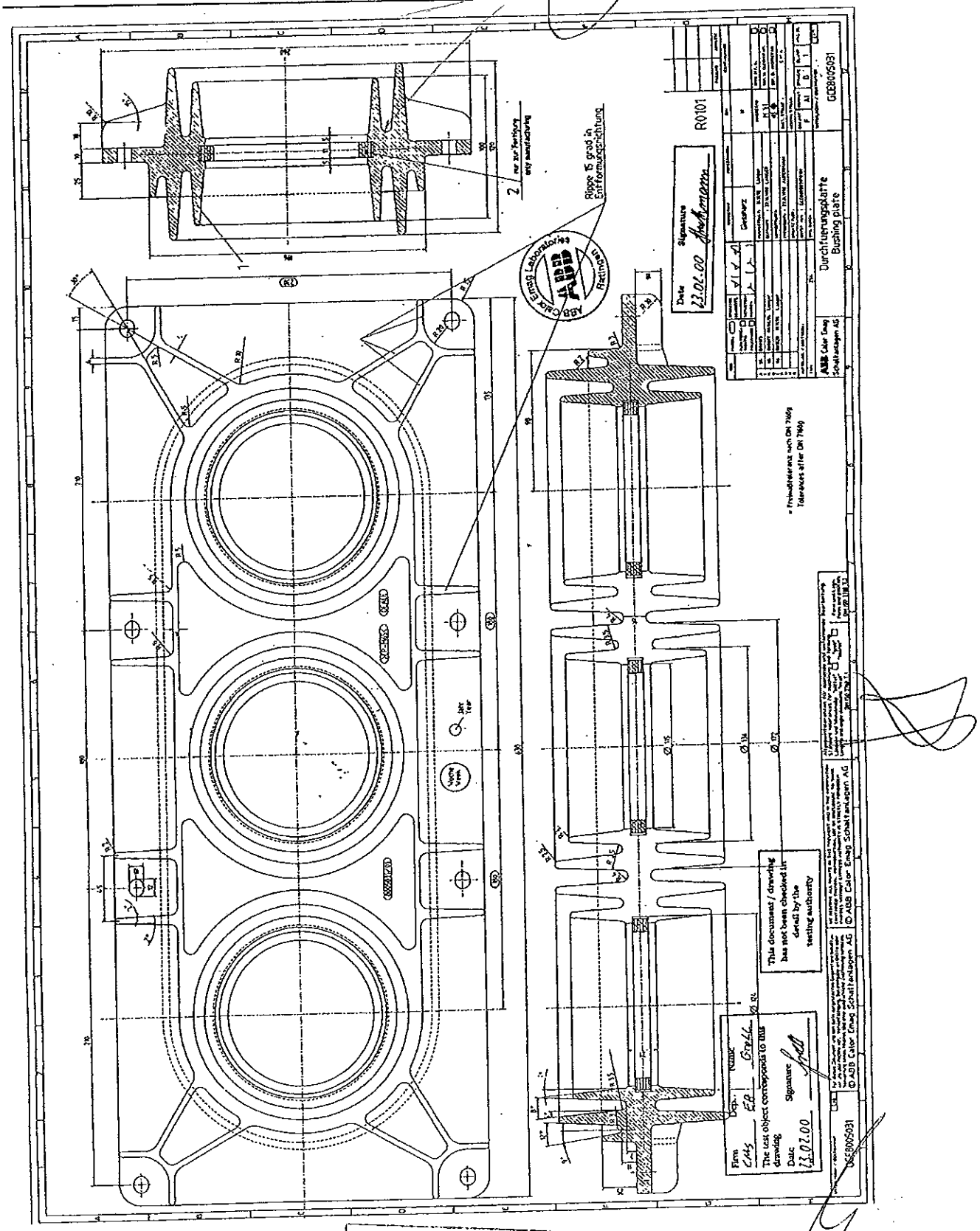
A copy of the following drawings is part of this Test Report:

Cubicle 12 kV, ≤ 1000 A, T.650	GCE8010450R0101,	sheet-no. 1,	index 00,
Bushing plate	GCE8005031R0101,	sheet-no. 1,	index 06,
Draw out VM1 12/17.5 kV in ZS1.2	GCE7004912R1141,	sheet-no. 7,	index 00,
Pole compl. VM1, 12 kV, 1250 A	GCE7003979R0104,	sheet-no. 1,	index 06,
VM1-Drive	GCE7004310R0104,	sheet-no. 1,	index 04.

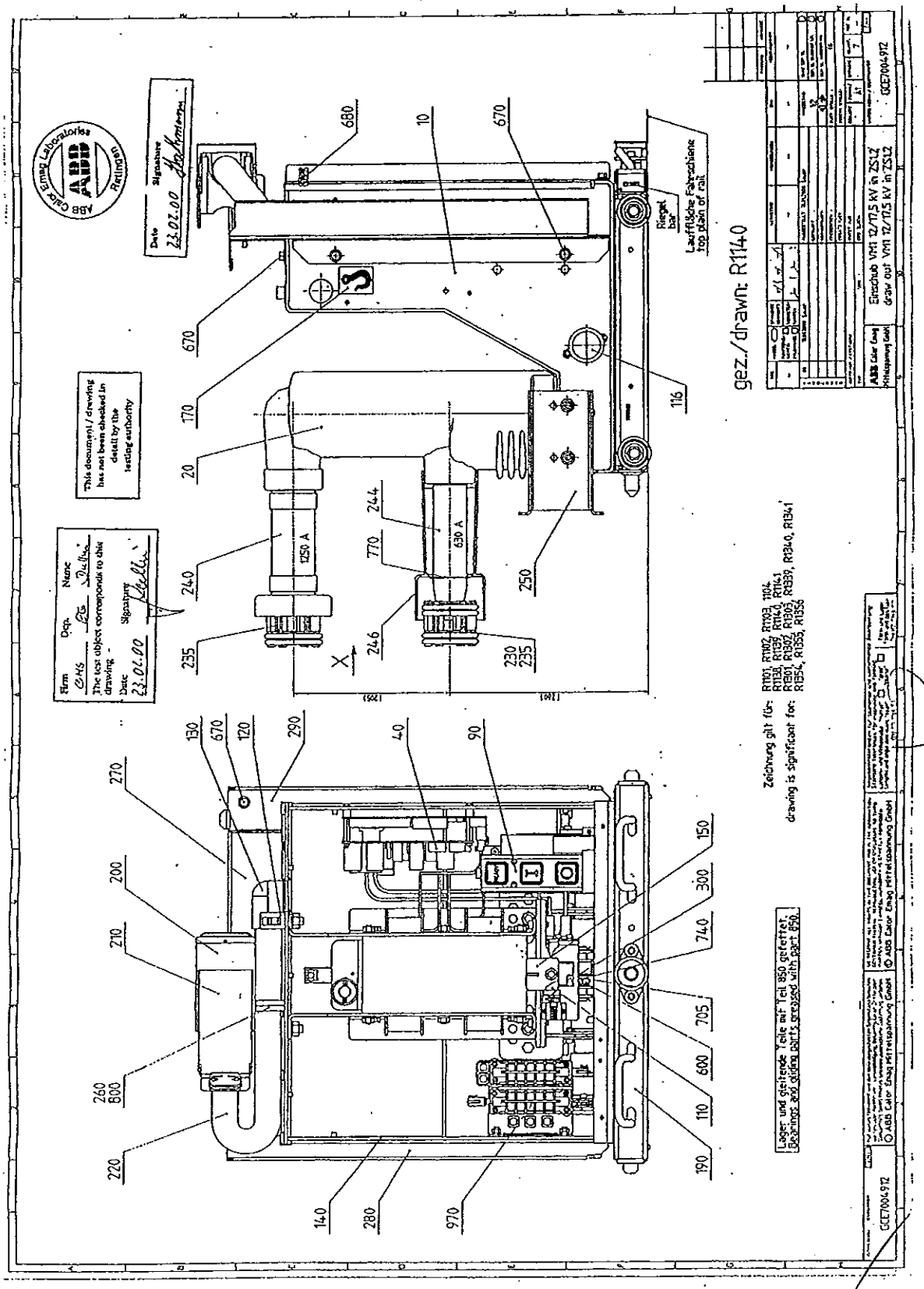
ВЯРНО С ОРИГИНАЛА



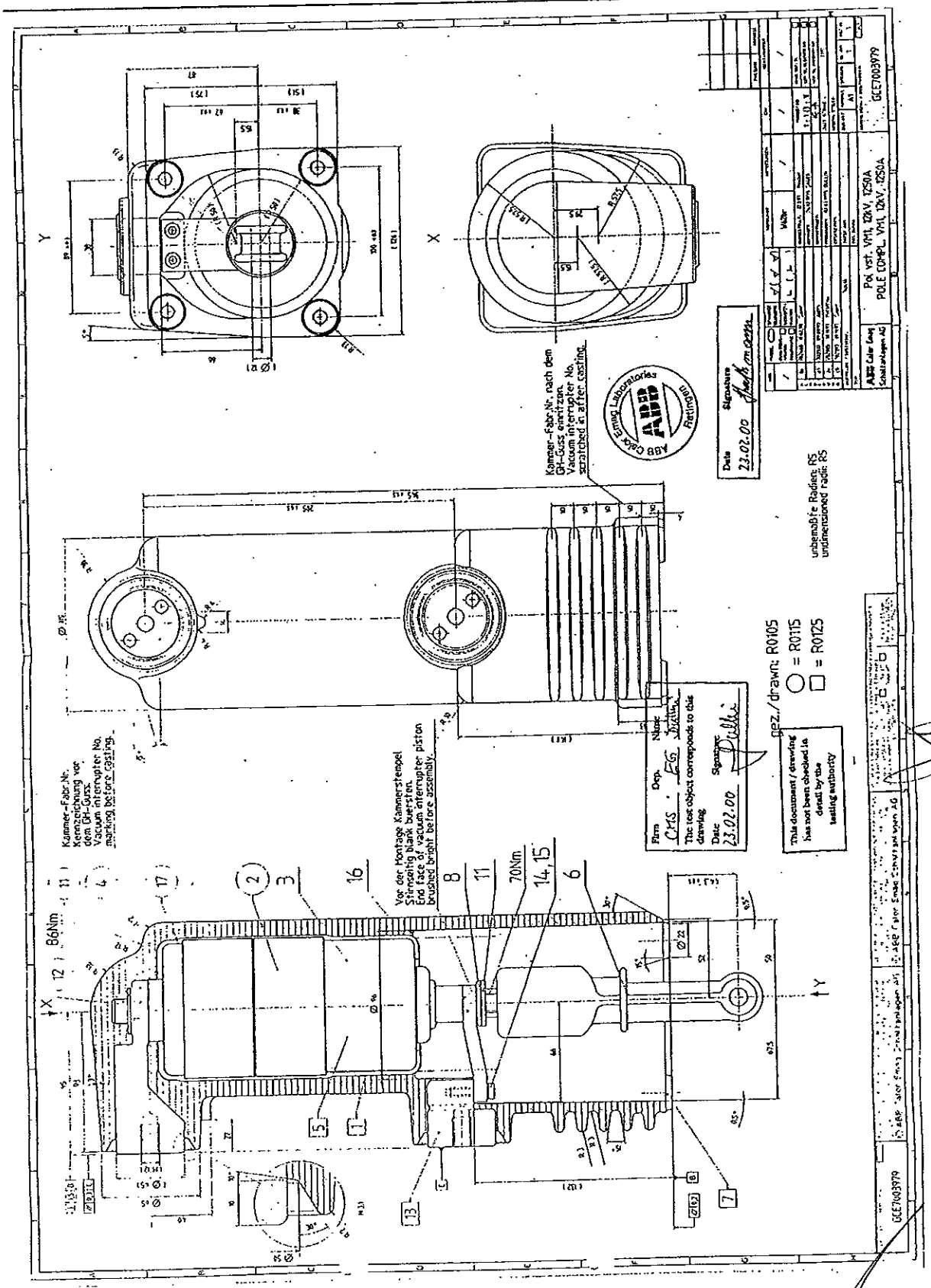
ВЯРНО С ОРИГИНАЛА



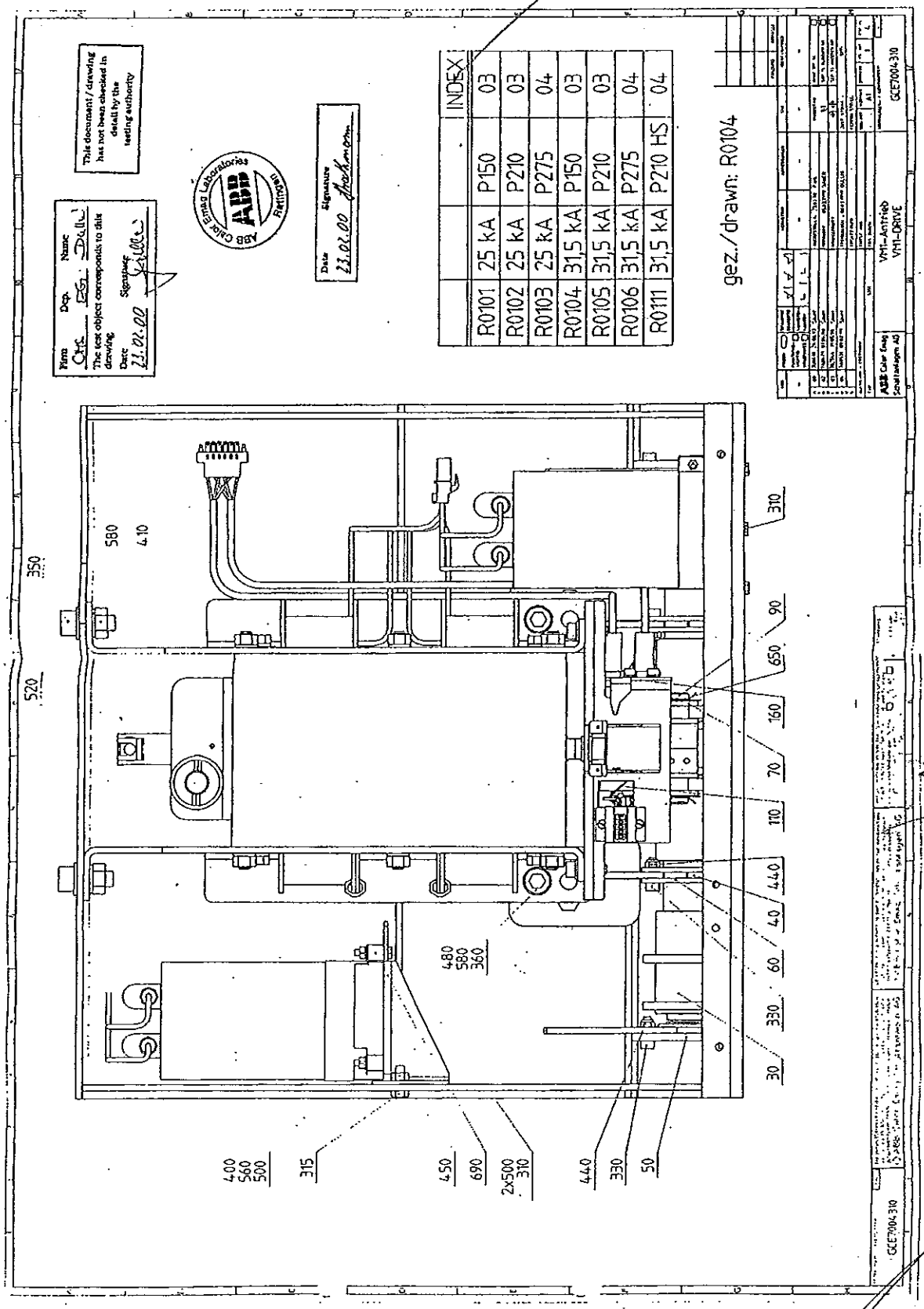
ВЯРНО С ОРИГИНАЛА



ВЕРНО С ОРИГИНАЛА



ВЯРНО С ОРИГИНАЛА



ВЯРНО С ОРИГИНАЛА

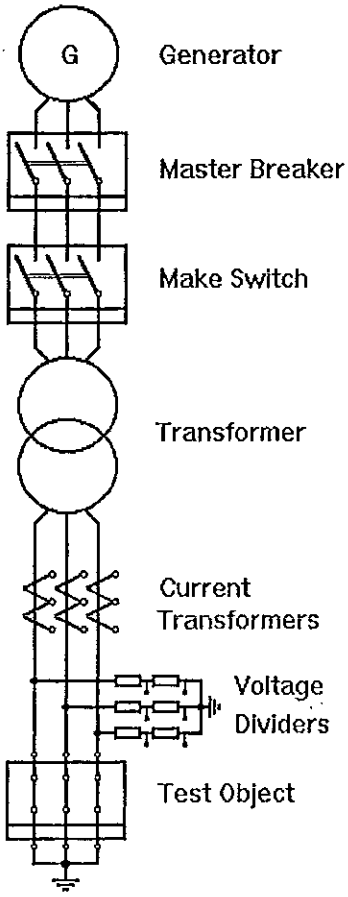
Technical Data of Test Circuits

Test	STC	-	-	-
Oscillogram-No. HZ 144 F 08	1 – 7	-	-	-
Number of phases (circuit)	3	-	-	-
Number of poles/phases (test object)	3	-	-	-
Power frequency Hz	50	-	-	-
Power factor cos φ	≤ 0.1	-	-	-
Earthing Generator	earthed via 5 kΩ	-	-	-
Earthing Transformer	not earthed	-	-	-
Earthing Short-circuit point	earthed	-	-	-
Circuit diagram Sheet no.:	12	-	-	-
Circuit impedance mΩ	≈ 5	-	-	-
-	-	-	-	-
TRV control elements	-	-	-	-
Capacitance in parallel µF	-	-	-	-
Resistance in series Ω	-	-	-	-
-	-	-	-	-
-	-	-	-	-
Prospective TRV -	-	-	-	-
TRV peak value u_c kV	-	-	-	-
Time co-ordinate t_3 µs	-	-	-	-
Time delay t_d µs	-	-	-	-
Based on kV	-	-	-	-
Rate-of-rise kV/µs	-	-	-	-
-	-	-	-	-
-	-	-	-	-
Voltage measurements	Divider 75 kΩ / 1.1 kΩ	-	-	-
Current measurements	Transformer 50 kA / 5 A	-	-	-

Remarks:-

ВЯРНО С ОРИГИНАЛА

Principle Diagram of Test Circuit



ВЯРНО С ОРИГИНАЛА

Peak and Short-Time Withstand Current Test

Actual values

Condition of test object before test: Swichgear new.

Connection to test object: By means of copper conductors to the busbars outside the right-hand panel, cable terminals of the center panel short-circuited and earthed.

Oscillogram-No. HZ 144 F 08				5	6	-	-
Peak short-circuit current		L1	kA	83.1	78.7	-	-
		L2	kA	24.8	23.8	-	-
		L3	kA	57.6	54.7	-	-
Short-circuit current	first cycle	L1	kA	35.1	33.5	-	-
		L2	kA	41.0	39.1	-	-
		L3	kA	34.0	32.5	-	-
	last cycle	L1	kA	28.1	30.2	-	-
		L2	kA	33.8	36.2	-	-
		L3	kA	27.3	29.3	-	-
Equivalent r.m.s. value		L1	kA	30.3	30.5	-	-
		L2	kA	36.5	36.7	-	-
		L3	kA	29.6	29.7	-	-
Average value			kA	32.1	32.3	-	-
Duration of short-circuit current			s	1.00	3.03	-	-
Short-time current	1 s	L1	kA	30.3	-	-	-
		L2	kA	36.5	-	-	-
		L3	kA	29.6	-	-	-
Average value			kA	32.1	-	-	-
Short-time current	3 s	L1	kA	-	30.7	-	-
		L2	kA	-	36.9	-	-
		L3	kA	-	29.9	-	-
Average value			kA	-	32.5	-	-

Condition of test object after test:
Switchgear and circuit-breaker without change.

Remarks:
HZ 144 F 08 / 1: Current calibration.
HZ 144 F 08 / 2 and 7: No-load operation before and after tests.
HZ 144 F 08 / 3 and 4: Tests with reduced values.

ВЯРНО С ОРИГИНАЛА

Actual Values of No-load Operations

Rated supply voltage of opening coil 220 V dc

	Operation	Voltage closing coil V	Closing time ms	Voltage opening coil V	Opening time ms
Test HZ 144 F 08 / 2	O	-	-	220	35.0
Test HZ 144 F 08 / 7	O	-	-	220	36.5

Measurement of the Resistance

	Phase L 1	Phase L 2	Phase L 3
Before Test HZ 144 F 08	117 μΩ	113 μΩ	103 μΩ
After Test HZ 144 F 08 / 6	120 μΩ	113 μΩ	103 μΩ

Measuring points: Infeeding busbar against short-circuit point in the center panel.

ВЯРНО С ОРИГИНАЛА

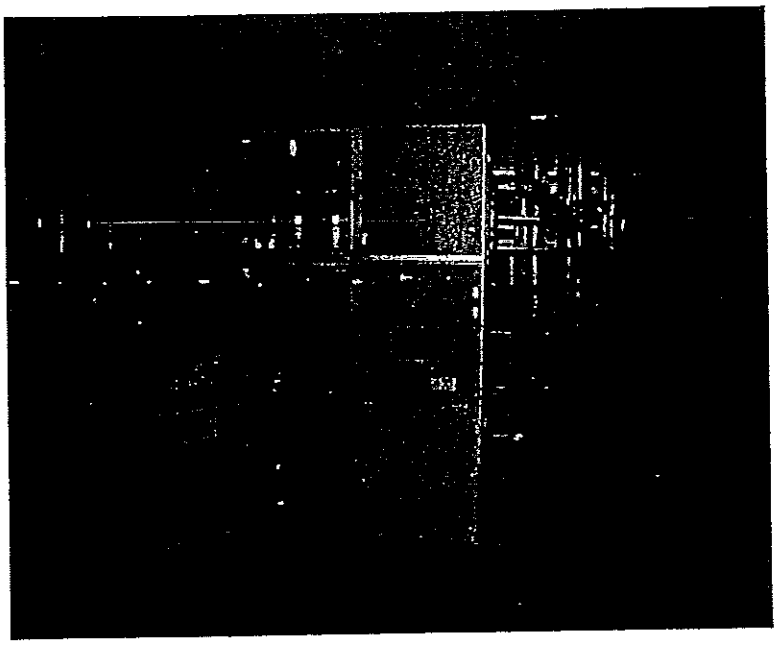


Photo No. 01
Before Test HZ 144 F 08 / 1

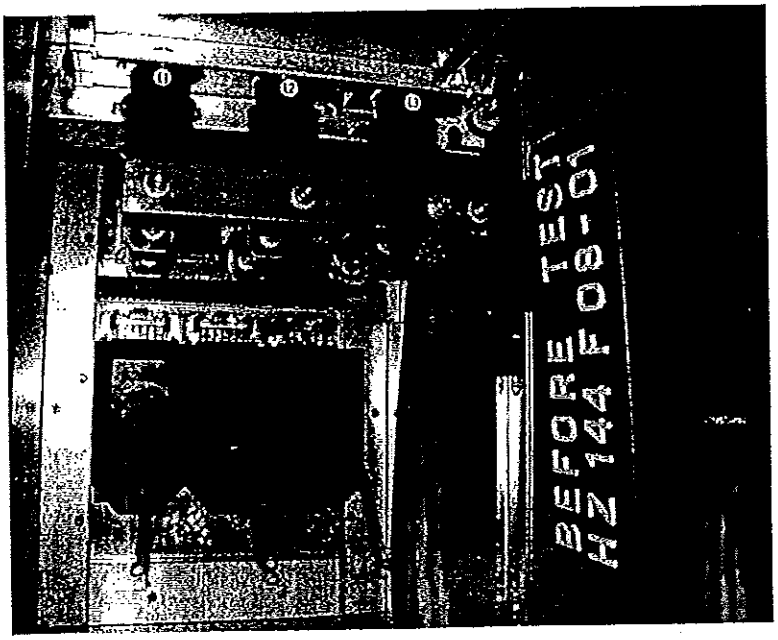


Photo No. 02
Before Test HZ 144 F 08 / 1

ВЯРНО С ОРИГИНАЛА

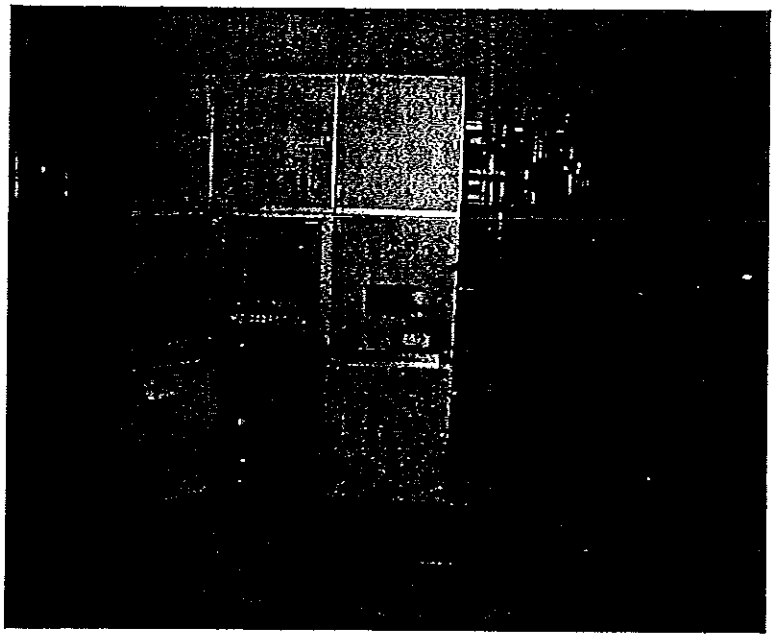


Photo No. 03
After Test HZ 144 F 08 / 6

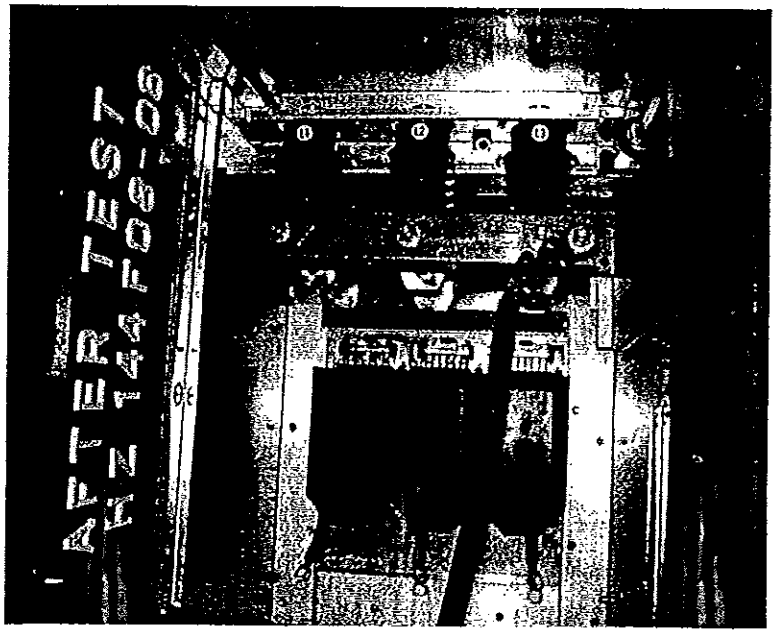


Photo No. 04
After Test HZ 144 F 08 / 6

ВЯРНО С ОРИГИНАЛА

13.2000

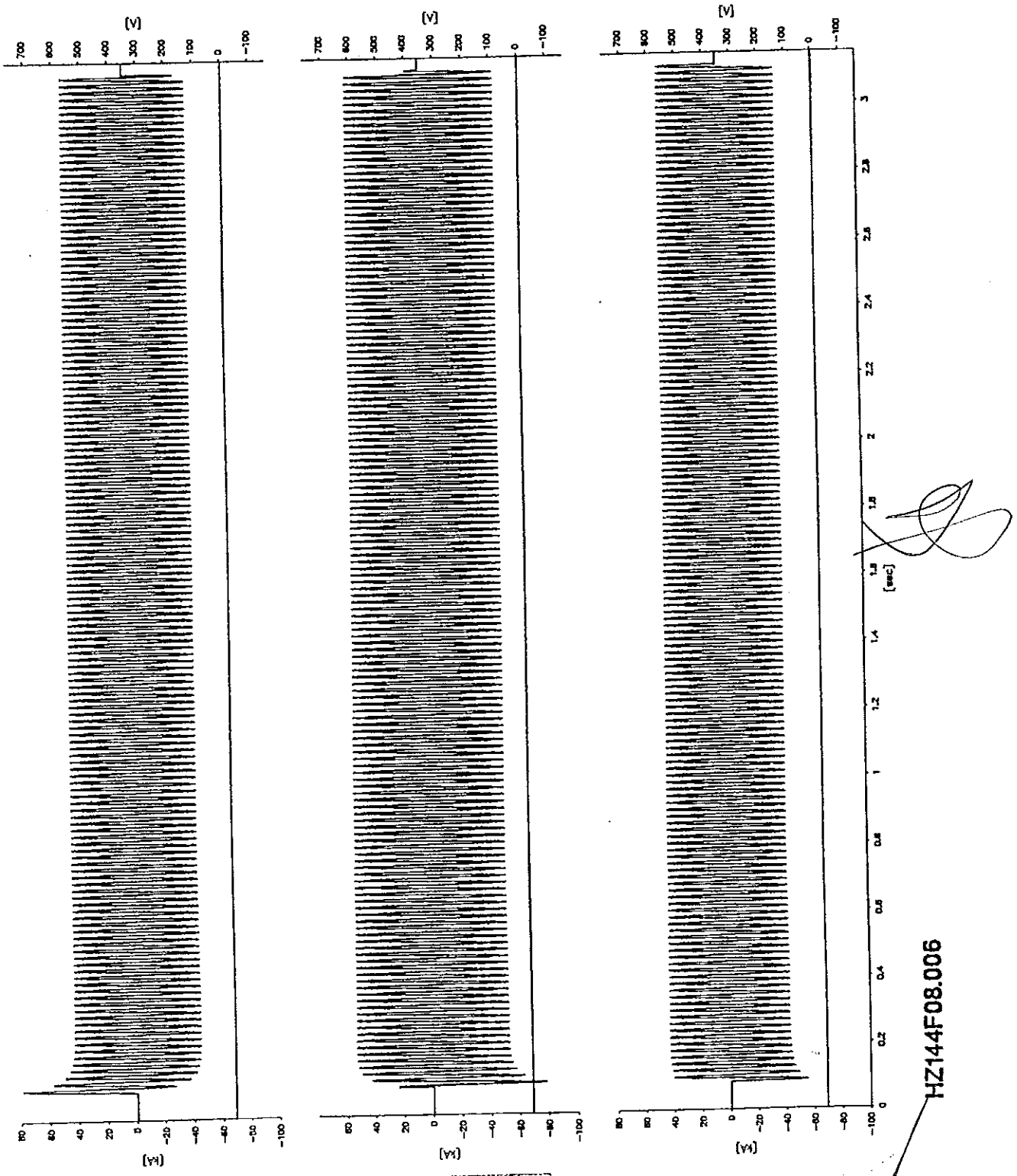
ВЯРНО С ОРИГИНАЛА

HZ144F08.002

HZ144F08.005

1.3.2000

ВЯРНО С ОРИГИНАЛА



1.3.2000

ВЯРНО С ОРИГИНАЛА

HZ144F08.006

13.2000

ВЯРНО С ОРИГИНАЛА

HZ144F08.007

ABB Trasmissione & Distribuzione S.p.A.
Unità operativa Sace T.M.S.
Via Friuli 4
I 24044 – Dalmine (BG)
Italy
Tel.: 0039.035.395111
Fax: 0039.035.395874
E – mail : sacetms.tipm@it.abb.com
Internet : //www.abb.com

TYPE TEST DOCUMENTATION No. 100081_C Page 1/1

Apparatus: Metal-clad switchgear type ZS1 rel 1.2 with vacum circuit-breaker type VD4/P 12.12.31 p=210

Identification: 1VCP0000138-Rev.-,en-Technical catalogue-2003-04

Performances:

Rated voltage :	12	kV
Rated lightning impulse withstand voltage :	75	kV
Rated power-frequency withstand voltage :	28	kV
Rated frequency :	50-60	Hz
Rated normal current (busbar) :	1250	A
Rated normal current (tee-off) :	1250	A
Rated peak withstand current :	80	kA
Rated short-time withstand current :	31.5	kA
Rated duration of short circuit :	3	s

Test reports verifying rating assigned by the manufacturer:

Performances	Test according to	Test reports	
		No.	Issued by
Dielectric test	IEC 60298 Subclausole 6.1	0003 Ra	PEHLA Hight-power Laboratories
Temperature-rise test	IEC 60298 Subclausole 6.3/6.4	0009 Ra	PEHLA Hight-power Laboratories
Short-time and peak withstand current test	IEC 60298 Subclausole 6.5	HZ 144 F08	Calor Emag Laboratories
Mechanical operation and interlock test	IEC 60298 Subclausole 6.102	MZ ZS1 A03	Calor Emag Laboratories
Internal arc test	IEC 60298 Annex AA	HZ 146 L02	Calor Emag Laboratories
Mechanical operation test	IEC 62271-100 subclause 6.101.2	0316 Ra	PEHLA Hight-power Laboratories
Making and breaking capacity test	IEC 62271-100 subclause 6.106	0231 Ra	PEHLA Hight-power Laboratories

ABB T&D Unità operativa SACE T.M.S. Laboratories Dalmine are accredited according UNI CEI EN ISO/IEC 17025 by SINAL under Reg. No. 0253
ABB Calor Emag Laboratories Ratingen are accredited according UNI CEI EN ISO/IEC 17025 by DATech under Reg. No. DAT-P-032/93
PEHLA Higth-power Laboratories are accredited according UNI CEI EN ISO/IEC 17025 by DATech under Reg. No. DAT-P-032/93

Date of issue:
03/09/23

Development Dept.
G.M. Cravanzola

ВЯРНО С ОРИГИНАЛА

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
Member of the Short-Circuit-Testing Liaison (STL)

Test Report

Report No.: 0003 Ra **Copy No.:** 0 **Contents:** 17 Sheets

Equipment under test:	Metal-clad air-insulated switchgear panel type ZS1.2, rated voltage 12 kV (width = 650 mm), drawing-no. GCE 8010450 R0102, with withdrawable vacuum circuit-breaker type VD4P 1212-31.
Manufacturer:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Client:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Testing station:	PEHLA - Testing Station Ratingen
Date of test:	17th and 18th January 2000
Applied test specifications:	IEC 60298: 1990-12, clauses 6.1.1, 6.1.3, 6.1.4a), 6.1.5 - 6.1.7, IEC 60694: 1996-05, clauses 6.2.1, 6.2.3 - 6.2.6.
Tests performed:	Dielectric type test. Standard lightning impulse withstand voltage test at 75 kV and power-frequency withstand voltage test at 28 kV to earth, between phases and across open switching device.
Test results:	The above ZS1.2-type panel passed the dielectric type test successfully. The respective dielectric requirements are met.

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

Technical Committee

i.V. Koch

Mannheim, 24th April 2001

Deutscher Akkreditierungs Rat DAR
DAT-P-032/93

ВЯРНО С ОРИГИНАЛА

Accreditation

The PEHLA-Testing Station Ratingen has been approved by the DATech (German accreditation body for technology) according to DIN EN 45001 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. DAT-P-032/93).

Under reference to DIN EN 45001 PEHLA states the following:

- The accreditation of the PEHLA-Testing Station or any of its test reports by themselves in no way constitute or imply product approval by DATech or any other body.
- If someone refers to a test in an accredited PEHLA-Testing Station this reference shall include the accreditation body, i.e. DATech, the relevant scope of the accreditation and the appropriate registration number.

STL-Member

PEHLA is foundation-member of the Short-Circuit Testing Liaison (STL) which has been founded in March 1969. STL is a forum for the international cooperation of the testing organisations with the further full members ASTA (GB), CESI (I), ESEF (F), KEMA (NL), SATS (N; S, SF) and STLNA (USA). In the framework of EC, STL has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Certificate

is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STLGuides valid at the time of the test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients instructions.
Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the equipment during test, and its condition after the tests.

Addresses:

Office: PEHLA-Geschäftsstelle
Hallenweg 40
D-68219 Mannheim

Testing Station: PEHLA-Testing Station Ratingen
Oberhausener Str. 33
D-40472 Ratingen

Manufacturer: ABB Calor Emag Mittelspannung GmbH
Oberhausener Str. 33
D-40472 Ratingen

Client: ABB Calor Emag Mittelspannung GmbH
Oberhausener Str. 33
D-40472 Ratingen

ВЕРНО С ОРИГИНАЛА

Table of Contents

ВЯРНО С ОРИГИНАЛА

List of Test Participants

Representatives of the Test Commlttee:

Mr. A. Meier	PEHLA- Testing Station Ratingen
Mr. H. Biallas	PEHLA- Testing Station Mannheim

Test Engineer:

Mr. G. Langwieler	PEHLA- Testing Station Ratingen (17th January 2000)
Mr. W. Schmiedel	PEHLA- Testing Station Ratingen (18th January 2000)

Other Participiants: -

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switchgear

Ratings assigned by the manufacturer

Test Object: Metal-clad air-insulated switchgear panel
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 07550027/2001/00
Drawing No.: GCE8010450 R0102 index 00
Year of manufacture: 2000

Rated voltage	12 kV
Rated lightning impulse withstand voltage	75 kV
Rated switching impulse withstand voltage	- kV
Rated power frequency withstand voltage	28 kV
Rated frequency	50 Hz
Rated normal current of busbar	2000 A
Rated normal current of tee-off	1000 A
Rated peak withstand current	80 kA
Rated short-time withstand current	31.5 kA
Rated duration of short-circuit	3 s
Insulating medium	air / vacuum
Rated functional pressure (abs./20 °C)	- kPa
Minimum functional pressure (abs./20 °C)	- kPa

Permissible values for internal arc faults:

Peak current	80 kA
Short-time current	31.5 kA
Duration of short-circuit	1 s
Max. ambient air temperature	40 °C

The above switchgear panel is fully described in the mentioned drawings.

Essential characteristics and installed devices:

The above switchgear panel is fully described in the mentioned drawings.
Essential details are:

- Busbar 2 x 80 mm x 10 mm / R 5 mm, Cu, bare.
- Busbar tee-off conductor 1 x 60 mm x 10 mm / R 5 mm, Cu, bare.
- tulip insulator with contact pin Ø = 35 mm.
- Current transformer type TPU 43.11, manufacturer: ABB, Serial-No. L1: 957058; L2: 957059; L3: 957060.
- Voltage transformer type TJC4, manufacturer: ABB, Serial-No. L1: 903568; L2: 903569; L3: 903770.
- Earthing switch type EK6-1208-150, Serial-No. 11/357/99.
- Cable conductor 60 mm x 10 mm / R 5 mm, Cu, bare.

Date of receipt of test object: 03rd January 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker

Ratings assigned by the manufacturer

Test Object: Vacuum circuit-breaker
Type: VD4P 1212-31
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 7006082/4001/99 **Year of manufacture:** 1999
Drawing No.: GCE 7002291 R 0152 index 00 (circuit-breaker)
Vacuum interrupter: Type VG4S, L1: No. VG4S 55830, L2: No. VG4S 55838, L3: No. VG4S 55829
Drawing No.: GCE 7003979 R 0104 index 06 (pole part)

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50	Hz
Rated normal current	1250	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current		
Rated short-circuit current	31.5	kA
D.C. component	30	%
Rated short-circuit making current	80	kA
Rated transient recovery voltage:		
Peak value	20.6	kV
Rate of rise	0.34	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3 s -CO-3 min-CO	
Arc extinguishing medium	vacuum	
Number of poles	3	
Number of units per pole	1	
Rated opening time	≤ 45	ms
Rated closing time	approx. 60	ms
Rated voltage of trip coil	220	V-DC
Rated voltage of closing coil	220	V-DC
Rated supply voltage	220	V-DC
Rated frequency of supply voltage	-	Hz
Max. ambient air temperature	40	°C
Further specifications:	-	

Essential characteristics: -

Date of receipt of test object: 03rd January 2000

ВЯРНО С ОРИГИНАЛА

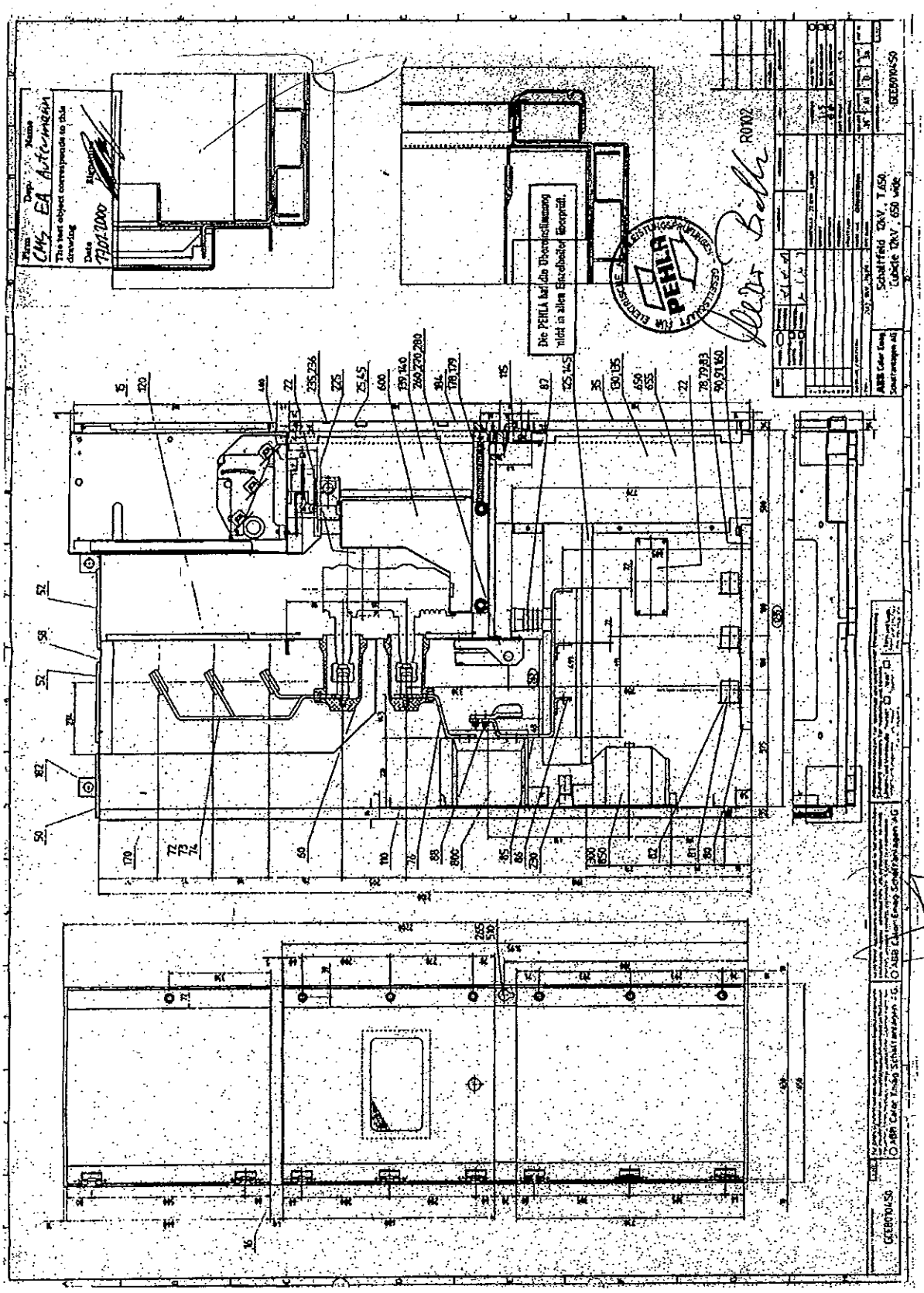
List of Drawings

The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. PEHLA has verified that these drawings adequately represent the equipment tested. These drawings have been stamped and signed by PEHLA representatives and are kept
☒ with the test documents at the test laboratory.
☐ at the client.

Drawing-No.	Index	Title	Additional remarks
GCE 8010450 R 0102	00	Cubicle 12 kV, 650 wide	included in this Test Report
GCE 7002291 R 0152	00	draw out VD4-P 12/17 kV ZS1.2	included in this Test Report
GCE 7002291 R 0104	06	Pole part	--

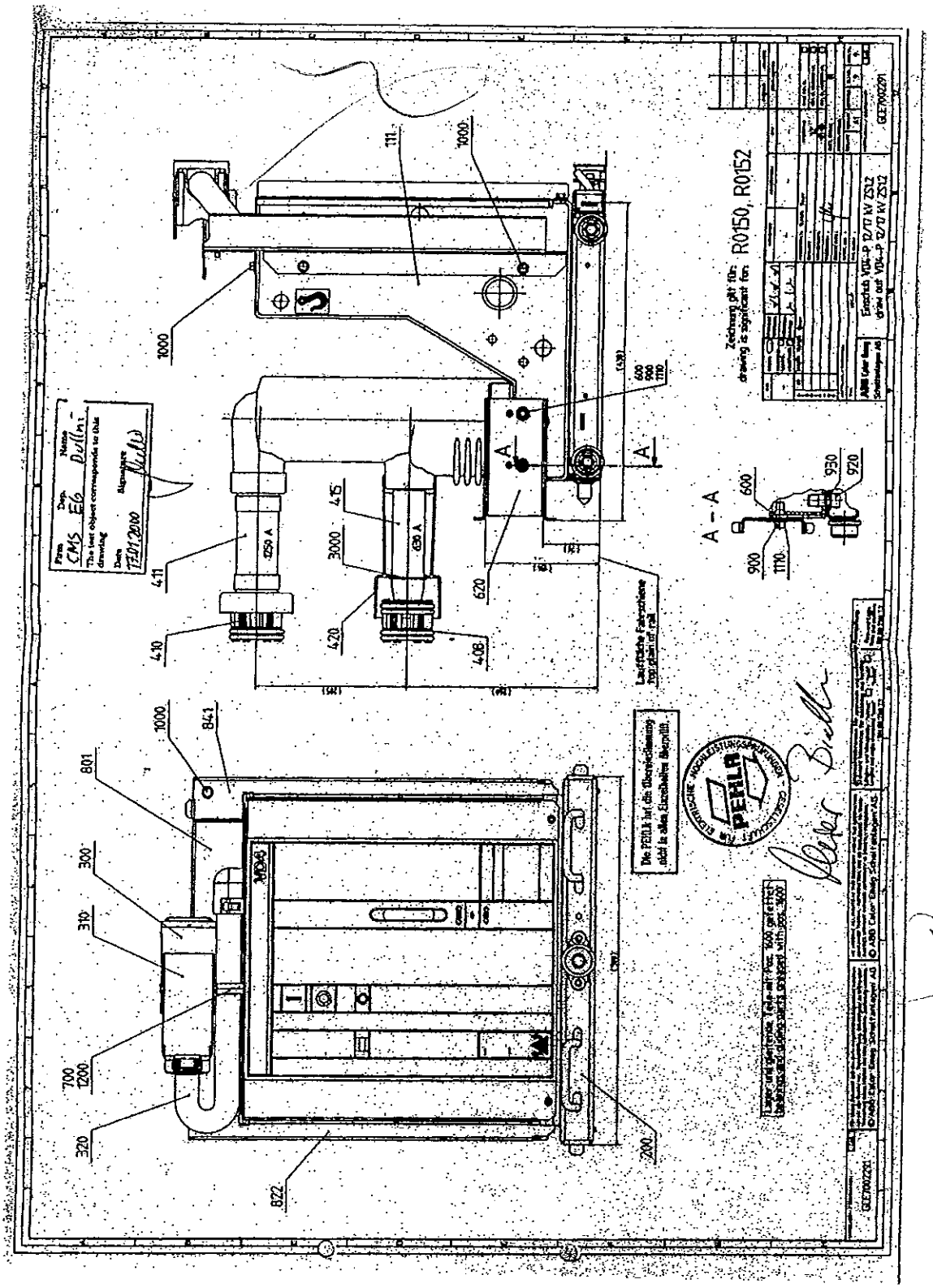
ВЕРНО С ОРИГИНАЛА

Drawing No. 8010450 R 0102



ВЯРНО С ОРИГИНАЛА

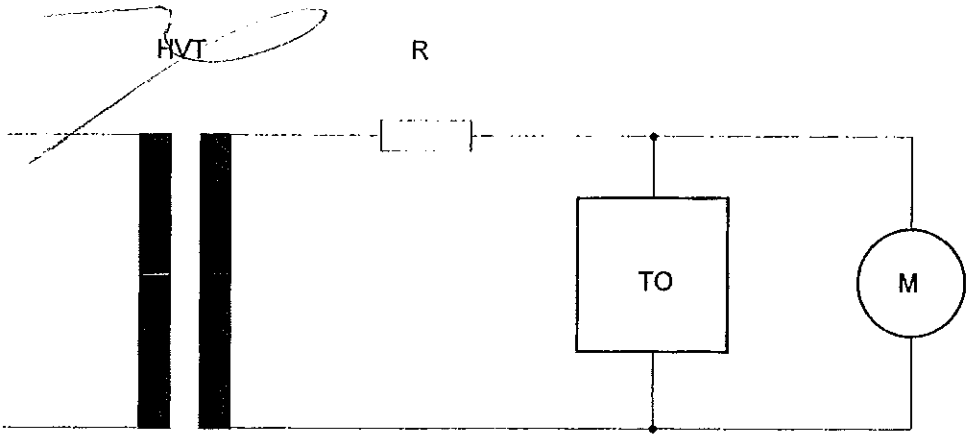
Drawing No. 7002291 R 0152



ПОРНО С ОРИГИНАЛА

Technical Data of Test Circuit

Power Frequency Voltage



Technical Data

HVT - High Voltage Test Transformer, Type TEO 250/20, Serial-No. 268 734,
manufacturer: Meßwandler-Bau GmbH, Bamberg

Rated Voltage	260	kV
Rated Capacity	50	kVA
Short Circuit Impedance	14.6	%

TO - Test Object

M - Voltage Measurement: Capacitive Divider Type CM 300 (Ident-No. ELK-000994) in connection with a Peak Voltmeter Type DMI 551/Haefely (Ident-No. ELK-000989)

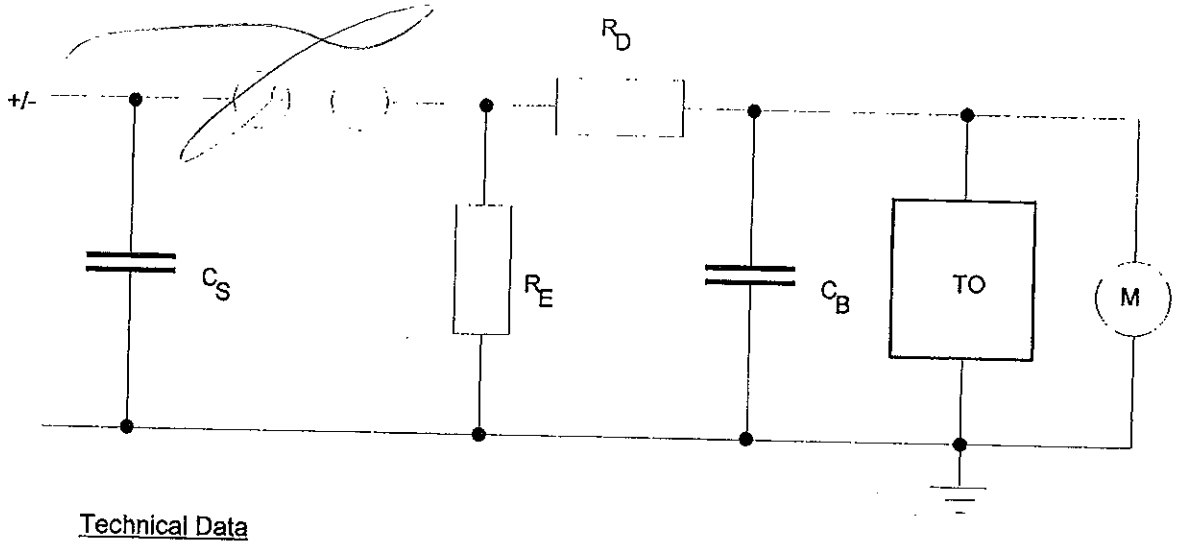
Verification of Calibration:

- Capacitive Divider (Ident-No. ELK-000994, ELK-000990, ELK-000992): calibrated in April 1998 at DEACE/LH, Calibration Report-No. 9800086.

- Peak Voltmeter Typ DMI 551 (Ident-No. ELK-000989): calibrated in April 1999 at DECMS/LK, Calibration Report No. 9900076.

Technical Data of Test Circuit

Lightning Impulse Voltage 1.2/50



Technical Data

Maximum Charging Voltage	U_Σ	=	200 kV
Number of Stages	n	=	2
Surge Capacity per Stage	C_S	=	600 nF
Load Capacitance	C_B	=	1000 pF
Damping Resistance	R_D	=	$R_{SI} + R_{SE}$
Internal Front Resistance per Stage	R_{SI}	=	20 Ω
External Front Resistance	R_{SE}	=	300 Ω
Discharge Resistance	R_E	=	2 R_P
Tail Resistance per Stage	R_P	=	115 Ω

TO - Test Object

M - Voltage Measurement: Capacitive Divider Type CS 200 SPZ (Ident-No. ELK-000893, ELK-000894) in connection with a Peak Voltmeter Type DMI 551/ Haefely (Ident-No. ELK-000989) and Oscilloscope Type TDS520 (Ident-No. ELK-000545).

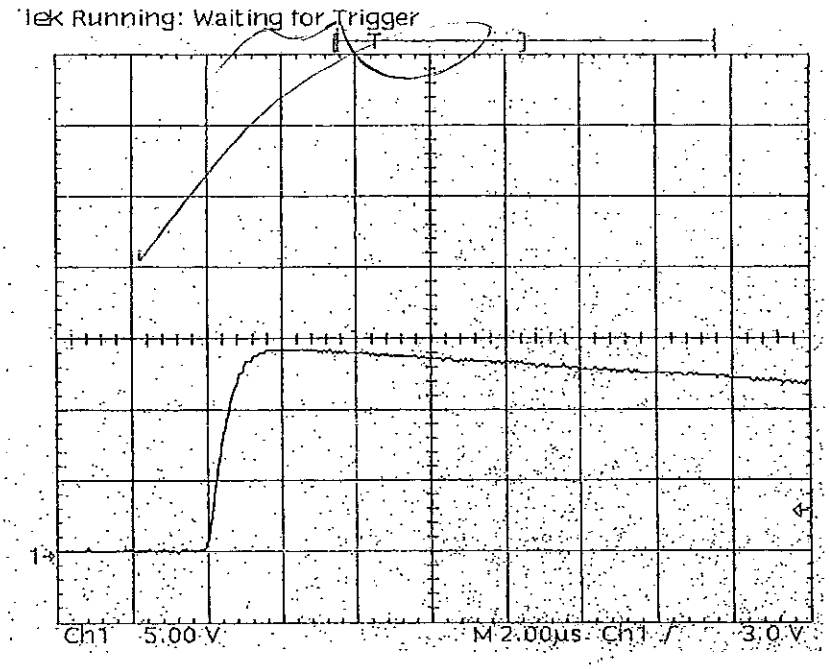
Verificatin of Calibration:

- Capacitive Divider (Ident-No. ELK-000893, ELK-000894, ELK-000922, ELK-001074): Calibrated in February 1998 at FGH Mannheim, FGH-Calibration-Report-No. 050 DKD-K-15901 98-02.
- Peak Voltmeter Type DMI 551 (Ident-No. ELK-000989): Calibrated in April 1999 at FGH Mannheim, FGH-Calibration-Report-No. 060 DKD-K-15901 99-04.
- Oscilloscope Type TDS520 (Ident-No. ELK-000545): Calibrated in March 1999 at DEACE/LK, Calibration-Report-No. 9900060.

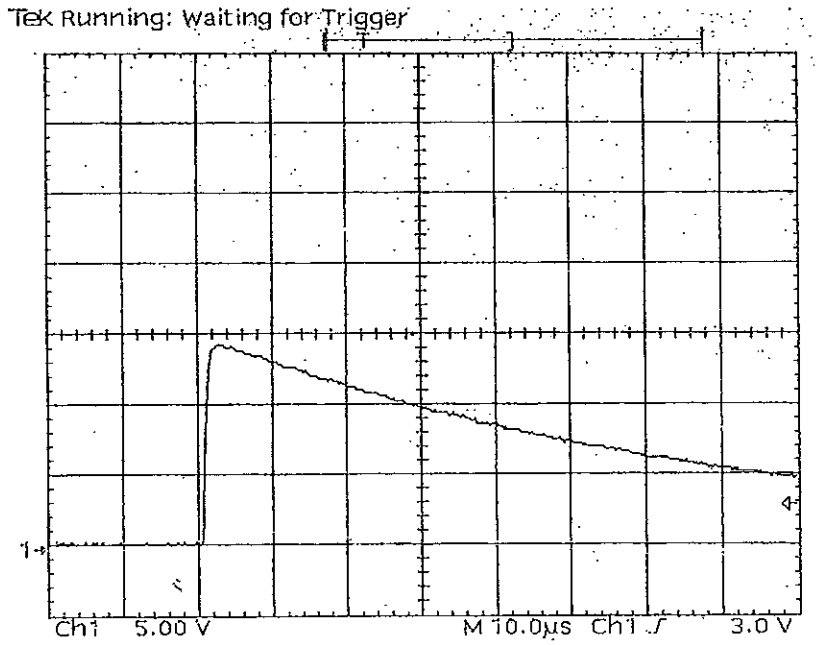
ВЯРНО С ОРИГИНАЛА

Lightning Impulse Voltage with the Test Object connected

(Standard Value: 1.2 ± 30 %/50 ± 20 %/peak ±3 %)



T_1 = 1.28 µs



T_2 = 50.7 µs

It was verified that the lightning impulse voltage during the tests was within the admissible tolerances at all test arrangements.

ВЕРНО С ОРИГИНАЛА

Atmospheric Conditions during Tests

Date of test: 17th January 2000

IEC 17A/567/Q: Corrigendum to subclause 6.2.1 of IEC60694, 2000-01 (Indices: ~ power frequency voltage; + positive lightning impulse voltage; - negative lightning impulse voltage)						
Input data			Correction factors		calculated	applied
air temperature t:		19 °C	air density correction factors	$k_{1\sim}$:	1.0252	-
air pressure b:		1035 hPa		k_{1+}:	1.0252	-
air humidity h:		6.51 g/m³		k_{1-} :	1.0252	-
50% disruptive-discharge voltages	$U_{B\sim}$:	kV	air humidity correction factors	$k_{2\sim}$:	0.9442	-
	U_{B+}:	kV		k_{2+}:	0.9535	-
	U_{B-}:	kV		k_{2-} :	0.9535	-
minimum discharge path L:		m	atmospheric correction factors	$K_{t\sim}$:	0.9680	0.9680
				K_{t+} :	0.9776	0.9776
				K_{t-} :	0.9776	0.9776

Date of test: 18th January 2000

IEC 17A/567/Q: Corrigendum to subclause 6.2.1 of IEC60694, 2000-01 (Indices: ~ power frequency voltage; + positive lightning impulse voltage; - negative lightning impulse voltage)						
Input data			Correction factors		calculated	applied
air temperature t:		21 °C	air density correction factors	$k_{1\sim}$:	1.0114	-
air pressure b:		1028 hPa		k_{1+}:	1.0114	-
air humidity h:		7.32 g/m³		k_{1-} :	1.0114	-
50% disruptive-discharge voltages	$U_{B\sim}$:	kV	air humidity correction factors	$k_{2\sim}$:	0.9548	-
	U_{B+}:	kV		k_{2+}:	0.9624	-
	U_{B-}:	kV		k_{2-} :	0.9624	-
minimum discharge path L:		m	atmospheric correction factors	$K_{t\sim}$:	0.9657	0.9657
				K_{t+} :	0.9733	0.9733
				K_{t-} :	0.9733	0.9733

ВЕРНО С ОРИГИНАЛА

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase and phase-to-ground.

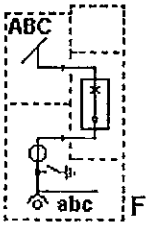
Date of test: 18th January 2000

Condition of test object before test: Factory new, clean and dry.

Connections to test object: Infeed of the test voltage at the led-out busbar right hand.

Front time T_1: 1.28 µs Time to half-value T_2: 50.7 µs Test frequency f: 150 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m³.

Test Arrangement 1: 			Applied power frequency voltage ~ kV	Result
Condition	Voltage applied to	Earthed	Applied lightning impulse voltage ± kV	Test duration or number of impulses / breakdowns
Vacuum circuit-breaker in service position and closed.	Aa	BCbcF	28 +75 -75	1 minute/0 [1] 15/0 15/0
	Bb	ACacF	28 +75 -75	1 minute/0 [1] 15/0 15/0
	Cc	ABabF	28 +75 -75	1 minute/0 [1] 15/0 15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

[1]) Due to the voltage transformers the test frequency was increased upto 150 Hz.

ВЯРНО С ОРИГИНАЛА

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase, phase-to-ground and across open switching device.

Date of test: 18th January 2000

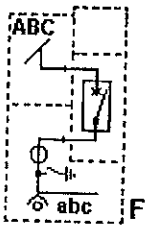
Condition of test object before test: Factory new, clean and dry.

Connections to test object: Infeed of the test voltage at the led-out busbar right hand resp. at the cable connecting bar in cable compartment.

Front time T_1: 1.14 µs Time to half-value T_2: 50.7 µs Test frequency f: 50/150 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m³.

Test Arrangement 2:



Condition	Voltage applied to	Earthed	Applied power frequency voltage ~ kV Applied lightning impulse voltage ± kV	Result Test duration or number of impulses / breakdowns
Vacuum circuit-breaker in service position and open.	A	BCabcF	28 +75 -75	1 minute/0 15/0 15/0
	B	ACabcF	28 +75 -75	1 minute/0 15/1 15/0
	C	ABabcF	28 +75 -75	1 minute/0 15/0 15/0
Vacuum circuit-breaker in service position and open.	a	bcABCF	28 +75 -75	1 minute/0 [1] 15/0 15/0
	b	acABCF	28 +75 -75	1 minute/0 [1] 15/0 15/0
	c	abABCF	28 +75 -75	1 minute/0 [1] 15/0 15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

[1]) Due to the voltage transformers the test frequency was increased upto 150 Hz.

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase, phase-to-ground and against shutter.

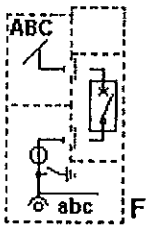
Date of test: 17th January 2000

Condition of test object before test: Factory new, clean and dry.

Connections to test object: Infeed of the test voltage at the led-out busbar right hand resp. at the cable connecting bar in the cable compartment.

Front time T_1: 1.14 µs Time to half-value T_2: 50.7 µs Test frequency f: 50/150 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m³.

Test Arrangement 3: 			Applied power frequency voltage ~ kV	Result
Condition	Voltage applied to	Earthed	Applied lightning impulse voltage ± kV	Test duration or number of impulses / breakdowns
Vacuum circuit-breaker in test position, shutters closed.	A	BCabcF	28 +75 -75	1 minute/0 15/0 15/0
	B	ACabcF	28 +75 -75	1 minute/0 15/0 15/0
	C	ABabcF	28 +75 -75	1 minute/0 15/0 15/0
Vacuum circuit-breaker in test position, shutters closed.	a	ABCbcF	28 +75 -75	1 minute/0 [1] 15/0 15/0
	b	ABCacF	28 +75 -75	1 minute/0 [1] 15/0 15/0
	c	ABCabF	28 +75 -75	1 minute/0 [1] 15/0 15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

[1]) Due to the voltage transformers the test frequency was increased upto 150 Hz.

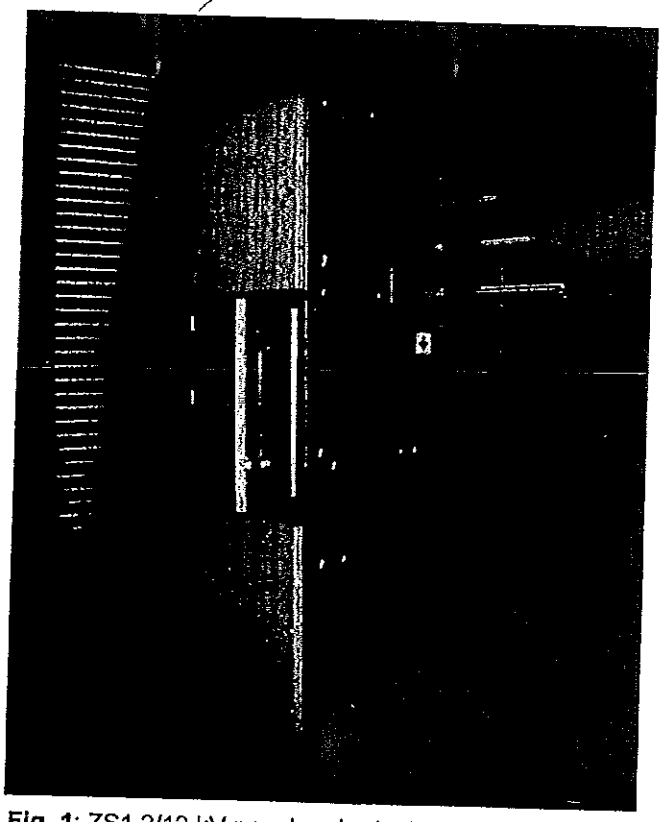


Fig. 1: ZS1.2/12 kV panel under test

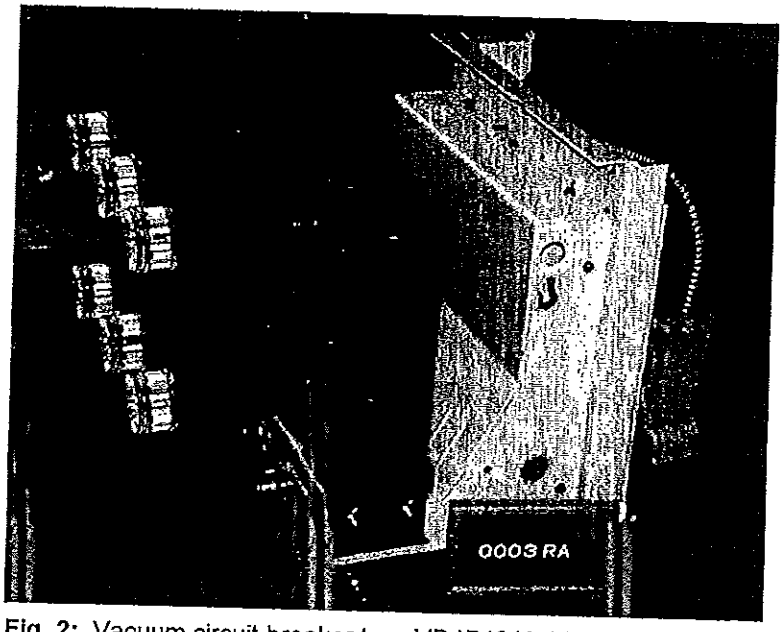


Fig. 2: Vacuum circuit-breaker type VD4P1212-31

ВЯРНО С ОРИГИНАЛА

ABB Trasmissione & Distribuzione S.p.A.
Unità operativa Sace T.M.S.
Via Friuli 4
I 24044 – Dalmine (BG)
Italy
Tel.: 0039.035.395111
Fax: 0039.035.395874
E-mail: sacetms.tipm@it.abb.com
Internet: //www.abb.com

TYPE TEST DOCUMENTATION No. 100087_C Page 1/1

Apparatus: Metal-clad switchgear type ZS1 rel 1.2 with vacum circuit-breaker type VD4/P 12.25.31 p=210

Identification: 1VCP0000138-Rev.-,en-Technical catalogue-2003-04

Performances:

Rated voltage :	12	kV
Rated lightning impulse withstand voltage :	75	kV
Rated power-frequency withstand voltage :	28	kV
Rated frequency :	50-60	Hz
Rated normal current (busbar) :	2500	A
Rated normal current (tee-off) :	2500	A
Rated peak withstand current :	63	kA
Rated short-time withstand current :	31.5	kA
Rated duration of short circuit :	3	s

Test reports verifying rating assigned by the manufacturer:

Performances	Test according to	Test reports	
		No.	Issued by
Dielectric test	IEC 60298 Subclausole 6.1	0016 Ra	PEHLA High-power Laboratories
Temperature-rise test	IEC 60298 Subclausole 6.3/6.4	HZ 147 E10	PEHLA High-power Laboratories
Short-time and peak withstand current test	IEC 60298 Subclausole 6.5	MP– A4/010735	CESI Laboratories
Mechanical operation and interlock test	IEC 60298 Subclausole 6.102	0020 Ra	PEHLA High-power Laboratories
Internal arc test	IEC 60298 Annex AA	HZ 146 L02	Calor Emag Laboratories
Mechanical operation test	IEC 62271-100 subclause 6.101.2	0317_2 Ra	PEHLA High-power Laboratories
Making and breaking capacity test	IEC 62271-100 subclause 6.106	0303 Ra	PEHLA High-power Laboratories

ABB T&D Unità operativa SACE T.M.S. Laboratories Dalmine are accredited according UNI CEI EN ISO/IEC 17025 by SINAL under Reg. No. 0253
ABB Calor Emag Laboratories Ratingen are accredited according UNI CEI EN ISO/IEC 17025 by DATech under Reg. No. DAT-P-032/93
PEHLA Higth-power Laboratories are accredited according UNI CEI EN ISO/IEC 17025 by DATech under Reg. No. DAT-P-032/93 and certificate D-PL-12072-06-01
CESI Laboratories Milano are accredited according UNI CEI EN ISO/IEC 17025 by SINAL under Reg. No. 030

Date of issue:
04/07/05

Development Dept.
G.M. Cravanzola

ВЯРНО С ОРИГИНАЛА

АББ Трансмисионе & Дистрибузионе С.п.А.
Унита Оператива Саче Т.М.С.
Виа Фриули 4
I 24044 – Далмине (BG)
Италия
тел.: 0039.035.395111
факс: 0039.035.395874
E – mail : sacetms.tipm@it.abb.com
интернет : //www.abb.com

ПРОТОКОЛ ЗА ТИПОВИ ИЗПИТАНИЯ No. 100087_C СТРАНЦИ 1/1

Apparatus: КРУ тип ZS1 изд. 1.2 с вакуумнен прекъсвач тип VD4/P 12.25.32 p=210

Идентификация: 1VCP0000138-Rev.-,en-Технчиески каталог-2003-04

Параметри:

Номинално напрежение:	12	kV
Ном. Издържано импулсно напрежение:	75	kV
Ном. Издържано напрежение с 50Hz:	28	kV
Номинална честота:	50-60	Hz
Номинален ток на шината:	2500	A
Номинален ток на ошиновката:	2500	A
Ном. Издържан ток, пикова стойност:	63	kA
Ном. Издържан кратковременен ток на к.с.:	31.5	kA
Ном. Продължителност на к.с.:	3	s

Test reports verifying rating assigned by the manufacturer:

Изпитания	Тест съгласно стандарт	Тестов протокол	
		No.	Издаден от
Диелектрични изпитания	IEC 60298 Subclausole 6.1	0016 Ra	ПЕХЛА Високо-мощностни лаборатории
Тест с повишаване на температурата	IEC 60298 Subclausole 6.3/6.4	HZ 147 E 10	АББ Калор Емаг Лаборатирии
Тест за кратковременен т.к.с. и пиков т.к.с.	IEC 60298 Subclausole 6.5	MP— A4/010735	АББ Калор Емаг Лаборатирии в лаборатория CESI Лаб.
Механична работа и тест за блокировки	IEC 60298 Subclausole 6.102	0020 Ra	ПЕХЛА Високо-мощностни лаборатории
Тест за вътрешна дъга	IEC 60298 Annex AA	HZ 146 L02	АББ Калор Емаг Лаборатирии
Тест за механична работа	IEC 62271-100 subclause 6.101.2	0317_2 Ra	ПЕХЛА Високо-мощностни лаборатории
Тест за способност за изкл. на т.к.с. и вкл. върху т.к.с.	IEC 62271-100 subclause 6.106	0303 Ra	ПЕХЛА Високо-мощностни лаборатории

Лабораторията на АВВ ТиД Унита Оперативa САЧЕ Т.М.С. в гр. Далмине е акредитирана съгласно UNI CEI EN ISO/IEC 17025 от SINAL с регистрационен номер Reg. No. 0253

Лабораторията на АББ Калор Емаг в гр. Ратинген, Германия е акредитирана съгласно UNI CEI EN ISO/IEC 17025 от DATech под регистрационен номер No. DAT-P-032/93

Високо-мощностните лаборатории ПЕХЛА са акредитирани съгласно UNI CEI EN ISO/IEC 17025 от DATech с регистрационен номер No. DAT-P-032/93 и сертификат Д-ПЛ-12072-06-01

ЧЕЗИ Лаборатории Милано са акредитирани съгласно UNI CEI EN ISO/IEC 17025 от SINAL с регистрационен номер Reg. No. 0030

Дата на издаване:
2004/07/05

Отдел за Развойна дейност

Г.М. Гравазола

ВЯРНО С ОРИГИНАЛА

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
Member of the Short-Circuit-Testing Liaison (STL)

Test Report

Report No.: 0317-2 Ra **Copy No.:** 1 **Contents:** 24 Sheets

Equipment under test: Vacuum circuit-breaker type VD4 17.20.32

Manufacturer:

Circuit-breaker: ABB T&D S.p.A. - Unità operativa Sace TMS, Via Friuli, 4 – 24044 Dalmine (BG), Italy

Pole parts inclusive vacuum interrupter: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Germany

Client: ABB T&D S.p.A. - Unità operativa Sace TMS, Via Friuli, 4 – 24044 Dalmine (BG), Italy

Testing station: PEHLA - Testing Laboratory Ratingen

Date of test: 29th April 2003 – 23rd May 2003

Applied test specifications:
The tests have been carried out in accordance with the client's instructions.
Test procedure and test parameters were guided by:
IEC 62271-100, 1st Ed, 2001-05, clause 6.101.1 and 6.101.2
IEC 60694, Ed.2.2, 2002-01

Tests performed:
In accordance with the requirements of class M2, 10 000 mechanical operating cycles without voltage on or current in the main circuit were carried out with the vacuum circuit-breaker of type VD4 17.20.32 to demonstrate the mechanical reliability.

Test results:
10 000 mechanical operating cycles were carried out.
After 6 400 operating cycles, the opening hook assembly was replaced.
Except for this maintenance, no changes impairing the function of the circuit-breaker were noted after the endurance test.

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

Technical Committee

Mannheim, 25th July 2003

03PE0001

Deutscher Akkreditierungs Rat DAR
DAT-P-032/93

Accreditation

The PEHLA-Testing Laboratory Ratingen has been approved by the DATech (German accreditation body for technology) according to DIN EN ISO/IEC 17025 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. DAT-P-032/93).

Under reference to DIN EN ISO/IEC 17025 PEHLA states the following:

- The accreditation of the PEHLA-Testing Laboratory or any of its test reports by themselves in no way constitute or imply product approval by DATech or any other body.
- If someone refers to a test in an accredited PEHLA-Testing Laboratory this reference shall include the accreditation body, i.e. DATech, the relevant scope of the accreditation and the appropriate registration number.

STL-Member

PEHLA is foundation-member of the Short-Circuit Testing Liaison (STL) which has been founded in March 1969. STL is a forum for the international co-operation of the testing organisations with the further full members ASTA (GB), CESI (I), ESEF (F), KEMA (NL), SATS (N, S, AIR) and STLNA (USA). In the Framework of EC, STL has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Certificate

is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of the test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients instructions.
Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the equipment during test, and its condition after the tests.

