TAP-4 CHECKLIST

Zensol recommends to check this list of important points in order to be well prepared to perform tests using the TAP-4. This process will also help you analyze the results more effectively.

A. Before testing (11 points)

Step	Description	Result	
A1	Make of transformer		
A2	Transformer build date		
A3	Make and model of OLTC		
A4	OLTC build date		
A5	Number of taps (according to EDF, HQ, etc. standards)		
A6	Number of OLTCs similar to the one tested		
A7	OLTC user manual	YES	NO
A8	Picture of the transformer	YES	NO
A9	Picture of the OLTC	YES	NO
A10	Do you know where to install the accelerometers?	YES	NO
A11	Do you know where to install the current clamp?	YES	NO

B. During the tests (7 points)

Step	Description	Result	
B1	History of interventions on the OLTC	YES	NO
B2	Agree with customer on test sequence -Off line: recommend testing all taps -On line: to be defined with the customer	OFF LINE ON LINE	
B3	Picture of tap configuration	YES	NO
B4	Overall picture of transformer with OLTC	YES	NO
B5	Picture showing location of accelerometer	YES	NO

B6	Picture showing location of current clamp	YES	NO
B7	Ensure presence and viability of data files for analysis (raw data)	YES	NO

C. After testing (7 points)

Systematic analysis method			
Step	**Description**	**Result**	
C1	Calculate envelopes	YES	NO
C2	Perform an Excel export to obtain an overview of the results	YES	NO
C3	Attempt to associate the impacts with the OLTC mechanism in order to identify and locate events in the vibro-acoustic trace	YES	NO
C4	With all the elements gathered before and during the tests, we recommend the following visual analysis: Impact analysis: - Time between impacts (examine tool) - Shape (scale tool) - Amplitudes (examine tool) - Relative to the end of the current (examine tool) Superposing and comparing traces: - odd-numbered vs. even-numbered taps - rise vs. fall between impacts - taps of an OLTC compared to one of the same type - current traces between taps or between OLTCs of the same type - high frequency vs. low frequency envelopes		
C5	Observation and identification of anomalies		
C6	Recommendations for future tests		
C7	Transfer and sharing of data and pictures with Zensol on DB TAP in an anonymous manner. The DB TAP goal is to build a base of healthy and unhealthy reference signatures.	YES	NO

EXAMPLE

A. BEFORE TESTING

A1. Make of transformer

A2. Transformer build date

A3. Make and model of OLTC

A4. OLTC build date

A5. Number of taps (according to EDF, HQ, etc. standards)

