



ETD TRANSFORMÁTORÝ a.s.
TECHNICAL INSPECTION AND TESTING ROOM



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Test Certificate

TKZ 20/103 A

Purchaser:	JSC „APSVIETIMAS“
Subject of tests:	Power three-phase regulator oil transformer type ETRZ 31 M-0, work No. 0969547
Date of the test:	30.6. ÷ 9.7.2020
Internal order No.:	13.00.0048 / 3010000246
Order No.:	ME000110327

Test results: listed in the text

Enclosures:

Enclosure to Test Certificate No. TKZ 20/103A – Lightning impulse test
Certificate No. TKZ 20/102A – Determination of sound levels
Certificate No. ORGREZ 709/2020-O – Insulating Oil Analysis

ETD TRANSFORMÁTORÝ a.s.
Technická kontrola a zkušebna

In Pilsen , 10.7.2020

Ing. Jakub Langer
Head of laboratory

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	Test Certificate Transformer tests		
Work No.: 0969547	Type: ETRZ 31 M-0	Manufacturer: ETD TRANSFORMÁTORÝ a.s.	

Purchaser:	JSC „APSVIETIMAS“	Internal order No.:	13.00.0048 3010000246
Order No.:	ME000110327	Register No.:	ME000110327

Technical data

Winding:	Output [kVA]:	Voltage [V]:	Current [A]:
1	25 000	115 000 $\pm 9 \times 1,778\%$	126
2	25 000	38 500 $\pm 2 \times 2,5\%$	375
3	25 000	11 000	1312

Standard:	IEC 60076				
Vector group:	YNyn0d11	Type of cooling:	ONAN/ONAF	Sort of loading:	S1
No. of phases:	3	Rated frequency:	50 Hz	Insulation class:	A

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Tests evaluation

The transformer complied to all tests, carried on according to IEC 60076.

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Measurement of voltage ratio and check of phase displacement					
For voltage ratio:			115 ±9x1,778% kV 38,5 ±2x2,5% kV (tap.No. 3)		
Connect. symbol corresponds:			YNyn0		
No. of tap:	Winding [V]:	For voltage ratio:	Failing of ratio [%]		
			A-0/Am-0m	B-0/Bm-0m	C-0/Cm-0m
1	133 402	3,465	-0,22	-0,26	-0,26
2	131 358	3,412	-0,23	-0,24	-0,25
3	129 313	3,359	-0,21	-0,26	-0,22
4	127 268	3,306	-0,20	-0,20	-0,23
5	125 224	3,253	-0,20	-0,22	-0,22
6	123 179	3,199	-0,14	-0,21	-0,19
7	121 134	3,146	-0,17	-0,19	-0,16
8	119 089	3,093	-0,16	-0,17	-0,18
9	117 045	3,040	-0,10	-0,17	-0,16
10	115 000	2,987	-0,11	-0,13	-0,14
11	112 955	2,934	-0,12	-0,12	-0,13
12	110 911	2,881	-0,08	-0,11	-0,11
13	108 866	2,828	-0,07	-0,09	-0,08
14	106 821	2,775	-0,05	-0,07	-0,08
15	104 777	2,721	-0,01	-0,08	-0,04
16	102 732	2,668	-0,02	-0,04	-0,03
17	100 687	2,615	0,01	-0,01	-0,02
18	98 642	2,562	0,01	0,01	0,01
19	96 598	2,509	0,06	0,04	0,03

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 TEST LABORATORY E-11	Test Certificate Transformer tests		
Work No.: 0969547	Type: ETRZ 31 M-0	Manufacturer: ETD TRANSFORMÁTORÝ a.s.	

Measurement of voltage ratio and check of phase displacement					
For voltage ratio:		115 ±9x1,778% kV (tap No. 1 +16%) 11 kV			
Connect. symbol corresponds:		YNd11			
No. of tap:	Winding [V]:	For voltage ratio:	Failing of ratio [%]:		
			A-0/a-c	B-0/b-a	C-0/c-b
1 (+16%)	133 402	7,002	-0,17	-0,22	-0,17
For voltage ratio:		38,5 ±2x2,5% kV 11 kV			
Connect. symbol corresponds:		YNd11			
No. of tap:	Winding [V]:	For voltage ratio:	Failing of ratio [%]:		
			Am-0m/a-c	Bm-0m/b-a	Cm-0m/c-b
1 (+5%)	40 425	2,122	0,19	0,16	0,21
2 (+2,5%)	39 463	2,071	0,08	0,08	0,11
3 (0%)	38 500	2,021	-0,03	-0,04	-0,03
4 (-2,5%)	37 538	1,970	-0,17	-0,16	-0,15
5 (-5%)	36 575	1,920	-0,29	-0,30	-0,29

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	Test Certificate Transformer tests			
Work No.: 0969547	Type: ETRZ 31 M-0		Manufacturer: ETD TRANSFORMÁTORÝ a.s.	

Applied voltage test (AV)

On the tested winding is applied the voltage U_{test} [kV], $f = 50$ Hz, $t = 60$ s against the tank and other windings.

Tested winding:	115 kV	38,5 kV	11 kV				
Testing voltage U_{test} [kV]:	100	85	28				

Chopped wave lightning impulse test (LI, LIN)

Tested windings:	115 kV	115 kV	38,5 kV	11 kV
Terminals:	A, B, C	0	Am, Bm, Cm	a, b, c
Testing voltage U_{test} [kV]:	550	250	185	75

Induced voltage test with partial discharge measurement (IVPD)

Rated voltage $U_r = 115$ kV

Testing voltage „phase – phase“ U _{test} . [kV]		<0,4Ur	1,2Ur	1,58Ur	2Ur	1,58 Ur												1,2 Ur	<0,4Ur
		46	138	182	230	182												80	27
Testing voltage „phase - earth“ U _{zk} /√3[kV]		<0,4Ur/√3	1,2Ur/√3	1,58Ur/√3	2Ur/√3	1,58 Ur/√3												1,2 Ur/√3	<0,4Ur/√3
		27	80	105	133	105												13	4
Measured	Test time t [s]	-	60	300	48	3600												60	-
						300	600	900	1200	1500	1800	2100	2400	2700	3000	3300	3600		
1U	Apparent charge [pC]	-	<10	<10	-	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-	
1V	Apparent charge [pC]	-	<10	<10	-	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-	
1W	Apparent charge [pC]	-	<10	<10	-	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-	

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	Test Certificate Transformer tests		
Work No.: 0969547	Type: ETRZ 31 M-0	Manufacturer: ETD TRANSFORMÁTORÝ a.s.	

Measurement of winding resistance							
Quoted value of winding resistance R [Ω] at temperature 20 °C							
Winding: No. of tap:	A-0	B-0	C-0	Winding: No. of tap:	Am-0	Bm-0	Cm-0
115 kV / 1	1,228	1,230	1,228	38,5 kV / 1 (+5%)	0,106	0,106	0,107
2	1,202	1,204	1,202	2 (+2,5%)	0,104	0,104	0,104
3	1,176	1,178	1,176	3 (0%)	0,102	0,102	0,102
4	1,150	1,152	1,150	4 (-2,5%)	0,100	0,099	0,100
5	1,124	1,126	1,124	5 (-5%)	0,097	0,097	0,097
6	1,098	1,100	1,098				
7	1,072	1,074	1,072	11 kV / -	a-b	a-c	b-c
8	1,046	1,048	1,046		0,0125	0,0125	0,0125
9	1,020	1,022	1,020				
10	0,992	0,994	0,990				
11	1,020	1,023	1,021				
12	1,046	1,049	1,046				
13	1,071	1,075	1,072				
14	1,097	1,100	1,098				
15	1,123	1,126	1,124				
16	1,149	1,152	1,150				
17	1,175	1,178	1,176				
18	1,201	1,204	1,201				
19	1,227	1,231	1,228				

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Work No.: 0969547	Type: ETRZ 31 M-0	Manufacturer: ETD TRANSFORMÁTORÝ a.s.	

Measurement of d.c. insulation resistance each winding to earth, and between windings					
Determination of capacitances windings-to-earth and between windings					
Measurement of dissipation factor (tg δ) of the insulation system capacitances					
Measured at winding temperature: 25 °C			Measured at winding temperature: 25 °C		
Connection at measurement:		$U_{\text{test.}} = 2500 \text{ V}_{\text{DC}}$		$U_{\text{test.}} = 10000 \text{ V}/50 \text{ Hz}$	
* remaining windings connected to transf. tank	$R_{\text{insulating}} [\text{M}\Omega]$		Connection at measurement:	$C [\text{nF}]$	$\text{tg } \delta [\%]$
	15 s	60 s			
115 kV / tank + *	13 330	15 270	115 kV – 38,5 kV	5,3	0,17
38,5 kV / tank + *	7 220	9 340	38,5 kV – 11 kV	10,5	0,20
11 kV / tank + *	5 640	9 880	115 kV – tank	3,1	0,21
115 kV + 38,5 kV / tank + *	7 970	13 140	38,5 kV – tank	1,2	0,39
115 kV + 11 kV / tank + *	4 660	6 840	11 kV – tank	9,8	0,36
38,5 kV + 11 kV / tank + *	9 180	11 500			
115 kV + 38,5 kV + 11 kV / tank + *	11 860	14 630			

Check of core and frame insulation					
Measured at oil temperature: 25 °C					
		$U_{\text{test.}} = 2500 \text{ V}_{\text{DC}}$			
		$R_{\text{insulating}} [\text{M}\Omega]$			
		15 s	60 s		
core / tank + frame		3 087	6 780		
frame / tank + core		2 754	5 410		

Measurement of dissipation factor (tg δ) and capacitance C of the bushings									
Measured at winding temperature: 25 °C									
Terminal / Serial No.		„A“ No. 19D4366		„B“ No. 19D4367		„C“ No. 19D4368		„0“ No. 2083541	
Connection at measurement:	U_{test}	$C_1 [\text{pF}]$	$\text{tg } \delta_1 [\%]$	$C_1 [\text{pF}]$	$\text{tg } \delta_1 [\%]$	$C_1 [\text{pF}]$	$\text{tg } \delta_1 [\%]$	$C_1 [\text{pF}]$	$\text{tg } \delta_1 [\%]$
Terminal - Power factor tap	2 kV	262,9	0,27	262,6	0,26	264,4	0,27	297,5	0,22
	4 kV	262,9	0,27	262,6	0,26	264,4	0,27	297,5	0,22
	6 kV	262,9	0,27	262,6	0,26	264,4	0,27	297,5	0,22
	8 kV	262,9	0,27	262,6	0,26	264,4	0,27	297,5	0,22
	10 kV	262,9	0,27	262,6	0,26	264,4	0,27	297,5	0,22
Connection at measurement:	U_{test}	$C_2 [\text{pF}]$	$\text{tg } \delta_2 [\%]$	$C_2 [\text{pF}]$	$\text{tg } \delta_2 [\%]$	$C_2 [\text{pF}]$	$\text{tg } \delta_2 [\%]$	$C_2 [\text{pF}]$	$\text{tg } \delta_2 [\%]$
Power factor tap - tank	2 kV	514,1	0,27	489,7	0,24	463,5	0,27	322,1	0,48

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Test of oil								
Oil type:	LYRA X		tg δ [%/90 °C]:	0,026	ρv [GΩm/90 °C]:	241,6	εr [-]:	2,12
Tr. tank:	Water content in oil[ppm]:	3	Up [kV/2,5mm]:	83,8	s [kV/2,5mm]:	6,0	V [%]:	7,2
Tap changer:	Water content in oil[ppm]:	5	Up [kV/2,5mm]:	88,0	s [kV/2,5mm]:	9,7	V [%]:	11,0

Leak testing with pressure for liquid immersed transformers (tightness test)
The test carried out for 48 hours + 24 hours duration from last tightness repair.
tank / external space with overpressure 40 kPa

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Work No.: 0969547	Type: ETRZ 31 M-0	Manufacturer: ETD TRANSFORMÁTORÝ a.s.	

Measurement of dissolved gases in dielectric liquid							
Detected gas	unit	value 1	value 2	value 3			
Oxygen (O ₂)	μl/l	4 486	4 873	3 685			
Nitrogen (N ₂)	μl/l	9 506	10 412	8 000			
Hydrogen (H ₂)	μl/l	0,0	0,0	0,0			
Carbon dioxide (CO ₂)	μl/l	79,9	99,5	93,5			
Carbon monoxide (CO)	μl/l	2	8,1	10,2			
Ethylen (C ₂ H ₄)	μl/l	2	31,9	22,5			
Ethane (C ₂ H ₆)	μl/l	0,0	0,0	0,0			
Methane (CH ₄)	μl/l	0,0	0,2	0,2			
Acetylene (C ₂ H ₂)	μl/l	0,0	0,0	0,0			
Propylene (C ₃ H ₆)	μl/l	0,0	0,0	0,0			
Propane (C ₃ H ₈)	μl/l	0,2	4,4	3,9			
Sum of hydrocarbons	μl/l	2,2	36,5	26,6			
Sum of combustible gases	μl/l	4,2	44,6	36,9			
Total gas content (Q _p)	%vol.	1,41	1,54	1,18			
Note: value 1 – before tests value 2 – after temperature rise test value 3 – after tests							

Measurement of no-load loss and current						
Measured values:					Guaranteed values:	
Energized winding 11 kV					tol.+30 %	tol.+0 %
U [V]	u [%]	I ₀ [A]	i ₀ [%]	ΔP ₀ [kW]	i ₀ [%]	ΔP ₀ [kW]
12 103	110	2,4	0,18	18,1		
11 556	105	1,3	0,10	15,1		
11 000	100	0,9	0,07	13,1	0,2	15
10 455	95	0,7	0,06	11,5		
9 908	90	0,6	0,05	10,2		

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 TEST LABORATORY E-11	Test Certificate Transformer tests		
Work No.: 0969547	Type: ETRZ 31 M-0	Manufacturer: ETD TRANSFORMÁTORÝ a.s.	

Measurement of short-circuit impedance and load loss									
Values for winding temperature 75 °C									
Measured values:							Guaranteed values:		
							$\Delta P_0 + \Delta P_k$	tol. $\pm 15\%$	tol. $\pm 0\%$
Powered winding:		Shorted winding:		For output:	u_k	ΔP_k	$\Sigma \Delta P$	u_k	ΔP_k
	Tap Nr.:		Tap Nr.:	S [kVA]	[%]	[kW]	[kW]	[%]	[kW]
115 kV	1	38,5 kV	3 (0%)	25 000	10,37	112,3			
	2				10,31	112,6			
	3				10,25	112,9			
	4				10,19	113,2			
	5				10,14	113,6			
	6				10,09	114,0			
	7				10,04	114,3			
	8				9,99	114,7			
	9				9,95	115,1			
	10				9,92	115,0	128,1	10,5	130
	11				9,89	119,0			
	12				9,87	122,8			
	13				9,85	126,8			
	14				9,85	131,1			
	15				9,85	135,8			
	16				9,86	140,7			
	17				9,88	146,1			
	18				9,91	151,8			
	19				9,95	158,0			
115 kV	1	38,5 kV	1 (+5%)	25 000	10,46	110,6			
	10				10,02	113,6	126,7	-	-
	19				10,07	156,7			
115 kV	1	38,5 kV	5 (-5%)	25 000	10,27	114,9			
	10				9,82	117,8	130,9	-	-
	19				9,85	160,9			

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Test Certificate Transformer tests

Work No.: 0969547

Type: ETRZ 31 M-0

Manufacturer: ETD TRANSFORMÁTORÝ a.s.