Addresses:

Office: PEHLA-Geschäftsstelle
Hallenweg 40
68219 Mannheim; Germany

Testing Station: PEHLA-Testing Laboratory Ratingen
Oberhausener Str. 33
40472 Ratingen; Germany

Manufacturer: ABB T&D S.p.A - Unità Operativa Sace TMS
Via Friuli, 4
24044 Dalmine (BG), Italy

ABB Calor Emag Mittelspannung GmbH
Oberhausener Str. 33
40472 Ratingen, Germany

Client: ABB T&D S.p.A - Unità Operativa Sace TMS
Via Friuli, 4
24044 Dalmine (BG), Italy

Table of Contents

List of Test Participants

Representatives of the Test Committee:

Mr. G. Heit	PEHLA-Testing Laboratory Mannheim
Mr. K.-H. Koch	PEHLA-Testing Laboratory Mannheim
Mr. M. Schöttler	PEHLA-Testing Laboratory Ratingen
Mr. U. Köster	PEHLA-Testing Laboratory Ratingen

Test Operator:

Mr. M. Schöttler	PEHLA-Testing Laboratory Ratingen
Mr. H.-W. Ott	PEHLA-Testing Laboratory Ratingen
Mr. J. Mendorf	PEHLA-Testing Laboratory Ratingen
Mr. A. Piglas	PEHLA-Testing Laboratory Ratingen

Representatives of the Client:

Mr. S. Magoni	ABB T&D S.p.A. - Unità operativa Sace TMS, Italy
Mr. L. Cavenati	ABB T&D S.p.A. - Unità operativa Sace TMS, Italy

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker

Ratings assigned by the manufacturer

Test Object: Vacuum circuit-breaker
Type: VD4 17.20.32
Manufacturer:
Circuit-breaker: ABB T&D S.p.A. - Unità operativa Sace TMS, Via Friuli, 4 – 24044 Dalmine (BG), Italy
Pole parts including vacuum interrupters: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Germany
Serial-No.: AD00011928 **Year of manufacture:** 2003
Drawing No.: TN. 7408 (circuit-breaker)
Vacuum interrupter: Type VG4S L1: No. 480320 L2: No. 8335/1 L3: No. 4832/1
Drawing No.: GCE7005745R0152 (pole part)

Rated voltage	17.5	kV
Rated lightning impulse withstand voltage	95	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	38	kV
Rated frequency	50	Hz
Rated normal current	2000	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current at 17.5 kV	31.5	kA
D.C. component	30	%
Rated short-circuit making current at 17.5 kV	80	kA
Rated transient recovery voltage:		
Peak value	30.0	kV
Rate of rise	0.42	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3s-CO-3min-CO	
Arc extinguishing medium	Vacuum	
Number of poles	3	
Number of units per pole	1	
Rated opening time	≥ 45	ms
Rated closing time	approx. 70	ms
Rated voltage of trip coil	220	V-DC
Rated voltage of closing coil	220	V-DC
Rated supply voltage	220	V-DC
Rated frequency of supply voltage	-	Hz

Essential characteristics and installed devices:

Motor Drive Type 701 921/804 (EL2)
After 6 400 operating cycles, the following part was replaced:
Part-no: 510569801
Part name: Gruppo Gancio di Apertura / opening hook assembly

Date of receipt of test object: 23rd April 2003

ВЯРНО С ОРИГИНАЛА

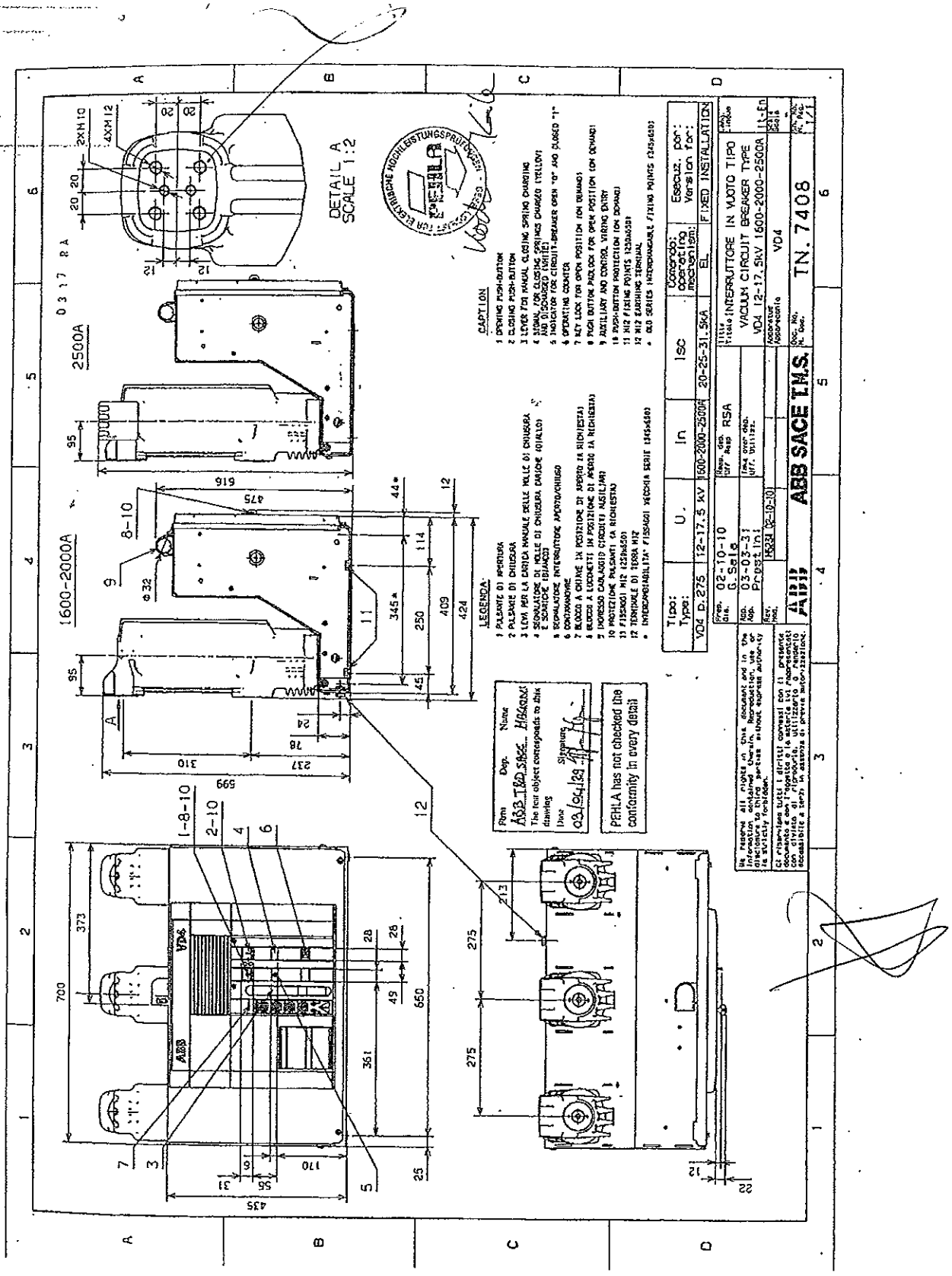
List of Drawings

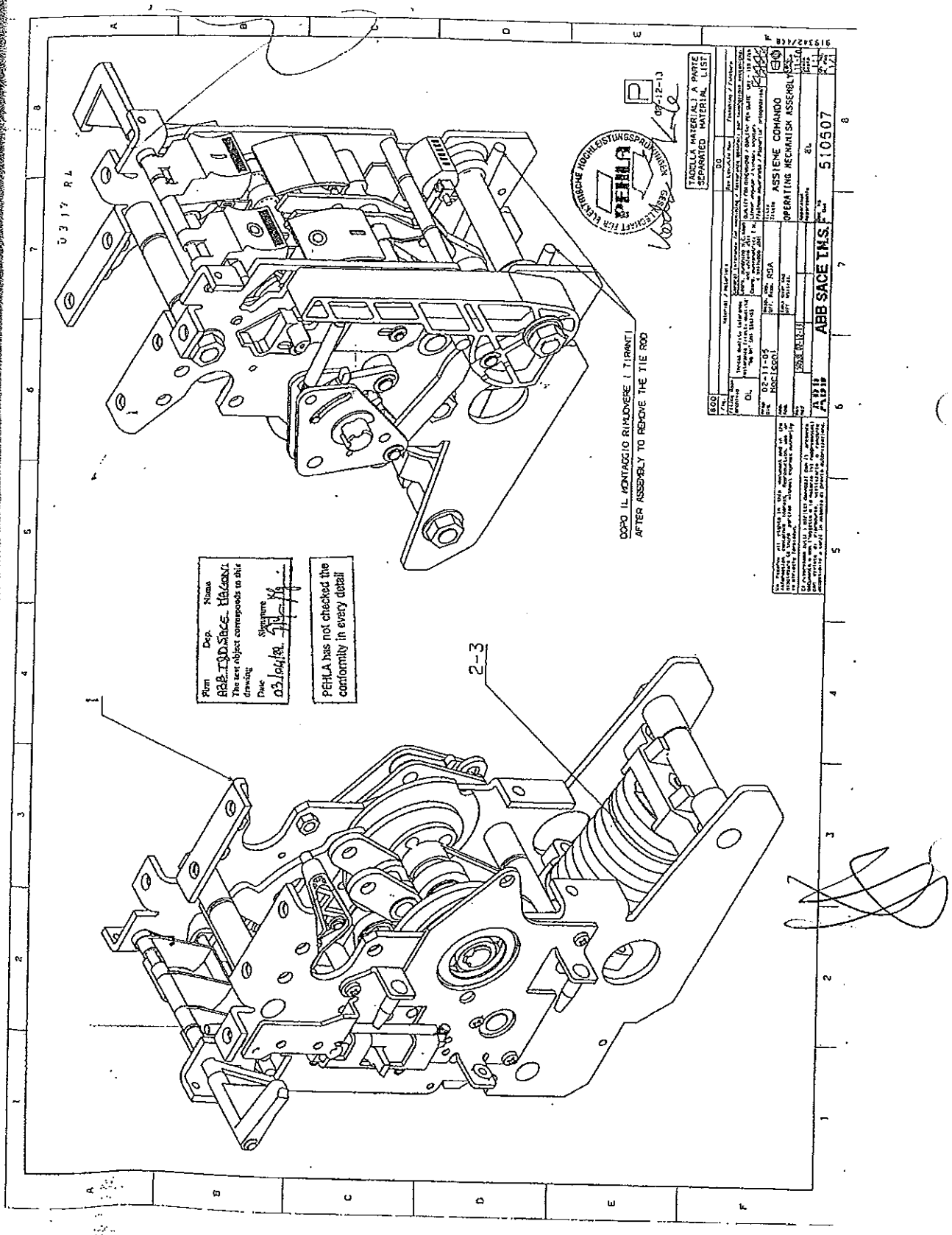
The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. PEHLA has verified that these drawings adequately represent the equipment tested. These drawings have been stamped and signed by PEHLA representatives and are kept

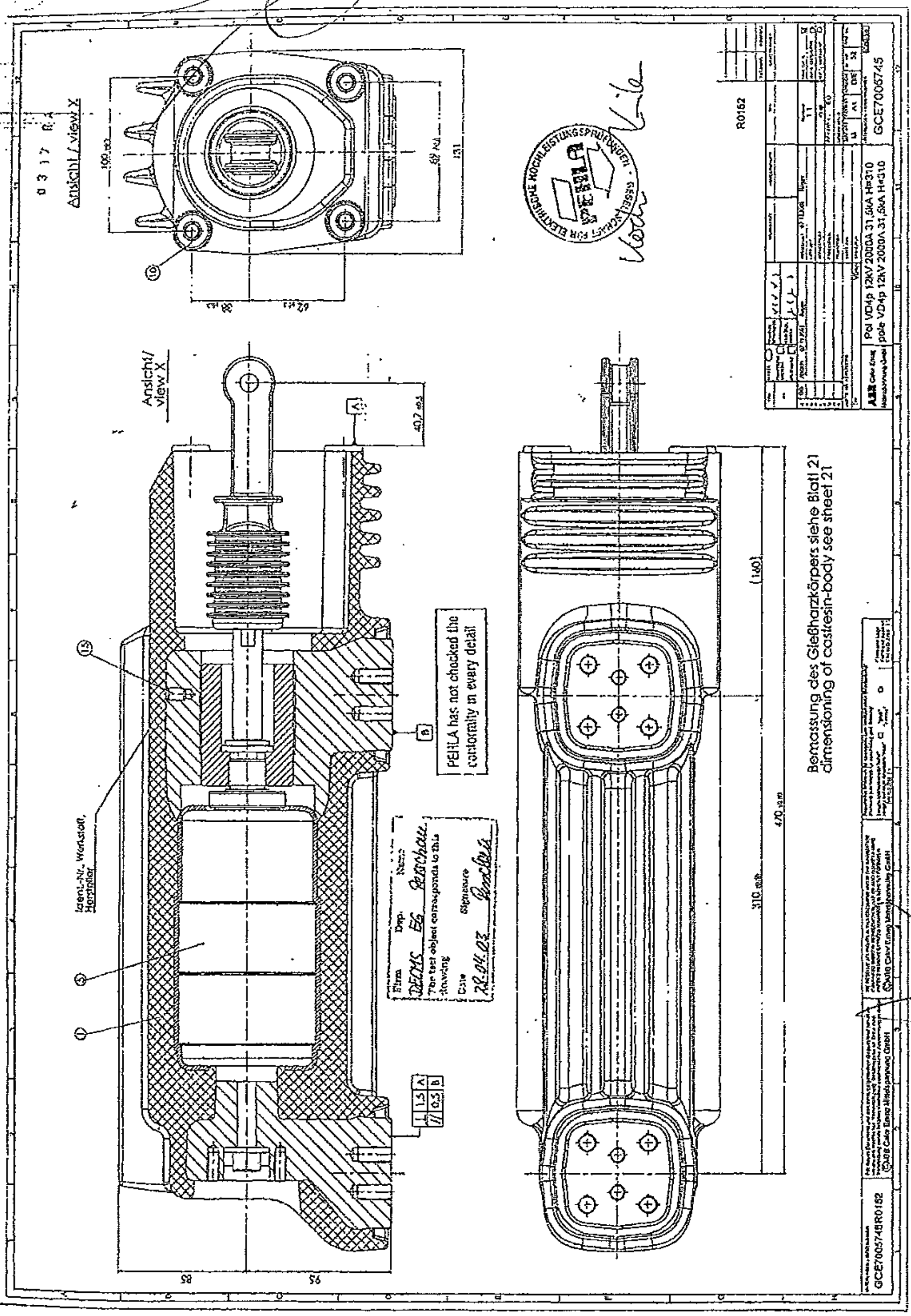
☒ with the test documents at the test laboratory.
☐ at the client.

The drawings contained in this document are identical with the checked, stamped and signed drawings.

Drawing-No.	Revision	Title	Additional remarks
TN. 7408	M5234	VACUUM CIRCUIT BREAKER TYPE VD4 12-17.5kV 1600-2000-2500A	Included in test report
510507	50538	OPERATING MECHANISM ASSEMBLY	Included in test report
GCE7005745R0152	00	pole VD4p 12kV 2000A 31,5kA H=310	Included in test report
510804	50538	COMPRESSION SPRING	—
510805	50538	COMPRESSION SPRING	—
GCE7005535R0101	03	Montagegruppe	—
Parts list			
510564		Ass. molle di ch. com. EL2	—
510507		Assieme comando EL2	—
GCE7005745R0152		Pol VD4P 12kV 2000A 31,5kA H=310	—




DOPO IL MONTAGGIO RIMUOVERE I TIRANTI
AFTER ASSEMBLY TO REMOVE THE TIE ROD
TAGLIA MATERIALI A PARTE
SEPARATED MATERIAL LIST
ASSIEME COMANDO
OPERATING MECHANISM ASSEMBLY
ABB SACE S.p.A.
510507
PEHLA has not checked the conformity in every detail
2-3


Ansicht / view X
Ansicht/ view X
PEHLA has not chekced the conformity in every detail
Firma DEMS EG
The test object corresponds to this drawing
Date 28.04.03
Bemassung des Gießharzkörpers siehe Blatt 21
dimensioning of castresin-body see sheet 21
Pol VD4p 12kV 2000A 31,5kA H=310
pole VD4p 12kV 2000A 31,5kA H=310
GCE7005745
R0152
GCE7005745R0152

Details on Performance of the Test

Prior to the endurance test, the following electrical and mechanical data were determined by measurements on the circuit-breaker and its auxiliary systems:

a) closing time (5 times *)
b) opening time (5 times *)
c) time spread between units of one pole - not applicable
d) time spread between poles (5 times *)
e) charging time of the motorized operating mechanism (5 times *)
f) consumption of the motorized operating mechanism (5 times *)
g) consumption of the tripping devices (5 times *)
h) duration of opening and closing command impulse
i) tightness
j) gas densities or pressures - not applicable
k) resistance of the main circuit (5 times *)
l) time-travel chart (5 times *)
m) other important characteristics
- contact travel
- check of vacuum of interrupters
- verification of the rated operating sequence (refer to clause 6.101.2.5 a))
- ambient atmospheric conditions

*) 5 times at rated, minimum and maximum supply voltage.

The subsequent endurance test comprising 10 000 mechanical operating cycles was structured as follows and carried out five times:

500 operating cycles with operating sequence C - 30 s - O - 30 s at the minimum supply voltage of closing and opening devices and motorized operating mechanism and the minimum pressure for operation

500 operating cycles with operating sequence C - 30 s - O - 30 s at the rated supply voltage of closing and opening devices and motorized operating mechanism and the rated pressure for operation

500 operating cycles with operating sequence C - 30 s - O - 30 s at the maximum supply voltage of closing and opening devices and motorized operating mechanism and at the maximum pressure for operation

250 operating cycles with operating sequence C - 30 s - O - 300 ms - CO - 90 s at the rated supply voltage of closing and opening devices and motorized operating mechanism and at the rated pressure for operation

For faster operation, the recharging motor was cooled by air pressure.

After each series of 2 000 operating sequences the operating characteristics: a), b), d), e), and l) as listed above have been recorded.

Following the endurance test, the measurements carried out before the mechanical endurance test were measured again for comparison. Check, whether the travel characteristics fell within the envelope curves, taken before the endurance test.

ВЯРНО С ОРИГИНАЛА

Results of measurements before the mechanical endurance test

Number of operations: counter: 99923

a/b) Opening and closing time:

Ua = 220 V DC

Operating time [ms]

measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	t_o (opening)			t_c (closing)		
U [V]	0.7 x Ua	1.0 x Ua	1.1 x Ua	0.85 x Ua	1.0 x Ua	1.1 x Ua
t [ms]	66.9	46.5	44.4	69.6	64.8	62.7
	66.9	47.1	44.4	69.0	64.5	62.7
	66.9	48.8	44.4	69.6	65.1	62.4
	67.8	46.8	44.4	69.3	64.8	62.4
	66.3	46.8	44.4	69.6	64.8	62.7

d) Time spread between the breaker poles:

The time spread between the breaker poles on closing and on opening of the circuit-breaker was measured to < 2 ms.

e/f) Charging time and power consumption of the motorized operating mechanism:

Rated voltage: Ua = 220 V DC

Measured values:

Measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

motor voltage	charging time after O-C operation [s]					current consumption [A]					power consumption [W]				
U = 0.85 x Ua = 187 V DC	3.99	4.08	4.20	4.25	4.20	0.98	0.96	1.02	1.02	1.00	183	180	191	191	187
U = 1.0 x Ua = 220 V DC	3.47	3.44	3.36	3.36	3.37	1.01	1.00	0.98	0.99	0.99	222	220	216	218	218
U = 1.1 x Ua = 242 V DC	2.77	2.99	2.97	3.00	3.00	1.02	1.02	1.02	1.03	1.03	247	247	247	249	249

ВЯРНО С ОРИГИНАЛА

g) Consumption of the tripping devices:

Measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	Shunt-release ON -MC					Shunt-release OFF -MO1				
Rated operating voltage U_a	220 V DC					220 V DC				
Current at minimum supply voltage [A]	0.72	0.72	0.72	0.72	0.72	0.52	0.52	0.52	0.52	0.52
Current at rated supply voltage [A]	0.88	0.84	0.88	0.88	0.88	0.68	0.64	0.68	0.64	0.68
Current at maximum supply voltage [A]	0.96	0.96	0.96	0.96	0.96	0.76	0.76	0.72	0.72	0.72

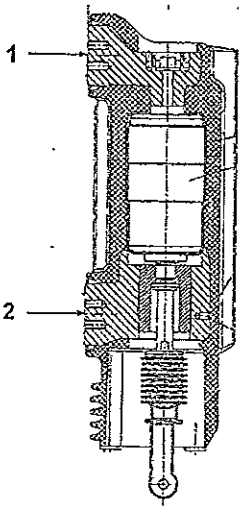
h) Duration of closing and opening command impulse:

Measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	Shunt-release ON -MC					Shunt-release OFF -MO1				
Duration of command impulse at minimum supply voltage [ms]	69.3	73.8	74.1	72.3	70.8	67.2	68.1	69.0	70.2	69.6
Duration of command impulse at rated supply voltage [ms]	67.2	64.8	67.2	67.8	69.0	46.2	47.1	48.3	47.1	48.3
Duration of command impulse at maximum supply voltage [ms]	62.7	63.0	63.0	62.4	66.6	47.1	47.7	48.	47.1	48.0

k) Resistance of the main conductors:

Measuring points:



Contact resistance measured during the 5 x CO operations at the minimum supply voltage of the coils:

Measuring points	L1 µΩ	L2 µΩ	L3 µΩ
1 - 2	12.4	11.4	11.8

Contact resistance measured during the 5 x CO operations at the rated supply voltage of the coils:

Measuring points	L1 µΩ	L2 µΩ	L3 µΩ
1 - 2	12.3	11.5	12.1

Contact resistance measured during the 5 x CO operations at the maximum supply voltage of the coils:

Measuring points	L1 µΩ	L2 µΩ	L3 µΩ
1 - 2	12.4	11.6	12.1

l) Time-travel chart with opening and closing speed: See diagram 1.1 and 1.2

Speed in [m/s]; Ua = 220 V DC
at U = 1.0 x Ua

	V_{O1}	V_{O2}	V_C
L2	1.18	1.30	0.91

The deviations from the measured mechanical time travel charts are in the allowable limits of the reference mechanical travel characteristics.

Vo1: opening speed considered 8.25 mm after the separation in the main contacts of phase L2.
Vo2: opening speed considered between 1.65 and 8.25 mm after the separation in the main contacts of phase L2.
Vc: closing speed considered 3.3 mm before the touching in the main contacts of phase L2.

m) Other important characteristics:

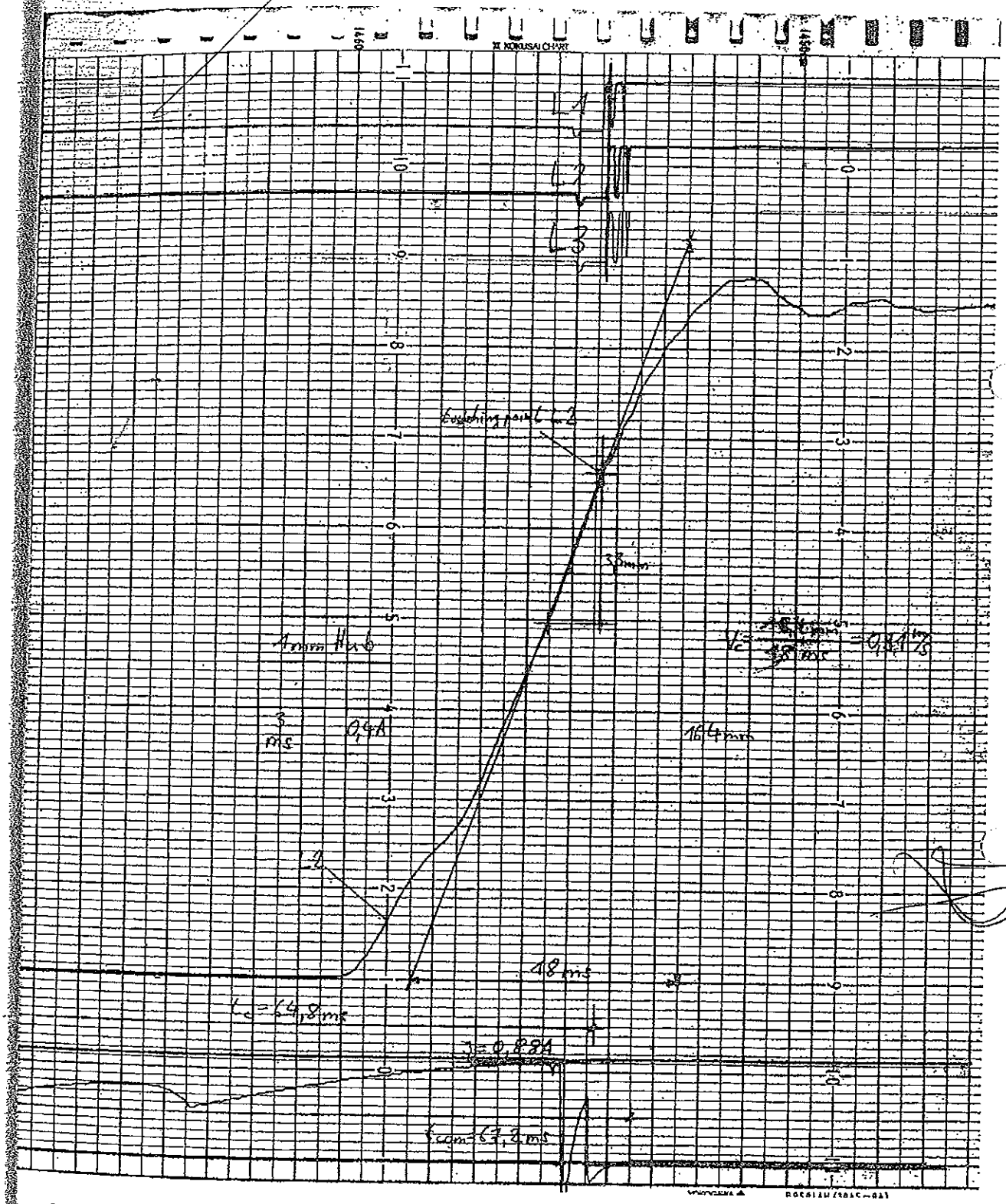
- **Contact travel:**

	L1	L2	L3
Total Travel [mm]	14.8	14.9	14.9
Cont.-travel [mm]	11.2	11.3	11.2
Contact-spring travel [mm]	3.6	3.6	3.7

- **Check of vacuum of interrupters:**
  60 kV DC ok
- **Verification of the rated operating sequence:**
  O-0.3s-CO-3min-CO at rated voltage ok
- **Ambient atmospheric conditions:**
  Date: 29th April 2003, ambient air temperature: approx. 23°C

ВЯРНО С ОРИГИНАЛА

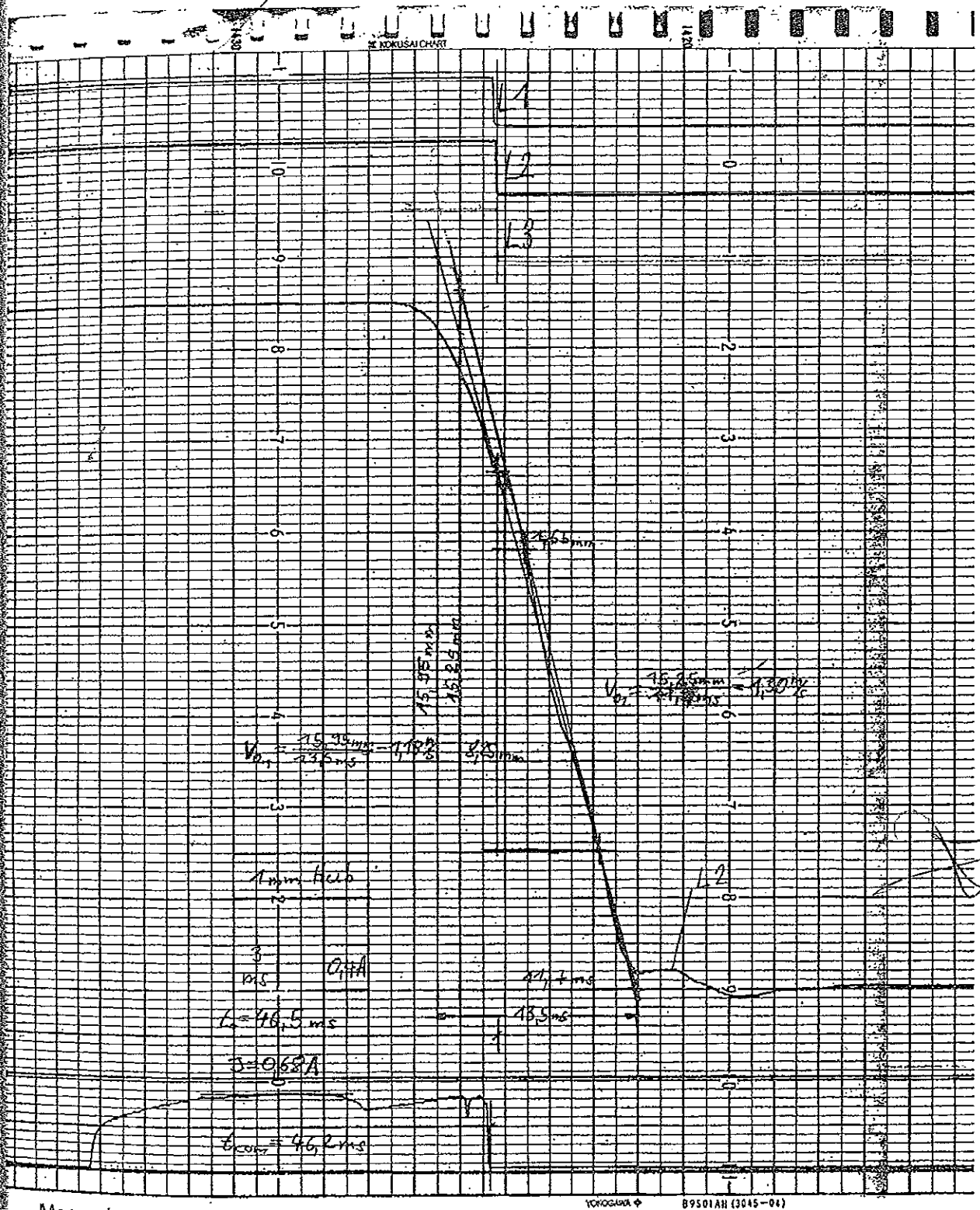
Diagram 1.1: Measurement of the operating speed before the mechanical endurance test



Measuring point: Insulated coupling rod in phase L2
Operating speed measured: V_c = 0.91 m/s at U = 1.0 x Ua
For the speed calculation, an enlarged similar triangle was used in order to increase the accuracy of the travel and time measurement.

ВЯРНО С ОРИГИНАЛА

Diagram 1.2: Measurement of the operating speed before the mechanical endurance test



Measuring point: Insulated coupling rod in phase L2
Operating speed measured: V_{O1} = 1.18 m/s, V_{O2} = 1.30 m/s at U = 1.0 x Ua
For the speed calculation, an enlarged similar triangle was used in order to increase the accuracy of the travel and time measurement.

Results of measurements during the mechanical endurance test

a/b) Opening and closing time:

Operating time [ms]		t_{o1} (opening)			t_c (closing)		
Ua = 220 V DC	U [V]	0.7 x Ua	1.0 x Ua	1.1 x Ua	0.85 x Ua	1.0 x Ua	1.1 x Ua
Number of operations: 2 000	t [ms]	66.6	47.4	44.7	68.4	63.6	61.5
Number of operations: 4 000	t [ms]	67.2	45.9	44.7	68.4	64.2	61.8
Number of operations: 6 000	t [ms]	67.5	46.5	44.7	68.1	63.9	62.1
Number of operations: 8 000	t [ms]	67,8	48,0	45,7	67,8	63,6	61,1

d) Time spread between the breaker poles:

The time spread between the breaker poles on closing and on opening of the circuit-breaker was measured to < 2 ms.

e) Charging time of the motorized operating mechanism:

	charging time after O-C operation [s]		
Motor voltage Ua = 220 V DC	U = 0.85 x Ua = 187 V DC	U = 1.0 x Ua = 220 V DC	U = 1.1 x Ua = 242 V DC
Number of operations: 2 000	4.04	3.23	2.80
Number of operations: 4 000	4.23	3.29	2.90
Number of operations: 6 000	4.20	3.23	2.98
Number of operations: 8 000	4.22	3.27	2.93

m) Other important characteristics - contact travel:

Contact travel in L2	Total Travel [mm]
Number of operations: 2 000	14.7
Number of operations: 4 000	14.7
Number of operations: 6 000	14.6
Number of operations: 8 000	14.6

l) Time-travel chart with opening and closing speed:

Speed in [m/s]; at Ua = 220 V DC L2	V_{o1} (8.25 mm)	V_{o2} (6.60 mm)	V_c (3.30 mm)
Number of operations: 2 000	1.08	1.31	0.91
Number of operations: 4 000	1.11	1.27	0.95
Number of operations: 6 000	1.10	1.29	0.91
Number of operations: 8 000	1.12	1.33	0.93

The deviations from the measured mechanical time travel charts are in the allowable limits of the reference mechanical travel characteristics.

Results of measurements after the mechanical endurance test

Number of operations: counter: 10027

a/b) Opening and closing time:

Ua = 220 V DC

Operating time [ms]

measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	t_o (opening)			t_c (closing)		
U [V]	0.7 x Ua	1.0 x Ua	1.1 x Ua	0.85 x Ua	1.0 x Ua	1.1 x Ua
t [ms]	71.4	48.6	45.9	68.4	63.9	62.1
	71.1	48.6	45.9	68.4	64.5	61.8
	70.2	48.3	45.9	68.1	64.2	61.8
	72.9	48.6	45.9	68.7	64.2	61.8
	71.1	48.3	45.6	68.1	64.2	61.8

d) Time spread between the breaker poles:

The time spread between the breaker poles on closing and on opening of the circuit-breaker was measured to < 2 ms.

e/f) Charging time and power consumption of the motorized operating mechanism:

Rated voltage: Ua = 220 V DC

Measured values:

Measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

motor voltage	charging time after O-C operation [s]					current consumption [A]					power consumption [W]				
U = 0.85 x Ua = 187 V DC	4.04	4.12	4.10	4.03	4.06	0.94	0.98	0.98	0.94	0.97	176	183	183	176	181
U = 1.0 x Ua = 220 V DC	3.15	3.12	3.12	3.12	3.11	0.97	0.96	0.96	0.96	0.96	213	211	211	211	211
U = 1.1 x Ua = 242 V DC	2.71	2.83	2.77	2.77	2.75	0.95	0.98	0.94	0.95	0.94	230	237	228	230	228

ВЯРНО С. ОРИГИНАЛА

g) Consumption of the tripping devices:

Measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	Shunt-release ON -MC					Shunt-release OFF -MO1				
Rated operating voltage U_a	220 V DC					220 V DC				
Current at minimum supply voltage [A]	0.68	0.72	0.72	0.72	0.72	0.56	0.52	0.52	0.52	0.52
Current at rated supply voltage [A]	0.88	0.88	0.88	0.88	0.88	0.68	0.72	0.68	0.68	0.68
Current at maximum supply voltage [A]	0.96	1.00	0.96	0.96	0.96	0.76	0.76	0.76	0.76	0.76

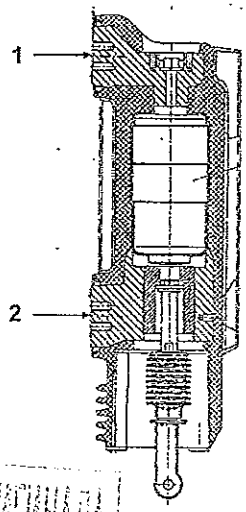
h) Duration of closing and opening command impulse:

Measured during the 5 x CO operations
- at the minimum supply voltage
- at the rated supply voltage
- at the maximum supply voltage

	Shunt-release ON -MC					Shunt-release OFF -MO1				
Duration of command impulse at minimum supply voltage [ms]	69.6	69.6	69.3	69.9	69.3	70.5	72.3	69.9	73.8	72.6
Duration of command impulse at rated supply voltage [ms]	65.7	66.3	66.0	66.0	66.0	50.7	50.4	51.9	51.6	50.7
Duration of command impulse at maximum supply voltage [ms]	64.5	64.2	63.9	64.2	64.2	51.9	50.7	52.2	51.6	50.7

k) Resistance of the main conductors:

Measuring points:



Contact resistance measured during the 5 x CO operations at the minimum supply voltage of the coils:

Measuring points	L1 µΩ	L2 µΩ	L3 µΩ
1 - 2	13.5	13.6	13.2

Contact resistance measured during the 5 x CO operations at the rated supply voltage of the coils:

Measuring points	L1 µΩ	L2 µΩ	L3 µΩ
1 - 2	14.3	14.1	13.3

Contact resistance measured during the 5 x CO operations at the maximum supply voltage of the coils:

Measuring points	L1 µΩ	L2 µΩ	L3 µΩ
1 - 2	13.8	14.0	13.7

l) Time-travel chart with opening and closing speed: See diagram 2.1 and 2.2

Speed in [m/s]; Ua = 220 V DC
at U = 1.0 x Ua

	V_{O1}	V_{O2}	V_C
L2	1.22	1.37	0.89

The deviations from the measured mechanical time travel charts are in the allowable limits of the reference mechanical travel characteristics.

V_{O1}: opening speed considered 8.25 mm after the separation in the main contacts of phase L2.
V_{O2}: opening speed considered between 1.65 and 8.25 mm after the separation in the main contacts of phase L2.
V_C: closing speed considered 3.3 mm before the touching in the main contacts of phase L2.

m) Other important characteristics:

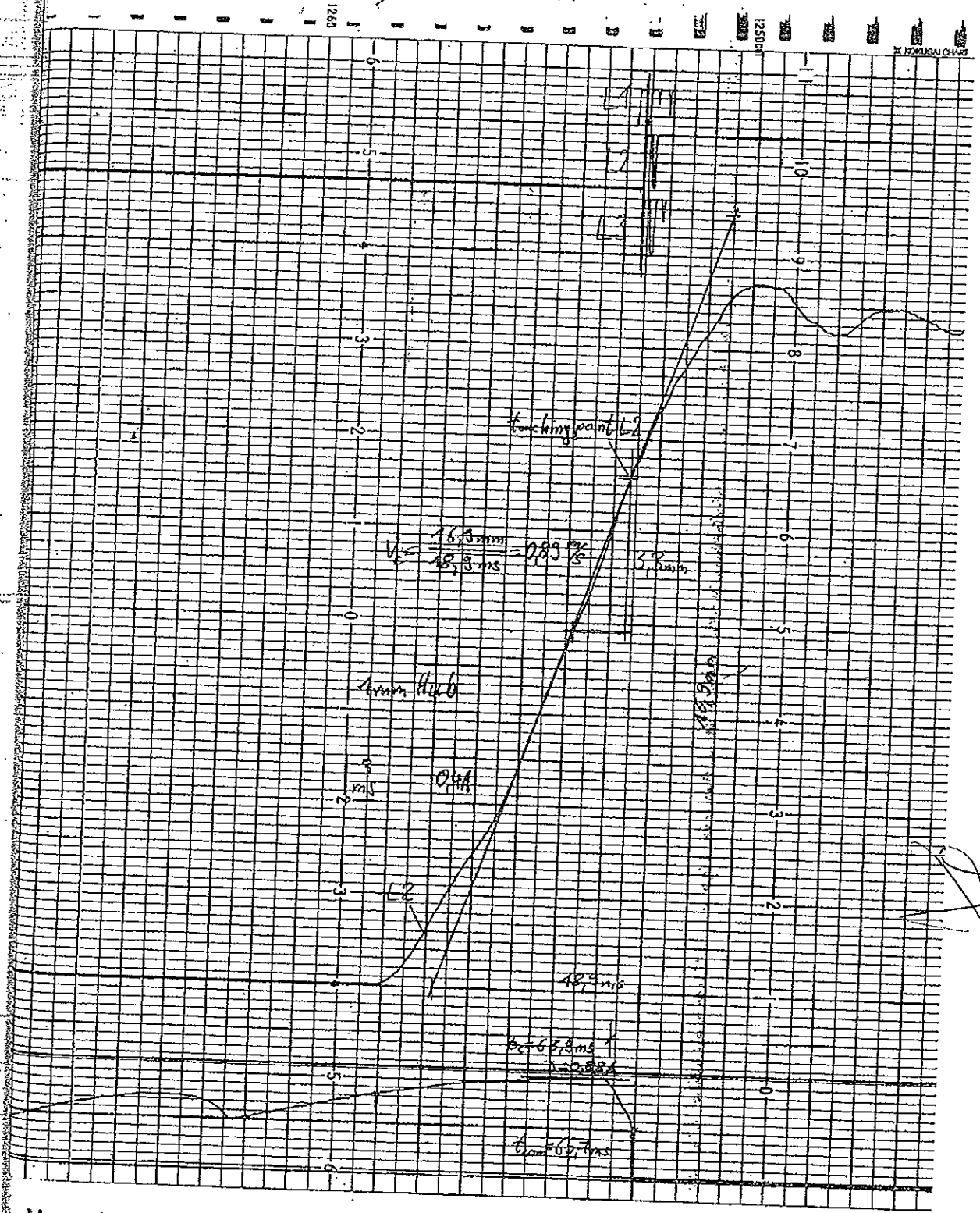
- **Contact travel:**

	L1	L2	L3
Total Travel [mm]	14.6	14.7	14.6
Cont.-travel [mm]	11.0	11.2	11.1
Contact-spring travel [mm]	3.6	3.5	3.5

- **Check of vacuum of interrupters:**
  60 kV DC ok
- **Verification of the rated operating sequence:**
  O-0.3s-CO-3min-CO at rated voltage ok
- **Ambient atmospheric conditions:**
  Date: 23rd May 2003, ambient air temperature: approx. 22°C

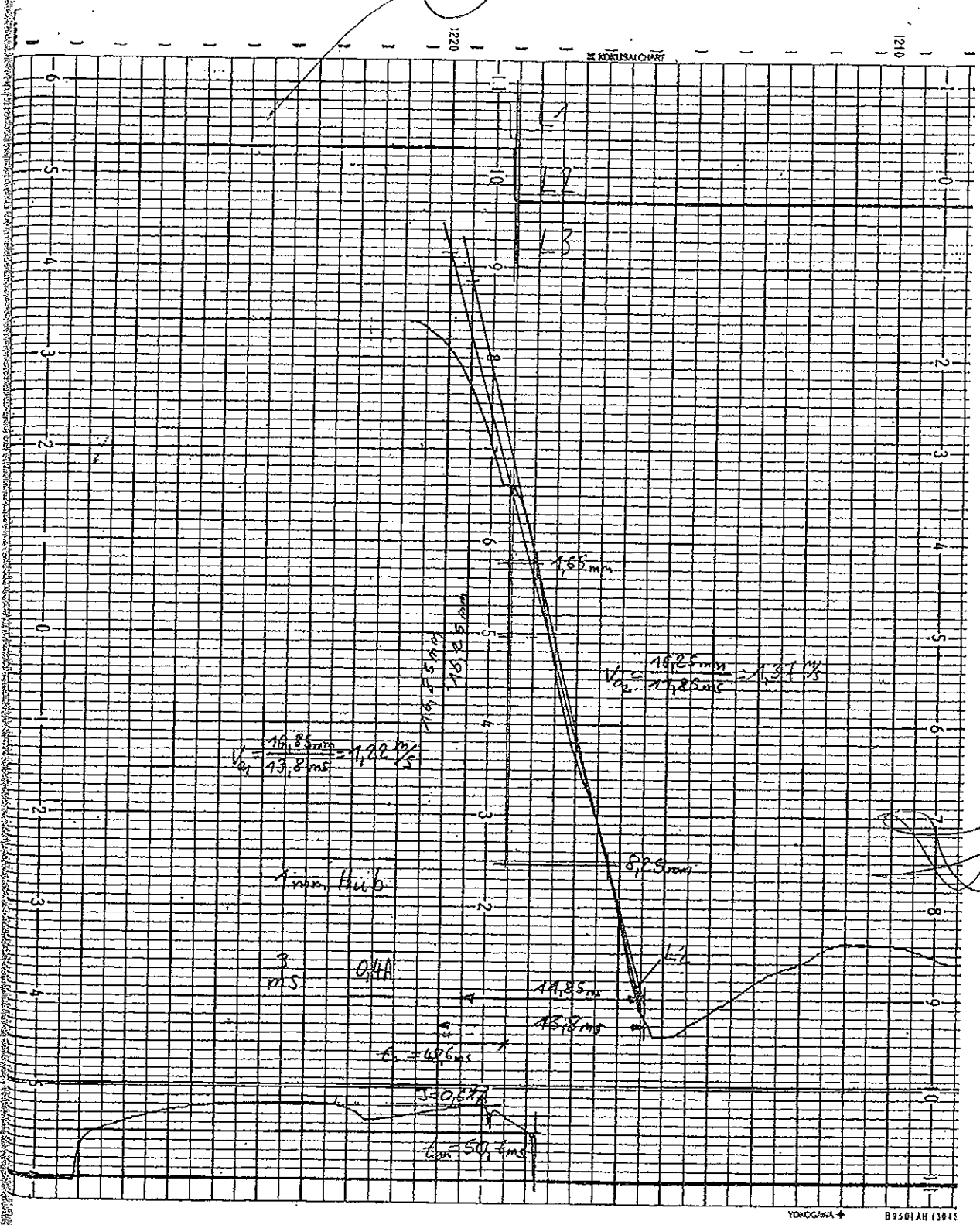
ВЯРНО С ОРИГИНАЛА

Diagram 2.1: Measurement of the operating speed after the mechanical endurance test



Measuring point: Insulated coupling rod in phase L2
Operating speed measured: V_C = 0.89 m/s at U = 1.0 x Ua
For the speed calculation, an enlarged similar triangle was used in order to increase the accuracy of the travel and time measurement.

Diagram 2.2: Measurement of the operating speed after the mechanical endurance test



Measuring point: Insulated coupling rod in phase L2
Operating speed measured: V_{01} = 1.22 m/s, V_{02} = 1.37 m/s at U = 1.0 x Ua
For the speed calculation, an enlarged similar triangle was used in order to increase the accuracy of the travel and time measurement.

Evaluation of the measurements before and after the test program

The reference mechanical travel characteristic was recorded at the rated supply voltage before the endurance test. All measured travel-curves fall within the limits of the two envelope curves which characterize the allowable deviations from the reference curve.

All characteristics measured before and after the test program do not show unacceptable variations.

The circuit-breaker operated only on command and did not operate without command.

After 6 400 operating cycles, the opening hook assembly was replaced.

Measuring Instrument Record

Test job no.: 940

Object tested: VD4 17.20.32

Date of test: 29th April – 23rd May 2003

Test report: PEHLA 0317-2Ra

Test operator: Ott/Schöttler

Instrument	Ident.-no.	Measuring	Remarks
Microohmmeter MO2A 50	ELK 001111	2pμΩ / 200μΩ	Resistance measurement
Resistive travel pick-up type lino pot Ts 50 502	ELK 001076	5 kΩ	Travel time measurement
DM 7100 Transient memory	ELK 000466	±2 V / full scale 50μs/word, channel 4 (12 bit)	
YEW-3063 Multi-pen	ELK 000464	0.25 V/cm-vernier 10 cm/min, channel 4	
Slide caliper rule	LAE 002162	0 - 300 mm	
Shunt 1.5A/150mV DM 7100 Transient memory	ELK 001044 ELK 000466	1.5A/150mV ±20/0.2 V/full scale 50 μsec/word/10ms/word channel 1, 2, 3, 8 (8 bit)	Current measurement (MC/MO1) Operating time measurement,
YEW-3063 Multi-pen	ELK 000464	Channel 1, 2, 3, 8, 0.25/1 V/cm-cal/vernier 10 cm/min	
Electronic time clock	ELK 001231	0-100s	Charging time measurement
Unigor 6E	ELK 000389	1 A	Motor current measurement
Vidar-Vacuum-Checker-Test device	DRU 000026	40/60kV DC	Vacuum-Checker-Test
DBC M2110	ELK 000359	300 V DC	Voltage measurement
Hygrometer Hygronom	FEU 000022	-30°C - +50°C	temperature measurement

ВЯРНО С ОРИГИНАЛА

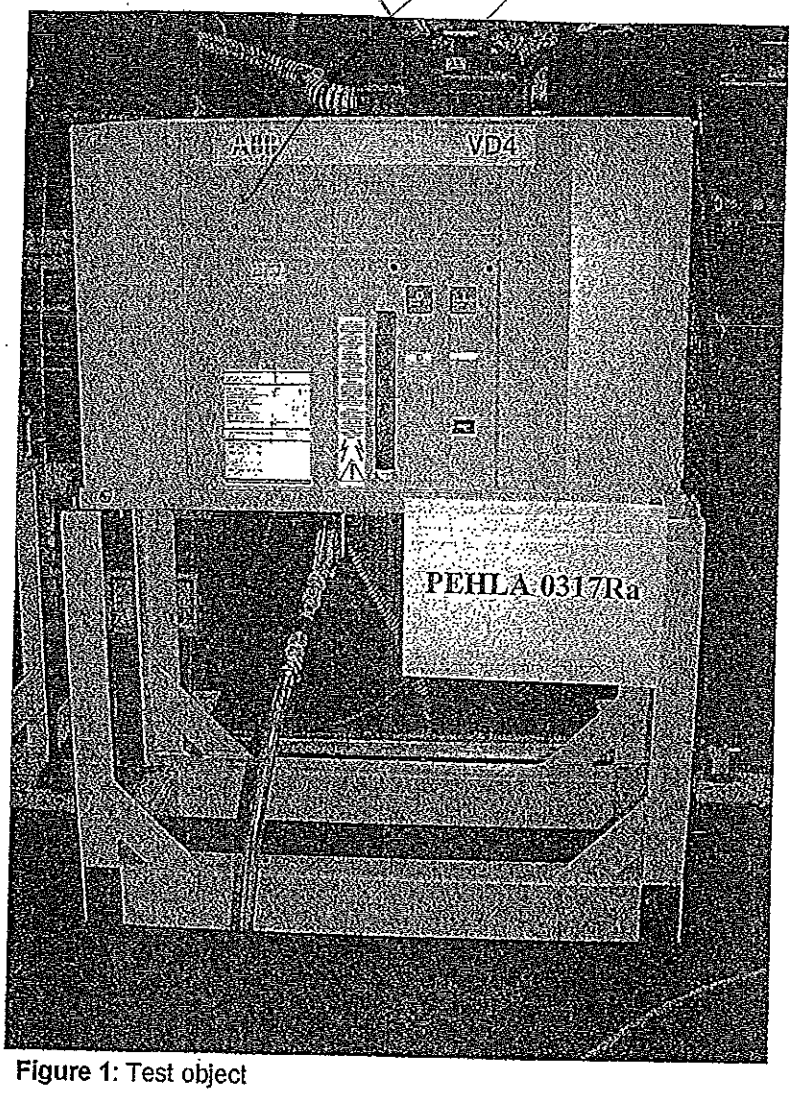


Figure 1: Test object

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
Member of the Short-Circuit-Testing Liaison (STL)

Test Report

Report No.: 0303Ra **Copy No.: 0** **Contents: 59 Sheets**

Equipment under test: Vacuum circuit-breaker type VD4.17.20.32 (17.5 kV, 2000 A, 31.5 kA) equipped with vacuum interrupters type VG4S.

Manufacturer:

Circuit-breaker: ABB T&D SpA, Divisione Sace T.M.S, Via Friuli, 4 – 24044 Dalmine (BG), Italy

Pole parts inclusive vacuum interrupters: ABB Calor Emag Mittelspannung GmbH, Oberhausener Str. 33, 40472 Ratingen, Germany

Client: ABB T&D SpA, Divisione Sace T.M.S, Via Friuli, 4 – 24044 Dalmine (BG), Italy

Testing station: PEHLA-Testing Laboratory Ratingen

Date of test: 9th and 10th January 2003

Applied test specifications:
The tests have been carried out in accordance with the client's instructions.
Test procedure and test parameters were based on:
IEC 62271-100/2001-05, Clauses 6.106.1, 6.106.2, 6.106.3, 6.106.4, 6.106.5, 6.108.3
STL-Guide to IEC 60056: 4th Edition: 1987, Amendment Slip No. 2

Tests performed:
Basic short-circuit test-duties T10 - T100 and double-earth fault breaking test.
No-load operations and measurement of the resistance of the pole parts before and after the tests.
Power-frequency withstand voltage test at 38.0 kV – 1 min before and after the tests.
Measurement of the time-travel characteristic before and after the tests.
For further details see sheet no. 3.

Test results:
The vacuum circuit-breaker passed the mentioned test successfully.

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

Technical Committee

Mannheim, 31st March 2003

i.V.

The test results relate only to the items te

Deutscher Akkreditierungs Rat DAR
DAT-P-032/93

ВЯРНО С ОРИГИНАЛА

Accreditation

The PEHLA-Testing Laboratory Ratingen has been approved by the DATech (German accreditation body for technology) according to DIN EN ISO/IEC 17025 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. DAT-P-032/93).

Under reference to DIN EN ISO/IEC 17025 PEHLA states the following:

- The accreditation of the PEHLA-Testing Laboratory or any of its test reports by themselves in no way constitute or imply product approval by DATech or any other body.
- If someone refers to a test in an accredited PEHLA-Testing Laboratory this reference shall include the accreditation body, i.e. DATech, the relevant scope of the accreditation and the appropriate registration number.

STL-Member

PEHLA is foundation-member of the Short-Circuit Testing Liaison (STL) which has been founded in March 1969. STL is a forum for the international co-operation of the testing organisations with the further full members ASTA (GB), CESI (I), ESEF (F), KEMA (NL), SATS (N, S, AIR) and STLNA (USA). In the Framework of EC, STL has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Certificate

is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of the test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients instructions.
Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the equipment during test, and its condition after the tests.

Addresses:

Office: PEHLA-Geschäftsstelle
Hallenweg 40
68219 Mannheim, Germany

Testing Station: PEHLA-Testing Laboratory Ratingen
Oberhausener Str. 33
40472 Ratingen, Germany

Manufacturer: ABB T&D SpA, Divisione SACE T.M.S.
Via Friuli, 4
24044 Dalmine (BG), Italy

ABB Calor Emag Mittelspannung GmbH
Oberhausener Str. 33
40472 Ratingen, Germany

Client: ABB T&D SpA, Divisione SACE T.M.S.
Via Friuli, 4
24044 Dalmine (BG), Italy

ВЯРНО С ОРИГИНАЛА

Tests performed:

Basic short-circuit test series T10 - T100 and double-earth fault breaking test.

T10: 3.56 kA at 18.9 kV / 3.54 kA at 18.8 kV / 3.56 kA at 18.8 kV
(10 % I_{sc} O-0.3s-CO-3min-CO).

T30: 10.2 kA at 19.1 kV / 10.2 kA at 18.6 kV / 10.1 kA at 18.5 kV
(30 % I_{sc} O-0.3s-CO-3 min-CO).

T60: 19.0 kA at 18.5 kV / 18.5 kA at 17.6 kV / 18.6 kA at 18.1 kV
(60 % I_{sc} O-0.3s-CO-3min-CO).

T100s: 33.2 kA at 20.8 kV / 32.3 kA at 19.3 kV / 32.3 kA at 19.5 kV
(100% I_{sc} O-0.3 s-CO-3min-CO).

T100a: 31.5 kA (24.3%$_{DC\text{-}comp.}$) at 19.6 kV / 32.0 kA (32.2%$_{DC\text{-}comp.}$) at 19.6 kV /
31.6 kA (26.8%$_{DC\text{-}comp.}$) at 19.6 kV
(100% I_{sc} O_{asym}/O_{asym}/O_{asym}).

Double-earth fault breaking test: 27.8 kA at 18.7 kV

No-load operations and measurement of the resistance of the pole parts before and after the tests.
Power-frequency withstand voltage test at 38.0 kV – 1 min before and after the tests.
Measurement of the time-travel characteristic before and after the tests.

Table of Contents

ВЯРНО С ОРИГИНАЛА

List of Test Participants

Representatives of the Test Committee:

Mr. G. Heit	PEHLA-Testing Laboratory Mannheim, Germany
Mr. K.-H. Diergardt	PEHLA-Testing Laboratory Ratingen, Germany

Test Engineer:

Mr. K.-H. Diergardt	PEHLA-Testing Laboratory Ratingen, Germany

Representatives of the Client:

Mr. S. Magoni	ABB T&D SpA, Division SACE T.M.S., Italy

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker

Ratings assigned by the manufacturer

Test Object: Vacuum circuit-breaker
Type: VD4.17.20.32
Manufacturer:
Circuit-breaker: ABB T&D SpA, Divisione Sace T.M.S, Via Friuli, 4 – 24044 Dalmine (BG), Italy
Pole parts including vacuum interrupters: ABB Calor Emag Mittelspannung GmbH, Oberhausener Str. 33, 40472 Ratingen, Germany
Serial-No.: AC00048045 **Year of manufacture:** 2002
Drawing No.: see sheet 7
Vacuum interrupter: Type: VG4S L1: No. 5081, L2: No. 5002, L3: No. 5006
Drawing No.: see sheet 7

Rated voltage	17.5	kV
Rated lightning impulse withstand voltage	95	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	38	kV
Rated frequency	50	Hz
Rated normal current	2000	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current at 17.5 kV	31.5	kA
D.C. component	30	%
Rated short-circuit making current at 17.5 kV	80	kA
Rated transient recovery voltage:		
Peak value	30.0	kV
Rate of rise	0.42	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3s-CO-3min-CO	
Arc extinguishing medium	Vacuum	
Number of poles	3	
Number of units per pole	1	
Rated opening time	≥ 45	ms
Rated closing time	approx. 70	ms
Rated voltage of trip coil	220	V-DC
Rated voltage of closing coil	220	V-DC
Rated supply voltage	220	V-DC
Rated frequency of supply voltage	-	Hz

Essential characteristics:
Motor Drive Type 701 921/804 Serial No. CA 69T L02 D (EL1)

Date of receipt of test object: 7th January 2003

ВЯРНО С ОРИГИНАЛА

List of Drawings

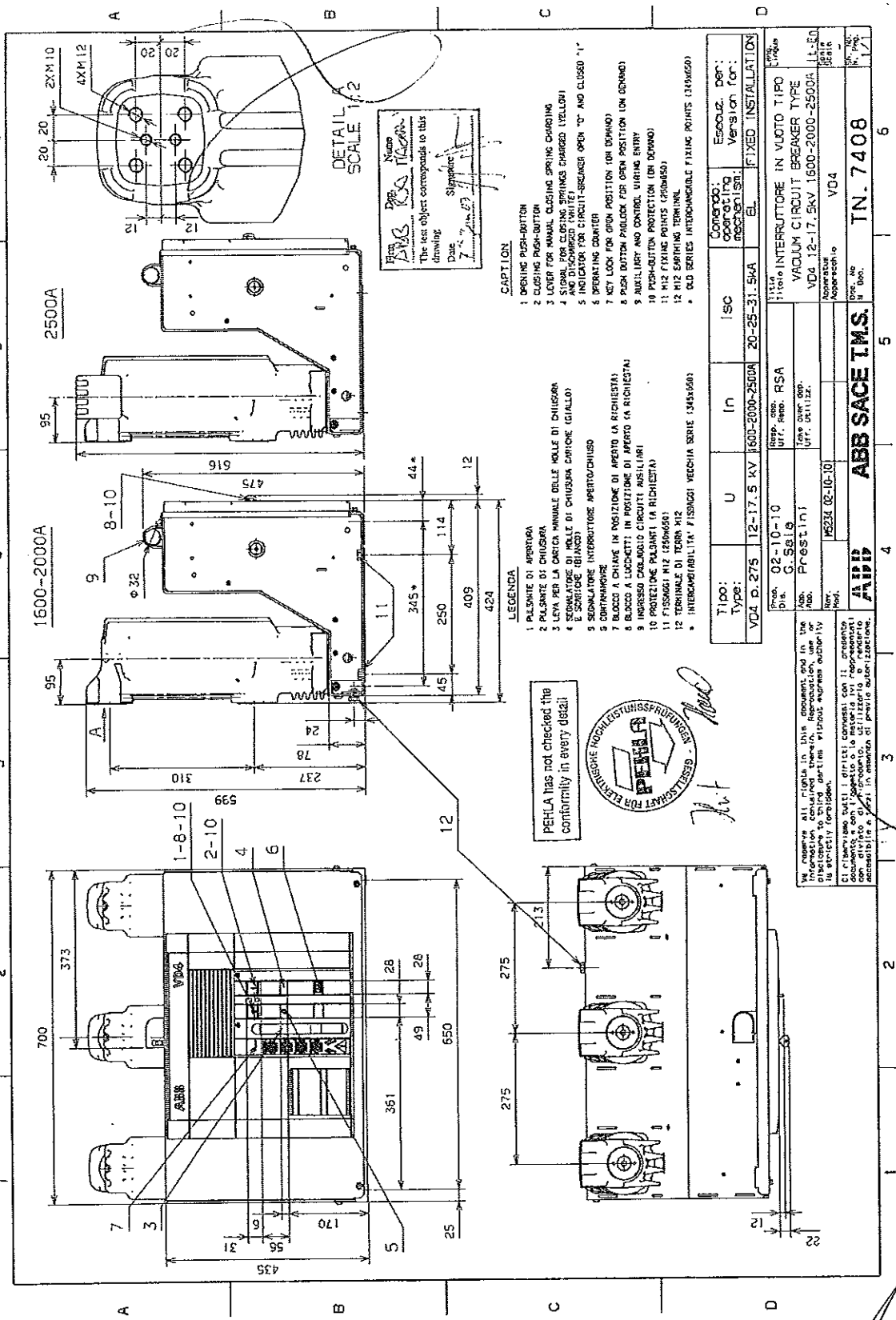
The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. PEHLA has verified that these drawings adequately represent the equipment tested. These drawings have been stamped and signed by PEHLA representatives and are kept

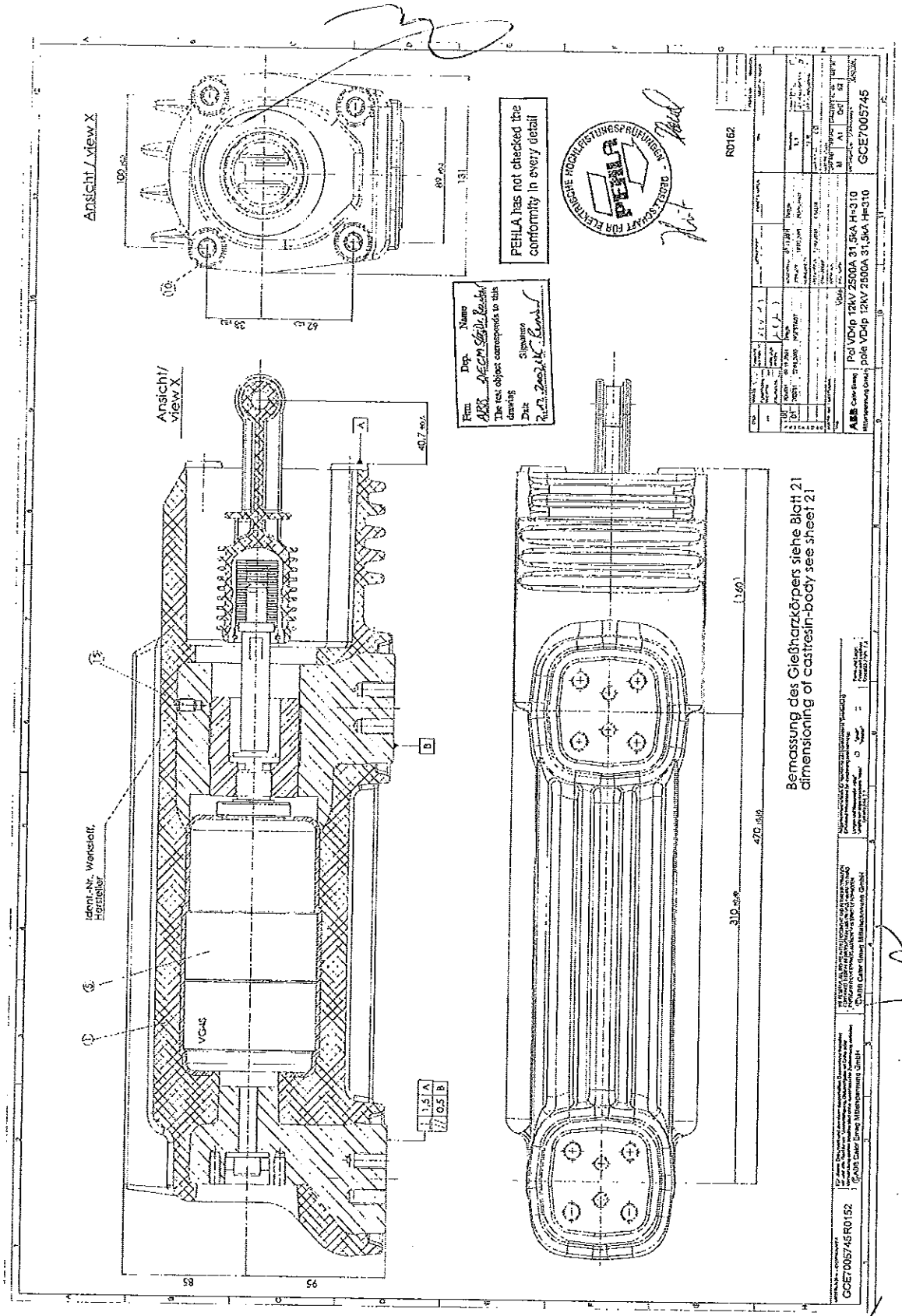
☒ with the test documents at the test laboratory.

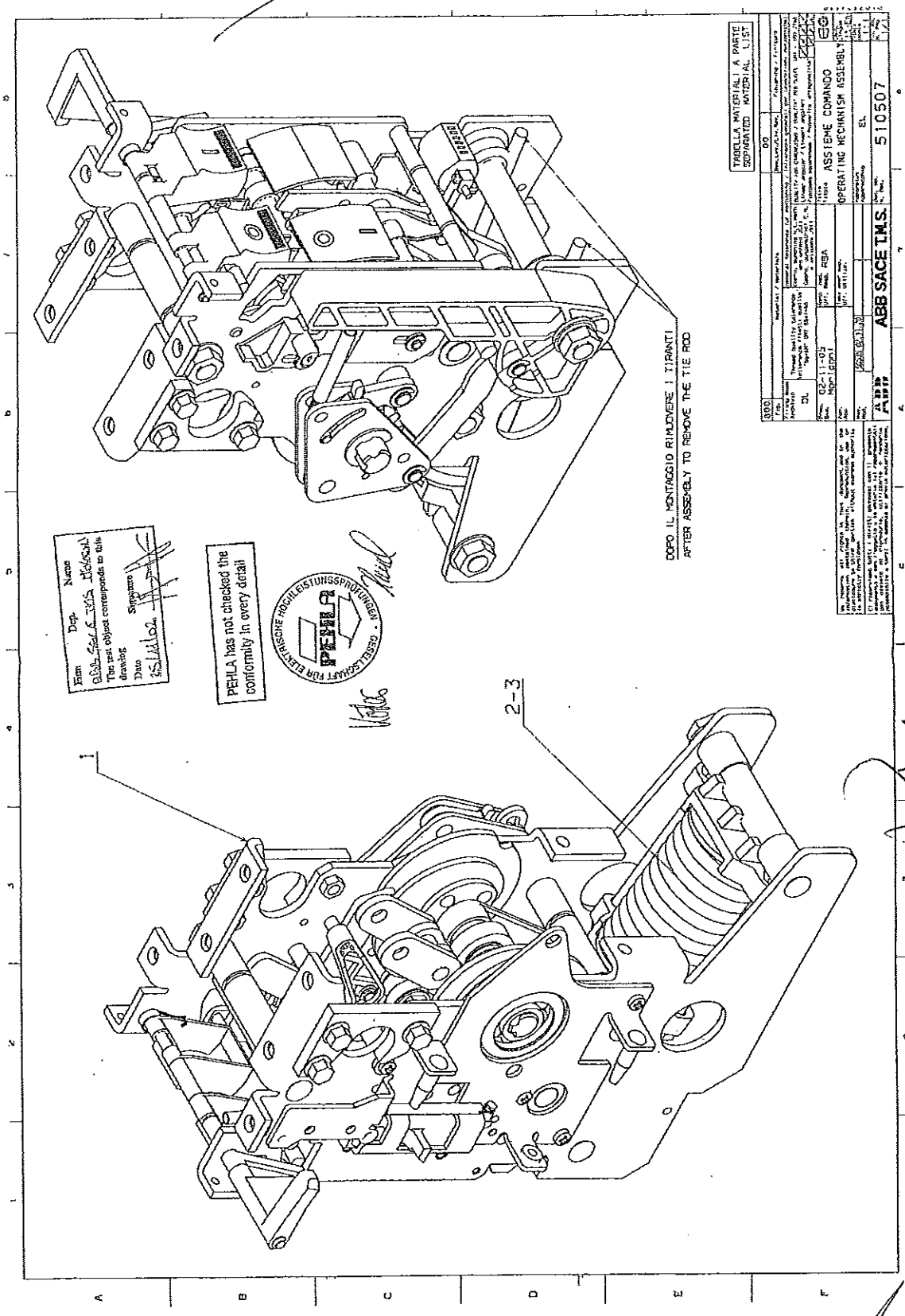
☐ at the client.

The drawings contained in this document are identical with the checked, stamped and signed drawings.

Drawing-No.	Revision	Title	Additional remarks
TN. 7408	M5234	VACUUM CIRCUIT BREAKER TYPE VD4 12-17.5 kV 1600-2000-2500A	Included in this Test Report
GCE7005745R0152	01	pole VD4p 12kV 2500A 31,5kA H=310	Included in this Test Report
510507	50535	OPERATION MECHANISM ASSEMBLY	Included in this Test Report
510564	50535	CLOSING SPRINGS ASSEMBLY	-
Parts list			
510564		Ass. molle di ch. com. EL1	-
510507		Assieme commando EL1	-
GCE7005745R0152		Pol VD4P 12kV 2000A 31,5kA H=310	-


DETAIL
SCALE 1:2
2500A
1600-2000A
CAPTION
1 OPENING PUSH-BUTTON
2 CLOSING PUSH-BUTTON
3 LEVER FOR MANUAL CLOSING SPRING CHARGING
4 SIGNAL FOR CLOSING SPRINGS CHARGED (YELLOW)
5 INDICATOR FOR CIRCUIT-BREAKER OPEN "O" AND CLOSED "I"
6 OPERATING COUNTER
7 KEY LOCK FOR OPEN POSITION (ON DEMAND)
8 PUSH BUTTON PADLOCK FOR OPEN POSITION (ON DEMAND)
9 AUXILIARY AND CONTROL WIRING ENTRY
10 PUSH-BUTTON PROTECTION (ON DEMAND)
11 M12 FIXING POINTS (250x650)
12 M12 EARTHING TERMINAL
* OLD SERIES INTERCHANGEABLE FIXING POINTS (345x650)
LEGENDA
1 PULSANTE DI APERTURA
2 PULSANTE DI CHIUSURA
3 LEVA PER LA CARICA MANUALE DELLE MOLLE DI CHIUSURA
4 SEGNALATORE DI MOLLE DI CHIUSURA CARICHE (GIALLO)
5 SEGNALATORE INTERRUTTORE APERTO/CHIUSO
6 CONTAMANOVRE
7 BLOCCO A CHIAVE IN POSIZIONE DI APERTO (A RICHIESTA)
8 BLOCCO A LUCCHETTI IN POSIZIONE DI APERTO (A RICHIESTA)
9 INGRESSO CABLAGGIO CIRCUITI AUSILIARI
10 PROTEZIONE PULSANTI (A RICHIESTA)
11 FISSAGGI M12 (250x650)
12 TERMINALE DI TERRA M12
* INTERCAMBIABILITA' FISSAGGI VECCHIA SERIE (345x650)
Tipo: VD4 D.275
U 12-17.5 kV
In 1600-2000-2500A
Isc 20-25-31.5kA
Comando: operating mechanism: EL
Esecuz. per: Version for: FIXED INSTALLATION
Data 02-10-10
Disegn. G.Sala
Resp. uff. Rems. RSA
Approv. Prestini
Data conv. appr.
Uff. Utilizz.
Titolo INTERRUTTORE IN VUOTO TIPO VACUUM CIRCUIT BREAKER TYPE VD4 12-17.5kV 1600-2000-2500A
Apparecchio VD4
Disegno No TN. 7408
ABB SACE T.M.S.
PEHLA has not checked the conformity in every detail
GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
ВЯРНО С ОРИГИНАЛА


Ansicht / view X
Ansicht / view X
PEHLA has not checked the conformity in every detail
Firm ABB
The test object corresponds to this drawing
Name
Signature
Date
Bemassung des Gießharzkörpers siehe Blatt 21
dimensioning of castresin-body see sheet 21
Pol VD4p 12kV 2500A 31,5kA H=310
pole VD4p 12kV 2500A 31,5kA H=310
GCE7005745
GCE7005745R0152
RD162
Idnnt-Nr. Werkstoff, Hersteller
VG45



Technical Data of Test Circuits

Test Basic Short-Circuit Test-Duty		T60		T100	
Test No.	0303Ra	04 – 07		08 – 19	
Number of phases	(test circuit)	3		3	
Rated voltage	kV	17.5		17.5	
Number of poles or phases	(test object)	3		3	
Voltage distribution	%	-		-	
Power frequency	Hz	50		50	
Power factor	cos φ	≤ 0.15		≤ 0.15	
Earthing conditions	Generator / System Transformer Short-circuit point	earthed via 5 kΩ not earthed earthed		earthed via 5 kΩ not earthed earthed	
Short-circuit breaking current	kA	18.9		31.5	
Test frequency	Hz	-		-	
Crest value of injected current	kA	-		-	
Corresponding test frequency	Hz	-		-	
Transient Recovery Voltage		required values	actual values	required values	actual values
TRV peak value u_c	kV	32.0	37.3	30.0	29.6
Time t_2 or t_3	µs	31.0	36.0	71.0	64.0
Time delay t_d	µs	-	-	-	-
Rate-of-rise u_1 / t_1 or u_c / t_3	kV/µs	1.04	1.04	0.42	0.46
Voltage u_1	kV	-	-	-	-
Time t_1	µs	-	-	-	-
First peak u_L	kV	-	-	-	-
Time t_L	µs	-	-	-	-
Rate of rise u_L/t_L	kV/µs	-	-	-	-
Surge impedance Z_L	Ω	-	-	-	-
Time Delay t_{dL}	µs	-	-	-	-
Crest value u_T	kV	-	-	-	-
Crest value u_c	kV	-	-	-	-
Voltage measurements		- -	Dividers 4.5 MΩ / 10 kΩ	- -	Dividers 4.5 MΩ / 10 kΩ
Current measurements		- -	Shunts 37.6 µΩ	- -	Shunts 37.6 µΩ

Remarks: -

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Circuits

Test	Basic Short-Circuit Test-Duty		T30		T10	
Test No.		0303Ra	20 – 24		25 – 27	
Number of phases	(test circuit)		3		3	
Rated voltage		kV	17.5		17.5	
Number of poles or phases	(test object)		3		3	
Voltage distribution		%	-		-	
Power frequency		Hz	50		50	
Power factor		cos φ	≤ 0.15		≤ 0.15	
Earthing conditions	Generator / System Transformer Short-circuit point		earthed via 5 kΩ not earthed earthed		earthed via 5 kΩ not earthed earthed	
Short-circuit breaking current		kA	9.45		3.15	
Test frequency		Hz	-		-	
Crest value of injected current		kA	-		-	
Corresponding test frequency		Hz	-		-	
Transient Recovery Voltage			required values	actual values	required values	actual values
TRV peak value u_c		kV	32.0	35.0	32.0	35.4
Time t_2 or t_3		µs	15.0	56.5 *1	15.0	49.0 *1
Time delay t_d		µs	-	-	-	-
Rate-of-rise u_1 / t_1 or u_c / t_3		kV/µs	2.14	0.62	2.14	0.72
Voltage u_1		kV	-	-	-	-
Time t_1		µs	-	-	-	-
First peak u_L		kV	-	-	-	-
Time t_L		µs	-	-	-	-
Rate of rise u_L/t_L		kV/µs	-	-	-	-
Surge impedance Z_L		Ω	-	-	-	-
Time Delay t_{dL}		µs	-	-	-	-
Crest value u_T		kV	-	-	-	-
Crest value u_c		kV	-	-	-	-
Voltage measurements			- -	Dividers 4.5 MΩ / 10 kΩ	- -	Dividers 4.5 MΩ / 10 kΩ
Current measurements			- -	Shunts 37.6 µΩ	- -	Shunts 37.6 µΩ

Remarks:

*1 Due to limitations of the test plant, the length of time t_3 of the TRV is greater than the rated value.

Technical Data of Test Circuits

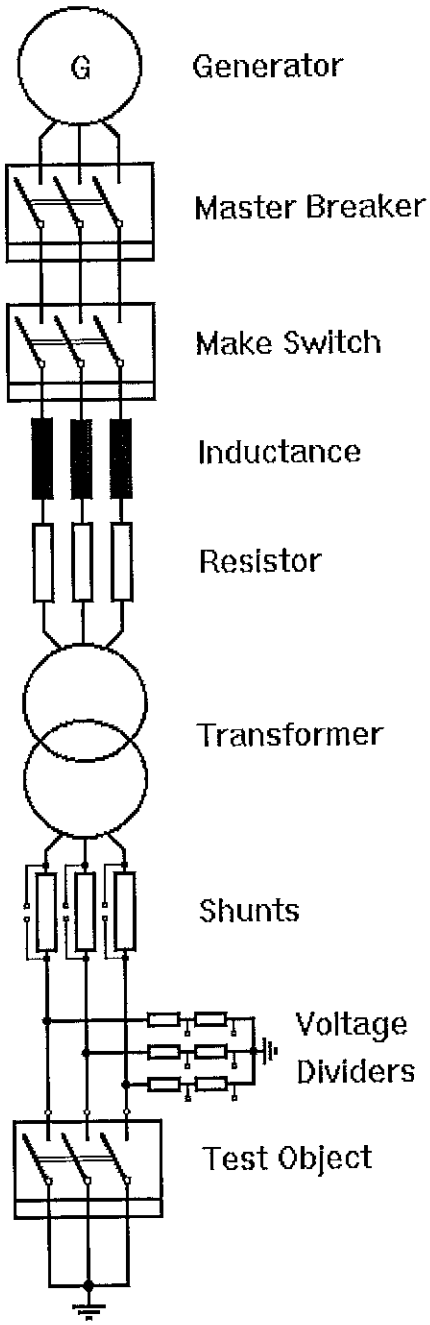
Test		Double-earth fault test		-	
Test No.	0303Ra	29 – 31		-	
Number of phases	(test circuit)	2		-	
Rated voltage	kV	17.5		-	
Number of poles or phases	(test object)	1		-	
Voltage distribution	%	-		-	
Power frequency	Hz	50		-	
Power factor	cos φ	≤ 0.15		-	
Earthing conditions	Generator / System	earthed via 5 kΩ		-	
	Transformer	not earthed		-	
	Short-circuit point	earthed		-	
Short-circuit breaking current	kA	27.4		-	
Test frequency	Hz	-		-	
Crest value of injected current	kA	-		-	
Corresponding test frequency	Hz	-		-	
Transient Recovery Voltage		required values	actual values	required values	actual values
TRV peak value u_c	kV	34.6	34.1	-	-
Time t_2 or t_3	µs	81.9	77.5	-	-
Time delay t_d	µs	-	-	-	-
Rate-of-rise u_1 / t_1 or u_c / t_3	kV/µs	0.42	0.44	-	-
Voltage u_1	kV	-	-	-	-
Time t_1	µs	-	-	-	-
First peak u_L	kV	-	-	-	-
Time t_L	µs	-	-	-	-
Rate of rise u_L/t_L	kV/µs	-	-	-	-
Surge impedance Z_L	Ω	-	-	-	-
Time Delay t_{dL}	µs	-	-	-	-
Crest value u_T	kV	-	-	-	-
Crest value u_c	kV	-	-	-	-
Voltage measurements		-	Dividers	-	-
		-	4.5 MΩ /	-	-
			10 kΩ		
Current measurements		-	Shunts	-	-
		-	37.6 µΩ	-	-

Remarks: -

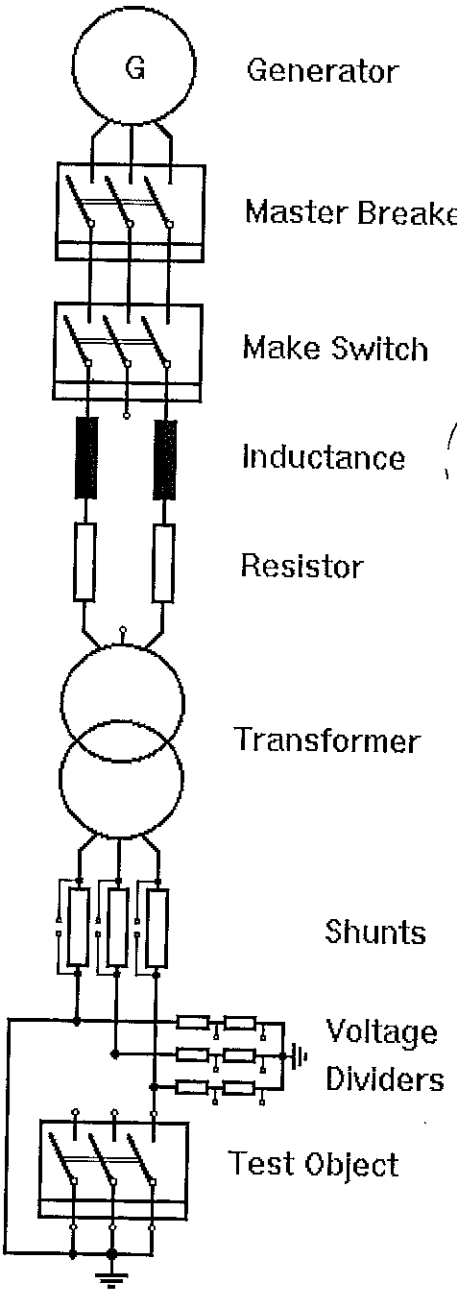
ВЯРНО С ОРИГИНАЛА

Principle Diagram of Three-phase Test Circuits

Basic Short-circuit Test Duties T10 - T100



Principle Diagram of Single-phase Test Circuit



ВЯРНО С ОРИГИНАЛА

Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: T60

Date of test: 09th January 2003

Condition of test object before test: Factory new.

Connections to test object: By means of copper bars to the upper terminals of the circuit-breaker. Lower terminals of the circuit-breaker short-circuited and earthed.

Arc extinguishing medium: Vacuum

Test No. PEHLA 0303Ra				6		7
Operating sequence				O - 0.3s - CO - 3min - CO		
Applied voltage		kV		-	18.6	17.7
Short-circuit making current		kA	L1	-	44.2	34.7
			L2	-	39.2	47.0
			L3	-	51.3	50.7
Short-circuit breaking current	Short-circuit current	kA	L1	19.6	18.4	18.6
			L2	17.8	18.5	18.5
			L3	19.6	18.7	18.8
	Average value	kA		19.0	18.5	18.6
	d.c. component	%	L1	< 20	< 20	< 20
			L2	< 20	< 20	< 20
			L3	< 20	< 20	< 20
Recovery voltage		kV	L1	10.7	10.1	10.5
			L2	10.7	10.1	10.4
			L3	10.7	10.2	10.4
Average value (phase-to-phase)		kV	-	18.5	17.6	18.1
Transient Recovery Voltage (TRV), first-pole-to-clear		kV		- 33.4	- 33.8	- 35.8
Arcing time		ms	L1	1.0	2.2	1.4
			L2	6.6	7.0	8.2
			L3	7.0	7.8	8.2
Closing time		ms		-	64.6	65.6
Opening time		ms		69.7	70.1	71.6
Result				P	P	P

Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

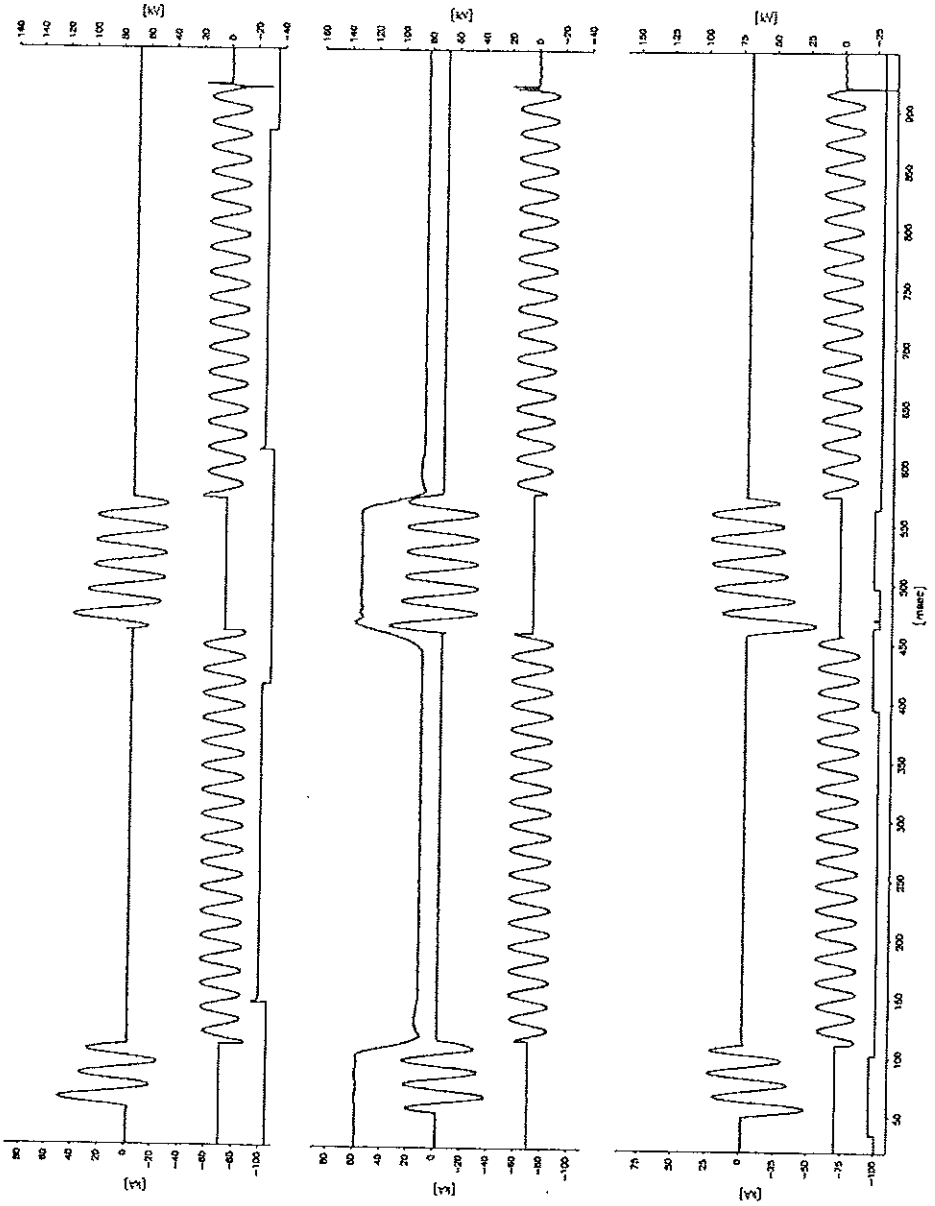
Remarks:

PEHLA 0303Ra / 01: Current calibration
PEHLA 0303Ra / 02: No-load operations before tests
PEHLA 0303Ra / 03: Voltage calibration
PEHLA 0303Ra / 04 and 05: Tests with reduced values
PEHLA 0303Ra / 06 and 07: The operating devices are supplied at their minimum voltage.

Condition of test object after test: Circuit-breaker without functional or visible change.