A6. Number of OLTCs similar to the one tested:
6
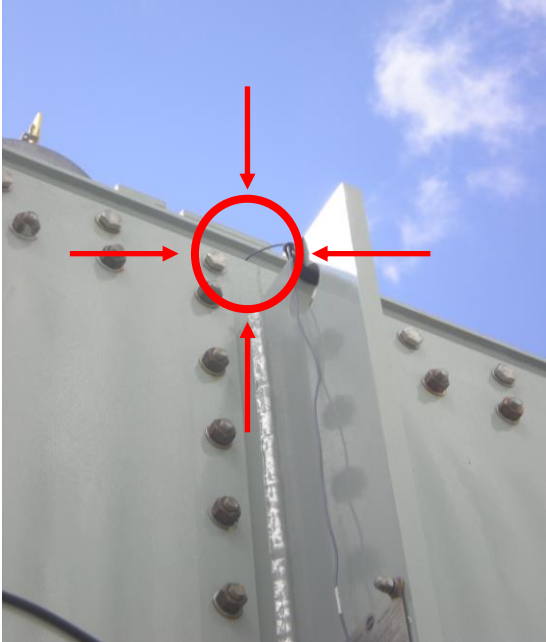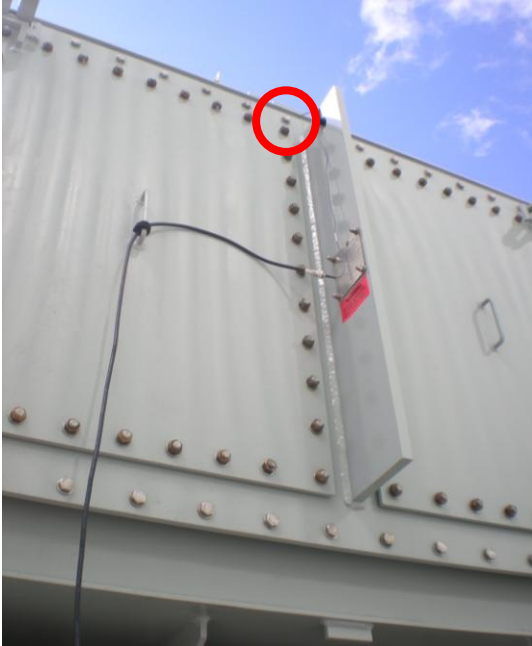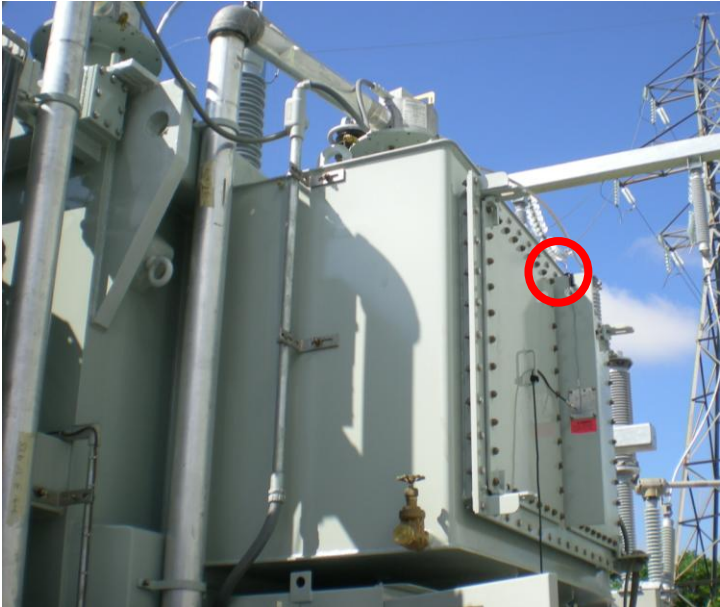
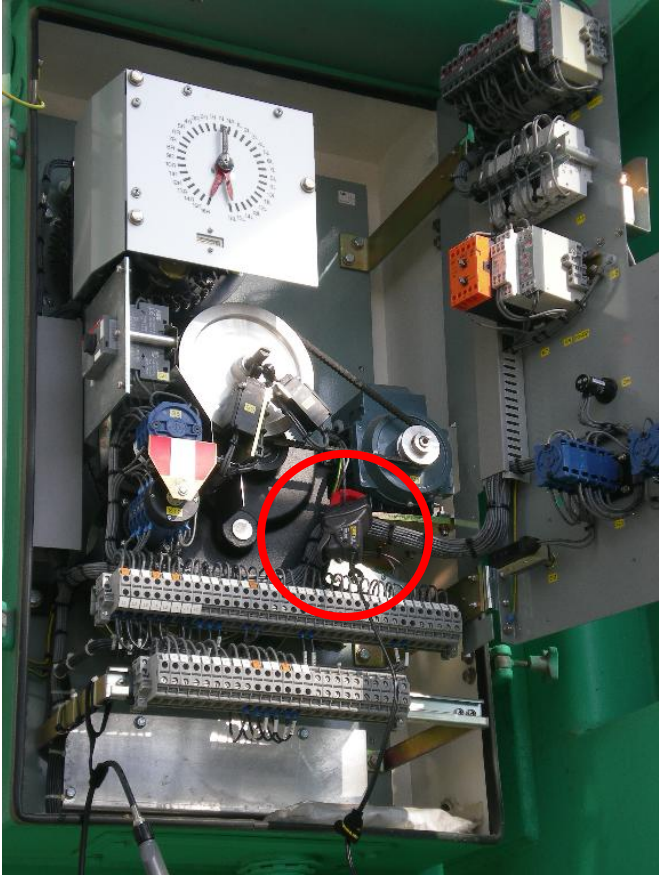**A7. OLTC user manual:**

A8. Picture of the transformer:

A9. Picture of the OLTC:

A10. Do you know where to install the acceleromter?

**A11. Do you know where to install the current clamp?**

B. DURING THE TESTS

B1. History of interventions on the OLTC:
YES.

B2. OFFLINE or ONLINE transformer:
Example 1 : OFFLINE
Example 2 : ONLINE – Tested tap : 5.

