

## Test Report

Report No.: 13031Ra

Copy No.: 0

Contents: 23 Sheets

**Test object:** Metal-enclosed, air-insulated switchgear in a two-panel arrangement  
**Designation:** ZS8.4, panel width 800 mm  
Rated voltage: 24 kV      Rated normal current: 1250 A      Rated frequency: 50 Hz

**Manufacturer:** ABB s.r.o., Brno, Czech Republic  
under licence of ABB Technology Ltd., Zurich, Switzerland

**Tested for:** ABB Technology Ltd., Zurich, Switzerland

**Testing station:** PEHLA-Testing Laboratory Ratingen, Germany

**Date of test:** 07<sup>th</sup> March 2013

**Applied test specifications:**

The tests have been carried out in accordance with:

IEC 62271-200 / Ed. 2.0 / 2011-10, cl. 6.106 and Annex AA

Additional requirements: Additional indicators placed within the low-voltage compartment

**Tests performed:**

Testing of the behaviour of the metal-enclosed, air-insulated switchgear, outgoing panel, width 800 mm, under conditions of arcing due to an internal fault. The test was performed three-phase in the busbar compartment for a peak current of 63 kA and a short-circuit current of 25 kA – 1 s at 50 Hz.

Continuation on sheet 3.

**Test results:**

The test object passed the test performed in accordance with the applied test specifications.

The requirements for the verification of the internal arc classification IAC AFLR 25kA 1s are met for the compartment tested.

The additional indicators placed within the low-voltage compartment did not ignite.



GESELLSCHAFT FÜR ELEKTRISCHE  
HOCHLEISTUNGSPRÜFUNGEN

*[Signature]*  
Management Committee

*[Signature]* *[Signature]*  
Technical Committee

Mannheim, 23<sup>rd</sup> May 2013

The test results relate only to the items tested.

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03PE0804

## Notes

### Accreditation

The PEHLA GbR, PEHLA-Testing Laboratory Ratingen has been approved by the DAkkS (German Accreditation Body) according to EN ISO/IEC 17025 for tests in the field of high-voltage switchgear and controlgear and power engineering equipment (Registration-No. D-PL-12072-06-01).

### STL-Member

PEHLA is founder member of the SHORT-CIRCUIT TESTING LIAISON (STL) which has been established in 1969. STL is a forum for the international cooperation of the testing organisations with the further full members ASTA (UK), CESI (IT), CPRI (IND), ESEF (FR), KEMA (NL), SATS (NO, SE, FI), STLNA (US, CA) and JSTC (JP). In the framework of EC, STL (EU) has been recognised in 1992 by EOTC as agreement group.

### PEHLA-Documents

#### 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.

#### 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.

#### 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.

#### 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.

### Uncertainty of the measurement systems

The PEHLA - Testing Laboratories apply the PEHLA Guide No. 12 for determining the uncertainties of measurement, based on ENV 13005 (Guide to the expression of uncertainty in measurement). As long as no explicit statements are made, the uncertainties required by the relevant standards have been complied with.

### Addresses

Office:	PEHLA-Geschäftsstelle Hallenweg 40 68219 Mannheim Germany Internet: <a href="http://www.pehla.com">www.pehla.com</a>	Client:	ABB AG Kallstadter Str. 1 68309 Mannheim as shareholder and contractor of PEHLA GbR
Testing Station:	PEHLA-Testing Laboratory Ratingen Oberhausener Str. 33 40472 Ratingen Germany		
Manufacturer:	ABB s.r.o. Videnska 117 Brno 619 00 Czech Republic under licence of ABB Technology Ltd., Zurich, Switzerland		
Tested for:	ABB Technology Ltd. Affolternstrasse 44 8050 Zurich Switzerland		

## Test Performed

### Continuation from Sheet 1

The test object consisted of a two-panel-arrangement of a metal-enclosed, air-insulated switchgear type ZS8.4 for 24 kV. The panel width was 800 mm for both outgoing panels. It was equipped with end covers on both sides. The initiation wire was installed across the tee-off busbars in the busbar compartment.

The test was performed for accessibility type A (restricted to authorized personnel only).

The switchgear was set up in a room mock-up with a ceiling height of 2.90 m above the floor (actual ceiling height was 2.88 m using the tolerance of  $\pm 50$  mm given by IEC). The distance between the rear wall of the test object and the room mock-up was 0.80 m. The distance between the side wall of the infeed panel and the side wall of the room mock-up was 0.10 m.

The internally developing pressure of the test object was relieved by operation of a pressure relief flap via a pressure relief duct into the outer air outside the room mock-up. Lateral outlet with an internal cross section of 815 mm x 328 mm with a pressure relief device with preloaded opening at the end of the outlet.

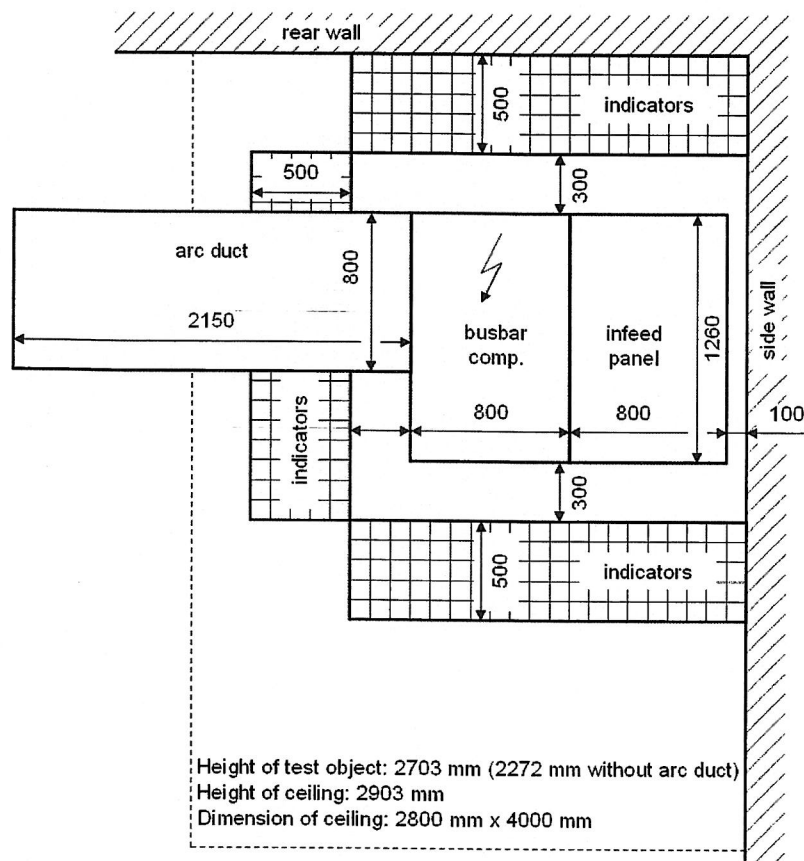
The three-phase infeed connection was made via cables to the cable terminals of the infeed panel and then via the busbars to the test panel.