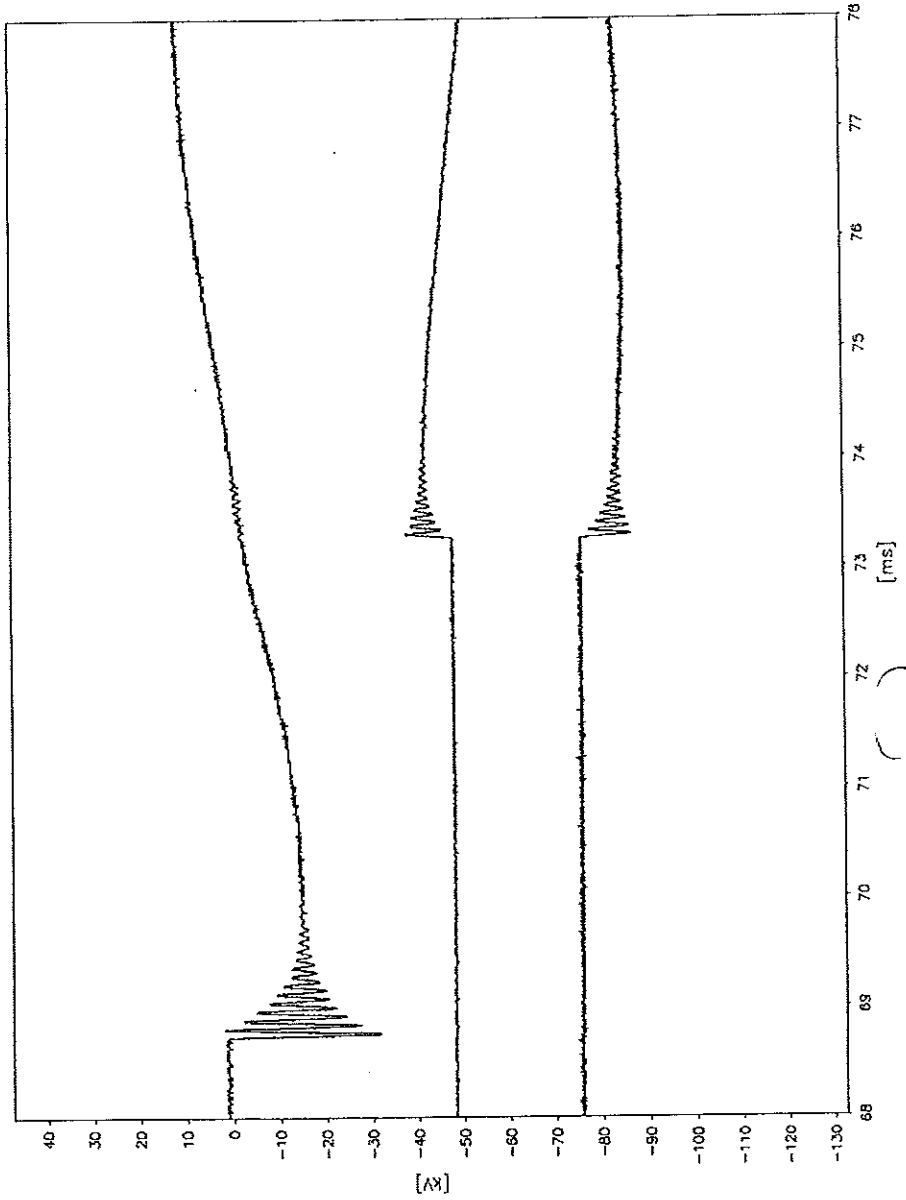
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0303Ra / 06



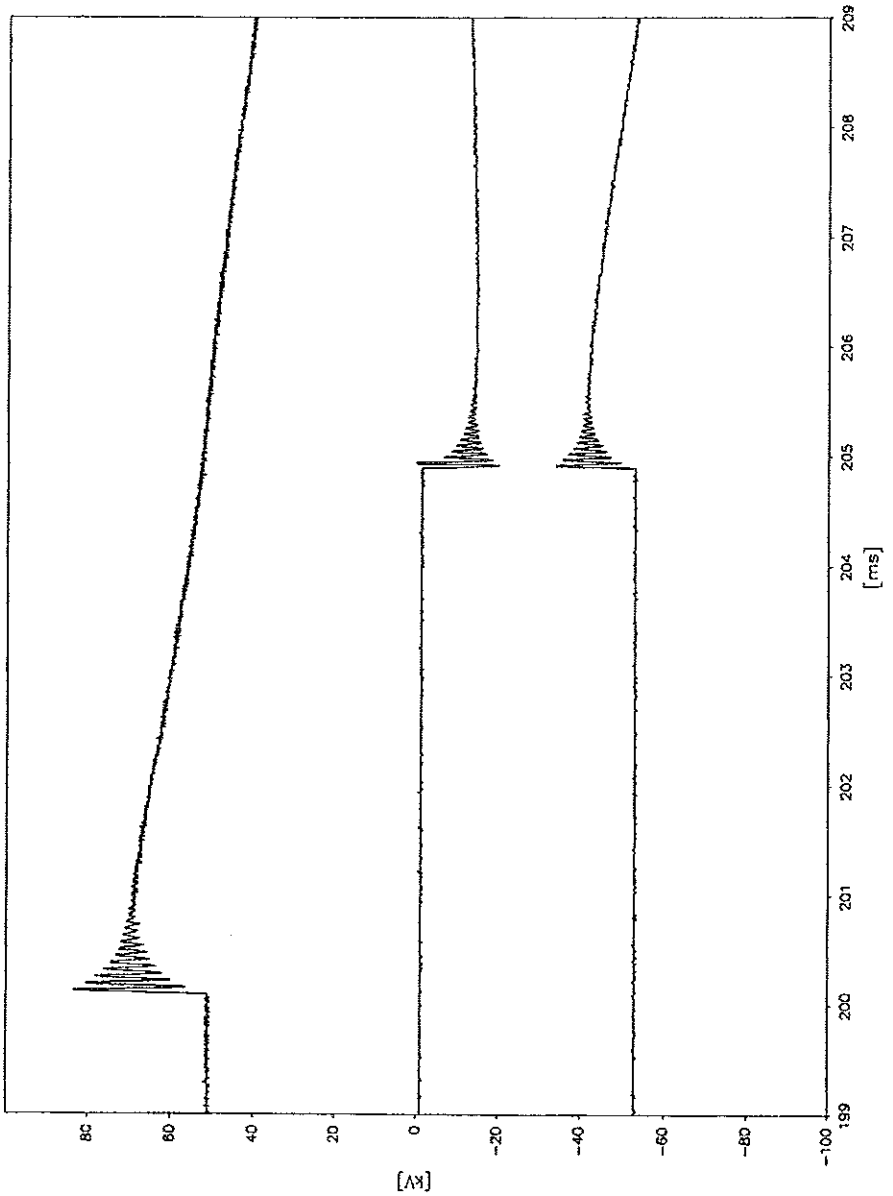
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0303Ra / 06
Transient Recovery Voltage, First O

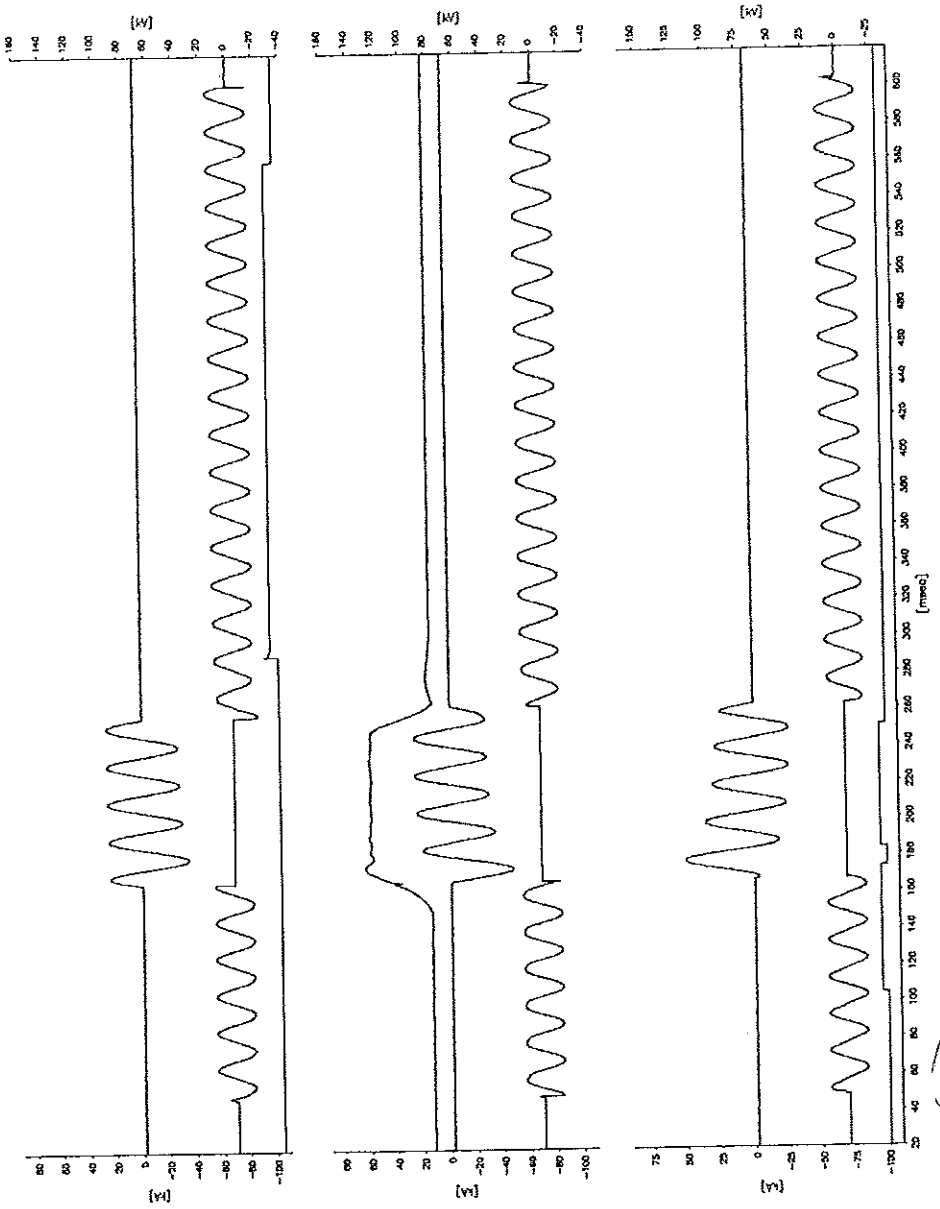


ВЯРНО С ОРИГИНАЛА

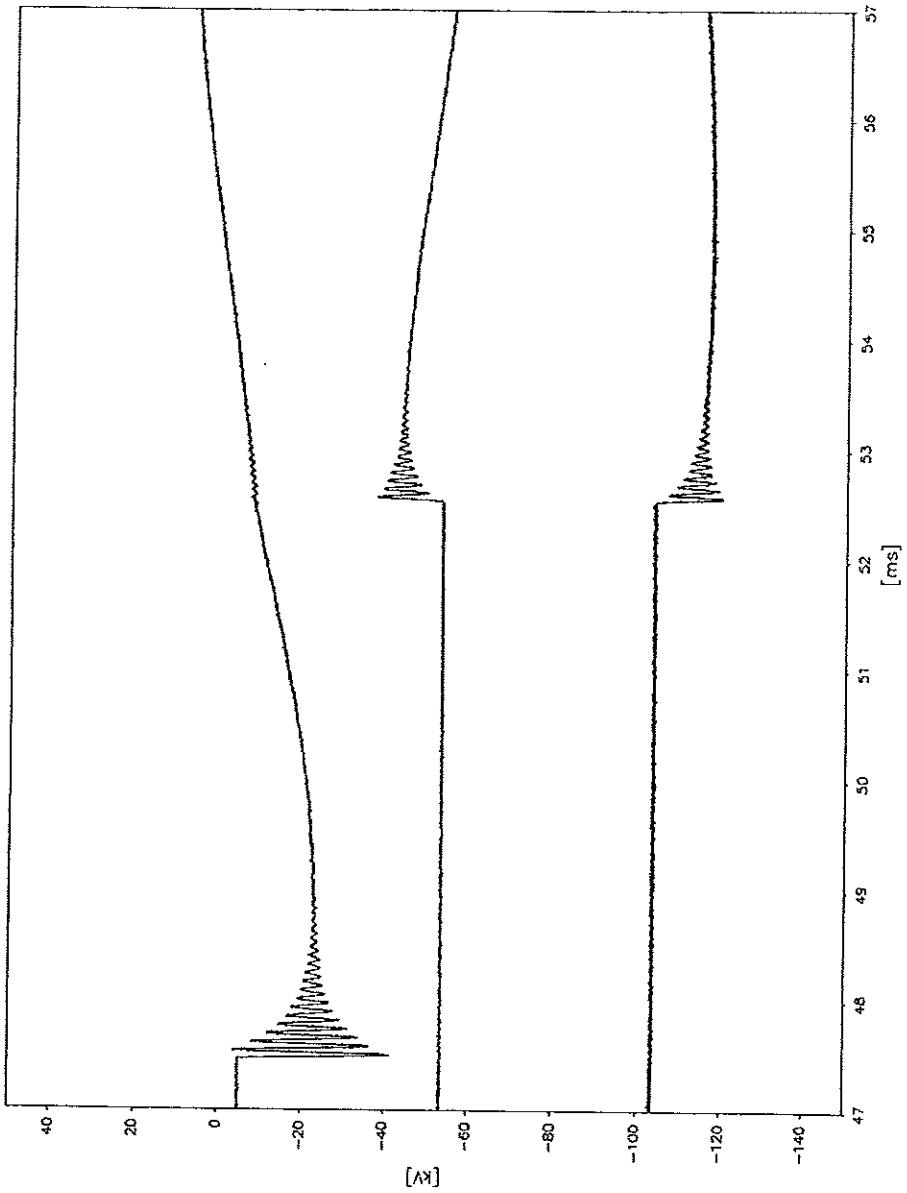
Test no.
PEHLA 0303Ra / 06
Transient Recovery Voltage, Second O



Test no.
PEHLA 0303Ra / 07



Test no.
PEHLA 0303Ra / 07
Transient Recovery Voltage



Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: T100s

Date of test: 09th January 2003

Condition of test object before test: As after test PEHLA 0303Ra / 07.

Connections to test object: By means of copper bars to the upper terminals of the circuit-breaker. Lower terminals of the circuit-breaker short-circuited and earthed.

Arc extinguishing medium: Vacuum

Test No. PEHLA 0303Ra				10		11
Operating sequence				O - 0.3s - CO - 3min - CO		
Applied voltage		kV		-	20.6	20.3
Short-circuit making current		kA	L1	-	56.1	88.8
			L2	-	83.7	77.8
			L3	-	84.7	55.6
Short-circuit breaking current	Short-circuit current	kA	L1	33.9	31.2	32.2
			L2	33.3	32.7	32.5
			L3	32.5	32.9	32.1
	Average value	kA		33.2	32.3	32.3
	d.c. component	%	L1	< 20	< 20	< 20
			L2	< 20	< 20	< 20
			L3	< 20	< 20	< 20
Recovery voltage		kV	L1	12.0	11.0	11.3
			L2	12.1	11.4	11.3
			L3	12.0	11.1	11.2
Average value (phase-to-phase)		kV	-	20.8	19.3	19.5
Transient Recovery Voltage (TRV), first-pole-to-clear		kV		- 33.4	- 28.6	- 32.5
Arcing time		ms	L1	5.2	8.4	17.5
			L2	10.5	8.6	10.1
			L3	10.3	3.0	18.1
Closing time		ms		-	66.2	62.0
Opening time		ms		68.5	70.0	73.3
Result				P	P	P

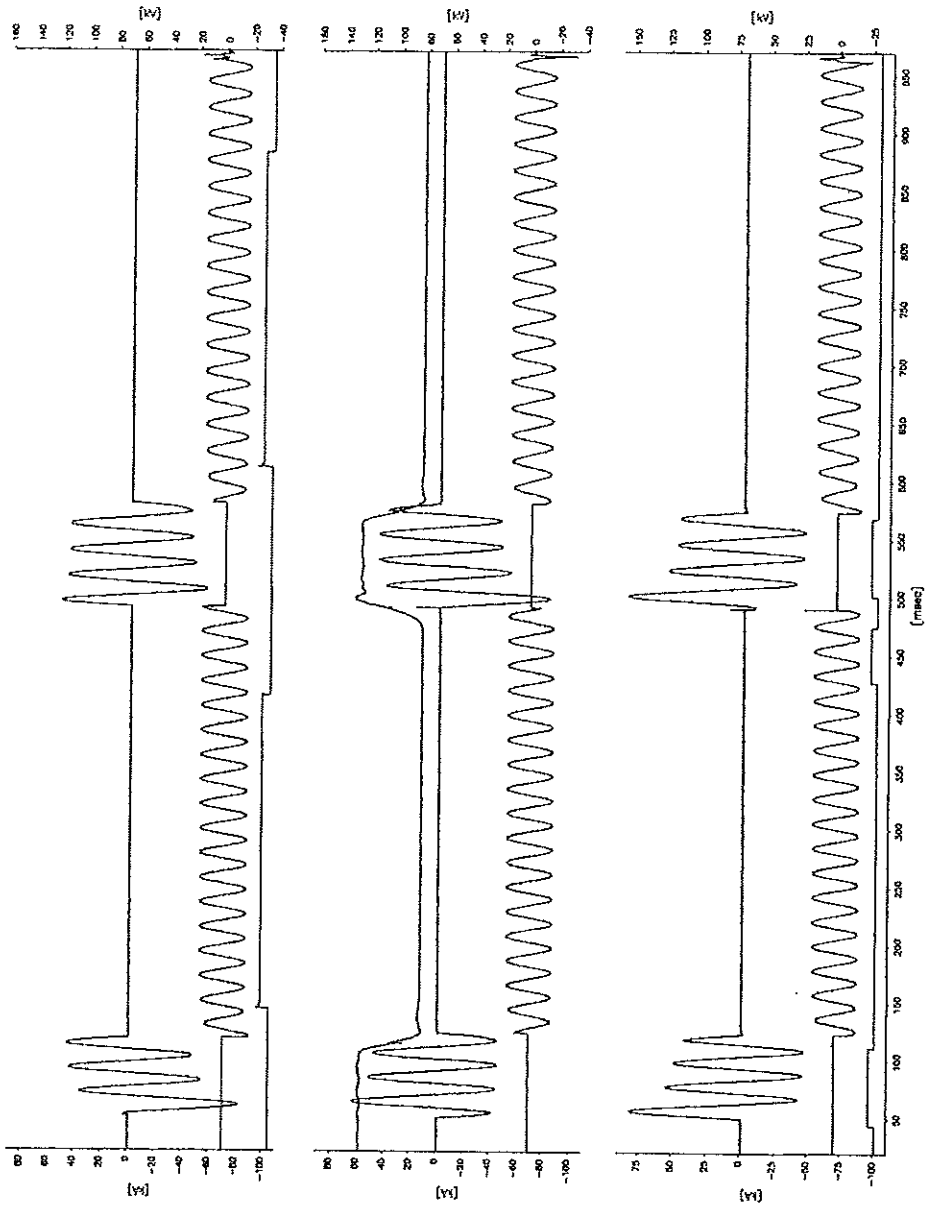
Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

Remarks:
PEHLA 0303Ra / 08 to 10: Tests with reduced values
PEHLA 0303Ra / 10 and 11: The operating devices are supplied at their minimum voltage.

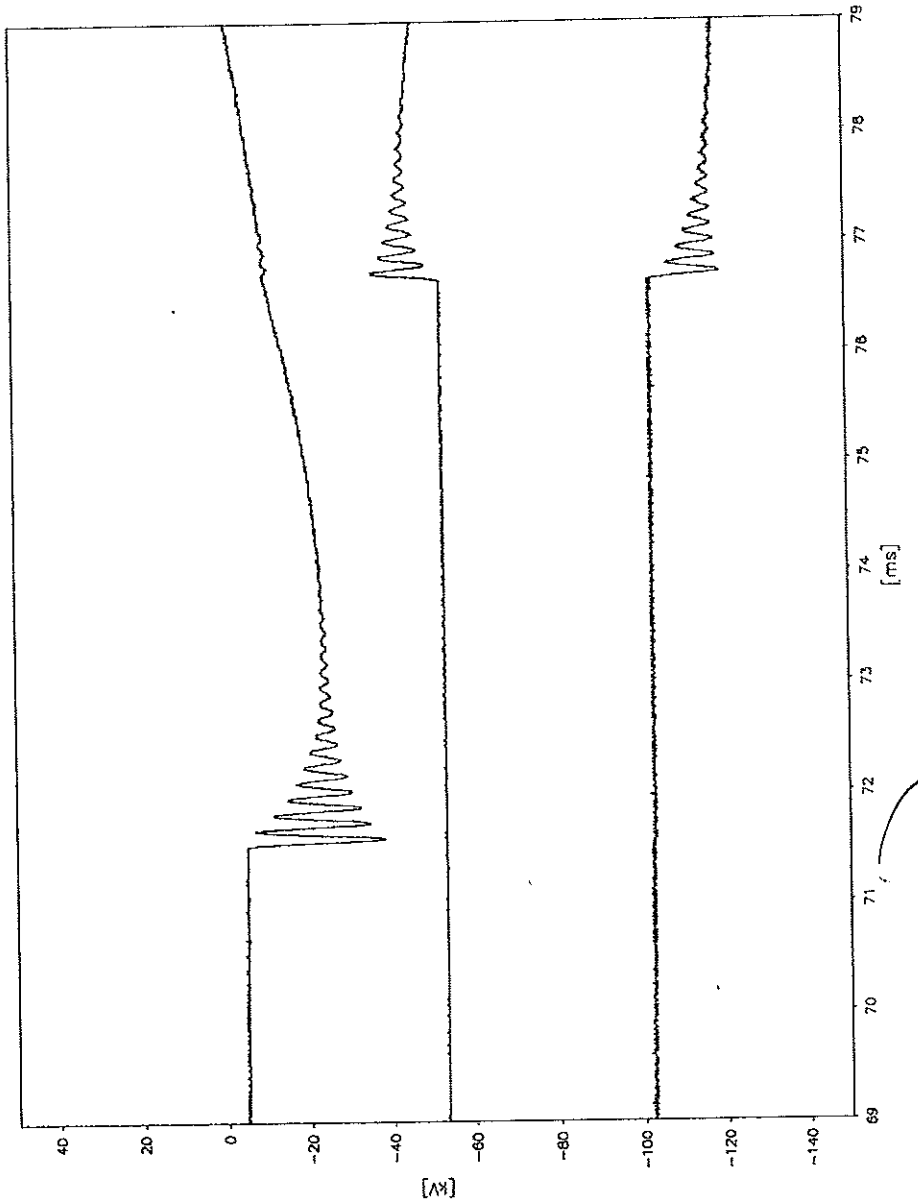
Condition of test object after test: Circuit-breaker without functional or visible change.

ВЯРНО С ОРИГИНАЛА

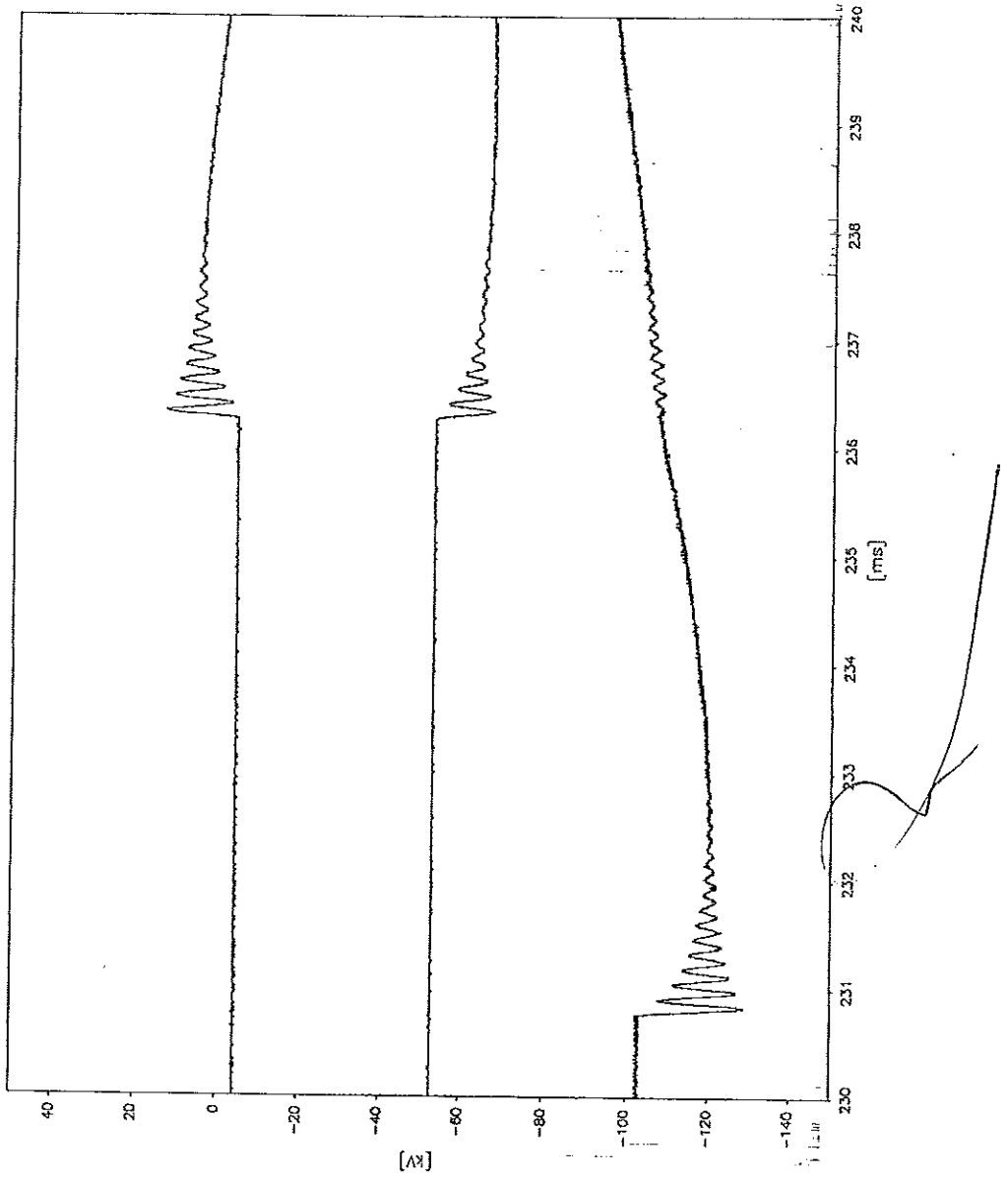
Test no.
PEHLA 0303Ra / 10



Test no.
PEHLA 0303Ra / 10
Transient Recovery Voltage, First O

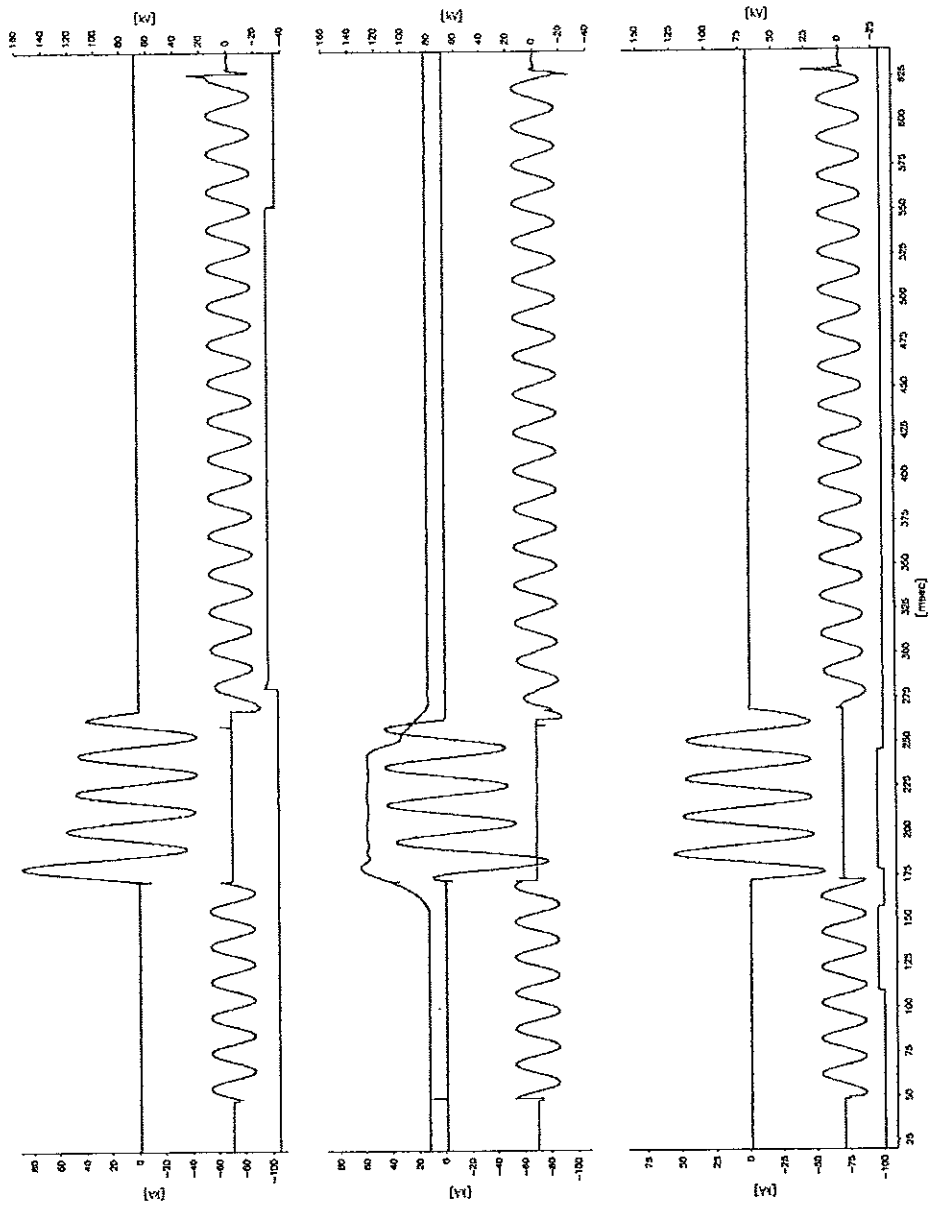


Test no.
PEHLA 0303Ra / 10
Transient Recovery Voltage, Second O



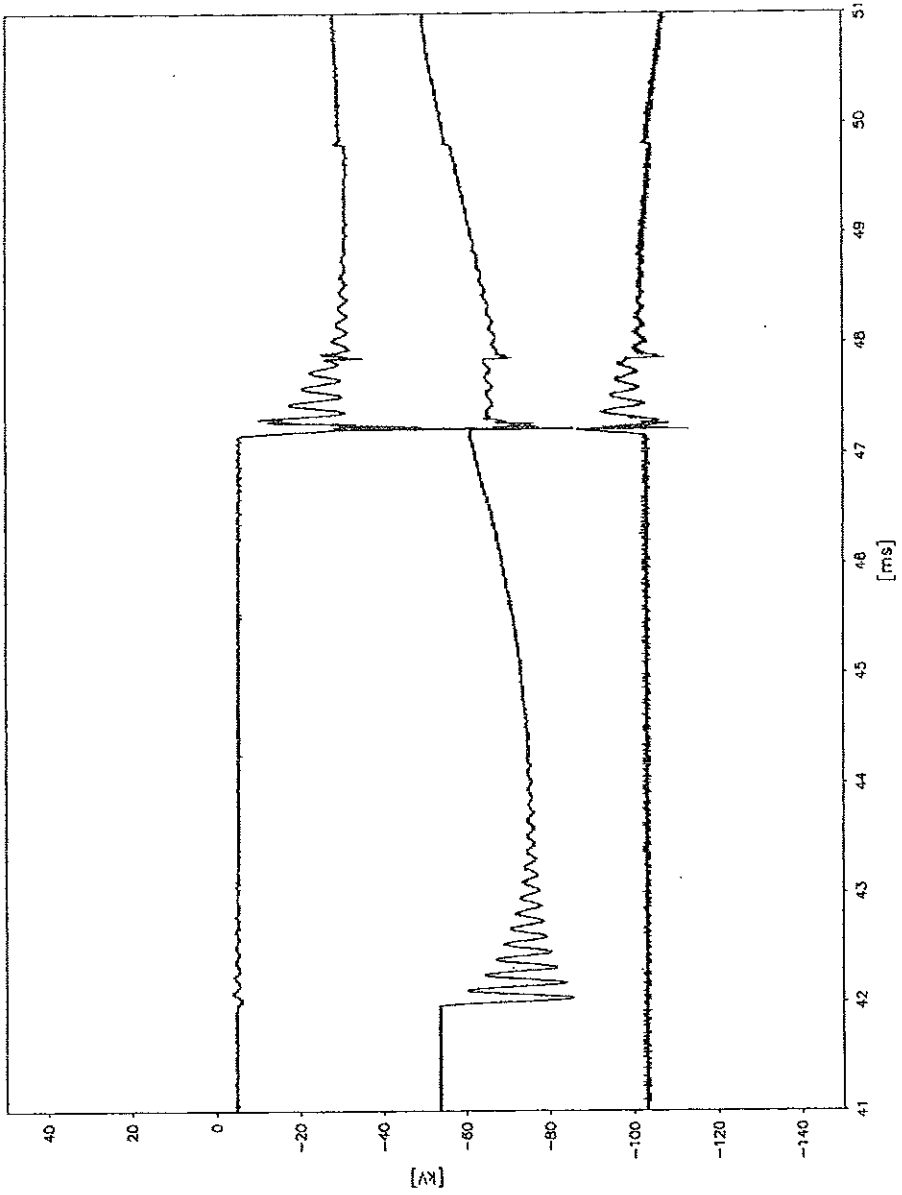
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0303Ra / 11



ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0303Ra / 11
Transient Recovery Voltage



Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: T100a

Date of test: 09th January 2003

Condition of test object before test: As after test PEHLA 0303Ra / 11.

Connections to test object: By means of copper bars to the upper terminals of the circuit-breaker. Lower terminals of the circuit-breaker short-circuited and earthed.

Arc extinguishing medium: Vacuum

Test No. PEHLA 0303Ra				17	18	19
Operating sequence				O	O	O
Applied voltage		kV		-	-	-
Short-circuit making current			L1	-	-	-
		kA	L2	-	-	-
			L3	-	-	-
Short-circuit breaking current			L1	30.8	31.8	31.3
	Short-circuit current	kA	L2	31.6	31.8	31.9
			L3	32.0	32.4	31.6
	Average value	kA		31.5	32.0	31.6
			L1	24.3	< 20	25.3
	d.c. component	%	L2	22.8	32.2	< 20
			L3	< 20	25.8	26.8
Δt_1			L1	12.3	-	-
		ms	L2	-	12.5	-
			L3	-	-	12.0
Peak last loop			L1	54.9	-	-
		kA	L2	-	56.7	-
			L3	-	-	55.4
Recovery voltage			L1	11.2	11.3	11.4
		kV	L2	11.7	11.5	11.0
			L3	11.1	11.2	11.5
Average value (phase-to-phase)		kV	-	19.6	19.6	19.6
Transient Recovery Voltage (TRV),				-	-	-
first-pole-to-clear		kV		33.6	33.4	31.6
Arcing time			L1	5.0	5.6	10.3
		ms	L2	9.4	10.9	5.2
			L3	9.4	10.7	9.6
Opening time		ms		45.4	45.2	45.1
Result				P	P	P

Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

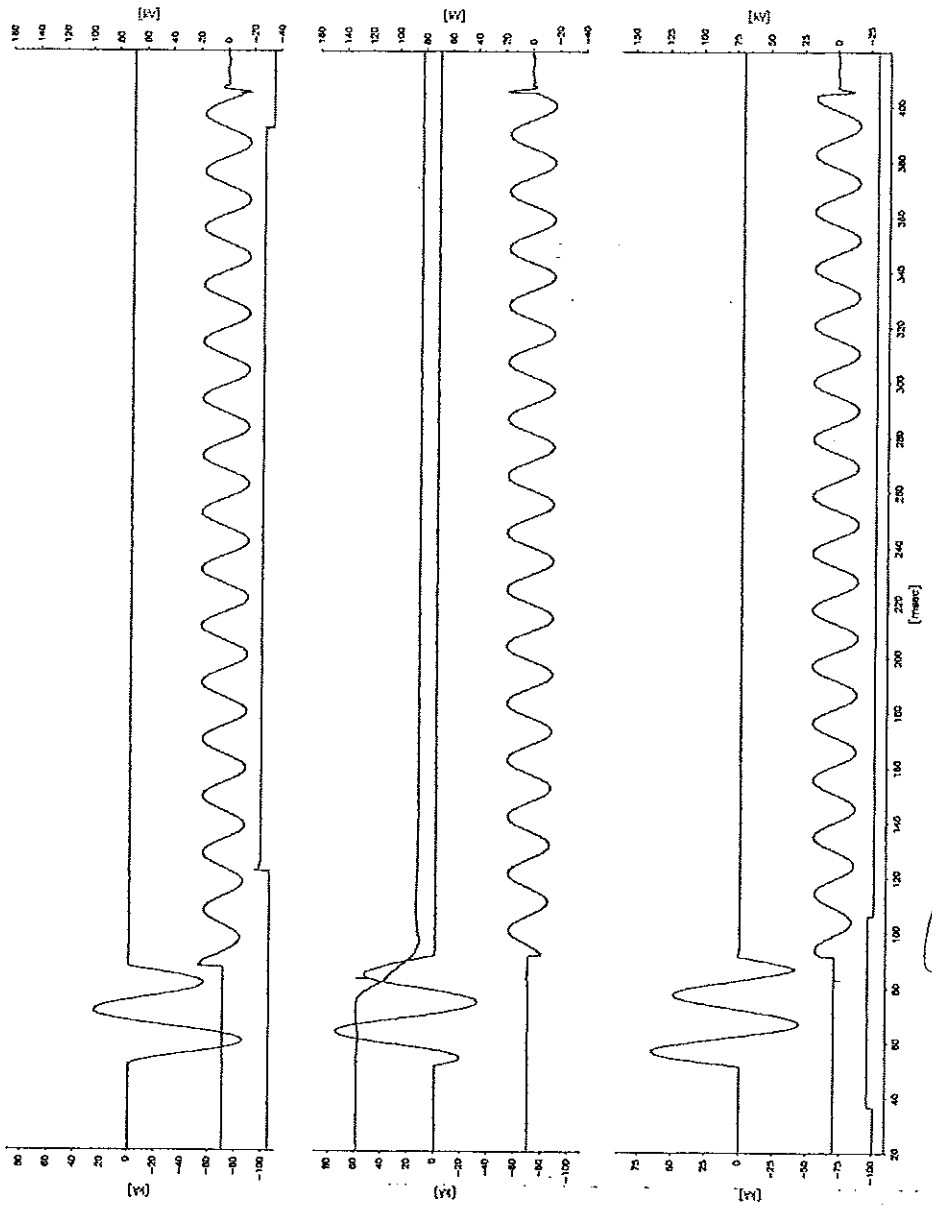
Remarks:

PEHLA 0303Ra / 12 to 16: Tests for determination of the prospective d.c. component.
PEHLA 0303Ra / 17 to 19: The operating devices are supplied at their maximum voltage.

Condition of test object after test: Circuit-breaker without functional or visible change.

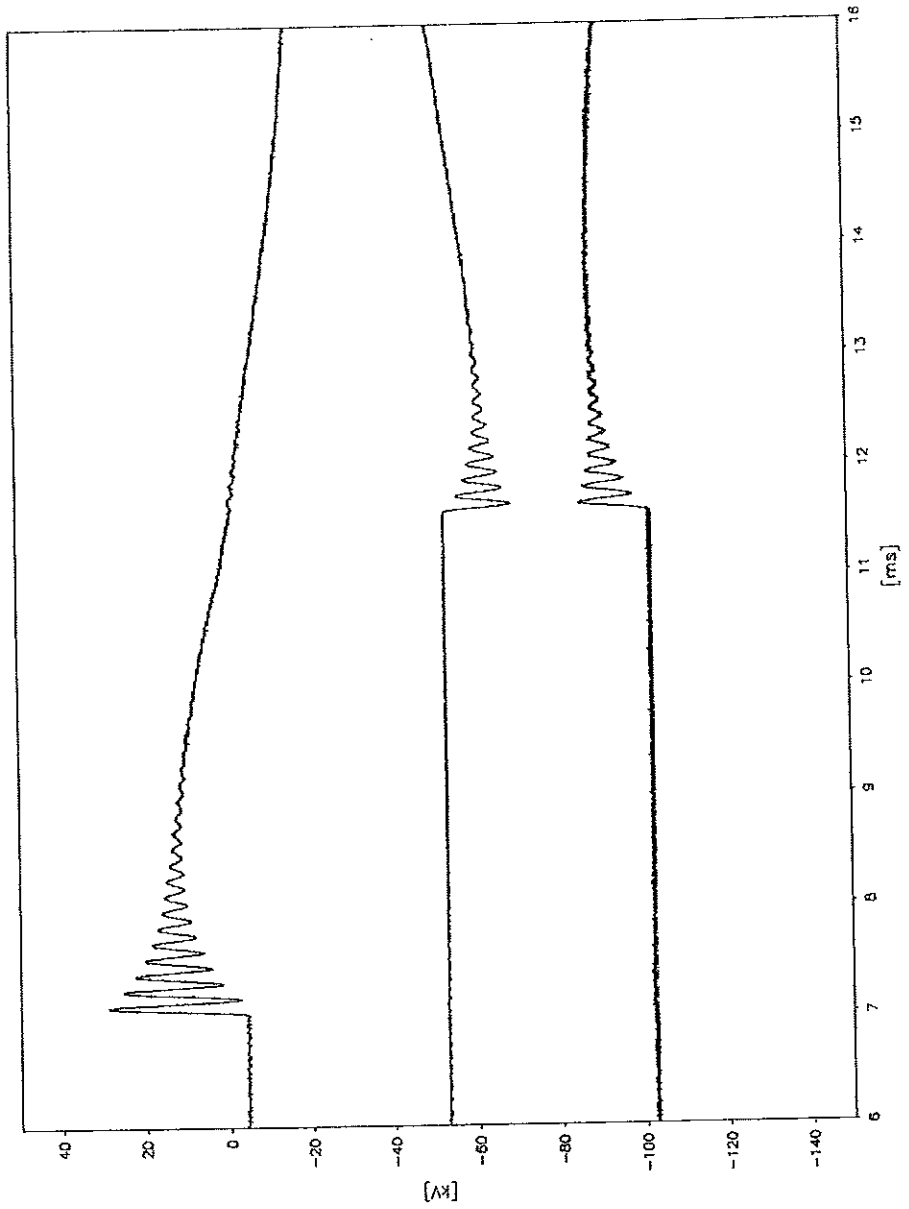
ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0303Ra / 17

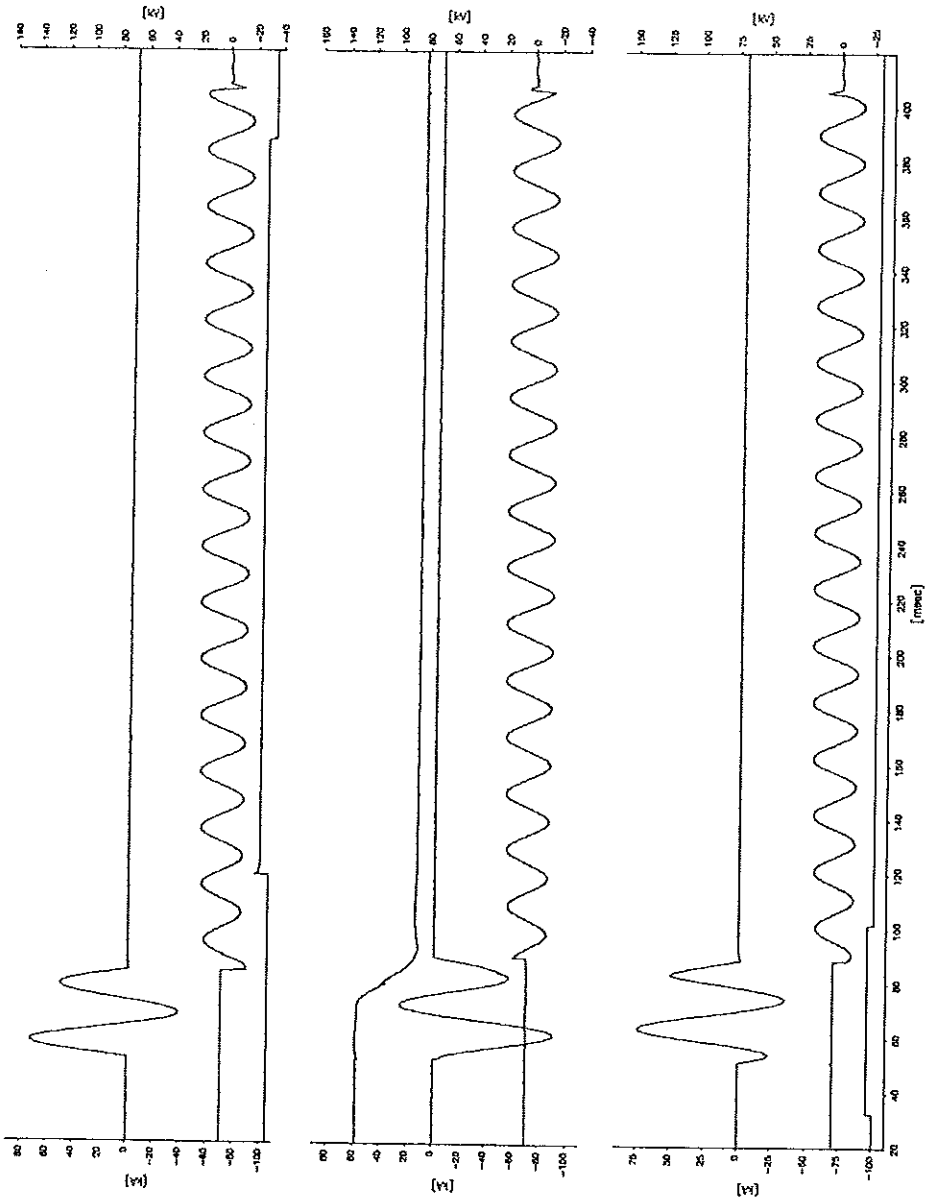


ВЯРНО С ОРИГИНАЛА

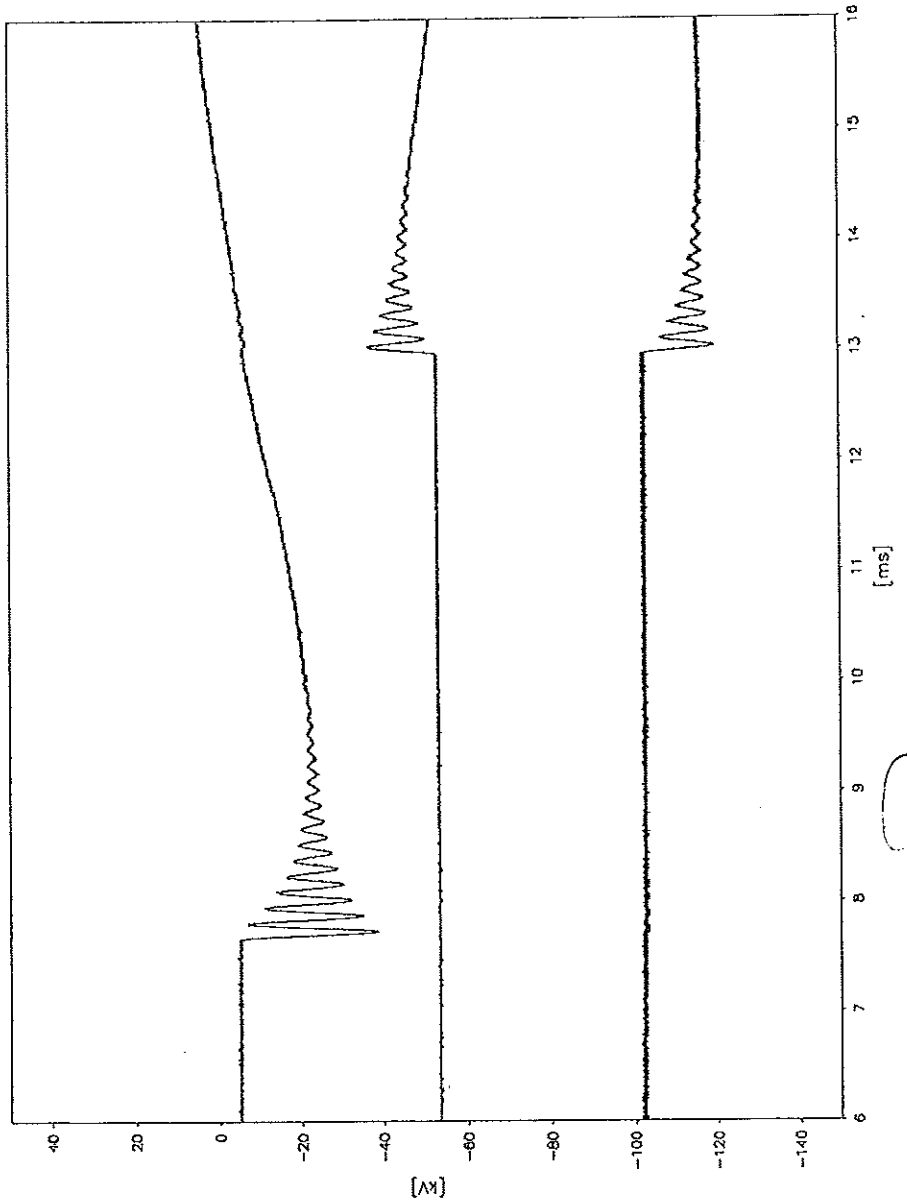
Test no.
PEHLA 0303Ra / 17
Transient Recovery Voltage



Test no.
PEHLA 0303Ra / 18

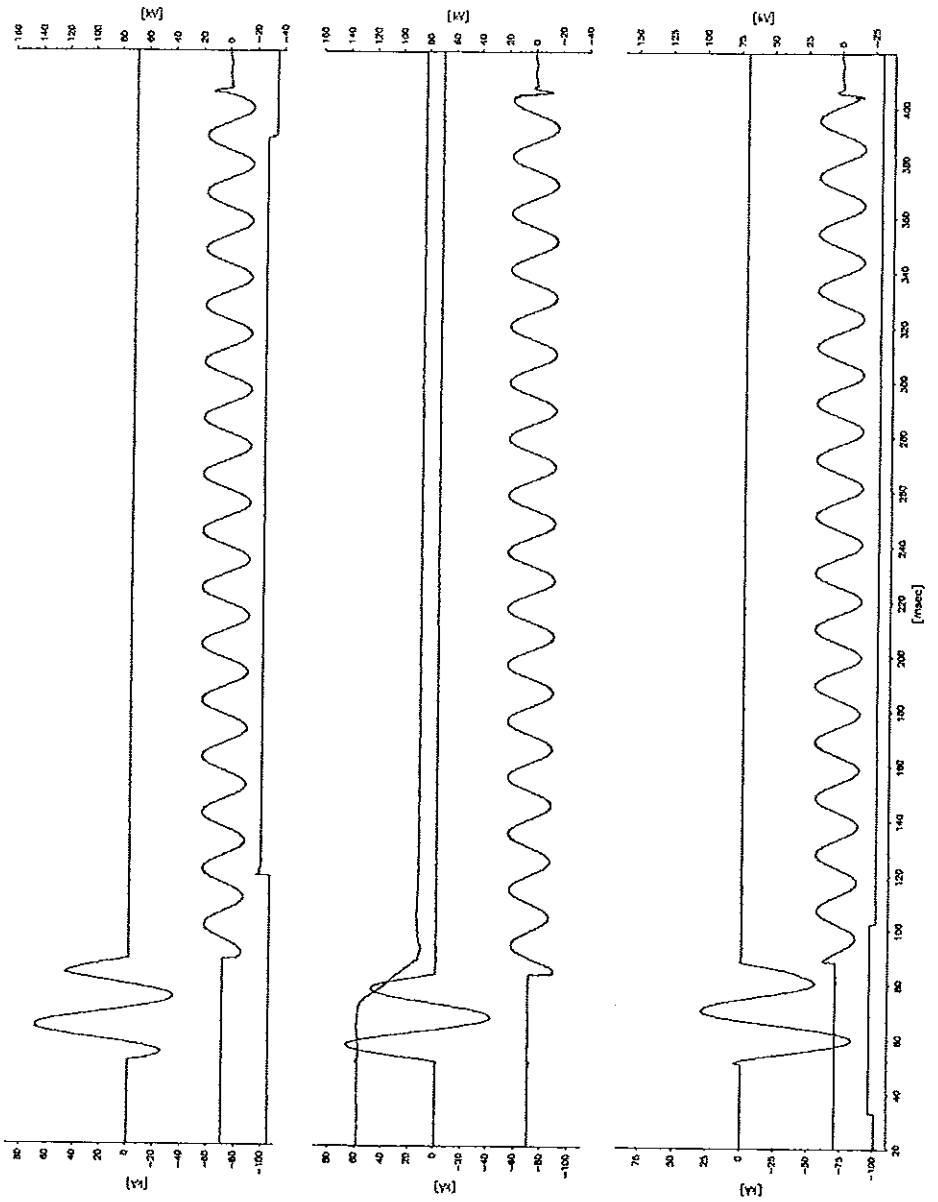


Test no.
PEHLA 0303Ra/ 18
Transient Recovery Voltage

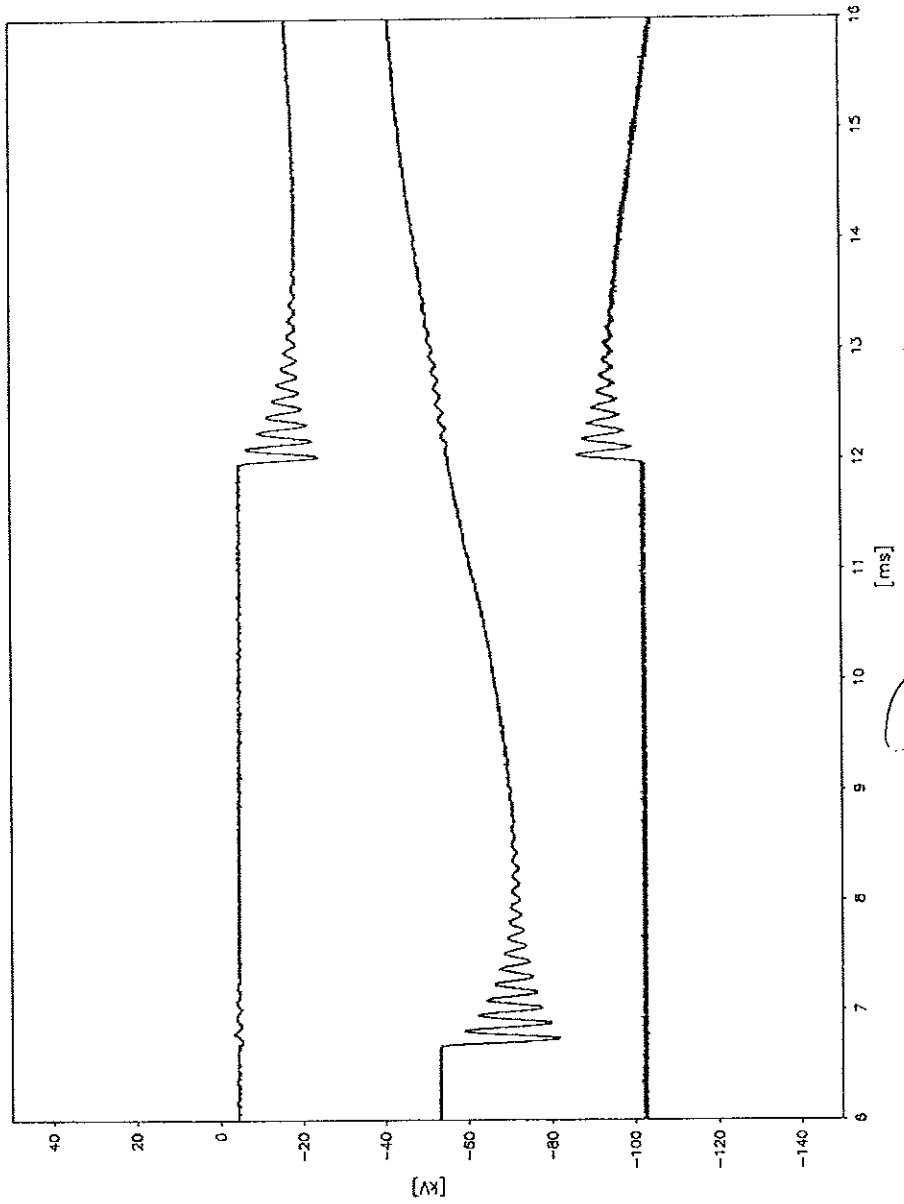


ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0303Ra / 19



Test no.
PEHLA 0303Ra / 19
Transient Recovery Voltage



Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: T30

Date of test: 10th January 2003

Condition of test object before test: As after test PEHLA 0303Ra / 19

Connections to test object: By means of copper bars to the upper terminals of the circuit-breaker. Lower terminals of the circuit-breaker short-circuited and earthed.

Arc extinguishing medium: Vacuum

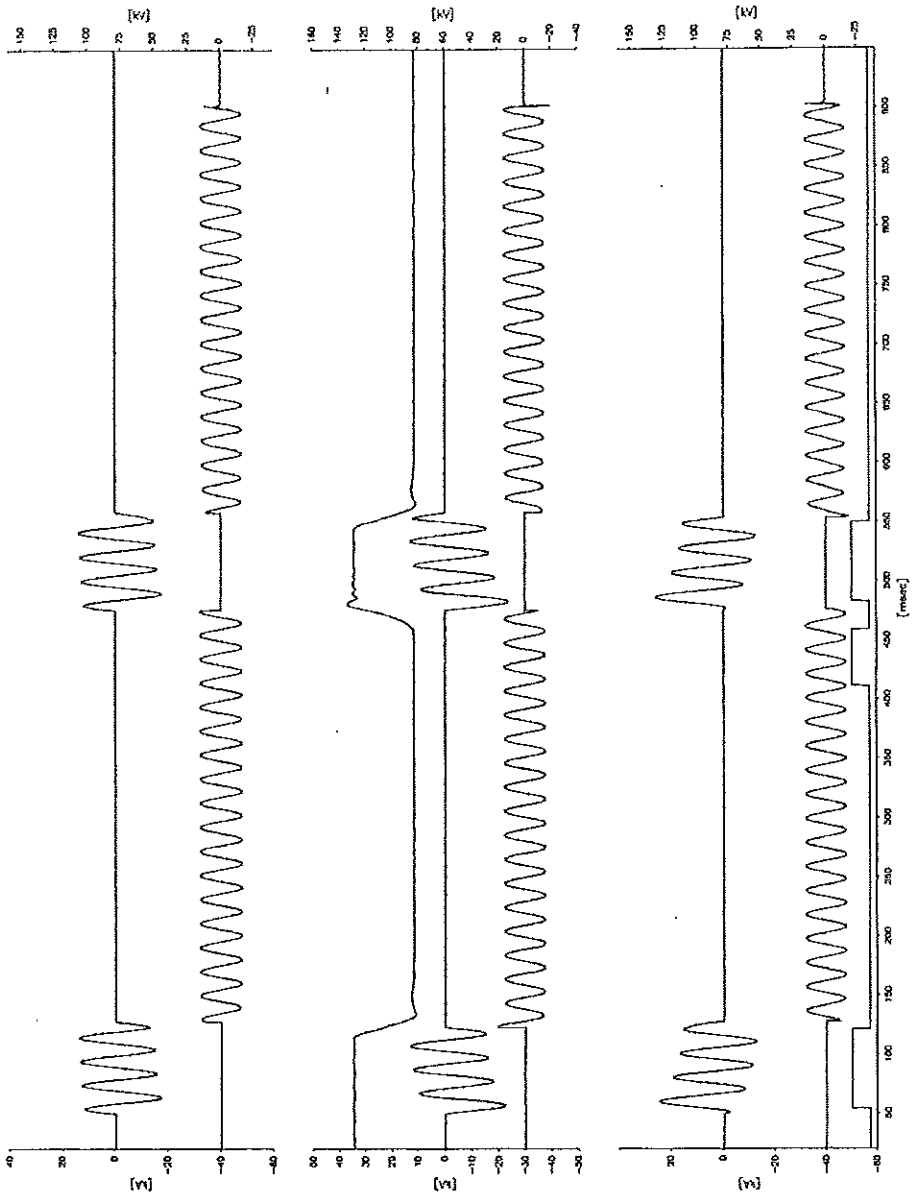
Test No. PEHLA 0303Ra				22		23
Operating sequence				O - 0.3s - CO - 3min - CO		
Applied voltage		kV		-	19.2	18.9
Short-circuit making current		kA	L1	-	17.7	16.0
			L2	-	23.7	24.7
			L3	-	25.7	24.0
Short-circuit breaking current	Short-circuit current	kA	L1	10.1	10.2	10.0
			L2	10.3	10.0	9.93
			L3	10.4	10.3	10.2
	Average value	kA		10.2	10.2	10.1
	d.c. component	%	L1	< 20	< 20	< 20
			L2	< 20	< 20	< 20
			L3	< 20	< 20	< 20
Recovery voltage		kV	L1	11.1	10.7	10.5
			L2	11.0	10.7	10.8
			L3	11.0	10.9	10.7
Average value (phase-to-phase)		kV	-	19.1	18.6	18.5
Transient Recovery Voltage (TRV), first-pole-to-clear		kV		- 34.2	- 32.4	- 31.8
Arcing time		ms	L1	7.0	7.0	7.8
			L2	2.0	7.0	3.6
			L3	7.0	2.0	8.0
Closing time		ms		-	64.8	65.4
Opening time		ms		66.1	68.0	68.6
Result				P	P	P

Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

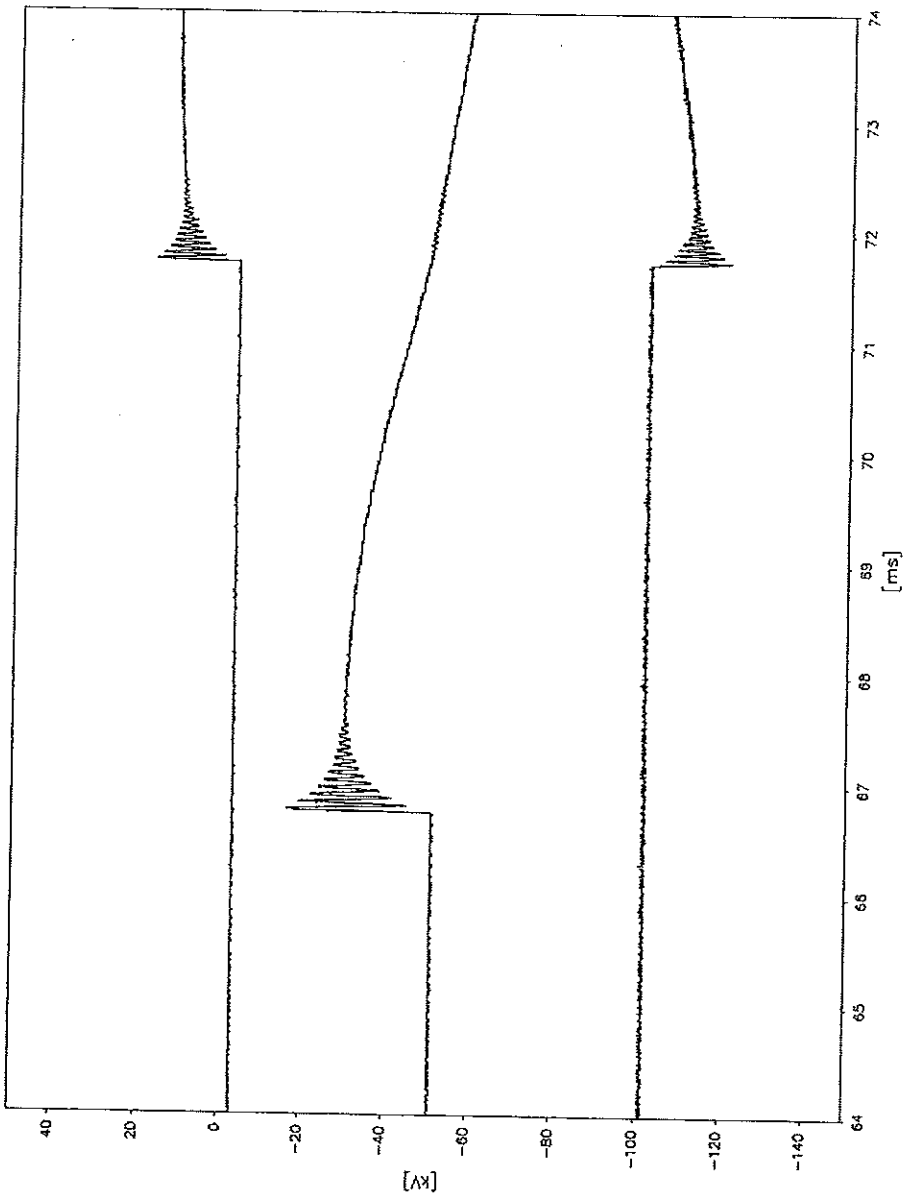
Remarks:
PEHLA 0303Ra / 20 and 21: Tests with reduced values
PEHLA 0303Ra / 22 and 23: The operating devices are supplied at their minimum voltage.

Condition of test object after test: Circuit-breaker without functional or visible change.

Test no.
PEHLA 0303Ra / 22

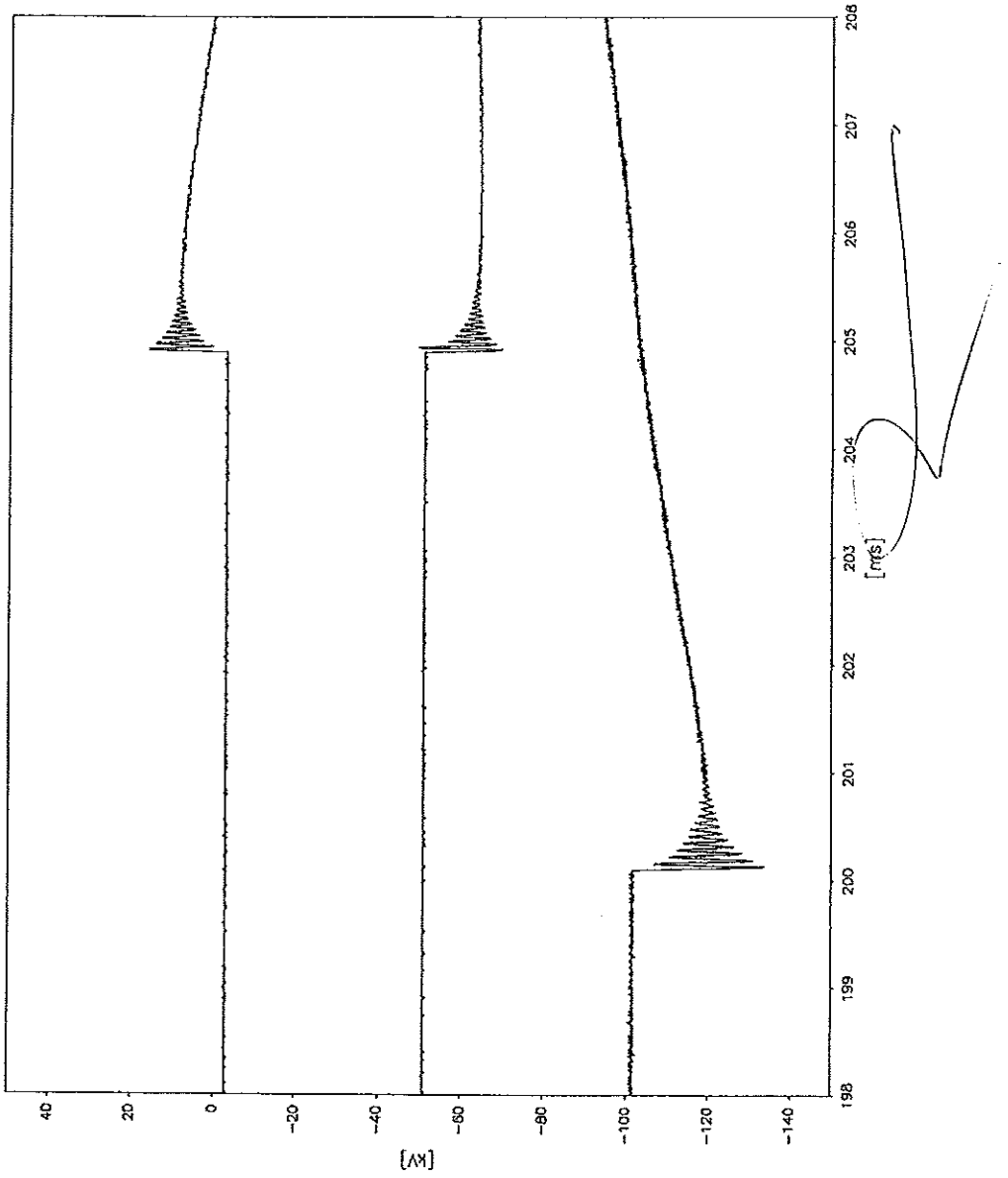


Test no.
PEHLA 0303Ra / 22
Transient Recovery Voltage, First O

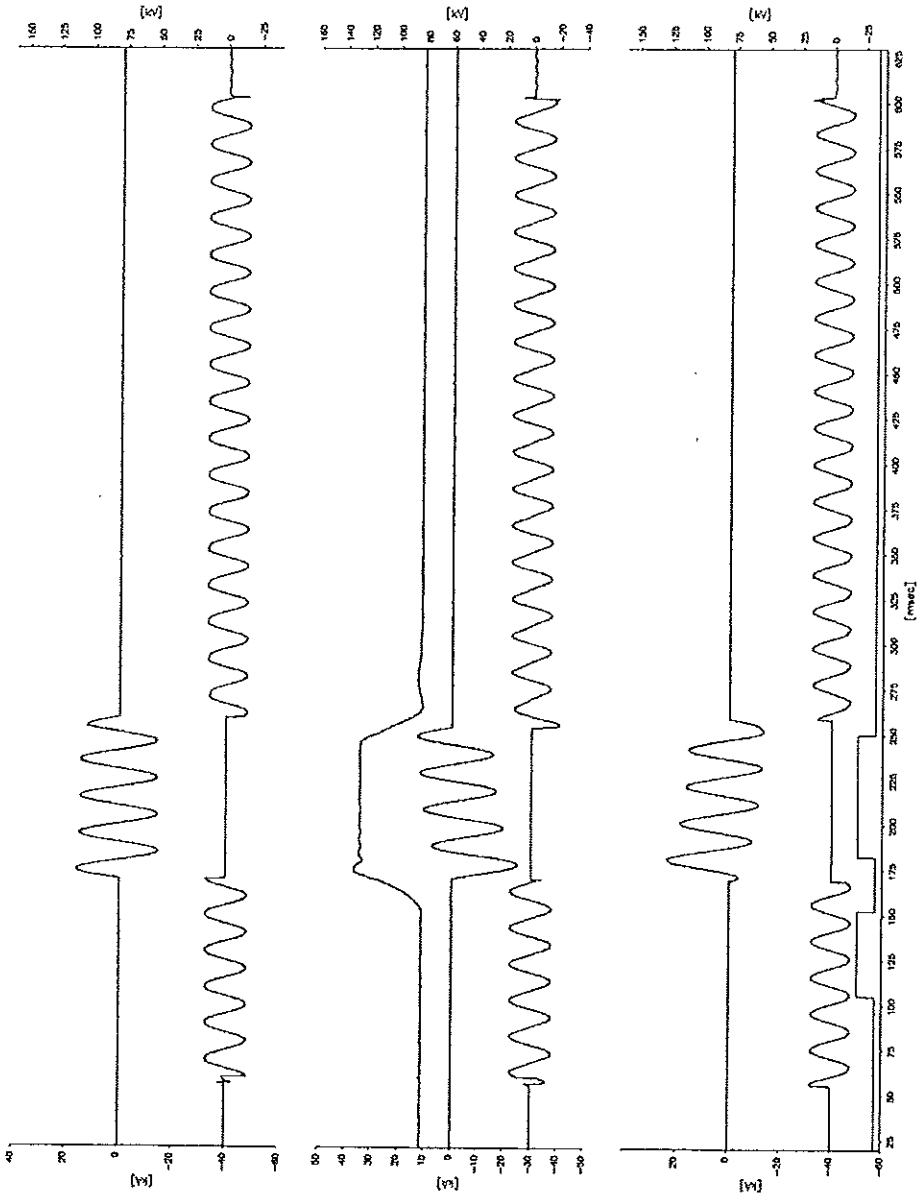


ВЕРНО С ОРИГИНАЛА

Test no.
PEHLA 0303Ra / 22
Transient Recovery Voltage, Second O

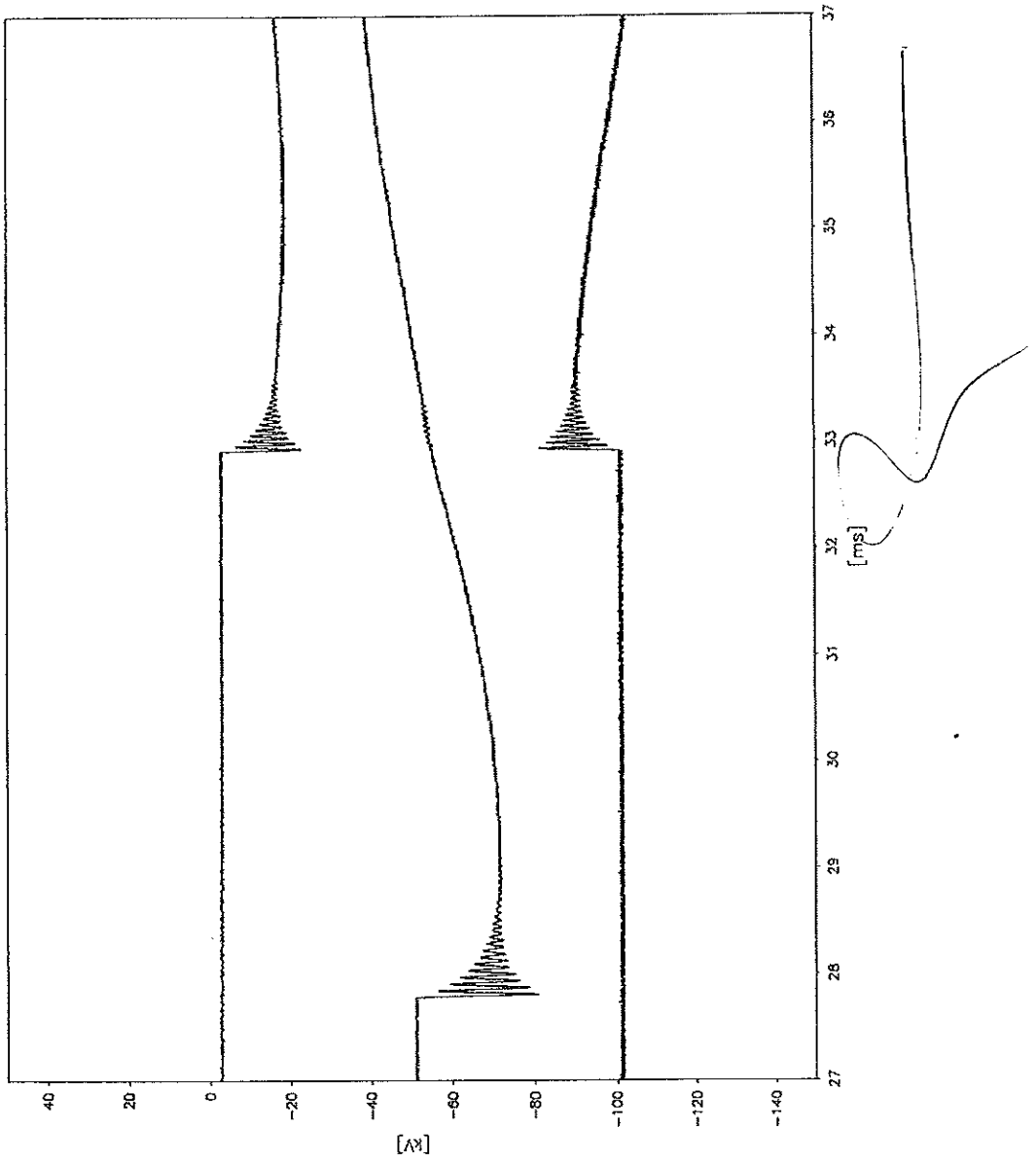


Test no.
PEHLA 0303Ra / 23



ВЕРНО С ОРИГИНАЛА

Test no.
PEHLA 0303Ra / 23
Transient Recovery Voltage



Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: T10

Date of test: 10th January 2003

Condition of test object before test: As after test PEHLA 0303Ra / 23

Connections to test object: By means of copper bars to the upper terminals of the circuit-breaker. Lower terminals of the circuit-breaker short-circuited and earthed.

Arc extinguishing medium: Vacuum

Test No. PEHLA 0303Ra				25		26
Operating sequence				O - 0.3s - CO - 3min - CO		
Applied voltage		kV		-	19.0	18.4
Short-circuit making current		kA	L1	-	6.1	5.3
			L2	-	8.1	8.2
			L3	-	8.6	8.5
Short-circuit breaking current	Short-circuit current	kA	L1	3.54	3.61	3.56
			L2	3.60	3.50	3.49
			L3	3.54	3.50	3.63
	Average value	kA		3.56	3.54	3.56
	d.c. component	%	L1	< 20	< 20	< 20
			L2	<20	< 20	< 20
			L3	<20	< 20	< 20
Recovery voltage		kV	L1	10.9	10.8	9.87
			L2	10.8	11.0	11.2
			L3	11.1	10.8	10.8
Average value (phase-to-phase)		kV		18.9	18.8	18.8
Transient Recovery Voltage (TRV), first-pole-to-clear		kV		- 36.6	- 31.8	- 33.1
Arcing time		ms	L1	8.0	7.5	7.6
			L2	3.0	7.5	2.8
			L3	8.0	2.5	7.8
Closing time		ms		-	64.0	67.0
Opening time		ms		65.0	67.0	67.5
Result				P	P	P

Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

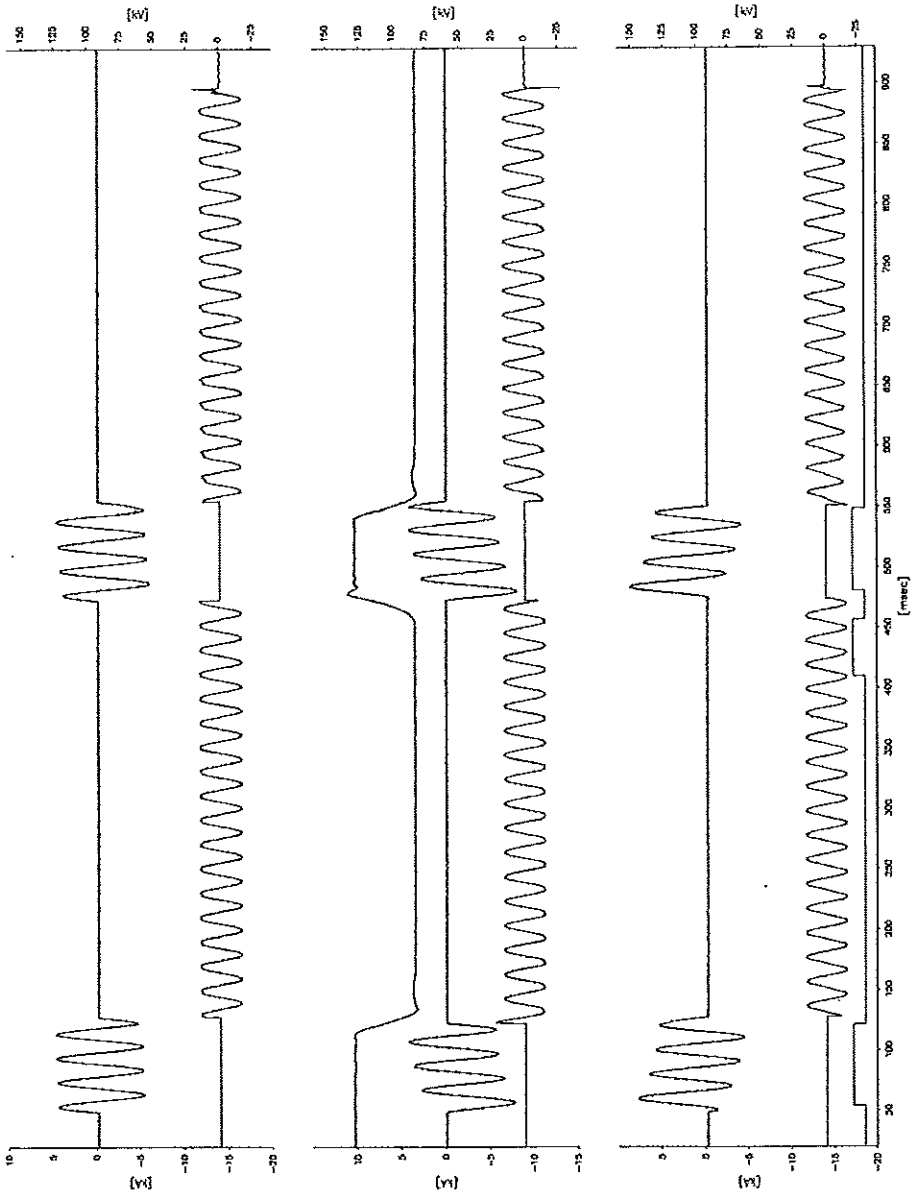
Remarks:

PEHLA 0303Ra / 24: Test with reduced values

PEHLA 0303Ra / 25 and 26: The operating devices are supplied at their minimum voltage.