B3. Picture of tap configuration:
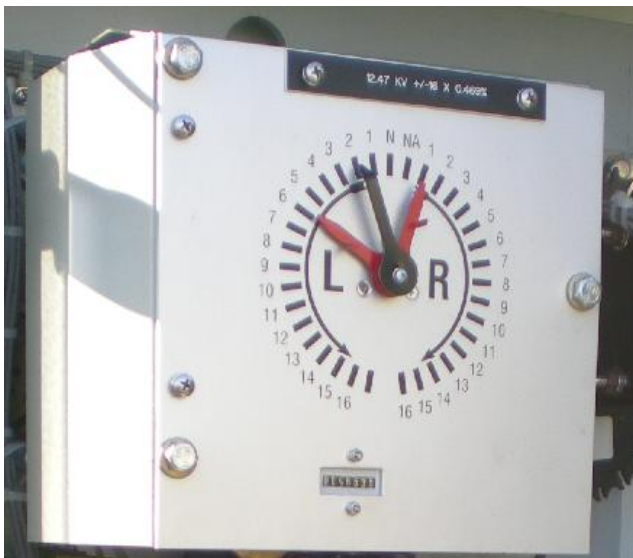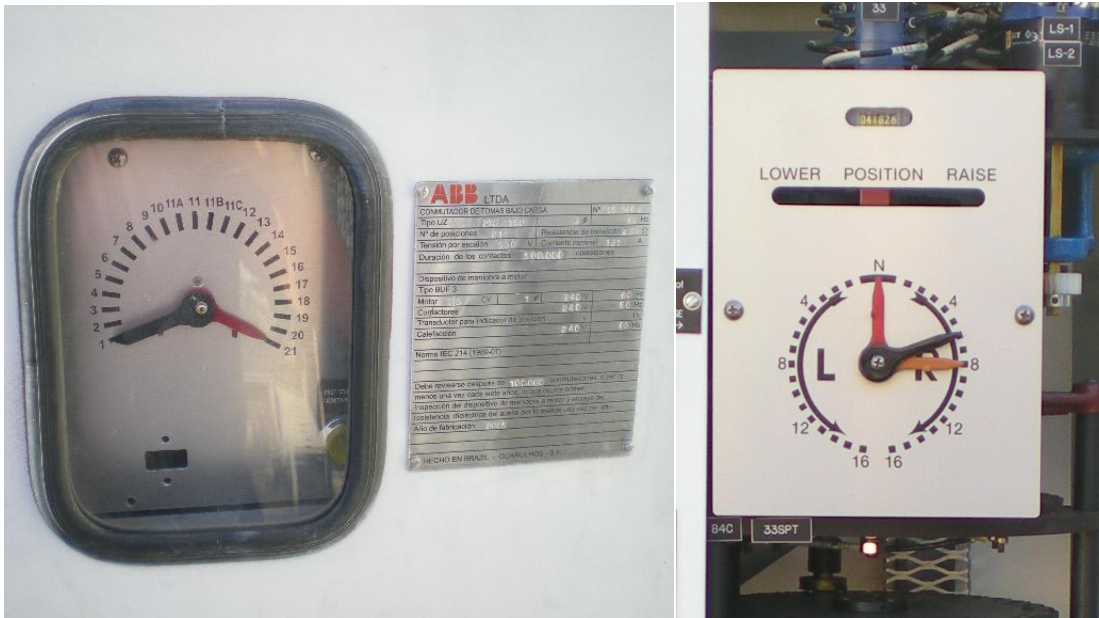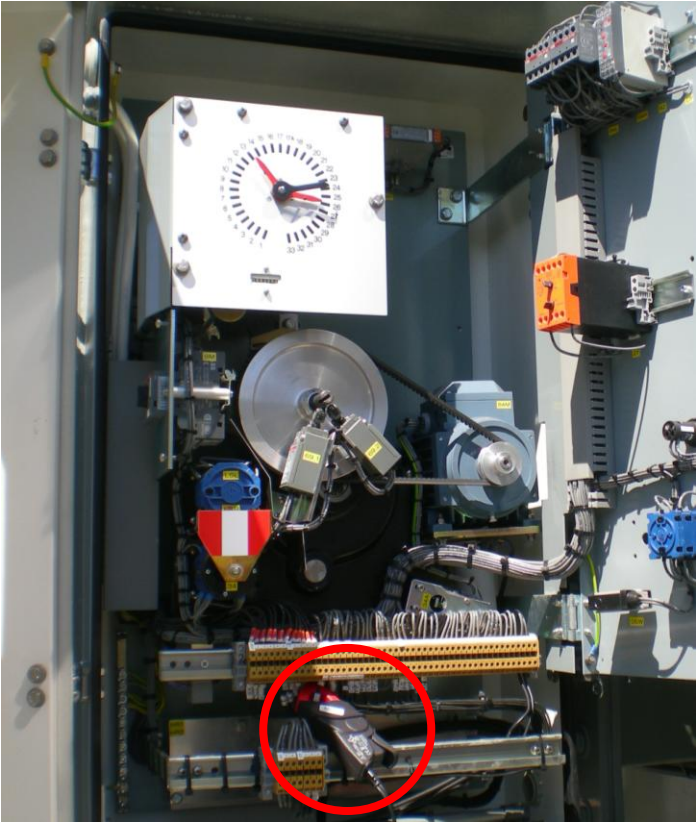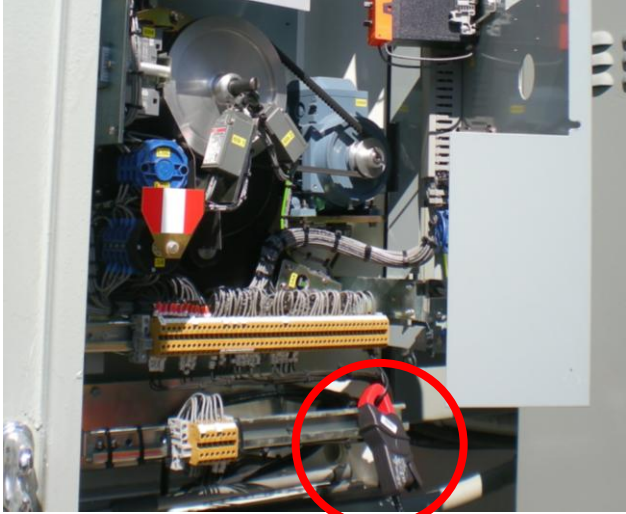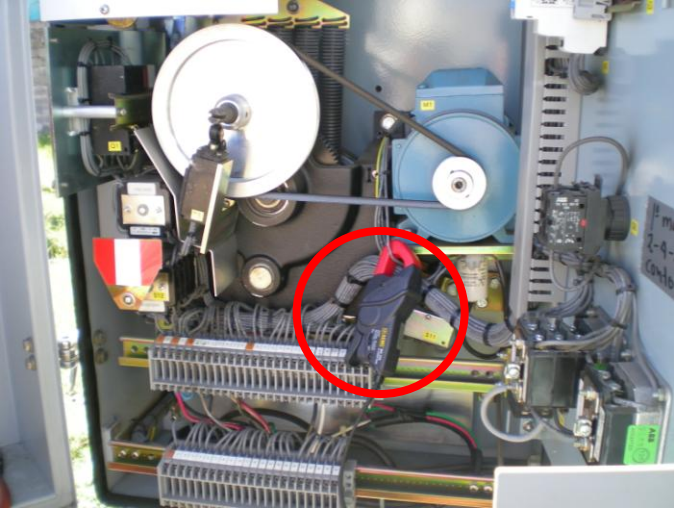
B4. Overall picture of transformer with OLTC:

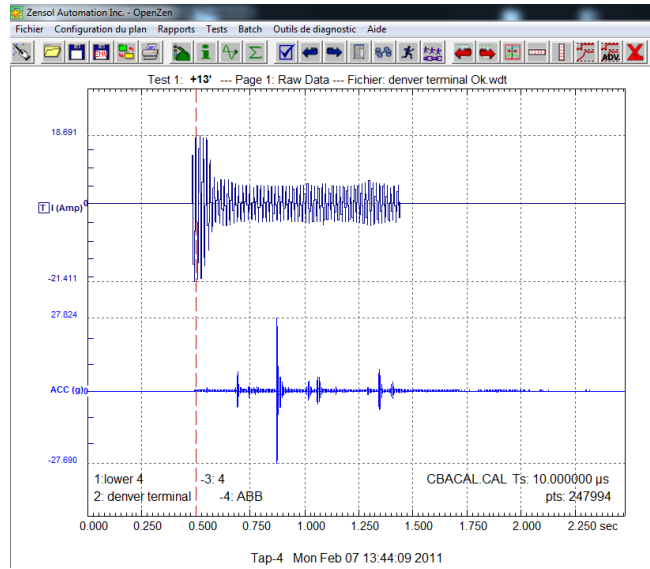**B5. Picture showing location of accelerometer:**
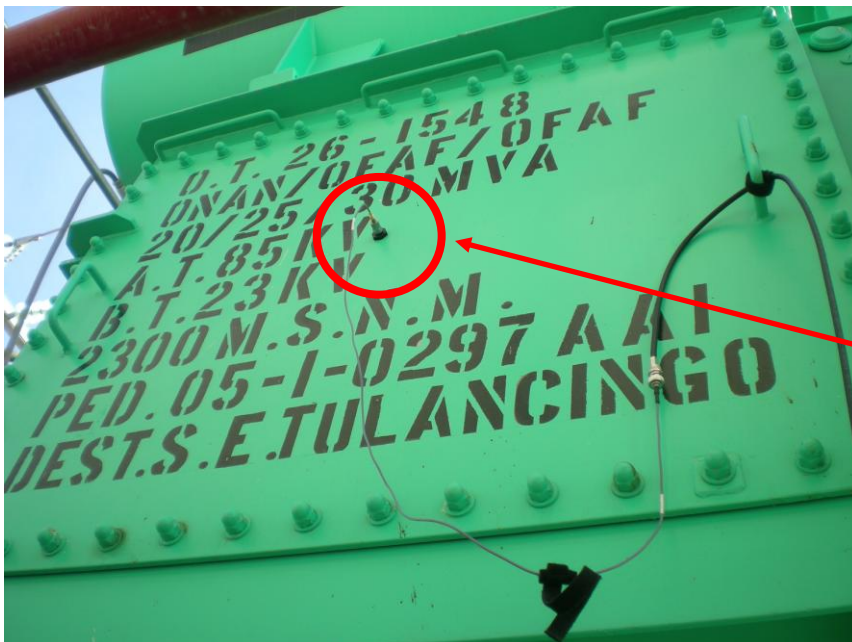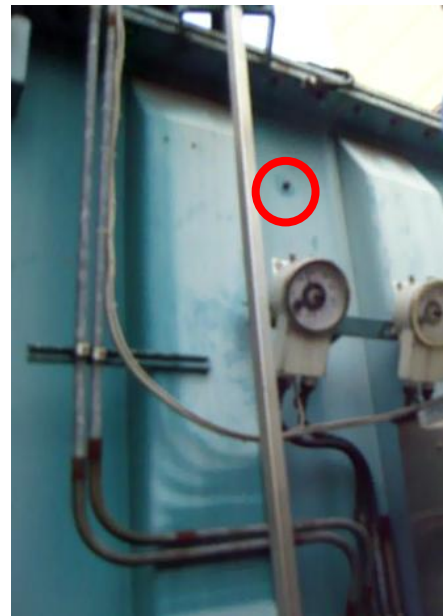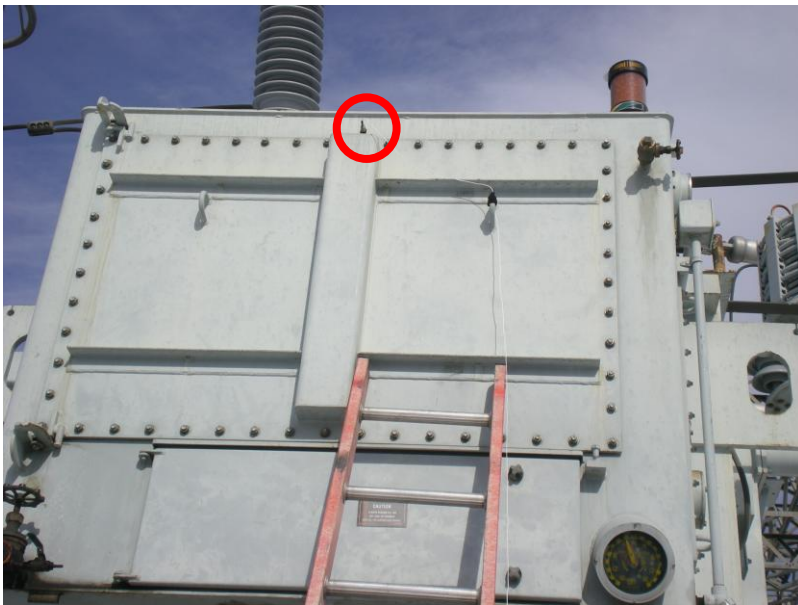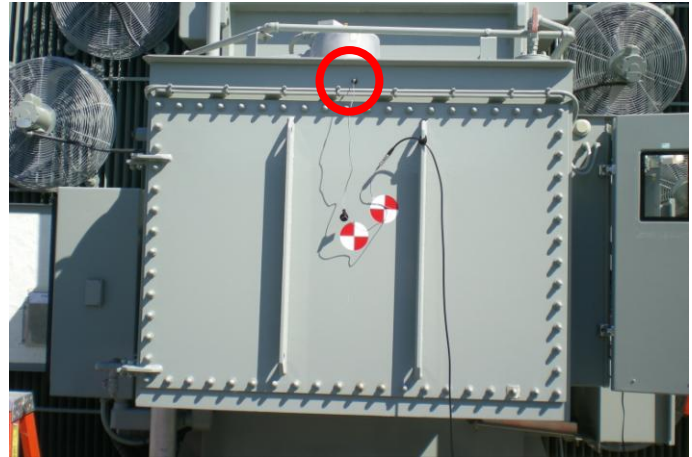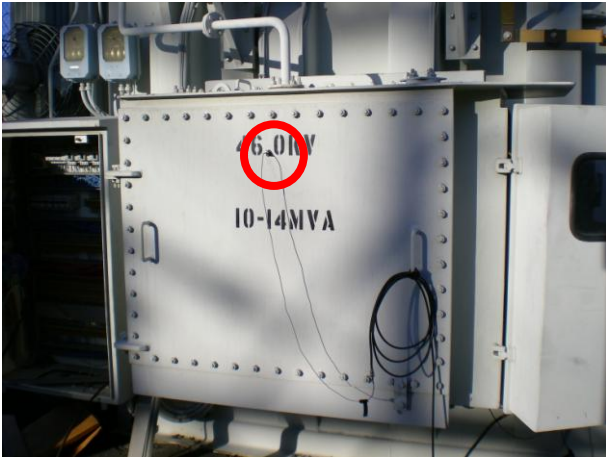
WRONG INSTALLATION