Each panel was equipped with a common earthing bar.

For the test, indicators of black cretonne (cotton fabric approximately  $150 \text{ g/m}^2$ ) were placed in front, on the left-hand side and in the rear of the switchgear as stated in the relevant test specifications. In addition vertical indicators were placed within the low-voltage compartment.

The test was filmed with a high-speed video camera with a frequency of 1000 frames/s and with two standard digital video cameras.

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



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## List of Test Participants

### Representatives of Technical Committee:

Mr. Joachim Köhler	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Herbert Feld	PEHLA-Testing Laboratory Berlin-Marzahn, Germany

### Test Engineer / Test Operator:

Mr. Joachim Köhler (Test Engineer)	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Frank Idaszek (Measurement)	PEHLA-Testing Laboratory Ratingen, Germany
Mr. Joachim Köhler (Machine Operator)	PEHLA-Testing Laboratory Ratingen, Germany

### Representatives of Client:

Mr. Jiri Lichtag	ABB s.r.o., Brno, Czech Republic
Mr. Drahomir Tuma	ABB s.r.o., Brno, Czech Republic
Mr. Vladimir Taus	ABB s.r.o., Brno, Czech Republic
Mr. Vlastimil Sindler	ABB s.r.o., Brno, Czech Republic
Mr. Jiri Prochazka	ABB s.r.o., Brno, Czech Republic

### Further Participants:

-

## Technical Data of Test Object

### Switchgear

**Test object:** Metal-enclosed, air-insulated switchgear in a two-panel arrangement  
**Designation:** ZS8.4, panel width 800 mm  
**Manufacturer:** ABB s.r.o., Brno, Czech Republic  
**Serial No.:** 1VLS1000028533/1 - left-hand side panel subjected to arcing  
1VLS1000028533/2 - right-hand side panel used as infeed panel  
**Year of manufacture:** 2013  
**Drawing No.:** 1VBP800046R0101

#### Ratings assigned by the manufacturer:

Rated voltage	24 kV
Rated normal current	1250 A
Rated frequency	50 Hz
Rated lightning impulse withstand voltage	125 kV
Rated switching impulse withstand voltage	- kV
Rated power-frequency withstand voltage	50 kV
Rated peak withstand current	63 kA
Rated short-time withstand current	25 kA
Rated duration of short-circuit	3 s
Insulating medium	air
Rated filling pressure for insulation	- kPa abs. at 20 °C
Minimum functional pressure for insulation	- kPa abs. at 20 °C

#### Permissible values for internal arc faults:

Peak current	63 kA
Short-circuit current	25 kA
Duration of short-circuit	1 s

#### Further data: -

#### Essential characteristics and installed devices:

The circuit-breaker compartments were equipped with an isolating truck type TE 2412-25, manufactured by ABB AG, Calor Emag Medium Voltage Products, Ratingen, Germany.

Serial no. 1VB40240275680 / 020 , year of manufacture 2009, in panel no. 1VLS1000028533/1 (left-hand side panel)

Serial no. 1VB4026257, year of manufacture 2013, in panel no. 1VLS1000028533/2, (right-hand side panel )

## List of Identified Drawings

The manufacturer has submitted to the testing laboratory drawings and other data containing sufficient information to unambiguously identify by type the essential details and parts of the test object presented for test.

The drawings have been stamped and signed by the manufacturer in order to guarantee that the drawings or data schedules truly represent the test object to be tested.

Further these drawings have been stamped and signed by PEHLA representatives and are kept

☐ at the client.

☒ with the test documents at the test laboratory.

The testing laboratory has checked that drawings and data schedules adequately represent the essential details and parts of the test object to be tested, but is not responsible for the accuracy of the detailed information.

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

Drawing No.	Rev.	P/D *)	Title	Additional remarks
1VBP800046R0102 Sheet 1	02	D	Lichtbogenprüfung ZS8.4 24kV IAC-Test ZS8.4 24kV	Included in this test report
1VBP800046R0101 Sheet 2	--	D	Lichtbogenprüfung ZS8.4 24kV Montage IAC-Test ZS8.4 24kV mounting	Included in this test report
1VB8002222R0104 Sheet 4	00	D	Abdeckung Rückwand, Tlg.800 H=1900 cover rear wall, p.800 h=1900	-
GCE8007400P0134/P0133	--	D	KRYT ZAONÍ END COVER	-
GCE8006900R0102 Sheet 2	06	D	ZS8.4 24KV VD4 ABZW. 1250A 25KA 800X1230 ZX8.4 24KV VD4 FEED. 1250A 25KA 800X1230	Included in this test report
GCE8006900R0102 Sheet 1 to 4/4	--	P	ZX8.4 24KV VD4 PŘÍV./VÝV.1250A 16KA 800X	-
GCE8007687P0101/P0131	00	D	Bodenblech Bottom plate	-
GCE8007609 Sheet 1/3	00	D	SEITENWAND SIDE-WALL	-
GCE8006891P0102/P0132 Sheet 2	00	D	Rückwand Tlg. 800 24kV VD4 (AS) rear wall p. 800 VD4	-
GCE8006289P0103/P0133 Sheet 3	00	D	Dachblech 800/1200 roof cover 800/1200	-
GCE8005645P0101	-	D	Zwischenblech, unten partition plate, bottom	-
GCE8008093P0101	00	D	Zwischenblech , oben Partition plate, roof	-
GCE8006309	00	D	ZWISCHENBLECH, MITTE PARTITION PLATE, CENTRE	-
GCE8007376P0101	00	D	Verstärkungsblech Tlg.800 reinforcements metal part.800	-