Measurement of short-circuit impedance and load loss

Values for winding temperature 75 °C

Measured values:							Guaranteed values:		
							$\Delta P_0 + \Delta P_k$	tol.	tol.+0%
Powered winding:	Shorted winding:	For output:	u_k	ΔP_k	$\Sigma \Delta P$	u_k	ΔP_k	$\Sigma \Delta P$	
Tap Nr.:	Tap Nr.:	S [kVA]	[%]	[kW]	[kW]	[%]	[kW]	[kW]	
115 kV	1	11 kV	-	25 000	17,44	108,0			
	2				17,38	108,3			
	3				17,32	108,6			
	4				17,27	108,9			
	5				17,22	109,2			
	6				17,16	109,5			
	7				17,12	109,8			
	8				17,07	110,2			
	9				17,03	110,5			
	10				16,99	110,5	123,6	17,5±7,5%	125
	11				16,97	114,4			
	12				16,95	118,1			
	13				16,93	122,1			
	14				16,93	126,4			
	15				16,93	130,9			
	16				16,94	135,8			
	17				16,96	141,1			
	18				16,99	146,8			
	19				17,04	152,9			
38,5 kV	1 (+5%)	11 kV	-	25 000	5,74	94,8			
	2 (+2,5%)				5,86	96,1			
	3 (0%)				5,98	97,4	110,5	6,5±15%	106
	4 (-2,5%)				6,11	98,9			
	5 (-5%)				6,26	100,0			

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Date: 10.7.2020	Testing engineer: Ing. Čiviš	Head of laboratory: Ing. Langer	ETD TRANSFORMÁTORÝ a.s. Technická kontrola a zkušebna -2-
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TR0008/03/RJ



Test Certificate Transformer tests

Work No.: 0969547

Type: ETRZ 31 M-0

Manufacturer: ETD TRANSFORMÁTORÝ a.s.

Temperature rise for liquid-immersed transformers

Temperature rise test carried on in short-circuited connection at $f = 50$ Hz

Energized winding: 115 kV tap. No.: 19 (-16%)

Short-circuited winding: 38,5 kV tap. No.: 3 (0%)

Type of cooling: ONAN/ONAF

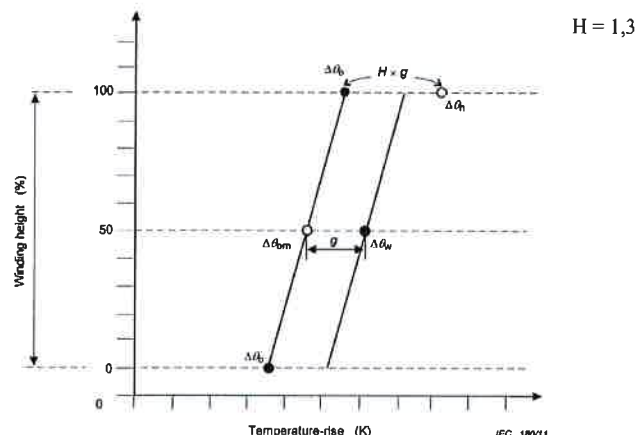
Description of cooling:

6 pcs radiators type FR3

2 pcs radiators type FR3L

2 pcs radiators type FR3R

10 pcs fans type EBM W8D500-CJ09-86



	ONAN		ONAF		
Measured winding	115 kV	38,5 kV	115 kV	38,5 kV	
Rated power S_n [MVA]	17,5	17,5	25	25	
Rated current I_n [A]	105	363	149	375	
Load loss ΔP_k [kW/75°C]	77,4		158,0		
No-load loss ΔP_0 [kW]	13,1		13,1		
Total losses $\Sigma \Delta P$ [kW]	90,5		171,1		
External cooling medium temp. Θ_a [°C]	26,3		24,5		
Top-liquid temp. rise (pocket) $\Delta \Theta_o$ [K]	47,6		50,0		
Top-liquid temperature rise $\Delta \Theta_o$ [K]	51,1		53,9		
Average liquid temperature rise $\Delta \Theta_{om}$ [K]	33,4		39,0		
Average winding gradient g [K]	6,5	5,5	14,1	9,7	
Average winding temperature rise $\Delta \Theta_w$ [K]	39,9	38,9	53,1	48,7	
Hot-spot winding temperature rise $\Delta \Theta_{h[K]}$	59,6	58,3	72,3	66,5	
For max. external cooling medium temp. Θ_a max. [°C]	40		40		
max. top-liquid temperature Θ_o max. [°C]	91,1		93,9		

Measurement of power taken by fan motor

Feeding voltage:	For 1 pc		For 10 pcs		
3x 400 V, 50 Hz	Feeding current I [A]	Inp. power P [W]	Feeding current I [A]	Inp. power P [W]	
Fans	0,137	72,7	1,355	710,1	

Date:	Testing engineer:	Head of laboratory:	ETD TRANSFORMÁTORÝ a.s. Technická kontrola a zkušebna -2-
10.7.2020	Ing. Čiviš	Ing. Langer	

TR0008/03/RJ

	ETD TRANSFORMÁTORÝ a.s. Zborovská 54/22, Doudlevice, 301 00 Plzeň, Česká republika	Certificate No.: TKZ 20/103 A	Page No.: 13 No. of pages: 14
	Test Certificate Transformer tests		
Work No.: 0969547	Type: ETRZ 31 M-0	Manufacturer: ETD TRANSFORMÁTORÝ a.s.	

Check the wiring and operation of the auxiliary circuits

Main, auxiliary, control, measuring, signalisation and guard circuits on the transformer according to EH 0003197 and EH 0003198 drawings.

Setting of instruments

Circuits:	Description:	Instrument (terminals):	Value:
Cooling control:	Automatic of cooling – switch on fans (oil)	BT1 (11-14)	60 °C
	Automatic of cooling – switch off fans (oil)	BT1 (11-14)	cca 48 °C
	Automatic of cooling – switch on fans (winding)	BT2 (11-14)	75 °C
	Automatic of cooling – switch off fans (winding)	BT2 (11-14)	cca 63 °C
Signalisation of fallures:	High temperature oil	BT1 (31-34)	90 °C
	High temperature winding	BT2 (31-34)	105 °C
Guard protection:	Dangerous temperature oil	BT1 (41-44)	100 °C
	Dangerous temperature winding	BT2 (41-44)	115 °C
Measuring:	Temperature increase, oil - winding for I_n	BT2 (5 - 5)	1,21 Ω (15 K)
Fans of motors:	Protection of fans	F01 – F10	0,16 A
Box equipment:	Heating	B51 (1-2)	10 °C

Insulation of auxiliary wiring (AuxW)

Repeated tests after final circuits connection.

Current transformer	2 500 V / 60 s / 50 Hz
Other circuits*	2 000 V / 60 s / 50 Hz

*Equipments with insulation level less than 2kV were disconnected from testing circuit.

Measurement of separate circuits insulation resistance

Measurement of individual circuits against earth	$U_{test} = 1\,000V_{DC}$
Individual circuits tested	$R_{insulating} > 500\,M\Omega$

Check of effective earth continuity between mounted devices and the protective circuit

Connection with protection circuits according to standard ČSN EN 61439-1 ed.2.

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Date: 10.7.2020	Testing engineer:  Ing. Čiviš	Head of laboratory:  Ing. Langer	ETD TRANSFORMÁTORÝ a.s. Technická kontrola a zkušebna -2-
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TR0008/03/RJ

	ETD TRANSFORMÁTORÝ a.s. Zborovská 54/22, Doudlevice, 301 00 Plzeň, Česká republika	Certificate No.: TKZ 20/103 A	Page No.: 14 No. of pages: 14
	Test Certificate Transformer tests		
Work No.: 0969547	Type: ETRZ 31 M-0	Manufacturer: ETD TRANSFORMÁTORÝ a.s.	

Tests on on-load tap-changers – Operation test

- 8 complete operating cycles with transformer not energized;
- 1 complete operating cycle with transformer not energized, with 85 % of the rated auxiliary supply voltage;
- 1 complete operating cycle with the transformer energized at rated voltage and frequency at no-load;
- 10 tap-change operations with ± 2 steps on either side of the principal tapping with as far as possible the rated current of the transformer, with one winding short – circuited.

Tests on no-load tap-changers (NLTC)

Operation test of NLTC was carried out during of the voltage ratio measurement, short-circuit impedance and load loss measurement and no-load loss and current measurement.

Check of the ratio and polarity of built-in current transformers

Check of the ratio and polarity of built-in current transformers – during measurement of short-circuit impedance and load loss.

List of equipment

Meters:	Fab. No.:	Date of calibration:	Date next calibration:	Pasport No.:
Current measurement transformer TETTEX 4874 sp.	32370 A÷C	12.01.2018	12.01.2023	8017-KL-T0003÷5-18
Voltage measurement transformer EPRO NVOS 50	2/12/3738÷3740	12.01.2018	12.01.2023	8017-KL-T0006÷8-18
Power analyzer NORMA 5000-PP64	WO15590BA	30.11.2019	30.11.2020	5249/19/A
Multimeter AGILENT 34970A	MY57007180	14.03.2020	14.03.2021	1252/20/A
Ratio and vector groupe MEGGER TTR 300	71273 1114	30.01.2019	30.01.2021	TKZ 19/014
Megaohmmeter C.A 6547	106803TAH	22.02.2020	22.02.2022	899/20/A
Kilovoltmeter MU17+A2	884764	20.02.2020	20.02.2022	893/20/A
Divider HIGHVOLT 250 kV - AC	884766	20.09.2019	20.09.2021	3880/19/A
Calibrator PD OMICRON CAL542B	GB324B	16.03.2020	16.03.2022	72/20/S
Kilovoltmeter HAEFELY 2000 kV	12100015.60.1÷2 12100015.65.1	26.07.2017	26.07.2022	2873/17/A
Measuring device HAEFELY HiAS 743	176632	21.02.2020	21.02.2022	896/20/A
Bridge MEGGER DELTA 4110	1777 1014	01.12.2018	01.12.2020	412/18/S
Dieltest of oil BAUR DTA 100	952922008	17.10.2019	17.10.2021	TKZ 19/210
Aquameter BAUR KFM 1000 S	959713011	28.04.2020	28.04.2022	TKZ 20/068
Schering bridge TETTEX 2801	121510	24.07.2017	24.07.2020	2755/17/A
Teraohmmeter SEFELEC M1500 UFA	676	24.07.2017	24.07.2020	2812/17/A
Gas chromatograph AGILENT 7890B	CN 18073060	22.08.2018	22.08.2021	TKZ 18/205
Acoustic calibrator CAL200	10693	27.11.2018	27.11.2021	6035-KL-K0056-18
Noise meter NTI Audio XL2 with microphone NTI Audio MC230	A2A-08124-E0 9106	14.02.2020	14.02.2023	6035-KL-Z0013-20

Date: 10.7.2020	Testing engineer:  Ing. Čiviš	Head of laboratory:  Ing. Langer	ETD TRANSFORMÁTORÝ a.s. Technická kontrola a zkušebna -2-
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TR0008/03/RJ

Enclosure to protocol No. TKZ 20/103A
Lighting impulse test

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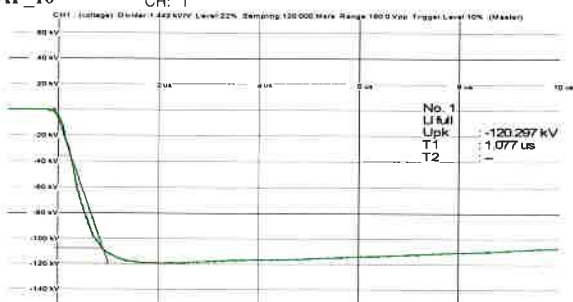
Work No.: 0969547

Temperature: 23 °C

Pressure: 730,5 mmHg

A_TAP_10

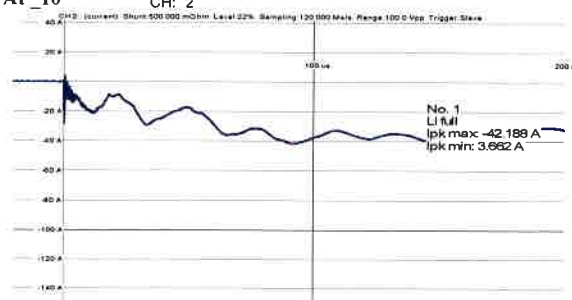
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No. 1 LI full Upk: -120.297 kV T1: 1.077 us T2: --

A_TAP_10

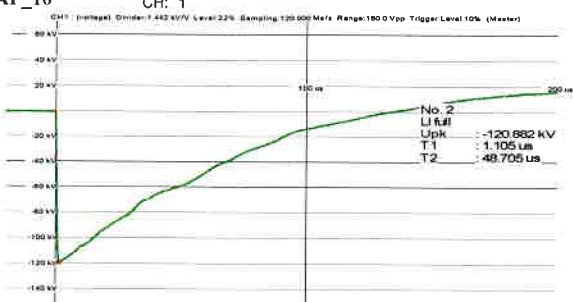
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No. 1 LI full Ipk max: -42.188 A Ipk min: 3.662 A

A_TAP_10

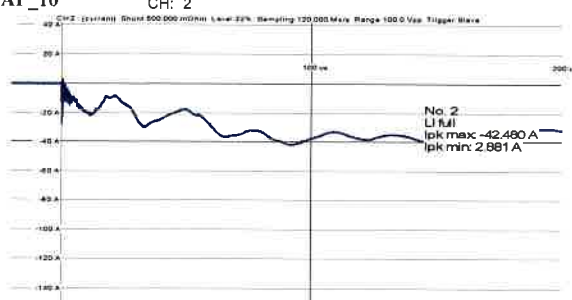
CH: 1



No. 2 LI full Upk: -120.882 kV T1: 1.105 us T2: 48.705 us

A_TAP_10

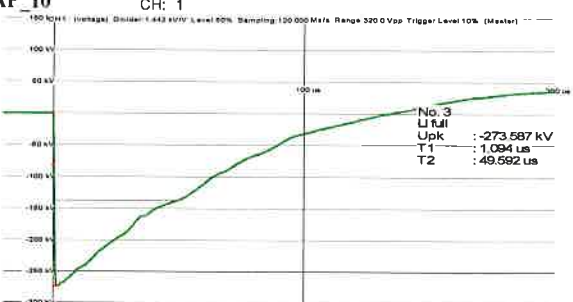
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No. 2 LI full Ipk max: -42.480 A Ipk min: 2.881 A