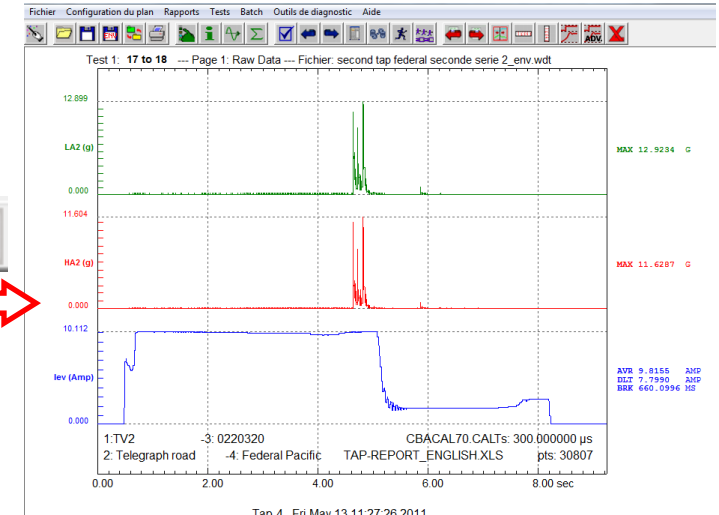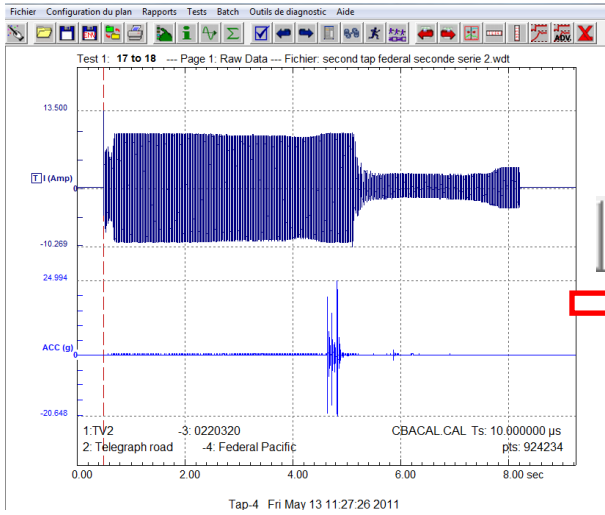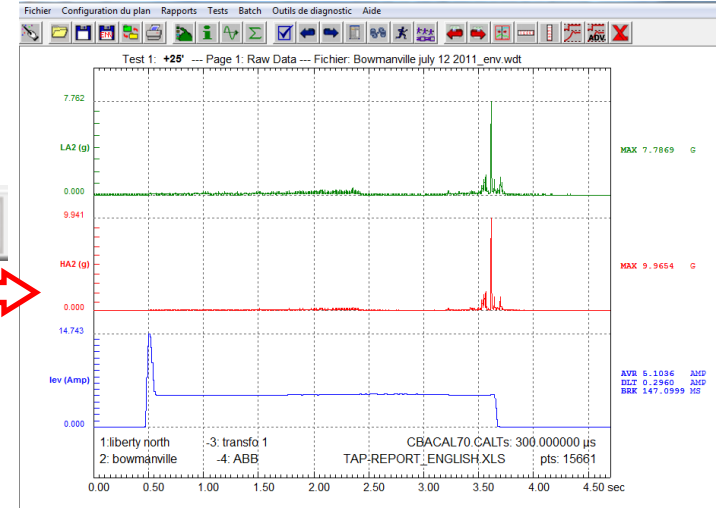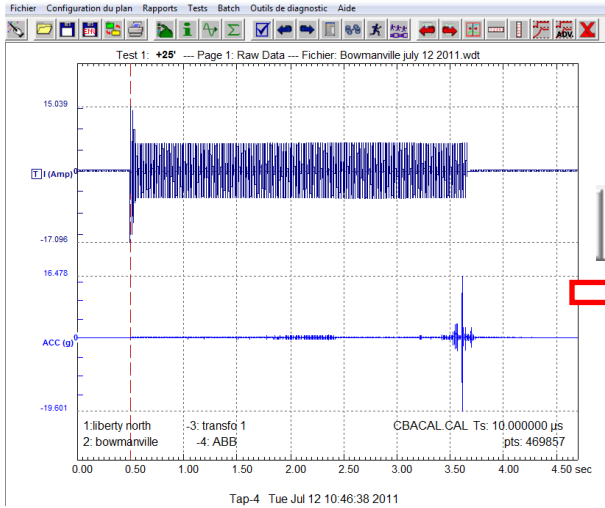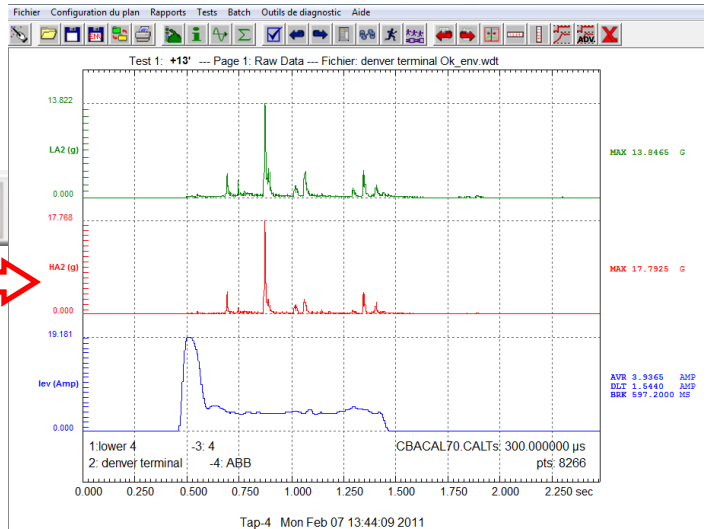