\*) P: Parts list, D: Drawing

**List of Identified Drawings (2)**

Drawing No.	Rev.	P/D *)	Title	Additional remarks
GCE8006712P0101 Sheet 1/2	01	D	Schottungsplatte , unten Partition plate , bottom	-
GCE8006713P0101 Sheet 1/2	01	D	Schottungsplatte , oben Partition plate , top	-
GCE8006497	00	D	Tuer , vollst. Door , compl.	-
1VB5006005R103 Sheet 2	01	D	Tür Tlg.800 (Schweißgruppe) door p.800 (welded group)	-
1VB5006006P0102 Sheet 4	--	D	Tür Tlg.800 door p.800	-
GCE8000495P0115 Sheet 12	00	D	Profilblech T.800 Profile plate p.800	-
GCE8000495P0116 Sheet 13	00	D	Profilblech T.800 Profile plate p.800	-
212-8010.00-00001	A	D/P	Scharnier RE / LH kpl. HINGE RH / LH	-
207-8068.00-00000	D	D/P	Schwenkhebel- Verschluss SWINGHANDLE LATCH	-
GCE8006315P0101 Sheet 1/2	02	D	Verstärkungsprofil, links Reinforcement, left	-
GCE8005637P0101	01	D	Bolzen Bolt	-
GCE8005636P0103/P0104	02	D	VÝZTUHA STRENGTHENING SHEET	-
1VB8002212R0321 Sheet 60	01	D	DE-Kanal T.800 (1250) Anfangsf. re/li m. Endkassette	-
GCE8006304	02	D	Montageblech Mounting support	-
GCE8006303P0103/P0104 Sheet 2	00	D	Halterung Support	-
GCE8008039	01	D	Führungsschiene, vollst. Guide rail, compl.	-
GCE8006926R0102 Sheet 2/2	--	D	Druckentlastungsklappe Pressure Rellief Flap	-
GCE8006506R0103 Sheet 3	00	D	Druckentlastungsklappe/ Streckgitter Tlg. 800 pressure relief flap/ grating p.800	-
GCE8007531 Sheet 3	00	D	Gerätekasten, vollst. l.v.compartment compl.	-
1VB8002212R0327	00	D	DE-Kanal T.800(1250) Endf.f.Anb.v.o.Mont.v.re. gas duct p.800(1250A)end panel f.conn.fr.t. ass.fr.ri.	-
1VL7622906R0101	00	D	ODFUK 1000/1200 GAS DUCT EXTENSION 1000/1200	-