A_TAP_10

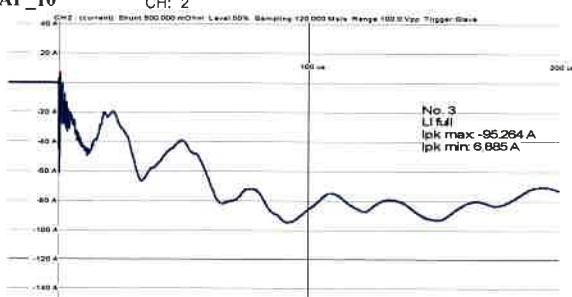
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No. 3 LI full Upk: -273.587 kV T1: 1.094 us T2: 49.592 us

A_TAP_10

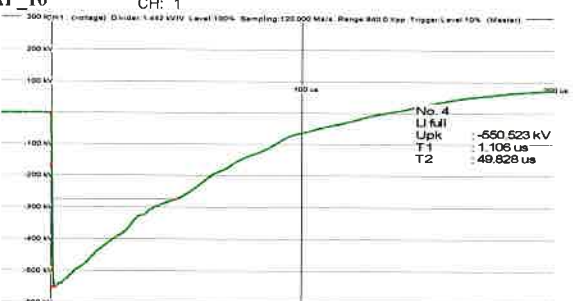
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No. 3 LI full Ipk max: -95.264 A Ipk min: 6.885 A

A_TAP_10

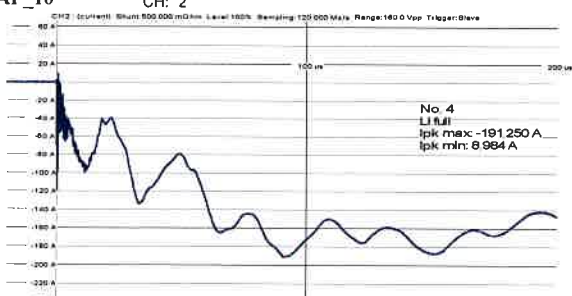
CH: 1



No. 4 LI full Upk: -550.523 kV T1: 1.106 us T2: 49.828 us

A_TAP_10

CH: 2



No. 4 LI full Ipk max: -191.250 A Ipk min: 8.984 A

Date:

02/07/20

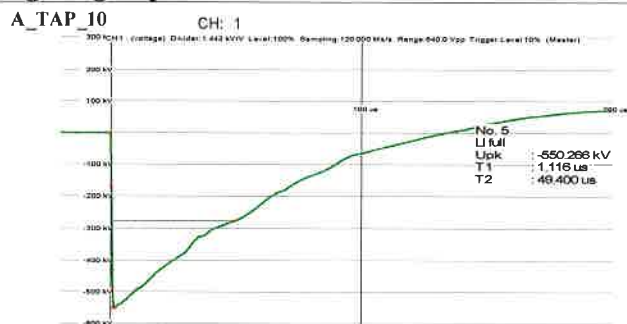
Testing engineer:

ETD TRANSFORMÁTORÝ a.s. Ing. Čiviš
Technická kontrola a zkušebna

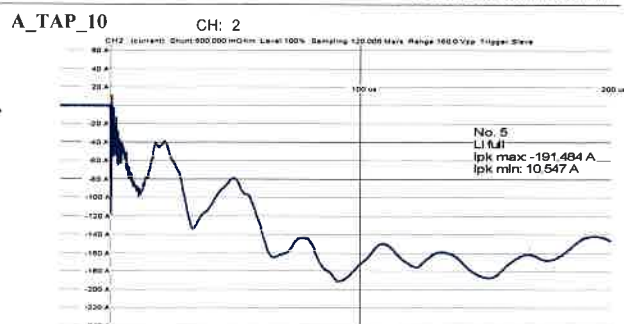
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Enclosure to protocol No. TKZ 20/103A
Lighting impulse test

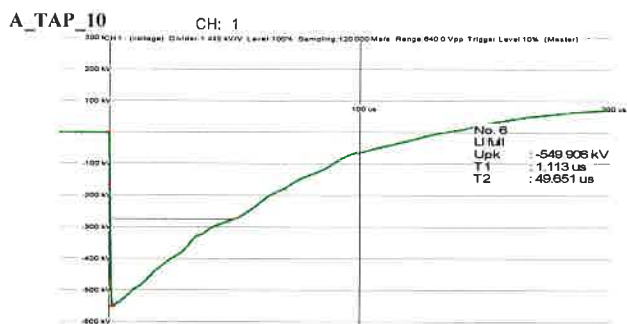
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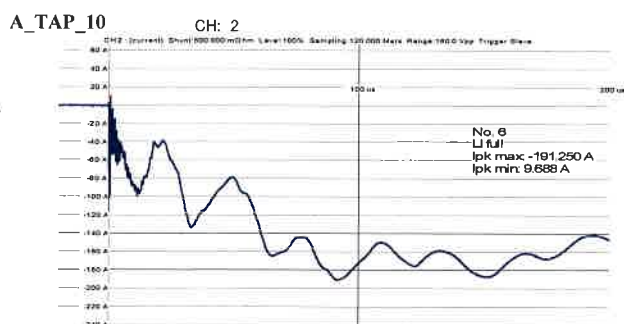
No. 5 LI full Upk: -550.266 kV T1: 1.116 us T2: 49.400 us



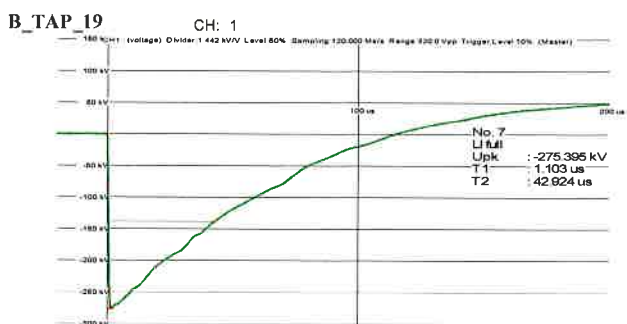
No. 5 LI full Ipk max: -191.484 A Ipk min: 10.547 A



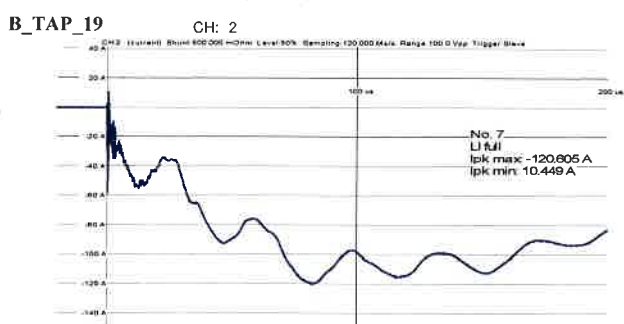
No. 6 LI full Upk: -549.906 kV T1: 1.113 us T2: 49.651 us



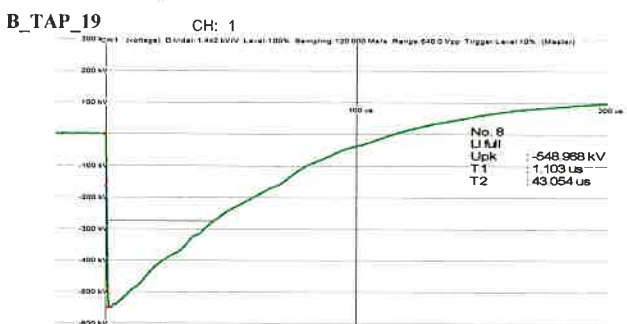
No. 6 LI full Ipk max: -191.250 A Ipk min: 9.688 A



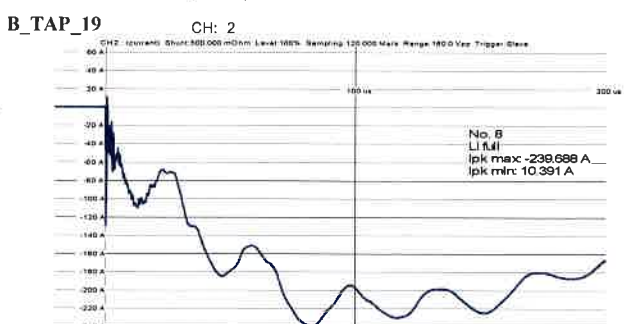
No. 7 LI full Upk: -275.395 kV T1: 1.103 us T2: 42.924 us



No. 7 LI full Ipk max: -120.605 A Ipk min: 10.449 A



No. 8 LI full Upk: -548.968 kV T1: 1.103 us T2: 43.054 us



No. 8 LI full Ipk max: -239.688 A Ipk min: 10.391 A

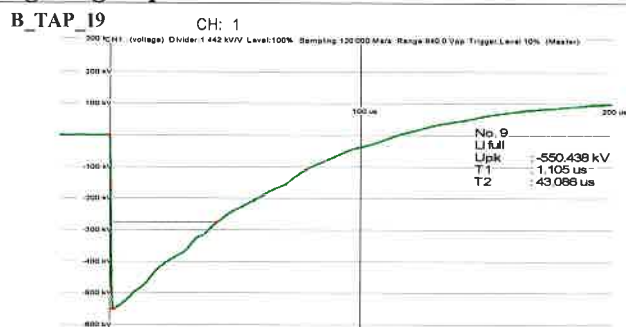
Date:
02/07/20

Testing engineer:
Ing. Čiviš

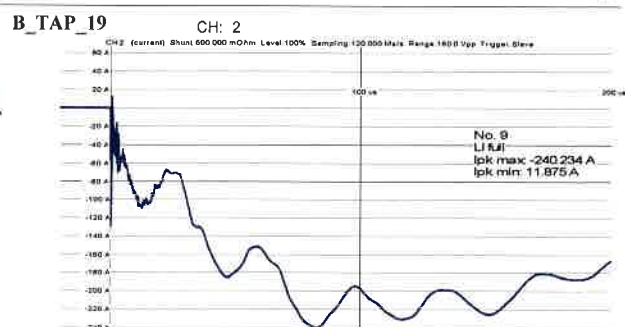
ETD TRANSFORMÁTORÝ a.s.
Technická kontrola a zkušebna
-2-

Enclosure to protocol No. TKZ 20/103A
Lighting impulse test

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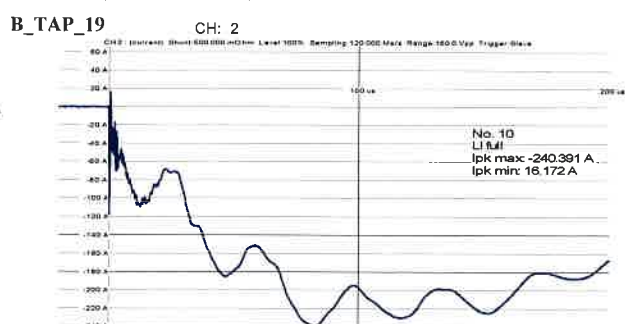
No. 9 LI full Upk: -550.438 kV T1: 1.105 us T2: 43.086 us



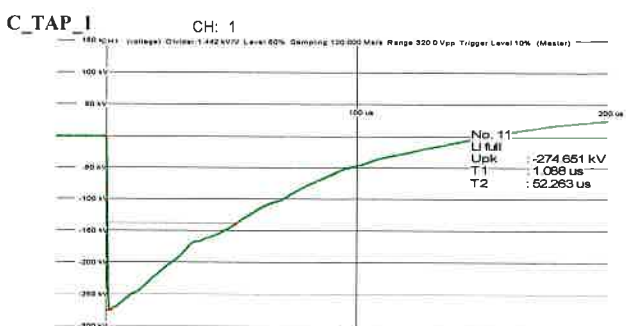
No. 9 LI full Ipk max: -240.234 A Ipk min: 11.875 A



No. 10 LI full Upk: -550.420 kV T1: 1.107 us T2: 43.047 us



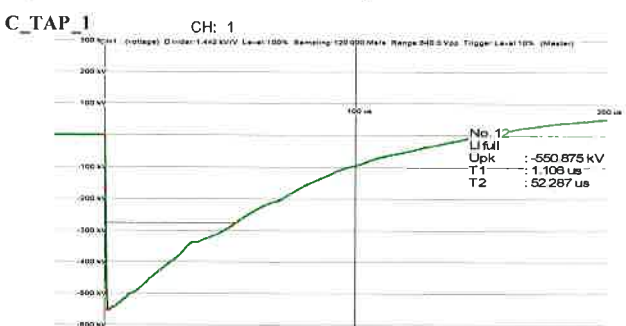
No. 10 LI full Ipk max: -240.391 A Ipk min: 16.172 A



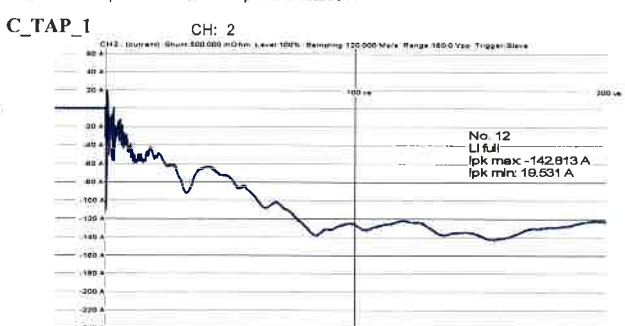
No. 11 LI full Upk: -274.651 kV T1: 1.088 us T2: 52.263 us



No. 11 LI full Ipk max: -71.143 A Ipk min: 10.205 A



No. 12 LI full Upk: -550.875 kV T1: 1.106 us T2: 52.287 us



No. 12 LI full Ipk max: -142.813 A Ipk min: 19.531 A

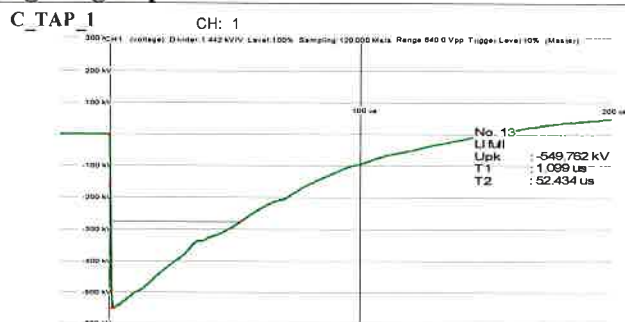
Date:
02/07/20

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Technická kontrola a zkušebna
-2-

Testing engineer:
Ing. Čiviš

Enclosure to protocol No. TKZ 20/103A
Lighting impulse test

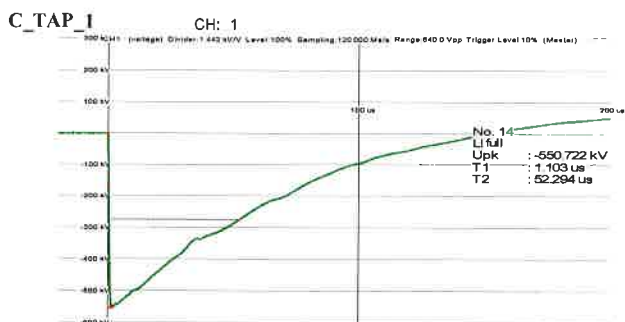
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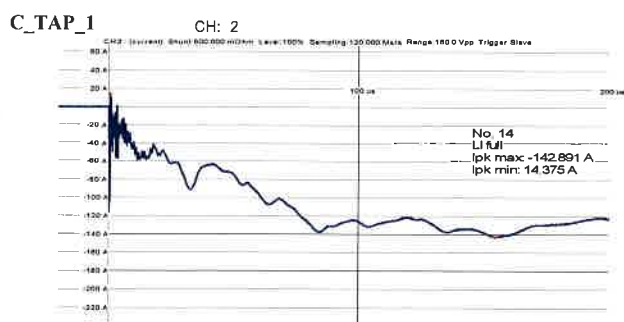
No. 13 LI full Upk: -549.762 kV T1: 1.099 µs T2: 52.434 µs