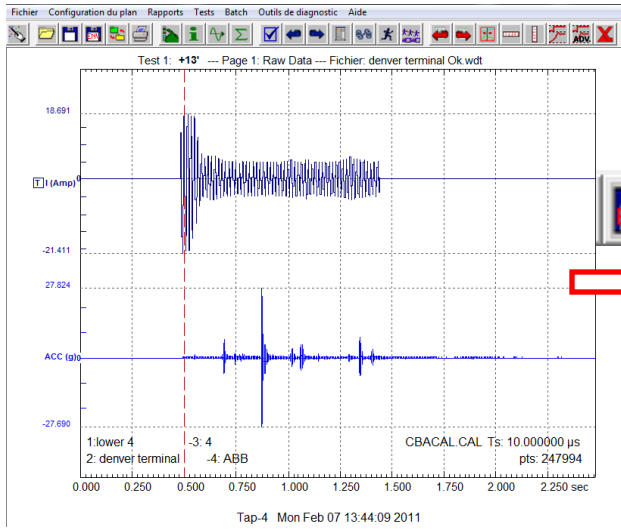**B6. Picture showing location of current clamp:**
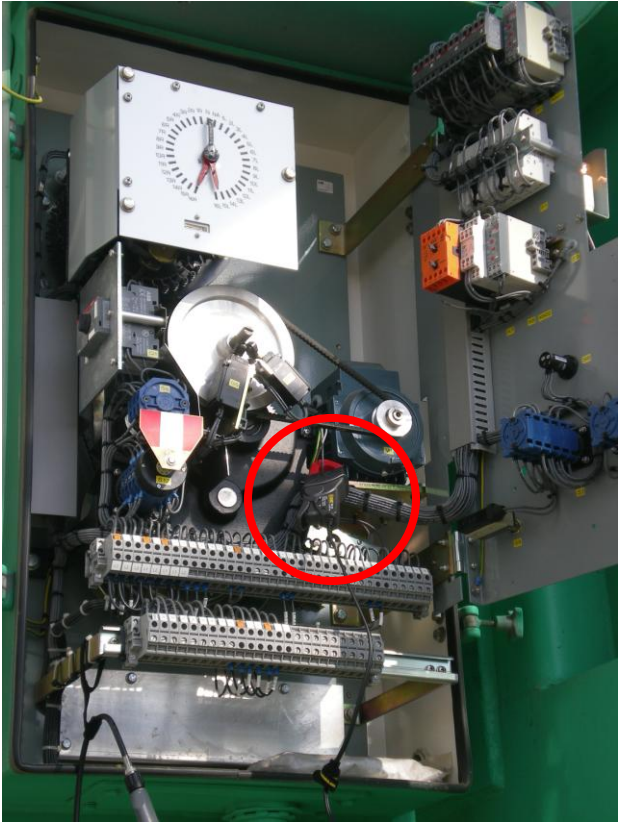
B7. Ensure presence and viability of data files for analysis (raw data):