\*) P: Parts list, D: Drawing



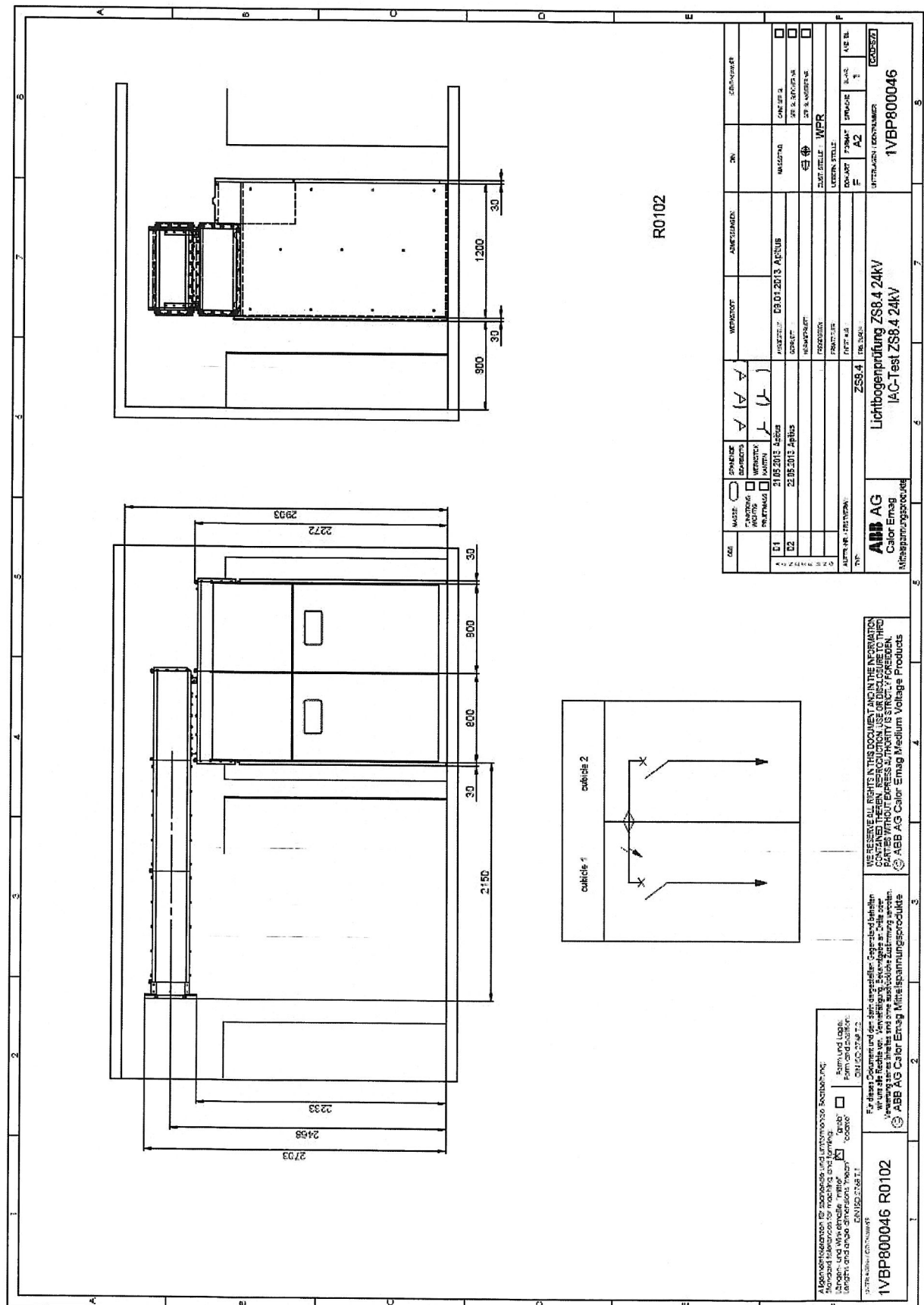
**List of Identified Drawings (3)**

Drawing No.	Rev.	P/D *)	Title	Additional remarks
1VL7622911R0101	00	D	PŘIPOJOVACÍ NÁSTAVEC KOMPLETNÍ CONNECITON BOX COMPLETE	-
1WAN 21106-G	1	D	AVLASTNINGSLUCKA för UniSafe och UNIGEAR typ ZS1	-
GCE 8006766R0101	01	D	Einfahrtulpe Spout	-
GCE8007521P0101	00	D	Kontaktstift Contact Pin	-
GCE8008201	00	D	Kabelanschluß,vollst. Cable connection,compl.	-
GCE8006383R0101	--	D	Abzweigschiene L1 Tee-Off Bar L1	-
GCE8006384R0101	--	D	Abzweigschiene L2 Tee-Off L2	-
GCE8006385R0101	--	D	Abzweigschiene L3 Tee-Off Bar L3	-
GCE8006475	--	D	Sammelschiene Busbar	-
1VL1260300A	--	D	UZEMŇOVAČ	-
GCE7373263R1203 Sheet 19	02	D	TRENNSCH 2412-25 ZS8.4 P210 S250 64P Iso. draw 2412-25 ZS8.4 P210 S250 64P	-