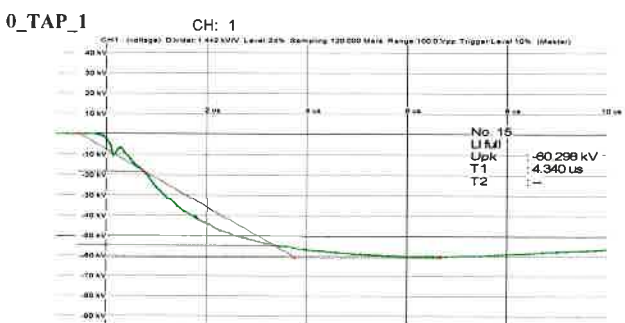
No. 13 LI full Ipk max: -142.500 A Ipk min: 14.844 A



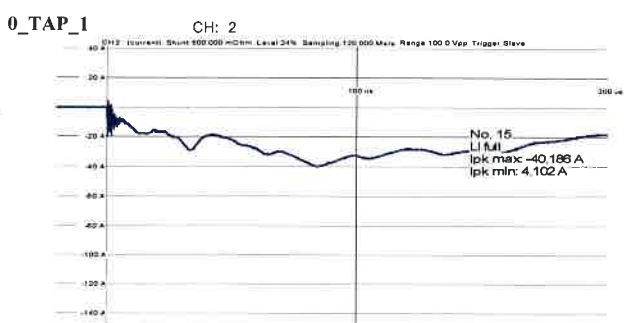
No. 14 LI full Upk: -550.722 kV T1: 1.103 µs T2: 52.294 µs



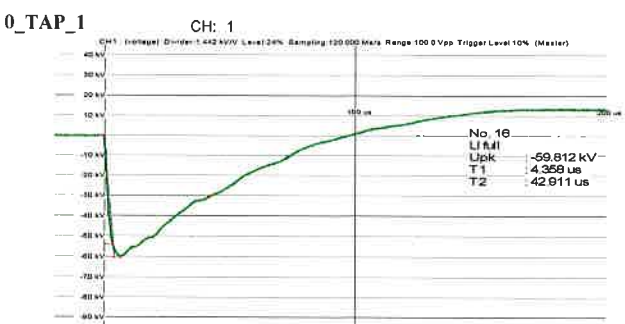
No. 14 LI full Ipk max: -142.891 A Ipk min: 14.375 A



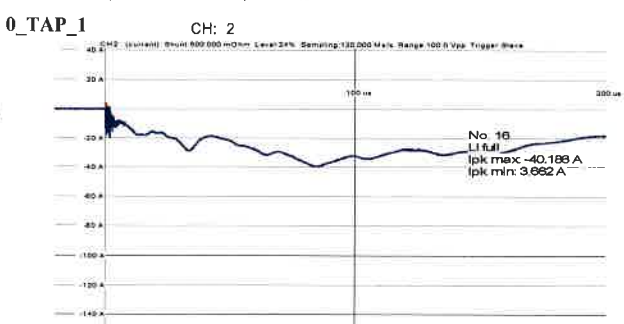
No. 15 LI full Upk: -60.298 kV T1: 4.340 µs T2: --



No. 15 LI full Ipk max: -40.186 A Ipk min: 4.102 A



No. 16 LI full Upk: -59.812 kV T1: 4.358 µs T2: 42.911 µs



No. 16 LI full Ipk max: -40.186 A Ipk min: 3.662 A

Date:
02/07/20

Testing engineer:
Ing. Čiviš

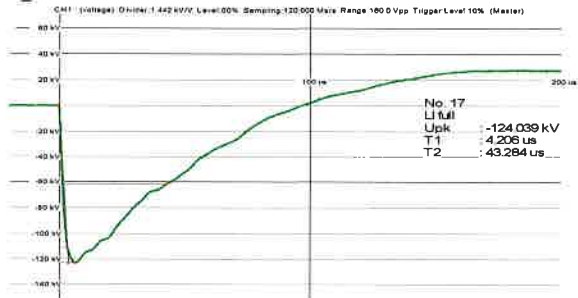
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Technická kontrola a zkušebna
-2-

Enclosure to protocol No. TKZ 20/103A
Lighting impulse test

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0_TAP_1

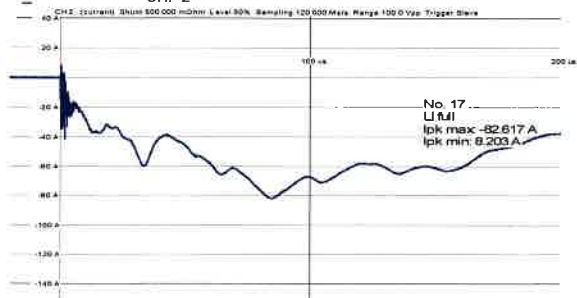
CH: 1



No. 17 LI full Upk: -124.039 kV T1: 4.206 us T2: 43.284 us

0_TAP_1

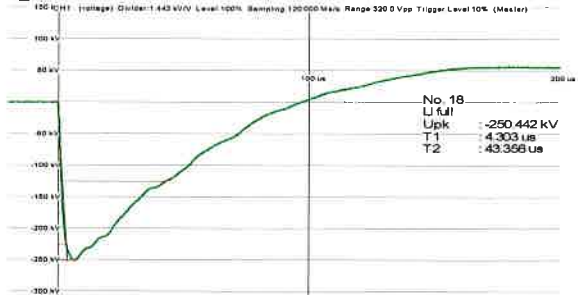
CH: 2



No. 17 LI full Ipk max: -82.617 A Ipk min: 8.203 A

0_TAP_1

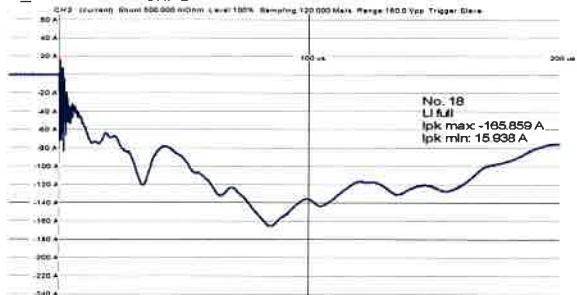
CH: 1



No. 18 LI full Upk: -250.442 kV T1: 4.303 us T2: 43.356 us

0_TAP_1

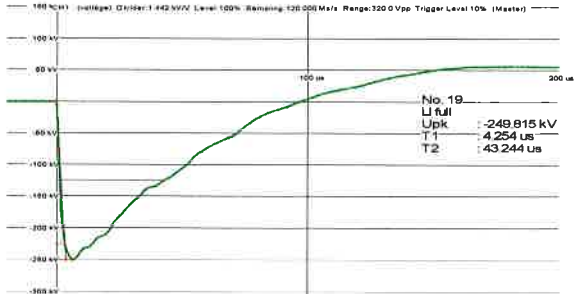
CH: 2



No. 18 LI full Ipk max: -165.859 A Ipk min: 15.938 A

0_TAP_1

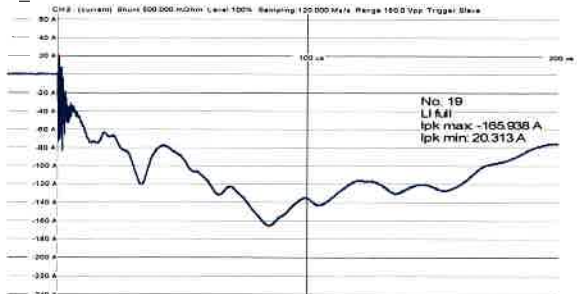
CH: 1



No. 19 LI full Upk: -249.815 kV T1: 4.254 us T2: 43.244 us

0_TAP_1

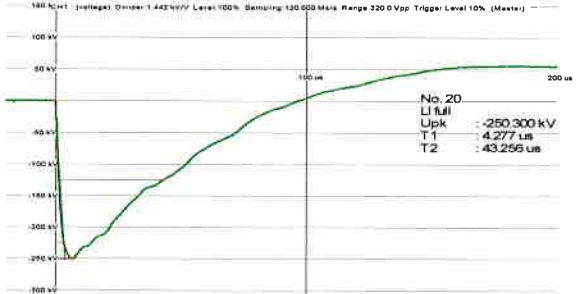
CH: 2



No. 19 LI full Ipk max: -165.938 A Ipk min: 20.313 A

0_TAP_1

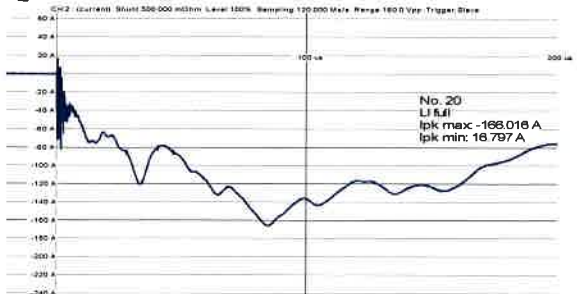
CH: 1



No. 20 LI full Upk: -250.300 kV T1: 4.277 us T2: 43.256 us

0_TAP_1

CH: 2



No. 20 LI full Ipk max: -166.016 A Ipk min: 16.797 A

Date:
02/07/20

Testing engineer:
Ing. Čiviš

ETD TRANSFORMÁTORY a.s.
Technická kontrola a zkušebna
-2-

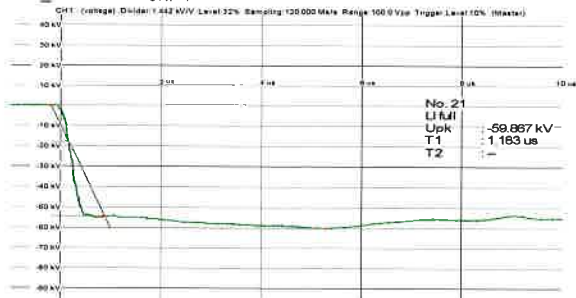
Enclosure to protocol No. TKZ 20/103A
Lighting impulse test

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AM TAP_3

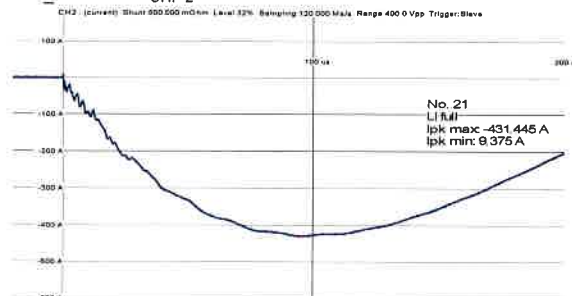
CH: 1



No. 21 LI full Upk: -59.867 kV T1: 1.183 us T2: --

AM TAP_3

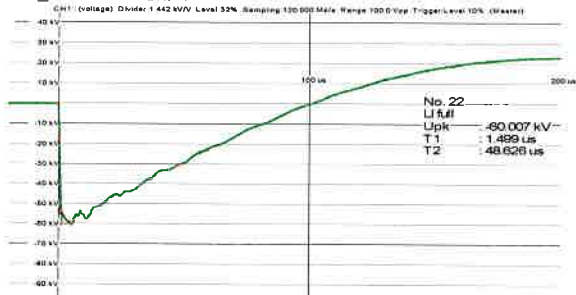
CH: 2



No. 21 LI full Ipk max: -431.445 A Ipk min: 9.375 A

AM TAP_3

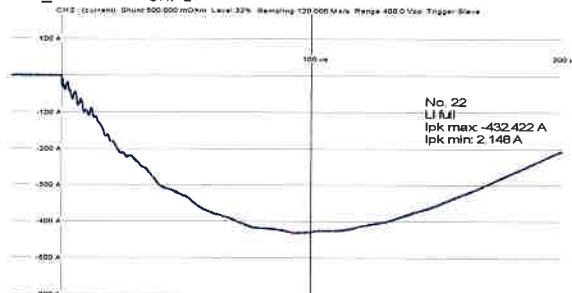
CH: 1



No. 22 LI full Upk: -60.007 kV T1: 1.499 us T2: 48.626 us

AM TAP_3

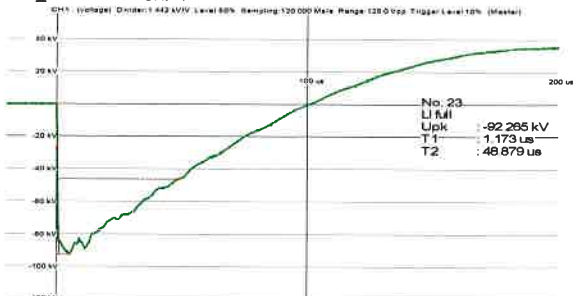
CH: 2



No. 22 LI full Ipk max: -432.422 A Ipk min: 2.148 A

AM TAP_3

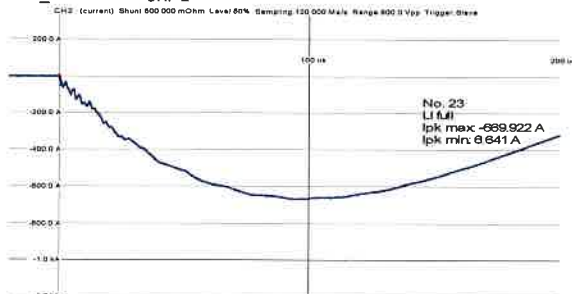
CH: 1



No. 23 LI full Upk: -92.265 kV T1: 1.173 us T2: 48.879 us

AM TAP_3

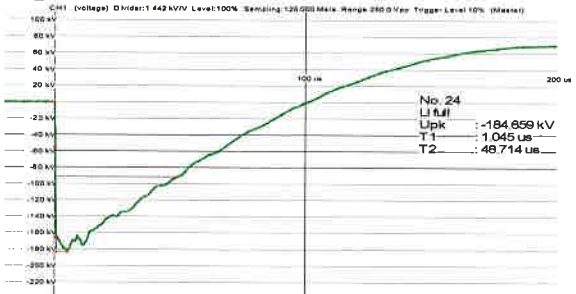
CH: 2



No. 23 LI full Ipk max: -669.922 A Ipk min: 6.641 A

AM TAP_3

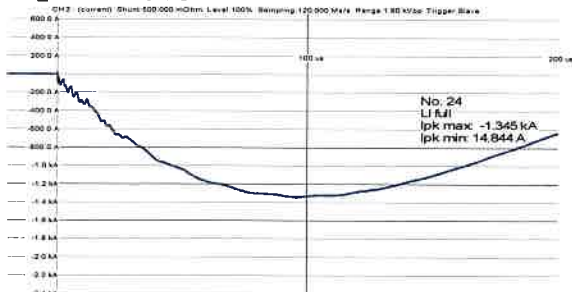
CH: 1



No. 24 LI full Upk: -184.659 kV T1: 1.045 us T2: 48.714 us

AM TAP_3

CH: 2



No. 24 LI full Ipk max: -1.345 kA Ipk min: 14.844 A

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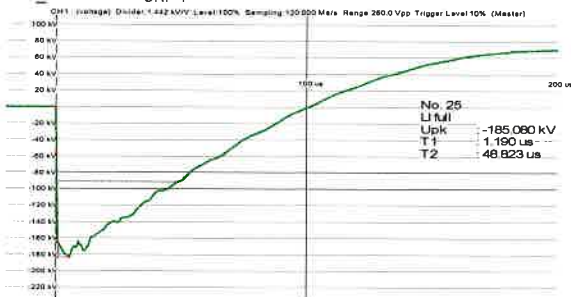
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AM TAP 3