Extension : « *.wdt* »
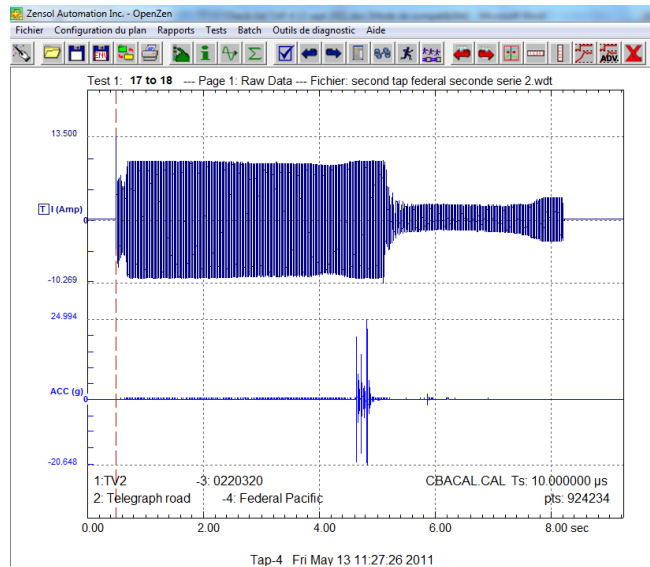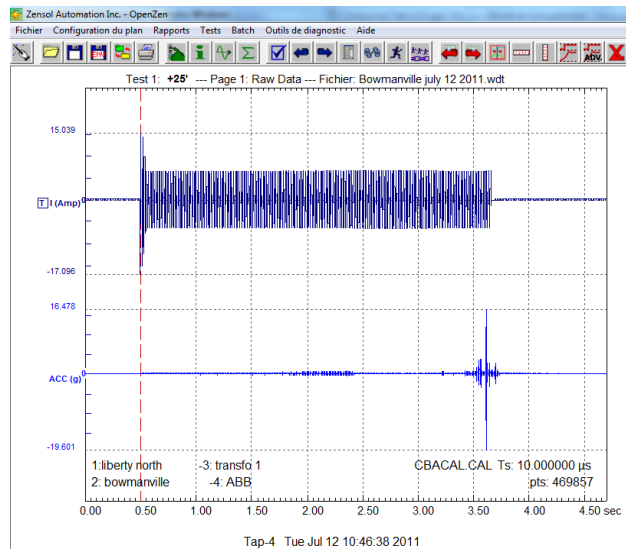
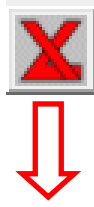# C. **AFTER TESTING**