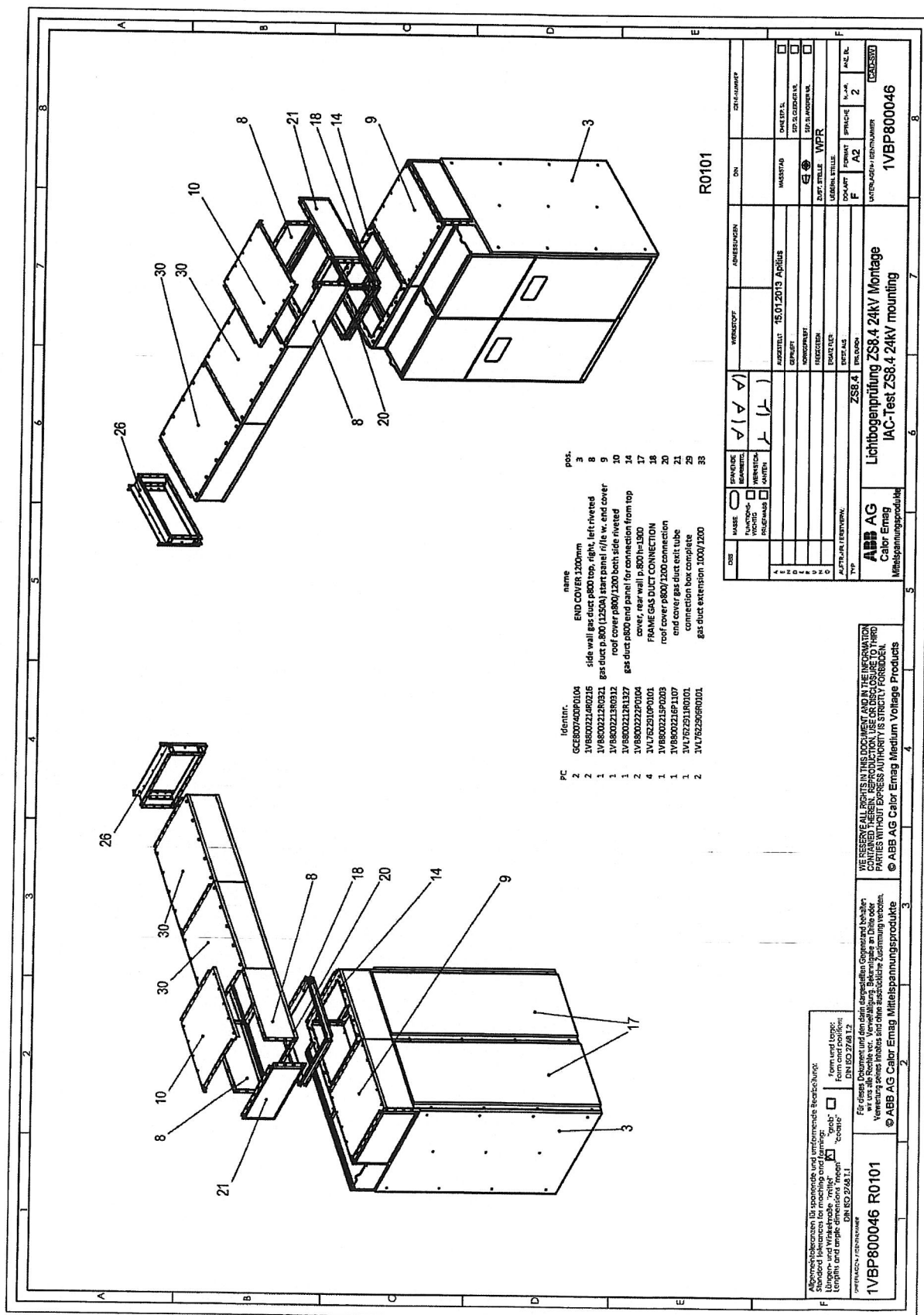
\*) P: Parts list, D: Drawing

Remarks: -

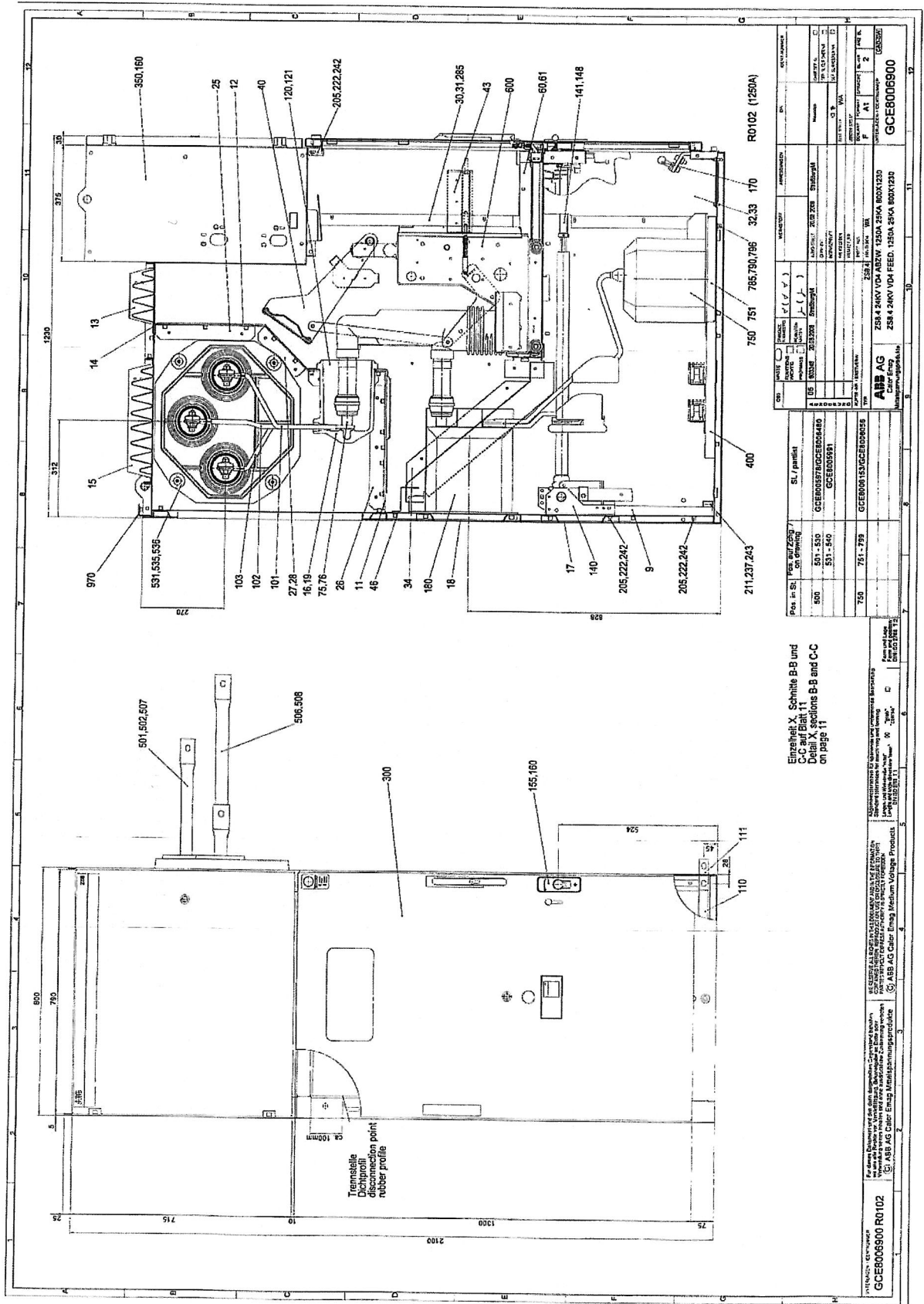
**Drawing No.**  
**1VBP800046R0102 Sheet 1**



**Drawing No.**  
**1VBP800046R0101 Sheet 2**



**Drawing No.**  
**GCE8006900R0102 Sheet 2**



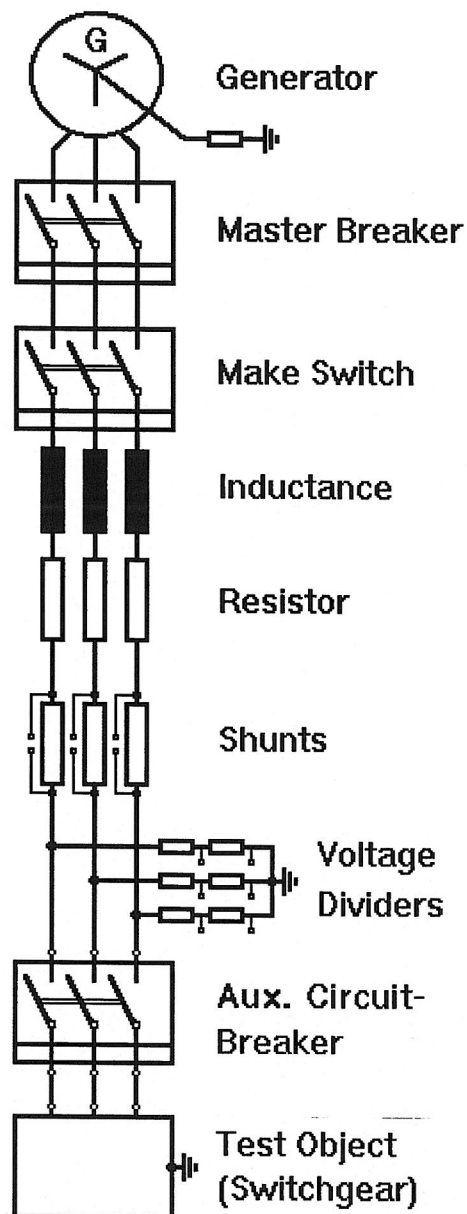


**Technical Data of Test Circuit**  
**Internal Arc Test**

Test performed		Internal Arc Test	-
Test No.	PEHLA 13031Ra /	02 - 06	-
Test circuit		Direct	-
Circuit diagram	Sheet No.	14	-
Current circuit			-
Number of phases		3	-
Power frequency	Hz	50	-
Power factor		< 0.15	-
Earthing conditions			-
Generator / System		earthed via 5 k $\Omega$	-
Transformer		-	-
Short-circuit point		not earthed	-
Test object		earthed	-
Test object (test values)			-
Number of phases		3	-
Measurement			-
Voltage measurement		Dividers 2500 V / 1 V	-
Current measurement		Shunts 4 $\mu\Omega$	-

**Remarks: -**

### Circuit Diagram Internal Arc Test



## Test Results Internal Arc Test

**Test performed:** Internal arc test  
**Date of test:** 07<sup>th</sup> March 2013  
**Condition of test object:** Factory new  
**Test arrangement:** See sheet 3  
**Connections to test object:** Infeed three-phase via cables to the cable terminals of the right-hand side infeed panel.  
**Arc initiation:** Three-phase by means of a copper wire Ø 0.5 mm across the tee-off busbars in the busbar compartment.