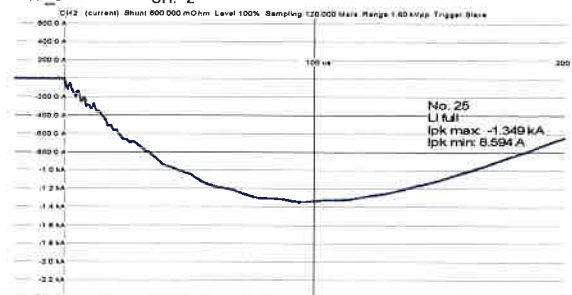
CH: 1



No. 25 LI full Upk: -185.080 kV T1: 1.190 us T2: 48.823 us

AM TAP 3

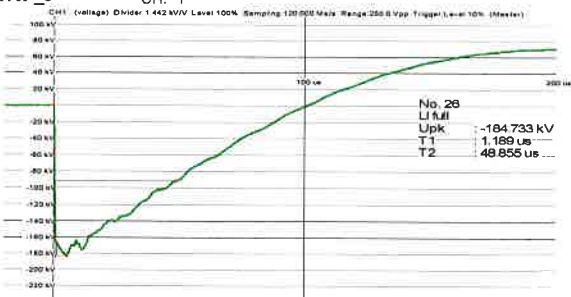
CH: 2



No. 25 LI full Ipk max: -1.349 kA Ipk min: 8.594 A

AM TAP 3

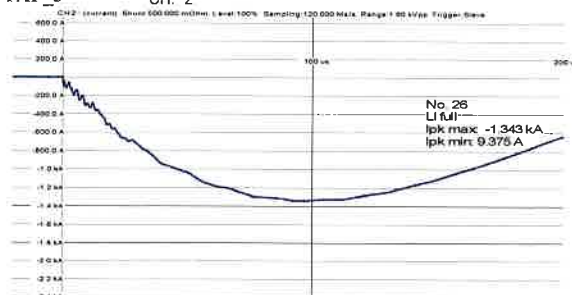
CH: 1



No. 26 LI full Upk: -184.733 kV T1: 1.189 us T2: 48.855 us

AM TAP 3

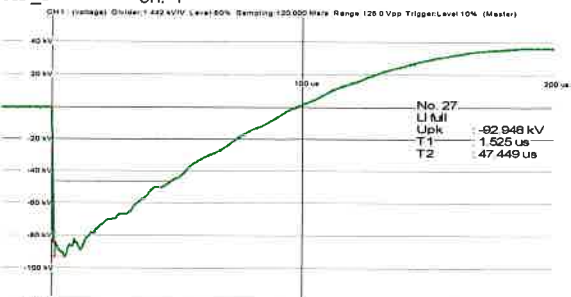
CH: 2



No. 26 LI full Ipk max: -1.343 kA Ipk min: 9.375 A

BM TAP 5

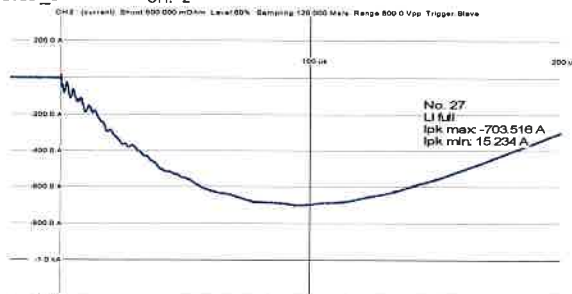
CH: 1



No. 27 LI full Upk: -92.948 kV T1: 1.525 us T2: 47.449 us

BM TAP 5

CH: 2



No. 27 LI full Ipk max: -703.516 A Ipk min: 15.234 A

BM TAP 5

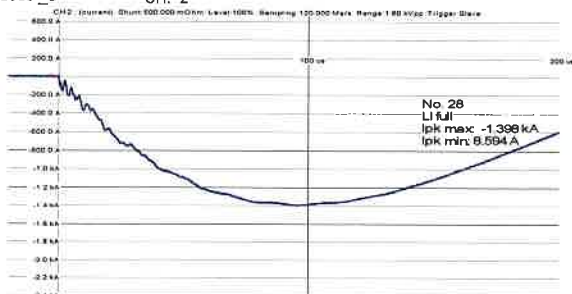
CH: 1



No. 28 LI full Upk: -184.405 kV T1: 1.298 us T2: 47.570 us

BM TAP 5

CH: 2



No. 28 LI full Ipk max: -1.398 kA Ipk min: 8.594 A

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Ing. Čiviš

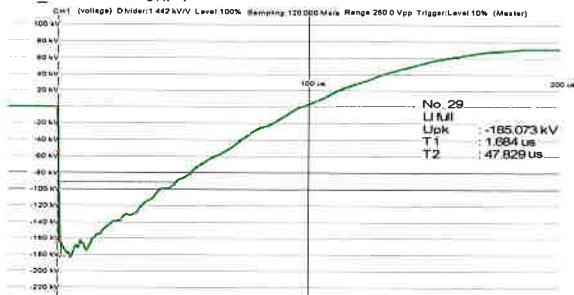
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BM TAP_5

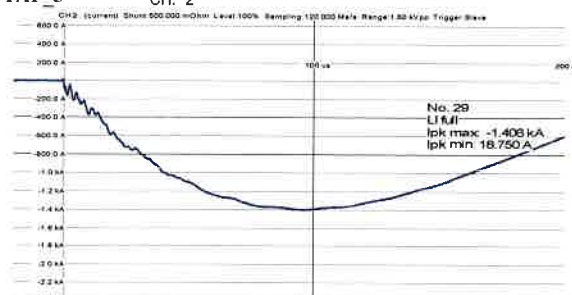
CH: 1



No. 29 LI full Upk: -185.073 kV T1: 1.684 us T2: 47.829 us

BM TAP_5

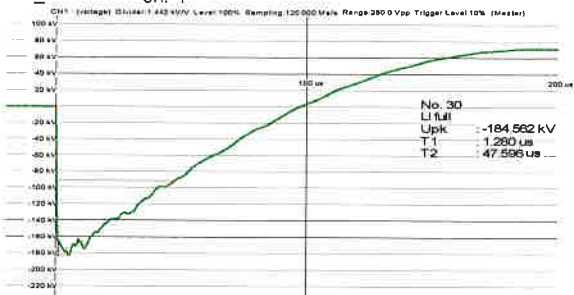
CH: 2



No. 29 LI full Ipk max: -1.406 kA Ipk min: 18.750 A

BM TAP_5

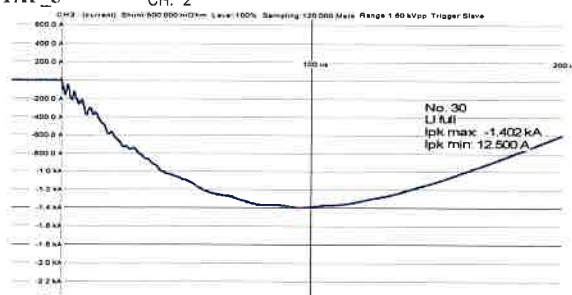
CH: 1



No. 30 LI full Upk: -184.562 kV T1: 1.280 us T2: 47.596 us

BM TAP_5

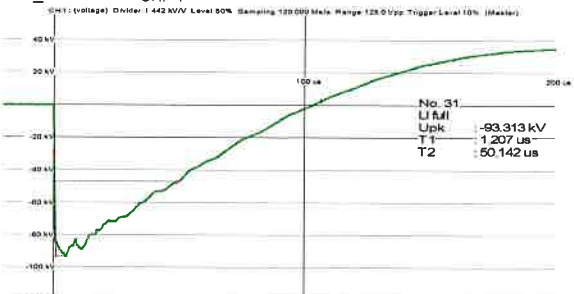
CH: 2



No. 30 LI full Ipk max: -1.402 kA Ipk min: 12.500 A

CM TAP_1

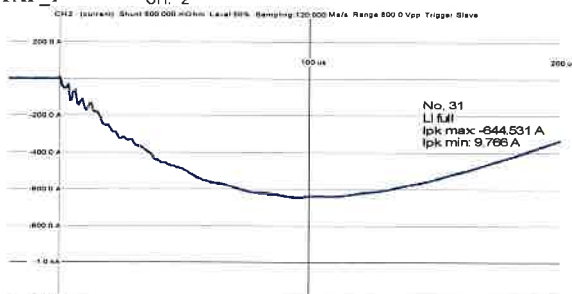
CH: 1



No. 31 LI full Upk: -93.313 kV T1: 1.207 us T2: 50.142 us

CM TAP_1

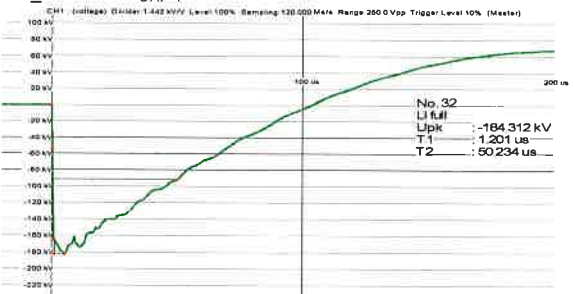
CH: 2



No. 31 LI full Ipk max: -644.531 A Ipk min: 9.766 A

CM TAP_1

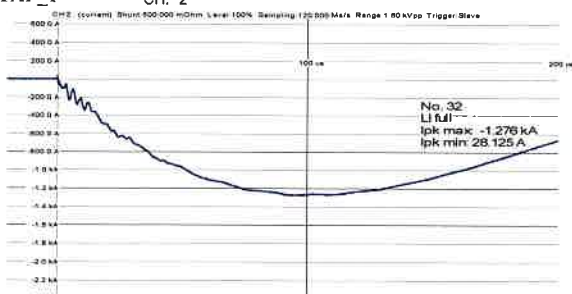
CH: 1



No. 32 LI full Upk: -184.312 kV T1: 1.201 us T2: 50.234 us

CM TAP_1

CH: 2



No. 32 LI full Ipk max: -1.276 kA Ipk min: 28.125 A

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[Signature]

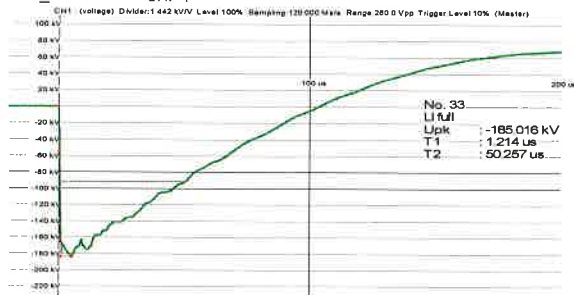
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CM TAP_1

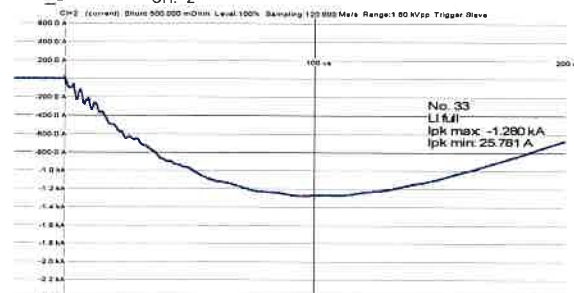
CH: 1



No. 33 LI full Upk: -185.016 kV T1: 1.214 us T2: 50.257 us

CM TAP_1

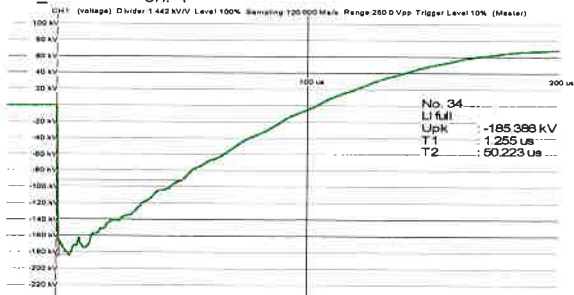
CH: 2



No. 33 LI full Ipk max: -1.280 kA Ipk min: 25.781 A

CM TAP_1

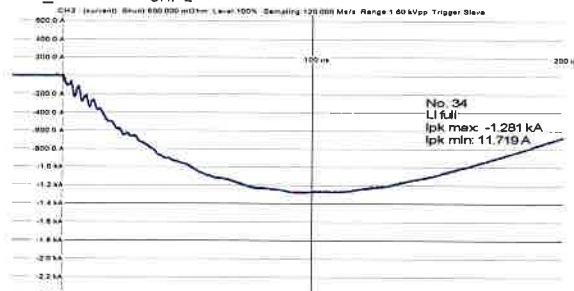
CH: 1



No. 34 LI full Upk: -185.386 kV T1: 1.255 us T2: 50.223 us

CM TAP_1

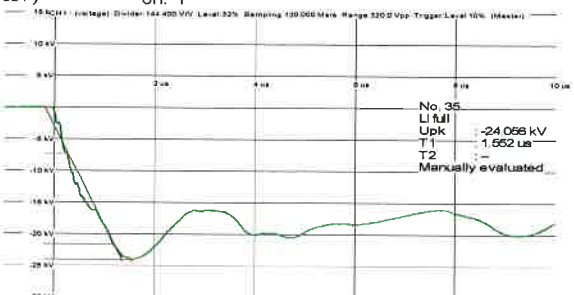
CH: 2



No. 34 LI full Ipk max: -1.281 kA Ipk min: 11.719 A

A (11KV)

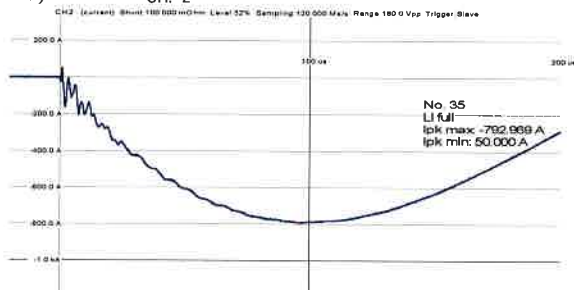
CH: 1



No. 35 LI full Upk: -24.056 kV T1: 1.552 us T2: -- Manually evaluated

A (11KV)