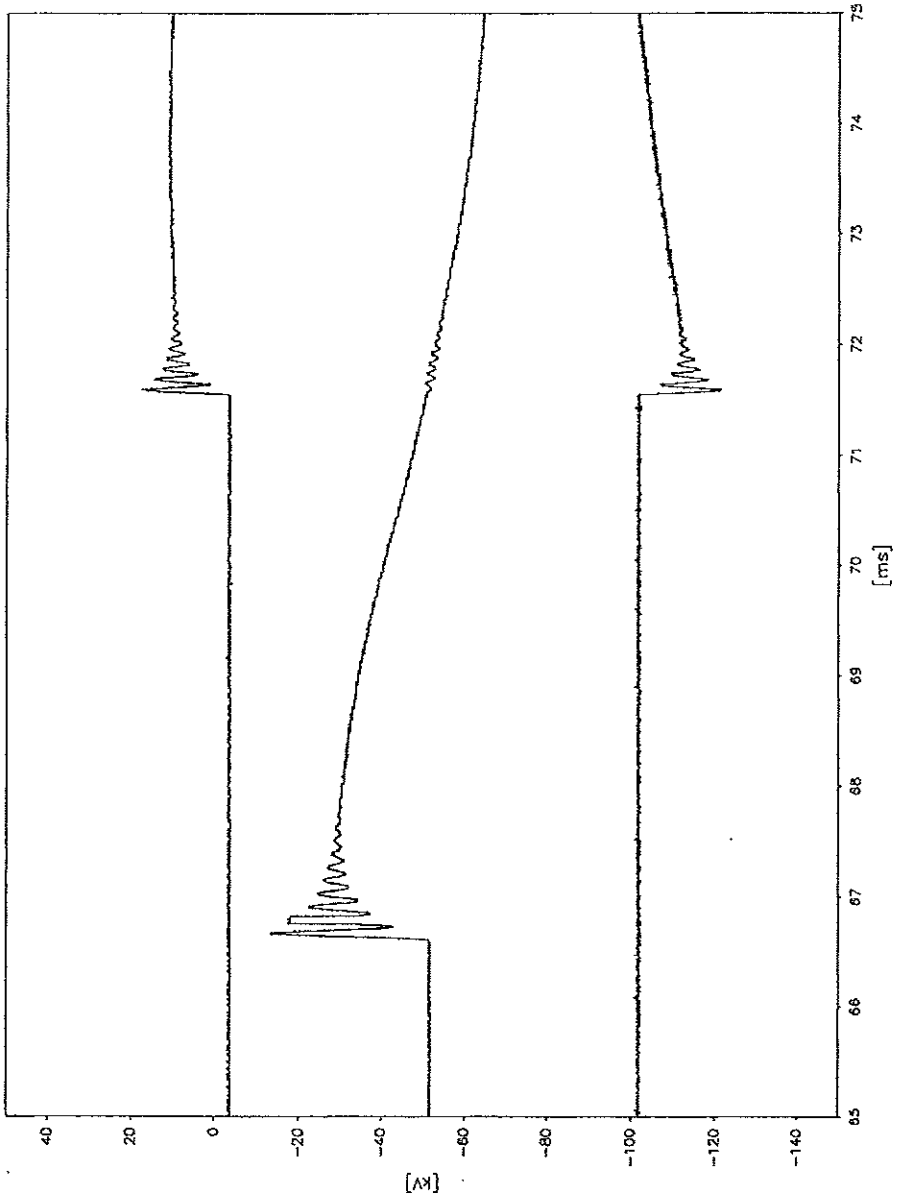
Condition of test object after test: Circuit-breaker without functional or visible change.

Test no.
PEHLA 0303Ra / 25

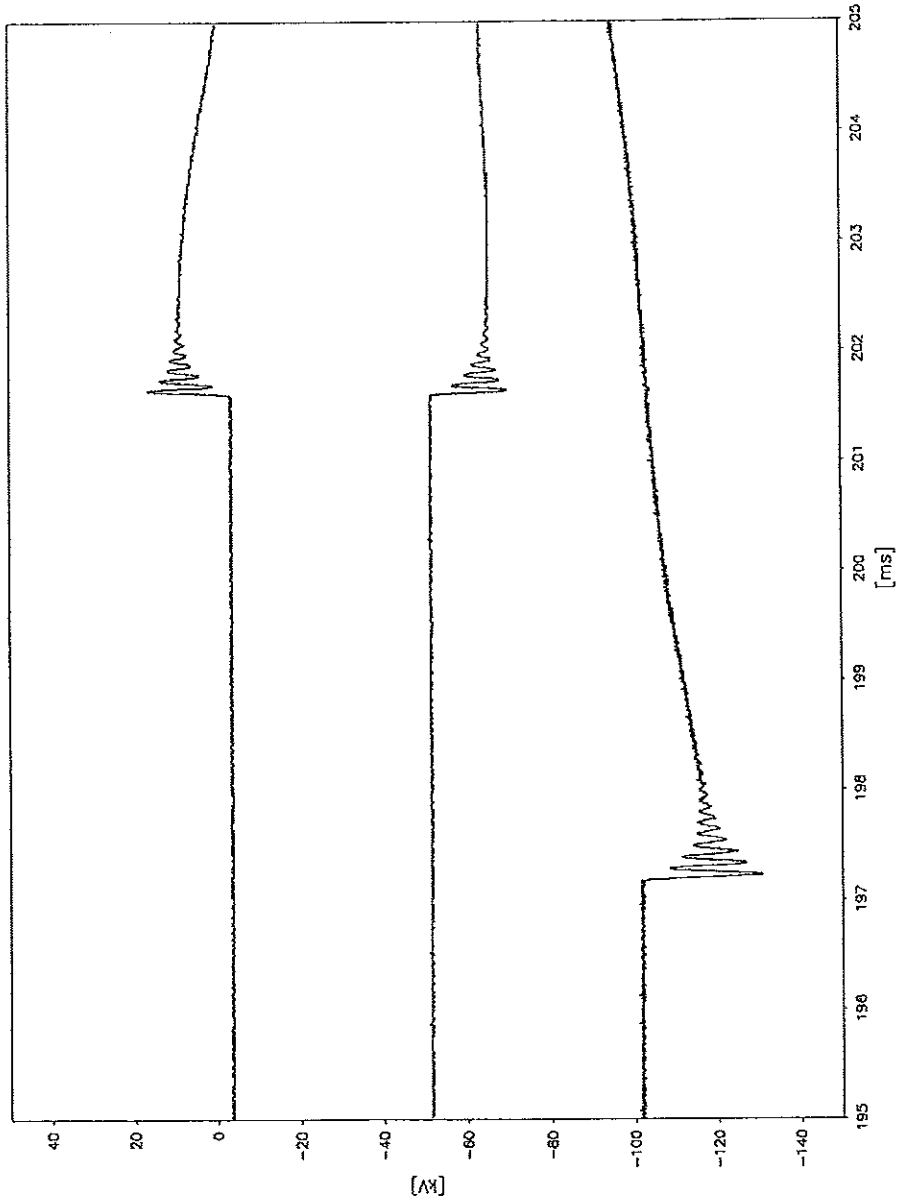


ВЯРНО С ОРИГИНАЛА

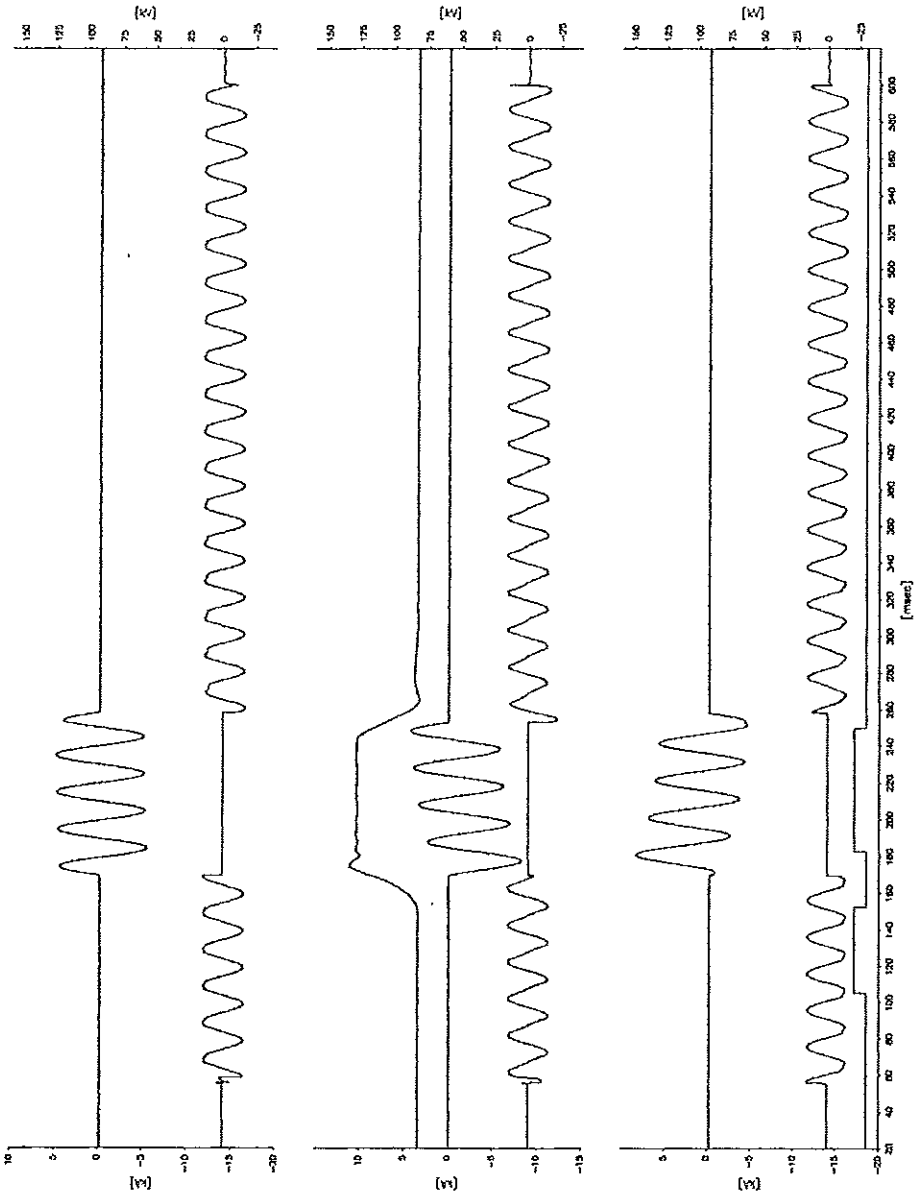
Test no.
PEHLA 0303Ra / 25
Transient Recovery Voltage, First O



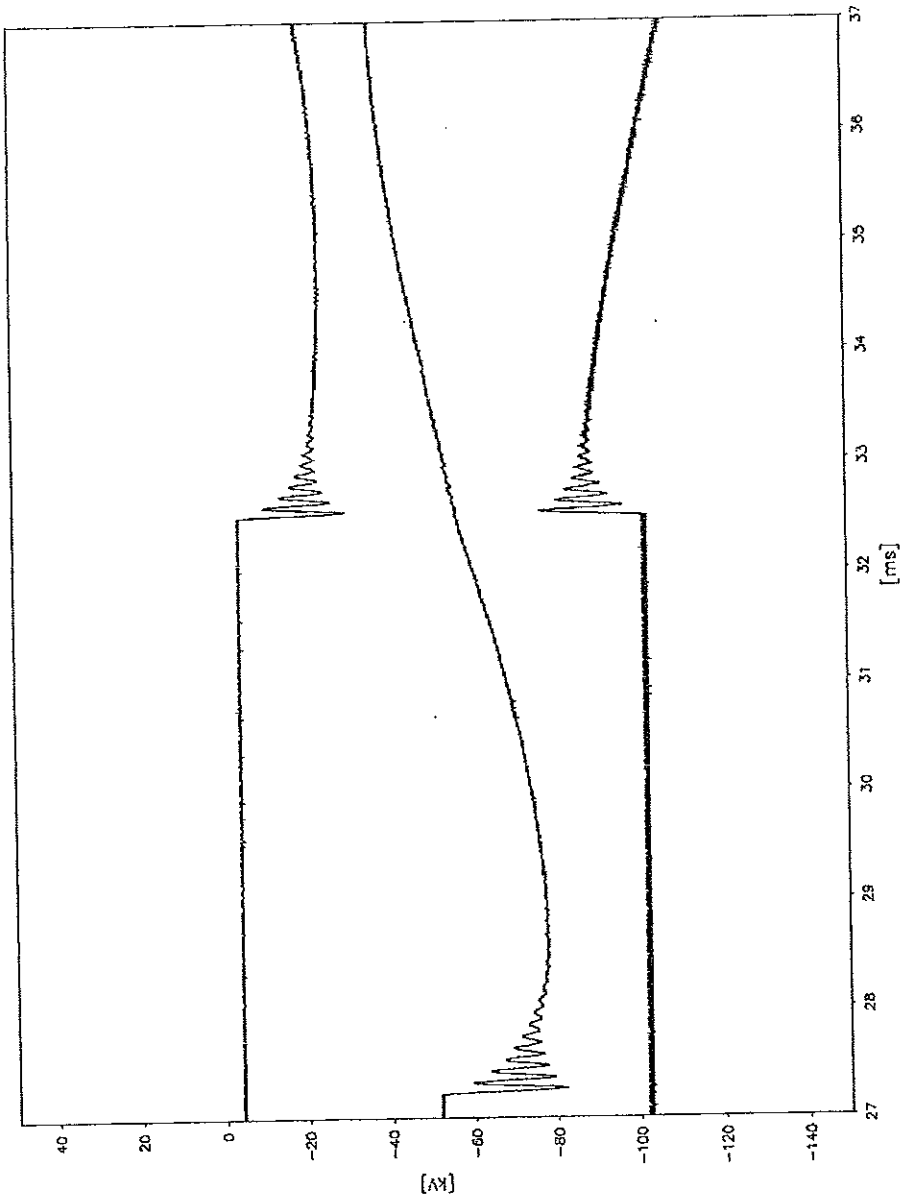
Test no.
PEHLA 0303Ra / 25
Transient Recovery Voltage, Second O



Test no.
PEHLA 0303Ra / 26



Test no.
PEHLA 0303Ra / 26
Transient Recovery Voltage



Short-Circuit Making and Breaking Tests

Circuit-breaker

Test duty: Double-earth fault test

Date of test: 10th January 2003

Condition of test object before test: As after test PEHLA 0303Ra / 26

Connections to test object: Phase L3 of the Test Laboratory connected by means of a copper bar to the upper terminal of phase L3 of the circuit-breaker, lower terminal of phase L3 of the circuit-breaker connected to phase L1 of the laboratory.

Arc extinguishing medium: Vacuum

Test No. PEHLA 0303Ra				33	-	-
Operating sequence				O	-	-
Applied voltage		kV		-	-	-
Short-circuit making current			L1	-	-	-
		kA	L2	-	-	-
			L3	-	-	-
Short-circuit breaking current			L1	27.8	-	-
	Short-circuit current	kA	L2	-	-	-
			L3	-	-	-
	Average value	kA		-	-	-
			L1	< 20	-	-
	d.c. component	%	L2	-	-	-
			L3	-	-	-
Recovery voltage			L1	18.7	-	-
		kV	L2	-	-	-
			L3	-	-	-
Average value (phase-to-phase)		kV	-	-	-	-
Transient Recovery Voltage (TRV), first-pole-to-clear		kV		- 32.8	- -	- -
Arcing time			L1	11.1	-	-
		ms	L2	-	-	-
			L3	-	-	-
Opening time		ms		46.8	-	-
Result				P	-	-

Legend: P: Positive, breaker cleared or breaker closed and cleared **N:** Negative, breaker failed

Remarks:

PEHLA 0303Ra / 27 to 32: Tests with reduced values
PEHLA 0303Ra / 33: The operating devices are supplied at their rated voltage.

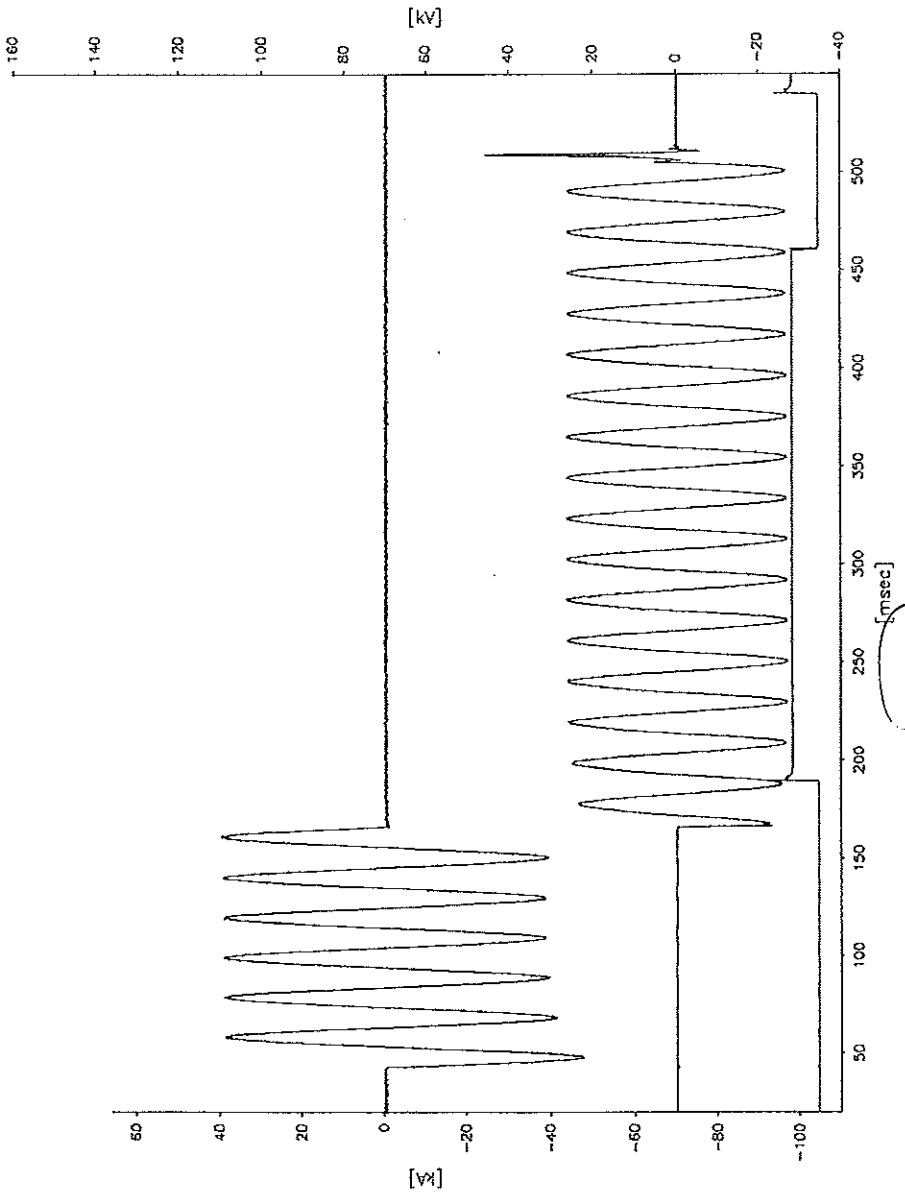
Condition of test object after test: Circuit-breaker without functional or visible change.

Power frequency withstand voltage test at 38 kV – 1 min successfully performed after test PEHLA 0303Ra/ 32.

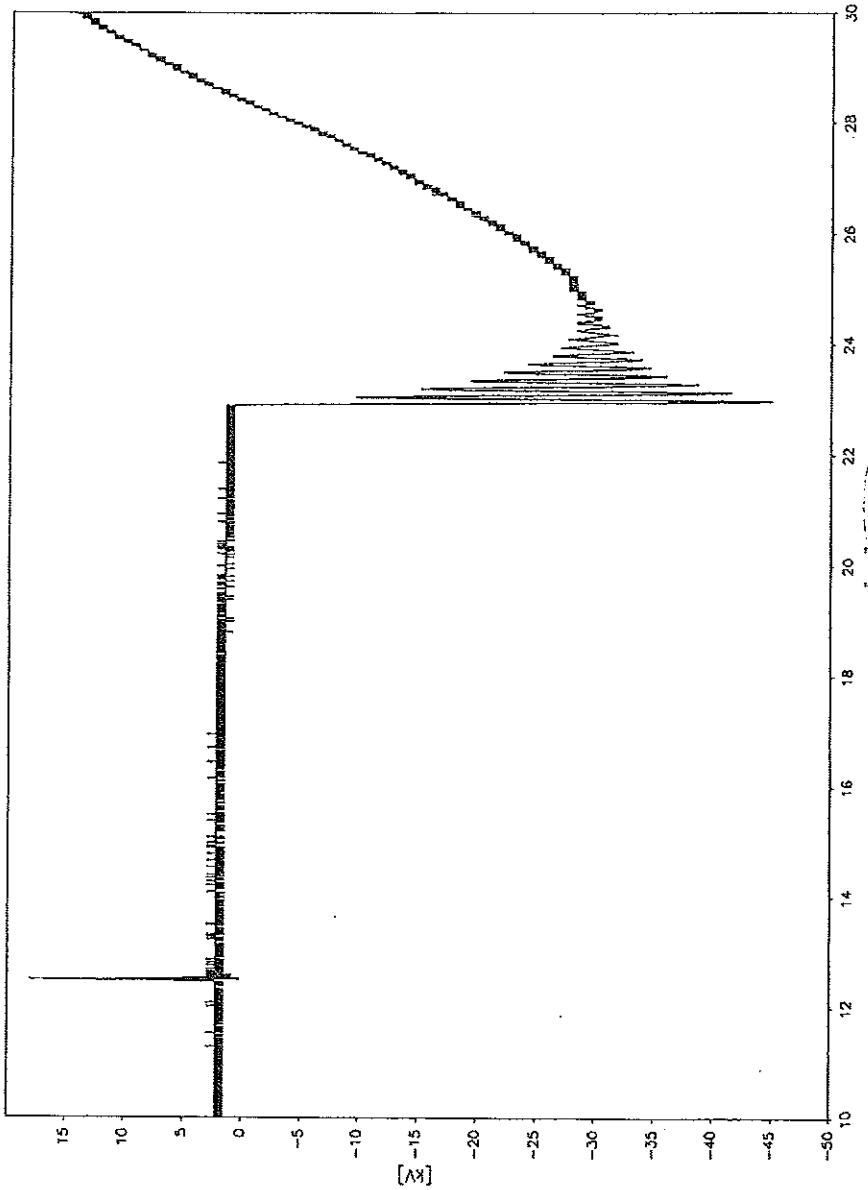
The deviations from the reference mechanical travel characteristic are in the allowable limits.

ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0303Ra / 33



Test no.
PEHLA 0303Ra / 33
Transient Recovery Voltage



Actual Values of No-load Operations

Rated supply voltage of closing coil: 220 V DC
Rated supply voltage of opening coil: 220 V DC

	Operation	Voltage closing coil (V)	Closing time (ms)	Voltage opening coil (V)	Opening time (ms)
Before basic short-circuit test duties					
Test 0303Ra / 002	O-	--	--	220	46.4
	CO	220	58.9	220	46.9
Test 0303Ra / 02A	O-	--	--	154	79.1
	CO	187	62.9	154	79.7
Test 0303Ra / 02B	O-	--	--	242	43.7
	CO	242	56.5	242	44.1
After double-earth fault test					
Test 0303Ra / 034	O-	--	--	220	45.3
	CO	220	60.1	220	46.3
Test 0303Ra / 34A	O-	--	--	154	70.7
	CO	187	64.9	154	73.8
Test 0303Ra / 34B	O-	--	--	242	43.2
	CO	242	57.7	242	44.1

Measurement of the Resistance

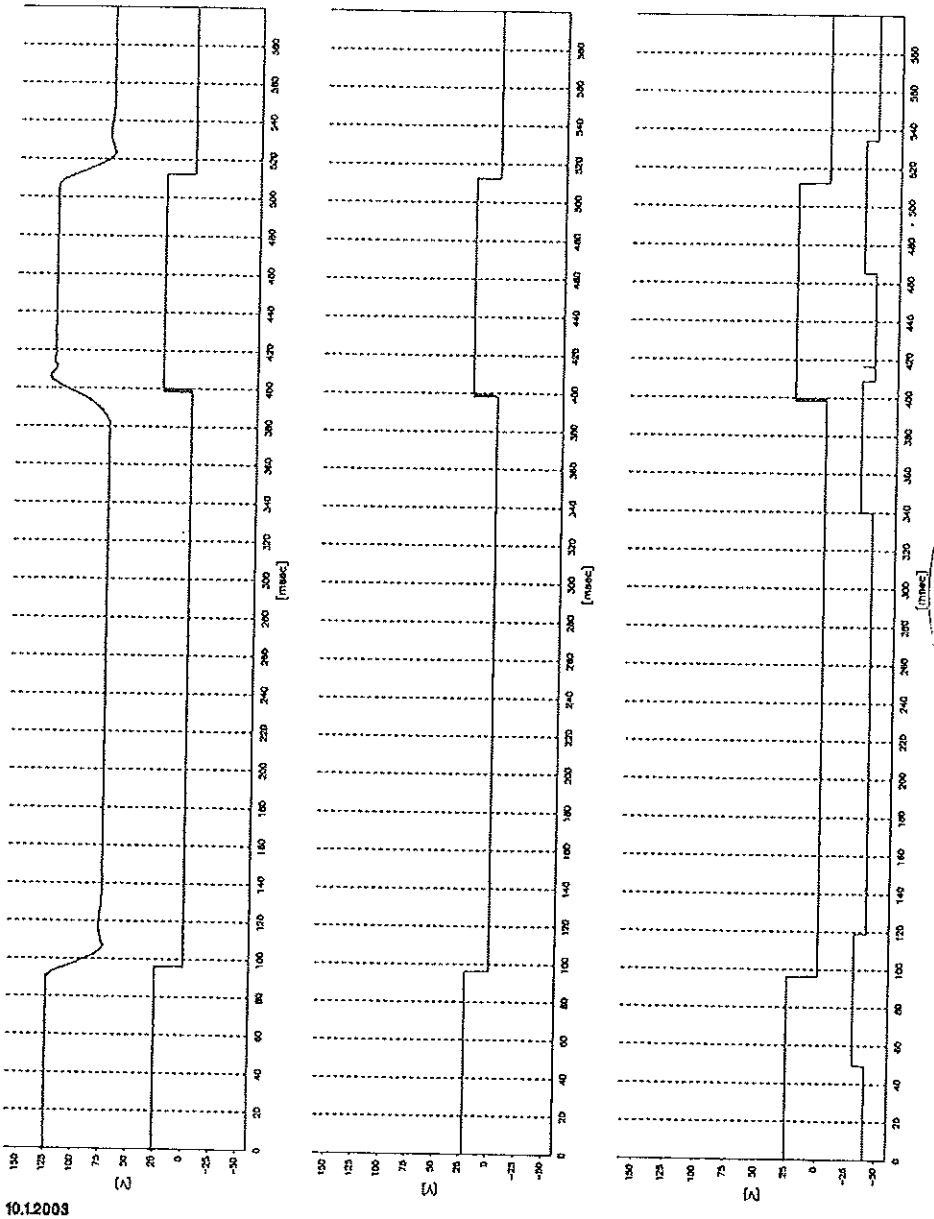
Ambient air temperature: ≈ 18 °C

	Resistance of the pole parts μΩ		
	L1	L2	L3
Before test 0303Ra / 004	12.3	12.7	12.1
After test 0303Ra / 034	18.8	17.8	17.8

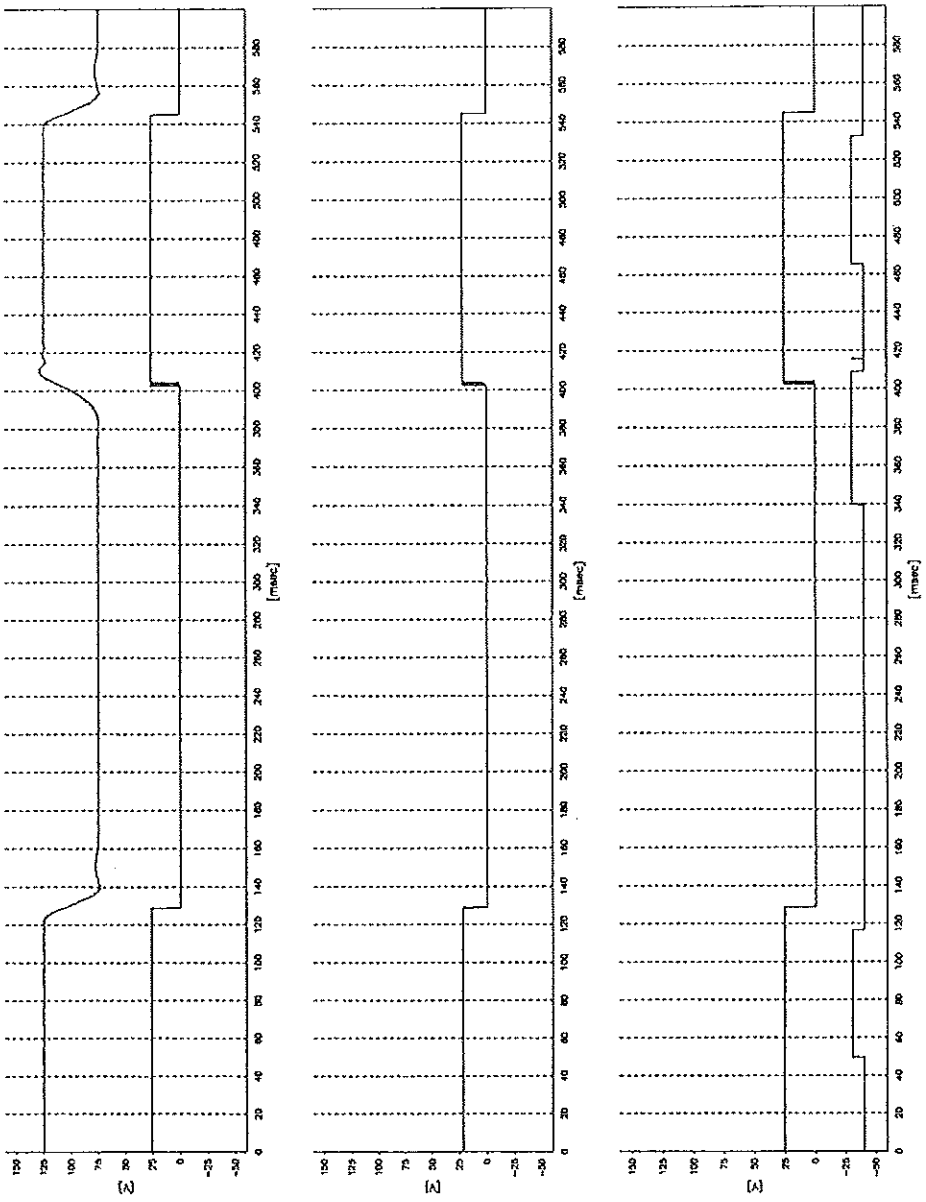
(The resistance values fulfil the requirements of STL-Guide to IEC56: 4th Edition: 1987, Amendment Slip No. 2).

Remarks:
Resistance measurement at direct current of: 50 A

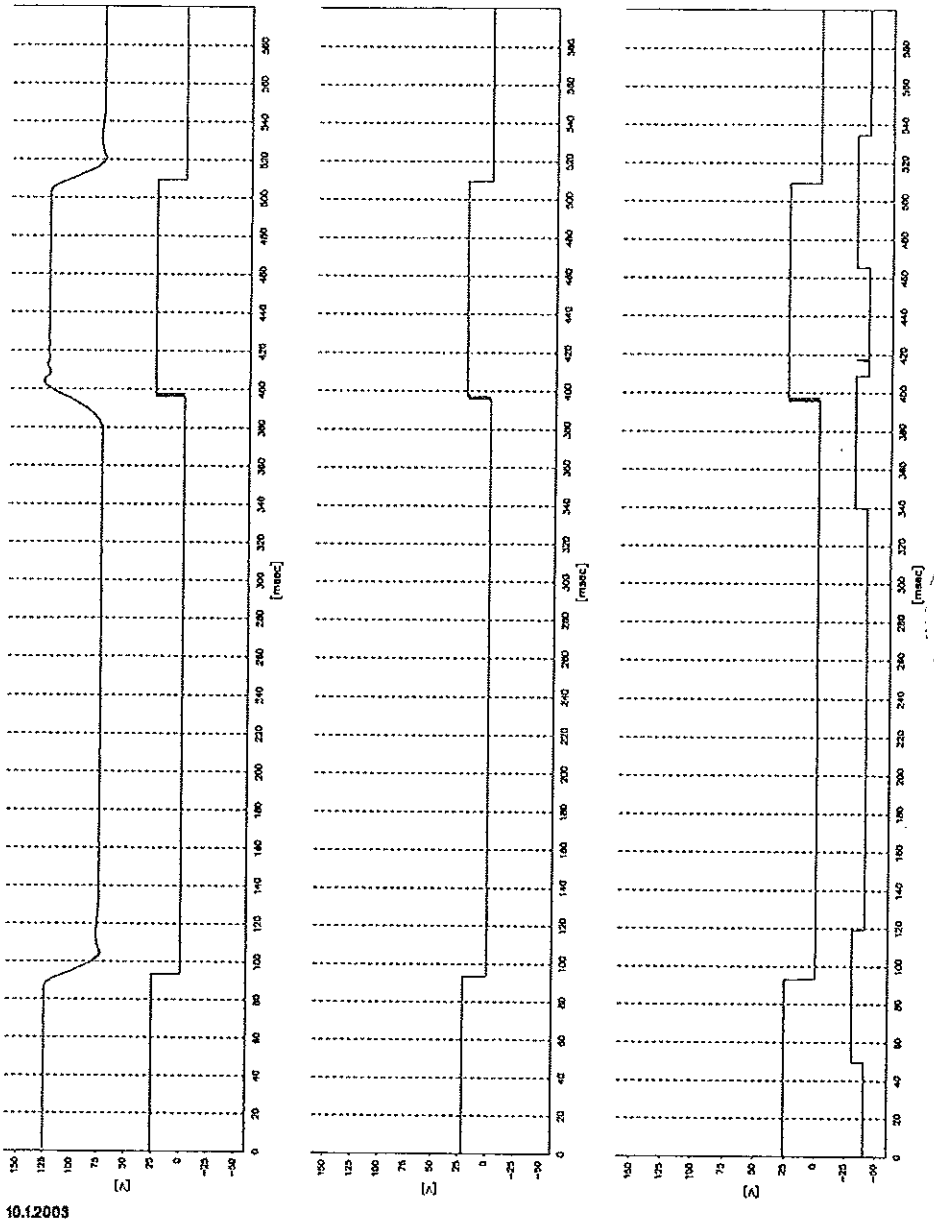
Test no.
PEHLA 0303Ra / 02



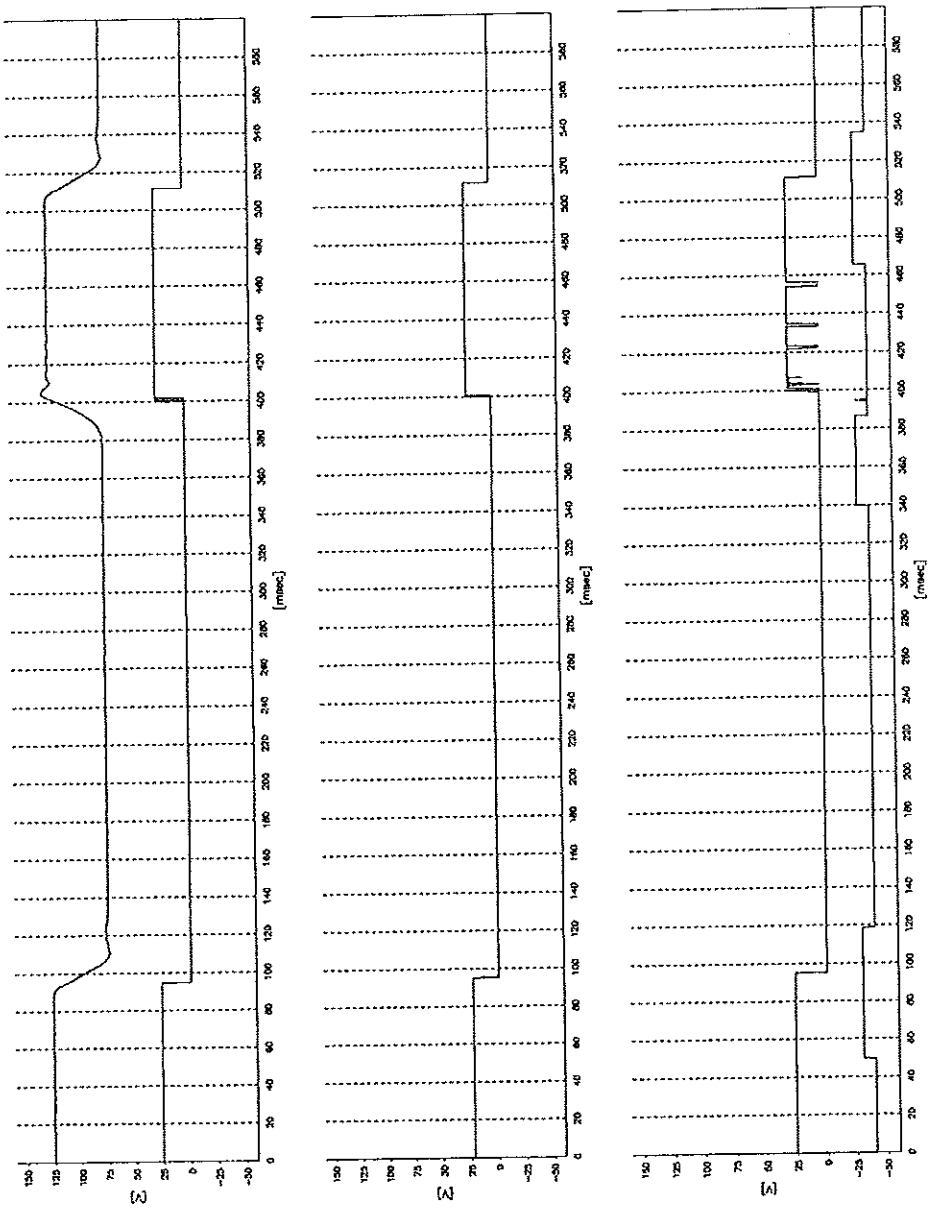
Test no.
PEHLA 0303Ra / 02A



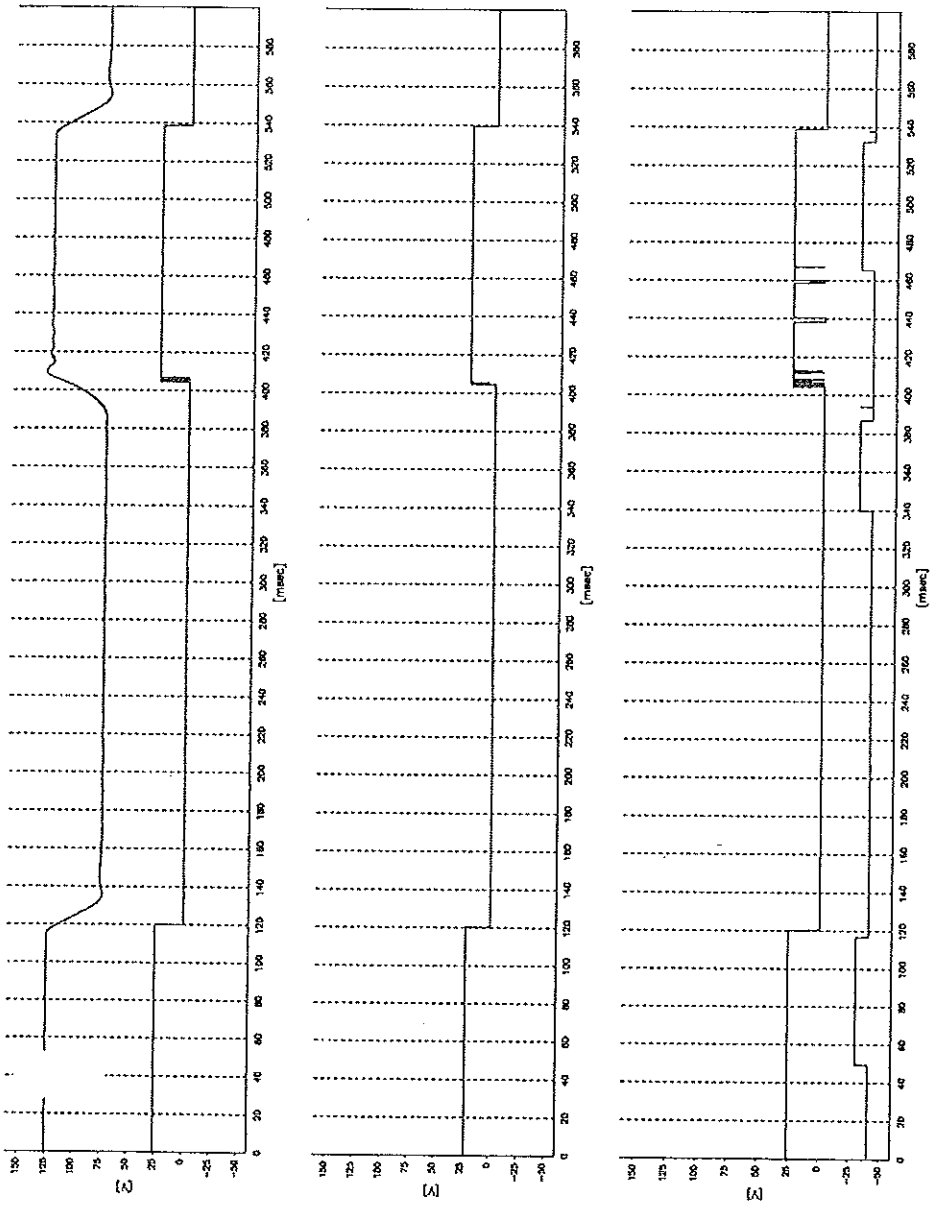
Test no.
PEHLA 0303Ra / 02B



Test no.
PEHLA 0303Ra / 34

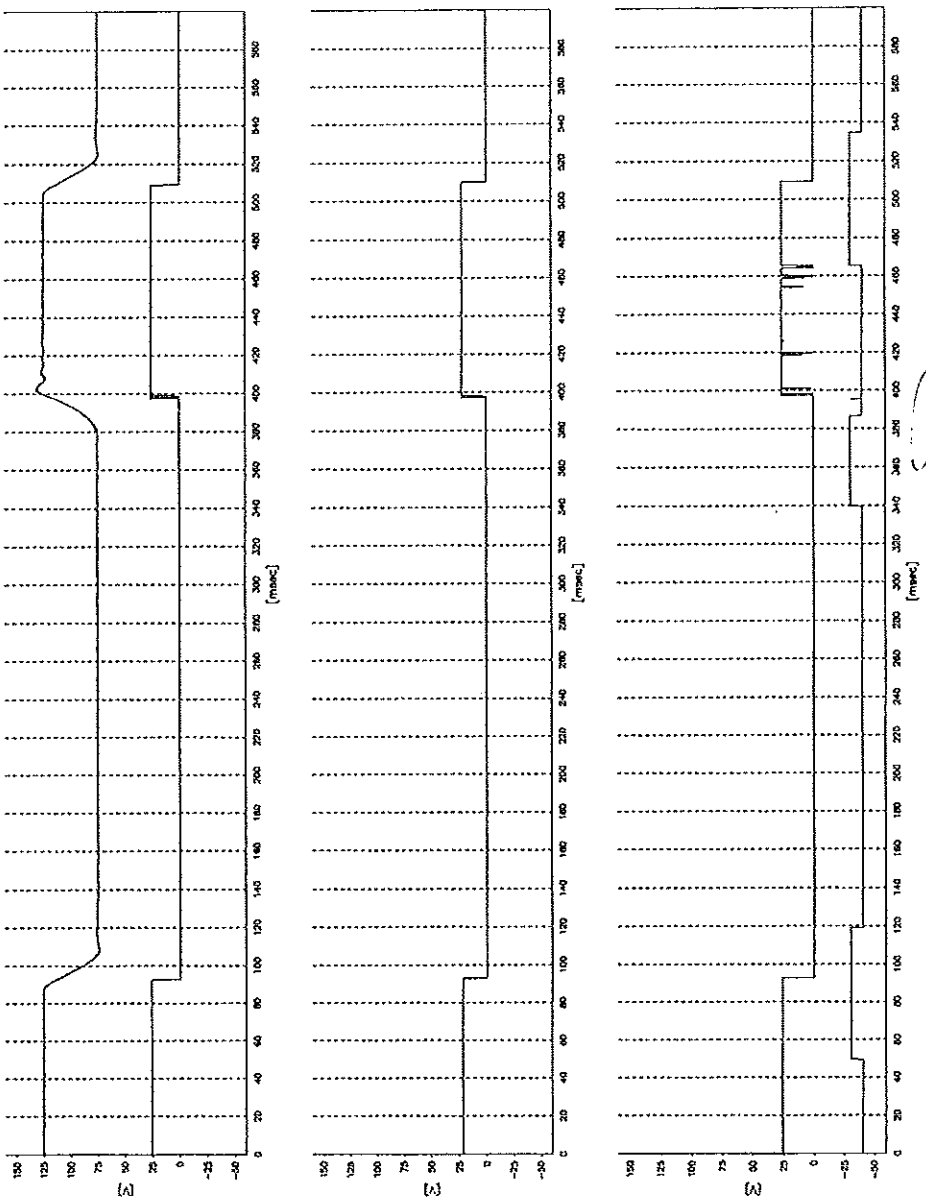


Test no.
PEHLA 0303Ra / 34A



ВЯРНО С ОРИГИНАЛА

Test no.
PEHLA 0303Ra / 034B



ВЯРНО С ОРИГИНАЛА

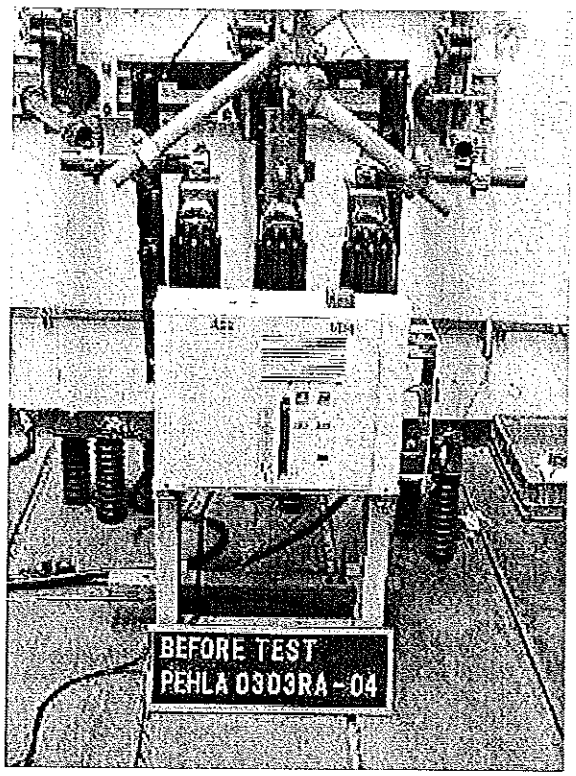


Photo No. 01
Before Test 0303Ra / 04

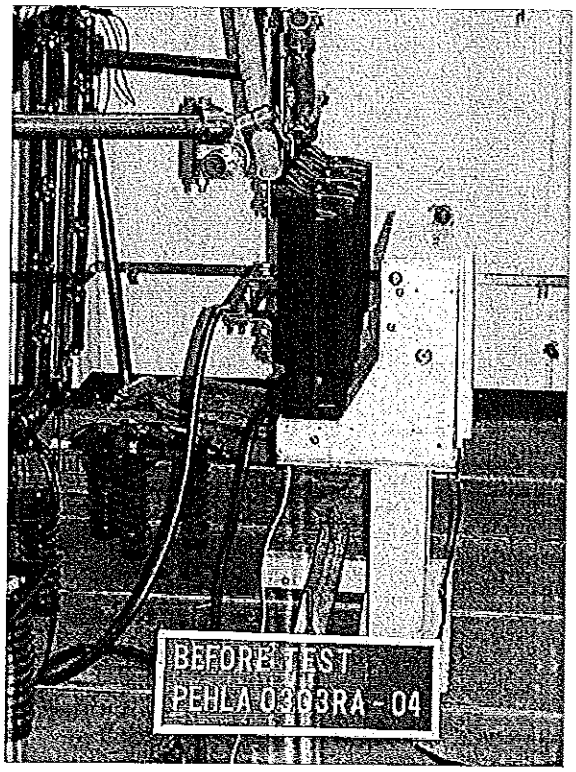


Photo No. 02
Before Test 0303Ra / 04

ВЯРНО С ОРИГИНАЛА

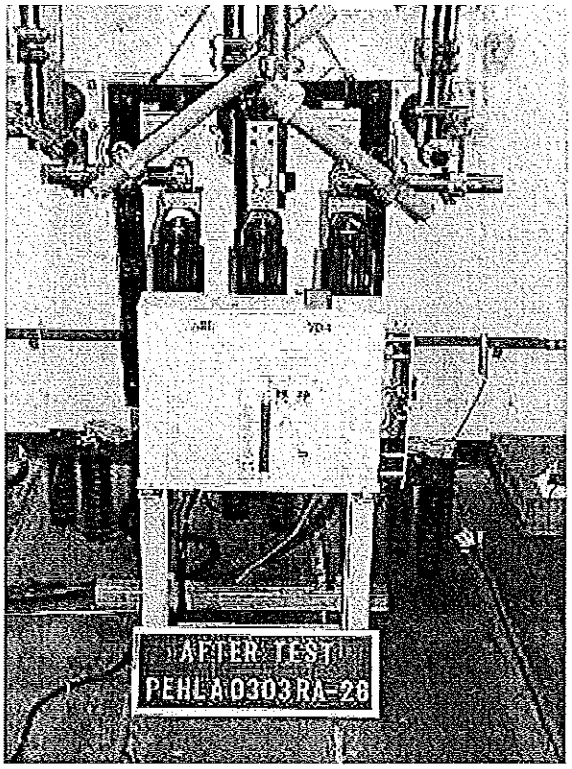


Photo No. 03
After Test 0303Ra / 26

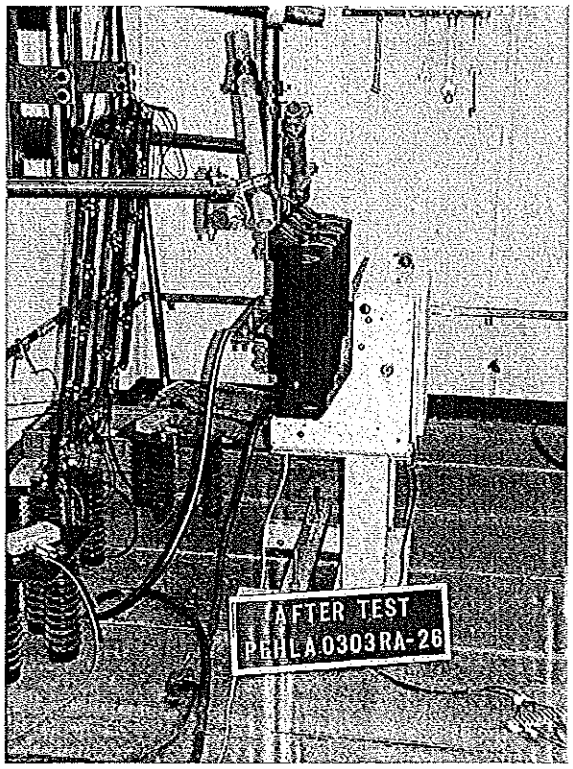


Photo No. 04
After Test 0303Ra / 26

ВЯРНО С ОРИГИНАЛА

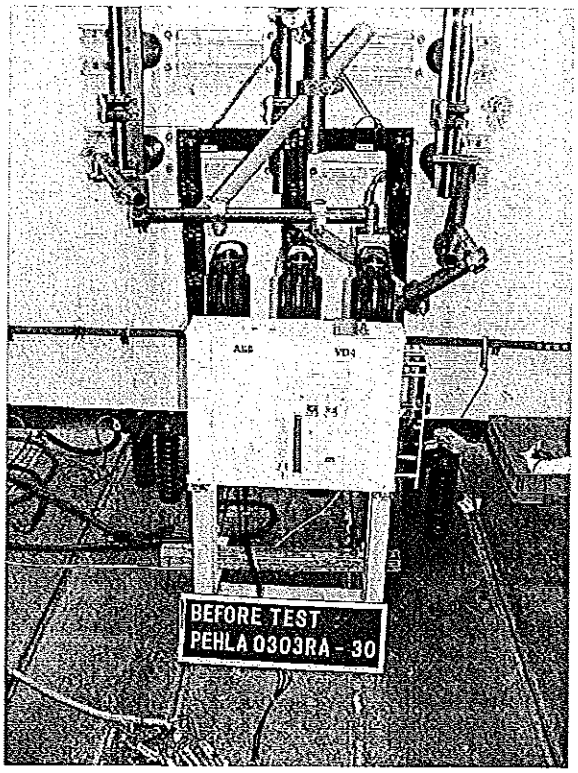


Photo No. 05
Before Test 0303Ra / 30

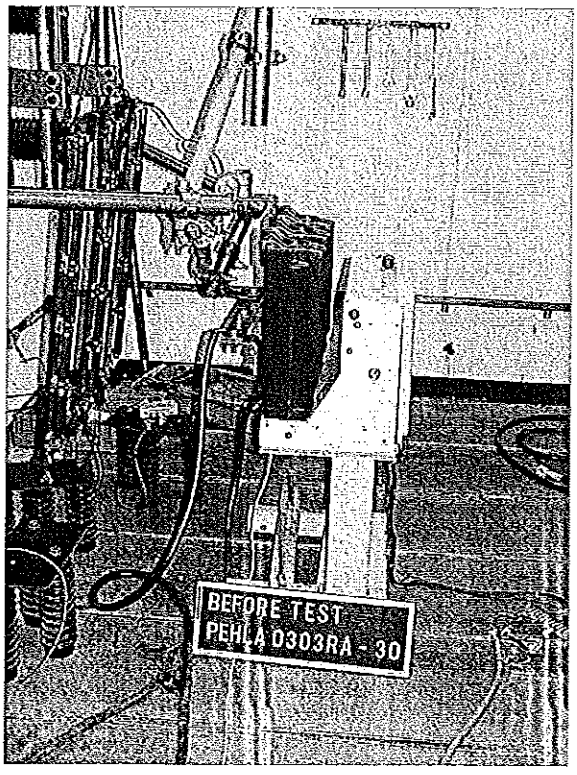


Photo No. 06
Before Test 0303Ra / 30

Remark: Photos of the test object after test 0303Ra / 34 are not available.

Deutscher Akkreditierungs Rat DAR
Reg.-Nr. DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. HZ 147 E 10

Issued by an Accredited Laboratory corresponding to EN 45001

Copy-No. 1e

Test Object

4-panel metal-clad air-insulated switchgear type ZS1.2 – 12 kV consisting of
- feeder panel 2000 A with vacuum circuit-breaker type VD4P 1220-31
- feeder panel 2500 A with vacuum circuit-breaker type VD4P 1225-31
- feeder panel 1600 A with vacuum circuit-breaker type VD4P 1216-31,
- feeder panel 630 A with vacuum circuit-breaker type VD4P 1206-31

max. ambient temperature ϑ_{umax} = 40 °C,

Rated voltage	U	12	kV
Rated normal current panel	I_n	2500 / 630	A
Rated frequency	f	50	Hz
Rated short-time withstand current	I_{th}	31.5	kA
Rated peak withstand current	I_p	80	kA
Rated duration of short-circuit current	t_{th}	3	s
Rated short-circuit breaking capacity at 12 kV	I_{sc}	31.5	kA
Max. ambient temperature	ϑ_u	40	°C

Manufacturer ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany

Tests performed Three-phase temperature-rise test at the rated currents of 2500 / 630 A at a power frequency of 50 Hz.
Measuring of the resistances of the main circuit.

Test Specification IEC Standard 60694/2nd Ed./1996-5, clause 6.4 and 6.5
IEC Standard 60298/3rd Ed./1990-12, clause 6.3 and 6.4

Test Results The 4-panel ZS1.2-type arrangement passed the above mentioned tests successfully. The respective requirements are met. The test results are tabulated on sheets 23 to 28.

Test Date May 31th - June 01st, 2000

Client ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany

ABB Calor Emag Laboratories ABB Ratingen

March 20th, 2001
Date of Issue

Laboratory Manager

Test Engineer

Total Number of Sheets: 33 Sheets (Test Report)

ABB Calor Emag Mittelspannung GmbH Ratingen
High-Power Testing Laboratory
Oberhausener Straße 33
D - 40472 Ratingen
Phone + 49 (0) 21 02 12-1905
Fax + 49 (0) 21 02 12-1713

ABB Calor Emag Laboratories

ABB

TEST REPORT No. HZ 147 E 10

Issued by an Accredited Laboratory corresponding to EN 45001

Test Object

4-panel metal-clad air-insulated switchgear type ZS1.2 – 12 kV
consisting of
- feeder panel 2000 A with vacuum circuit-breaker type VD4P 1220-31
- feeder panel 2500 A with vacuum circuit-breaker type VD4P 1225-31
- feeder panel 1600 A with vacuum circuit-breaker type VD4P 1216-31
- feeder panel 630 A with vacuum circuit-breaker type VD4P 1206-31

max. ambient temperature ϑ_{umax} = 40 °C,

Rated voltage	U	12	kV
Rated normal current panel	I_n	2500 / 630	A
Rated frequency	f	50	Hz
Rated short-time withstand current	I_{th}	31.5	kA
Rated peak withstand current	I_p	80	kA
Rated duration of short-circuit current	t_{th}	3	s
Rated short-circuit breaking capacity at 12 kV	I_{sc}	31.5	kA
Max. ambient temperature	ϑ_u	40	°C

Manufacturer

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany

Tests performed

Three-phase temperature-rise test at the rated currents of 2500 / 630 A at a power frequency of 50 Hz.
Measuring of the resistances of the main circuit.

Test Specification

IEC Standard 60694/2nd Ed./1996-5, clause 6.4 and 6.5
IEC Standard 60298/3rd Ed./1990-12, clause 6.3 and 6.4

Test Results

The 4-panel ZS1.2-type arrangement passed the above mentioned tests successfully. The respective requirements are met. The test results are tabulated on sheets 23 to 28.

Test Date

May 31th - June 01st, 2000

Client

ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany

March 20th, 2001
Date of Issue **Laboratory Manager** **Test Engineer**

Total Number of Sheets: 33 Sheets (Test Report)

ABB Calor Emag Mittelspannung GmbH Ratingen
High-Power Testing Laboratory
Oberhausener Straße 33
D - 40472 Ratingen
Phone. + 49 (0) 21 02 12-1905
Fax + 49 (0) 21 02 12-1713

ВЯРНО С ОРИГИНАЛА

Table of Contents

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switchgear – Feeder Panel 1

Ratings assigned by the manufacturer

Test Object: Metal-clad air-insulated switchgear panel with vacuum circuit-breaker type VD4P
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 7550027/2011/00 (switchgear) **Year of manufacture:** 2000
Drawing No.: GCE8010452R0111

Rated voltage	12 kV
Rated lightning impulse withstand voltage	75 kV
Rated switching impulse withstand voltage	- kV
Rated power frequency withstand voltage	28 kV
Rated frequency	50 Hz
Rated normal current of busbar	2500 A
Rated normal current of feeder	2000 A
Rated peak withstand current	80 kA
Rated short-time withstand current	31.5 kA
Rated duration of short-circuit	3 s
Insulating medium	air / vacuum
Rated functional pressure (abs. / 20°C)	- kPa
Minimum functional pressure (abs. / 20°C)	- kPa
Permissible values for internal arc faults:	
Peak current	80 kA
Short-time current	31.5 kA
Duration of short-circuit	1 s
Max. ambient air temperature	40 °C

The above mentioned switchgear panel is fully described by the mentioned drawings.

Essential characteristics and installed devices:

The power loss of the controlgear in the low voltage compartment was simulated by a heating resistor of 60 W.

Current transformer:

Manufacturer	Type	Year of manufacture	Insulation class
WIRGES GmbH	ASS 12-20	2000	E
Voltages	**Frequency**	**Sort-time withst. current**	**Peak withstand current**
12/28/975 kV	50 Hz	31.5 kA / 3 s	80 kA
Serial Nos.	**L1** 166472 **L2** 167473; **L3** 166474		
Core 1	2000 / 5 A; 15 VA, accuracy class 1		
Core 2	2000 / 5 A; 15 VA, 5P 10		

Date of receipt of test object: 19th May 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switchgear – Feeder Panel 2

Ratings assigned by the manufacturer

Test Object: Metal-clad air-insulated switchgear panel with vacuum circuit-breaker type VD4P
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 7550027/2012/00 (switchgear) **Year of manufacture:** 2000
Drawing No.: GCE8010452R0112

Rated voltage	12 kV
Rated lightning impulse withstand voltage	75 kV
Rated switching impulse withstand voltage	- kV
Rated power frequency withstand voltage	28 kV
Rated frequency	50 Hz
Rated normal current of busbar	2500 A
Rated normal current of feeder	2500 A
Rated peak withstand current	80 kA
Rated short-time withstand current	31.5 kA
Rated duration of short-circuit	3 s
Insulating medium	air / vacuum
Rated functional pressure (abs. / 20°C)	- kPa
Minimum functional pressure (abs. / 20°C)	- kPa
Permissible values for internal arc faults:	
Peak current	80 kA
Short-time current	31.5 kA
Duration of short-circuit	1 s
Max. ambient air temperature	40 °C

The above mentioned switchgear panel is fully described by the mentioned drawings.

Essential characteristics and installed devices:

The power loss of the controlgear in the low voltage compartment was simulated by a heating resistor of 60 W.

Current transformer:

Manufacturer	**Type**	**Year of manufacture**	**Insulation class**
WIRGES GmbH	ASS 12-20	2000	E
Voltages	**Frequency**	**Sort-time withst. current**	**Peak withstand current**
12/28/975 kV	50 Hz	31.5 kA / 3 s	80 kA
Serial Nos.	L1 166479 L2 167480; L3 166481		
Core 1	2500 / 5 A; 15 VA, accuracy class 1		
Core 2	2500 / 5 A; 15 VA, 5P 10		

Date of receipt of test object: 19th May 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switchgear – Feeder Panel 3

Ratings assigned by the manufacturer

Test Object: Metal-clad air-insulated switchgear panel with vacuum circuit-breaker type VD4P
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 7550027/2007/00 (switchgear) **Year of manufacture:** 2000
Drawing No.: GCE8010452R0103

Rated voltage	12 kV
Rated lightning impulse withstand voltage	75 kV
Rated switching impulse withstand voltage	- kV
Rated power frequency withstand voltage	28 kV
Rated frequency	50 Hz
Rated normal current of busbar	2500 A
Rated normal current of feeder	1600 A
Rated peak withstand current	80 kA
Rated short-time withstand current	31.5 kA
Rated duration of short-circuit	3 s
Insulating medium	air / vacuum
Rated functional pressure (abs. / 20°C)	- kPa
Minimum functional pressure (abs. / 20°C)	- kPa
Permissible values for internal arc faults:	
Peak current	80 kA
Short-time current	31.5 kA
Duration of short-circuit	1 s
Max. ambient air temperature	40 °C

The above mentioned switchgear panel is fully described by the mentioned drawings.

Essential characteristics and installed devices:

The power loss of the controlgear in the low voltage compartment was simulated by a heating resistor of 60 W.

Current transformer:

Manufacturer	**Type**	**Year of manufacture**	**Insulation class**
WIRGES GmbH	ASS 12-20	2000	E
Voltages	**Frequency**	**Sort-time withst. current**	**Peak withstand current**
12/28/975 kV	50 Hz	31.5 kA / 3 s	80 kA
Serial Nos.	**L1** 166458 **L2** 167459; **L3** 166460		
Core 1	1600 / 5 A; 15 VA, accuracy class 1		
Core 2	1600 / 5 A; 15 VA, 5P 10		

Date of receipt of test object: 19th May 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switchgear – Feeder Panel 4

Ratings assigned by the manufacturer

Test Object: Metal-clad air-insulated switchgear panel with vacuum circuit-breaker type VD4P
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 7550027/2003/00 (switchgear) **Year of manufacture:** 2000
Drawing No.: GCE8010450R0101

Rated voltage	12 kV
Rated lightning impulse withstand voltage	75 kV
Rated switching impulse withstand voltage	- kV
Rated power frequency withstand voltage	28 kV
Rated frequency	50 Hz
Rated normal current of busbar	2500 A
Rated normal current of feeder	630 A
Rated peak withstand current	80 kA
Rated short-time withstand current	31.5 kA
Rated duration of short-circuit	3 s
Insulating medium	air / vacuum
Rated functional pressure (abs. / 20°C)	- kPa
Minimum functional pressure (abs. / 20°C)	- kPa
Permissible values for internal arc faults:	
Peak current	80 kA
Short-time current	31.5 kA
Duration of short-circuit	1 s
Max. ambient air temperature	40 °C

The above mentioned switchgear panel is fully described by the mentioned drawings.

Essential characteristics and installed devices:

In order to generate the power losses of the 630 A current transformers a heat power of 5 W was feeded to each c.t.. The heating resistors were adhered on the surface of each c.t.

The power loss of the controlgear in the low voltage compartment was simulated by a heating resistor of 60 W.

Current transformer:

Manufacturer	Type	Year of manufacture	Insulation class
ABB EJF Czech Republic	TPU 43.11	2000	E
Voltages	**Frequency**	**Sort-time withst. current**	**Peak withstand current**
12/28/95 kV	50 Hz	31.5 kA / 3 s	80 kA
Serial Nos.	**L1** 957055 **L2** 957056; **L3** 957057		
Core 1	1250 / 5 A; 15 VA, accuracy class 0.5		
Core 2	1250 / 5 A; 15 VA, accuracy class 5P		

Date of receipt of test object: 19th May 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker in Feeder Panel 1

Ratings assigned by the manufacturer

Test Object:	Vacuum circuit-breaker (draw-out unit)
Type:	VD4P 1220-31
Manufacturer:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.:	7007054/4001/00 **Year of manufacture:** 2000
Drawing No.:	GCE7000162R1173 (circuit-breaker)
Vacuum Interrupter:	Type: VG4-S L1: No. 1115, L2: No. 1116, L3: No. 1117
Drawing No.:	GCE7005745R0122 (pole part)

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50	Hz
Rated normal current	2000	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current	31.5	kA
D.C. component	30	%
Rated short-circuit making current	80	kA
Rated transient recovery voltage:		
Peak value	20.6	kV
Rate of rise	0.34	kV/µs
First-pole-to-clear-factor	1.5	.
Rated operating sequence	O-0.3 s –CO-3 min-CO	
Arc extinguishing medium	vacuum	
Rated pressure / Minimal pressure (20 °C)	-	ka
Insulating medium		
Rated pressure / Minimal pressure (20 °C)	-	kPa
Driving mechanism		
Rated pressure / Minimal pressure (20 °C)	-	kPa
Number of poles	3	
Number of units per pole	1	
Rated opening time	≤ 45	ms
Rated closing time	approx. 60	ms
Rated voltage of trip coil	220	V-DC
Rated voltage of closing coil	220	V-DC
Rated supply voltage	220	V-DC
Rated frequency of supply voltage	-	Hz
Further specifications:		
Max. ambient air temperature	40	°C

Essential characteristics:
The breaker was switched off and in disconnecting position during the test.

Date of receipt of test object: 19th May 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker in Feeder 2

Ratings assigned by the manufacturer

Test Object: Vacuum circuit-breaker (draw-out unit)
Type: VD4P 1225-31
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 7007054/4005/00 **Year of manufacture:** 2000
Drawing No.: GCE7000162R01178 (circuit-breaker) P=275
Vacuum interrupter: Type: VG4-S L1: No. 1172, L2: No. 1173, L3: No. 1110
Drawing No.: GCE7005745R0122 (pole part)

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50	Hz
Rated normal current	2500	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current	31.5	kA
D.C. component	30	%
Rated short-circuit making current	80	kA
Rated transient recovery voltage:		
Peak value	20.6	kV
Rate of rise	0.34	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3 s –CO-3 min-CO	
Arc extinguishing medium	vacuum	
Rated pressure / Minimal pressure (20 °C)	-	kPa
Insulating medium		
Rated pressure / Minimal pressure (20 °C)	-	kPa
Driving mechanism		
Rated pressure / Minimal pressure (20 °C)	-	kPa
Number of poles	3	
Number of units per pole	1	
Rated opening time	≤ 45	ms
Rated closing time	approx. 60	ms
Rated voltage of trip coil	220	V-DC
Rated voltage of closing coil	220	V-DC
Rated supply voltage	220	V-DC
Rated frequency of supply voltage	-	Hz
Further specifications:		
Max. ambient air temperature	40	°C

Essential characteristics:
-

Date of receipt of test object: 19th May 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker in Feeder Panel 3

Ratings assigned by the manufacturer

Test Object: Vacuum circuit-breaker (draw-out unit)
Type: VD4P 1216-31
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 7007054/4004/00 **Year of manufacture:** 2000
Drawing No.: GCE7000162R1172 (circuit-breaker) P=210
Vacuum interrupter: Type: VG4-S L1: No. 1126, L2: No. 1109, L3: No. 1125
Drawing No.: GCE7005745R0122 (pole part)

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50	Hz
Rated normal current	1600	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current	31.5	kA
D.C. component	30	%
Rated short-circuit making current	80	kA
Rated transient recovery voltage:		
Peak value	-20.6	kV
Rate of rise	0.34	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3 s –CO-3 min-CO	
Arc extinguishing medium	vacuum	
Rated pressure / Minimal pressure (20 °C)	-	kPa
Insulating medium		
Rated pressure / Minimal pressure (20 °C)	-	kPa
Driving mechanism		
Rated pressure / Minimal pressure (20 °C)	-	kPa
Number of poles	3	
Number of units per pole	1	
Rated opening time	≤ 45	ms
Rated closing time	approx. 60	ms
Rated voltage of trip coil	220	V-DC
Rated voltage of closing coil	220	V-DC
Rated supply voltage	220	V-DC
Rated frequency of supply voltage	-	Hz
Further specifications:		
Max. ambient air temperature	40	°C

Essential characteristics:
The breaker was switched off and in disconnecting position during the test.

Date of receipt of test object: 19th May 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker in Feeder Panel 4

Ratings assigned by the manufacturer

Test Object: Vacuum circuit-breaker (draw-out unit)
Type: VD4P 1206-31
Manufacturer: ABB Calor Emag Mittelspannung GmbH, Ratingen, Germany
Serial-No.: 7006082/4002/99 **Year of manufacture:** 1999
Drawing No.: GCE7002291R0150 (circuit-breaker) P=150
Vacuum interrupter: Type VG4-S L1: No. 55830, L2: No. 55838, L3: No. 55829
Drawing No.: GCE7003979R0104 (pole part)

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50	Hz
Rated normal current	630	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current	31.5	kA
D.C. component	30	%
Rated short-circuit making current	80	kA
Rated transient recovery voltage:		
Peak value	20.6	kV
Rate of rise	0.34	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3 s –CO-3 min-CO	
Arc extinguishing medium	vacuum	
Rated pressure / Minimal pressure (20 °C)	-	kPa
Insulating medium		
Rated pressure / Minimal pressure (20 °C)	-	kPa
Driving mechanism		
Rated pressure / Minimal pressure (20 °C)	-	kPa
Number of poles	3	
Number of units per pole	1	
Rated opening time	≤ 45	ms
Rated closing time	approx..60	ms
Rated voltage of trip coil	220	V-DC
Rated voltage of closing coil	220	V-DC
Rated supply voltage	220	V-DC
Rated frequency of supply voltage	-	Hz
Further specifications:		
Max. ambient air temperature	40	°C

Essential characteristics:
-

Date of receipt of test object: 19th May 2000

ВЯРНО С ОРИГИНАЛА

List of Drawings

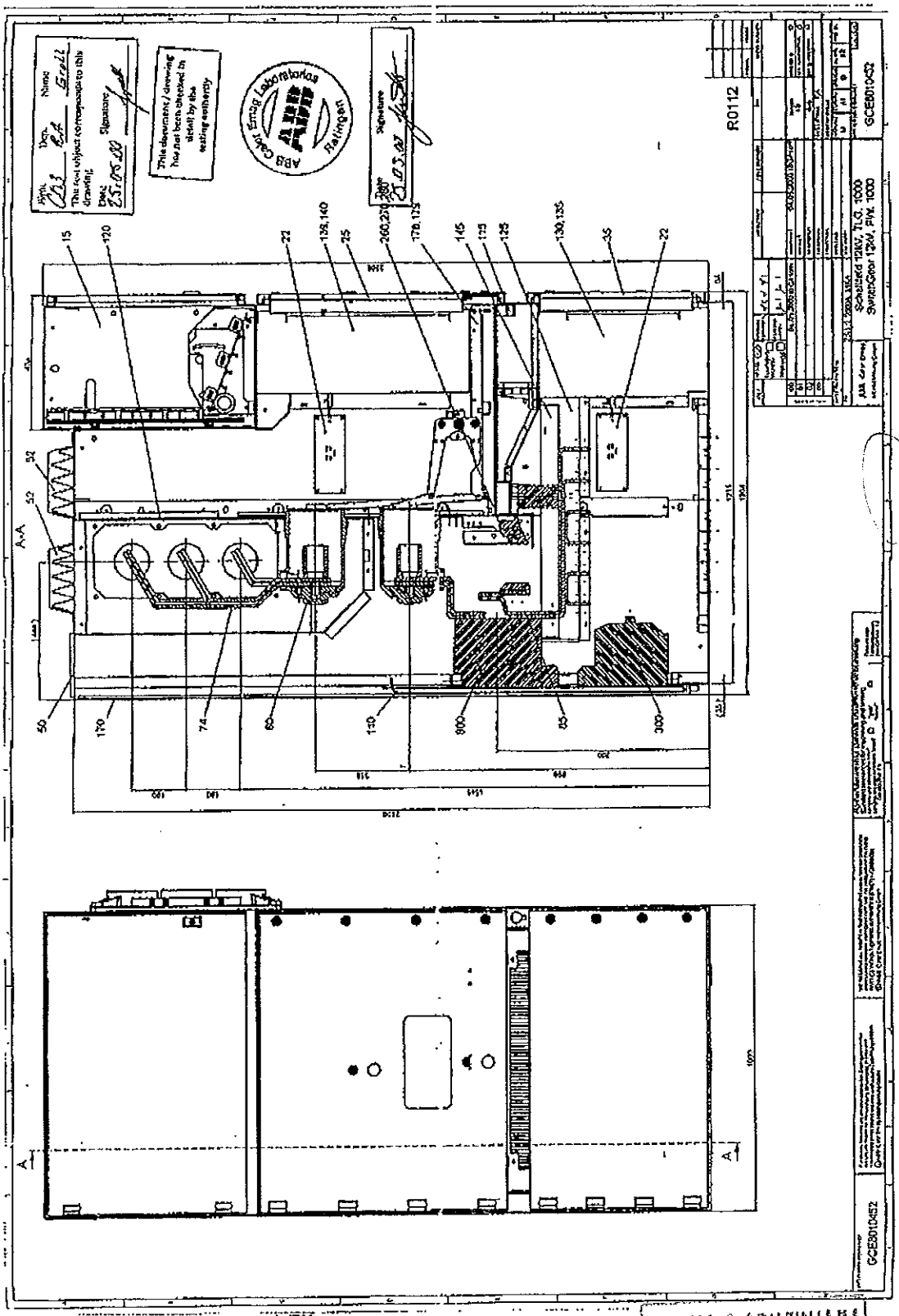
The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. These drawings have been stamped and signed by the manufacturer representative. The drawings has not been checked in detail by the testing authority. The drawings are kept

x with the test documents at the test laboratory.
at the client.