Test No.:		Applied voltage (phase to phase):	Test frequency:	Test duration:
PEHLA 13031Ra / 06		7.50 kV	50 Hz	1.04 s
Test current				
	Peak current  kA	AC component		Integral  kA
		During the first three half-cycles  kA	At the end of the test  kA	
L1	65.9	27.5	25.6	24.5
L2	56.0	28.3	26.5	25.8
L3	50.6	28.3	25.9	25.3
Average value				25.2
Equivalent short-circuit duration		1.05 s	related to a short-circuit current of	
				25.0 kA.

### Assessment of the test:

Criteria according to IEC 62271-200		fulfilled (yes/no)
No.1:	Correctly secured doors and covers do not open	yes
No.2:	No fragmentation of the enclosure occurs and no parts more than 60 g fly away	yes
No.3:	Arcing does not cause holes in the accessible sides up to a height of 2 m	yes
No.4:	Indicators do not ignite due to the effect of hot gases	yes
No.5:	The enclosure remains connected to its earthing point	yes

**Remarks:** PEHLA 13031Ra / 01: Current calibration  
 PEHLA 13031Ra / 02 - 05: Pre-test on external short-circuit to determine the settings for testing

### Test results:

The test object passed the test performed in accordance with the applied test specifications. The requirements for the verification of the internal arc classification IAC AFLR 25kA 1s are met for the compartment tested. The additional indicators placed within the low-voltage compartment did not ignite.

**Pressure measurement:**

Pressure sensor 1: Door of cable compartment:	23.8 kPa
Pressure sensor 2: Rear wall busbar compartment:	43.3 kPa
Pressure sensor 3: Gas duct, rear side above switchgear:	51.1 kPa
Pressure sensor 4: Gas duct, bottom side besides switchgear	33.2 kPa

## Photos

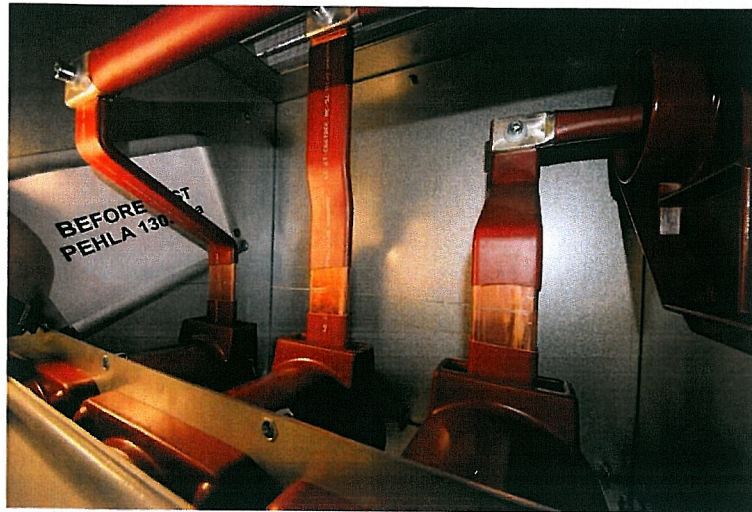


Photo No. 01  
Before test PEHLA 13031Ra / 06  
Initiation wire across tee-off busbars



Photo No. 02  
Before test PEHLA 13031Ra / 06  
Test object, front view with doors of left-hand side panel opened.



## Photos

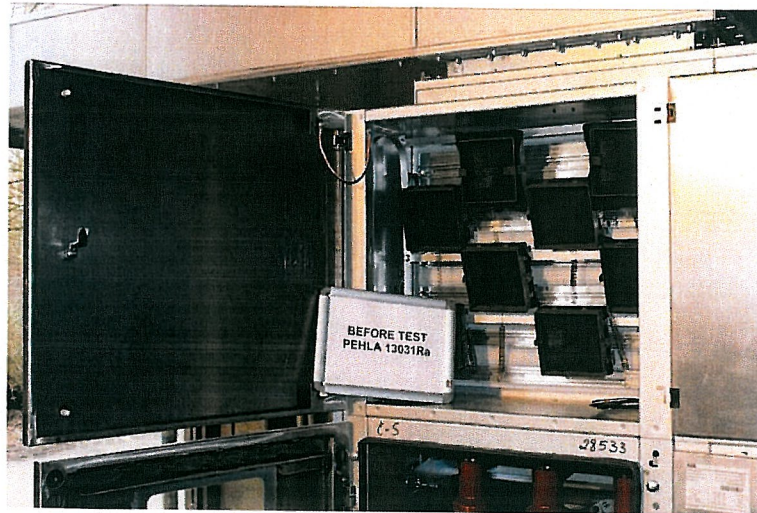


Photo No. 03  
Before test PEHLA 13031Ra / 06  
Additional indicators within low-voltage compartment