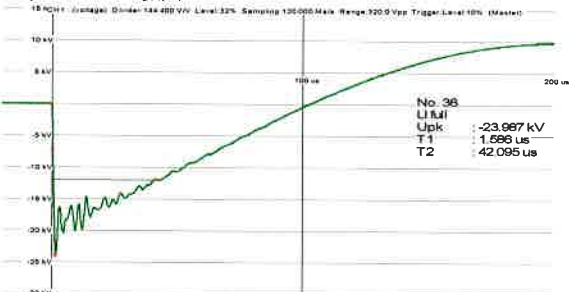
CH: 2



No. 35 LI full Ipk max: -792.969 A Ipk min: 50.000 A

A (11KV)

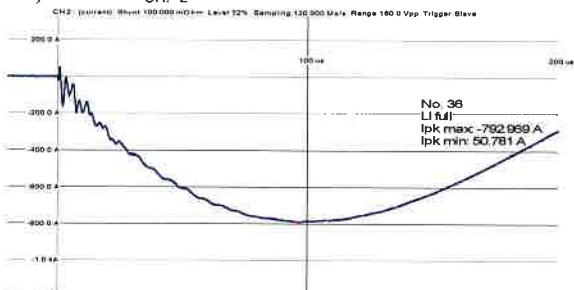
CH: 1



No. 36 LI full Upk: -23.987 kV T1: 1.586 us T2: 42.095 us

A (11KV)

CH: 2



No. 36 LI full Ipk max: -792.969 A Ipk min: 50.781 A

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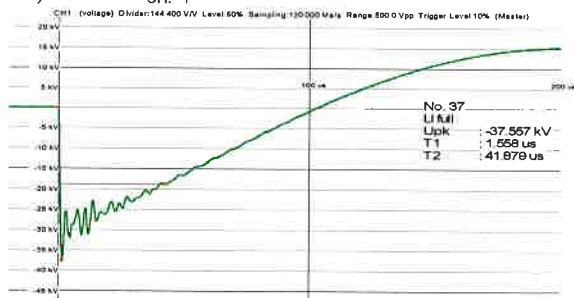
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A (11KV)

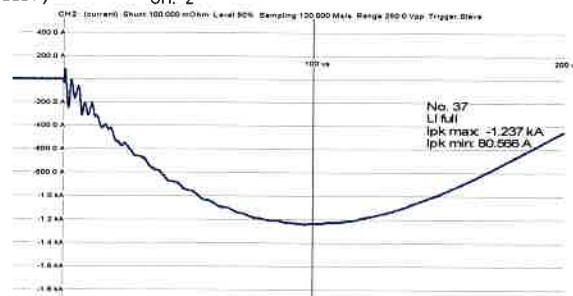
CH: 1



No. 37 LI full Upk: -37.557 kV T1: 1.558 us T2: 41.879 us

A (11KV)

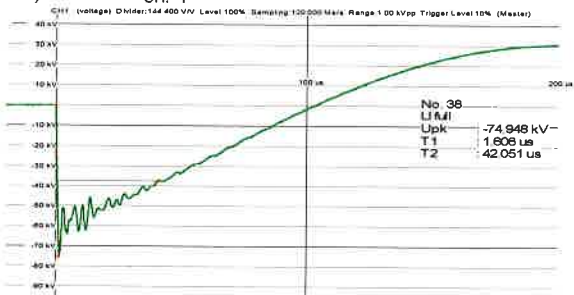
CH: 2



No. 37 LI full Ipk max: -1.237 kA Ipk min: 80.566 A

A (11KV)

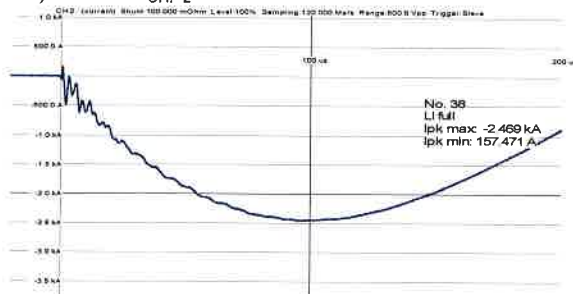
CH: 1



No. 38 LI full Upk: -74.948 kV T1: 1.606 us T2: 42.051 us

A (11KV)

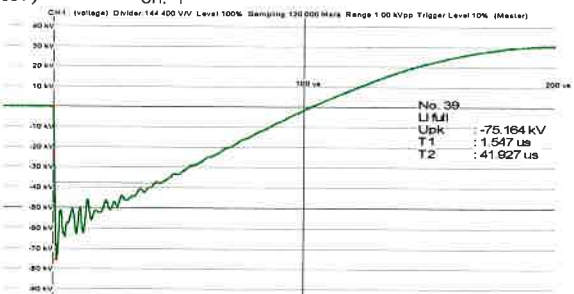
CH: 2



No. 38 LI full Ipk max: -2.469 kA Ipk min: 157.471 A

A (11KV)

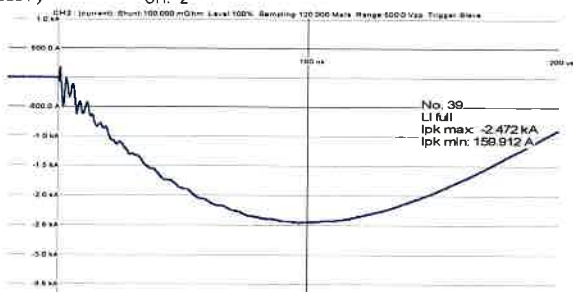
CH: 1



No. 39 LI full Upk: -75.164 kV T1: 1.547 us T2: 41.927 us

A (11KV)

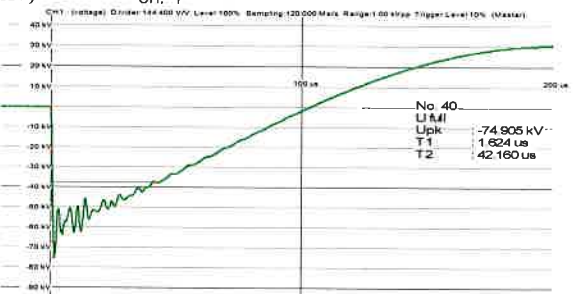
CH: 2



No. 39 LI full Ipk max: -2.472 kA Ipk min: 159.912 A

A (11KV)

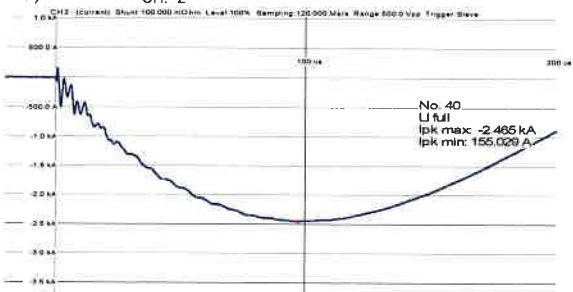
CH: 1



No. 40 LI full Upk: -74.905 kV T1: 1.624 us T2: 42.160 us

A (11KV)

CH: 2



No. 40 LI full Ipk max: -2.465 kA Ipk min: 155.029 A

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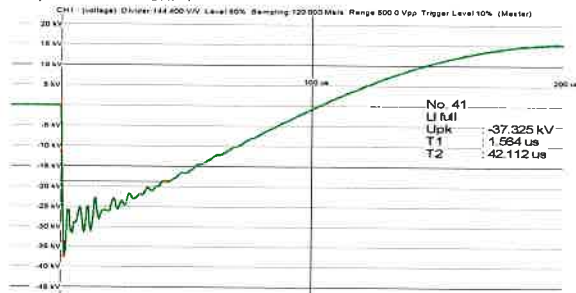
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B (11KV)

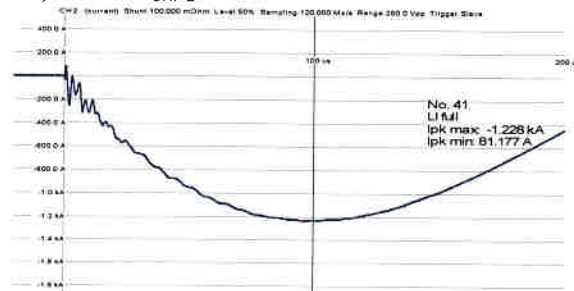
CH: 1



No. 41 LI full Upk: -37.325 kV T1: 1.564 us T2: 42.112 us

B (11KV)

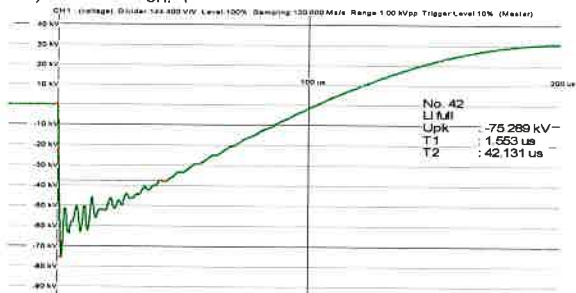
CH: 2



No. 41 LI full Ipk max: -1.228 kA Ipk min: 81.177 A

B (11KV)

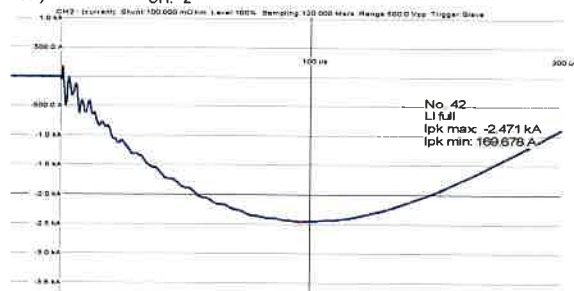
CH: 1



No. 42 LI full Upk: -75.289 kV T1: 1.553 us T2: 42.131 us

B (11KV)

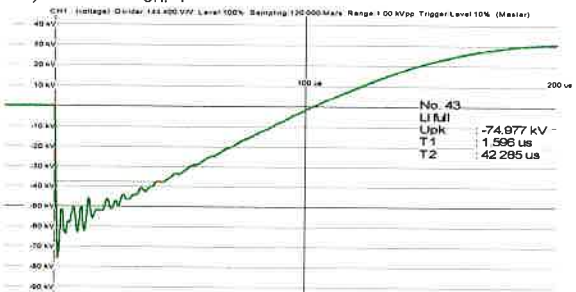
CH: 2



No. 42 LI full Ipk max: -2.471 kA Ipk min: 169.678 A

B (11KV)

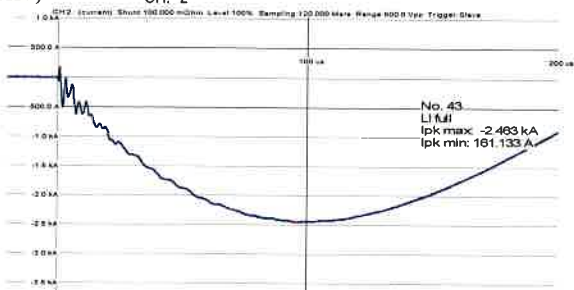
CH: 1



No. 43 LI full Upk: -74.977 kV T1: 1.596 us T2: 42.285 us

B (11KV)

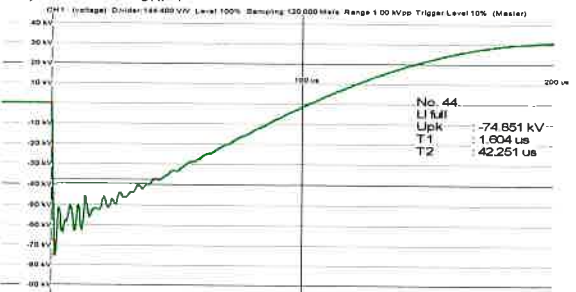
CH: 2



No. 43 LI full Ipk max: -2.463 kA Ipk min: 161.133 A

B (11KV)

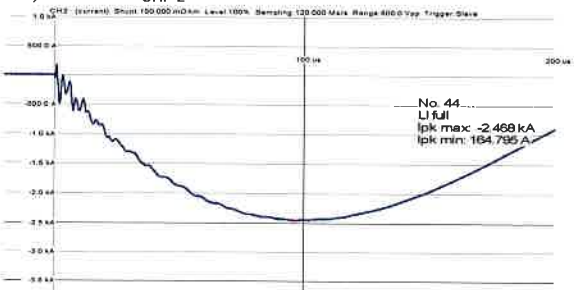
CH: 1



No. 44 LI full Upk: -74.851 kV T1: 1.604 us T2: 42.251 us

B (11KV)

CH: 2



No. 44 LI full Ipk max: -2.468 kA Ipk min: 164.795 A

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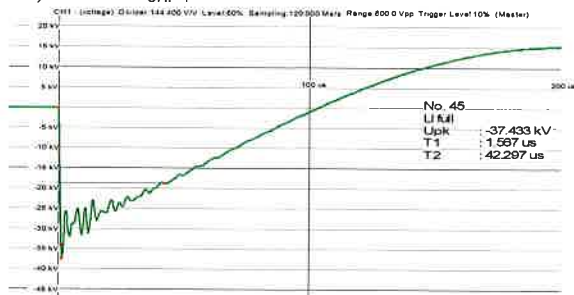
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C (11KV)

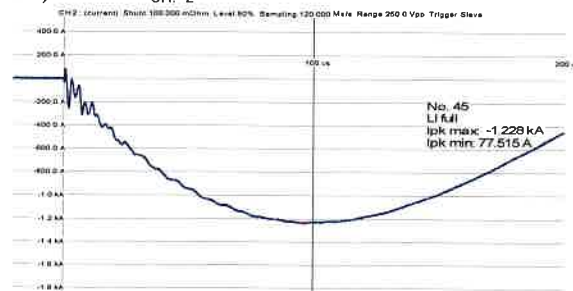
CH: 1



No. 45 LI full Upk: -37.433 kV T1: 1.567 us T2: 42.297 us

C (11KV)

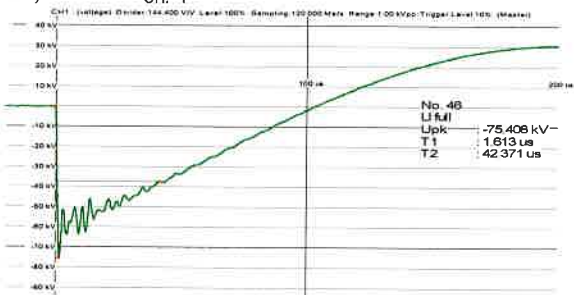
CH: 2



No. 45 LI full Ipk max: -1.228 kA Ipk min: 77.515 A

C (11KV)

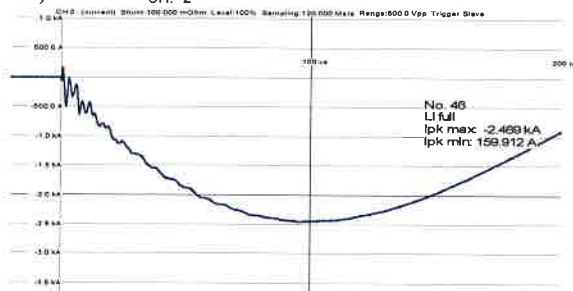
CH: 1



No. 46 LI full Upk: -75.408 kV T1: 1.613 us T2: 42.371 us

C (11KV)