Drawing no.	Description
GCE8010452R0112 index 00	Switchgear 12 kV, PW1000
GCE8010450R0101 index 00	Cubicle 12 kV, ≤1000 A; T. 650
GCE7000162R1178 index 00	Einschub für ZS1.2, VD4-P
GCE7002291R0150 index 00	Draw-out VD4P 12/17.5 kV, ZS1.2
GCE7005745R0102 index 05	Pole compl. VM1 12 kV, 2000 A
GCE7003979R0104 index 05	Pole compl. VM1 12 kV, 1250 A

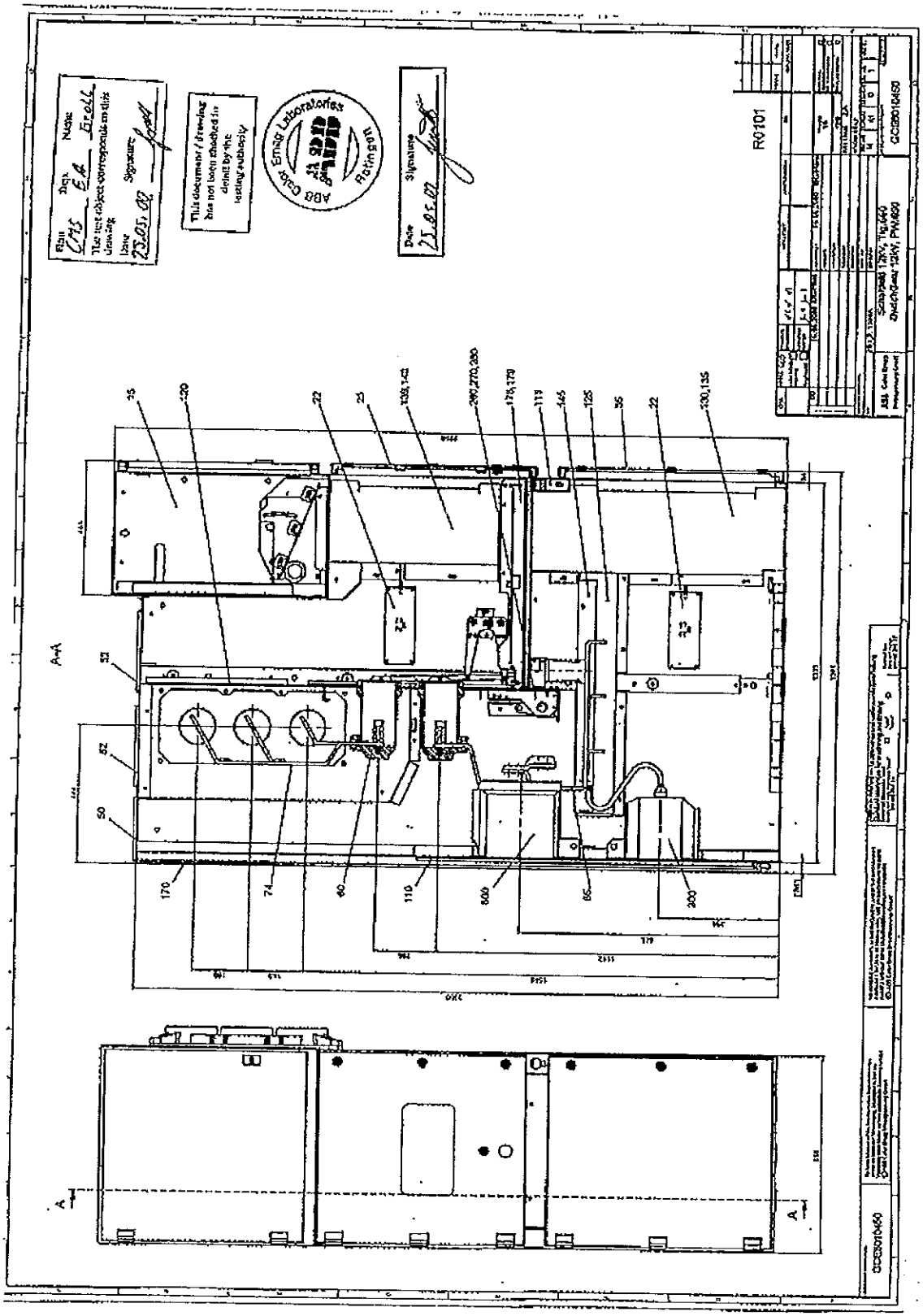
ВЯРНО С ОРИГИНАЛА

Feeder Panel (Panel 2)



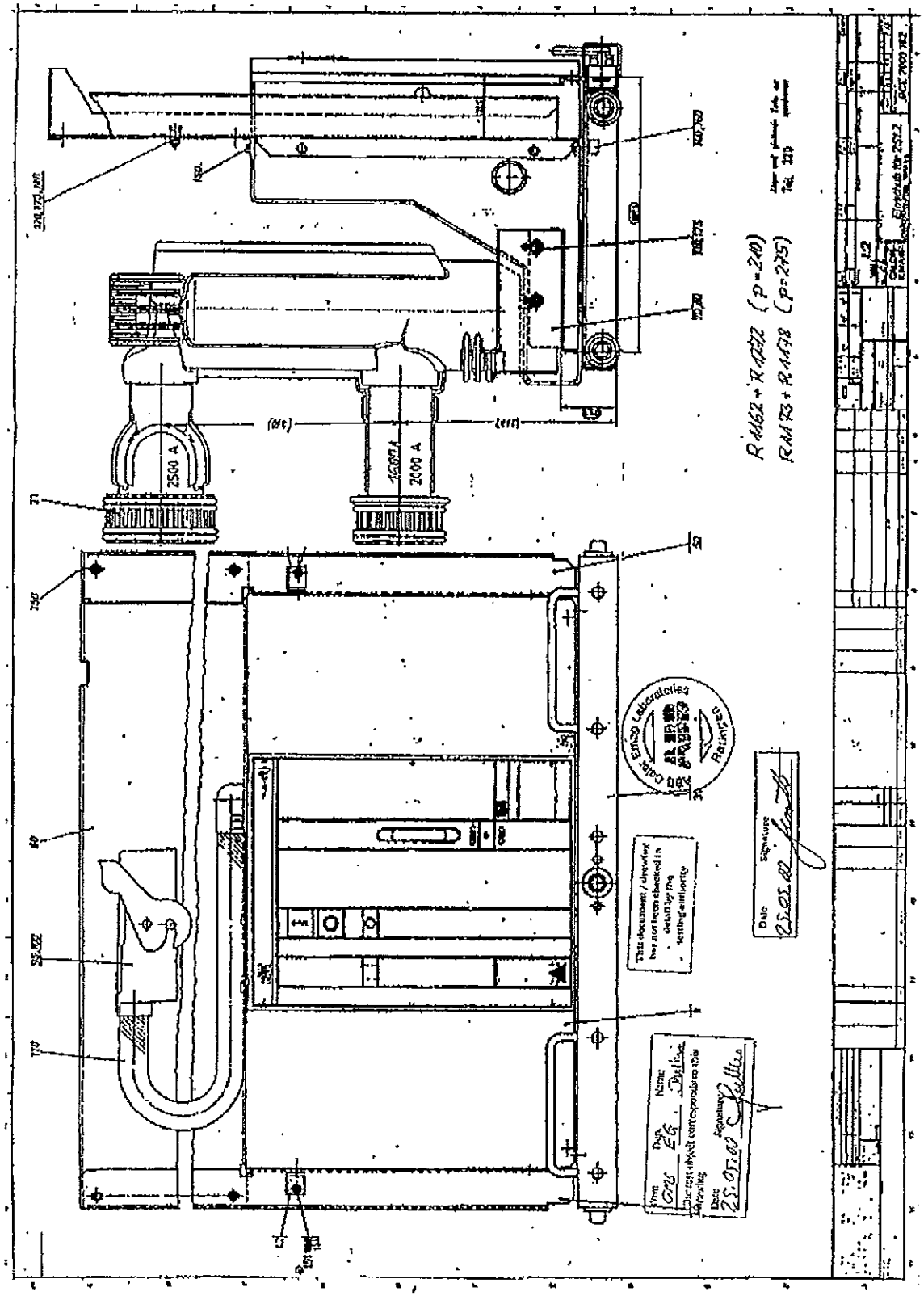
ВЯРНО С ОРИГИНАЛА

Feeder Panel (Panel 4)



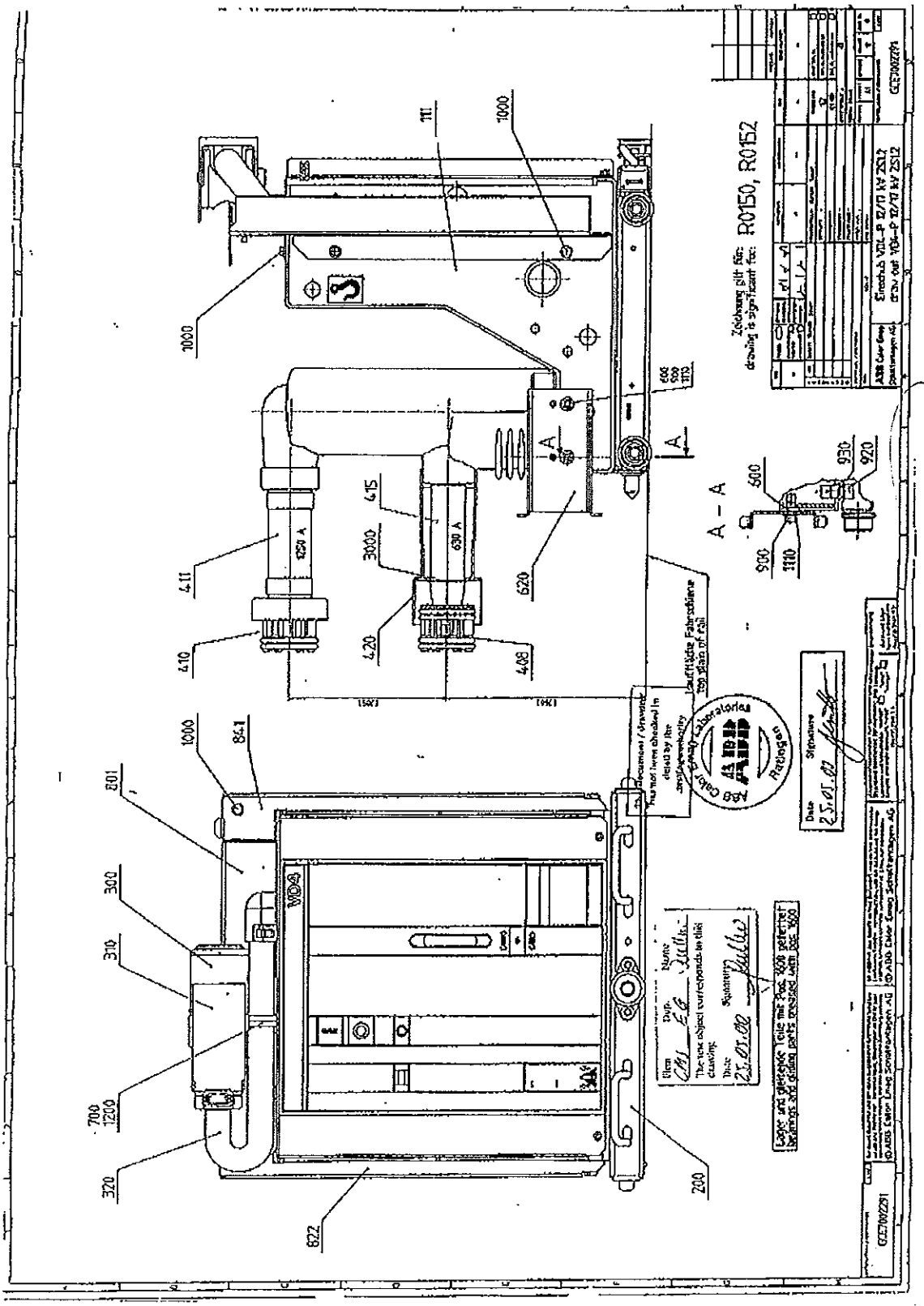
ВЯРНО С ОРИГИНАЛА

Circuit-Breaker (Panel 2)



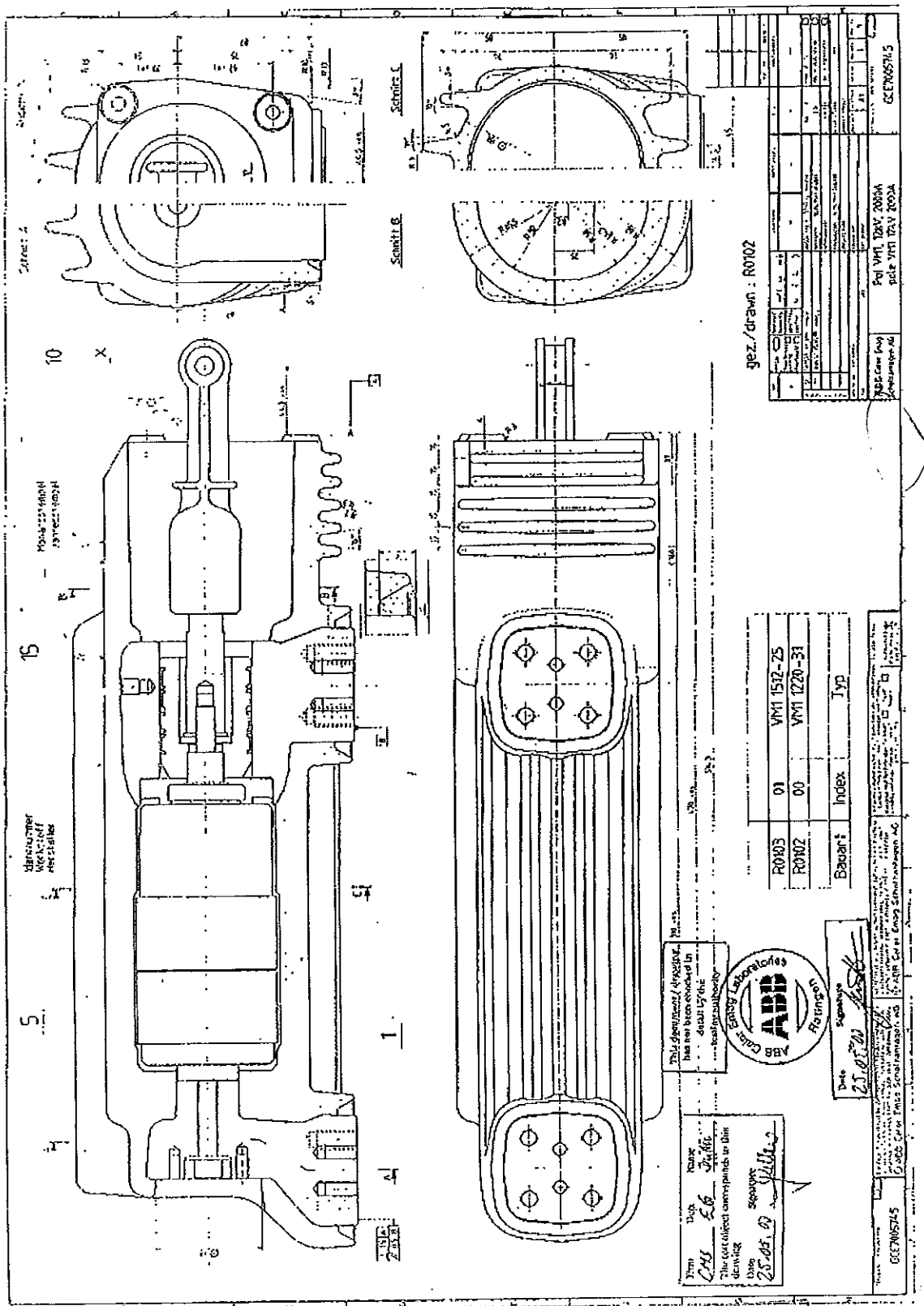
ВЯРНО С ОРИГИНАЛА

Circuit-Breaker (Panel 4)



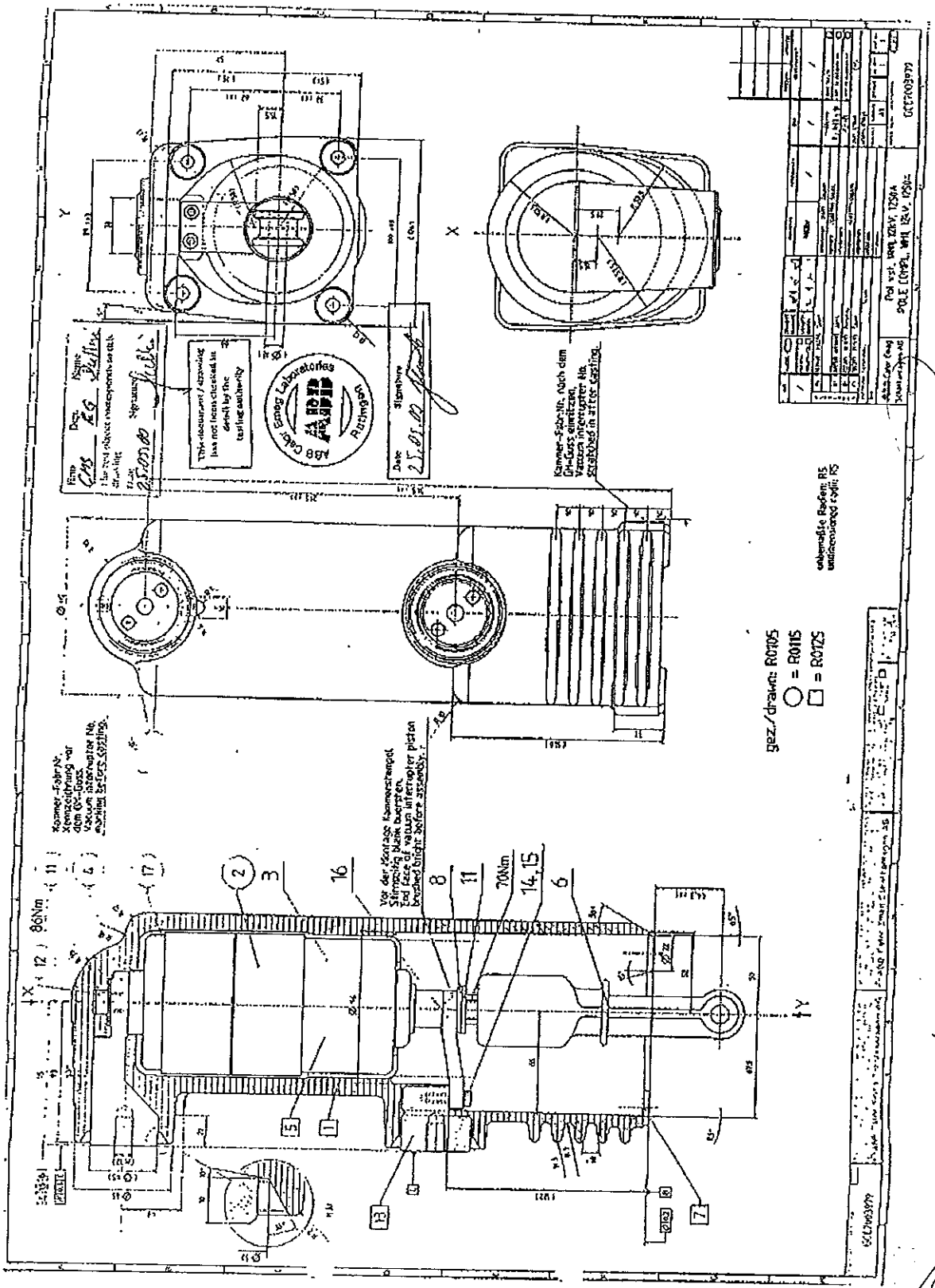
ВЯРНО С ОРИГИНАЛА

Pole Part (Circuit Breaker Panel 2)



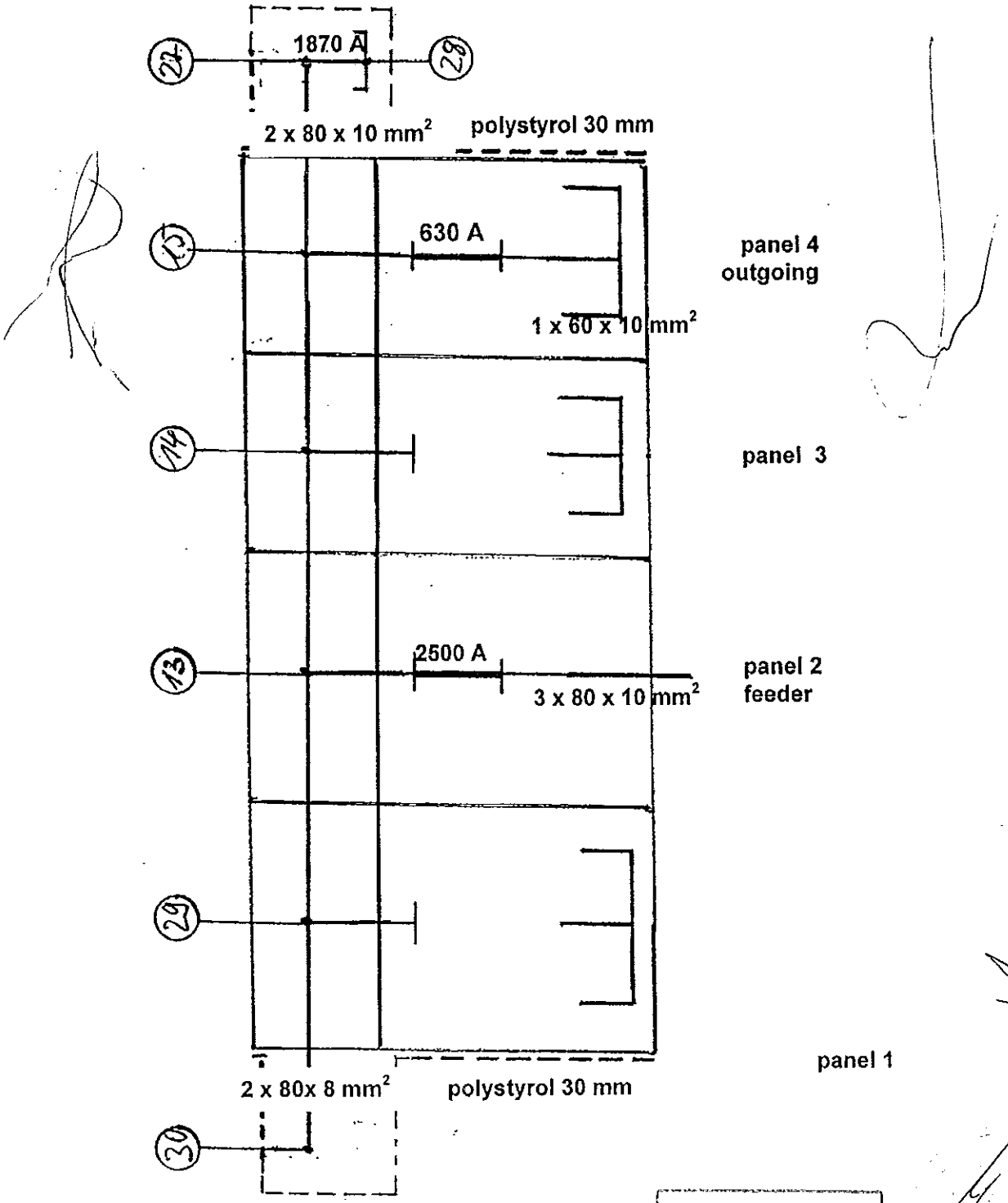
ВЯРНО С ОРИГИНАЛА

Pole Part (Circuit Breaker Panel 4)



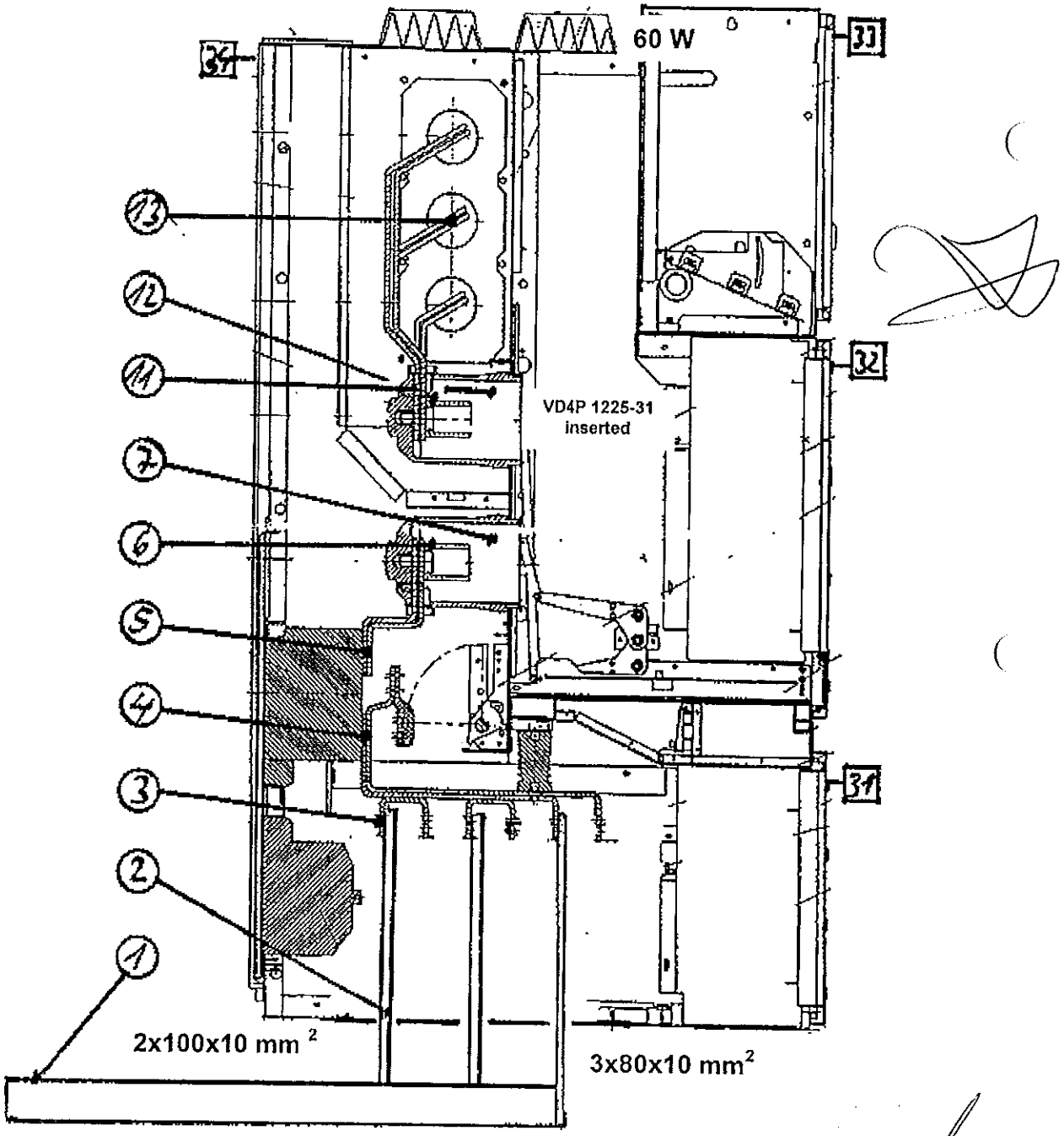
ВЗРНО С ОРИГИНАЛА

Test Arrangement and Measurement Points for Temperatures and Resistances of the Busbars



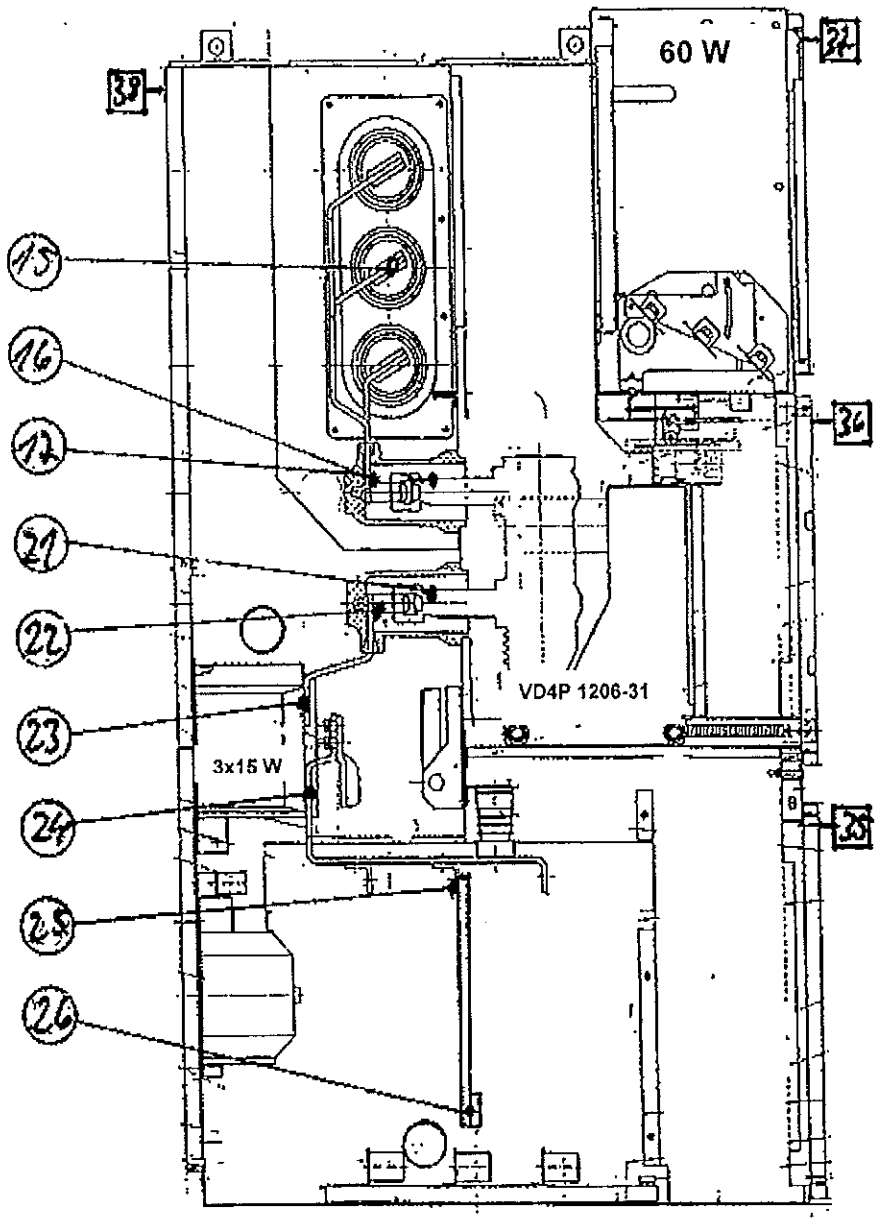
ВЯРНО С ОРИГИНАЛА

Measurement Points for Temperatures and Resistances of the Feeder Panel (Panel 2)



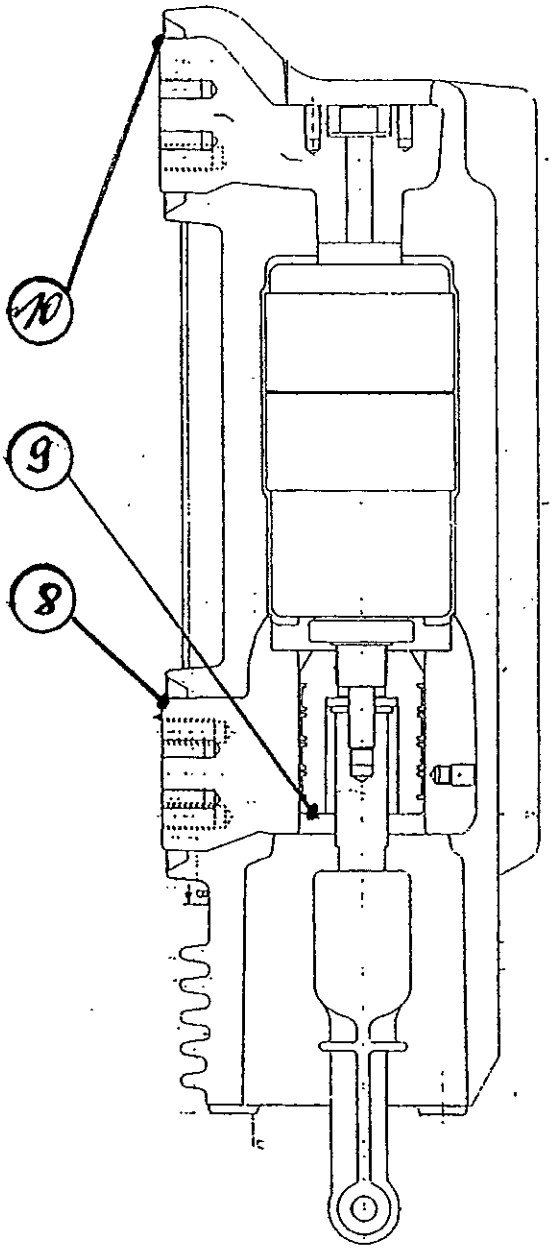
ВЯРНО С ОРИГИНАЛА

Measurement Points for Temperatures and Resistances of Feeder Panel (Panel 4)



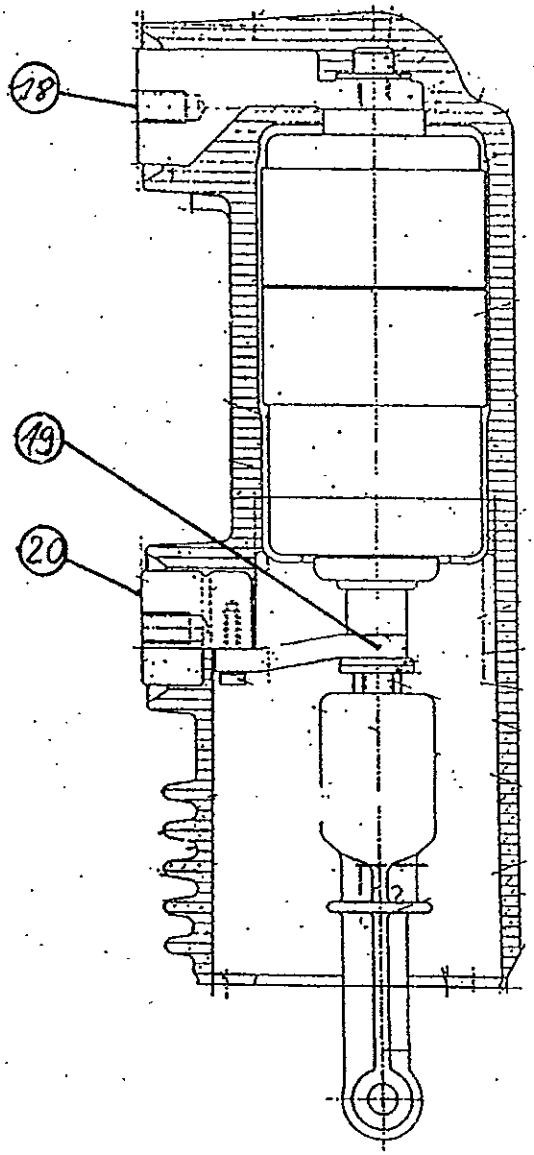
ВЯРНО С ОРИГИНАЛА

Measurement Points for Temperatures of the Circuit-Breaker Poles Panel 2



ВЯРНО С ОРИГИНАЛА

Measurement Points for Temperatures of the Circuit-Breaker Poles
Panel 4



ВЯРНО С ОРИГИНАЛА

Measurement of the Resistance of the Main Circuit

Date of test: 31st May 2000 - before temperature rise test
01st June 2000 - after temperature rise test

Condition of test object before test: factory new panels

Ambient air temperature: before temperature rise test 21 °C
after temperature rise test 22 °C

Measurement between points (see sheet 20-22)	Resistance of the main circuit μΩ		
	L1 before/after[1)]	L2 before/after[1)]	L3 before/after[1)]
2 - 14 (panel 2)	53.7 / 53.5	52.2 / 52.0	50.6 / 50.3
14 - 26 (panel 4)	110 / 109	104 / 103	94.0 / 93.8

Remarks: [1)] Before: before temperature rise test
After: after temperature rise test

Resistance measurement at direct current of: 50 A

ВЯРНО С ОРИГИНАЛА

Temperature Rise Test

Date of test: 31st May and 01st June 2000

Condition of test object before test: factory new panels

Connections to test object: feeder:

two bars 100x10 mm² Cu, length about 2 m outside the panel and three bars 80x10 mm² Cu, length about 0.8 m inside the panel

neutral points:

1. cable terminal of feeder panel 4 with one bar 80x10 mm² Cu, length about 0.4
2. extended busbar of panel 4 with two bars 80x10 mm² Cu

Duration of test: 10 **h**
Ambient air temperature: 28.6 **°C**
Test current: see below **A**
Test frequency 50 **Hz**

Distribution of the currents of the panels:

panel or busbar	current in A			
	phase L1	phase L2	phase L3	average value
panel 2, feeder 2000 A	2504	2498	2507	2503
busbar panel 2 - 4	2504	2498	2507	2503
panel 4, outgoing 6300 A	690	667	668	675

Remarks:

1. The permitted temperature rises are valid for an ambient air temperature of 40 °C.
2. The distribution of the currents at the busbar connections of the feeder panel 4 was done by using iron cores over the extended busbar.
3. The side walls of the panels and the extended busbars were covered by expanded polystyrene sheets of 30 mm thickness.
4. The temperatures were measured by thermocouples type T. For the measurement points of the main circuit the thermocouples were inserted into holes and fixed. The measurement system determines the average value of the ambient temperatures, calculates the differences to the temperatures of all measuring points and records the temperature rises directly.
5. The circuit breakers of the panels 1 and 3 were switched off and in disconnected position.

ВЯРНО С ОРИГИНАЛА

Continuation from sheet 25

Measuring point (see sheet 18 - 23)		Description of measuring point	Kind of measuring point	Final temperature rise K	Permitted temperature rise K
31	-	Front door top cable comp. panel 2	Access. part expected to be touched in normal operation	3.7	30
32	-	Front door top c.b. comp. panel 2	Access. part expected to be touched in normal operation	5.7	30
33	-	Front door top low volt. comp. pan. 2	Access. part expected to be touched in normal operation	12.0	30
34	-	Rear wall top panel 2	Accessible part which need not to be touched in normal op.	15.9	40
35	-	Front door top cable comp. panel 4	Access. part expected to be touched in normal operation	2.7	30
36	-	Front door top c.b. comp. panel 4	Access. part expected to be touched in normal operation	6.6	30
37	-	Front door top low volt. comp. pan. 4	Access. part expected to be touched in normal operation	11.0	30
38	-	Rear wall top panel 4	Accessible part which need not to be touched in normal op.	8.7	40

ВЯРНО С ОРИГИНАЛА

Temperature rises and Permitted Temperature rises of the Feeder Panel 2 and the Busbar – right side

ABB Calor Emag Laboratory Test report HZ147E10 **01.06.2000**

Temperature-rise of switchgear ZS1.2 - 12 kV with VD4P 1225-31 with UG4-S

Test current : 2503 A
Ambient temperature : 27.8 °C

No.	Measuring points Name	Temperature rise dt / K P1	P2	P3
28	neutral point ext. busbar	48.5	49.0	46.6
27	end of busbar panel 4	55.8	52.3	46.4
15	busbar / jumper bar pan. 4	66.0	65.7	57.5
14	busbar / jumper bar pan. 3	68.8	69.5	63.3
13	jumper bar / busbar pan.2	54.5	60.0	59.8
12	upper disconn. cont. pan.	61.8	64.3	62.6
11	upper disconn. cont. c.b.	61.9	63.9	62.4
10	upper pole terminal	62.6	64.7	62.9
9	contact piston c.b. pan.2	60.6	63.1	61.7
8	lower pole terminal	58.5	60.5	59.2
7	lower disconn. cont. c.b.	58.3	59.2	58.6
6	lower disconn. cont. pan.	60.5	59.8	60.2
5	upper c.t. terminal	62.5	64.0	61.9
4	lower c.t. terminal	47.6	49.9	47.1
3	cable terminal panel 2	42.6	44.5	38.9
2	cable bar bottom inside p.	32.6	35.2	35.3
1	feeder bar 1 m before 2	28.6	31.6	32.4

ВЯРНО С ОРИГИНАЛА

Temperature rises and Permitted Temperature rises of the Feeder Panel 4 and the Busbar – left side

ABB Calor Emag Laboratory Test report HZ147E10 **01.06.2000**

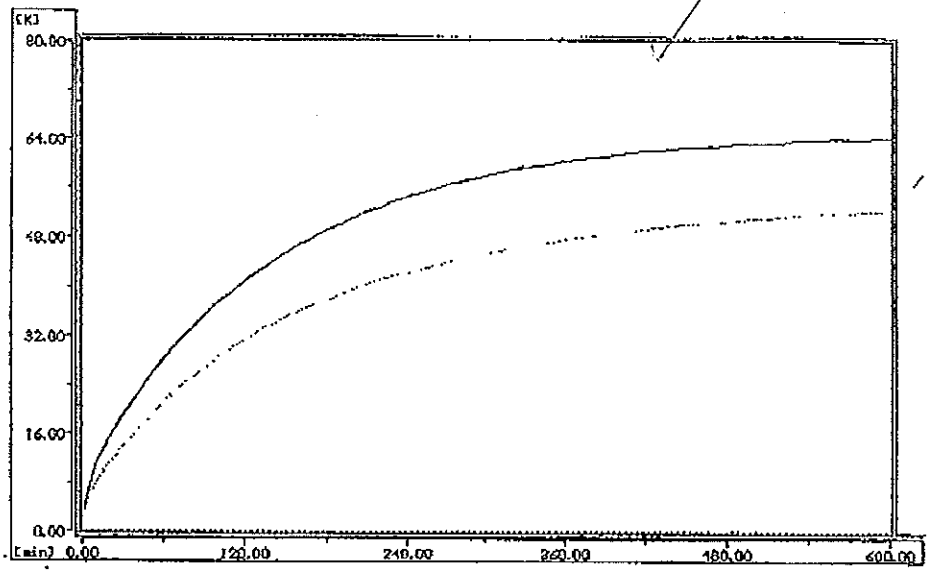
Temperature-rise of switchgear ZS1.2 - 12 kV with UD4P 1206-31 with UG4-S

No.	Measuring points Name	Temperature-rise dT / K P1	P2	P3
30	end of busbar panel 1	7.4	5.9	12.1
29	busbar / jumper bar pan. 1	15.9	18.7	22.0
13	busbar / jumper bar pan. 2	54.5	60.0	59.8
14	busbar / jumper bar pan. 3	68.8	69.5	63.3
15	jumper bar / busbar pan. 4	66.0	65.7	57.5
16	upper disconn. cont. panel	53.6	53.1	51.6
17	upper disconn. cont. c.b.	48.8	48.6	47.0
18	upper pole terminal	44.2	45.5	44.2
19	current lead / mowea. stem	41.6	40.6	41.4
20	lower pole terminal	39.6	39.9	39.2
21	lower disconn. cont. c.b..	36.8	38.8	38.0
22	lower disconn. cont. panel	35.2	33.7	32.2
23	upper c.t. terminal	27.2	27.6	26.3
24	lower c.t. terminal	22.4	22.8	21.3
25	cable terminal panel 4	20.9	20.9	19.9
26	neutral point inside pan.4	20.5	20.3	20.2

Test current : 675 A
Ambient temperature : 27.8 °C

ВЯРНО С ОРИГИНАЛА

Temperature rises of the Upper Pole Terminal of C.B. Panel 2 and Upper Disconnecting Contact of Panel 4



measurement point 10 / L2

measurement point 16 / L2

ВЯРНО С ОРИГИНАЛА

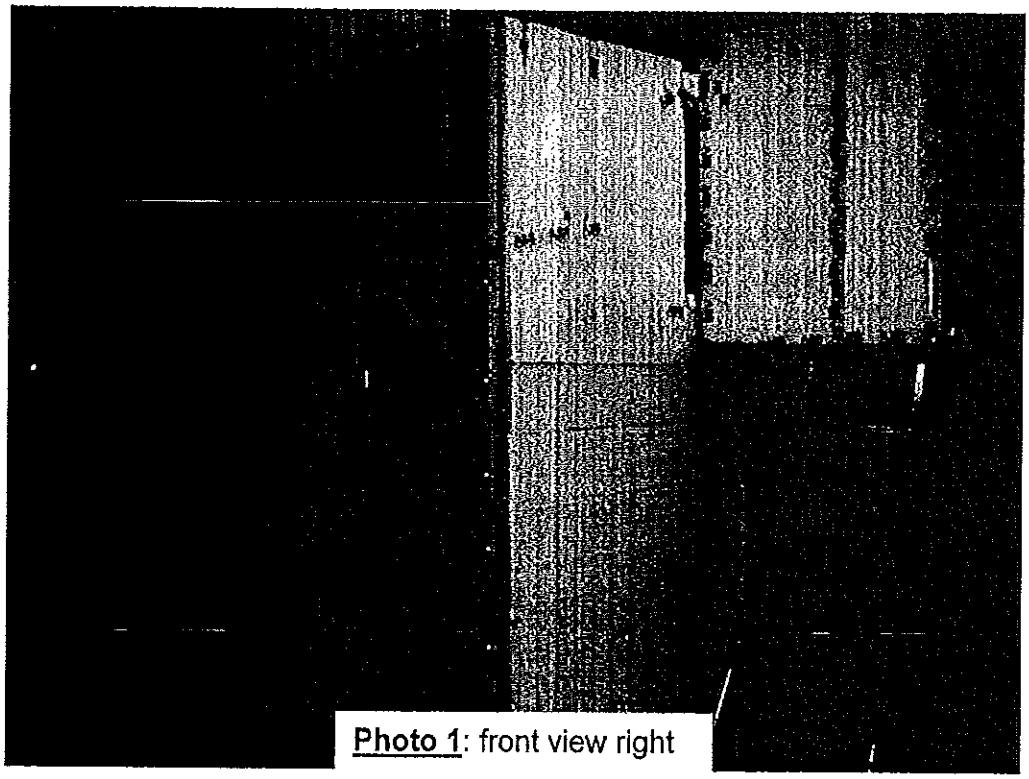


Photo 1: front view right

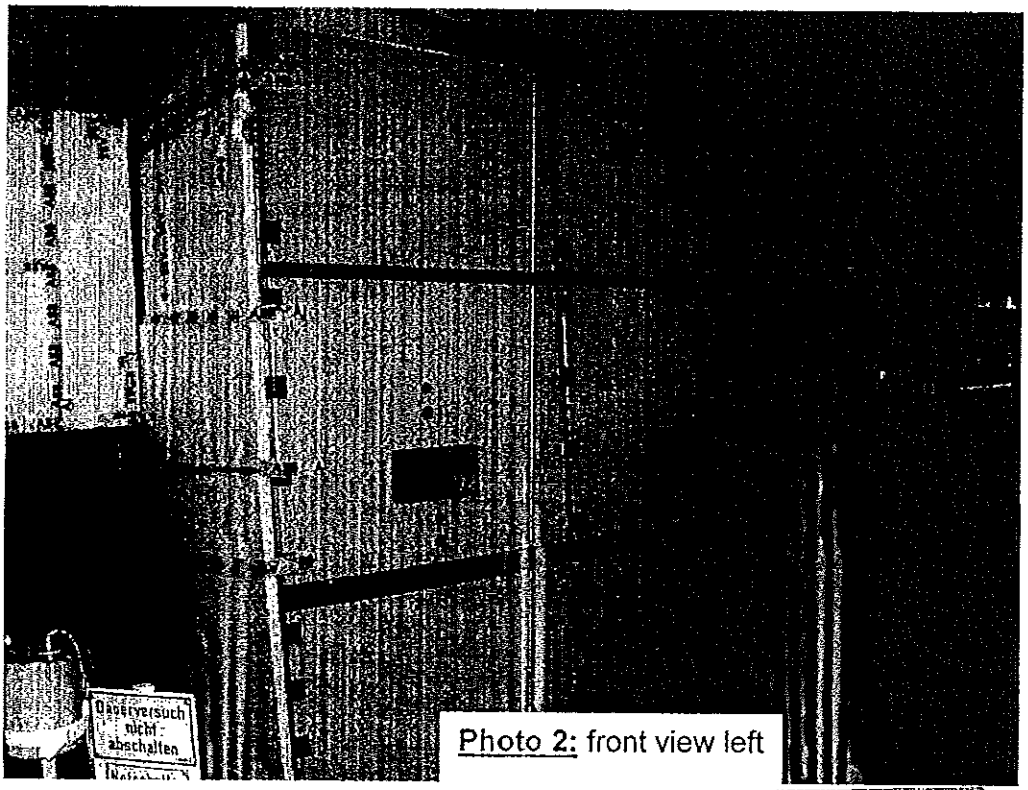


Photo 2: front view left

ВЯРНО С ОРИГИНАЛА

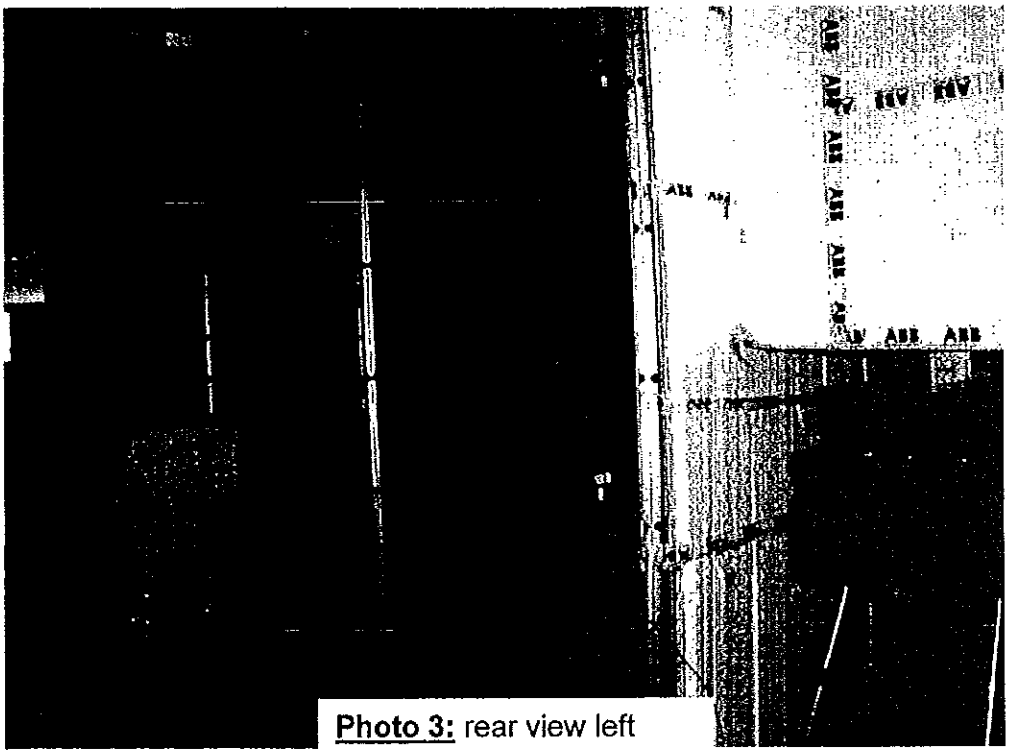


Photo 3: rear view left

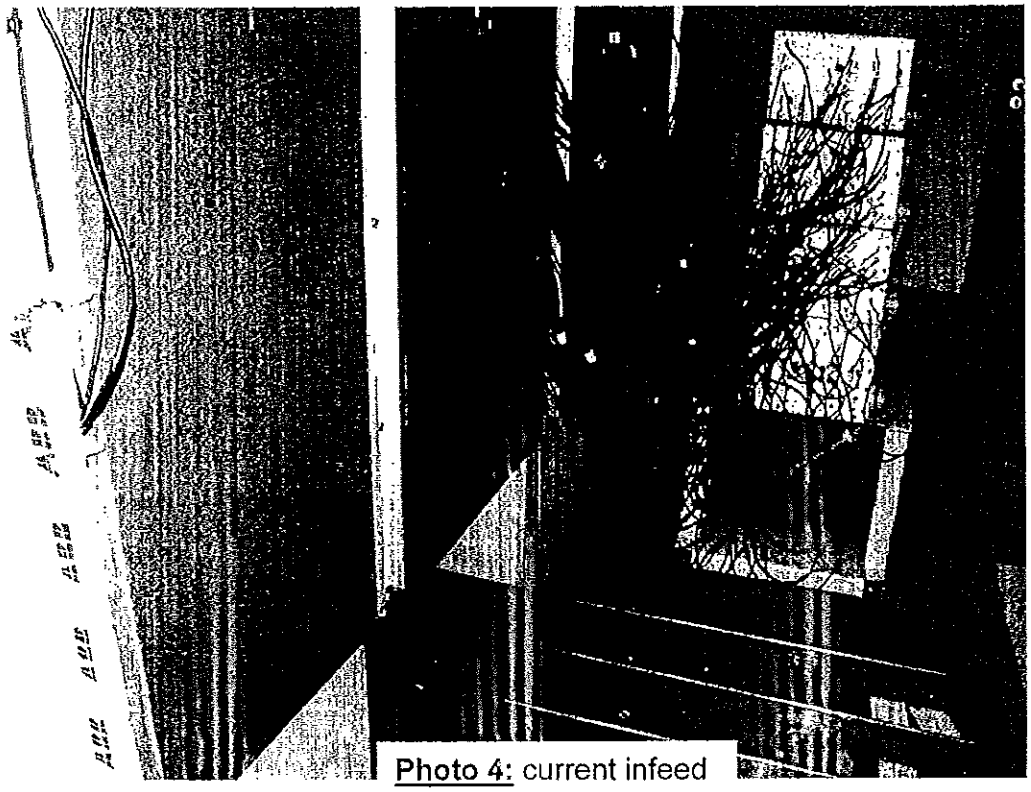


Photo 4: current infeed

ВЯРНО С ОРИГИНАЛА

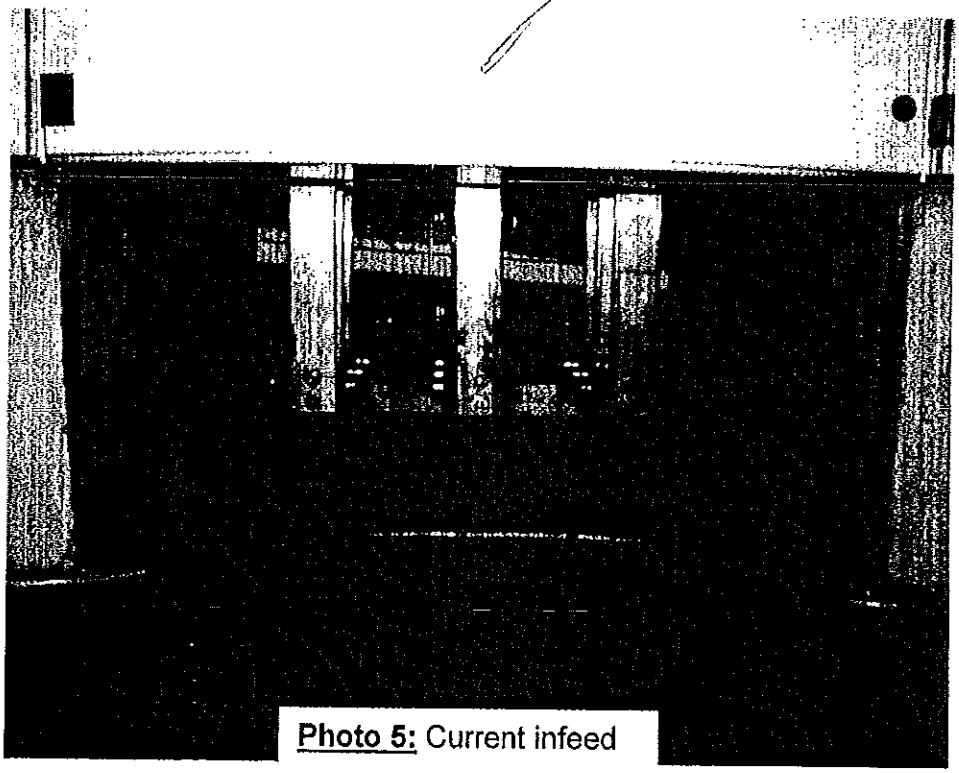


Photo 5: Current infeed

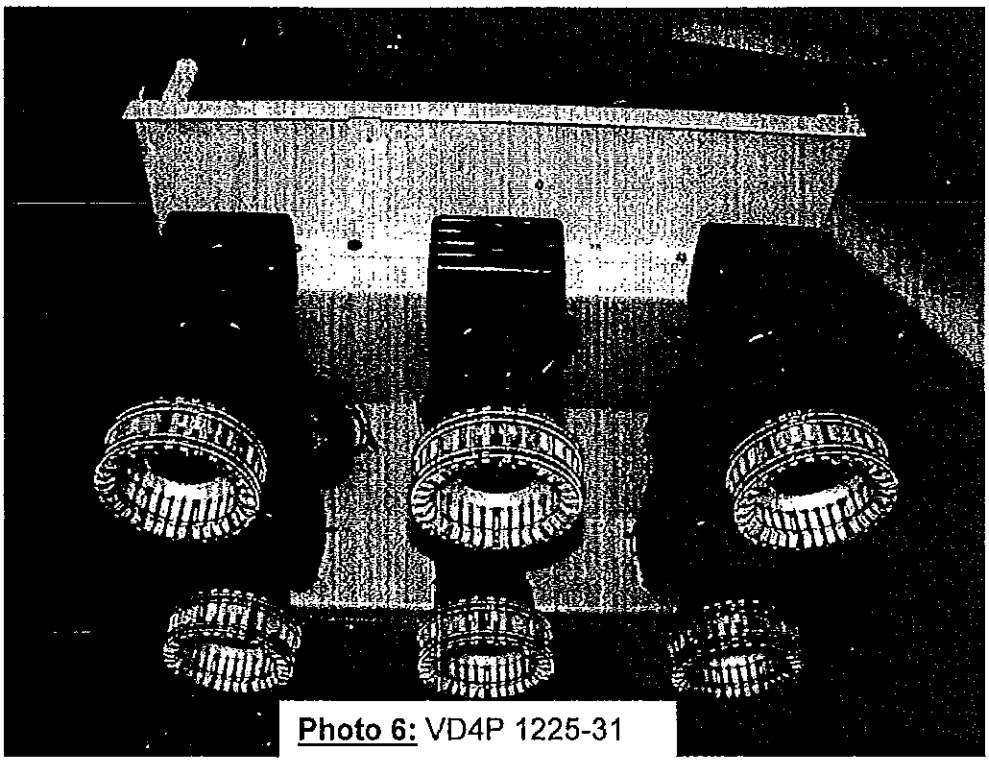


Photo 6: VD4P 1225-31

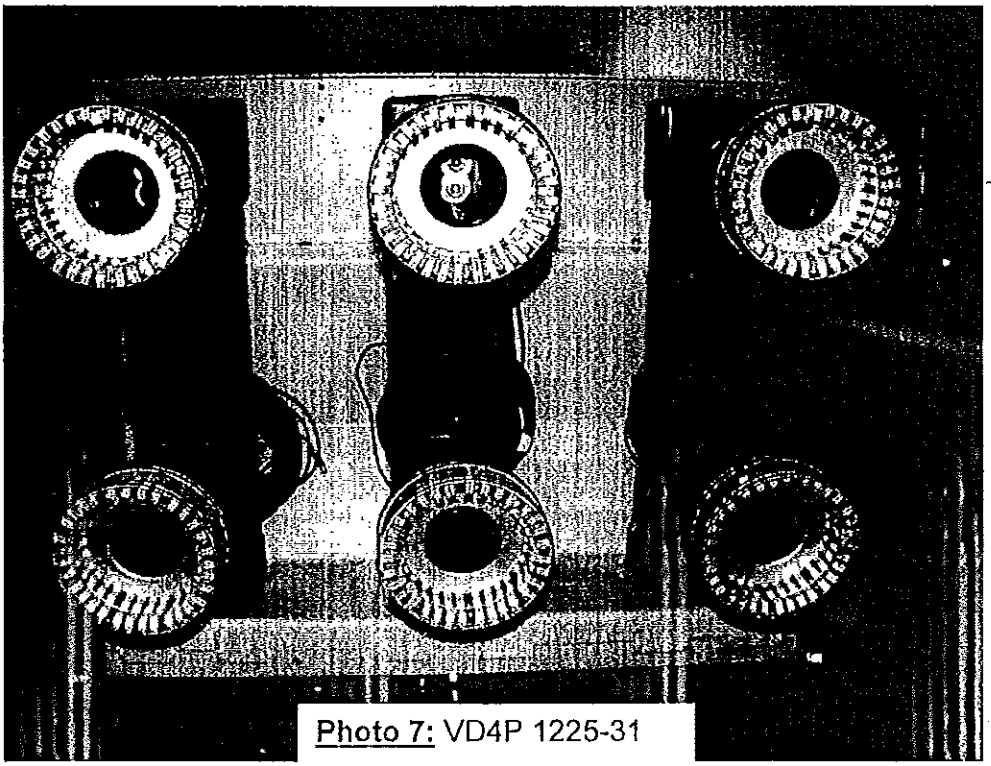


Photo 7: VD4P 1225-31

ВЯРНО С ОРИГИНАЛА

Rated characteristics of the apparatus installed in the equipment

Three-pole medium-voltage vacuum insulated circuit-breaker in withdrawable version

manufacturer	**ABB**
designation / type	VD4/P 12.25.32
serial number	AD00140546
voltage	12 kV
lightning impulse withstand voltage	75 kV peak
power frequency withstand voltage	28 kV rms
frequency	50÷60 Hz
normal current	2500 A
breaking capacity	31,5 kA
short-time withstand current	31,5 kA for 3s
making capacity	80 kA at 12 kV

earthing switch

manufacturer	**ABB**
designation / type	EK6 1208-275
serial number	033522
voltage	12 kV
insulation level	28 - 75
frequency	50 ÷ 60 Hz
short-circuit making current	80 kA
short-time withstand current	31,5 kA
short-circuit duration	3 s

Medium-voltage cast resin current transformer

manufacturer	**ABB**
designation / type	TPU 46-11
voltage	12 kV
frequency	50 Hz
ratio	2500/5-5 A
short-time withstand current	80 for 1 s
peak withstand current	200 kA

ВЯРНО С ОРИГИНАЛА

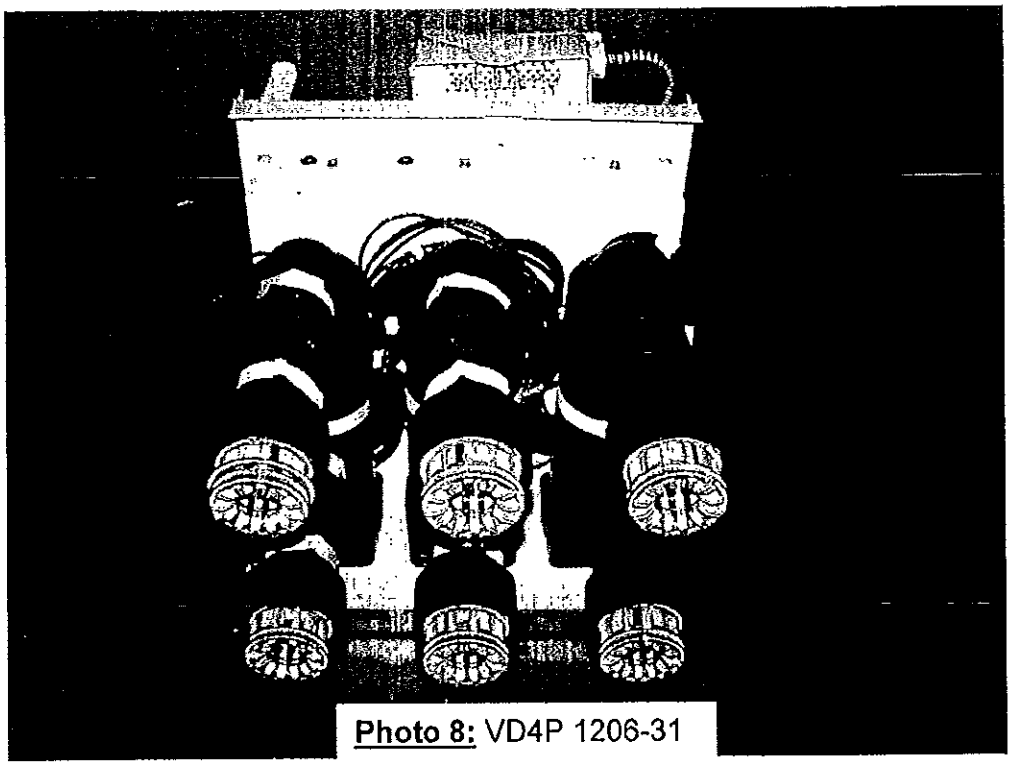


Photo 8: VD4P 1206-31

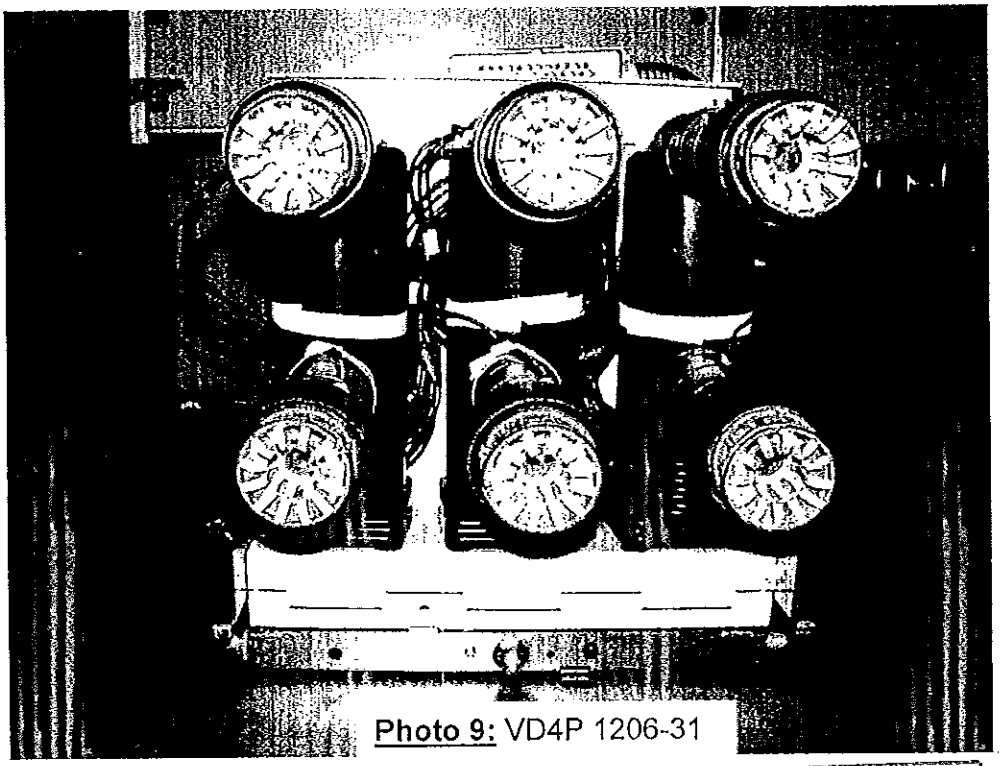


Photo 9: VD4P 1206-31

ВЯРНО С ОРИГИНАЛА

Deutscher Akkreditierungs Rat

Reg. No.
DAT-P-032/93

ABB Calor Emag Laboratories

ABB

TEST REPORT No. HZ 146 L 02

Sheet 1

Issued by an Accredited Laboratory corresponding to EN 45001

Copy-No. 1

Test Object

Three-panel arrangement of metal-clad, air insulated switchgear type ZS1.2 (650 mm, 1000 mm, 800 mm width) equipped with bushing plates

Rated voltage	U_r	12 kV
Rated normal current	I_r	1000/1600/1600 A
Rated frequency	f_r	50/60 Hz
Rated short-time withstand current	I_k	31.5 kA
Rated peak withstand current	I_p	80 kA
Rated duration of short-circuit current	t_k	3 s

Manufacturer

ABB Calor Emag Mittelspannung GmbH, Oberhausener Str. 33, 40472 Ratingen, Deutschland

Tests performed

Testing of the behaviour of the metal-clad switchgear under conditions of arcing due to internal faults with 31.5 kA - 1.0 s in different compartments of the three panels. For further details see sheet-no. 2 to 5.

Test Specification

The test has been carried out in accordance with the client's instructions. Test procedure and test parameters were based on IEC 60298/3rd Ed/1990-12, Clause 6.108, Annex AA in conjunction with PEHLA-Recommendation No. 4 / 3.1995.
(Accessibility Type A: Metal-enclosed switchgear and controlgear with accessibility restricted to authorized personnel only).

Test Results

The assessment of the test was carried out in accordance with criteria 1 to 6 of the above mentioned test specifications.
For further details see sheet-no. 2 to 5 and 19 to 25.

Test Date

04th to 12th July 2000

Client

ABB Calor Emag Mittelspannung GmbH, Oberhausener Str. 33, 40472 Ratingen, Deutschland

ABB Calor Emag Laboratories ABB Ratingen

12th February 2002
Date of Issue

Dr. Stefan Göttlich
Laboratory Manager

Andreas Brandt
Test Engineer

Total Number of Sheets: 34 Sheets — **11 Oszillograms**

This test report refers exclusively to the object tested.
ABB Calor Emag Mittelspannung GmbH is certified according to DIN ISO 9001 by DQS under Reg. No. 373-02

ABB Calor Emag Laboratories Ratingen are accredited according to EN 45001 by DATech under Reg.No. DAT-P-032/93

ABB Calor Emag Mittelspannung GmbH Ratingen
High-Power Testing Laboratory
Oberhausener Straße 33
40472 Ratingen, Deutschland
Phone + 49 (0) 21 02 12-1352
Fax + 49 (0) 21 02 12-1719

ВЯРНО С ОРИГИНАЛА

Comments on Test Arrangement and on the Test

The test object was a three-panel arrangement of a metal-clad, air insulated switchgear type ZS1.2 for 12 kV, consisting of a 650 mm width outgoing panel left-handed, of a 1000 mm width incoming panel in centre and a 800 mm width outgoing panel right-handed. The switchgear was installed in a room mock up with a ceiling height of approximately 3 m. The distance between the rear wall of the switchgear and the room mock up was approximately 0.2 m. The pressure relief took place by a top mounted pressure relief duct overcoming 1800 mm at the side wall of the left-handed panel.

Each panel was equipped with a VD4 vacuum circuit-breaker dummy and a common earthing bar of copper 30 x 8 mm^2.

Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

For all tests black cretonne indicators (cotton fabric approximately 150 g/m^2) were placed in front of and on both sides of the switchgear as stated in the relevant test regulations.

During the tests the pressure gauge in the compartment under test was measured and recorded. The tests were filmed with a high-speed video camera with a frequency of 500 frames/s.

The evaluation of the RMS-value of the short-circuit current was made according to the Simpson-Formula.

ВЯРНО С ОРИГИНАЛА

Test Results:

Test-no.: HZ 146 L 02 / 03 Internal arcing test in the cable compartment of the left-handed panel (650 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm at the cable terminals.

Peak short-circuit current: 72.5 kA
Short-circuit current: 30.6 kA - 1.05 s equivalent to 31.5 kA - 1.02 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test-no.: HZ 146 L 02 / 05 Internal arcing test in the cable compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm at the cable terminals.

Peak short-circuit current: 77.3 kA
Short-circuit current: 31.5 kA - 1.05 s equivalent to 31.5 kA - 1.05 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Test Results:

Test-no.: HZ 146 L 02 / 06 Internal arcing test in the circuit-breaker compartment of the left-handed panel (650 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 across the upper contact arms of the circuit-breaker.

Peak short-circuit current: 79.3 kA
Short-circuit current: 31.5 kA - 1.05 s equivalent to 31.5 kA - 1.05 s

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test-no.: HZ 146 L 02 / 07 Internal arcing test in the busbar compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 mm across the busbars.

Peak short-circuit current: 78.8 kA
Short-circuit current: 31.6 kA - 1.05 s equivalent to 31.5 kA - 1.05 s

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Test Results:

Test-no.: HZ 146 L 02 / 08 Internal arcing test in the busbar compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 across the busbars.

Peak short-circuit current: 77.3 kA
Short-circuit current: 31.5 kA - 1.05 s equivalent to 31.5 kA - 1.05 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

Test-no.: HZ 146 L 02 / 09 Internal arcing test in the circuit-breaker compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the lower contact arms of the circuit-breaker.

Peak short-circuit current: 77.2 kA
Short-circuit current: 31.3 kA - 1.05 s equivalent to 31.5 kA - 1.04 s

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Contents

ВЯРНО С ОРИГИНАЛА

Assessment of the Test

Extraction of IEC 60298/3rd Ed/1990-12, Annex AA

The following criteria allow for the arcing effects.
It is to be observed:

Criterion No. 1

Whether correctly secured doors, covers, etc., do not open.

Criterion No. 2

Whether parts (of the metal-enclosed switchgear and controlgear), which may cause a hazard, do not fly off. This includes large parts or those with sharp edges, for example, inspection windows, pressure relief flaps, cover plates, etc.

Criterion No. 3

Whether arcing does not cause holes to develop in the freely accessible parts of the enclosure as a result of burning or other effects.

Criterion No. 4

Whether the indicators arranged vertically do not ignite. Indicators ignited as a result of paint or stickers burning are excluded from this assessment.

Criterion No. 5

Whether the indicators arranged horizontally do not ignite. Should they start to burn during the test, the assessment criterion may be regarded as having been met, if proof is established of the fact that the ignition was caused by glowing particles rather than hot gases. Pictures taken by high-speed cameras should be produced in evidence.

Criterion No. 6

Whether all earthing connections are still effective.

Remark:

When the PEHLA-Recommendation No. 4 is stated under *Test Specification* in the Test Report the results of each test were assessed by all six criteria.

ВЯРНО С ОРИГИНАЛА

Participants of the Tests

Client:	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland
Representatives of the client:	
Mr. Aufermann	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. EA
Mr. Groll	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. EA
Mr. Martschat	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. EA
Representatives of the laboratory:	
Mr. Dr. Göttlich	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. LL
Test Engineer:	
Mr. Strathmann	ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland Dept. LL

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear (left-handed)

Test Object: Metal-clad, air insulated switchgear

Type: ZS1.2, 650 mm width

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland

Serial-No.: 7550027/2001/00 **Year of manufacture:** 2000

Drawing Nos.: See sheet-no. 12

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated current (busbar)	2000	A
Rated current (tee-off)	1000	A
Rated short-circuit peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20 ° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	80	kA
Short-time withstand current	31.5	kA
Short-circuit duration	1	s

Additional specifications and data:

- busbars 2 x 80 mm x 10 mm / R 5 mm, Cu, bare
- tee-off bars 1 x 60 mm x 10 mm / R 5 mm, Cu, bare

Date of receipt of test object: 3rd July 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear (centre)

Test Object: Metal-clad, air insulated switchgear

Type: ZS1.2, 1000 mm width

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland

Serial-No.: 7550027/2009/00 **Year of manufacture:** 2000

Drawing Nos.: See sheet-no. 12

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated current (busbar)	2000	A
Rated current (tee-off)	1600	A
Rated short-circuit peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20 ° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	80	kA
Short-time withstand current	31.5	kA
Short-circuit duration	1	s

Additional specifications and data:

- busbars 2 x 80 mm x 10 mm / R 5 mm, Cu, bare
- tee-off bars 2 x 100 mm x 10 mm / R 5 mm, Cu, bare

Date of receipt of test object: 3rd July 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

(Ratings assigned by the manufacturer)

Switchgear (right-handed)

Test Object: Metal-clad, air insulated switchgear

Type: ZS1.2, 800 mm width

Manufacturer: ABB Calor Emag Mittelspannung GmbH, 40472 Ratingen, Deutschland

Serial-No.: 7550027/2005/00 **Year of manufacture:** 2000

Drawing Nos.: See sheet-no. 12

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated current (busbar)	2000	A
Rated current (tee-off)	1600	A
Rated short-circuit peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated short-circuit duration	3	s
Insulating medium	air	
Rated filling pressure (abs., 20 ° C)	-	kPa

Prospective values under internal-arc conditions:

Peak withstand current	80	kA
Short-time withstand current	31.5	kA
Short-circuit duration	1	s

Additional specifications and data:

- busbars 2 x 80 mm x 10 mm / R 5 mm, Cu, bare
- tee-off bars 2 x 80 mm x 10 mm / R 5 mm, Cu, bare

Date of receipt of test object: 3rd July 2000

ВЯРНО С ОРИГИНАЛА

Table of Drawings of Test Objects

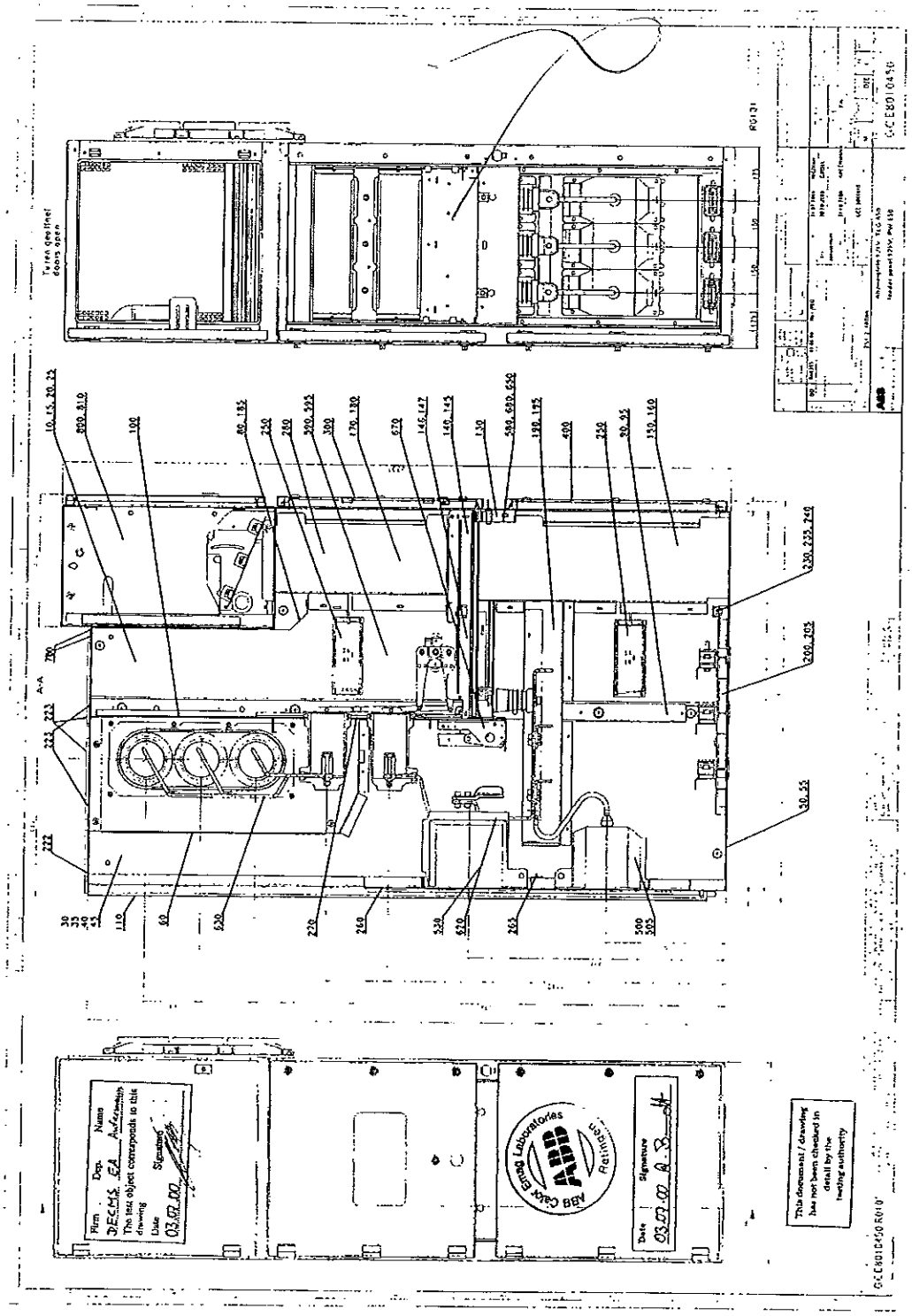
The drawings submitted for identification of the test object were stamped and signed by the test engineer.

The manufacturer/client has guaranteed by signature on the drawings that the equipment submitted for tests has been manufactured in accordance with the given drawings.