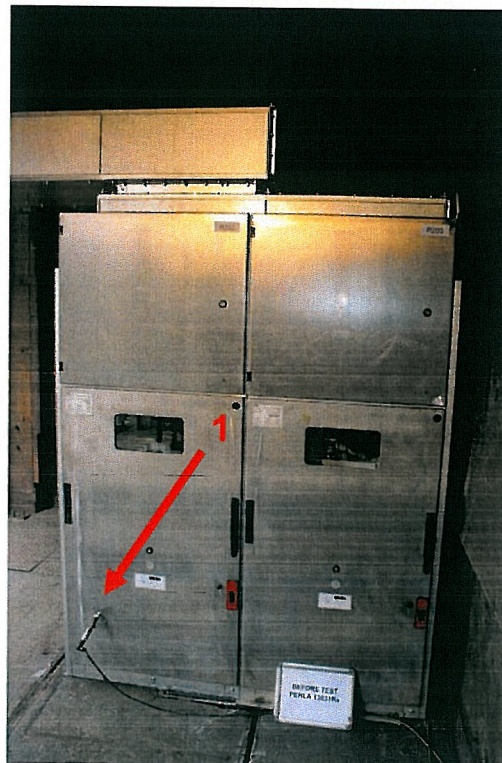


Photo No. 04  
Before test PEHLA 13031Ra / 06  
Test object, front view with pressure sensor 1

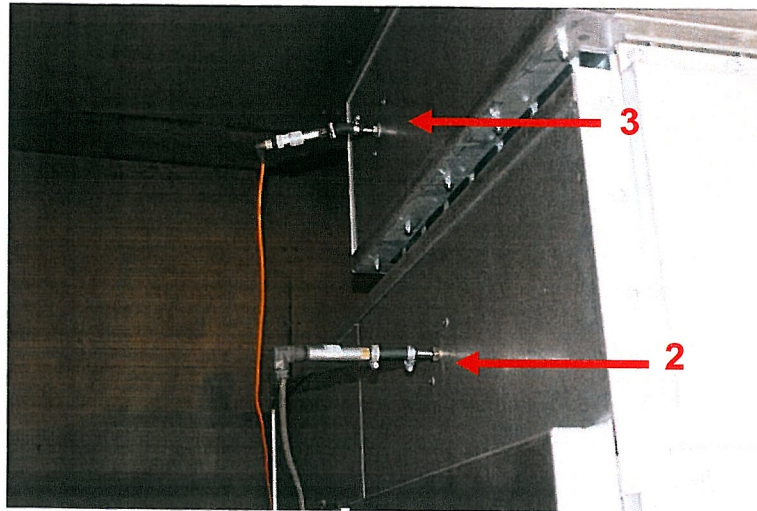
**Photos**

Photo No. 05  
Before test PEHLA 13031Ra / 06  
Test object, rear view with pressure sensors 2 and 3

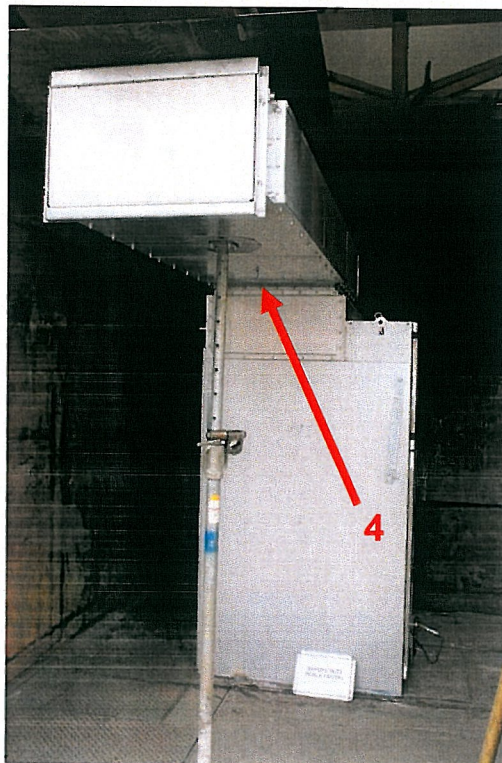


Photo No. 06  
Before test PEHLA 13031Ra / 06  
Test object, side view with pressure sensor 4



## Photos

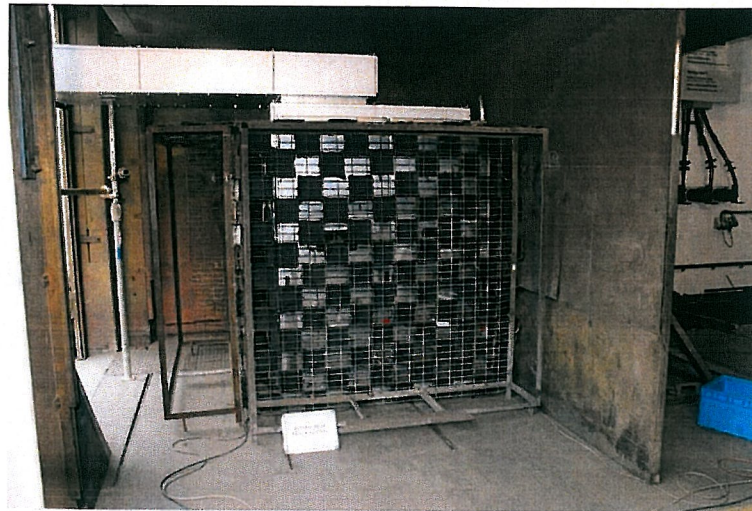


Photo No. 07  
Before test PEHLA 13031Ra / 06  
Test object, front view with indicators



Photo No. 08  
Before test PEHLA 13031Ra / 06  
Test object, side view with indicators and closed hatch at the end of the outlet

## Photos

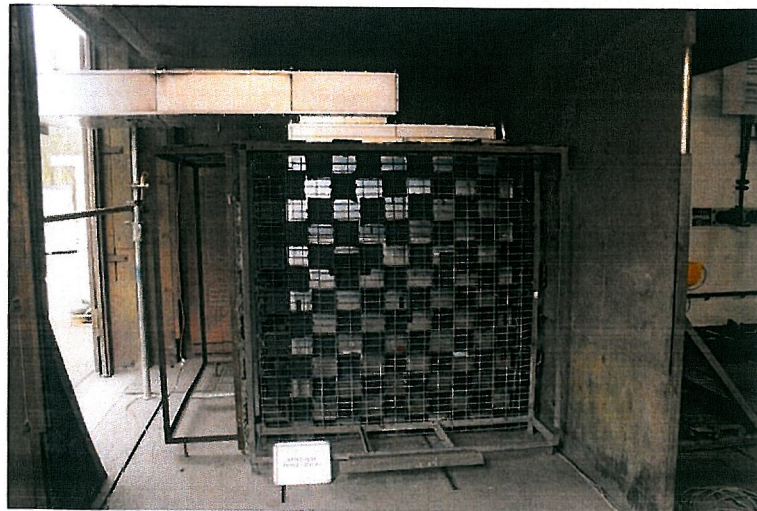


Photo No. 09  
After test PEHLA 13031Ra / 06  
Test object, front view with indicators