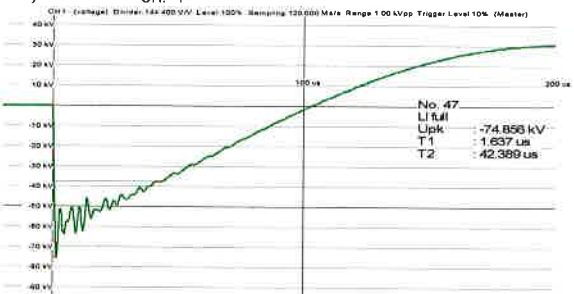
CH: 2



No. 46 LI full Ipk max: -2.469 kA Ipk min: 159.912 A

C (11KV)

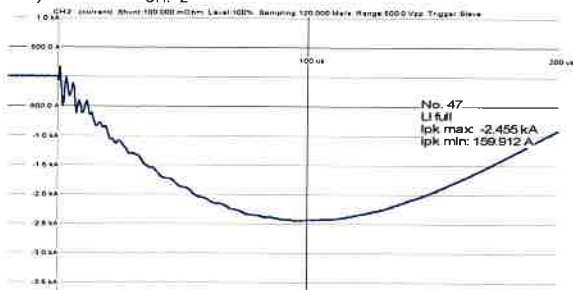
CH: 1



No. 47 LI full Upk: -74.856 kV T1: 1.637 us T2: 42.389 us

C (11KV)

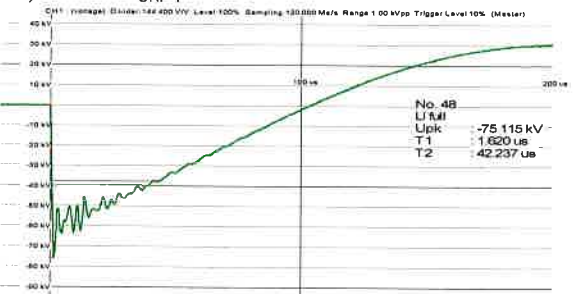
CH: 2



No. 47 LI full Ipk max: -2.455 kA Ipk min: 159.912 A

C (11KV)

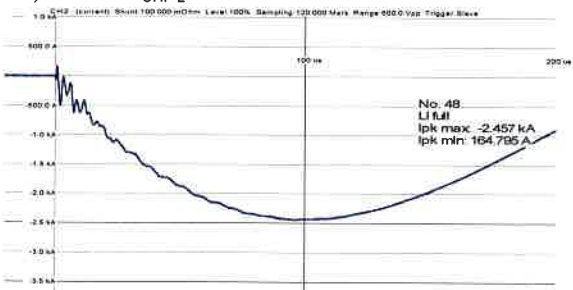
CH: 1



No. 48 LI full Upk: -75.115 kV T1: 1.620 us T2: 42.237 us

C (11KV)

CH: 2



No. 48 LI full Ipk max: -2.457 kA Ipk min: 164.795 A

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Testing engineer:
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tel.: +420 373 031 402, e-mail: jakub.langer@etd-bez.cz



Number of pages: 1/10

Test Certificate

TKZ 20/102A

Purchaser:	JSC „APSVIETIMAS“
Subject of tests:	Power three-phase regulator oil transformer type ETRZ 31 M-0, work No. 0969547
Date of the test:	1st – 2nd July 2020
Internal order No.:	13.00.0048 / 3010000246
Order No.:	ME000110327

Test methods:

ČSN EN 60076-10 ed. 2

Power transformers – Part 10: Determination of sound levels

Test results: listed in the text

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In Pilsen, 2nd July 2020


Ing. Jakub Langer
Head of laboratory

**ETD TRANSFORMÁTORÝ a.s.**Certificate No.:
TKZ 20/102APage No.: 2
No. of pages: 10**Test Certificate**
Power Transformer - Determination of Sound Levels

Work No.: 0969547

Type ETRZ 31 M-0

Manufacturer: ETD TRANSFORMÁTORÝ a.s.

Purchaser:	JSC „APSVIETIMAS“	Internal order No.:	13.00.0048 3010000246
Order No.:	ME000110327	Register No.:	ME000110327

Technical data

Winding:	Output [kVA]:	Voltage [V]:	Current [A]:
1	25 000	115 000 $\pm 9 \times 1.778\%$	126
2	25 000	38 500 $\pm 2 \times 2.5\%$	375
3	25 000	11 000	1312

Vector group:	YNyn0d11	Type of cooling:	ONAN/ONAF	Sort of loading:	S1
No. of phases:	3	Rated frequency:	50 Hz	Insulation class:	A

Contents:

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Method of measurements	2
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Calibration	2
Test evaluation	3
Environmental correction	3
Layout of measuring points	4
Results of measurements	5
Charts of measurement	9

Method of measurements

Standard:	IEC 60076-10		
Method:	Sound pressure level (Ch. 11)	Weighting filter:	A - filter
	Point by point method	Zone:	1/3 octave

Measuring instruments

Sound Level Meter	NTi Audio XL2	Serial number:	A2A-08124-EO	Calibration certificate:	6035-KL-Z0013-20
Microphone	M2230	Serial number:	9106		
Acoustic calibrator	CAL200	Serial number:	10693	Calibration certificate:	6035-KL-K0056-18

Calibration

Sound Level Meter is checked before and after each measurement using acoustic calibrator
Acoustic calibrator, sound level meter and microphone are calibrated once every three years
approved external organizations

Date:	Tested by:  Ing. Windrich Ing. Lexa	Approved:  Ing. Langer	ETD TRANSFORMÁTORÝ a.s. Technická kontrola a zkušebna -2-
2nd July 2020			

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ETD	ETD TRANSFORMÁTORÝ a.s.	Certificate No.: TKZ 20/102A	Page No.: 3 No. of pages: 10
Test Certificate Power Transformer - Determination of Sound Levels			
Work No.: 0969547	Type ETRZ 31 M-0	Manufacturer: ETD TRANSFORMÁTORÝ a.s.	

Test evaluation

- 1) Load operation $I_k = 100\% I_n$ – without fans (ONAN) - measurement at 0.3 m from the principal radiation surface:
 - Corrected average sound pressure level – $L_{pA} = 47 \text{ dB(A)}$
 - Sound power level – $L_{WA} = 65 \text{ dB(A)}$
- 2) No-load operation $U = 100\% U_n$ – without fans (ONAN) - measurement at 0.3 m from the principal radiation surface:
 - Corrected average sound pressure level – $L_{pA} = 57 \text{ dB(A)}$
 - Sound power level – $L_{WA} = 74 \text{ dB(A)}$
- 3) No-load operation $U = 100\% U_n$ – fans on (ONAF) - measurement at 2.0 m from the principal radiation surface:
 - Corrected average sound pressure level – $L_{pA} = 55 \text{ dB(A)}$
 - Sound power level – $L_{WA} = 77 \text{ dB(A)}$
- 4) Calculated final acoustic level ONAN - sum of acoustic components 1) and 2):
 - Sound power level - $L_{WA} = 75 \text{ dB(A)}$
 - Sound pressure level at the measuring distance of 0.3 m - $L_{pA} = 57 \text{ dB(A)}$
- 5) Calculated final acoustic level ONAF - sum of acoustic components 1) and 3):
 - Sound power level - $L_{WA} = 77 \text{ dB(A)}$
 - Sound pressure level at the measuring distance of 2.0 m - $L_{pA} = 56 \text{ dB(A)}$

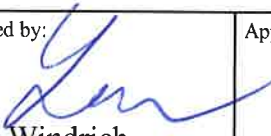
Guaranteed sound pressure level L_{pA} ONAN(0.3 m) $\leq 60 \text{ dB(A)}$ tolerance + 3 dB(A)

Guaranteed sound pressure level L_{pA} ONAF(2.0 m) $\leq 65 \text{ dB(A)}$ tolerance + 3 dB(A)

The test results are positive.

Environmental correction

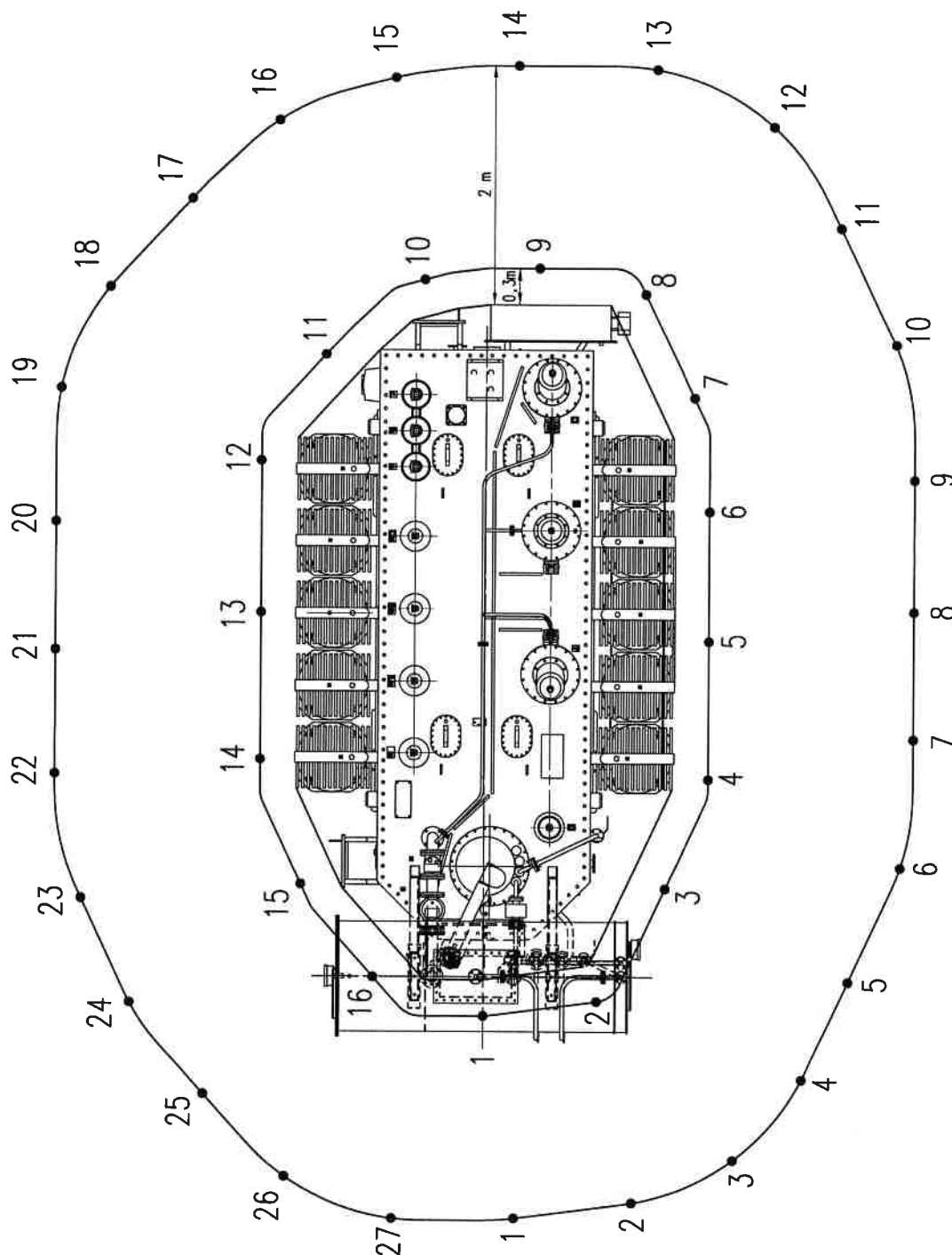
Length of the test room - l_r	152.2 [m]
Width of the test room - w_r	24.1 [m]
Height of the test room - h_r	22.0 [m]
Total area of the surface of the test room - S_v	15086.3 [m ²]
Acoustic absorption coefficient - α	0.2
Sound absorption area - A	3017.3 [m ²]
Height of the transformer tank - h	2.95 [m]
Measuring distance – d_1, d_2	0.3[m] 2.0 [m]
Length of the measuring contour - l_{m1}, l_{m2}	16.8[m] 26.8 [m]
Area of the measuring surface – S_1, S_2	54.6[m ²] 132.7 [m ²]
The height of the transformer tank is higher than 2.5 m → two measuring level in 1/3 and 2/3 height of transformer tank.	

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Layout of measuring points



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2nd July 2020	 Ing. Windrich Ing. Lexa	 Ing. Langer	
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Results of measurements

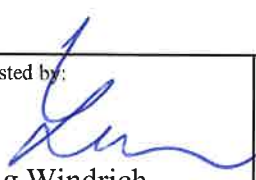
1) Noise of the background - measurement at 0.3 m from the principal radiation surface:

Sound pressure level of the background noise L_{pAi} dB(A)				
meas. point No.	beginning of the test		end of the test	
	height No.1	height No.2	height No.1	height No.2
1	42.6	42.7	42.3	42.0
4	42.7	41.7	42.0	41.6
7	43.1	41.5	42.0	42.0
10	41.4	41.0	42.2	42.2
13	43.6	41.6	43.5	41.9
$\overline{L_{bgA}}$	42.6 dB(A)		41.8 dB(A)	

2) Noise of the background - measurement at 2.0 m from the principal radiation surface:

Sound pressure level of the background noise L_{pAi} dB(A)				
meas. point No.	beginning of the test		end of the test	
	height No.1	height No.2	height No.1	height No.2
1	42.2	41.5	42.4	41.6
6	41.3	41.8	42.5	41.6
11	42.4	42.8	42.9	41.6
16	41.9	41.0	41.8	41.3
21	41.5	41.4	41.8	40.9
$\overline{L_{bgA}}$	42.1 dB(A)		41.6 dB(A)	

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3) Load operation $I_k = 100\% I_n$ - without fans (ONAN) - measurement at 0.3 m from the principal radiation surface:

Sound pressure level L_{pAi} dB(A)					
meas. point No.	height No.1	height No.2	meas. point No.	height No.1	height No.2
1	47.2	45.9	9	46.8	46.9
2	43.4	47.3	10	48.8	47.0
3	45.0	46.3	11	45.3	49.9
4	57.7	49.3	12	47.2	48.7
5	49.7	49.1	13	48.5	44.7
6	51.4	47.1	14	48.7	45.4
7	48.2	48.6	15	47.1	47.1
8	44.1	46.3	16	45.3	46.0
$\overline{L}_{pA0}$ - uncorrected average sound pressure level				48.7 dB(A)	

$\overline{L}_{pA0} - \max \overline{L}_{bgA}$	6.1 dB(A)
Initial $\overline{L}_{bgA}$ - final $\overline{L}_{bgA}$	0.7 dB(A)
Environmental correction K	0.3 dB(A)
Corrected average A-weighted sound pressure level $\overline{L}_{pA}$	47.3 dB(A)
A - weighted sound power level L_{WA}	64.7 dB(A)
$\overline{L}_{pA0} - \max \overline{L}_{bgA}$ - value is lower than 8 dB(A) but higher than 3 dB(A) while value initial $\overline{L}_{bgA}$ - final $\overline{L}_{bgA}$ is lower than 3dB(A) - test can be accepted	

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Test Certificate

Power Transformer - Determination of Sound Levels

Work No.: 0969547

Type ETRZ 31 M-0

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4) No-load operation $U = 100\% U_n$ – without fans (ONAN) – measurement at 0.3 m from the principal radiation surface:

Sound pressure level L_{pAi} dB(A)					
meas. point No.	height No.1	height No.2	meas. point No.	height No.1	height No.2
1	55.0	58.6	9	52.0	55.3
2	55.7	54.4	10	57.5	58.6
3	58.4	56.8	11	58.9	61.8
4	62.2	54.5	12	55.6	51.0
5	53.1	50.4	13	53.5	49.9
6	57.7	50.7	14	57.3	55.5
7	51.8	54.2	15	62.3	60.8
8	61.0	59.7	16	53.9	50.5
$\overline{L}_{pA0}$ – uncorrected average sound pressure level				57.4 dB(A)	

$\overline{L}_{pA0} - \max \overline{L}_{bgA}$	14.8 dB(A)
Initial $\overline{L}_{bgA}$ - final $\overline{L}_{bgA}$	0.7 dB(A)
Environmental correction K	0.3 dB(A)
Corrected average sound pressure level $\overline{L}_{pA}$	56.9 dB(A)
Sound power level L_{WA}	74.3 dB(A)
$\overline{L}_{pA0} - \max \overline{L}_{bgA}$ - measured value is above 8 dB – test can be accepted	

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Power Transformer - Determination of Sound Levels

Work No.: 0969547

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Manufacturer: ETD TRANSFORMÁTORÝ a.s.