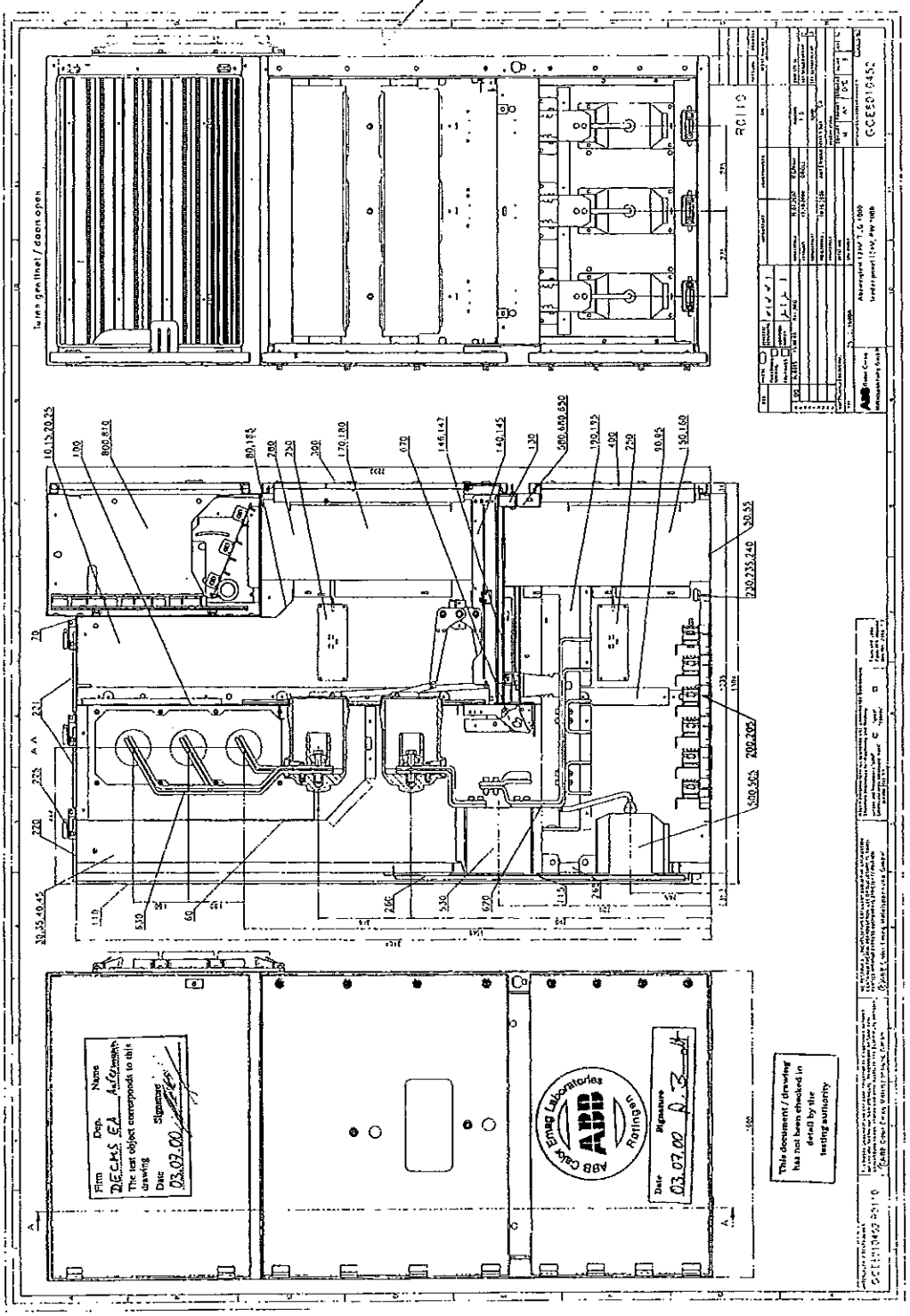
A copy of the following drawing is part of this Test Report:

ZS 1.2, feeder panel 12 kV, PW.650	GCE8010450R0101, sheet 1, index 00,
ZS 1.2, feeder panel 12 kV, PW.1000	GCE8010452R0110, sheet 19, index 00,
ZS 1.2, feeder panel 12 kV, PW.800	GCE8010451R0103, sheet 3, index 00,
Type Test Arrangement (internal fault) ZS1.2 - Panel	GCEP800241 sheet 1, index 00

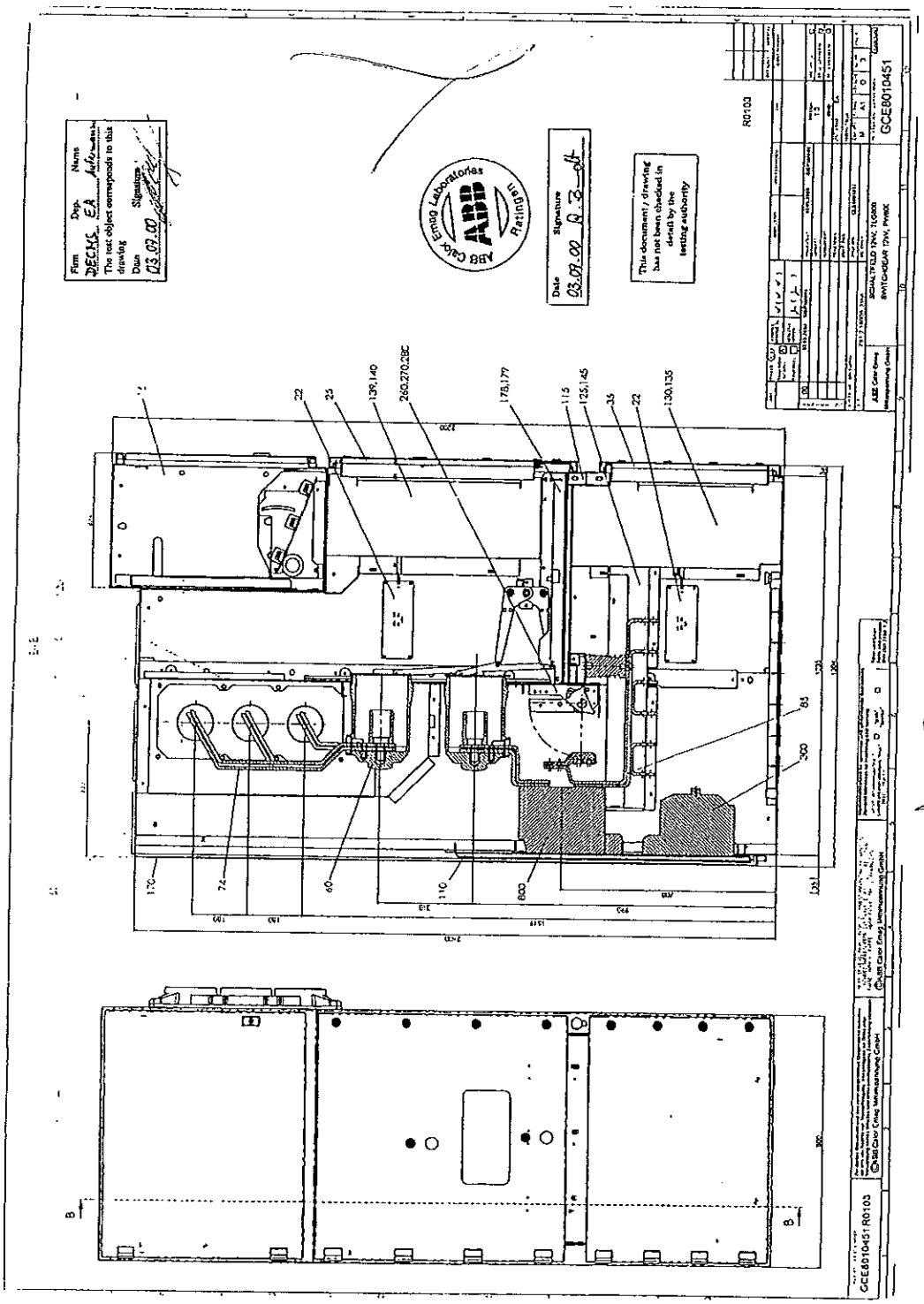
ВЯРНО С ОРИГИНАЛА



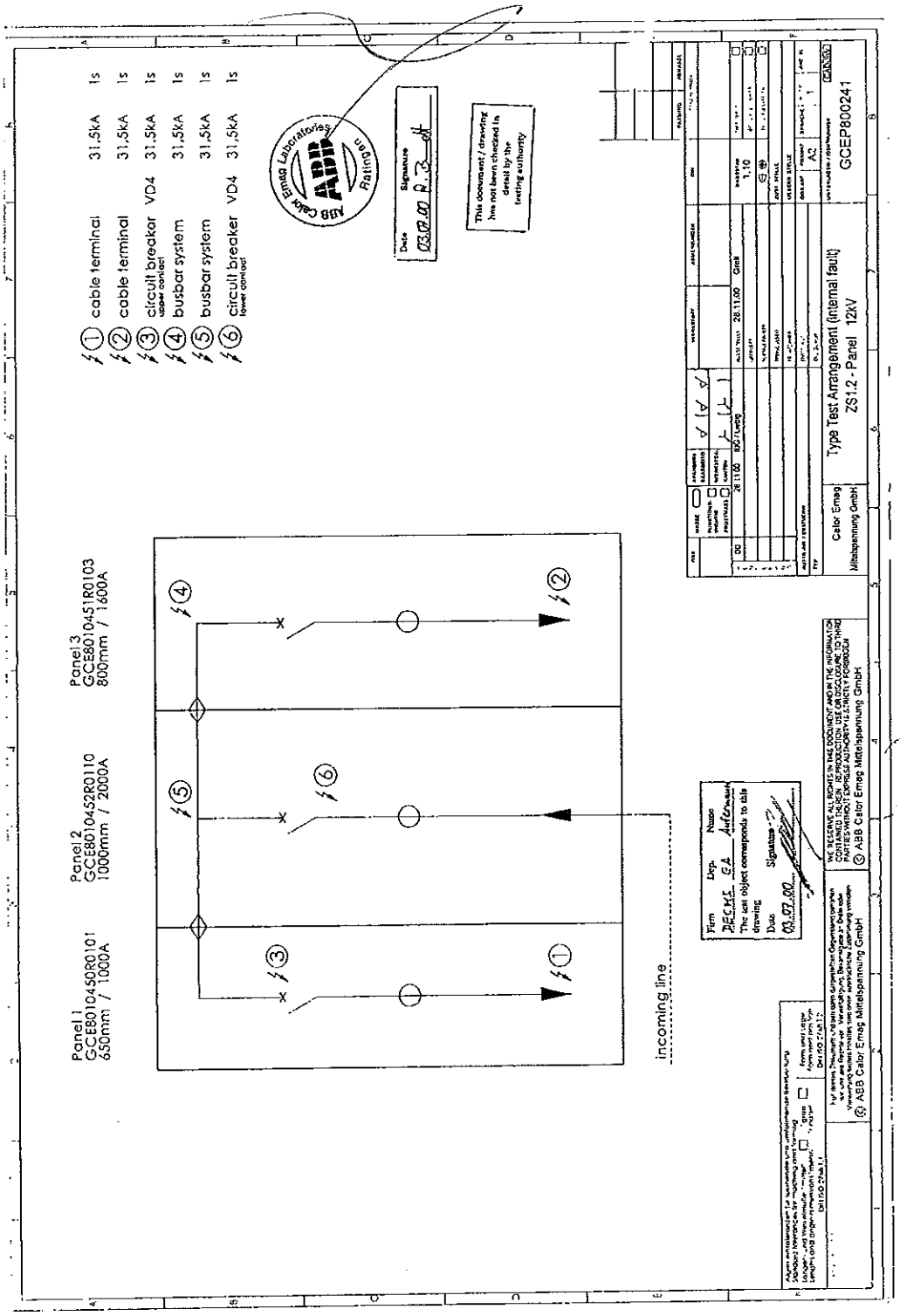
ВЯРНО С ОРИГИНАЛА



ВЯРНО С ОРИГИНАЛА



ВЯРНО С ОРИГИНАЛА



ВЯРНО С ОРИГИНАЛА

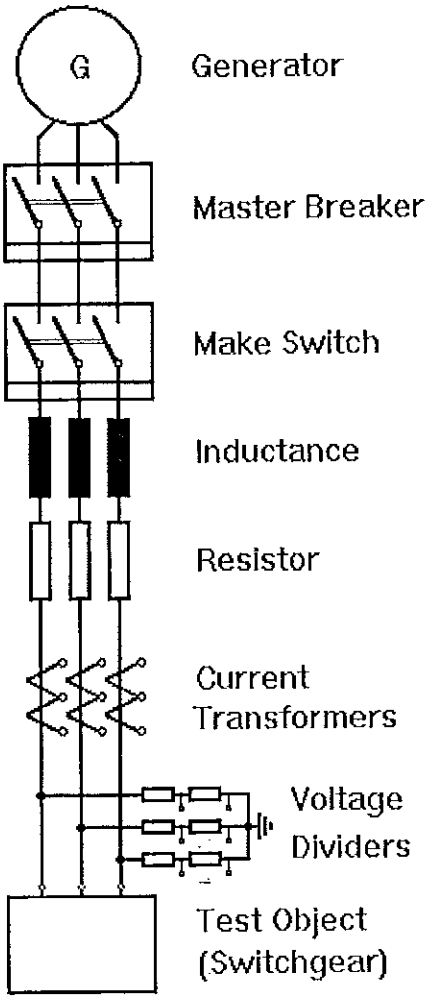
Technical Data of Test Circuit

Test		Internal fault	-	-	-
Oscillogram-No. HZ 146 L 02		02 - 09	-	-	-
Number of phases	(circuit)	3	-	-	-
Number of poles/phases	(test object)	3	-	-	-
Power frequency	Hz	50	-	-	-
Power factor	cos φ	≤ 0.15	-	-	-
Earthing	Generator	earthed via 5 kΩ	-	-	-
	Transformer	not earthed	-	-	-
	Short-circuit point	not earthed	-	-	-
Circuit diagram	Sheet no.:	18	-	-	-
Circuit impedance	mΩ	≈ 120	-	-	-
-		-	-	-	-
TRV control elements		-	-	-	-
Capacitance in parallel	µF	-	-	-	-
Resistance in series	Ω	-	-	-	-
-		-	-	-	-
-		-	-	-	-
Prospective TRV	-	-	-	-	-
TRV peak value u_c	kV	-	-	-	-
Time co-ordinate t_3	µs	-	-	-	-
Time delay t_d	µs	-	-	-	-
Based on	kV	-	-	-	-
Rate-of-rise	kV/µs	-	-	-	-
-		-	-	-	-
-		-	-	-	-
Voltage measurements		Divider 375 kΩ / 2 kΩ	-	-	-
Current measurements		Transformer 50 kA / 5 A	-	-	-

Remarks:
HZ 146 L 02 / 01: Current calibration
HZ 146 L 02 / 04: Pre-test

ВЯРНО С ОРИГИНАЛА

Principle Diagram of Test Circuit



ВЯРНО С ОРИГИНАЛА

Determination of the Prospective Short-Circuit Current

Condition of test object before test: -

Arrangement: See sheet-no. 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

For the determination of the prospective short-circuit current the infeeding busbars of the test plant were short-circuited and earthed outside the switchgear under test.

Test-No.: HZ 146 L 02 / 02		Applied voltage (phase-to-phase) 6.5 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	81.9	37.4	30.0	30.2
L2	27.7	36.4	30.5	30.7
L3	67.2	37.2	29.8	30.0
	Average value	37.0	30.1	30.3
Equivalent duration of short-circuit current 1.01 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks: -

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: Switchgear factory-new.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the cable compartment of the left-handed panel (650 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm at the cable terminals.

Test-No.: HZ 146 L 02 / 03		Applied voltage (phase-to-phase) 6.5 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	72.5	37.1	30.4	30.2
L2	27.0	36.0	30.9	31.0
L3	60.7	37.4	30.1	30.6
Average value		36.9	39.8	30.6
Equivalent duration of short-circuit current 1.02 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 26 to 34. The measured pressure gauge was about 75 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 146 L 02 / 03.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the cable compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm at the cable terminals.

Test-No.: HZ 146 L 02 / 05		Applied voltage (phase-to-phase) 6.65 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	77.3	38.3	30.9	31.4
L2	25.7	36.7	31.2	31.3
L3	60.9	37.7	31.7	31.7
	Average value	37.6	31.3	31.5
Equivalent duration of short-circuit current 1.05 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 26 to 34. The measured pressure gauge was about 57 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 146 L 02 / 05.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the circuit-breaker compartment of the left-handed panel (650 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 across the upper contact arms of the circuit-breaker

Test-No.: HZ 146 L 02 / 06		Applied voltage (phase-to-phase) 6.65 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	79.3	38.7	30.3	31.0
L2	26.1	37.1	32.3	31.8
L3	62.6	38.3	32.0	31.6
Average value		38.0	31.5	31.5
Equivalent duration of short-circuit current 1.05 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 26 to 34. The measured pressure gauge was about 48 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 146 L 02 / 06.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the busbar compartment of the right-handed panel (800 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 mm across the busbars.

Test-No.: HZ 146 L 02 / 07		Applied voltage (phase-to-phase) 6.65 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	78.8	39.0	32.0	31.8
L2	23.3	36.6	31.4	31.3
L3	60.3	38.4	31.6	31.6
	Average value	38.0	31.7	31.6
Equivalent duration of short-circuit current 1.05 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 26 to 34. The measured pressure gauge was about 27 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 146 L 02 / 07.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the busbar compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire Ø 0.5 across the busbars.

Test-No.: HZ 146 L 02 / 08		Applied voltage (phase-to-phase) 6.65 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	77.3	38.5	30.8	31.2
L2	25.4	37.4	32.1	32.2
L3	61.4	38.4	31.4	31.2
	Average value	38.1	31.4	31.5
Equivalent duration of short-circuit current 1.05 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no. 26 to 34. The measured pressure gauge was about 23 kPa.

Assessment of the test:
- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

Internal Arcing Test

Condition of test object before test: as after test HZ 146 L 02 / 08.

Arrangement: See sheet-no.: 2

Connection: Infeed of current was made three-phase by means of a three core cable 1 x 3 x 240 mm^2 through the closed bottom of the centre panel.

Ignition: Internal arcing test in the circuit-breaker compartment of the centre panel (1000 mm width), ignition of arc three-phase by means of a copper wire ∅ 0.5 mm across the lower contact arms of the circuit-breaker.

Test-No.: HZ 146 L 02 / 09		Applied voltage (phase-to-phase) 6.65 kV		Duration of short-circuit current 1.05 s
	Peak short-circuit current kA	Short-circuit current: first cycle kA	last cycle kA	Arithmetic mean value kA
L1	77.2	38.0	31.4	31.2
L2	27.1	37.0	32.0	31.7
L3	62.1	38.0	30.5	31.0
	Average value	37.7	31.3	31.3
Equivalent duration of short-circuit current 1.04 s			**corresponding to a short-circuit current of** 31.5 kA	

Remarks and condition of test object after test:
The condition of the switchgear before and after test is shown on the photos on sheet-no 26 to 34.
The measured pressure gauge was about 44 kPa.

Assessment of the test:

- Correctly secured doors, covers, etc. did not open (Criterion No. 1).
- Parts of the switchgear, which may cause injury to persons, did not fly off (Criterion No. 2).
- Arc did not cause holes to develop in the outer, freely accessible parts of the enclosure as a result of burning or other effects (Criterion No. 3).
- The indicators arranged vertically did not ignite (Criterion No. 4).
- The indicators arranged horizontally did not ignite (Criterion No. 5).
- All earthing connections were still effective (Criterion No. 6).

ВЯРНО С ОРИГИНАЛА

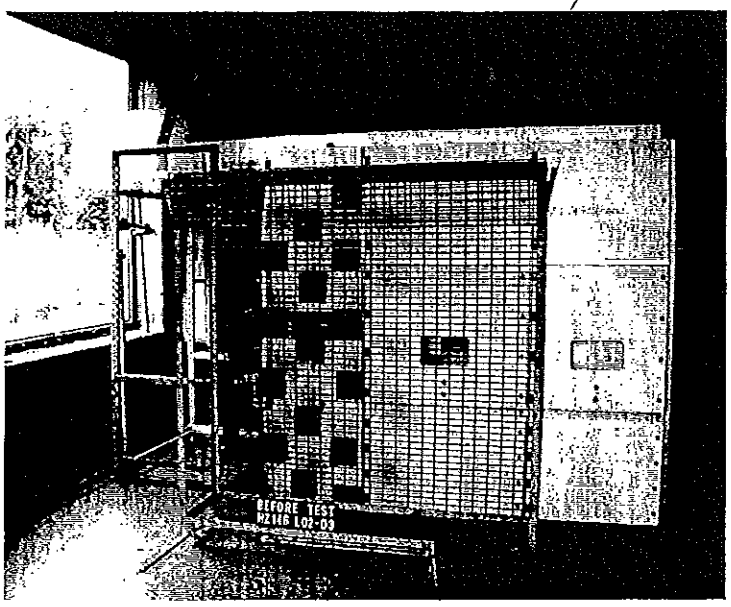


Photo No. 01
Before Test HZ 146 L 02 / 03

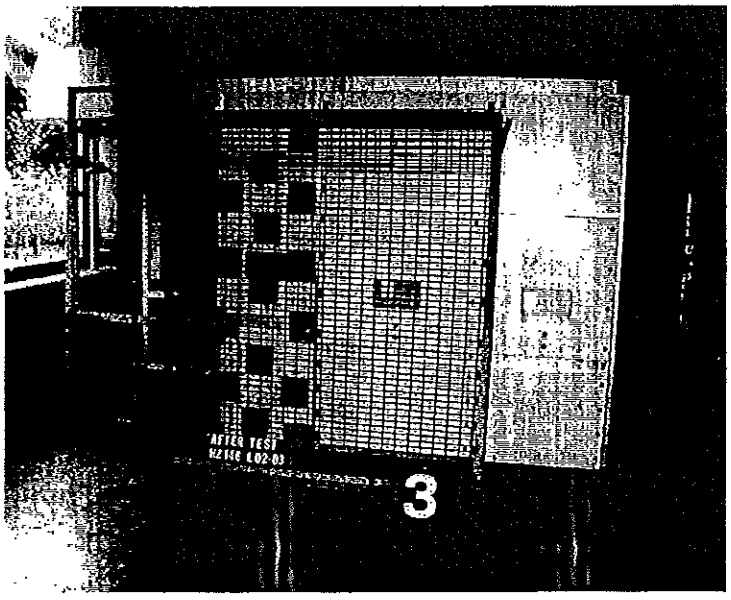


Photo No. 02
After Test HZ 146 L 02 / 03

ВЯРНО С ОРИГИНАЛА

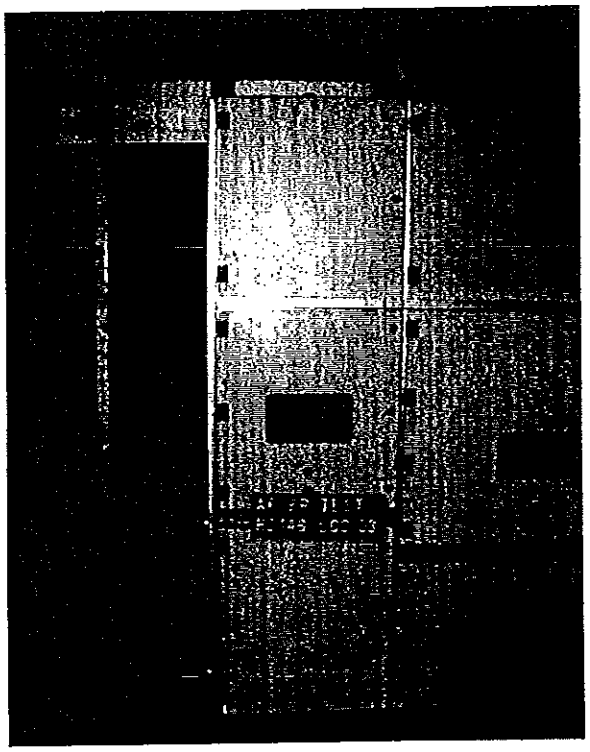


Photo No. 03
After Test HZ 146 L 02 / 03

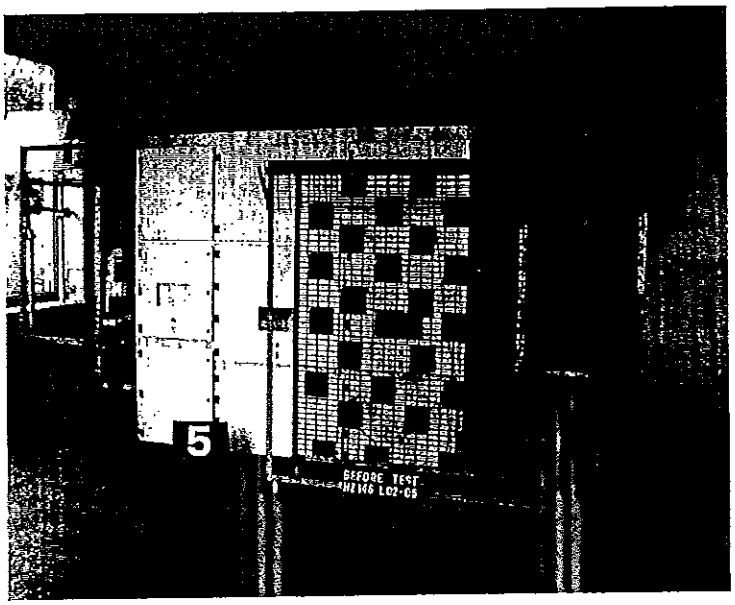


Photo No. 04
Before Test HZ 146 L 02 / 05

ВЯРНО С ОРИГИНАЛА

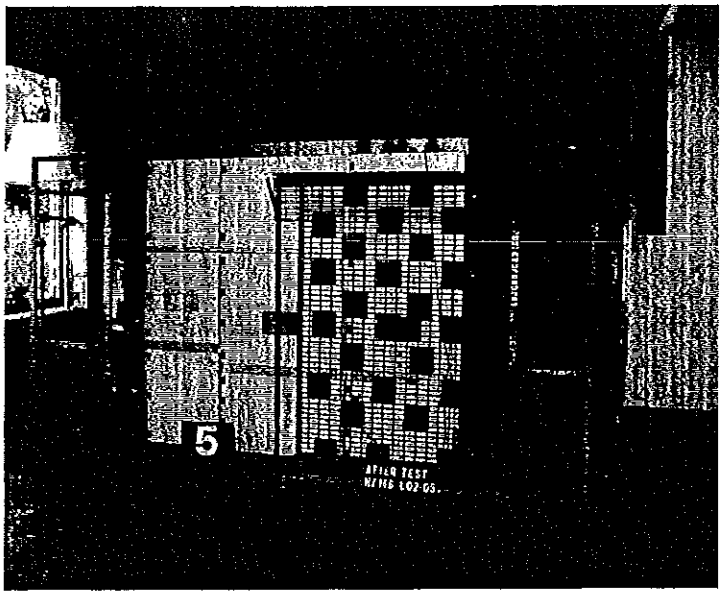


Photo No. 05
After Test HZ 146 L 02 / 05

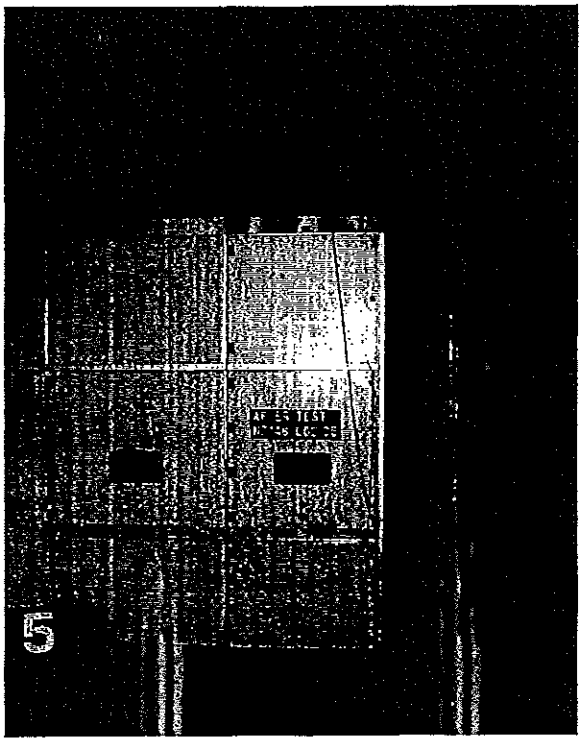


Photo No. 06
After Test HZ 146 L 02 / 05

ВЯРНО С ОРИГИНАЛА

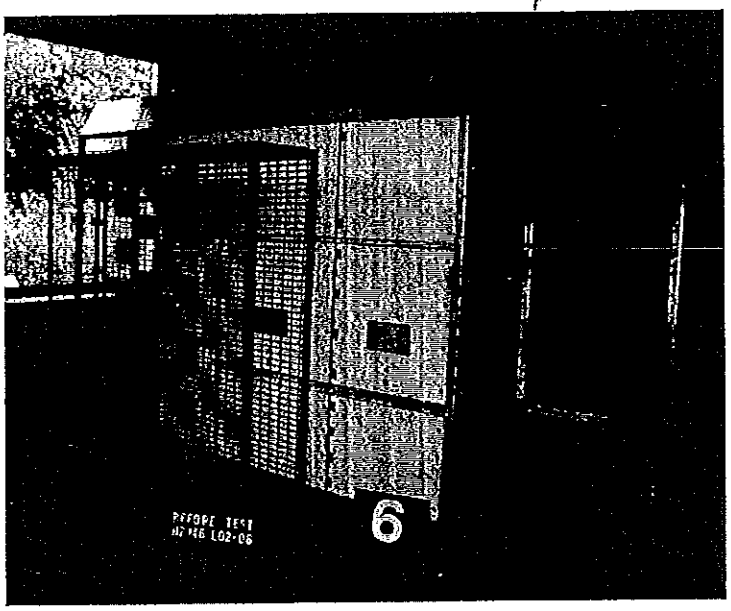


Photo No. 07
Before Test HZ 146 L 02 / 06

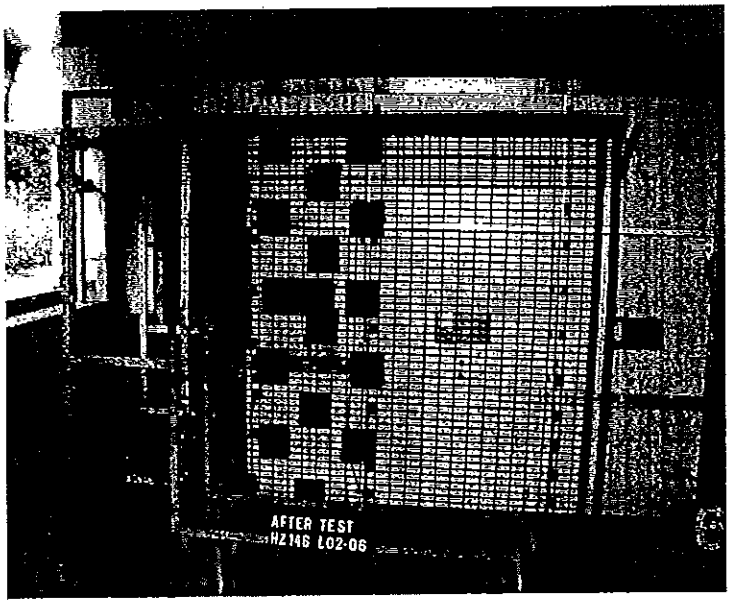


Photo No. 08
After Test HZ 146 L 02 / 06

ВЯРНО С ОРИГИНАЛА

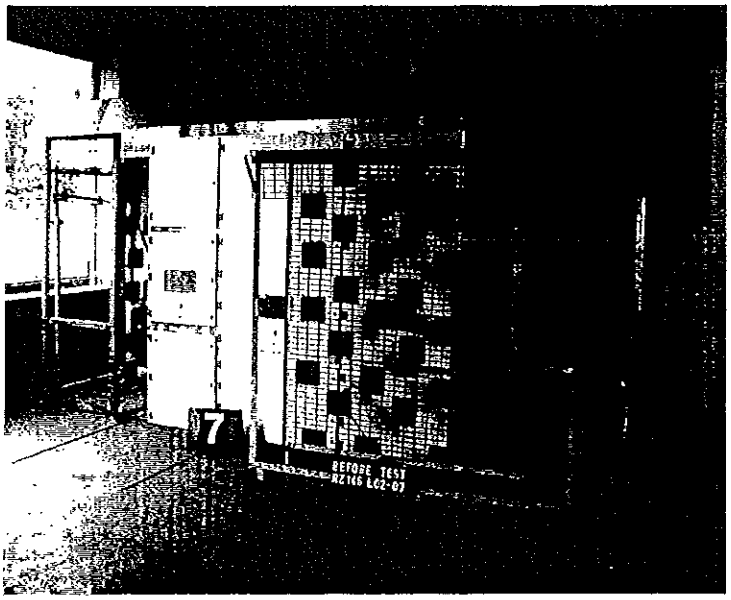


Photo No. 09
Before Test HZ 146 L 02 / 07

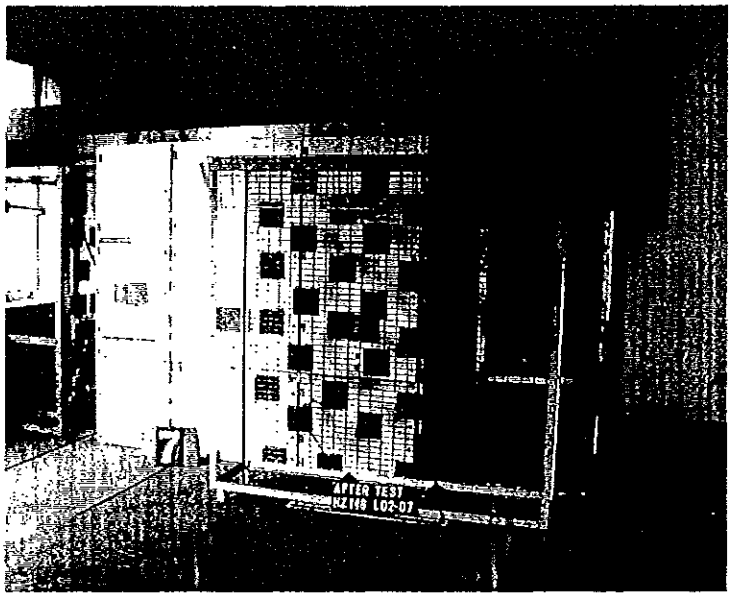


Photo No. 10
After Test HZ 146 L 02 / 07

ВЯРНО С ОРИГИНАЛА

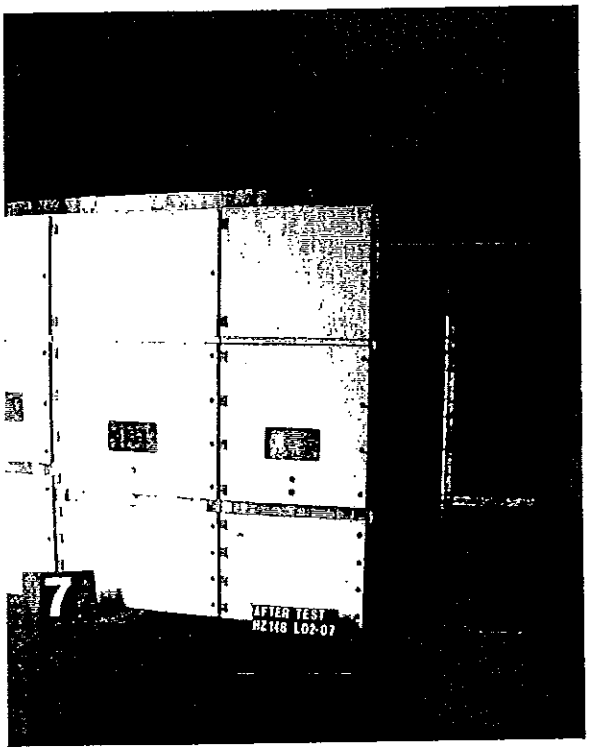


Photo No. 11
After Test HZ 146 L 02 / 07

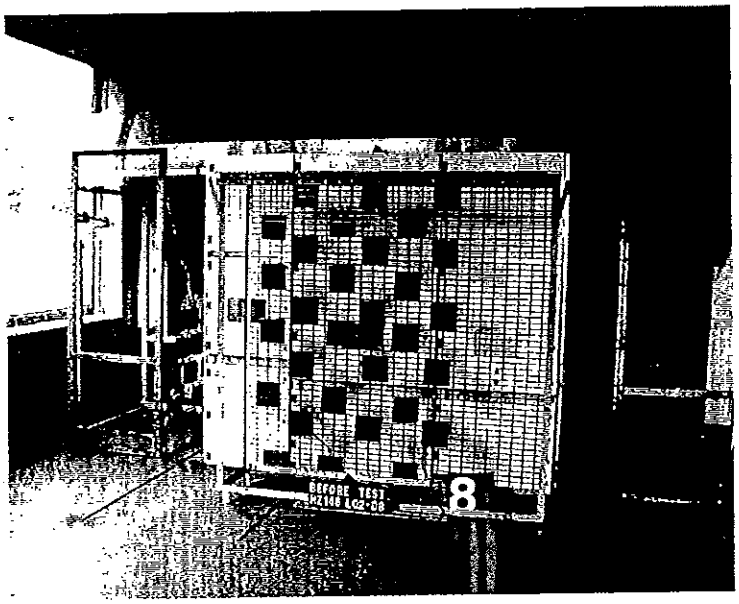


Photo No. 12
Before Test HZ 146 L 02 / 08

ВЯРНО С ОРИГИНАЛА

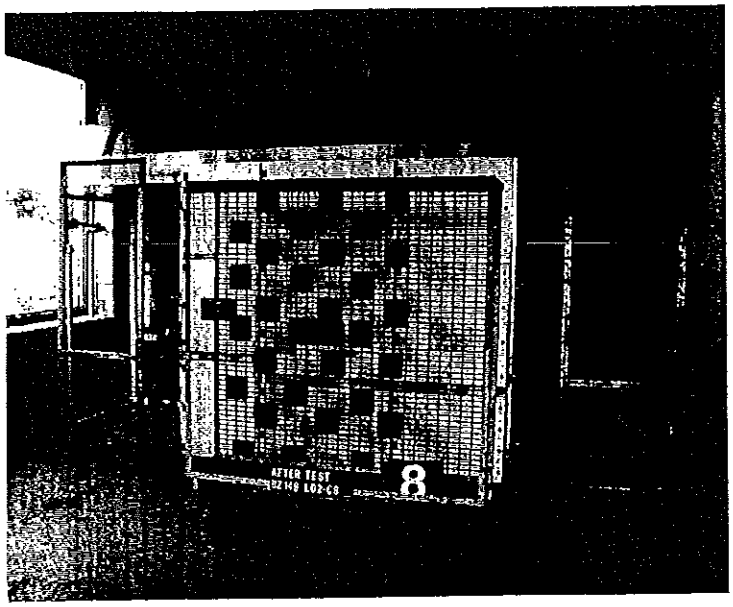


Photo No. 13
After Test HZ 146 L 02 / 08

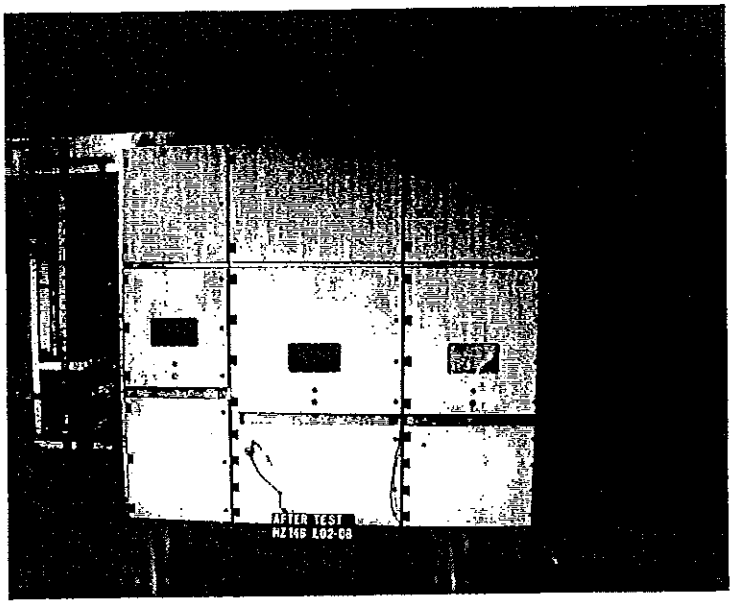


Photo No. 14
After Test HZ 146 L 02 / 08

ВЯРНО С ОРИГИНАЛА

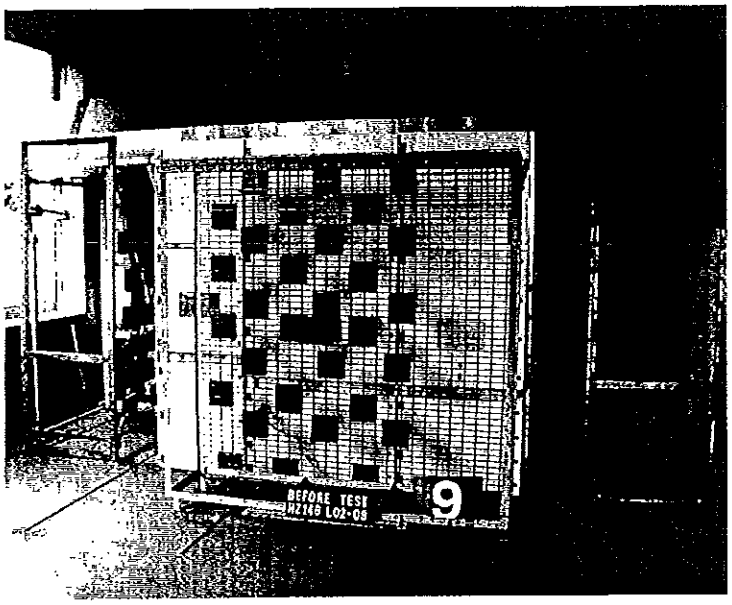


Photo No. 15
Before Test HZ 146 L 02 / 09

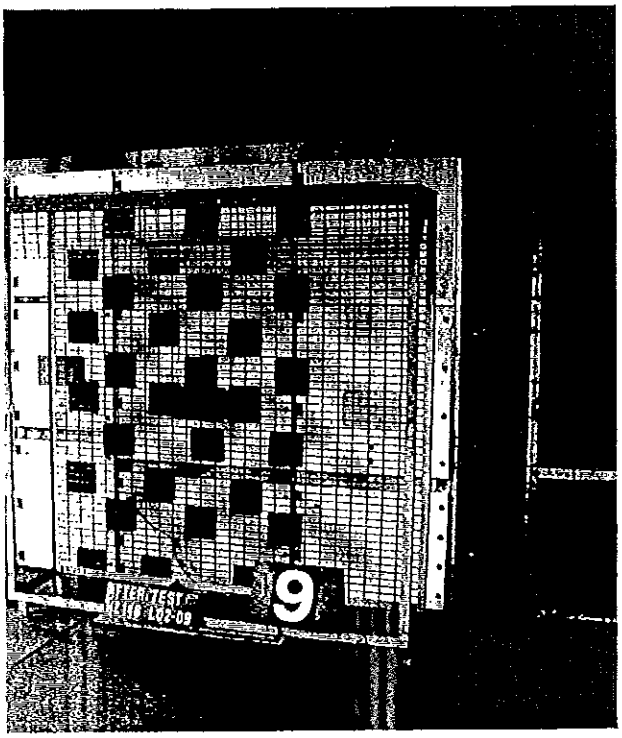


Photo No. 16
After Test HZ 146 L 02 / 09

ВЯРНО С ОРИГИНАЛА

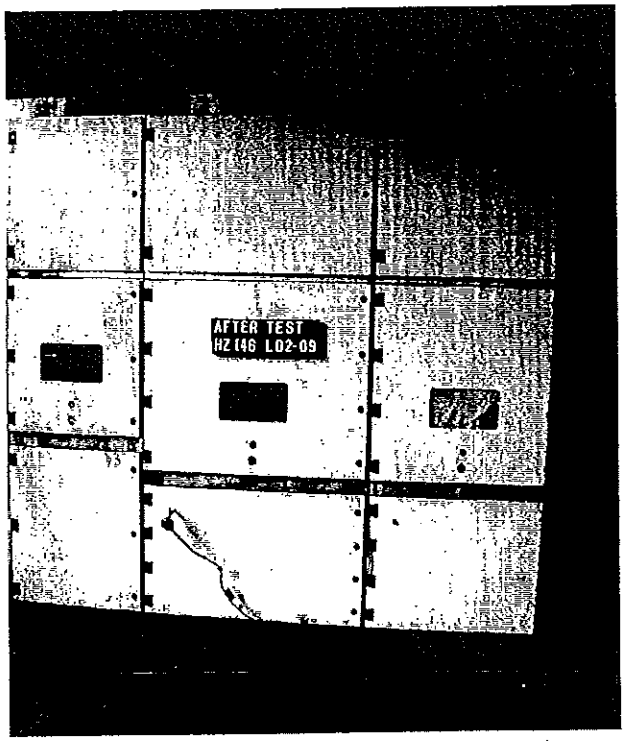
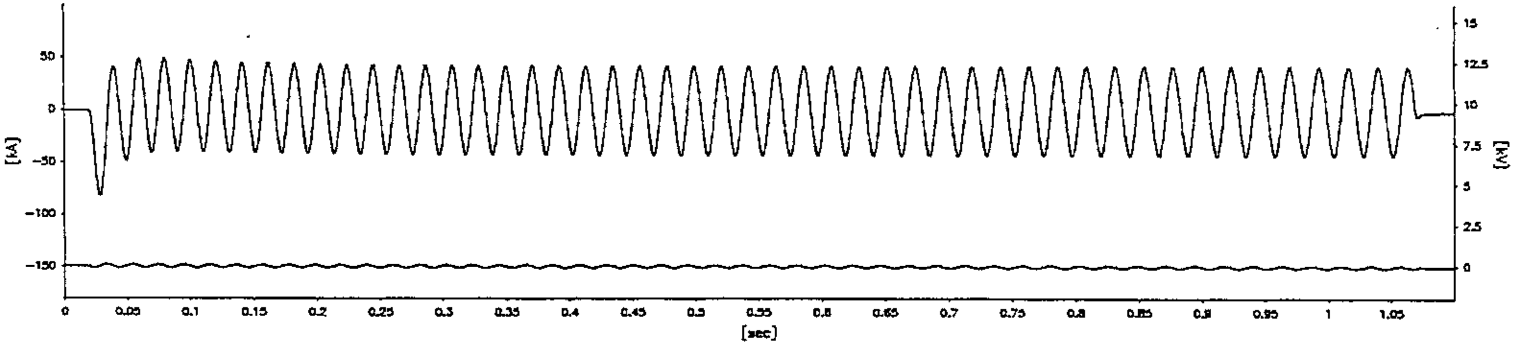
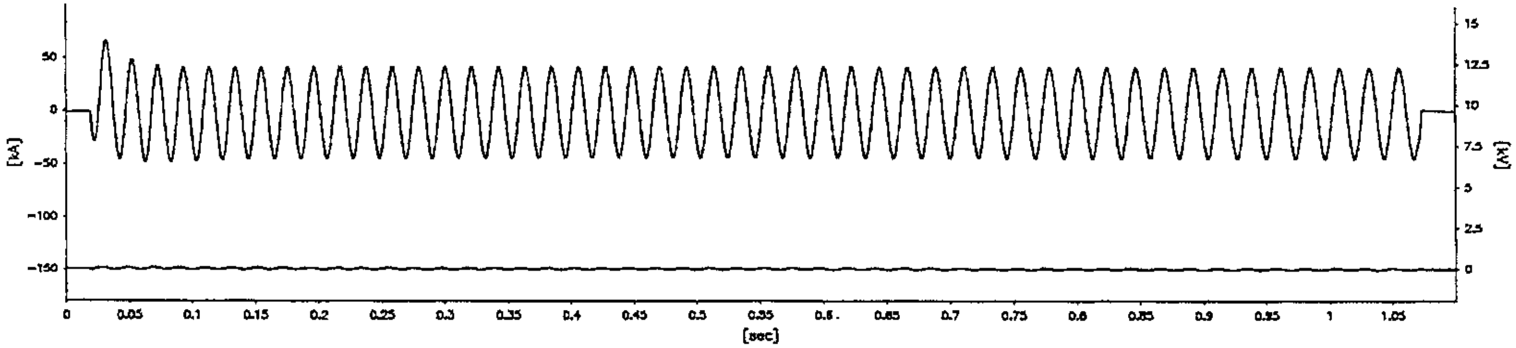


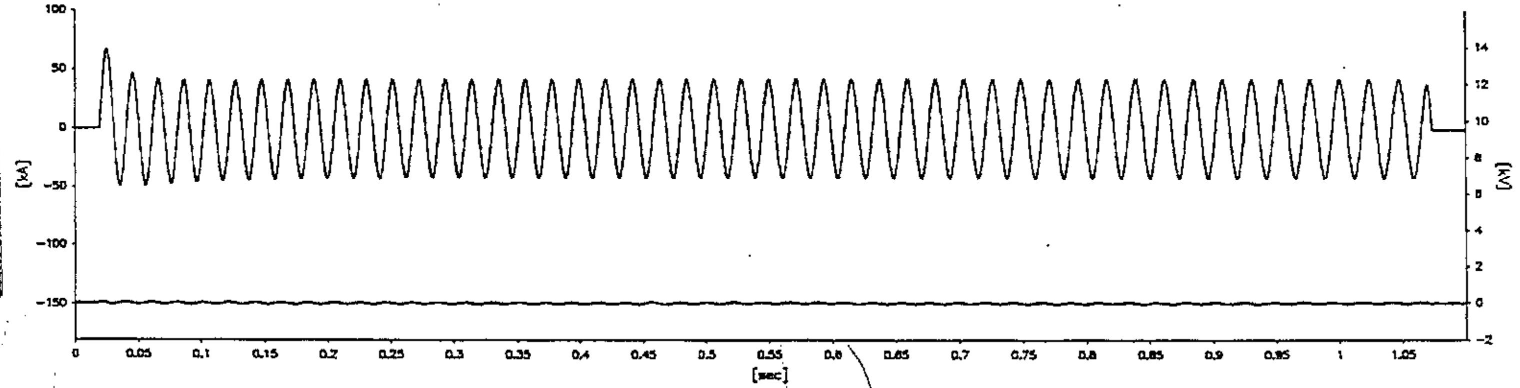
Photo No. 17
After Test HZ 146 L 02 / 09

ВЯРНО С ОРИГИНАЛА

6.7.2000







HZ146L02.002

ВЯРНО С ОРИГИНАЛА

4.7.2000

HZ146L02.003

ВЯРНО С ОРИГИНАЛА

20.2.2002

HZ146L02.03

ВЯРНО С ОРИГИНАЛА

10.7.2000

HZ146L02.005

ВЯРНО С ОРИГИНАЛА

20.2.2002

ВЯРНО С ОРИГИНАЛА

HZ146L02.005

10.7.2000

HZ146L02.006

ВЯРНО С ОРИГИНАЛА

20.2.2002

ВЯРНО С ОРИГИНАЛА

HZ146L02.006

10.7.2000

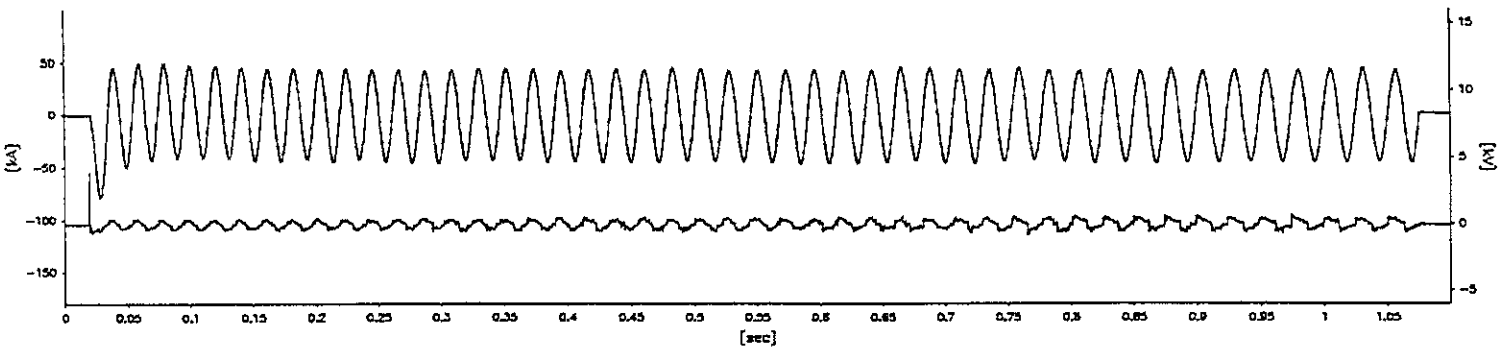
HZ146L02.007

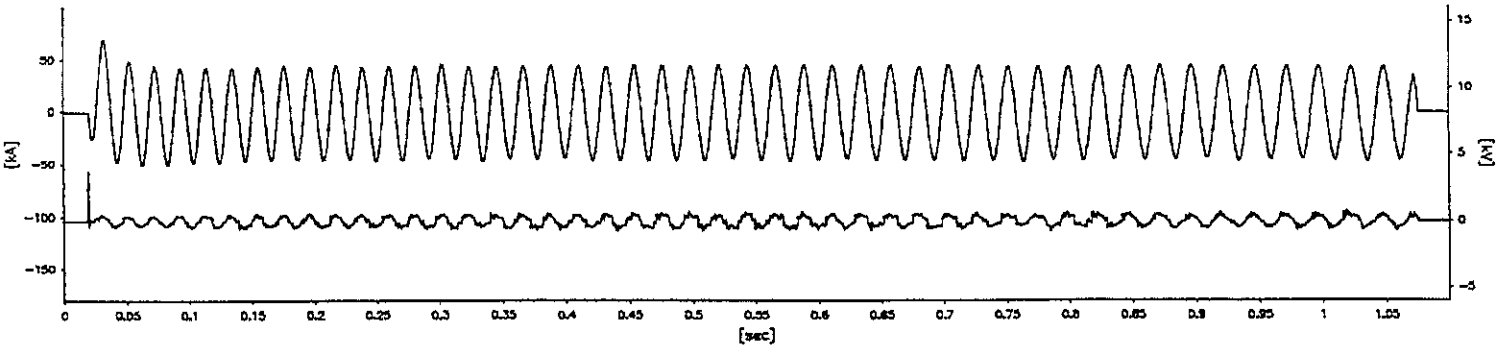
20.2.2002

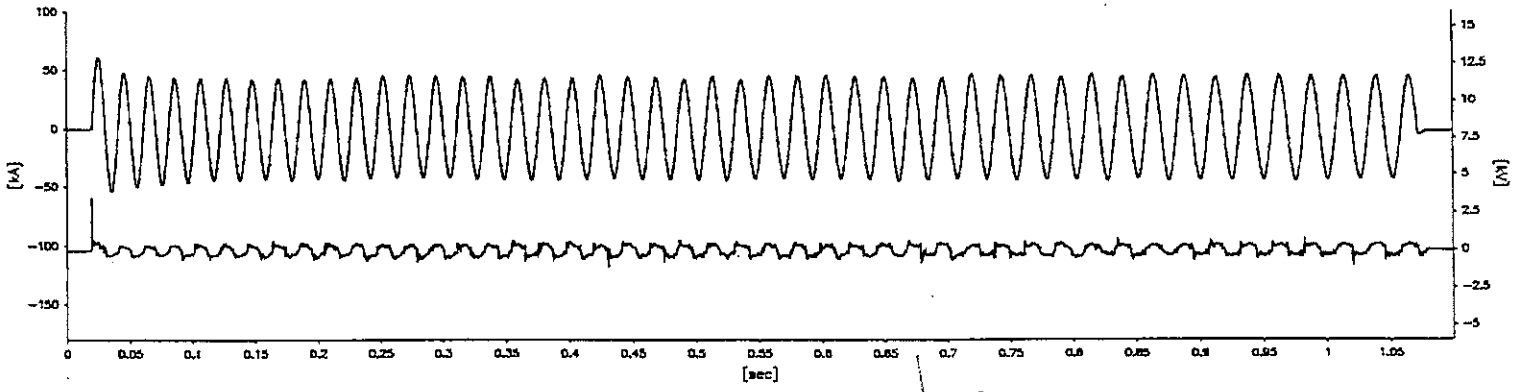
ВЯРНО С ОРИГИНАЛА

HZ146L02.007

12.7.2000







HZ146L02.008

HZ146L02.008

20.2.2002

ВЯРНО С ОРИГИНАЛА

12.7.2000

ВЯРНО С ОРИГИНАЛА

HZ146L02.009

20.2.2002

ВЯРНО С ОРИГИНАЛА

HZ146L02.009

client	ABB Technology Ltd. - Zurich (Switzerland)
equipment under test	Three-phase metal-clad switchgear and controlgear, for medium voltage, fitted with vacuum circuit breaker composed by no.1 section designed: UniGear ZS1
tests performed	short-time and peak withstand current tests of the main and earthing circuits
normative documents	IEC 62271-200 (2003-11) ed. 1.0
receipt date of the sample	February 6, 2004
test date	**from** February 9, 2004 **to** February 9, 2004
no. of pages	20 **no. of pages annexed** 10

CESI
COPIA CONFORME ALL'ORIGINALE
COPY TRUE TO THE ORIGINAL

first issue date	April 6, 2004	
prepared	PeC/TEST - C. Del Giorgio	
verified	PeC/TEST - A. Geroli	
approved	PeC/TEST - V. Scarioni	CESI CENTRO ELETTROTECNICO SPERIMENTALE ITALIANO Business Unit Prove e Componenti *Il Responsabile del Laboratorio*

tests witnessed by:	Mr. Zdenek Otrisal	ABB s.r.o. organization unit EJF Brno - Czech Republic
	Mr. Vit Badin	"
	Mr. Frantisek Svoboda	"
	Mr. Miroslav Vyhnanek	"
	Mr. Manzoni	ABB PT S.p.a. Unità Operativa SACE PT MV

identification of the object: effected
The Manufacturer guarantees that the tested object is manufactured according to the submitted drawings. CESI checked that these drawings adequately represent in shape and dimensions the essential details and the parts of the tested object.
These drawings identified by CESI and numbered **A4/008152 no.1 to 22** have been returned to the Client.

Only for laboratory requirement, in order to reproduce the test conditions, all the laboratory data are contained in the document marked: MP-A4/004075

The measurement uncertainties of the test results reported in this document are the following:
voltage: ± 5 % ; **current:** ± 5 % ; **time:** ± 5 %
The measurement uncertainties are estimated at the level of twice the standard deviation (corresponding, in the case of normal distribution, to a confidence level of about 95 %) and have to be considered as maximum values.

activity code: 406870

ВЯРНО С ОРИГИНАЛА

Pages annexed

- Oscillogram from test report MP-A4/04075 (total pages:10)

Reference document

- drawings identified by CESI and numbered **A4/008152 no.1 to 22**

Rated characteristics of the test objects assigned by the Client

metal enclosed switchgear

manufacturer	ABB s.r.o. organization unit EJF Brno - Czech Republic
designation / type	UniGear ZS1 12.25.31
serial number	1VLS 1000003842/007
voltage	12 kV
insulation level	
power frequency withstand voltage	28 kV rms
lightning impulse withstand voltage	75 kV peak
frequency	50 Hz
normal current	2500 A
short-time withstand current for main circuits	31,5 kA
peak withstand current for main circuits	80 kA
duration of short-circuit for main circuits	3 s
short-time withstand current for earthing circuits	31,5 kA
peak withstand current for earthing circuits	80 kA
duration of short-circuit for earthing circuits	1 s
degree of protection	IP41

ВЯРНО С ОРИГИНАЛА

Rated characteristics of the apparatus installed in the equipment

Three-pole medium-voltage vacuum insulated circuit-breaker in withdrawable version

manufacturer	ABB
designation / type	VD4/P 12.25.32
serial number	AD00140546
voltage	12 kV
lightning impulse withstand voltage	75 kV peak
power frequency withstand voltage	28 kV rms
frequency	50÷60 Hz
normal current	2500 A
breaking capacity	31,5 kA
short-time withstand current	31,5 kA for 3s
making capacity	80 kA at 12 kV

earthing switch

manufacturer	ABB
designation / type	EK6 1208-275
serial number	033522
voltage	12 kV
insulation level	28 - 75
frequency	50 ÷ 60 Hz
short-circuit making current	80 kA
short-time withstand current	31,5 kA
short-circuit duration	3 s

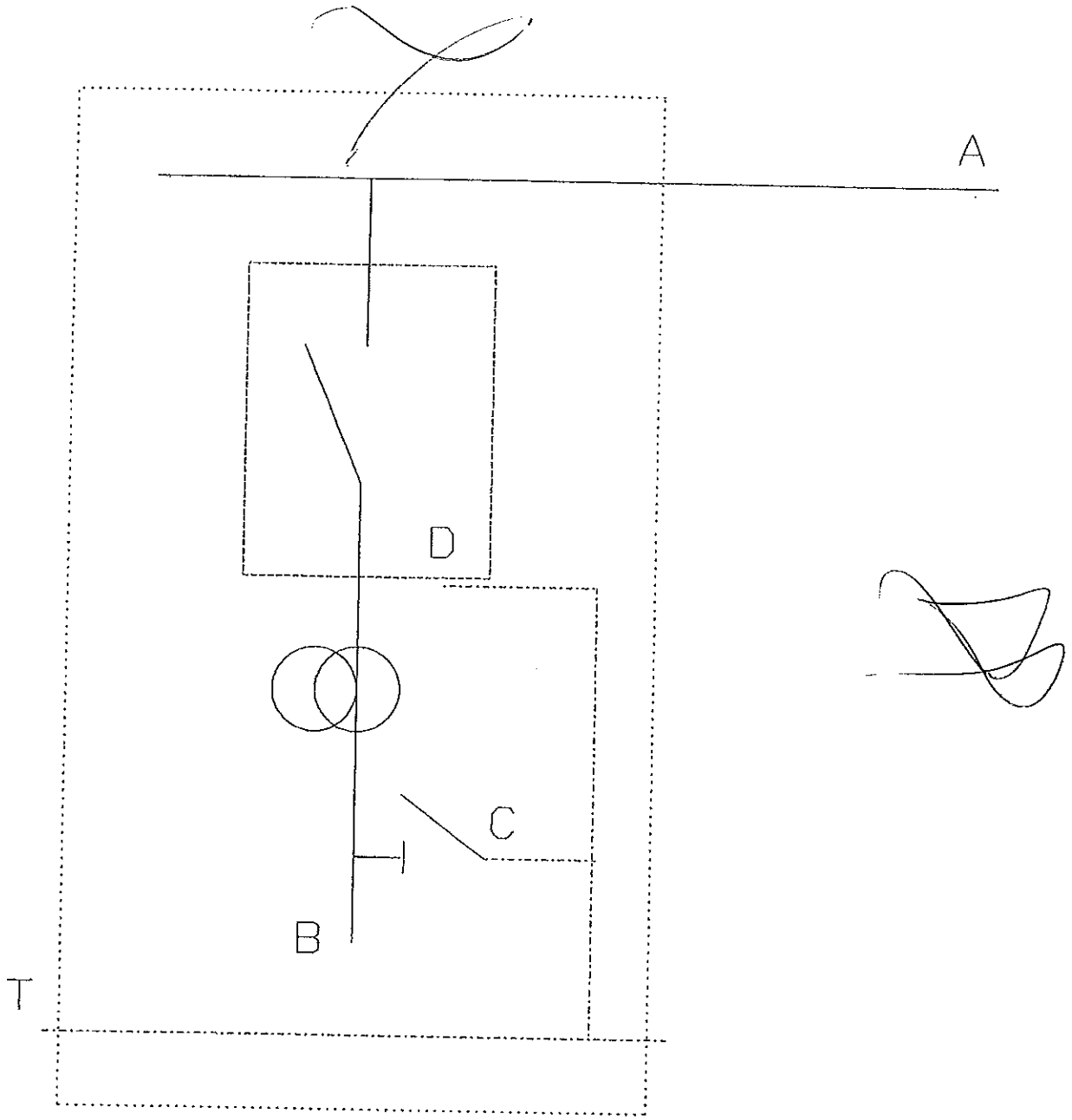
Medium-voltage cast resin current transformer

manufacturer	ABB
designation / type	TPU 46-11
voltage	12 kV
frequency	50 Hz
ratio	2500/5-5 A
short-time withstand current	80 for 1 s
peak withstand current	200 kA

ВЯРНО С ОРИГИНАЛА

Connection points for short-circuit tests

Test configuration M8000



ВЯРНО С ОРИГИНАЛА

Verification of the short-time and peak withstand current of the main and earthing circuits

Test arrangements and test procedure

The equipment under test was placed, on a metallic platform, as in normal use and was appropriately insulated from earth.

Main circuits

The tests were performed supplying the terminals of the main busbars (point "A" of the configuration M8000) by one tubular copper conductor per-phase having a cross sectional area of 700 mm²; these conductors were clamped together at a distance of 30 cm from the incoming terminals of the equipment under test. The short-circuit was put in the point "B".

The three-phase short-circuit test on the earthing switch was performed supplying the point "B" and the short-circuit has been made closing the earthing switch at the point "C".

Earthing circuits

The verification of the short-circuit strength of the earthing circuit was performed connecting a single phase supply to one of the main busbars terminal (point "A") and the terminal of the earthing circuit (point "T").

The continuity between the main circuit and the earthing circuit of the withdrawable circuit-breaker was effected connecting one terminal and the metallic frame (point "D").

The single-phase short-circuit test on the earthing switch was performed supplying the point "B" and the terminal of the earthing circuit (point "T"). The short-circuit has been made closing the earthing switch at the points "C".

Three-phase short-circuit test results

Test circuit: M016
Test configuration: M8000
Protocol number of the oscillograms: MP-A4/004075

Conditions of the apparatus before the tests: as supplied by the Customer.

Before the short-circuit test the no-load operation on the circuit-breaker have been performed

type of operation	oscillogram	Operational time		
		pole R	pole S	pole T
	No./sheets	ms	ms	ms
closing	101/2	65,2	65,2	64,6
opening		48,7	48,8	49,0

date: February 9, 2004

test	oscillogram	connection points		voltage	current values				duration	frequency	notes
		supply	shot-circuit		peak	r.m.s.	average	I^2t			
no.	no./sheets	point	point	V	A	A	A	MA^2s	s	Hz	no.
1	2/1	A	B	-	82620	31900 32670 32220	32260	-	1,0	50	a b
2	3/1	A	B	-	79200	31740 32410 32000	32050	-	3,0	50	a b c
4	7/1	B	C	-	80120	31590 31940 31550	31690	-	1,0	50	a b
5	8/1	B	C	-	79020	31550 31910 31530	31660	-	3,0	50	a b

conditions of the apparatus after the tests: see notes

a : the apparatus did not show any permanent deformation of its metallic structure and bars; the insulation of the conductors and the supporting insulating parts did not show any significant sign of deterioration.
b : the equipments provided into the apparatus operated regularly and did not show any mark of damage.
c : after the test the no-load operation on the circuit-breaker at rated auxiliary voltage was performed

type of operation	oscillogram	Operational time		
		pole R	pole S	pole T
	No./sheets	ms	ms	ms
closing	102/2	65,2	65,5	65,2
opening		48,4	48,4	48,6

Single-phase short-circuit test results

Test circuit: M015
Test configuration: M8000
Protocol number of the oscillograms: MP-A4/004075

Conditions of the apparatus before the tests: as supplied by the Customer

date: February 9, 2004

test	oscillogram	connection points		voltage	current values			duration	frequency	notes
		supply	short-circuit		peak	r.m.s.	I^2t			
no.	no./sheets	point	point	V	A	A	MA^2s	s	Hz	no.
3	5/1	A-T	D	-	79080	31900	-	1,01	50	a b c
6	10/1	B-T	C	-	79040	31700	-	1,0	50	a b c

conditions of the apparatus after the tests; see notes

a : the apparatus did not show any permanent deformation of its metallic structure and bars; the insulation of the conductors and the supporting insulating parts did not show any significant sign of deterioration.
b : the equipments provided into the switchgear and controlgear operated regularly and did not show any mark of damage.
c : the continuity of the earthing circuit was not impaired.

ВЯРНО С ОРИГИНАЛА

Measurement of the resistance of the main circuit

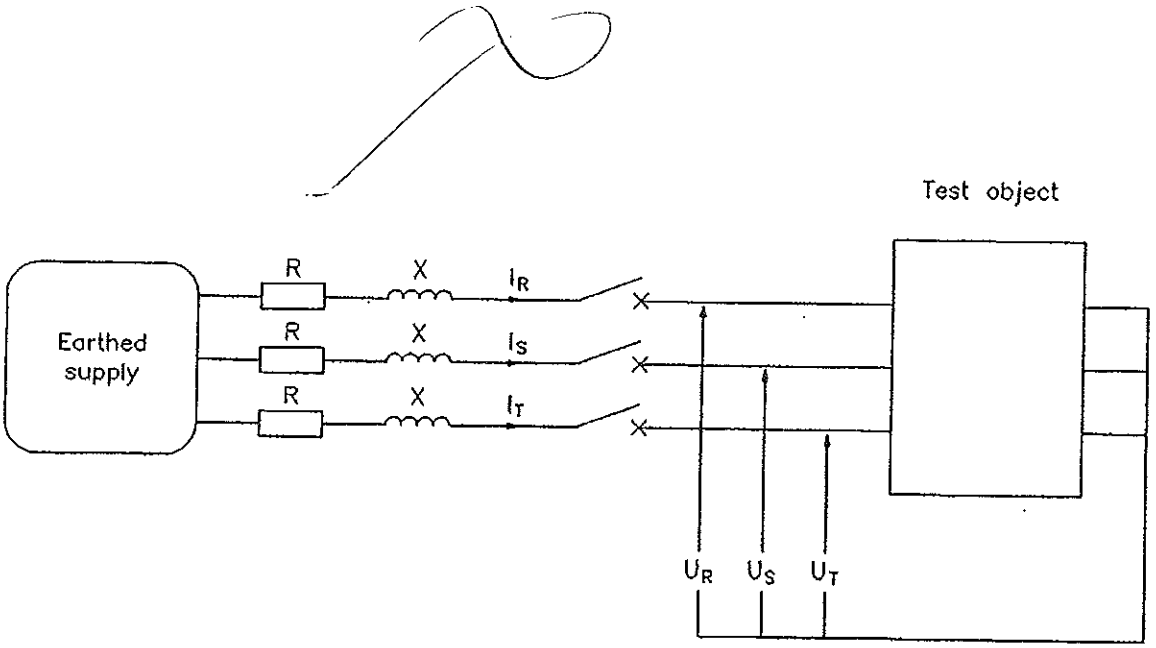
Resistance measured with 100 A d.c.

date: February 9, 2004

measurement effected	resistance ($\mu\Omega$) across the pole			ambient air temperature
	R	S	T	°C
before the tests	14	13	13	16,0
after the test no.3	14	13	13	16,0

note: -

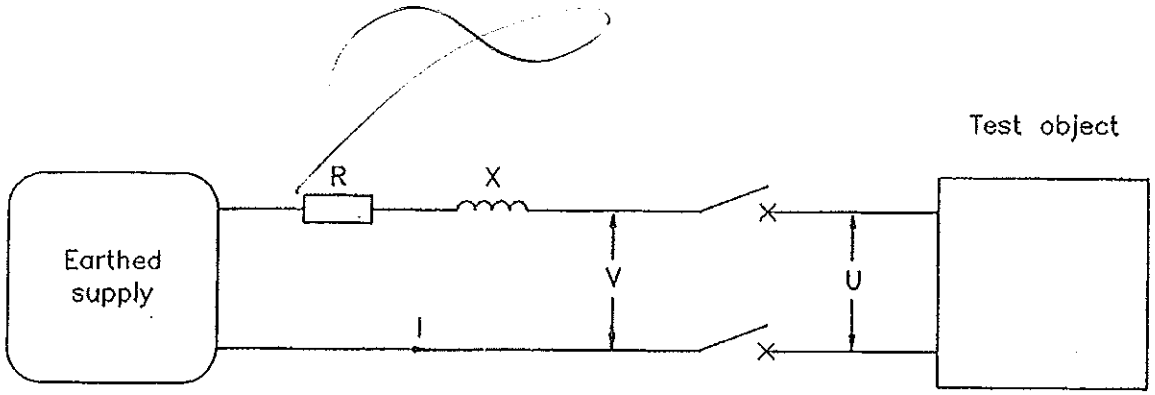
Test circuit M016



Symbols used in this diagram are the same as those on the oscillograms.

ВЯРНО С ОРИГИНАЛА

Test circuit M015



Symbols used in this diagram are the same as those on the oscillograms.