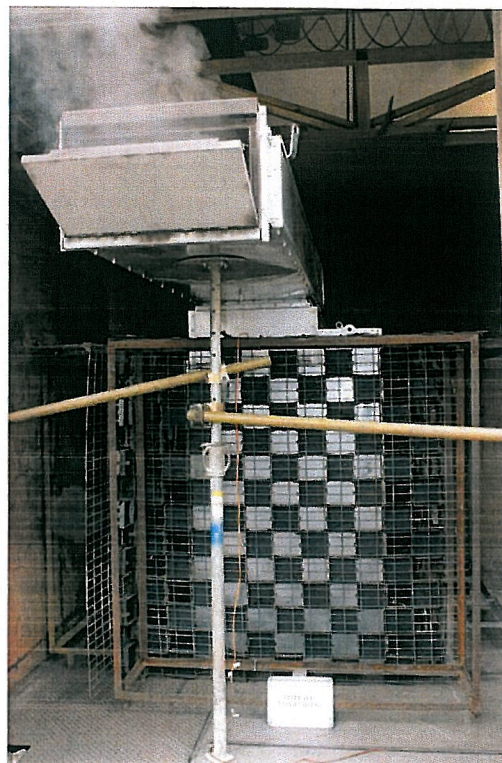


Photo No. 10  
After test PEHLA 13031Ra / 06  
Test object, side view with indicators and opened hatch at the end of the outlet



## Photos

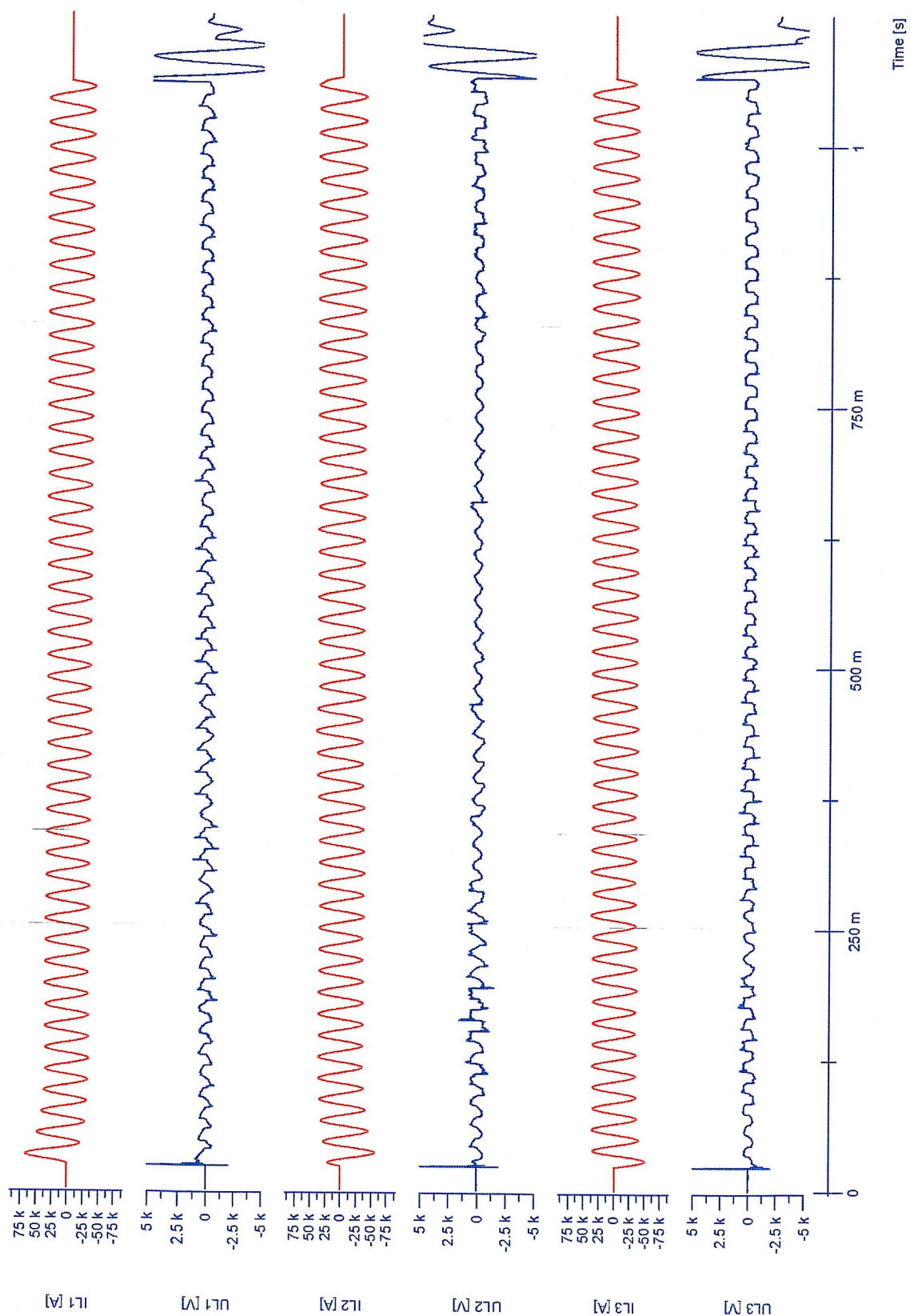


Photo No. 11  
After test PEHLA 13031Ra / 06  
Test object, front view without indicators



Photo No. 12  
After test PEHLA 13031Ra / 06  
Additional indicators within low-voltage compartment

**Oscillogram No.  
PEHLA 13031Ra / 06**



**Oscillogram No.  
PEHLA 13031Ra / 06**