5) No-load operation $U = 100\% U_n$ – fans on (ONAF) - measurement at 2.0 m from the principal radiation surface:

Sound pressure level L_{pAi} dB(A)					
meas. point No.	height No.1	height No.2	meas. point No.	height No.1	height No.2
1	52.5	54.7	15	59.8	55.9
2	52.9	51.9	16	54.3	53.6
3	53.1	52.4	17	58.7	57.9
4	55.0	57.0	18	56.9	58.6
5	54.2	55.3	19	56.4	54.3
6	56.7	56.7	20	54.2	55.3
7	56.1	58.6	21	54.2	54.8
8	55.9	57.8	22	54.6	55.3
9	54.4	54.1	23	59.5	59.8
10	55.2	54.6	24	55.6	56.2
11	53.7	56.8	25	54.7	53.6
12	58.8	58.3	26	53.2	55.1
13	57.3	54.9	27	53.5	53.8
14	60.0	55.2			
$\overline{L}_{pA0}$ – uncorrected average sound pressure level				56.1 dB(A)	

$\overline{L}_{pA0} - \max \overline{L}_{bgA}$	14.0 dB(A)
Initial $\overline{L}_{bgA}$ - final $\overline{L}_{bgA}$	0.5 dB(A)
Environmental correction K	0.7 dB(A)
Corrected average sound pressure level $\overline{L}_{pA}$	55.3 dB(A)
Sound power level L_{WA}	76.5 dB(A)
$\overline{L}_{pA0} - \max \overline{L}_{bgA}$ - measured value is above 8 dB – test can be accepted	

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Test Certificate

Power Transformer - Determination of Sound Levels

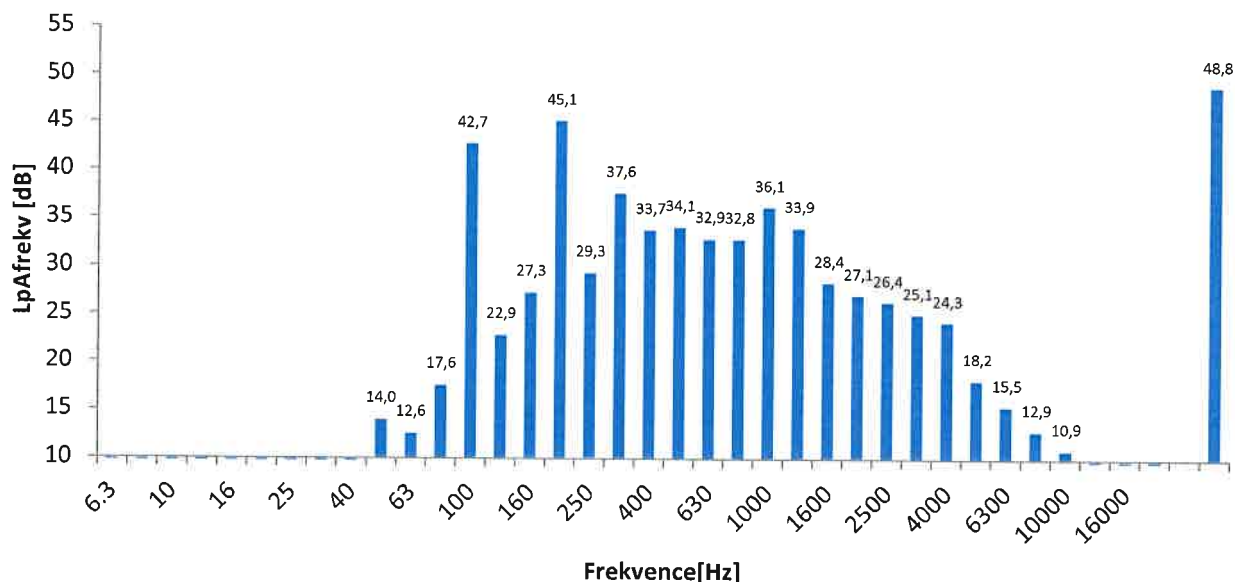
Work No.: 0969547

Type ETRZ 31 M-0

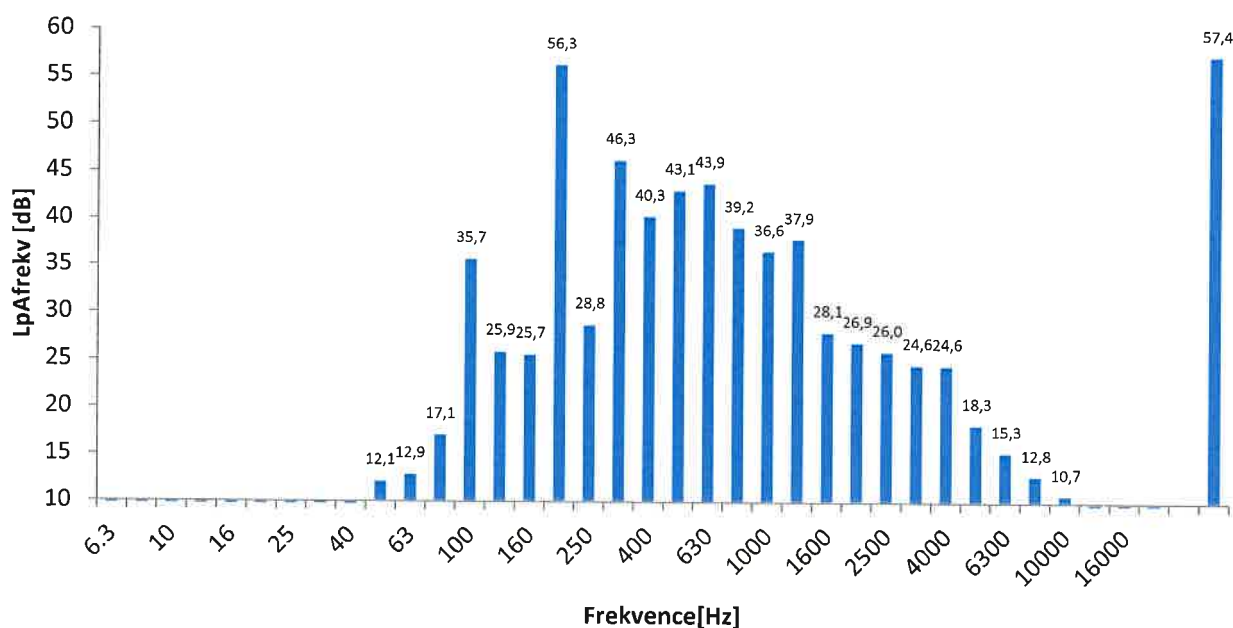
Manufacturer: ETD TRANSFORMÁTORÝ a.s.

Charts of measurement

Mean pressure spectrum L_{pA0} $I_k = 100\% I_n$ - without fans (ONAN)



Mean pressure spectrum L_{pA0} $U = 100\% U_n$ - without fans (ONAN)



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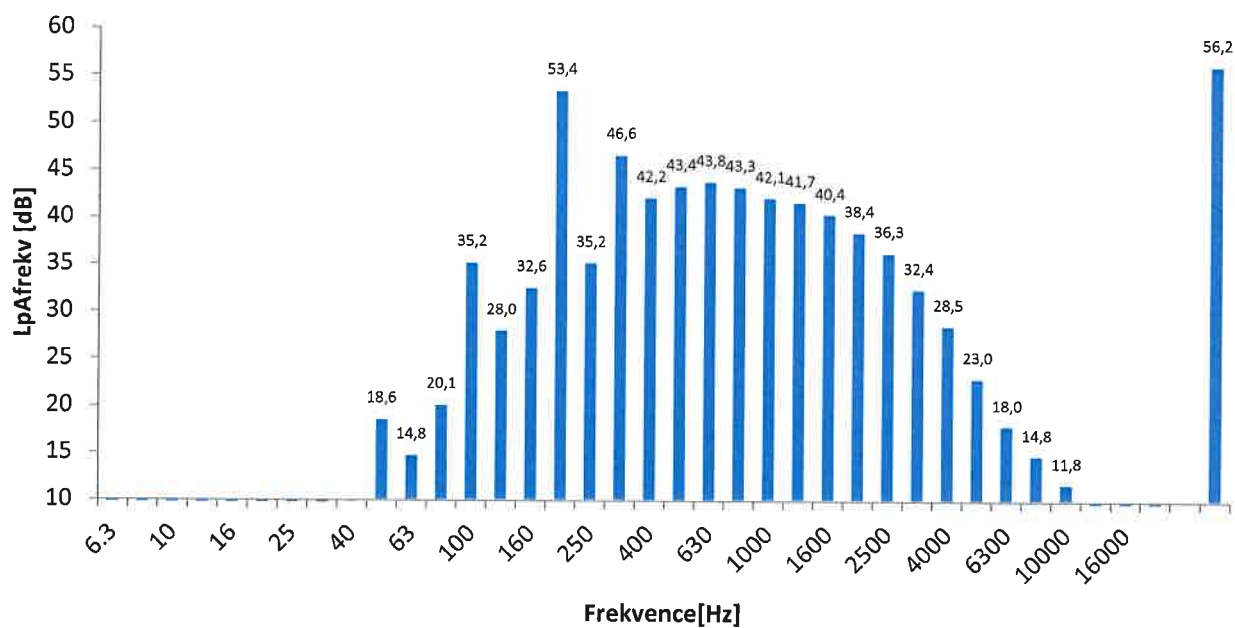
ETD TRANSFORMÁTORÝ a.s.

Certificate No.:
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No. of pages: 10**Test Certificate**
Power Transformer - Determination of Sound Levels

Work No.: 0969547

Type ETRZ 31 M-0

Manufacturer: ETD TRANSFORMÁTORÝ a.s.

Mean pressure spectrum L_{pA0} $U = 100\% U_n$ – fans on (ONAF)

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ORGREZ, a.s. Electrical Engineering Laboratory Division
Testing laboratory E01

Vítkova 17, Prague 8 - Karlín, 18600, Czech republic

Phone: +420 222314320 E-mail: laborg@orgrez.cz



Testing laboratory No. 1179.2 – accredited by CAI according to ČSN EN ISO/IEC 17025:2018

TEST REPORT

709/2020-O

Customer: ETD TRANSFORMÁTORÝ a.s.
Zborovská 22/54
301 00 Plzeň

Tested object: JSC "APSVIETIMAS", Litva
Serial number: 0969547
Equipment: power transformer
Operating condition: new equipment

Type: RTRZ31M-O
Manufacturer: ETD Transformátory a.s.
Year of manufacture: 2020
Voltage: 115/38.5 kV
Rating: 25 MVA
Insulating liquid: Nytro Lyra X
Weight of filling: 12 200 kg

Made by: Ing. Lenka Košanová



Date of issue: 03/07/2020

Issued:

Ing. Lenka Košanová
Vice-head for chemistry

Annotation: †N - non-accredited test.

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Used instruments and equipment, uncertainty

INSULATING OIL ANALYSIS

Test Report Number: 709/2020-O

Measured by

Laboratory Conditions:

Šimon Kotek

- 1) Digital thermometer, hygrometer and barometer, Serial. No: 34901952, type GFTB200, manufacturer GREISINGER electronic GmbH, y.m. 2009.

Acidity:

Šimon Kotek, Petra Jermářová

- 1) Analytic Balances, Serial. No: K9300294, type Helago, HM 202, manufacturer A&D Instruments Ltd..
- 2) Balances, Serial. No: 8790, type MC1, LC 202S, manufacturer Sartorius.
- 3) Dosino 800, Serial. No: 1800002004270, type Dosino 800, manufacturer Metrohm, y.m. 2012.
- 4) Stirrer 801, Serial. No: 1801001050462, type Stirrer 801, manufacturer Metrohm, y.m. 2012.
- 5) 916 Ti - Touch, Serial. No: 1916001005258, type 916 Ti - Touch, manufacturer Metrohm, y.m. 2012.

Expanded uncertainty: $\pm 15\%$ of rdg..

Antioxidant Content:

Šimon Kotek, Petra Jermářová

- 1) Infrared Spectrometer, Serial. No: 469, type M 500, manufacturer Buck Scientific Inc..

*The reported expanded uncertainty is stated as the standard uncertainty multiplied by $k=2$, and has been determined according to EA4/16. The coverage factor $k=2$ for a normal distribution corresponds to a coverage probability of approximately 95%.
rdg. ... reading value.*

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Insulating Oil Analysis

Test Report Number: 709/2020-O (Serial No.: 0969547)
Place of sampling: transformer tank, bottom
Oil temperature: 30°C / 25°C (dry) - top / bottom layer of oil
Insulating liquid: Nytro Lyra X
Oil colour: transparent
Date of sampling: 02/07/2020 (sampling carried by a third party)
Date of delivery: 03/07/2020
Date of testing: 03/07/2020

Temperature in lab:	26°C	Relative air humidity in lab:	46%
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Test	Unit	Standard	Result
Acidity	mg KOH/g	SOP 2-14/72 (ČSN EN 62021-1; ZM-12)	0.001
Antioxidant content	% w.	SOP 2-16/72 (ČSN EN 60666, ZM-15) †N	0.39

– END OF TEST REPORT –