ВЯРНО С ОРИГИНАЛА

Photographs of the test object

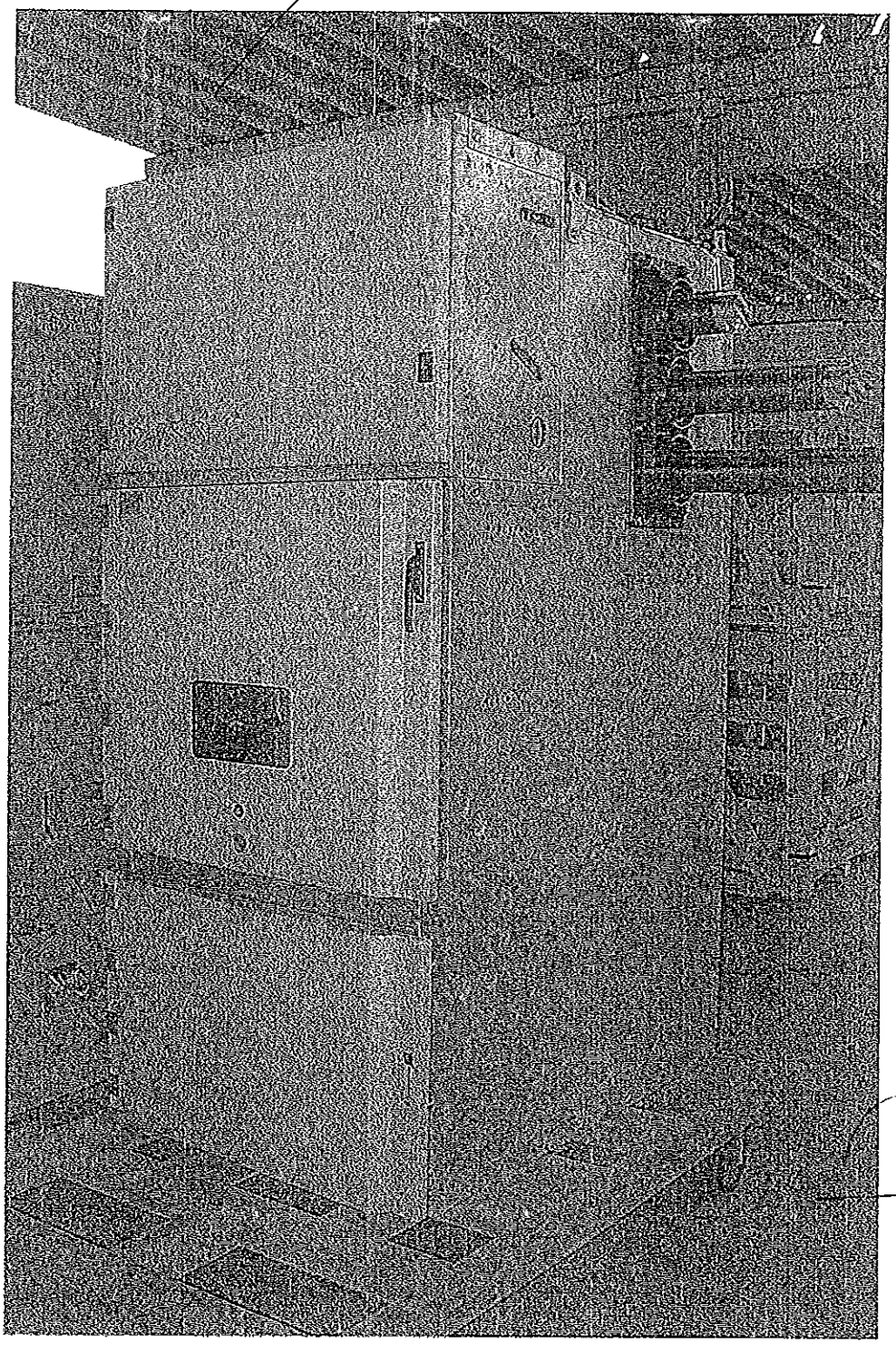


Photo no. 1

ВЯРНО С ОРИГИНАЛА

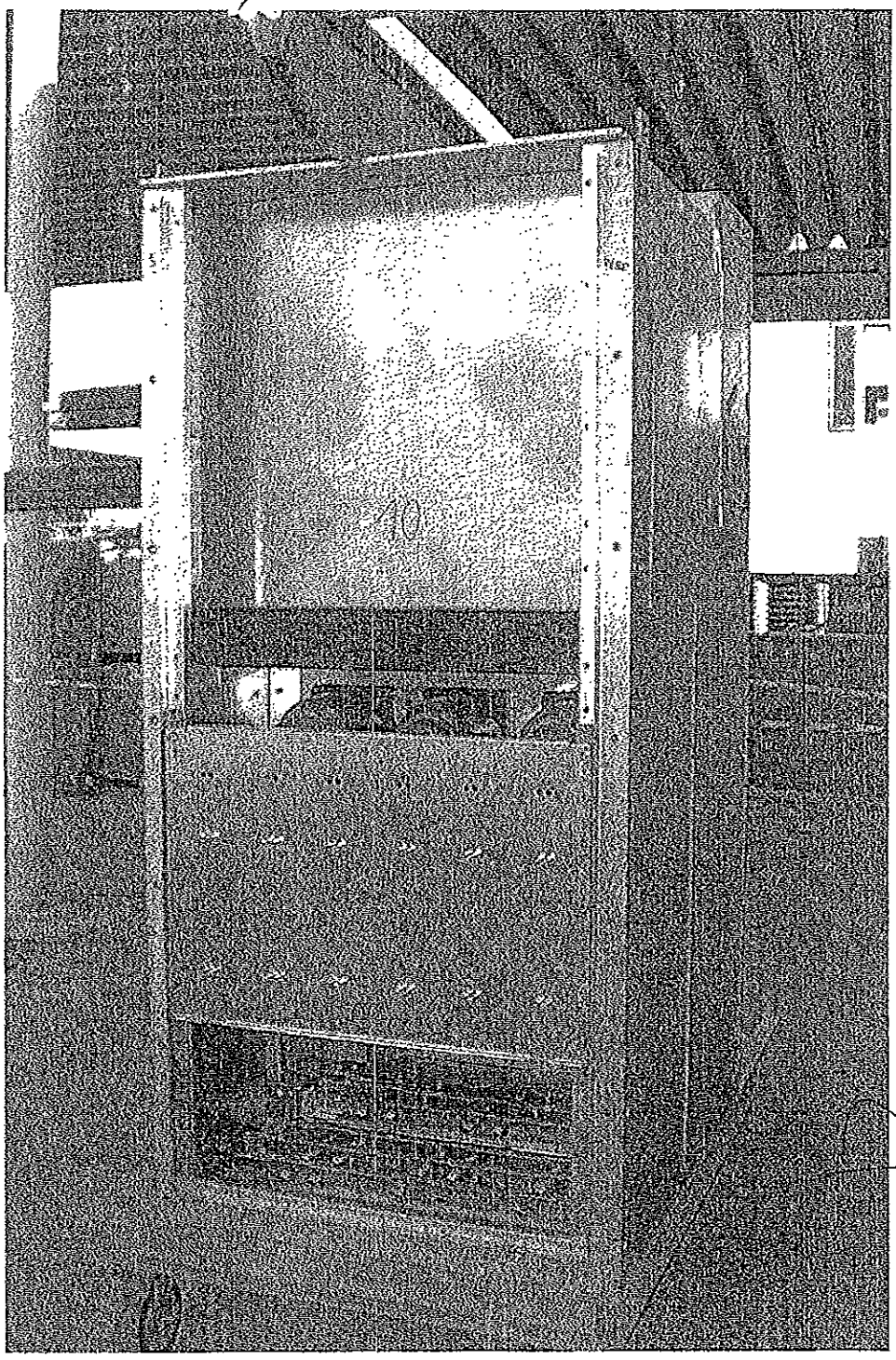


Photo no. 2

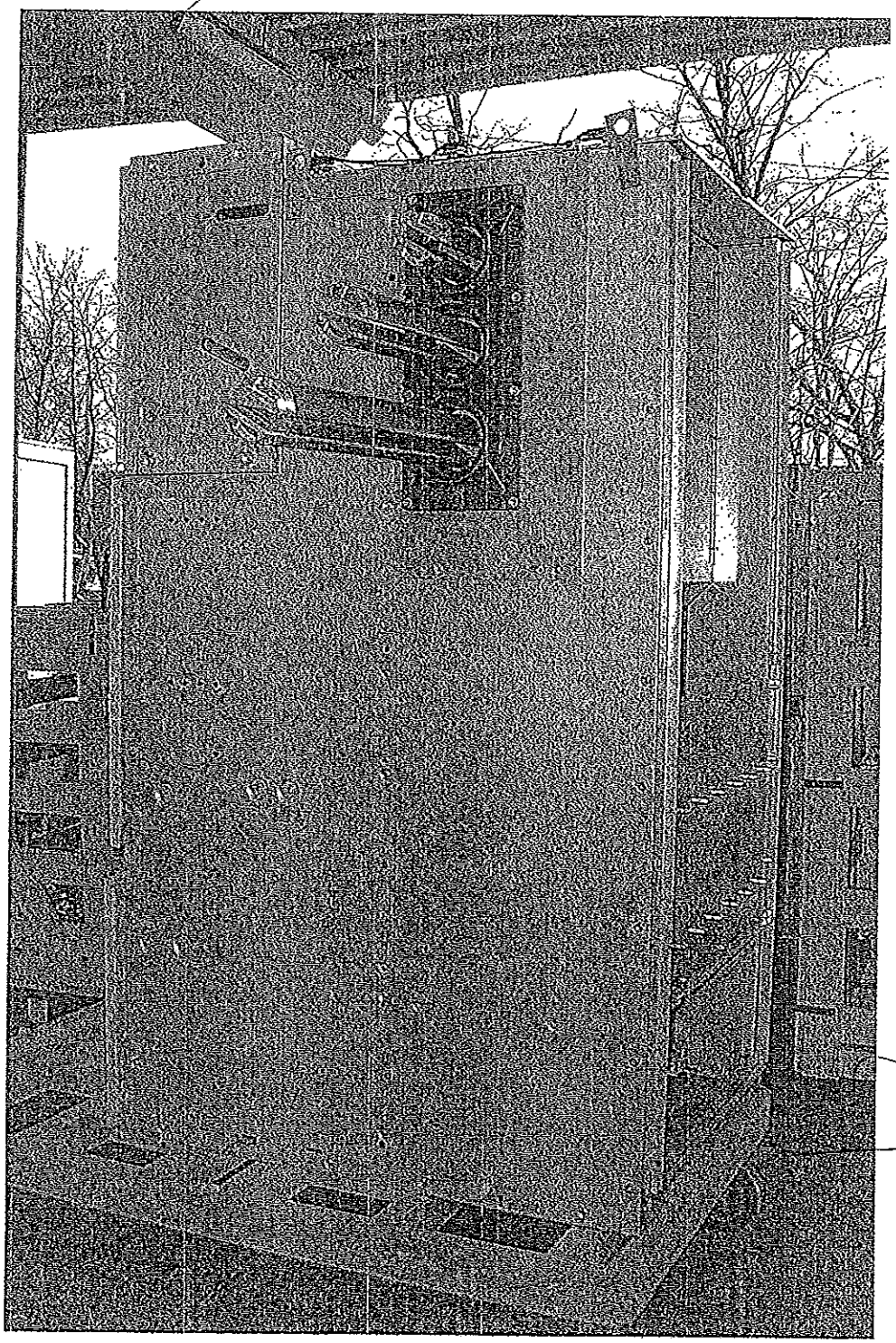


Photo no. 3

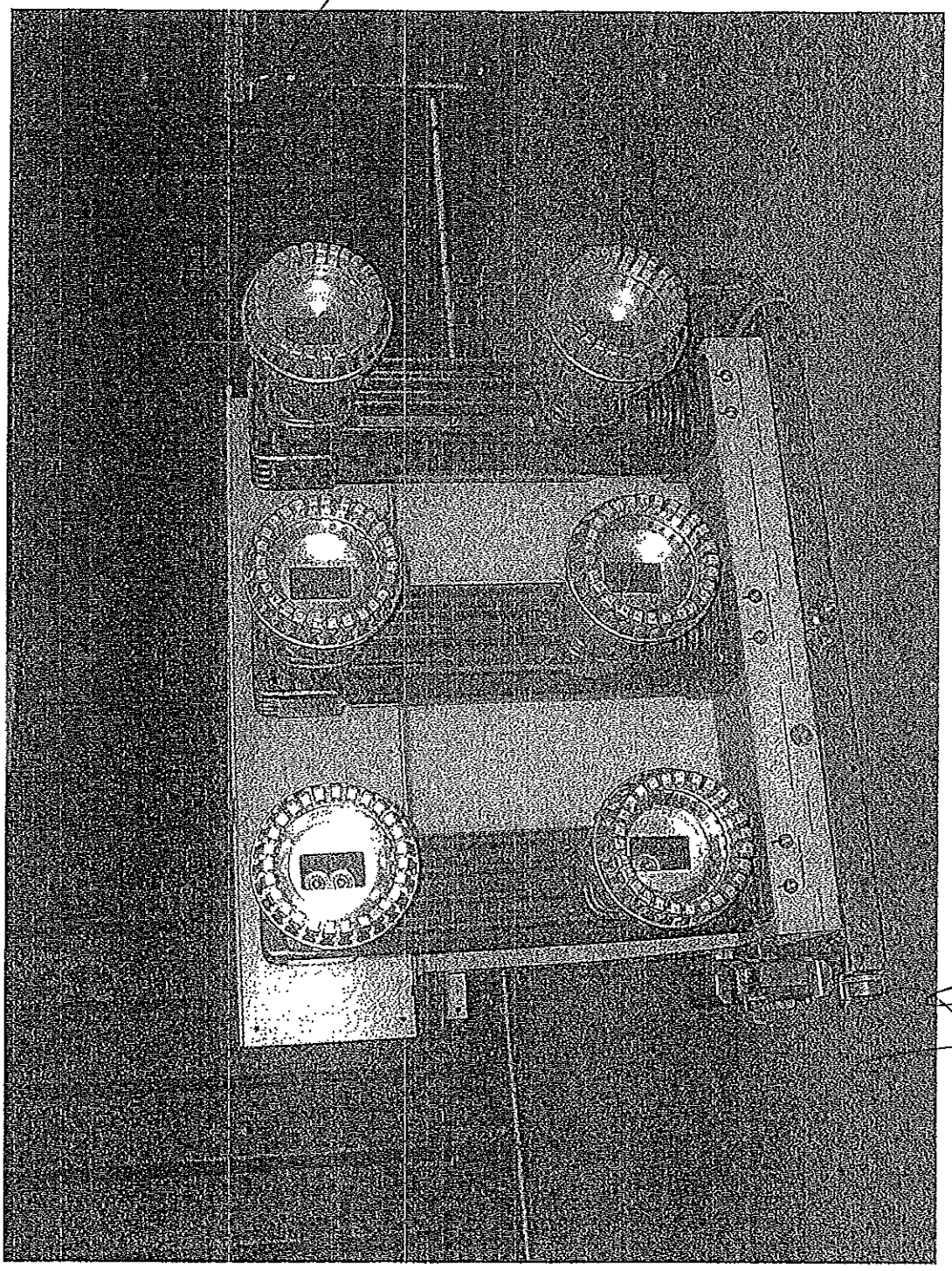


Photo no. 4

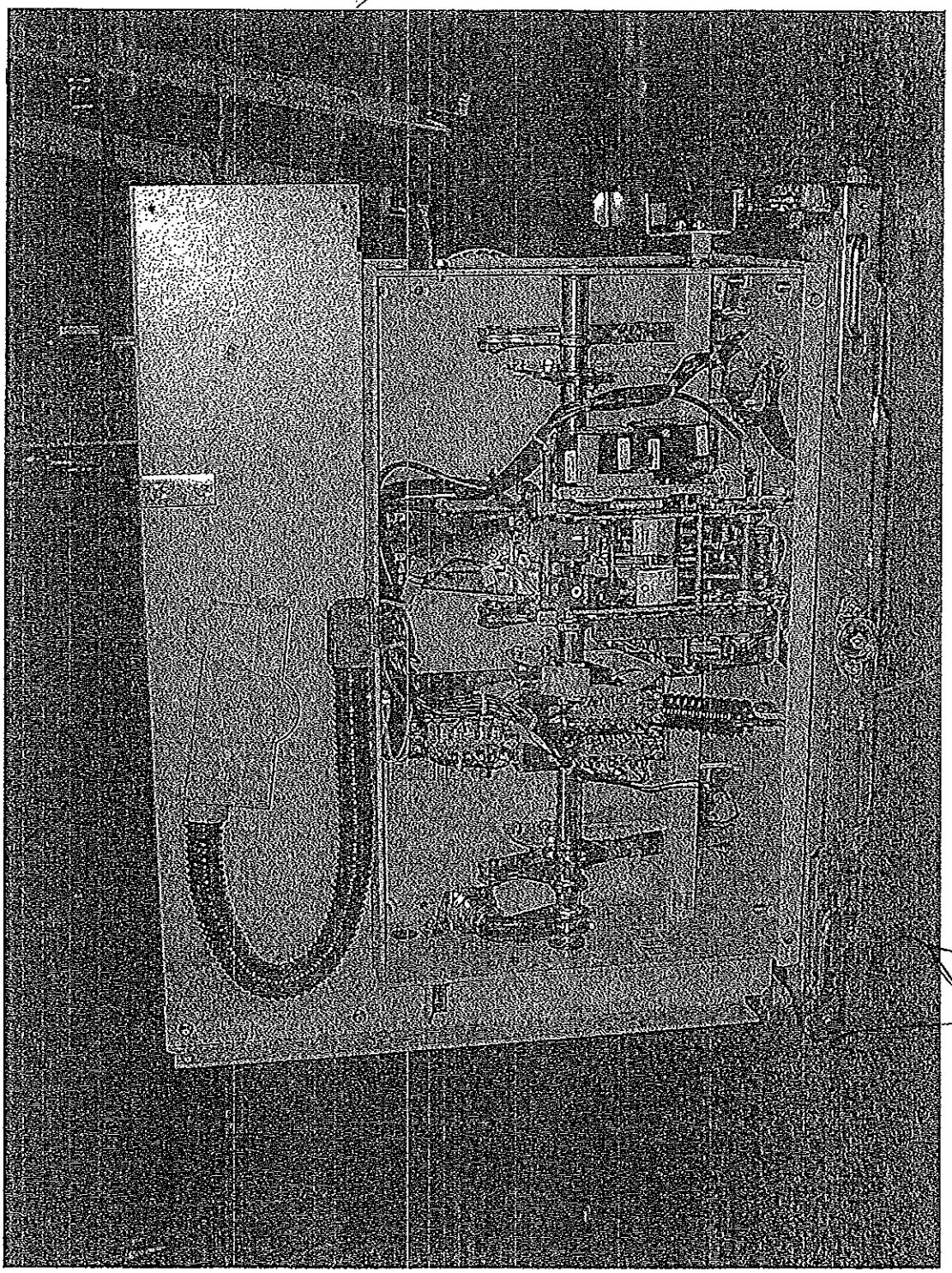


Photo no. 5

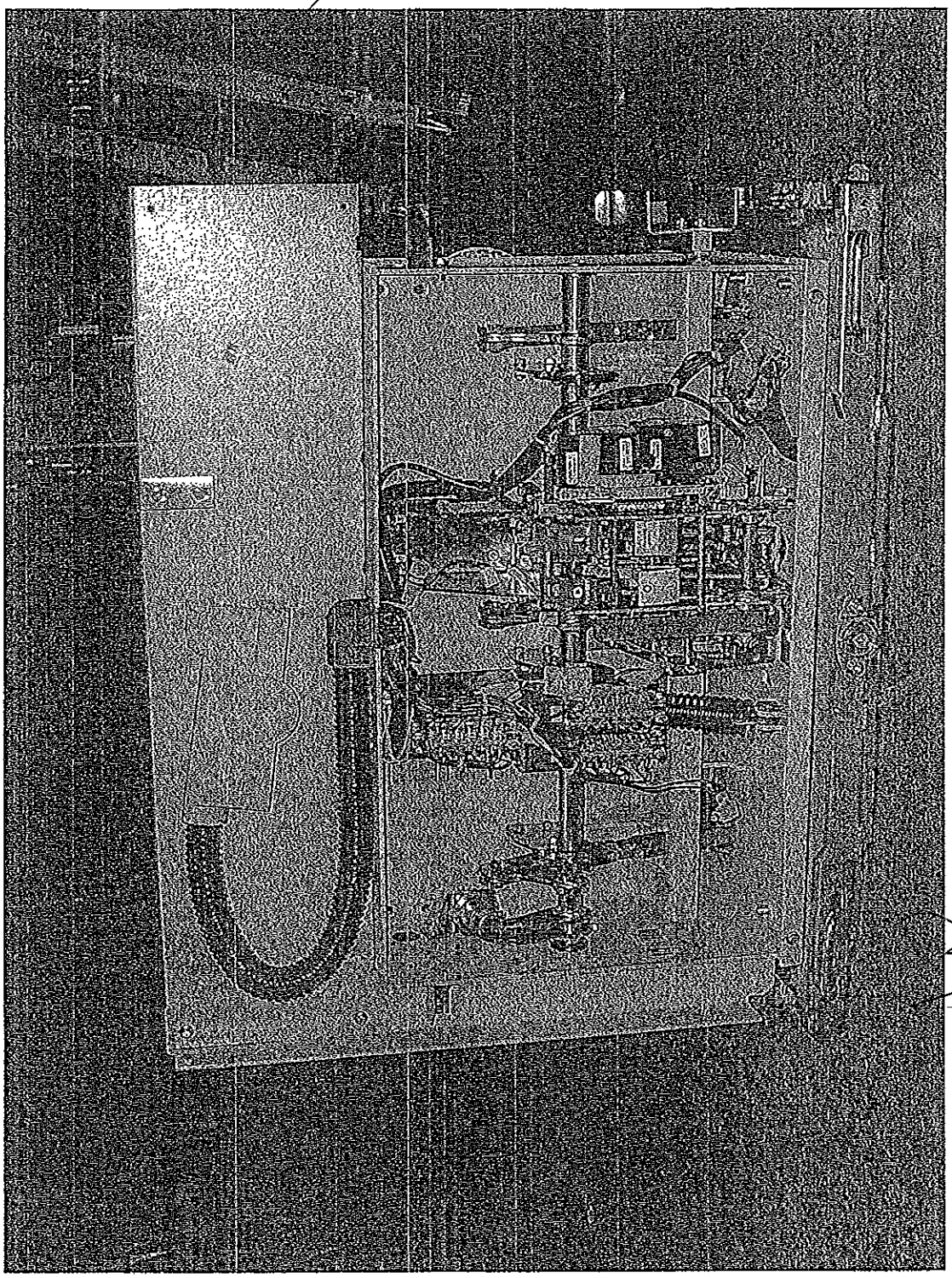


Photo no. 6

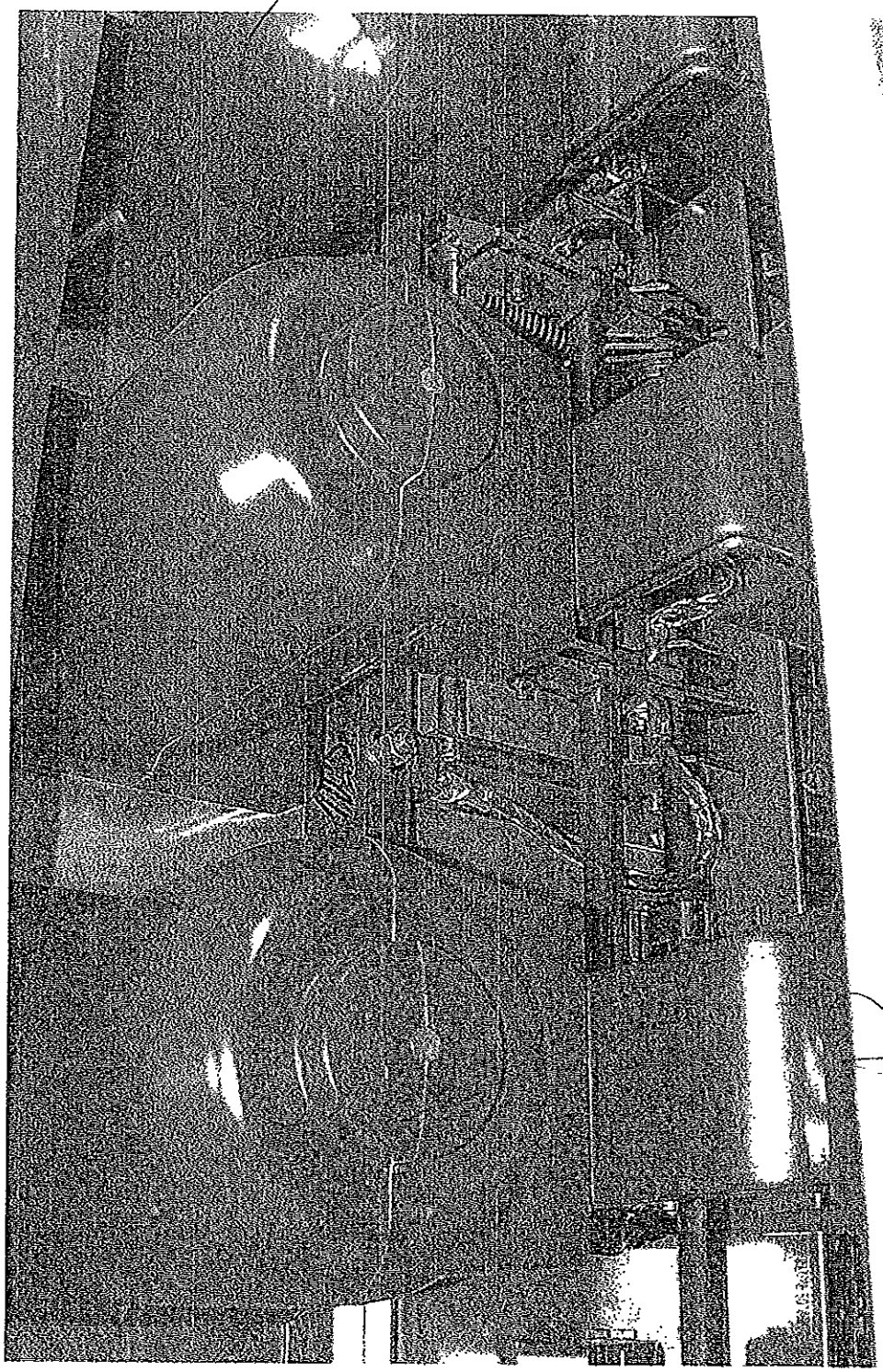


Photo no. 7

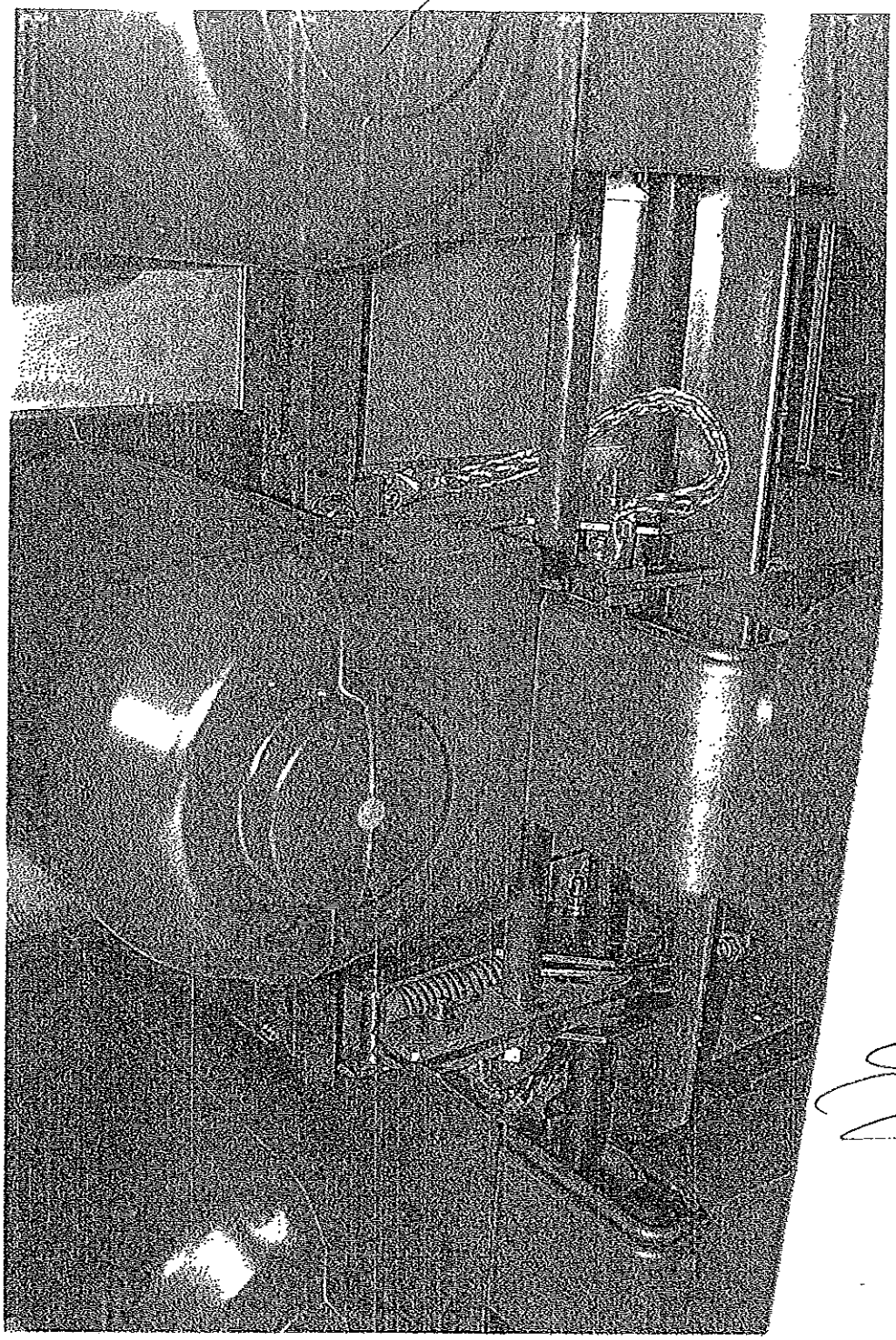


Photo no. 8

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
Member of the Short-Circuit-Testing Liaison (STL)

Test Document

Report No.: 0020 Ra **Copy No.:** 0 **Contents: 11 Sheets**

Equipment under test: Metal-clad air-insulated switchgear panel from a 12 kV switchgear type ZS1.2 (T = 1000 mm), drawing-no. GCE 8010452 R0112, with withdrawable vacuum circuit-breaker type VD4P 1225-31 and with earthing switch type EK6-1208-275

Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany

Client: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany

Testing station: PEHLA-Prüffeld Ratingen

Date of test: 08th May 2000

Applied test specifications:
IEC 60298, 3rd edition, 1990-12, clause 6.102
IEC 60694, 2nd edition, 1996-5

According to STL Objectives and Operating Principles PEHLA issues a Test Document following exclusively the above mentioned test specifications and the STL Guides wherever applicable.

Tests performed:
Mechanical operation test comprising 50 operations of the vacuum circuit-breaker type VD4P 1225-31, 50 operations of the earthing switch type EK6 and 25 manual insertions and withdrawals of the withdrawable part. The interlocks of the circuit-breaker, withdrawable part and the earthing switch were tested in the respective position.

Test results:
All switching devices, removable parts and the mechanical and electrical interlocks passed the mechanical operation test successfully. They were in proper working order and the effort to operate them practically the same before and after the test.

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

Technical Committee

Mannheim, 10th October 2000

Deutscher Akkreditierungs Rat DAR
DAT-P-032/93

ВЯРНО С ОРИГИНАЛА

Accreditation

The PEHLA-Prüffeld Ratingen has been approved by the DATech (German accreditation body for technology) according to DIN EN 45001 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. DAT-P-032/93).

Under reference to DIN EN 45001 PEHLA states the following:

- The accreditation of the PEHLA-Prüffeld or any of its test reports by themselves in no way constitute or imply product approval by DATech or any other body.
- If someone refers to a test in an accredited PEHLA-Prüffeld this reference shall include the accreditation body, i.e. DATech, the relevant scope of the accreditation and the appropriate registration number.

STL-Member

PEHLA is foundation-member of the Short-Circuit Testing Liaison (STL) which has been founded in March 1969. STL is a forum for the international cooperation of the testing organisations with the further full members ASTA (GB), CESI (I), ESEF (F), KEMA (NL), SATS (N; S, SF) and STLNA (USA). In the framework of EC, STL has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Certificate

is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STLGuides valid at the time of the test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients instructions.
Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the equipment during test, and its condition after the tests.

Addresses:

Office:	PEHLA-Geschäftsstelle Hallenweg 40 D-68219 Mannheim
Testing Station:	PEHLA-Prüffeld Ratingen Oberhausener Str. 33 D-40472 Ratingen
Manufacturer:	ABB Calor Emag Mittelspannung GmbH Oberhausener Str. 33 D-40472 Ratingen
Client:	ABB Calor Emag Mittelspannung GmbH Oberhausener Str. 33 D-40472 Ratingen

ВЯРНО С ОРИГИНАЛА

Contents

ВЯРНО С ОРИГИНАЛА

List of Test Participants

Representatives of Test Committe:

Mr. U. Köster	PEHLA-Testing Station Ratingen
Mr. W. Stolz	PEHLA-Testing Station Mannheim

Test Engineer:

Mr. U. Koal	PEHLA-Testing Station Ratingen

Other Participants:

Mr. L. Hörbelt	PEHLA-Testing Station Ratingen

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switchgear

Ratings assigned by the manufacturer

Test Object: Metalclad air-insulated switchgear panel
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 07550027/2010/00 **Year of manufacture:** 2000
Drawing No.: GCE8010452 R0112 index 00

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated normal current of busbar	2500	A
Rated normal current of feeder	2500	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31,5	kA
Rated duration of short-circuit	3	s
Insulating medium	air / vacuum	
Rated operating pressure (abs./20 °C)	-	MPa
Minimum operating pressure (abs./20 °C)	-	MPa
Max. ambient air temperature	40	°C
Permissible values for internal arc faults:		
Peak current	80	kA
Short-time current	31,5	kA
Duration of short-circuit	1	s

Essential characteristics and installed devices:

Date of receipt of test object: 08th May 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device

Ratings assigned by the manufacturer

Test Object:	Vacuum circuit-breaker
Type:	VD4P 1225-31
Manufacturer:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.:	07007054/4001/00 **Year of manufacture:** 2000
Drawing No.:	GCE 7000162 R1178 index 00 (breaker)
Vacuum interrupter:	L1: No. 00G4S01115, L2: No. 00G4S01116, L3: No. 00G4S01117
Drawing No.:	GCE 7005535 R0101 index 02 (interrupter)

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated nominal current	2500	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current		
Rated short-circuit current	31.5	kA
D.C. component	30	%
Rated short-circuit making current	80	kA
Rated transient recovery voltage		
Peak value	-	kV
Rate of rise	-	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3s-CO-3min-CO	
Arc extinguishing medium	vacuum	
Rated pressure / Minimal pressure (20 °C)		MPa
Insulating medium		
Rated pressure / Minimal pressure (20 °C)		MPa
Driving mechanism		
Type of drive	VD4 drive	
Rated pressure / Minimal pressure (20 °C)		MPa
Number of poles	3	
Number of units per pole	1	
Rated opening time	≤ 45	ms
Rated closing time	Approx. 60	ms
Rated voltage of opening release	220	V
Rated voltage of closing release	220	V
Rated supply voltage	220	V
Rated frequency of supply voltage	-	Hz
Max. ambient air temperature	40	°C
Further specifications:	-	

Essential characteristics:

Date of receipt of test object: 08th May 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object
Switching Device
Ratings assigned by the manufacturer

Test Object: Earthing switch
Type: EK6-1208-275
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 02/032/00 **Year of manufacture:** 2000
Drawing No.: GCE7169312 R0116 index 20
Vacuum interrupter:
Drawing No.:

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated nominal current	-	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current		
Rated short-circuit current	31.5	kA
D.C. component	-	%
Rated short-circuit making current	80	kA
Rated transient recovery voltage		
Peak value	-	kV
Rate of rise	-	kV/µs
First-pole-to-clear-factor	-	
Rated operating sequence	-	
Arc extinguishing medium	-	
Rated pressure / Minimal pressure (20 °C)		MPa
Insulating medium		
Rated pressure / Minimal pressure (20 °C)		MPa
Driving mechanism		
Type of drive	-	
Rated pressure / Minimal pressure (20 °C)		MPa
Number of poles	3	
Number of units per pole	-	
Rated opening time	-	ms
Rated closing time	-	ms
Rated voltage of opening release	-	V
Rated voltage of closing release	-	V
Rated supply voltage	-	V
Rated frequency of supply voltage	-	Hz
Max. ambient air temperature	40	°C
Further specifications:	-	

Essential characteristics:

Date of receipt of test object: 08th May 2000

ВЯРНО С ОРИГИНАЛА

List of Drawings

The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. PEHLA has verified that these drawings adequately represented the equipment tested. These drawings have been stamped and signed by PEHLA representatives and are kept

☒ with the test documents at the test laboratory.

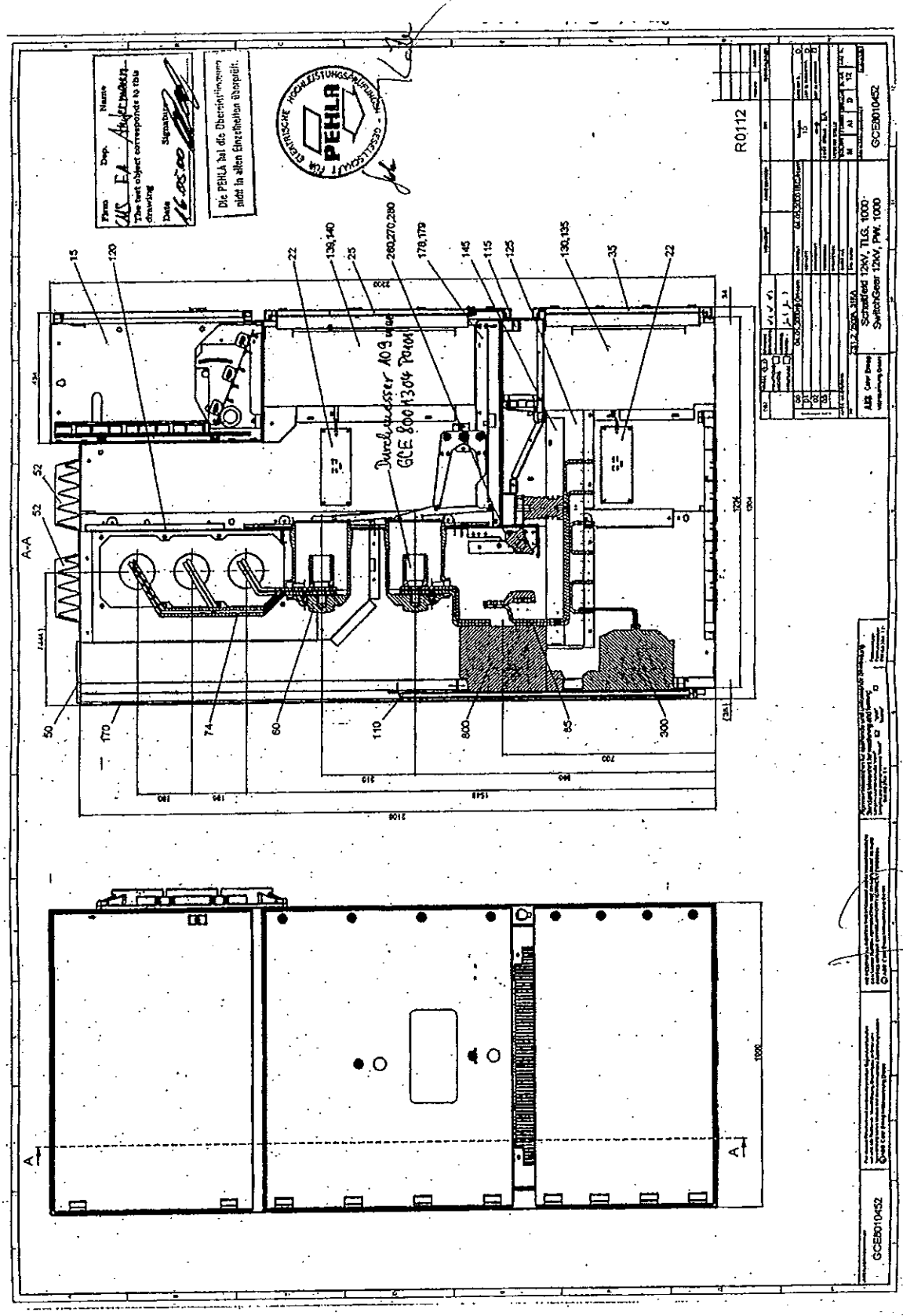
☐ at the client.

Drawing-No.	Revision	Title	Additional remarks
GCE 8010452 R0112	Index 00	Switchgear 12 kV PW.1000	
GCE 7000162 R1178	Index 00	Draw out VD4-P for ZS1.2	
GCE7169312 R0116	Index 20	Earthing switch EK6 12-24 kV	

A copy of the following drawings is part of this Test Report:

Metalclad air-insulated switchgear panel GCE 8010452 R0112 index 00

ВЯРНО С ОРИГИНАЛА



ВЯРНО С ОРИГИНАЛА

Mechanical Operation Test

List of interlocks:

1. Withdrawable part in test-position
   - Circuit-breaker ON: prevented to move the withdrawable part in service-position

2. Withdrawable part in service-position
   - Circuit-breaker ON: prevented to move the withdrawable part in test-position

3. Withdrawable part between service and test position:
   - prevented to switch ON the circuit-breaker

4. Withdrawable part in test-position
   - Circuit-breaker OFF and earthing switch ON: prevented to move the withdrawable part in service-position

5. Withdrawable part in test-position
   - circuit-breaker ON and earthing switch ON: prevented to move the withdrawable part in service-position

6. Withdrawable part not in test-position
   - prevented to switch ON the earthing switch

All the above mentioned interlocks were checked, for this the circuit-breaker and the earthing switch were operated 50 times and the withdrawable part was inserted and withdrawn 25 times.

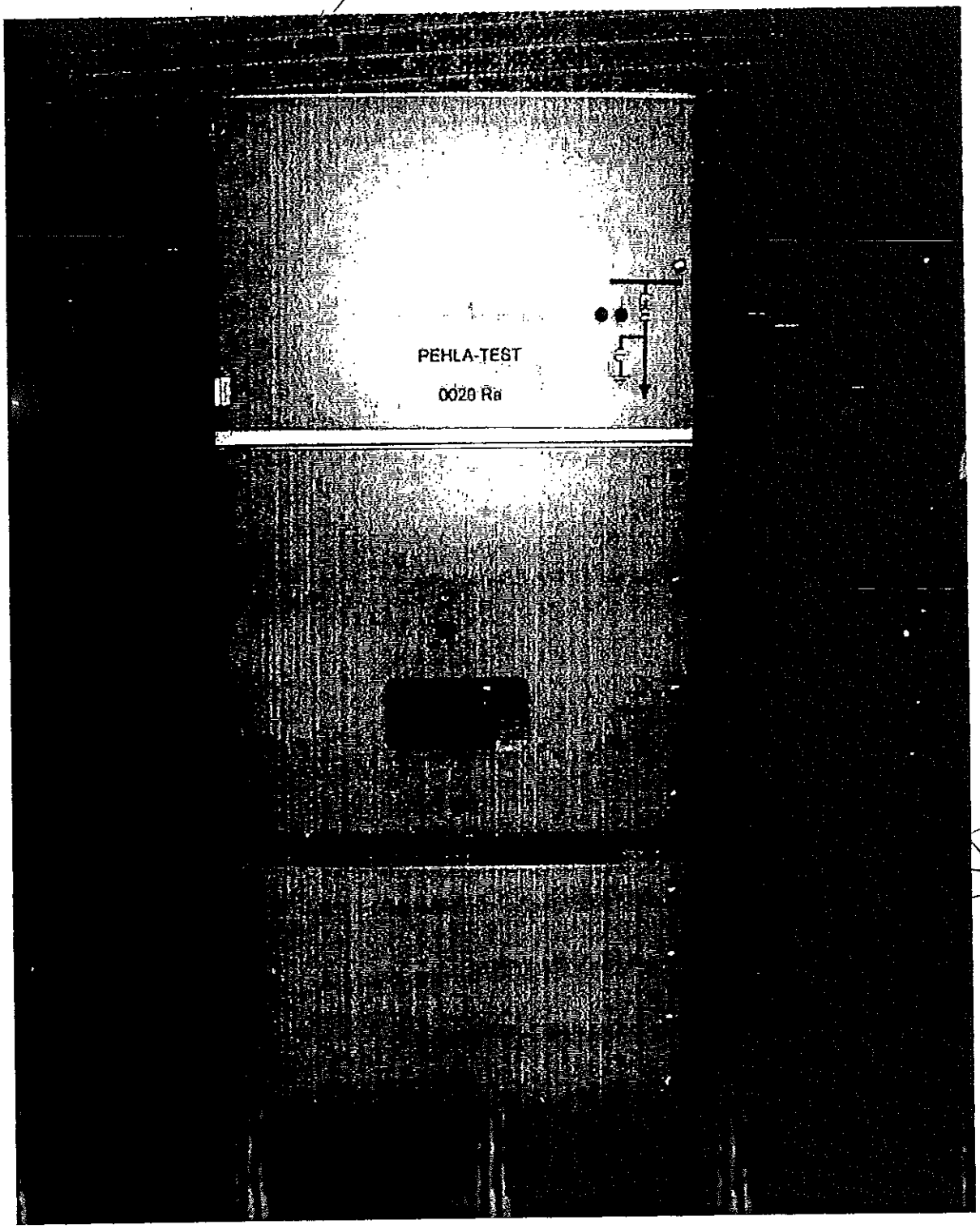


Fig. 1: Test object

ВЯРНО С ОРИГИНАЛА

PEHLA

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN
Member of the Short-Circuit-Testing Liaison (STL)

Test Report

Report No.: 0016 Ra **Copy No.:** 0 **Contents:** 19 Sheets

Equipment under test:	Metal-clad air-insulated switchgear panel type ZS1.2, rated voltage 12 kV (width = 1000 mm), drawing-no. GCE 8010452 R0112, with vacuum circuit-breaker type VD4P 1225-31.
Manufacturer:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Client:	ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Testing station:	PEHLA - Testing Station Ratingen
Date of test:	8th May 2000
Applied test specifications:	IEC 60298: 1990-12, clauses 6.1.1, 6.1.3, 6.1.4 a), 6.1.5 - 6.1.7, IEC 60694: 1996-05, clauses 6.2.1, 6.2.3 - 6.2.6.

Tests performed: Dielectric type test.

- Standard lightning impulse withstand voltage test at 75 kV and power-frequency withstand voltage test at 28 kV to earth, between phases and across open switching device.
- 2-kV-AC Voltage test on auxiliary and control circuits.

Test results: The above ZS1.2-type panel with VD4P 1225-31 passed the dielectric type test successfully. The respective requirements are met.

GESELLSCHAFT FÜR ELEKTRISCHE HOCHLEISTUNGSPRÜFUNGEN

Technical Committee

Mannheim, 04th July 2001

Deutscher Akkreditierungs Rat DAR DAT-P-032/93

ВЯРНО С ОРИГИНАЛА

Accreditation

The PEHLA-Testing Station Ratingen has been approved by the DATech (German accreditation body for technology) according to DIN EN 45001 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. DAT-P-032/93).

Under reference to DIN EN 45001 PEHLA states the following:

- The accreditation of the PEHLA-Testing Station or any of its test reports by themselves in no way constitute or imply product approval by DATech or any other body.
- If someone refers to a test in an accredited PEHLA-Testing Station this reference shall include the accreditation body, i.e. DATech, the relevant scope of the accreditation and the appropriate registration number.

STL-Member

PEHLA is foundation-member of the Short-Circuit Testing Liaison (STL) which has been founded in March 1969. STL is a forum for the international cooperation of the testing organisations with the further full members ASTA (GB), CESI (I), ESEF (F), KEMA (NL), SATS (N; S, SF) and STLNA (USA). In the framework of EC, STL has been recognised in 1992 by EOTC as agreement group.

PEHLA-Documents

A Certificate

is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STLGuides valid at the time of the test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Document

is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test.
For these tests the equipment under test must be clearly identified by technical description, drawings and additional specifications.

A Test Report

is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients instructions.
Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the equipment during test, and its condition after the tests.

Addresses:

Office: PEHLA-Geschäftsstelle
Hallenweg 40
D-68219 Mannheim

Testing Station: PEHLA-Testing Station Ratingen
Oberhausener Str. 33
D-40472 Ratingen

Manufacturer: ABB Calor Emag Mittelspannung GmbH
Oberhausener Str. 33
D-40472 Ratingen

Client: ABB Calor Emag Mittelspannung GmbH
Oberhausener Str. 33
D-40472 Ratingen

ВЯРНО С ОРИГИНАЛА

Table of Contents

ВЯРНО С ОРИГИНАЛА

List of Test Participants

Representatives of the Test Committee:

Mr. A. Meier	PEHLA - Testing Station Ratingen
Mr. W. Stolz	PEHLA - Testing Station Mannheim

Test Engineer:

Mr. U. Lisseck	PEHLA - Testing Station Ratingen

Other Participiants: -

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switchgear

Ratings assigned by the manufacturer

Test Object: Metal-clad air-insulated switchgear panel
Type: ZS1.2
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 07550027/2010/00 **Year of manufacture:** 2000
Drawing No.: GCE 8010452 R0112 Index 00

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated normal current of busbar	2500	A
Rated normal current of tee-off	2500	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Insulating medium	air	
Rated functional pressure (abs./20 °C)	-	kPa
Minimum functional pressure (abs./20 °C)	-	kPa
Permissible values for internal arc faults:		
Peak current	80	kA
Short-time current	31.5	kA
Duration of short-circuit	1	s
Max. ambient air temperature	40	°C

The above switchgear panel is fully described in the mentioned drawings.

Essential characteristics and installed devices:

The above switchgear panel is fully described in the mentioned drawings.
Essential details are:

- Busbar 2 x 80 mm x 10 mm / R 5 mm, Cu, bare, with bushing plate.
- Busbar tee-off conductor 2 x 100 mm x 10 mm / R 5 mm, Cu, bare.
- tulip insulator with contact pin Ø = 109 mm.
- Current transformer type ASS 12 – 20, manufacturer: WTW, Serial-No. L1: 00/166476; L2: 00/166477; L3: 00/166478.
- Voltage transformer type VES 12 – 02, manufacturer: WTW, Serial-No. L1: 00/166610; L2: 00/166611; L3: 00/166612.
- Earthing switch type EK6-1208-275, Serial-No. 02/032/00.
- Cable conductor 2 x 100 mm x 10 mm / R 5 mm, Cu, bare.

Date of receipt of test object: 8th May 2000

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Object

Switching Device – Circuit-Breaker

Ratings assigned by the manufacturer

Test Object: Vacuum circuit-breaker
Type: VD4P 1225-31
Manufacturer: ABB Calor Emag Mittelspannung GmbH, D-40472 Ratingen, Germany
Serial-No.: 7007054/4001/00 **Year of manufacture:** 2000
Drawing No.: GCE 7000162 R1178 Index 00 (circuit-breaker)
Vacuum interrupter: Type VG4S, L1: No. 00G4S01115, L2: No. 00G4S01116, L3: No. 00G4S01117
Drawing No.: GCE 7005535 R0101 index 02 (interrupter)

Rated voltage	12	kV
Rated lightning impulse withstand voltage	75	kV
Rated switching impulse withstand voltage	-	kV
Rated power frequency withstand voltage	28	kV
Rated frequency	50/60	Hz
Rated normal current	2500	A
Rated peak withstand current	80	kA
Rated short-time withstand current	31.5	kA
Rated duration of short-circuit	3	s
Rated short-circuit breaking current		
...Rated short-circuit current	31.5	kA
D.C. component	30	%
Rated short-circuit making current	80	kA
Rated transient recovery voltage:		
Peak value	20.6	kV
Rate of rise	0.34	kV/µs
First-pole-to-clear-factor	1.5	
Rated operating sequence	O-0.3 s -CO-3 min-CO	
Arc extinguishing medium	Vacuum	
Number of poles	3	
Number of units per pole	1	
Rated opening time	≤ 45	ms
Rated closing time	approx. 60	ms
Rated voltage of trip coil	230	V-DC
Rated voltage of closing coil	230	V-DC
Rated supply voltage	230	V-DC
Rated frequency of supply voltage	-	Hz
Max. ambient air temperature	40	°C
Further specifications:	-	

Essential characteristics: -

Date of receipt of test object: 8th May 2000

ВЯРНО С ОРИГИНАЛА

List of Drawings

The manufacturer has guaranteed, that the equipment submitted for test has been manufactured in full accordance with the following drawings. PEHLA has verified that these drawings adequately represent the equipment tested. These drawings have been stamped and signed by PEHLA representatives and are kept

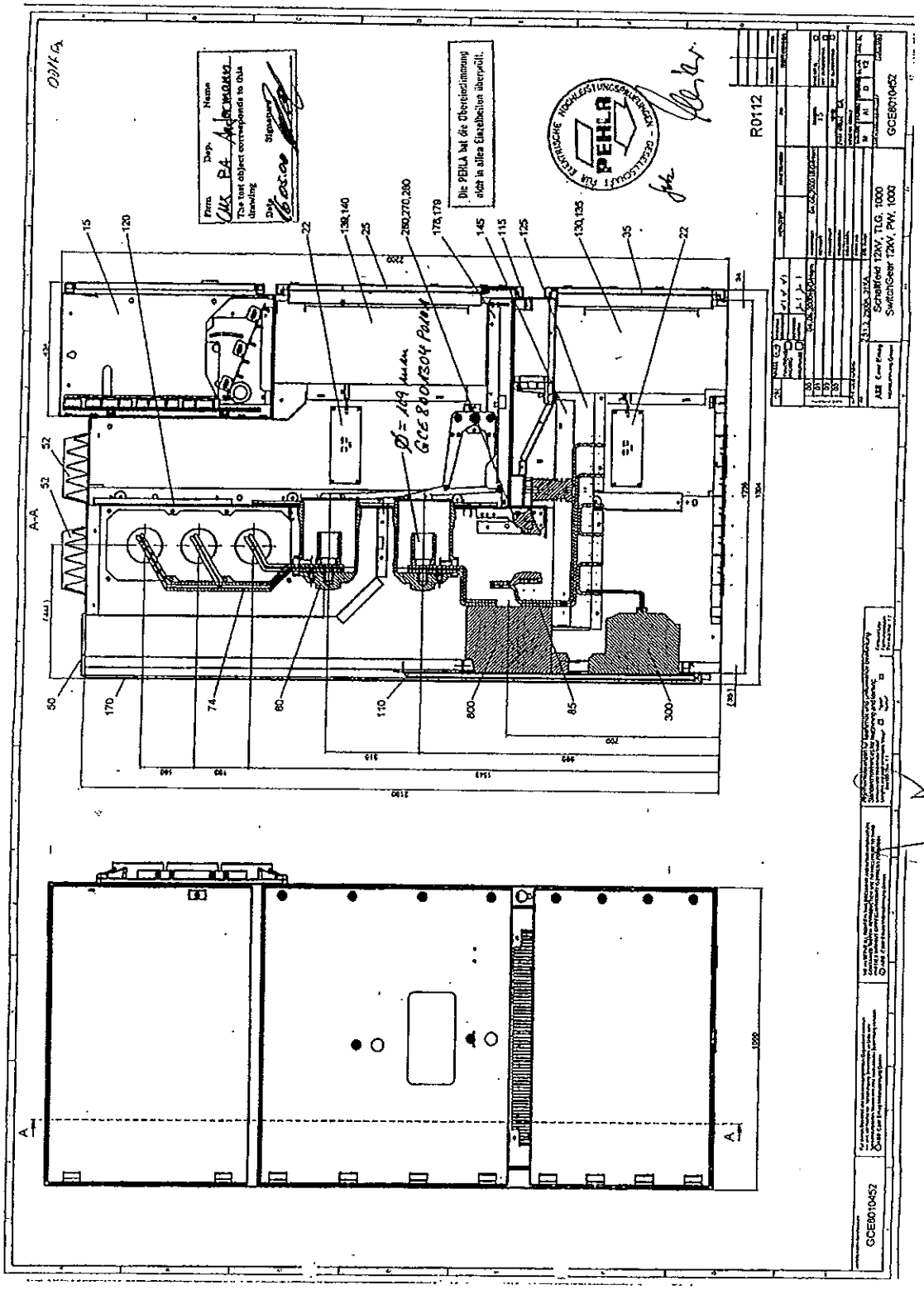
☒ with the test documents at the test laboratory.

☐ at the client.

Drawing-No.	Index	Title	Additional remarks
GCE 8010452 R0112	00	SWITCHGEAR 12kV; PW1000	A copy is included in this Test Report
GCE 8001304 P0101	03	CONTACT PIN	--
GCE 7000162 R1178	00	Einschub für ZS1.2	A copy is included in this Test Report
GCE 7005535 R0101	00	Interrupter	--

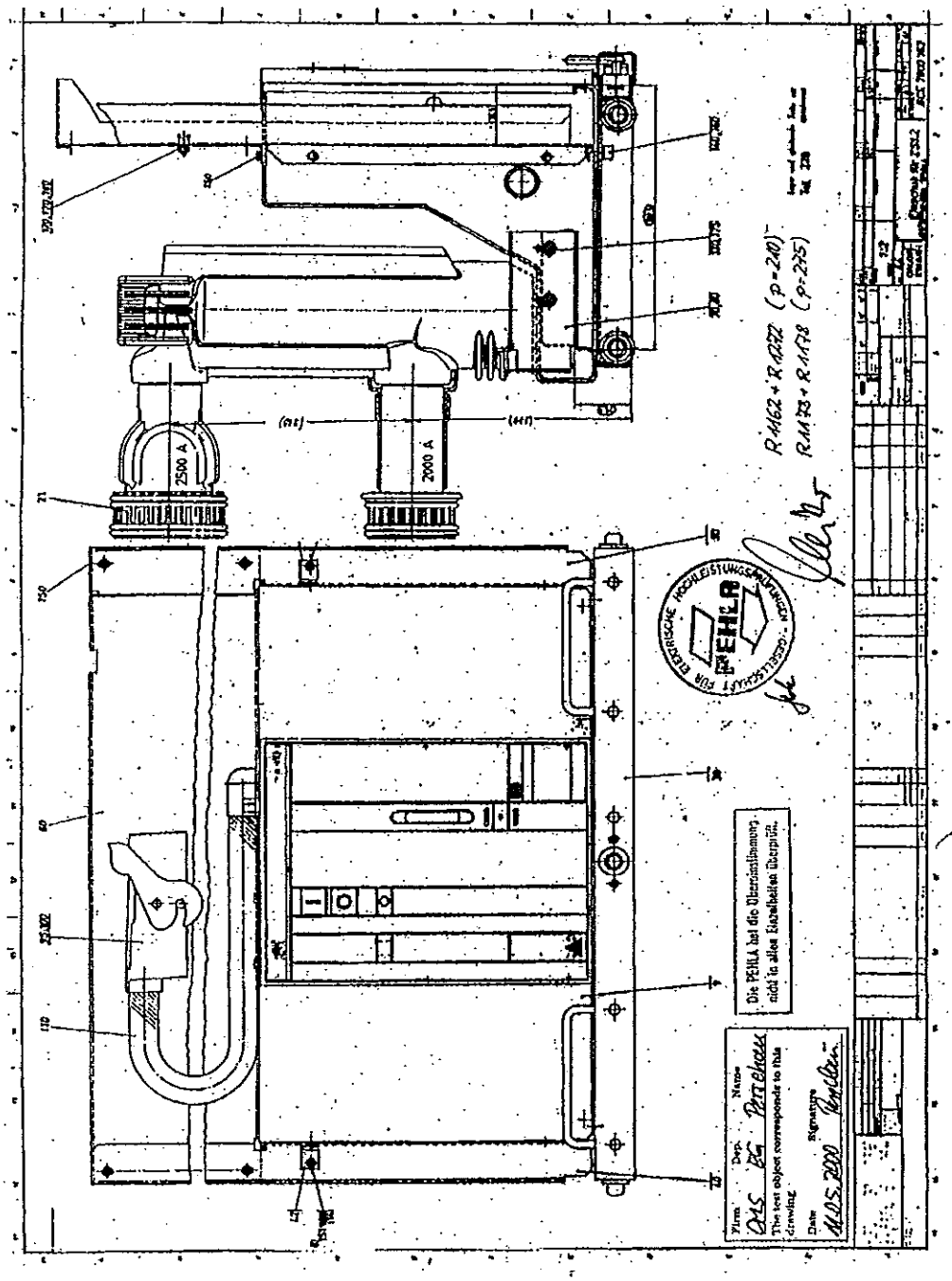
ВЯРНО С ОРИГИНАЛА

Drawing No. 8010452R0112



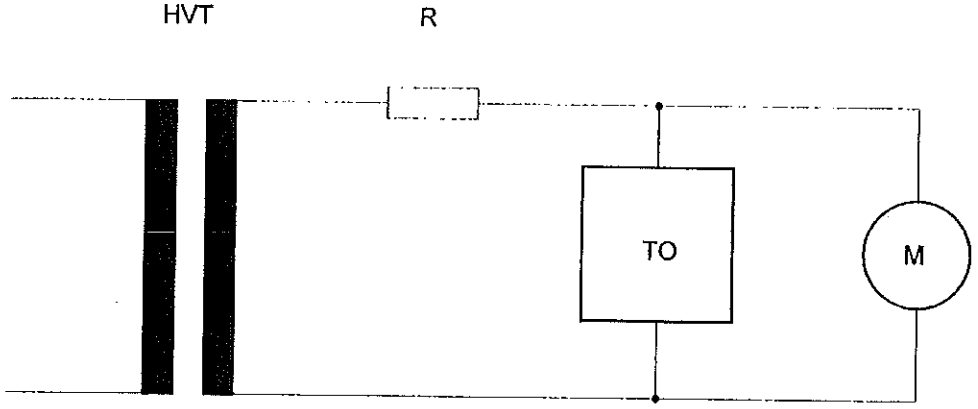
ВЯРНО С ОРИГИНАЛА

Drawing No. 7000162R1178



ВЯРНО С ОРИГИНАЛА

Technical Data of Test Circuit
Power Frequency Voltage



Technical Data

HVT - High Voltage Test Transformer, Type TEO 250/20, Serial-No. 268 734,
manufacturer: Meßwandler-Bau GmbH, Bamberg

Rated Voltage	260	kV
Rated Capacity	50	kVA
Short Circuit Impedance	14.6	%

TO - Test Object: ZS1.2/12kV –type panel, 2500 A

M - Voltage Measurement: Capacitive Divider Type CM 300 (Ident-No. ELK-000994) in connection with a Peak Voltmeter Type DMI 551/Haefely (Ident-No. ELK-000989)

Verification of Calibration:

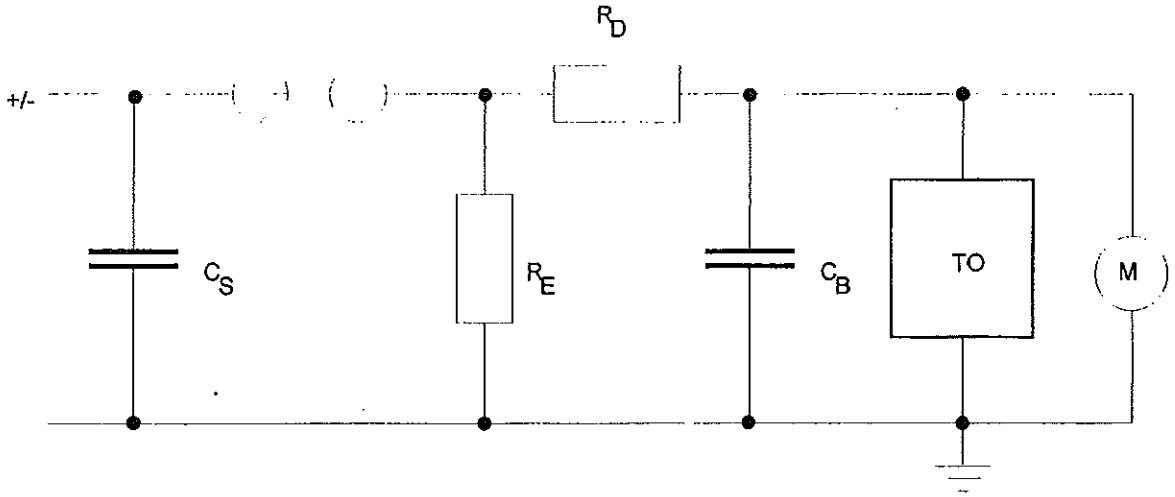
- Capacitive Divider (Ident-No. ELK-000994, ELK-000990, ELK-000992): calibrated on April 1998 at DEACE/LH, Calibration Report-No. 9800086.

- Peak Voltmeter Typ DMI 551 (Ident-No. ELK-000989): calibrated on April 2000 at DECMS/LK, Calibration Report No. 2000353.

ВЯРНО С ОРИГИНАЛА

Technical Data of Test Circuit

Lightning Impulse Voltage 1.2/50



Technical Data

Impulse Generator Type SGSA-400-20, WO: 4549-51, manufacturer: Haefely

Maximum Charging Voltage	U_Σ	=	400 kV
Number of Stages	n	=	4
Surge Capacity per Stage	C_S	=	600 nF
Load Capacitance	C_B	=	2000 pF
Damping Resistance	R_D	=	R_{SI}
Internal Front Resistance per Stage	R_{SI}	=	52 Ω
Discharge Resistance	R_E	=	4 R_P
Tail Resistance per Stage	R_P	=	115 Ω

TO - Test Object: ZS1.2/12kV –type panel, 2500 A

M - Voltage Measurement: Resistance divider RT400 (ident-no.: ELK-000937) in connection with a peak voltmeter type SV 642/Haefely (ident-no. ELK-000064) and oscilloscope type TDS520/ Tektronix (ident-no. ELK-000545).

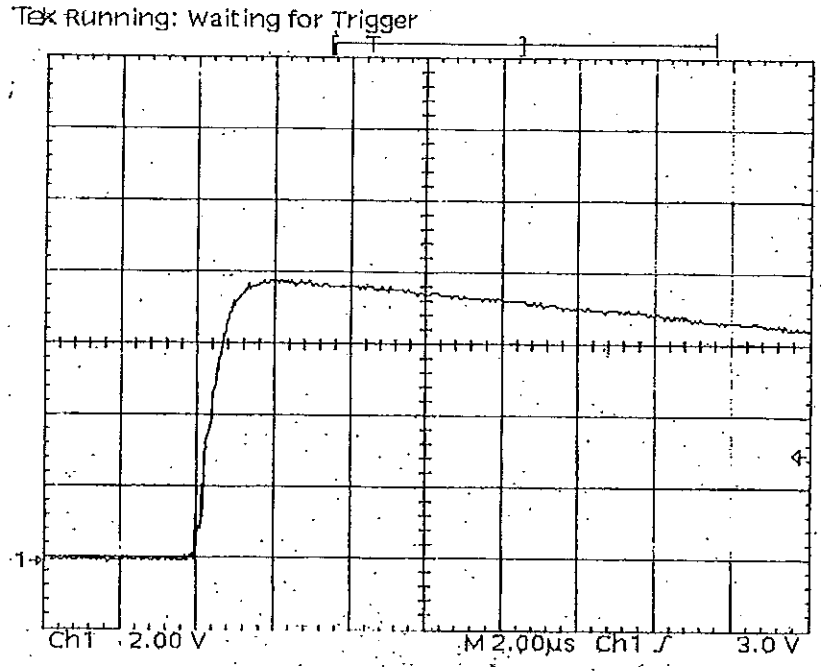
Verification of Calibration:

- Resistance divider RT400 (ident-no. ELK-000937, ELK-000940, ELK-000942): calibrated in April 1996 at FGH-Mannheim, FGH-Calibration-Report-No. 012 DKD-K-15901 96-04.
- Peak voltmeter type SV 642 (ident-no. ELK-000064): calibrated in December 1999 at DECMS/LK, Calibration-Report-No. 9900279.
- Oscilloscope Type TDS520 (Ident-No. ELK-000545): calibrated in March 2000 at DECMS/LK, Calibration-Report-No. 2000297.

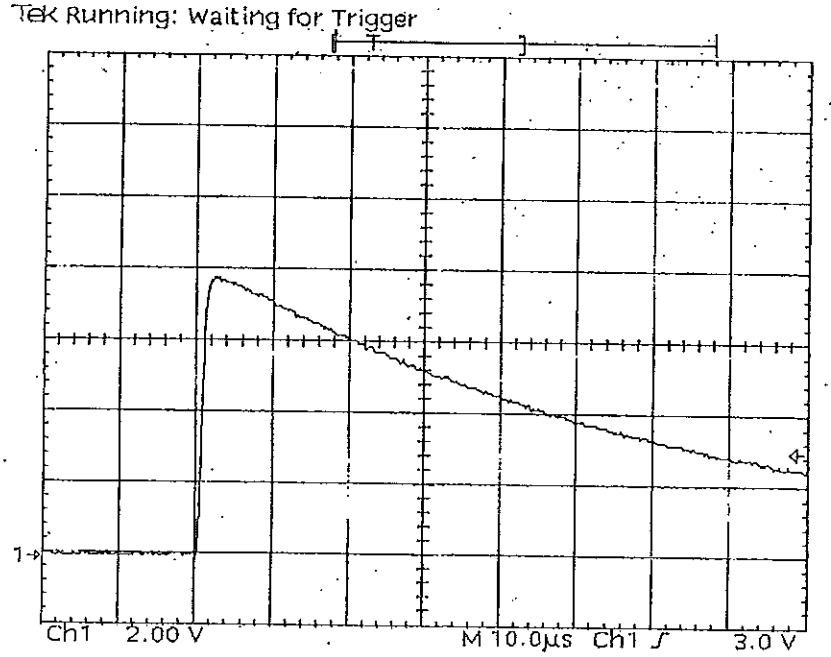
ВЯРНО С ОРИГИНАЛА

Lightning Impulse Voltage with the Test Object connected

(Standard Value: 1.2 ± 30 %/50 ± 20 %/peak ±3 %)



T_1 = 1.23 µs



T_2 = 49.0 µs

ВЯРНО С ОРИГИНАЛА

Atmospheric Conditions during Tests

Date of test: 8th May 2000

IEC 17A/567/Q: Corrigendum to subclause 6.2.1 of IEC60694, 2000-01 (Indices: ~ power frequency voltage; + positive lightning impulse voltage; - negative lightning impulse voltage)							
Input data				Correction factors		calculated	applied
air temperature t:		24.5	°C	air density correction factors	$k_{1\sim}$:	0.994	-
air pressure b:		1022	hPa		k_{1+}:	0.994	-
air humidity h:		10.955	g/m³		k_{1-} :	0.994	-
50% disruptive-discharge voltages	$U_{B\sim}$:		kV	air humidity correction factors	$k_{2\sim}$:	1.000	-
	U_{B+}:		kV		k_{2+}:	1.000	-
	U_{B-}:		kV		k_{2-} :	1.000	-
minimum discharge path L:			m	atmospheric correction factors	$K_{t\sim}$:	0.994	0.994
					K_{t+} :	0.994	0.994
					K_{t-} :	0.994	0.994

ВЯРНО С ОРИГИНАЛА

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase, phase-to-ground and against shutter.

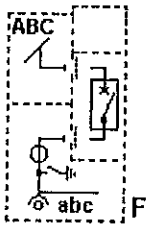
Date of test: 8th May 2000

Condition of test object before test: Factory new, clean and dry.

Connections to test object: Infeed of the test voltage at the led-out busbar right hand resp. at the cable connecting bar in the cable compartment.

Front time T_1: 1.23 µs Time to half-value T_2: 49.0 µs Test frequency f: 150 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m³.

Test Arrangement 1: 			Applied power frequency voltage ~ kV Applied lightning impulse voltage ± kV	Result Test duration or number of impulses / breakdowns
Condition	Voltage applied to	Earthed		
Vacuum circuit-breaker in test position, shutters closed.	Aa	BCbcF	28 +75 -75	1 minute/0 [1] 15/0 15/0
	Bb	ACacF	28 +75 -75	1 minute/0 [1] 15/0 15/0
	Cc	ABabF	28 +75 -75	1 minute/0 [1] 15/0 15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

[1]) Due to the voltage transformers the test frequency was increased upto 150 Hz.

ВЯРНО С ОРИГИНАЛА

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase, phase-to-ground and across open switching device.

Date of test: 8th May 2000

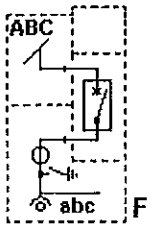
Condition of test object before test: Factory new, clean and dry.

Connections to test object: Infeed of the test voltage at the led-out busbar right hand resp. at the cable connecting bar in cable compartment.

Front time T_1: 1.23 µs Time to half-value T_2: 49.0 µs Test frequency f: 50/150 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m³.

Test Arrangement 2:



Condition	Voltage applied to	Earthed	Applied power frequency voltage ~ kV / Applied lightning impulse voltage ± kV	Result: Test duration or number of impulses / breakdowns
Vacuum circuit-breaker in service position and open.	A	BCabcF	28 +75 -75	1 minute/0 15/0 15/0
	B	ACabcF	28 +75 -75	1 minute/0 15/0 15/0
	C	ABabcF	28 +75 -75	1 minute/0 15/0 15/0
Vacuum circuit-breaker in service position and open.	a	bcABCF	28 +75 -75	1 minute/0 [1] 15/0 15/0
	b	acABCF	28 +75 -75	1 minute/0 [1] 15/1 15/0
	c	abABCF	28 +75 -75	1 minute/0 [1] 15/0 15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

[1]) Due to the voltage transformers the test frequency was increased upto 150 Hz.

ВЯРНО С ОРИГИНАЛА

Lightning Impulse Voltage Test
Power Frequency Voltage Test

Test performed: Test of insulation phase-to-phase and phase-to-ground.

Date of test: 8th May 2000

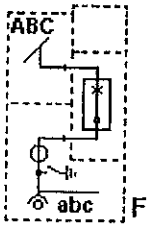
Condition of test object before test: Factory new, clean and dry.

Connections to test object: Infeed of the test voltage at the led-out busbar right hand.

Front time T_1: 1.23 µs Time to half-value T_2: 49.0 µs Test frequency f: 150 Hz

All voltage values are corrected with the applied atmospheric correction factor.
The applied test voltages refer to the standard atmosphere of 20 °C, 1013 hPa and 11 g/m³.

Test Arrangement 3:



Condition	Voltage applied to	Earthed	Applied power frequency voltage ~ kV / Applied lightning impulse voltage ± kV	Result: Test duration or number of impulses / breakdowns
Vacuum circuit-breaker in service position and closed.	Aa	BCbcF	28	1 minute/0 [1]
			+75	15/0
			-75	15/0
	Bb	ACacF	28	1 minute/0 [1]
			+75	15/0
			-75	15/0
	Cc	ABabF	28	1 minute/0 [1]
			+75	15/1
			-75	15/0

Remarks: A,a = Phase L1, B,b = Phase L2, C,c = Phase L3, F = Frame

[1]) Due to the voltage transformers the test frequency was increased upto 150 Hz.

ВЯРНО С ОРИГИНАЛА

2 kV Power Frequency Voltage Test at auxiliary and Control Circuits

Technical Data of Test Equipment:

High Voltage Test Equipment

Manufacturer: HCK Essen
Type: WP-500-4
Serial-No. G170-9402002
Rated Voltage: 0 - 4 kV
Ident-No.: ELK-000807/806/805

Verification of Calibration:

Calibrated in August 1999 at DECMS-LK,
Calibration-Report-No. 9900180

Test Procedure:

The auxiliary and control circuits of the switchgear and of the circuit-breaker were subjected to the AC voltage withstand test between the auxiliary and control circuits connected together as a whole and the frame of the switchgear panel (see IEC60694:1996-05 clause 6.2.10).

The AC Test voltage is 2000 V, Test duration = 1 minute.

Test Result:

Date of Test: 8th May 2000

The 2 kV AC voltage test at 2000 V - 1 minute was passed successfully.

No disruptive discharges occurred during test.

ВЯРНО С ОРИГИНАЛА

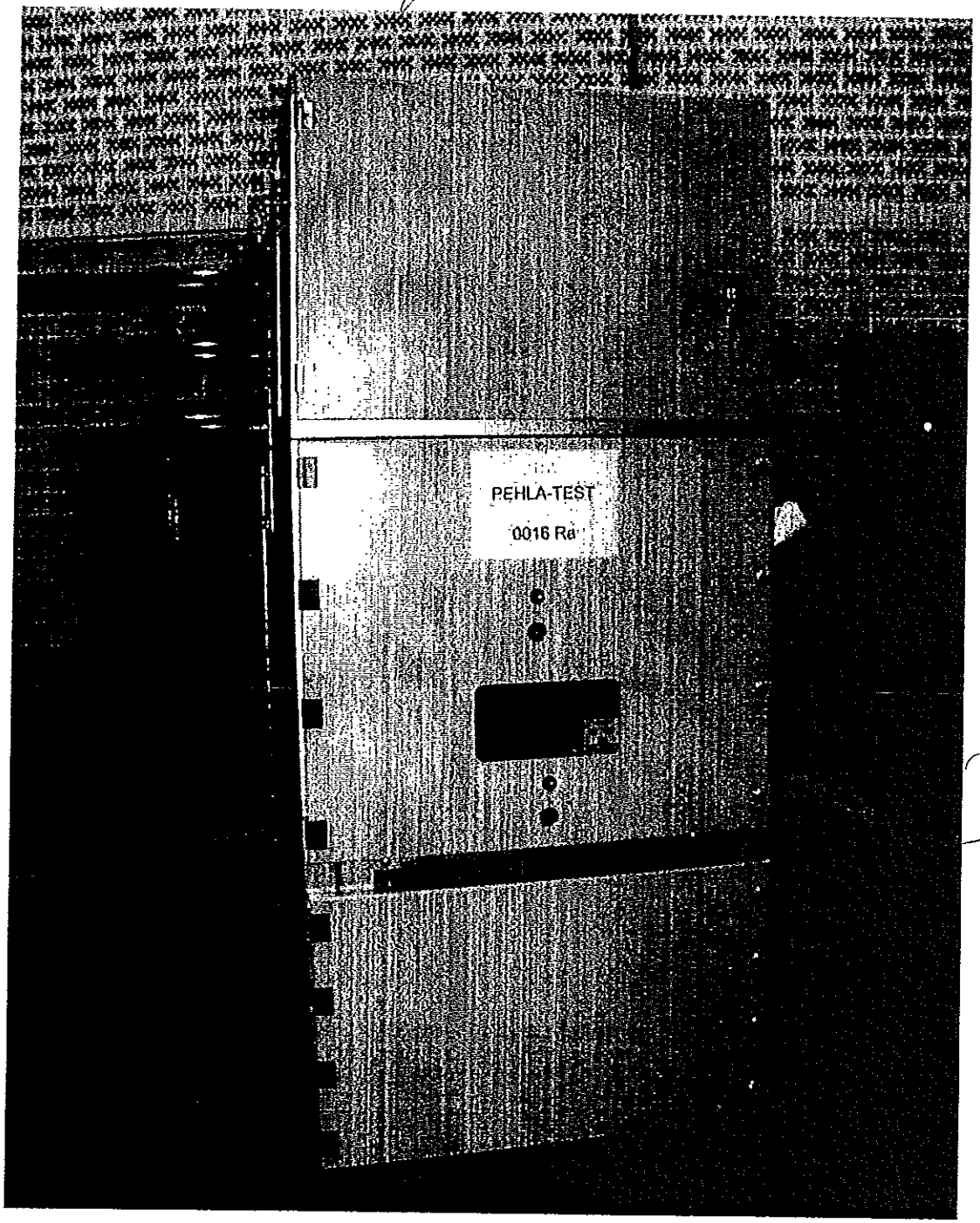


Fig. 1: ZS1.2/12 kV panel

ВЯРНО С ОРИГИНАЛА

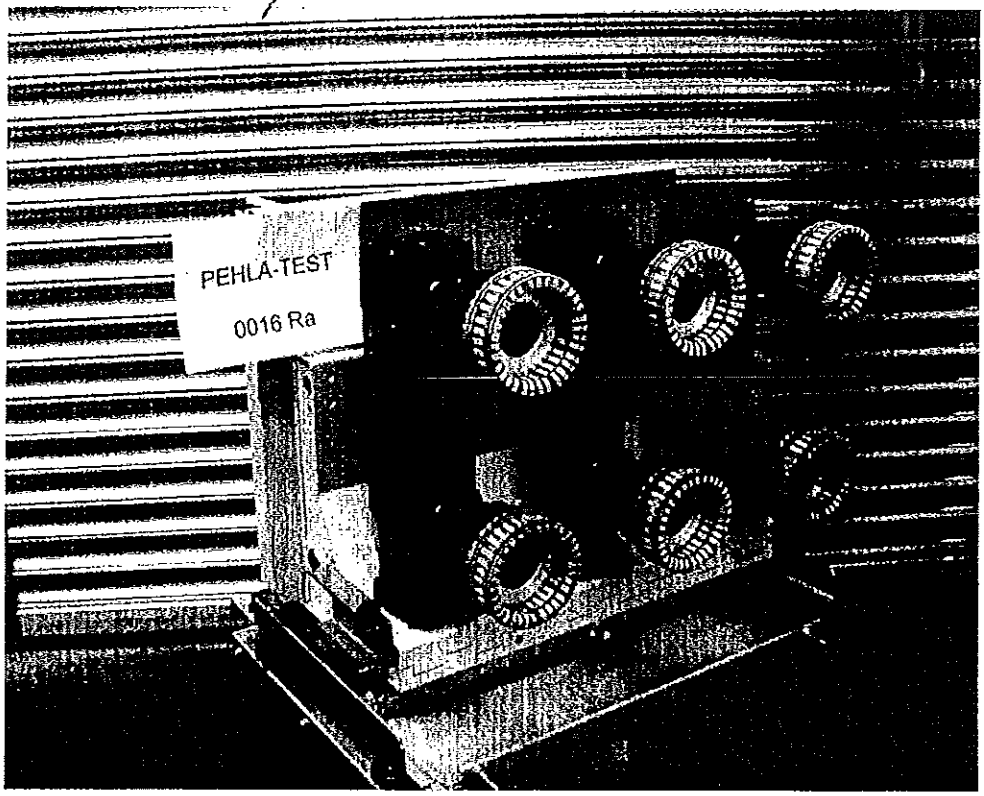


Fig. 2: Vacuum circuit-breaker type VD4P 1225-31

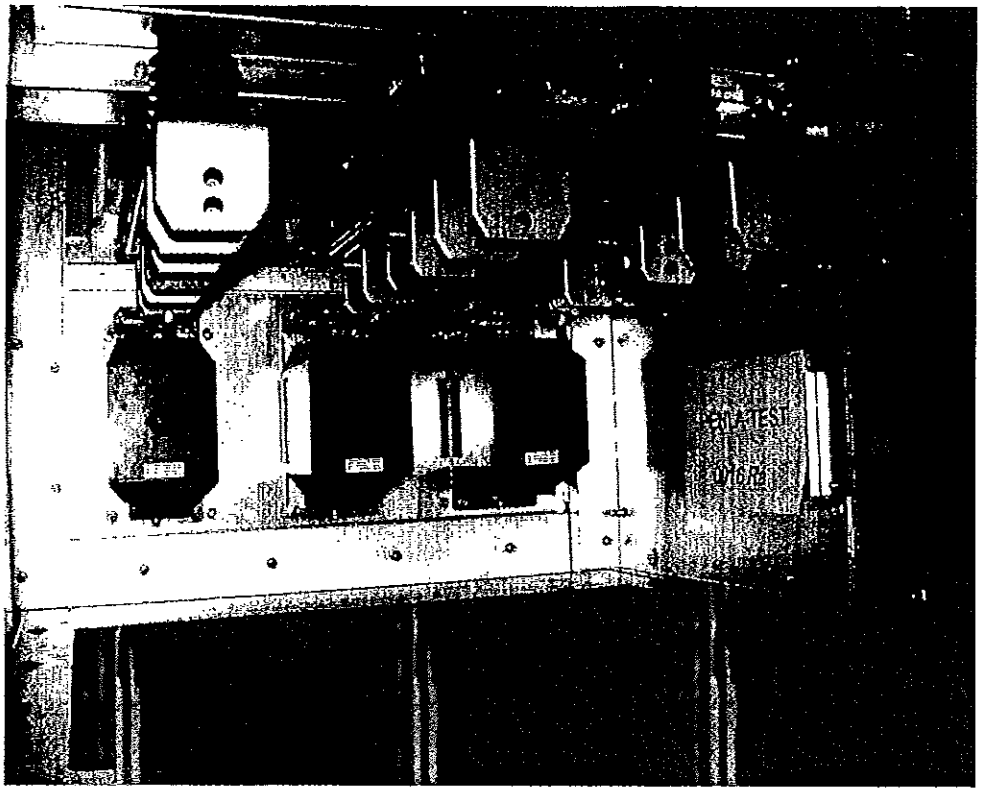


Fig. 3: Cable compartement

ВЯРНО С ОРИГИНАЛА

Приложение 1.3 - Акредитация

ВЯРНО С ОРИГИНАЛА

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

Accreditamento n°
Accreditation n°
0253 Rev. **1**

Si dichiara che
We declare that
ABB S.p.A. Power Products Division
Sede/Headquarters:
Via Friuli 4 - 24044 Dalmine BG

è conforme ai requisiti della norma
UNI CEI EN ISO/IEC 17025:2005 "Requisiti generali per la competenza dei Laboratori di prova e taratura"

meets the requirements of the standard
EN ISO/IEC 17025:2005 "General Requirements for the Competence of Testing and Calibration Laboratories" standard

quale
Laboratorio di Prova

as
Testing Laboratory

L'accreditamento attesta la competenza tecnica del Laboratorio relativamente allo scopo riportato nelle schede allegate al presente certificato. Le schede possono variare nel tempo. I requisiti gestionali della ISO/IEC 17025:2005 (sezione 4) sono scritti in un linguaggio idoneo all'attività dei Laboratori di Prova, sono conformi ai principi della ISO 9001:2008 ed allineati con i suoi requisiti applicabili.
Il presente certificato non è da ritenersi valido se non accompagnato dalle schede allegate e può essere sospeso o revocato in qualsiasi momento nel caso di inadempienza accertata da parte di ACCREDIA.
La vigenza dell'accreditamento può essere verificata sul sito WEB (www.accredia.it) o richiesta direttamente ai singoli Dipartimenti .

The accreditation certifies the technical competence of the laboratory limited to the scope detailed in the attached Enclosure. The scope may vary in the time. The management system requirements in ISO/IEC 17025:2005 (Section 4) are written in a language relevant to Testing Laboratories operations and meet the principles of ISO 9001:2008 and are aligned with its pertinent requirements.
The present certificate is valid only if associated to the annexed schedule, and can be suspended or withdrawn at any time in the event of non fulfilment as ascertained by ACCREDIA.
The in force status of the accreditation may be checked in the WEB site (www.accredia.it) or on direct request to appointed Department.

Data di 1ª emissione *1st issue date*	Data di modifica *Modification date*	Data di scadenza *Expiring date*
1999-07-08	**2015-07-16**	**2019-07-11**

Il Direttore Generale
The General Director
(Dr. Filippo Trifiletti)

Il Direttore di Dipartimento
Department Director
(Dr.ssa Silvia Tramontin)

Il Presidente
The President
(Ing. Giuseppe Rossi)

Sede operativa e legale: Via Guglielmo Saliceto, 7/9 | 00161 Roma - Italy | Tel. +39 06 8440991 | Fax +39 06 8841199
info@accredia.it | www.accredia.it | Partita IVA - Codice Fiscale 10566361001

ВЯРНО С ОРИГИНАЛА

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of
EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests that the testing laboratory

PEHLA GbR
PEHLA-Prüffeld Ratingen
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the notice of accreditation of 2012-05-09 with the accreditation number D-PL-12072-06 and is valid until 2017-05-08. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: **D-PL-12072-06-01**

Frankfurt am Main, 2012-05-09

Dipl.-Ing. (FH) Ralf Egner
Head of Division 2

This document is a translation. The definitive version is the original German accreditation certificate.

See notes overleaf.

ВЯРНО С ОРИГИНАЛА

Deutsche Akkreditierungsstelle GmbH

Office Berlin
Spittelmarkt 10
10117 Berlin

Office Frankfurt am Main
Gartenstraße 6
60594 Frankfurt am Main

Office Braunschweig
Bundesallee 100
38116 Braunschweig

The accreditation was granted pursuant to the Act on the Accreditation Body (AkkStelleG) of 31 July 2009 (Federal Law Gazette I p. 2625) and the Regulation (EC) No 765/2008 of the European Parliament and of the Council of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products (Official Journal of the European Union L 218 of 9 July 2008, p. 30). DAkkS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Forum (IAF) and International Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations.

The up-to-date state of membership can be retrieved from the following websites:
EA: www.european-accreditation.org
ILAC: www.ilac.org
IAF: www.iaf.nu

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

Accreditamento n° / *Accreditation n°* **0030** Rev. **2**

Si dichiara che / *We declare that* **CESI S.p.A.**
Sede/Headquarters:
Via Rubattino 54 - 20134 Milano MI

è conforme ai requisiti della norma / *meets the requirements of the standard* UNI CEI EN ISO/IEC 17025:2005 "Requisiti generali per la competenza dei Laboratori di prova e taratura" / *EN ISO/IEC 17025:2005 "General Requirements for the Competence of Testing and Calibration Laboratories" standard*

quale / *as* **Laboratorio di Prova** / ***Testing Laboratory***

L'accreditamento attesta la competenza tecnica del Laboratorio relativamente allo scopo riportato nelle schede allegate al presente certificato. Le schede possono variare nel tempo. I requisiti gestionali della ISO/IEC 17025:2005 (sezione 4) sono scritti in un linguaggio idoneo all'attività dei Laboratori di Prova, sono conformi ai principi della ISO 9001:2008 ed allineati con i suoi requisiti applicabili.
Il presente certificato non è da ritenersi valido se non accompagnato dalle schede allegate e può essere sospeso o revocato in qualsiasi momento nel caso di inadempienza accertata da parte di ACCREDIA.
La vigenza dell'accreditamento può essere verificata sul sito WEB (www.accredia.it) o richiesta direttamente ai singoli Dipartimenti .

The accreditation certifies the technical competence of the laboratory limited to the scope detailed in the attached Enclosure. The scope may vary in the time. The management system requirements in ISO/IEC 17025:2005 (Section 4) are written in a language relevant to Testing Laboratories operations and meet the principles of ISO 9001:2008 and are aligned with its pertinent requirements.
The present certificate is valid only if associated to the annexed schedule, and can be suspended or withdrawn at any time in the event of non fulfilment as ascertained by ACCREDIA.
The in force status of the accreditation may be checked in the WEB site (www.accredia.it) or on direct request to appointed Department.

Data di 1ª emissione *1st issue date* **1992-02-27**	Data di modifica *Modification date* **2016-04-14**	Data di scadenza *Expiring date* **2020-03-09**
Il Direttore Generale *The General Director* (Dr. Filippo Trifiletti)	Il Direttore di Dipartimento *Department Director* (Dr.ssa Silvia Tramontin)	Il Presidente *The President* (Ing. Giuseppe Rossi)

ACCREDIA
Sede operativa e legale: Via Guglielmo Saliceto, 7/9 | 00161 Roma - Italy | Tel. +39 06 8440991 | Fax +39 06 8841199
info@accredia.it | www.accredia.it | Partita IVA - Codice Fiscale 10566361001

ВЯРНО С ОРИГИНАЛА

ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

CERTIFICATO DI ACCREDITAMENTO
Accreditation Certificate

Accreditamento n°
Accreditation n° **0030** Rev. **2**

Si dichiara che
We declare that

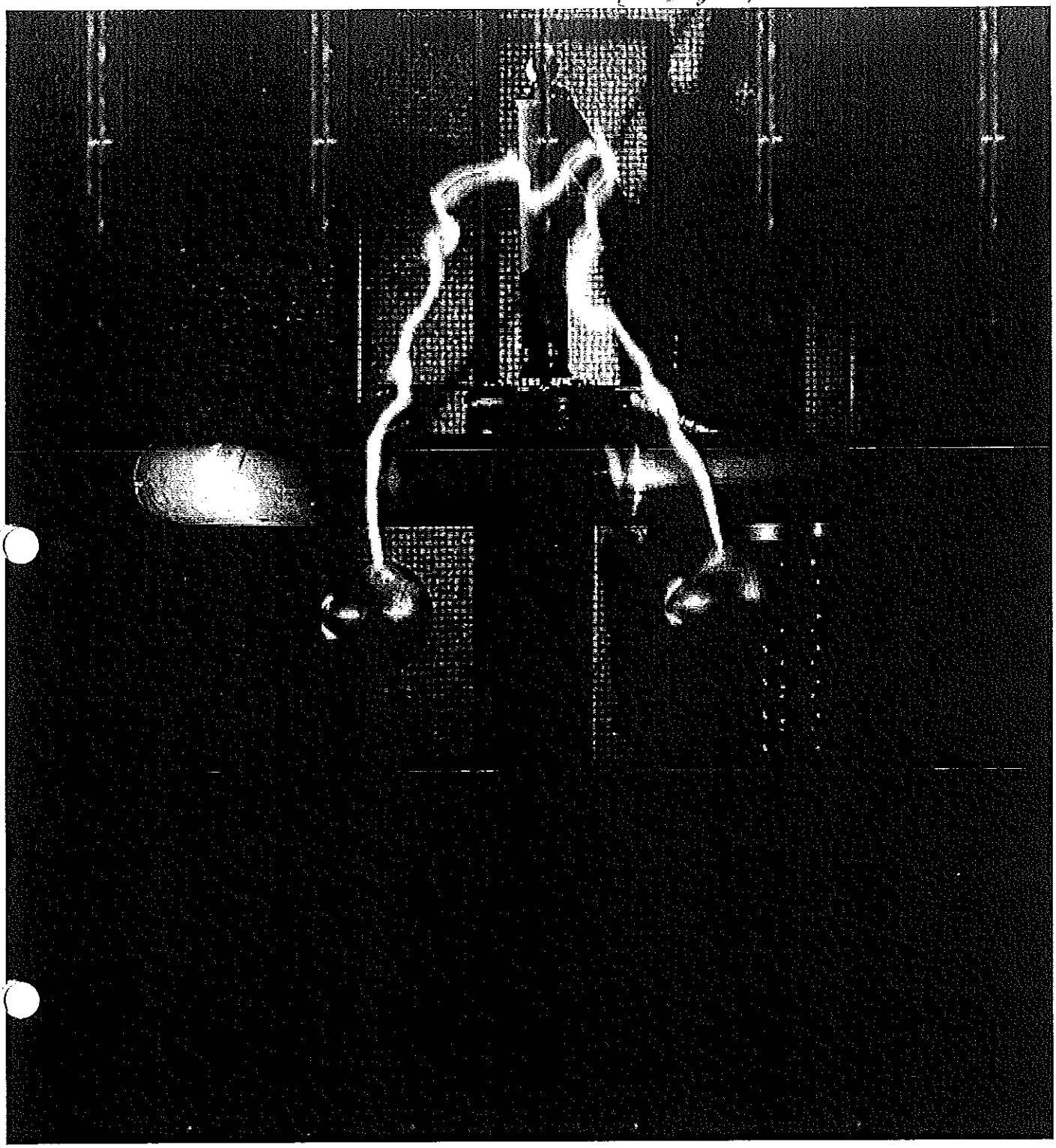
Sedi operative:

CESI S.p.A.
Via Rubattino 54
20134 Milano MI
CESI S.p.A. - Sede di Piacenza
Via Nino Bixio 39
29100 Piacenza PC
CESI S.p.A. - Sede di Seriate
Via Pastrengo 9
24068 Seriate BG

Sede operativa e legale: Via Guglielmo Saliceto, 7/9 | 00161 Roma - Italy | Tel. +39 06 8440991 | Fax +39 06 8841199
info@accredia.it | www.accredia.it | Partita IVA - Codice Fiscale 10566361001

ВЯРНО С ОРИГИНАЛА

652



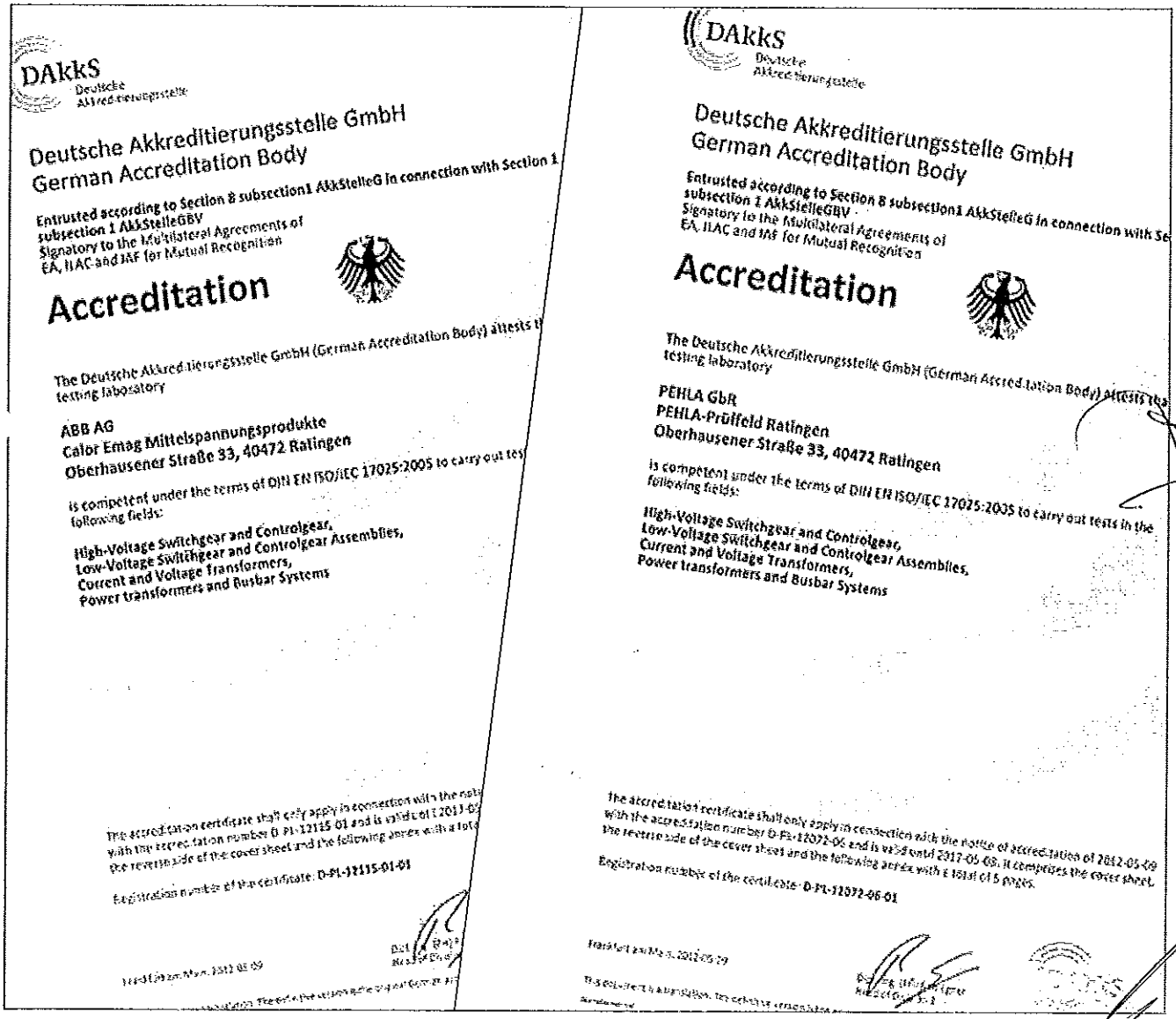
Power and productivity
for a better world™

ABB

ВЯРНО С ОРИГИНАЛА

Introducing Laboratories Ratingen

Since 1954, the laboratories of ABB AG – Calor Emag Medium Voltage Products have performed tests on medium voltage equipment. Our laboratories, which are located in Ratingen, Germany, contain all the facilities necessary for tests in the medium voltage range.
The ABB Laboratories Ratingen and PEHLA Testing Laboratories Ratingen are accredited by the German Accreditation Authority (DAkkS). As a shareholder of PEHLA GbR we are also a member laboratory of the Short-circuit Testing Liaison. We provide our customers with high performance and independent testing carried out in accordance with customer requirements or national and international standards.



DAkkS
Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests the testing laboratory

ABB AG
Calor Emag Mittelspannungsprodukte
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the notice of accreditation of 2012-05-09 with the accreditation number D-PL-12115-01-01 and is valid until 2017-05-08. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: D-PL-12115-01-01

DAkkS
Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH
German Accreditation Body

Entrusted according to Section 8 subsection1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV
Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition

Accreditation

The Deutsche Akkreditierungsstelle GmbH (German Accreditation Body) attests the testing laboratory

PEHLA GbR
PEHLA-Prüffeld Ratingen
Oberhausener Straße 33, 40472 Ratingen

is competent under the terms of DIN EN ISO/IEC 17025:2005 to carry out tests in the following fields:

High-Voltage Switchgear and Controlgear,
Low-Voltage Switchgear and Controlgear Assemblies,
Current and Voltage Transformers,
Power transformers and Busbar Systems

The accreditation certificate shall only apply in connection with the notice of accreditation of 2012-05-09 with the accreditation number D-PL-12072-06-01 and is valid until 2017-05-08. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 5 pages.

Registration number of the certificate: D-PL-12072-06-01

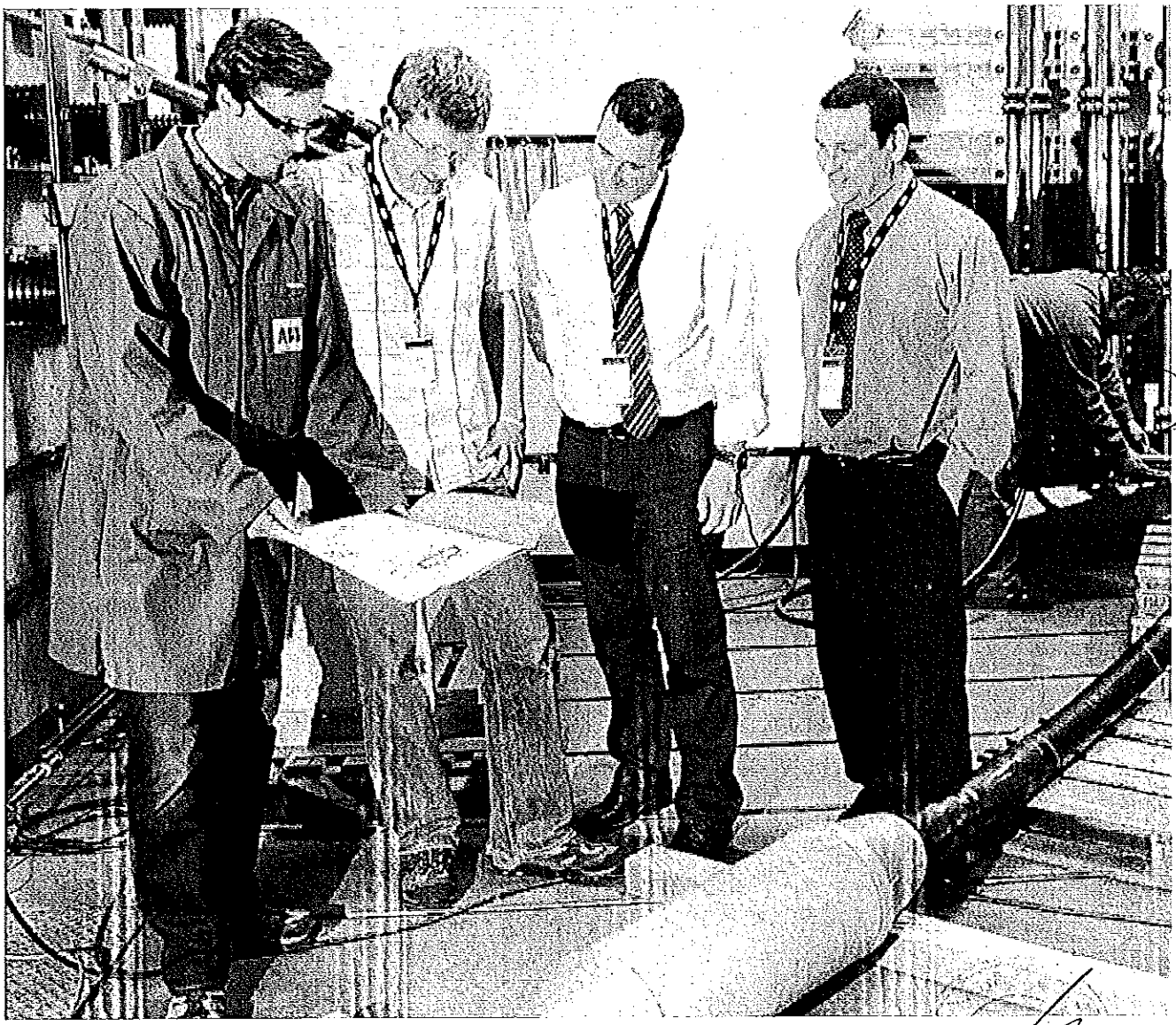
ВЯРНО С ОРИГИНАЛА

Why testing at Laboratories Ratingen?

With 60 years of experience we know how to perform tests professionally. Starting with the planning and preparation phase we cooperate closely with our customers in order to ensure an optimal testing. Our organization provides flexible planning which ensures short-term reservation.
When testing at the Laboratories Ratingen our customers may choose to either prepare the test objects on their own or make use of our assembly and installation service. By request an on-site testing can be performed in the customer's facilities. All test results will be evaluated by our team of highly qualified and experienced experts in close cooperation with the customers.
Our laboratories are equipped with a SF_6 module to handle and recycle the gas for environmental safety. The accreditation as ABB Laboratories Ratingen and as PEHLA Testing Laboratories Ratingen ensures that all tests are fully independent.

Services we provide:

- On-site testing and diagnostics with mobile test equipment
- Independent witnessing of tests
- Inspections, examinations and diagnostics
- Manufacturing of prototypes and individual parts
- Assembly of prototypes and test objects
- Assembly and installation work
- Calibration of electrical and mechanical measuring equipment



Our documentation to the customers

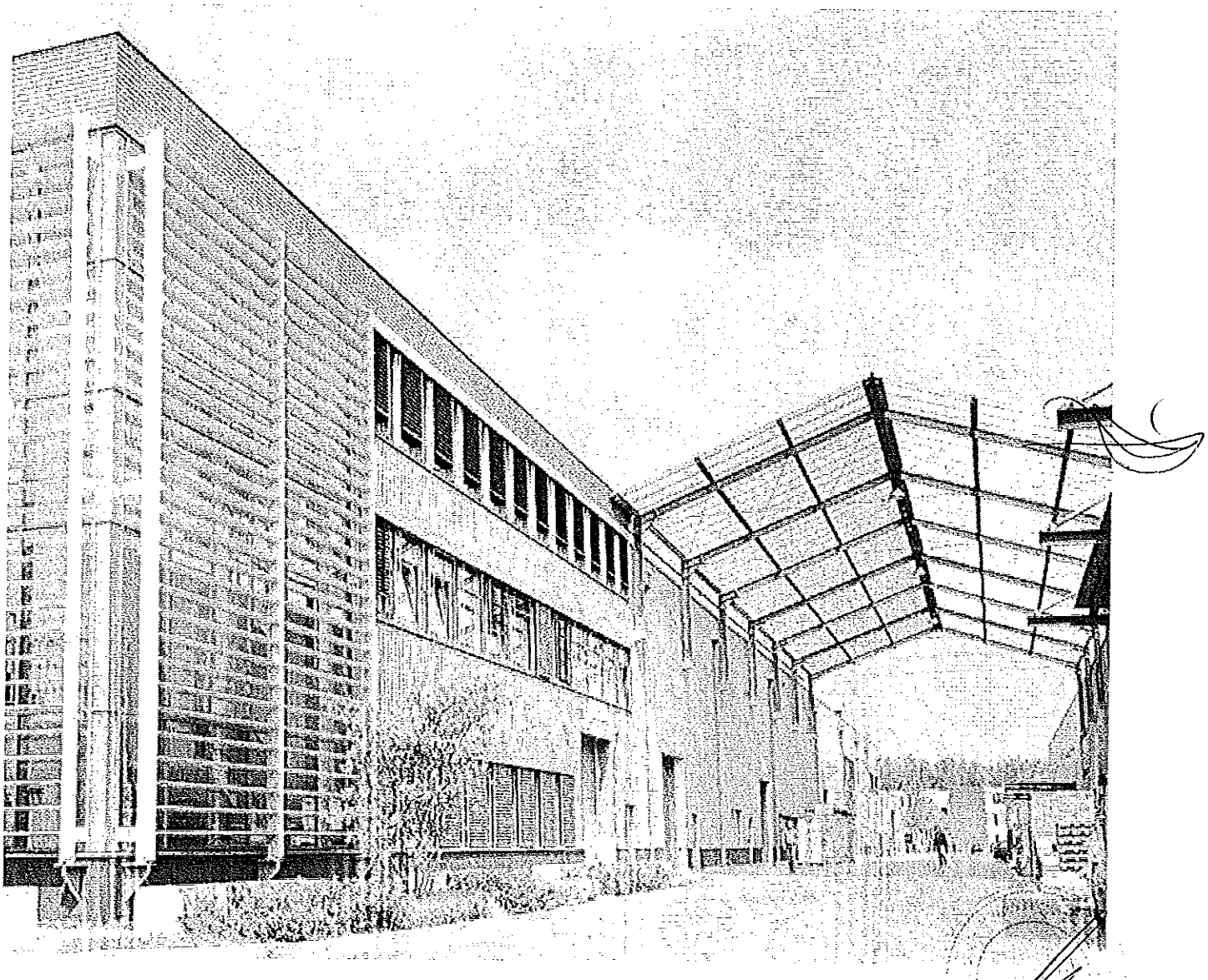
When testing at Laboratories Ratingen different types of documentation can be issued.

Type test certificate
A type test certificate is issued for type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of the test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

Test document
A test document is issued for parts of type tests which have successfully been carried out in full compliance with the relevant specifications or standards and STL Guides valid at the time of test. For these tests the test object must be clearly identified by technical description, drawings and additional specifications.

Test report
A test report is issued for all other tests which have been carried out according to specifications, standards or "PEHLA-Richtlinien" (PEHLA Guides) and/or clients' instructions. Similarly, this test report contains all test results, details of the conditions under which the tests were carried out, also details relating to the behaviour of the test object, and its condition after the tests.

Test confirmation
A test confirmation is issued immediately after the tests. It confirms that the tests have been conducted and is valid only until publishing the detailed results in an entire document.



Development tests, type tests or acceptance tests

Laboratories Ratingen are able to offer any kind of test your company needs.

The laboratories are fully equipped to perform complete type tests on medium voltage equipment with state-of-the-art technology. All tests can be carried out as ABB tests or as PEHLA tests.

Tests we provide

- Type tests
- Development tests
- Acceptance tests (also in other test laboratories)
- Certification tests

Our test portfolio:

Tests \ Products	MV circuit-breaker	Metal enclosed switchgear	Power transformer	Disconnector & earthing switch	Switch fuse unit	Earthig facility	Bushing	Instrument transformer	Fuse	Cable accessory	Auxiliary circuit	Substation
Making and Breaking test	●	●		●	●				●		●	●
STC test	●	●	●	●		●	●	●		●	●	●
Internal arc test		●										●
Capacitive switching test	●			●								
Temperature rise test	●	●		●	●	●	●	●	●	●	●	●
Climatic test	●	●	●	●	●	●	●	●	●	●	●	
Dielectric test	●	●		●	●	●	●	●	●	●	●	●
IP/IK-coding test	●	●										●
Partial discharge test	●	●		●	●	●	●	●		●		●
Mechanical operation test	●	●		●	●						●	
Mechanical endurance test	●			●	●						●	
High and low temperature test	●	●		●			●		●		●	
Tightness test	●	●		●			●					
Pressure test	●	●		●								

● Tests at Ratingen possible ☐ Tests not applicable to this product

ВЯРНО С ОРИГИНАЛА

Overview of standards

High-voltage switchgear and controlgear	IEC 62271-1	IEC 62271-100	IEC 62271-102
	IEC 62271-103	IEC 62271-104	IEC 62271-105
	IEC 62271-106	IEC 62271-110	IEC 62271-111
	IEC 62271-200	IEC 62271-201	IEC 62271-202
	IEC 62271-203	IEC 62271-304	IEC 60529
High-voltage test techniques	IEC 60060-1	IEC 60060-2	IEC 60270
Power transformers	IEC 60076-5	IEC 60076-11	
High-voltage fuses	IEC 60282-1	IEC 60282-2	
Bushings	IEC 60137		
Insulators	IEC 60660		
Instrument transformers	IEC 61869-1	IEC 61869-2	IEC 61869-3
Live working	IEC 60832-1	IEC 60832-2	IEC 61230
Low-voltage switchgear and controlgear	IEC 60947-1	IEC 60947-2	IEC 60947-3
ANSI / IEEE	IEEE C37.04 ANSI C37.54	ANSI C37.06 IEEE C37.60	IEEE C37.09

Other standards on request.

Testing facilities

The Laboratories Ratingen are coordinating tests very well even if different kind of tests in more than one laboratory are required. Customers, who need various tests, can therefore rely on well-organized test procedures – quickly and at fair conditions.

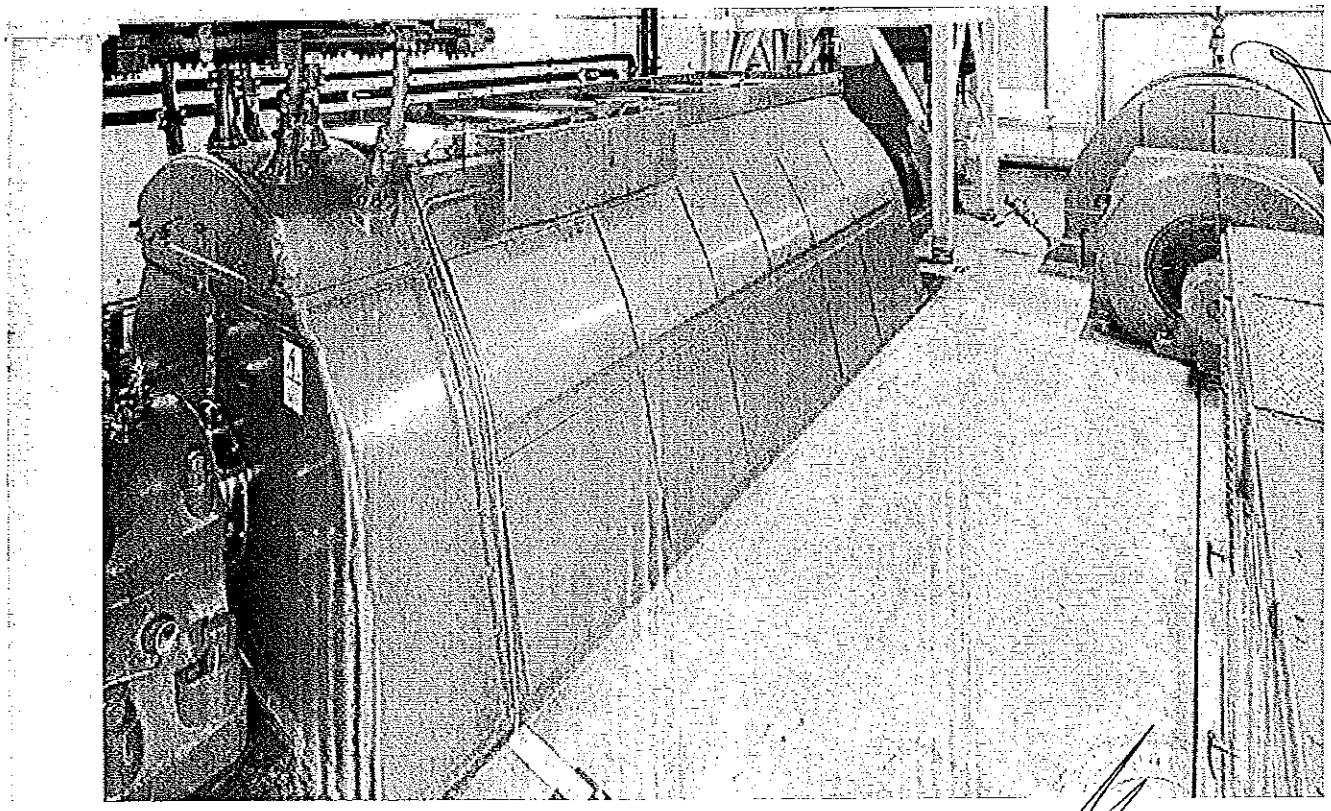
High-power testing laboratory
The high power testing laboratory is equipped with a 2800 MVA short-circuit test generator and oil-insulated power transformers and is therefore able to perform making and breaking tests at several voltage- and short-circuit current levels.

A special dry-type power transformer is available to perform peak-withstand current- and short-time withstand current test up to 250 kA and 100 kA r.m.s for three seconds.

Inside the room simulation of the arcing test bay, internal arcing tests can be performed for switchgear, containers or even substations.

A capacitor bank allows to perform different capacitive tests (e.g. line- or cable-charging current switching tests, back-to-back- and single-capacitor-bank current switching tests).

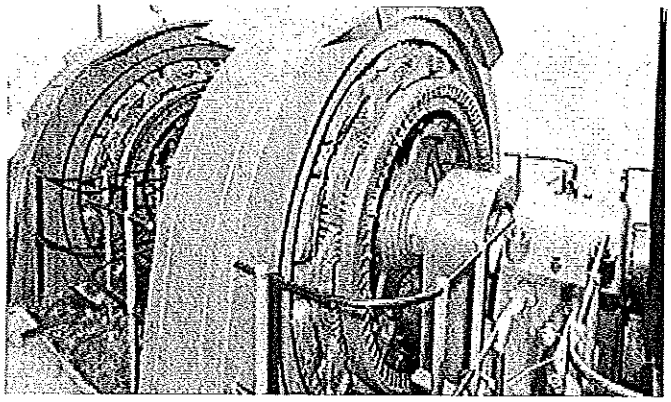
With the miscellaneous equipment like different reactors and resistors, measurement equipment etc., it is possible to perform a wide range of load current switching tests as well.

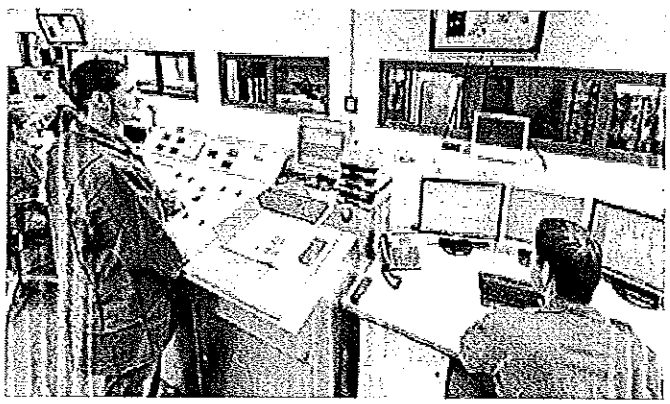


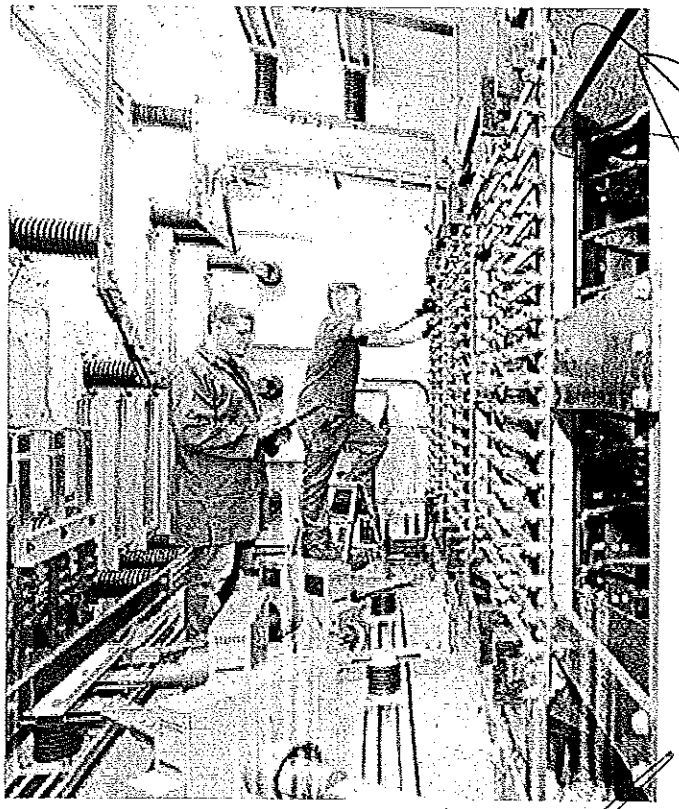
Testing facilities

The tests, which can be performed at our high power testing laboratory, are:

- Short-circuit making and breaking capacity test
  up to
  - 50 kA at 12 kV
  - 31.5 kA at 17.5 kV
  - 25 kA at 24 kV
  - 16 kA at 40.5 kV
- Switching capacity test
  Load currents
  - Capacitive
  - Inductive
  - Ohmic
  - Inductive-ohmic
- Peak withstand current test
  - Up to 250 kA
- Short-time withstand current test
  - Up to 100 kA and up to 3s (4s)
- Internal arc fault test
  - Up to 50 kA
- Different tests
  - beyond the standards according to client's instructions



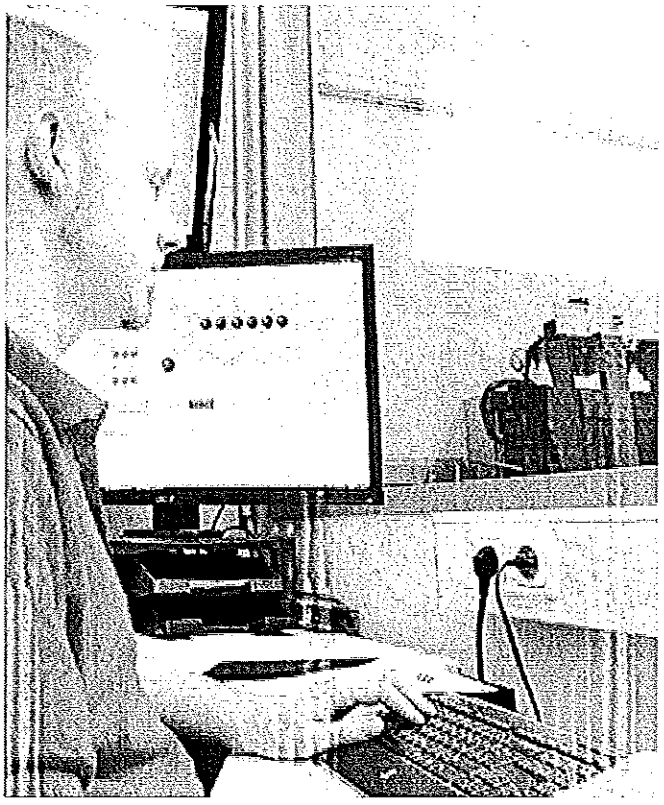


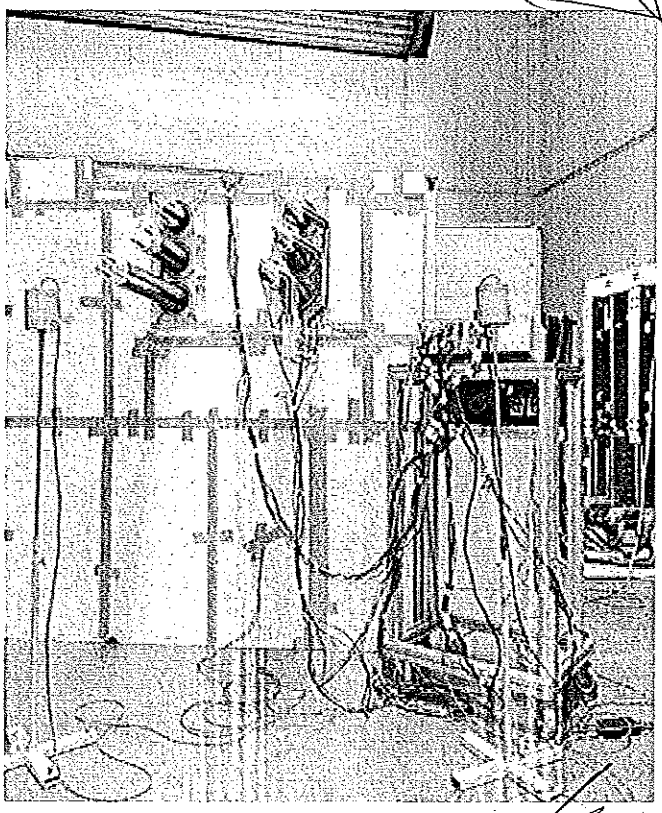


Temperature-rise testing laboratory
The temperature-rise testing laboratory is suited to perform tests with a continuous current up to 5000 A on switchgear and switching devices. Through automated and computer controlled tests we use our recourses in the most efficient and effective way. Therefore we can offer precise, reliable and quick tests during day and night-time to our customers.

During the test, currents and temperatures are checked every 10 minutes. Shorter measurement intervals for currents and temperatures are possible. A control circuit guarantees a constant three-phase current through the entire test. The test is automatically stopped if a temperature limit is exceeded or the test duration is over.

- Temperature-rise tests
  - Up to 180 measuring points can be connected
  - Single-phase and three-phase
    - Up to 5000 A at 50 Hz
    - Up to 4000 A at 60 Hz
- Additionally we can offer
  - Magnetic field measurement
  - Thermal imaging





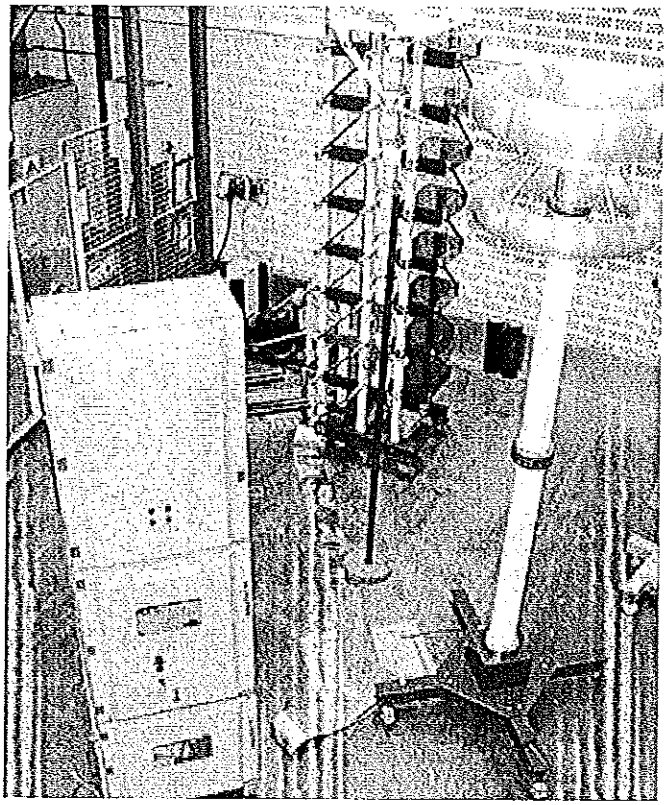
Testing facilities

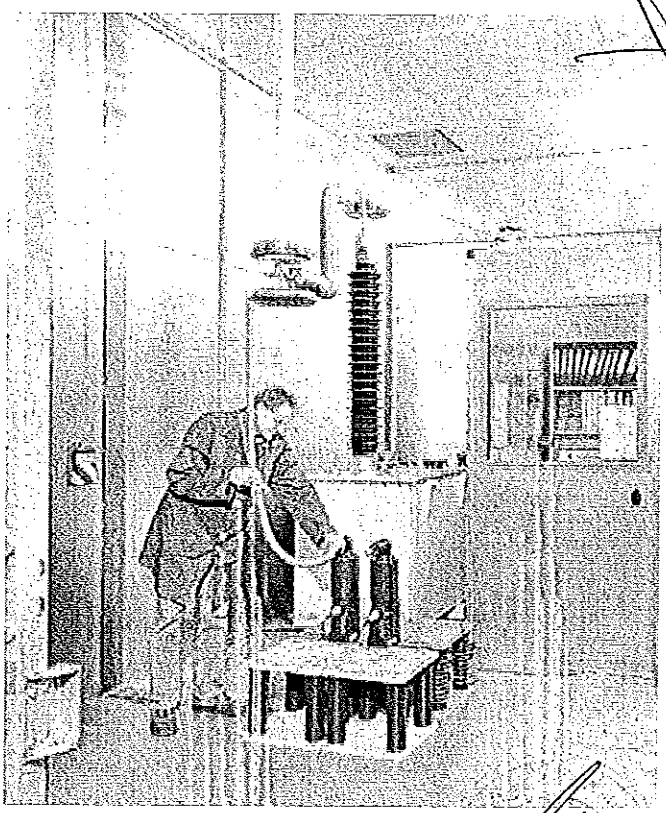
High-voltage testing laboratory
With the test facilities in our high voltage testing laboratory all dielectric and partial discharge tests for medium voltage equipment can be carried out. For sensitive partial discharge tests a special test chamber is available with a background level < 1 pC.

In order to offer on-site testing the high-voltage laboratory has mobile test equipment.

The high-voltage testing laboratory performs the following tests:

- Standard lightning impulse voltage tests
  - Up to 800 kV
- Power-frequency voltage tests
  - Stationary up to 260 kV
  - Mobile up to 230 kV
- Partial discharge tests
  - Stationary up to 150 kV
  - Mobile up to 230 kV
- Degree of protection tests
- Tests on auxiliary and control circuits





Mechanical testing laboratory
The mechanical testing laboratory offers different functional, environmental and material tests especially on medium and low voltage equipment and their components.

The functional tests include endurance tests on switching devices, kinematic chain tests and function tests on any kind of interlocking or control system. For long-duration tests automatic control and monitoring systems are available to supervise various signals for diagnostics.

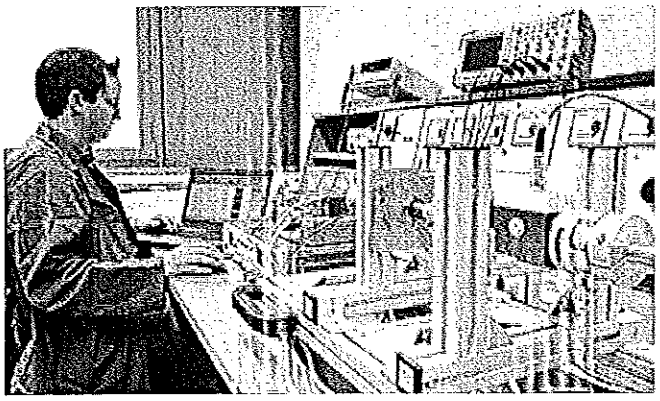
A wide range of measurement equipment is able to record via special sensors many additional data for detailed investigation of the test objects characteristics, like travels, rotation angles, forces, torques, pressures, temperatures, binary signal states and gas densities.

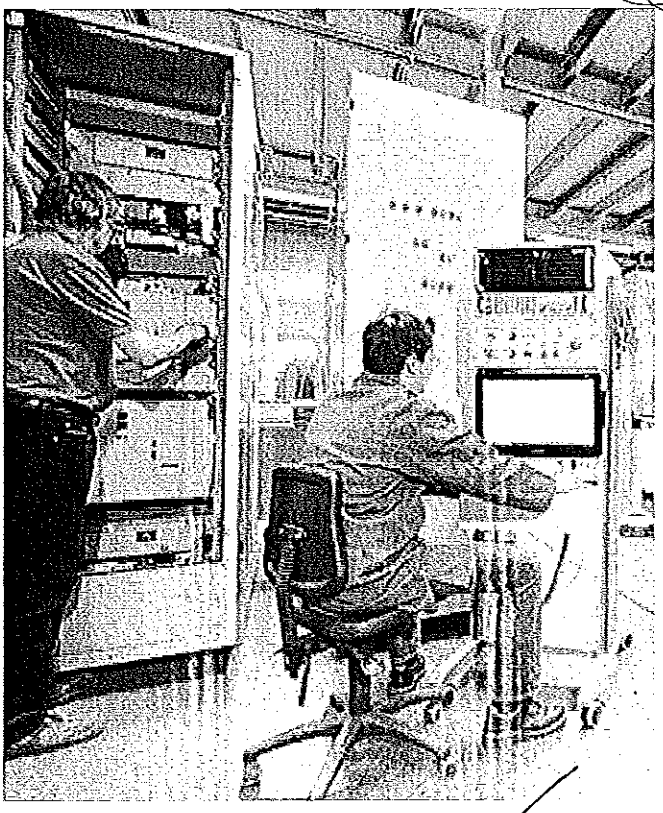
For gas-filled equipment we offer additionally gas-tightness and pressure withstand tests.

The environmental tests combine the above mentioned measurements and functional tests with special conditions during storage and/or operation like extreme temperatures, humidity, vibrations, inclination and other impacts.

Material testing concentrates on load tests like tensile, compression, mechanical impact IK-coding, torsion and bending tests.

High-speed video recording can be used for visual examination of very fast processes (up to 10,000 pic./s).





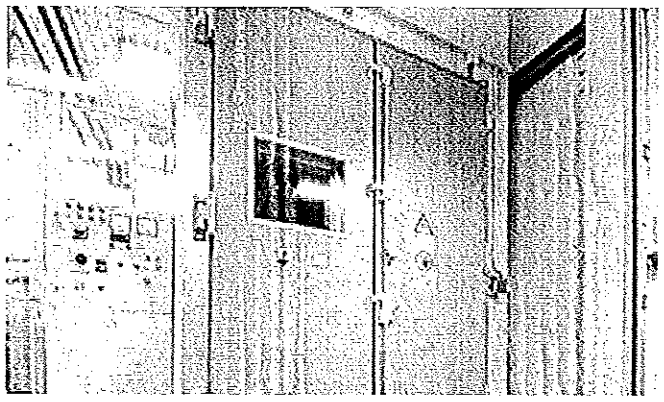
Testing facilities

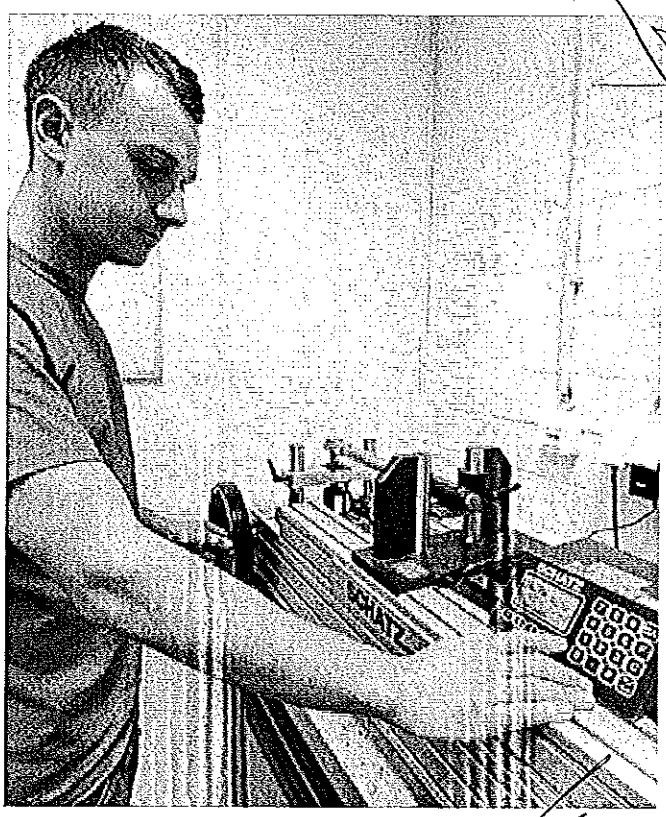
Material testing laboratory
In this laboratory various climatic tests on materials, components and complete medium voltage switchgear panels can be carried out.

The testing facilities include two accessible climatic / thermo chambers. The main tests offered by the material testing laboratory are:

- Temperature tests
  - Range: -70 °C to +150 °C
  - Test voltage: 95 kV (1-phase)
- Climatic tests
  - Temperature range: +20 °C to +90 °C
  - Humidity range: 10 - 98 %
  - Test voltage: 95 kV (1-phase)
- Corrosion tests
  - Salt fog tests
  - Fog tests with sulfur dioxide
  - Tests with condensed water containing climate

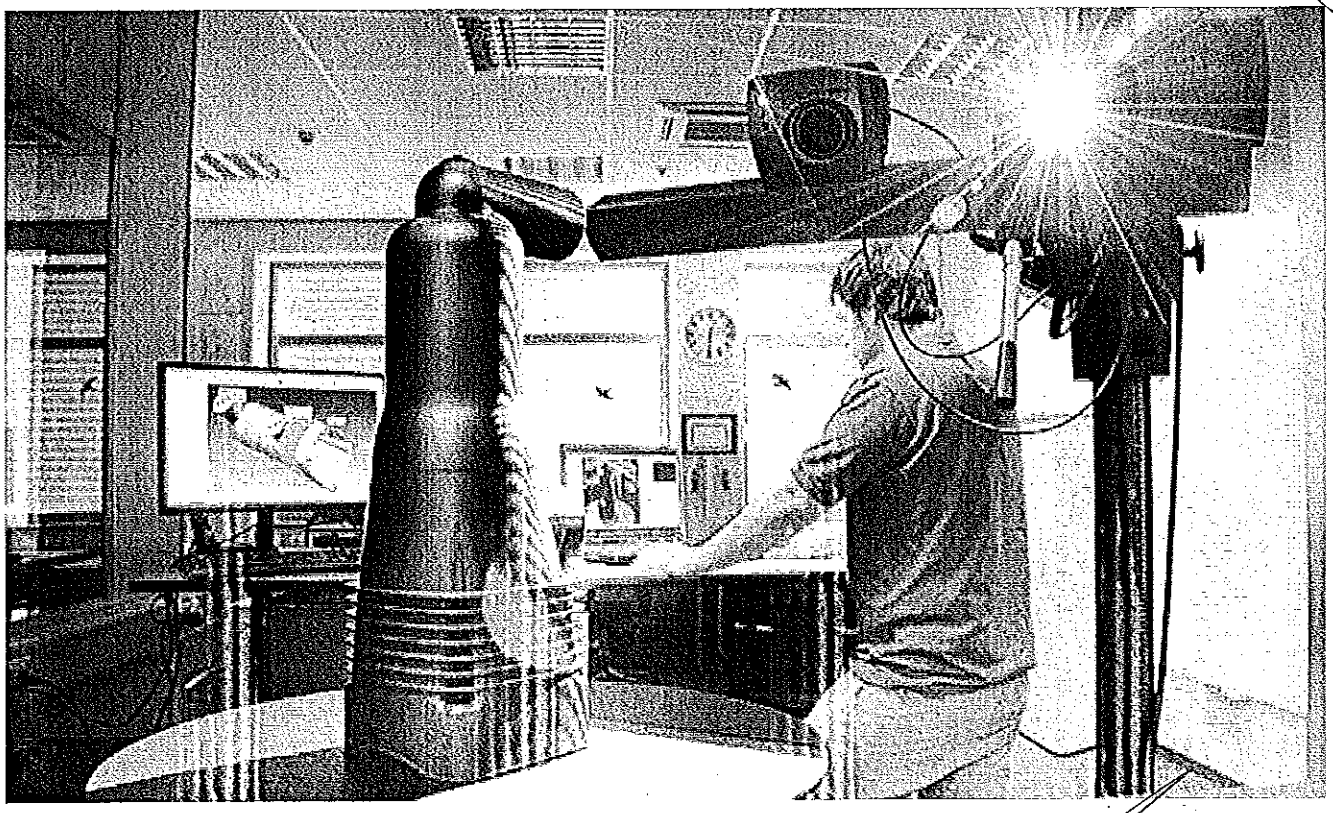
Calibration service
At the calibration laboratory we are able to calibrate electrical measurement instruments, force measurement instruments, length measurement equipment, torque wrenches and pressure gas equipment.





Initial sampling inspection
Objects with different size can be digitized with top-quality by 3D-scanning.

The 3D scanner will also be used for
- Quality checks
  - Comparison of nominal/actual measurement data according to CAD data set
  - Measurement of form and position tolerances without complex construction
  - Measurement of free formed surfaces
  - Serial measurement for quality checks, process safety
- Toolroom
  - Generation of drawings for CAD system derives from scan process
  - Check of initial batches

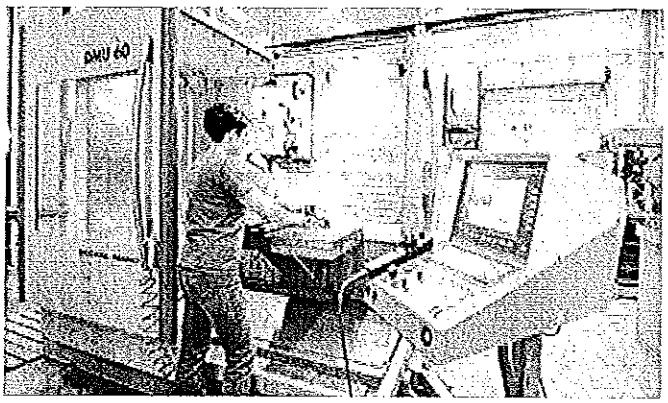


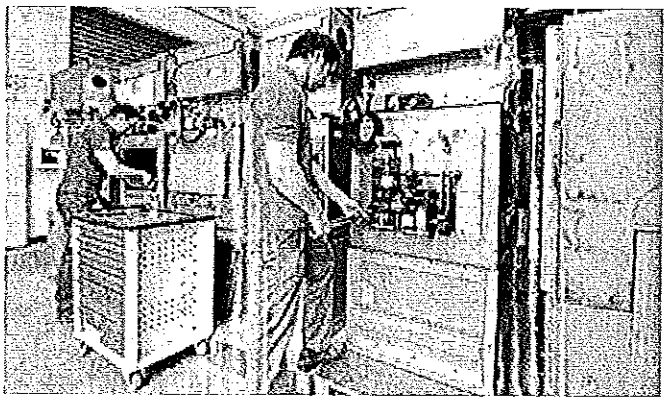
Workshop of the Laboratories

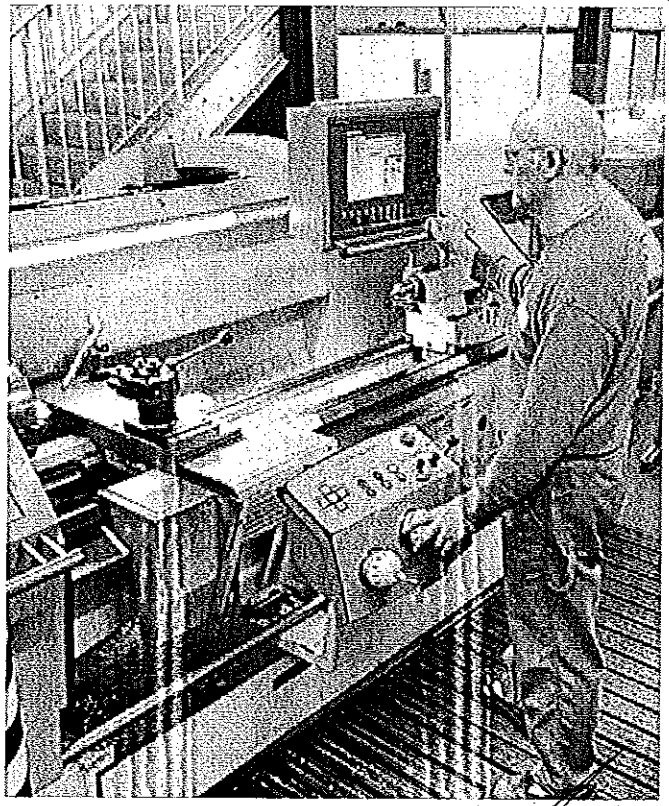
The workshop manufactures prototypes and test arrangements as well as provides complete assembly and installation service in connection with tests.

If defects occur during tests our workshop offers immediate repair service and manufacturing of spare parts.

In order to offer optimal service the workshop is fully equipped for all kind of metal processing.







Contacts at the Laboratories Ratingen

If you need more information on Laboratories Ratingen or if you would like to make reservations for a test please contact:

General manager
Dr. Stefan Göttlich
Phone: +49 2102 12-1736
Fax: +49 2102 12-1713
E-Mail: stefan.goettlich@de.abb.com

Manager of high-power testing laboratory
Dr. Martin Wember
Phone: +49 2102 12-1353
Fax: +49 2102 12-1713
E-Mail: martin.wember@de.abb.com

Manager of temperature-rise, material testing and calibration laboratory
Claus Loquingen
Phone: +49 2102 12-1372
Fax: +49 2102 12-1713
E-Mail: claus.loquingen@de.abb.com

Manager of high-voltage testing laboratory
Ralf Hutmacher
Phone: +49 2102 12-1968
Fax: +49 2102 12-1713
E-Mail: ralf.hutmacher@de.abb.com

Manager of mechanical testing and electronic laboratory
Michael Schöttler
Phone: +49 2102 12-1703
Fax: +49 2102 12-1713
E-Mail: michael.schoettler@de.abb.com

Manager of workshop
Reiner Huhle
Phone: +49 2102 12-1277
Fax: +49 2102 12-1713
E-Mail: reiner.huhle@de.abb.com

Contact

ABB AG
Calor Emag Medium Voltage Products
Oberhausener Strasse 33
40472 Ratingen, Germany
Phone: +49 2102 12-0
Fax: +49 2102 12-17 77
E-Mail: powertech@de.abb.com

www.abb.com/laboratories-ratingen

DEABB 2497 13 gb Printed in Germany (08.13-1000-AMC)

Power and productivity
for a better world™

DAkkS
Deutsche
Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Anlage zur Akkreditierungsurkunde D-PL-12115-01-00 nach DIN EN ISO/IEC 17025:2005

Gültigkeitsdauer: 20.04.2017 bis 19.04.2022 Ausstellungsdatum: 20.04.2017

Urkundeninhaber:

ABB AG
Kallstater Str. 1, 68309 Mannheim

Standort:
ABB AG
Calor Emag Mittelspannungsprodukte
Oberhausener Straße 33, 40472 Ratingen

Prüfungen in den Bereichen:

Geräte und Anlagen der Nieder-, Mittel- und Hochspannung

Dem Prüflaboratorium ist, ohne dass es einer vorherigen Information und Zustimmung der DAkkS bedarf, die Anwendung der hier aufgeführten genormten oder ihnen gleichzusetzenden Prüfverfahren mit unterschiedlichen Ausgabeständen gestattet.

Das Prüflaboratorium verfügt über eine aktuelle Liste aller Prüfverfahren im flexiblen Akkreditierungsbereich.

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61869-1 VDE 0414-9-1: April 2010 IEC 61869-1 Edition 1.0, 2007-10	Messwandler – Teil 1: Allgemeine Anforderungen (IEC 61869-1:2007, modifiziert); Deutsche Fassung EN 61869-1:2009 Instrument transformers – Part 1: General requirements (IEC 61869-1:2007, modified); German version EN 61869-1:2009	

ВЯРНО С ОРИГИНАЛА

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61869-2 VDE 0414-9-2: 2013-07 + DIN EN 61869-2 Berichtigung 1: 2014-06; VDE 0414-9-2 Berichigung 1: 2014-06 IEC 61869-2 Edition 1.0, 2012-09	Messwandler – Teil 2: Zusätzliche Anforderungen für Stromwandler (IEC 61869-2:2012); Deutsche Fassung EN 61869-2:2012 Instrument transformers – Part 2: Additional requirements for current transformers (IEC 61869-2:2012); German version EN 61869-2:2012	
Elektrotechnik	DIN EN 61869-3 (VDE 0414-9-3): Mai 2012 IEC 61869-3 Edition 1.0, 2011-07	Messwandler – Teil 3: Zusätzliche Anforderungen für induktive Spannungswandler (IEC 61869-3:2011); Deutsche Fassung EN 61869-3:2011 Instrument transformers – Part 3: Additional requirements for inductive voltage transformers (IEC 61869-3:2011); German version EN 61869-3:2011	
Elektrotechnik	DIN EN 61869-4 VDE 0414-9-4: April 2015 IEC 61869-4 Edition 1.0, 2013-11	Messwandler - Teil 4: Zusätzliche Anforderungen für kombinierte Wandler (IEC 61869-4:2013) Deutsche Fassung EN 61869-4:2014 Instrument transformers - Part 4: Additional requirements for combined transformers German version EN 61869-4:2014	
Elektrotechnik	DIN EN 61869-5 (VDE 0414-9-5) Mai 2012 IEC 61869-5 Edition 1.0, 2011-07	Messwandler - Teil 5: Zusätzliche Anforderungen für kapazitive Spannungswandler (IEC 61869-5:2011); Deutsche Fassung EN 61869-5:2011 Instrument transformers – Part 5: Additional requirements for capacitor voltage transformers (IEC 61869-5:2011); German version EN 61869-5:2011	

ВЯРНО С ОРИГИНАЛА

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60060-1 (VDE 0432-1) Oktober 2011 IEC 60060-1 Edition 3.0, 2010-09	Hochspannungs-Prüftechnik – Teil 1: Allgemeine Begriffe und Prüfbedingungen (IEC 60060-1:2010); Deutsche Fassung EN 60060-1:2010 High-voltage test techniques – Part 1: General definitions and test requirements (IEC 60060-1:2010); German version EN 60060-1:2010	
Elektrotechnik	DIN EN 60060-2 (VDE 0432-2) Oktober 2011 IEC 60060-2 Edition 3.0, 2010-11	Hochspannungs-Prüftechnik – Teil 2: Messsysteme (IEC 60060-2:2010); Deutsche Fassung EN 60060-2:2011 High-voltage test techniques – Part 2: Measuring systems (IEC 60060-2:2010); German version EN 60060-2:2011	(without annex A) (ohne Anhang A)
Elektrotechnik	DIN EN 60076-5 (VDE 0532-76-5) Januar 2007 IEC 60076-5 Third Edition, 2006-02	Leistungstransformatoren – Teil 5: Kurzschlussfestigkeit (IEC 60076-5:2006); Deutsche Fassung EN 60076-5:2006 Power transformers – Part 5: Ability to withstand short-circuit (IEC 60076-5:2006); German version EN 60076-5:2006	
Elektrotechnik	DIN EN 60076-11 (VDE 0532-76-11) April 2005 IEC 60076-11 First Edition, 2004-05	Leistungstransformatoren – Teil 11: Trockentransformatoren (IEC 60076-11:2004); Deutsche Fassung EN 60076-11:2004 Power transformers – Part 11: Dry-type transformers (IEC 60076-11:2004); German version EN 60076-11:2004	
Elektrotechnik	DIN EN 60137 (VDE 0674-5) Juli 2009 IEC 60137	Isolierte Durchführungen für Wechselspannungen über 1 000 V (IEC 60137:2008); Deutsche Fassung EN 60137:2008 Insulated bushings for alternating voltages above	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
	Edition 6.0, 2008-07	1000 V (IEC 60137:2008); German version EN 60137:2008	
Elektrotechnik	DIN EN 62271-103 (VDE 0671-103) April 2012 IEC 62271-103 Edition 1.0, 2011-06	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 103: Lastschalter für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-103:2011); Deutsche Fassung EN 62271-103:2011 High-voltage switchgear and controlgear – Part 103: Switches for rated voltages above 1 kV up to and including 52 kV (IEC 62271-103:2011); German version EN 62271-103:2011	
Elektrotechnik	DIN EN 62271-104 (VDE 0671-104) November 2015 IEC 62271-104 Edition 2.0, 2015-02	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 104: Wechselstrom-Lastschalter für Bemessungsspannungen über 52 kV (IEC 62271-104:2015); Deutsche Fassung EN 62271-104:2015 High-voltage switchgear and controlgear – Part 104: Alternating current switches for rated voltages higher than 52 kV (IEC 62271-104:2015); German version EN 62271-104:2015	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60270 (VDE 0434) August 2001 + DIN EN 60270 Berichtigung 1: November 2002; VDE 0414-9-2 Berichigung 1: November 2002 IEC 60270 Third edition, 2000-12 + Amendement 1 Third edition, 2015-11	Hochspannungs-Prüftechnik Teilentladungsmessungen (IEC 60270:2000) Deutsche Fassung EN 60270:2001 High-voltage test techniques – Partial discharge measurement (IEC 60270:2000); German version EN 60270:2001	
Elektrotechnik	DIN EN 60282-1 (VDE 0670-4) August 2010 IEC 60282-1 Edition 7.1, 2014-07	Hochspannungssicherungen Teil 1: Strombegrenzende Sicherungen (IEC 60282-1:2009) Deutsche Fassung EN 60282-1:2009 High-voltage fuses – Part 1: Current-limiting fuses (IEC 60282-1:2009); German version EN 60282-1:2009	
Elektrotechnik	IEC 60282-2 Edition 3.0, 2008-04	High-voltage fuses – Part 2: Expulsion fuses	
Elektrotechnik	DIN EN 62271-106 (VDE 0671-106) Juni 2011 IEC 62271-106 Edition 1.0, 2011-08	Hochspannungs-Schaltgeräte und -Schaltanlagen – Teil 106: Wechselstrom-Schütze, Kombinationsstarter und Motorstarter mit Schützen (IEC 62271-106:2011); Deutsche Fassung EN 62271-106:2011 High-voltage switchgear and controlgear – Part 106: Alternating current contactors, contactor-based controllers and motor-starters (IEC 62271-106:2011); German version EN 62271-106:2011	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60529 (VDE 0470-1) September 2014 IEC 60529 Edition 2.2, 2013-08	Schutzarten durch Gehäuse (IP-Code) (IEC 60529:1989 + A1:1999 + A2:2013) Deutsche Fassung EN 60529:1991 + A1: 2000 + A2:2013 Degree of protection provided by enclosures (IP Code) (IEC 60529:1989 + A1:1999 + A2:2013) German version EN 60529:1991 + A1: 2000 + A2:2013	
Elektrotechnik	DIN EN 60660 (VDE 0441-3) Dezember 2000 IEC 60660 Edition 2.0, 1999-10	Isolatoren Prüfungen an Innenraum-Stützern aus organischem Werkstoff für Netze mit Nennspannungen über 1 kV bis kleiner 300 kV (IEC 60660:1999) Deutsche Fassung EN 60660:1999 Insulators – Tests on indoor post insulators of organic material for systems with nominal voltages greater than 1 kV up to but not including 300 kV (IEC 60660:1999); German version EN 60660:1999	
Elektrotechnik	DIN EN 60832-1 (VDE 0682-211) Dezember 2010 IEC 60832-1 Edition 1.0, 2010-02	Arbeiten unter Spannung – Isolierende Stangen und auswechselbare Arbeitsköpfe – Teil 1: Isolierende Stangen (IEC 60832-1:2010) Deutsche Fassung EN 60832-1:2010 + Cor.:2010 Live working - Insulating sticks and attachable devices - Part 1: Insulating sticks (IEC 60832-1:2010) German version EN 60832-1:2010 + Cor.:2010	
Elektrotechnik	DIN EN 60832-2 (VDE 0682-212) Dezember 2010 IEC 60832-2 Edition 1.0, 2010-02	Arbeiten unter Spannung – Isolierende Stangen und auswechselbare Arbeitsköpfe Teil 2: Auswechselbare Arbeitsköpfe (IEC 60832-2:2010); Deutsche Fassung EN 60832-2:2010 + Cor.:2010 Live working - Insulating sticks and attachable devices - Part 2: Attachables devices (IEC 60832-2:2010); German version EN 60832-2:2010 + Cor.:2010	

ВЯРНО С ОРИГИНАЛА

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60947-1: (VDE 0660-100) Oktober 2011	Niederspannungsschaltgeräte – Teil 1: Allgemeine Festlegungen (IEC 60947-1:2007 + A1:2010); Deutsche Fassung EN 60947-1:2007 + A1:2011	
	DIN EN 60947-1/A2 (VDE 0660-100/A2) Mai 2014	Niederspannungsschaltgeräte – Teil 1: Allgemeine Festlegungen (IEC 17B/1806/CDV:2013); Deutsche Fassung EN 60947-1:2007/FprA2:2013	
	IEC 60947-1 Edition 5.2 2014-09 + Amendement 1 + 2	Low-voltage switchgear and controlgear - Part 1: General rules (IEC 60947-1:2007 + A1:2010); German version EN 60947-1:2007 + A1:2011	
Elektrotechnik	DIN EN 60947-2: VDE 0660-101 Januar 2014	Niederspannungsschaltgeräte – Teil 2: Leistungsschalter (IEC 60947-2:2006 + A1:2009 + A2:2013); Deutsche Fassung EN 60947-2:2006 + A1:2009 + A2:2013	
	DIN EN 60947-2 (VDE 0660-101) März 2015	Niederspannungsschaltgeräte – Teil 2: Leistungsschalter (IEC 121A/26/CDV:2014); Deutsche Fassung FprEN 60947-2:2014	
	IEC 60947-2 Edition 5.0 2016-06	Low-voltage switchgear and controlgear – Part 2: Circuit-breakers (IEC 60947-2: 2016); German version EN 60947-2:2006 + A1:2009 + A2:2013	

ВЯРНО С ОРИГИНАЛА

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60947-3: VDE 0660-10 Dezember 2012	Niederspannungsschaltgeräte - Teil 3: Lastschalter, Trennschalter, Lasttrennschalter und Schalter-Sicherungs-Einheiten (IEC 60947-3:2008 + A1:2012); Deutsche Fassung EN 60947-3:2009 + A1:2012	
	DIN EN 60947-3 Berichtigung 1 (VDE 0660-107 Berichtigung 1) März 2015	Niederspannungsschaltgeräte – Teil 3: Lastschalter, Trennschalter, Lasttrennschalter und Schalter-Sicherungs-Einheiten (IEC 60947-3:2008 + A1:2012); Deutsche Fassung EN 60947-3:2009 + A1:2012, Berichtigung zu DIN EN 60947-3 (VDE 0660-107):2012-12; (IEC-Cor.:2013 zu IEC 60947-3:2008/A1:2012)	
	DIN EN 60947-3/A2:2015-03; VDE 0660-107/A2:2015-03	Niederspannungsschaltgeräte – Teil 3: Lastschalter, Trennschalter, Lasttrennschalter und Schalter-Sicherungs-Einheiten (IEC 121A/7/CDV:2014); Deutsche Fassung EN 60947-3:2009/FprA2:2014	
	IEC 60947-3 Edition 3.1 2012-04 + Amendement 1	Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units (IEC 60947-3:2008 + A1:2012); German version EN 60947-3:2009 + A1:2012	
Elektrotechnik	DIN EN 61230, (VDE 0683-100) Juli 2009	Ortsveränderliche Geräte zum Erden oder Erden und Kurzschließen (IEC 61230:2008); Deutsche Fassung EN 61230:2008	
	IEC 61230 Edition 2.0, 2008-07	Live working - Portable equipment for earthing or earthing and short-circuiting (IEC 61230:2008); German version EN 61230:2008	

ВЯРНО С ОРИГИНАЛА

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61869-1 VDE 0414-9-1 April 2010 IEC 61869-1 Edition 1.0, 2007-10	Messwandler Teil 1: Allgemeine Anforderungen (IEC 61869-1:2007, modifiziert); Deutsche Fassung EN 61869-1:2009 Instrument transformers - Part 1: General requirements (IEC 61869-1:2007, modified); German version EN 61869-1:2009	
Elektrotechnik	DIN EN 62271-1 VDE 0671-1 August 2009 + DIN EN 62271-1/A1 VDE 0671-1/A1 April 2012 IEC 62271 Edition 1.1, 2011-08	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 1: Gemeinsame Bestimmungen (IEC 62271-1:2007); Deutsche Fassung EN 62271-1:2008 Hochspannungs-Schaltgeräte und --Schaltanlagen Teil 1: Gemeinsame Bestimmungen (IEC 62271-1:2007/A1:2011); Deutsche Fassung EN 62271-1:2008/A1:2011 High-voltage switchgear and controlgear - Part 1: Common specifications (IEC 62271-1:2007); German version EN 62271-1:2008	
Elektrotechnik	DIN EN 62271-100 VDE 0671-100 August 2013 IEC 62271-100 Edition 2.1, 2012-09	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 100: Wechselstrom-Leistungsschalter (IEC 62271-100:2008 + A1:2012); Deutsche Fassung EN 62271-100:2009 + A1:2012 High-voltage switchgear and controlgear – Part 100: Alternating current circuit-breakers (IEC 62271-100:2008 + A1:2012); German version EN 62271-100:2009 + A1:2012	

ВЯРНО С ОРИГИНАЛА

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 62271-102 VDE 0671-102 August 2013 +	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 102: Wechselstrom-Trennschalter und -Erdungsschalter (IEC 62271-102:2001 + Corrigenda 2002 & 2003 + A1:2011); Deutsche Fassung EN 62271-102:2002 + Cor.:2008 + A1:2011	
	DIN EN 62271-102/A2 VDE 0671-102/A2 Dezember 2013	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 102: Wechselstrom-Trennschalter und -Erdungsschalter (IEC 62271-102:2001/A2:2013); Deutsche Fassung EN 62271-102:2002/A2:2013	
	IEC 62271-102 Edition 1.2, 2013-02	High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches (IEC 62271-102:2001 + Corrigenda 2002 & 2003 + A1:2011 + A2:2013); German version EN 62271-102:2002 + Cor.:2008 + A1:2011 + A2:2013	
Elektrotechnik	DIN EN 62271-105 VDE 0671-105 August 2013	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 105: Wechselstrom-Lastschalter-Sicherungs-Kombinationen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-105:2012); Deutsche Fassung EN 62271-105:2012	
	IEC 62271-105 Edition 2.0, 2012-09	High-voltage switchgear and controlgear – Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV (IEC 62271-105:2012); German version EN 62271-105:2012	
Elektrotechnik	DIN EN 62271-110 VDE 0671-110 August 2013	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 110: Schalten induktiver Lasten (IEC 62271-110:2012 + corrigendum Oct. 2012); Deutsche Fassung EN 62271-110:2012	
	IEC 62271-110 Edition 3.0, 2012-09	High-voltage switchgear and controlgear – Part 110: Inductive load switching (IEC 62271-110:2012 + corrigendum Oct. 2012); German version EN 62271-110:2012	

ВЯРНО С ОРИГИНАЛА

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	E DIN EN 62271-111 VDE 0671-111 September 2014 IEC 62271-111: 2012(E) IEEE Std C37.60- 2012(E) Edition 2.0 2012-09	Hochspannungs-Schaltgeräte -und Schaltanlagen Teil 111: Automatische Wiedereinschalter und Fehlerunterbrecher für Wechselspannungssysteme bis 38 kV (IEC 17A/1060/CD:2014) High-voltage switchgear and controlgear – Part 111: Automatic circuit reclosers and fault interrupters for alternating current systems up to 38 kV	
Elektrotechnik	DIN EN 62271-200 VDE 0671-200 August 2012 + Berichtigung 1 IEC 62271-200 Edition 2.0, 2011-10 + Corrigendum 1	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 200: Metallgekapselte Wechselstrom-Schaltanlagen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-200:2011); Deutsche Fassung EN 62271-200:2012 + Berichtigung 1:2016-01 High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV (IEC 62271-200:2011 + Corrigenda 2015); German version EN 62271-200:2012 + Berichtigung 1:2016-01	
Elektrotechnik	DIN EN 62271-201 VDE 0671-201 Juli 2007 IEC 62271-201 Edition 2.0, 2014-03	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 201: Isolierstoffgekapselte Wechselstrom-Schaltanlagen für Bemessungsspannungen über 1 kV bis einschließlich 52 kV (IEC 62271-201:2006); Deutsche Fassung EN 62271-201:2006 High-voltage switchgear and controlgear - Part 201: AC insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV (IEC 62271-201:2014);	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 62271-202 VDE 0671-202 August 2007 IEC 62271-202 Edition 2.0, 2014-03	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 202: Fabrikfertige Stationen für Hochspannung/Niederspannung (IEC 62271-202:2006); Deutsche Fassung EN 62271-202:2007 High-voltage switchgear and controlgear – Part 202: High-voltage/ low-voltage prefabricated substation (IEC 62271-202:2014);	
Elektrotechnik	DIN EN 62271-203 VDE 0671-203 November 2012 IEC 62271-203 Edition 2.0, 2011-09	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 203: Gasisolierte metallgekapselte Schaltanlagen für Bemessungsspannungen über 52 kV (IEC 62271-203:2011); Deutsche Fassung EN 62271-203:2012 High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV (IEC 62271-203:2011); German version EN 62271-203:2012	
Elektrotechnik	E DIN EN 62271-304 VDE 0671-304 April 2007 IEC/TS 62271-304 Edition 1.0, 2008-05	Zusätzliche Anforderungen an gekapselte Schaltgerätekombinationen und Hochspannungsschaltanlagen von 1 kV bis 52 kV für den Einsatz unter erschwerten klimatischen Bedingungen (IEC 17C/373/CD:2006) High-voltage switchgear and controlgear – Part 304: Design classes for indoor enclosed switchgear and controlgear for rated voltages above 1 kV up to and includuing 52 kV to be used in severe climatic conditions (IEC/TS 62271-304:2008)	

ВЯРНО С ОРИГИНАЛА

680

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	E DIN IEC 62271-37-013 VDE 0671-37-013: 2012-09 IEC/IEEE 62271-37-013 Edition 1.0, 2015-10	Hochspannungs-Schaltgeräte und -Schaltanlagen Teil 37-013: Wechselstrom-Generatorschalter (IEC 17A/993/CD:2011) High-voltage switchgear and controlgear – Part 37-013: Alternating-current generator circuit-breakers	
Elektrotechnik	DIN EN 60068-2-1 VDE 0468-2-1 Januar 2008 IEC 60068-2-1 Edition 6.0, 2007-03	Umgebungseinflüsse - Teil 2-1: Prüfverfahren - Prüfung A: Kälte (IEC 60068-2-1:2007); Deutsche Fassung EN 60068-2-1:2007 Environmental testing – Part 2-1: Tests – Test A: Cold (IEC 60068-2-1:2007); German version EN 60068-2-1:2007	
Elektrotechnik	DIN EN 60068-2-2 VDE 0468-2-2 Mai 2008 IEC 60068-2-2 Edition 5.0, 2007-07	Umgebungseinflüsse - Teil 2-2: Prüfverfahren - Prüfung B: Trockene Wärme (IEC 60068-2-2:2007); Deutsche Fassung EN 60068-2-2:2007 Environmental testing – Part 2-2: Tests – Test B: Dry heat (IEC 60068-2-2:2007) German version EN 60068-2-2:2007	
Elektrotechnik	DIN EN 60068-2-30 Juni 2006 IEC 60068-2-30 Edition 3.0, 2005-08	Umgebungseinflüsse - Teil 2-30: Prüfverfahren - Prüfung Db: Feuchte Wärme, zyklisch (12 + 12 Stunden) (IEC 60068-2-30:2005); Deutsche Fassung EN 60068-2-30:2005 Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle) (IEC 60068-2-30:2005) German version EN 60068-2-30:2005	
Elektrotechnik	IEC 62262 Edition 1.0, 2002-02	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code) German version SN EN 62262:2002	

ВЯРНО С ОРИГИНАЛА

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 60068-2-75 VDE 0468-2-75 2015-08 IEC 60068-2-75 Edition 2.0, 2014-09	Umgebungseinflüsse - Teil 2-75: Prüfungen - Prüfung Eh: Hammerprüfungen (IEC 60068-2-75:2014); Deutsche Fassung EN 60068-2-75:2014 Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests (IEC 60068-2-75:2014) German version EN 60068-2-75:2014	
Elektrotechnik	IEEE Std C37.04- 1999 June 1999	IEEE Standard Rating Structure for AC High-Voltage Circuit Breakers IEEE Std C37.04-1999 (Revision of IEEE Std C37.04-1979)	
Elektrotechnik	IEEE Std C37.06-2009 November 2009	IEEE Standard for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities for Voltages Above 1000 V IEEE Std C37.06-2009 (Revision of ANSI C37.06-2000)	
Elektrotechnik	IEEE Std C37.09-1999 (R2007) June 1999	IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis IEEE Std C37.09™-1999 (R2007) (Revision of IEEE Std C37.09-1979)	
Elektrotechnik	ANSI C37.54- 2002 March 2003	American National Standard For Indoor Alternating Current High-Voltage Circuit Breakers Applied as Removable Elements in Metal-Enclosed Switchgear— Conformance Test Procedures	
Elektrotechnik	ANSI C37.20.2-2015	IEEE Standard for Metal-Clad Switchgear	
Elektrotechnik	ANSI C37.20.7-2007	IEEE Guide for Testing Metal-Enclosed Switchgear Rated Up to 38 kV for Internal Arcing Faults	
Elektrotechnik	ANSI C37.122.2- 2011	IEEE Guide for the Application of Gas Insulated Substations 1kV to 52kV	
Elektrotechnik	IEEE Std C57.13-2008	IEEE Standard Requirements for Instrument Transformers	

ВЯРНО С ОРИГИНАЛА

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	E DIN EN 61180 VDE 0432-10 Juli 2013	Hochspannungs-Prüftechnik für Niederspannungsgeräte Begriffe, Prüfung und Prüfbedingungen, Prüfgeräte	
	DIN EN 61180-1 VDE 0432-10 Mai 1995	Hochspannungs-Prüftechnik für Niederspannungsgeräte Begriffe, Prüfung und Prüfbedingungen (IEC 61180-1:1992); Deutsche Fassung EN 61180-1:1994	
	IEC 61180-1 Edition 1.0, 1992-10	High-voltage test techniques for low voltage equipment – Part 1: Definitions, test and procedure requirements (IEC 61180-1:1992); German version EN 61180-1:1994	
	DIN EN 61180-2 VDE 0432-11 Mai 1995	Hochspannungs-Prüftechnik für Niederspannungsgeräte Prüfgeräte (IEC 61180-2:1994); Deutsche Fassung EN 61180-2:1994	
	IEC 61180-2 Edition 1.0, 1994-06	High-voltage test techniques for low-voltage equipment – Part 2: Test equipment (IEC 61180-2:1994); German version EN 61180-2:1994	

ВЯРНО С ОРИГИНАЛА

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61439-1 VDE 0660-600-1 Juni 2012 +	Niederspannungs-Schaltgerätekombinationen Teil 1: Allgemeine Festlegungen (IEC 61439-1:2011); Deutsche Fassung EN 61439-1:2011	
	DIN EN 61439-1 Bbl 1 VDE 0660-600-1 Bbl 1 Berichtigung 1 Dezember 2014 +	Berichtigung zu DIN EN 61439-1 Beiblatt 1 (VDE 0660-600-1 Beiblatt 1):2014-06	
	DIN EN 61439-1 VDE 0660-600-1 Beiblatt 1: Juni 2014	Niederspannungs-Schaltgerätekombinationen Teil 1: Allgemeine Festlegungen; Beiblatt 1: Leitfaden für die Spezifikation von Schaltgerätekombinationen (IEC/TR 61439-0:2013)	
	IEC 61439-1 Edition 2.0, 2011-08	Low-voltage switchgear and controlgear assemblies – Part 1: General rules (IEC 61439-1:2011); German version EN 61439-1:2011	
	IEC/TR 61439-0 Edition 2.0, 2013-04	Low-voltage switchgear and controlgear assemblies – Part 0: Guidance to specifying assemblies	
Elektrotechnik	DIN EN 61439-2 VDE 0660-600-2 Juni 2012	Niederspannungs-Schaltgerätekombinationen Teil 2: Energie-Schaltgerätekombinationen (IEC 61439-2:2011); Deutsche Fassung EN 61439-2:2011	
	IEC 61439-1 Edition 2.0, 2011-08	Low-voltage switchgear and controlgear assemblies – Part 2: Power switchgear and controlgear assemblies (IEC 61439-2:2011); German version EN 61439-2:2011	

ВЯРНО С ОРИГИНАЛА

684

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61439-3 VDE 0660-600-3 Februar 2013 +	Niederspannungs-Schaltgerätekombinationen Teil 3: Installationsverteiler für die Bedienung durch Laien (DBO) (IEC 61439-3:2012); Deutsche Fassung EN 61439-3:2012	
	DIN EN 61439-3 VDE 0660-600-3 Berichtigung 1 Oktober 2014	Berichtigung zu DIN EN 61439-3 (VDE 0660-600-3):2013-02; (IEC-Cor.:2013 zu IEC 61439-3:2012)	
	IEC 61439-3 Edition 1.0, 2012-02	Low-voltage switchgear and controlgear assemblies – Part 3: Distribution boards intended to be operated by ordinary persons (DBO) (IEC 61439-3:2012); German version EN 61439-3:2012	
Elektrotechnik	DIN EN 61439-4 VDE 0660-600-4 September 2013	Niederspannungs-Schaltgerätekombinationen Teil 4: Besondere Anforderungen für Baustromverteiler (BV) (IEC 61439-4:2012); Deutsche Fassung EN 61439-4:2013	
	IEC 61439-4 Edition 1.0, 2012-11	Low-voltage switchgear and controlgear assemblies – Part 4: Particular requirements for assemblies for construction sites (ACS) (IEC 61439-4:2012); German version EN 61439-4:2013	

Fachbereich	Norm / Hausverfahren / Version	Titel der Norm oder des Hausverfahrens (ggf. Abweichungen / Modifizierungen von Normverfahren angeben)	Prüfbereich / Einschränkung
Elektrotechnik	DIN EN 61439-5 VDE 0660-600-5 Oktober 2011	Niederspannungs-Schaltgerätekombinationen Teil 5: Schaltgerätekombinationen in öffentlichen Energieverteilungsnetzen (IEC 61439-5:2010); Deutsche Fassung EN 61439-5:2011	
	E DIN EN 61439-5 VDE 0660-600-5 Juli 2014	Niederspannungs-Schaltgerätekombinationen Teil 5: Schaltgerätekombinationen in öffentlichen Energieverteilungsnetzen (IEC 17D/492/CDV:2013); Deutsche Fassung FprEN 61439-5:2013	
	IEC 61439-5 Edition 2.0, 2014-08	Low-voltage switchgear and controlgear assemblies - Part 5: Assemblies for power distribution in public networks (IEC 61439-5:2014);	
Elektrotechnik	DIN EN 60439-1 VDE 0660-500 Beiblatt 2 Mai 2009	Niederspannungs-Schaltgerätekombinationen Teil 1: Typgeprüfte und partiell typgeprüfte Kombinationen – Technischer Bericht: Verfahren für die Prüfung unter Störlichtbogenbedingungen (IEC/TR 61641:2008)	
	IEC TR 61641 Edition 3.0, 2014-09	Enclosed low-voltage switchgear and controlgear assemblies – Guide for testing under conditions of arcing due to internal fault	

ВЯРНО С ОРИГИНАЛА

Д Е К Л А Р А Ц И Я

за конфиденциалност и извършен оглед на обект по предмета на поръчката

Долуподписаният Георги Николов Табаков в качеството ми на представляващ „Електролукс Табаков и синове" ООД,участник в процедура за възлагане на обществена поръчка с реф. № PPD 17 – 052 и предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика",

Д Е К Л А Р И Р А М, ЧЕ:

1/ Представител на участника, когото представлявам е извършил оглед на енергийния обект от обхвата на Обособена позиция 4 /ОП 4/ - Модернизация (ретрофит) на закрита разпределителна уредба 10 kV в подстанция „Георги Димитров", а именно: п/ст „„Георги Димитров" и съм запознат със съществуващото положение в обекта.

2/ Няма да разпространявам поверителна информация, във връзка с извършения оглед на обекта на Възложителя, като ми е известно, че за поверителна се счита всяка информация, относно пропускателния режим в обекта, организацията на работната сила и работния процес, наличното оборудване и техническите схеми на функционирането му, системите за защита и сигурност в обекта и всичко, което е свързано с наличното оборудване, съоръжения и тяхното функциониране в съответния обект.

3/ Прилагам документ за извършен оглед, съставен на място в подстанцията.

Приложение: съгласно текста

Дата 25.07.2017 г.

Декларатор:
/Георги Табаков-Управител/

687

Д Е К Л А Р А Ц И Я

за конфиденциалност във връзка с посещение на обект

Долуподписаният Светлана Георгиева Канева
(собствено, бащино и фамилно име)

ЕГН 6612113475, притежаващ лична карта № 670386823, издадена на 30.06.2010
от МВР-Пловдив с постоянен адрес: гр. Пловдив, ЖК „Тракия" бл. 14 вх. Б

Представител на „Електрохимик Табаков и синове" ООД
(наименование на юридическото лице/физическото лице и вид на търговеца)

Със седалище и адрес на управление:
гр. Пловдив, ул. „Сердика" 9,

заинтересовано лице по смисъла на §2, т.14 от Допълнителните разпоредби на Закона за обществените поръчки за открита процедура за възлагане на обществена поръчка с предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика ", реф. № PPD 17 - 052, във връзка с посещението на обекта, предмет на обществената поръчка, с цел запознаване със съществуващото му положение, включително с действащите електрически съоръжения и спецификата на ПС „Георги Димитров"

Д Е К Л А Р И Р А М:

1. Няма да разгласявам по никакъв начин информацията станала ми известна при запознаване със съществуващото му положение, включително с действащите електрически съоръжения и спецификата на ПС „Георги Димитров"
2. Наясно съм, че разгласяване на информация по смисъла на настоящата декларация представлява всякакъв вид устно или писмено изявление, предаване наинформация на хартиен, електронен или друг носител, включително по поща, факс или електронна поща, както и всякакъв друг начин на разгласяване наинформация, в това число чрез средствата за масово осведомяване, печатните издания или интернет.

Известна ми е отговорността по чл.313 от Наказателния кодекс.

Дата 17.07.17 г. Декларатор: _____
подпис

_____
трите имена

Лице за възложител: Красимир Димитров

ДЕКЛАРАЦИЯ

за приемане на условията в проекта на договор

Долуподписаният Георги Николов Табаков в качеството ми на представляващ „Електролукс Табаков и синове" ООД, участник в обществена поръчка с реф. № PPD 17 – 052 и предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика", Обособена позиция 4 /ОП 4/ - Модернизация (ретрофит) на закрита разпределителна уредба 10 kV в подстанция „Георги Димитров";

Д Е К Л А Р И Р А М, ЧЕ:

Приемам условията в проекта на договор, приложен в документацията за участие.

Дата 25.07.2017 г.

Декларатор:
/Георги Табаков-Управител/

685

Д Е К Л А Р А Ц И Я
за срока на валидност на офертата

Долуподписаният Георги Николов Табаков, притежаващ лична карта №641449027, издадена на 17.11.2010 г..от МВР– гр. Пловдив, адрес с.Белащица, общ.Родопи, обл.Пловдив, ул."Съединение" №2Б в качеството ми на Управител на „Електролукс Табаков и синове" ООД участник в процедура за възлагане на обществена поръчка с предмет: „Модернизация (ретрофит) на електрически уредби 110/20 (10) kV и въвеждането им в режим на телемеханика", реф. № PPD 17-052,
Обособена позиция 4 /ОП 4/ - Модернизация (ретрофит) на закрита разпределителна уредба 10 kV в подстанция „Георги Димитров";

Д Е К Л А Р И Р А М, ЧЕ:

С подаване на офертата за участие в обществената поръчка, направените от нас предложения и поети ангажименти са валидни за срока, посочен в обявлението, считано от крайния срок за подаване на офертите.

Дата 25.07.2017 г.

Декларатор:
/Георги Табаков-Управител/

690