C1. Calculate envelopes:

C2. Perform an Excel export to obtain an overview of the results:

Test Summary Sheet before export:

Tap details sheet before export:

Results after export:

Labels (callouts): AVR, DLT, MAX, Operation Length, Inrush, END, Ratio

Results - TAP-4

								Test time	
Default Test Plan for	@R		Compteur		59189				
Exploitation	T6		# Série		@R5			@R8	
Inventaire	1U-0080		Temp. Huile		30				
Poste		MONTMORENCY 69 KV	Type Essai		HORS_SERVICE				

| | | CURRENT | | | | | ACCELEROMETER1 | | |

Test num.	Tap name	Operation length	Current average	Inrush	Current delta	End of operation time	HF MAX	LF MAX	HF/LF RATIO
		Time in ms		Current in Amps		Time in ms		Acceleration in G	
	Averages:	6237.81	1.299904281	4.543144906	0.1532005	1145.206284	22.1206286	26.6634957	0.84245729
1	+8	5510.00	1.298856	4.387579	0.107729	761.100098	22.268593	24.573019	0.90622129
2	+9	11185.00	1.30213	4.632944	0.368353	755.800781	22.852091	28.730633	0.79539114
3	+10	11190.00	1.305267	4.66041	0.332341	762.5	22.036751	29.754477	0.74061967
4	+11	5525.00	1.300699	4.383917	0.103456	1133.799805	20.001513	21.398794	0.93470282
5	+12	5520.00	1.300251	4.668955	0.11078	770.5	29.452614	27.467167	1.07228438
6	+13	5515.00	1.300914	4.517586	0.104677	1135.300293	16.676355	23.110386	0.72159569
7	+14	5510.00	1.29969	4.514534	0.107118	766.900391	20.454306	32.237839	0.6344813

Values low
Values i
Values high

ABF (g) — 24.572 ... 0.000 — MAX (G) — MAX 24.5730 G

AHF (g) — 22.268 ... 0.000 — MAX (G) — MAX 22.2686 G

CR1 (A) — 4.427 ... 0.000 — Inrush (Amp), END (ms), AVR (Amp), DLT (Amp), Operation length (ms)

1:T6   -3:MONTMORENCY 69 KV   CBACAL69.CAL Ts: 300.000000 µs
2:1U-0080   -4:59189   pts: 24878

AVR 1.2989 AMP
DLT 0.1077 AMP
END 763.1001 MS
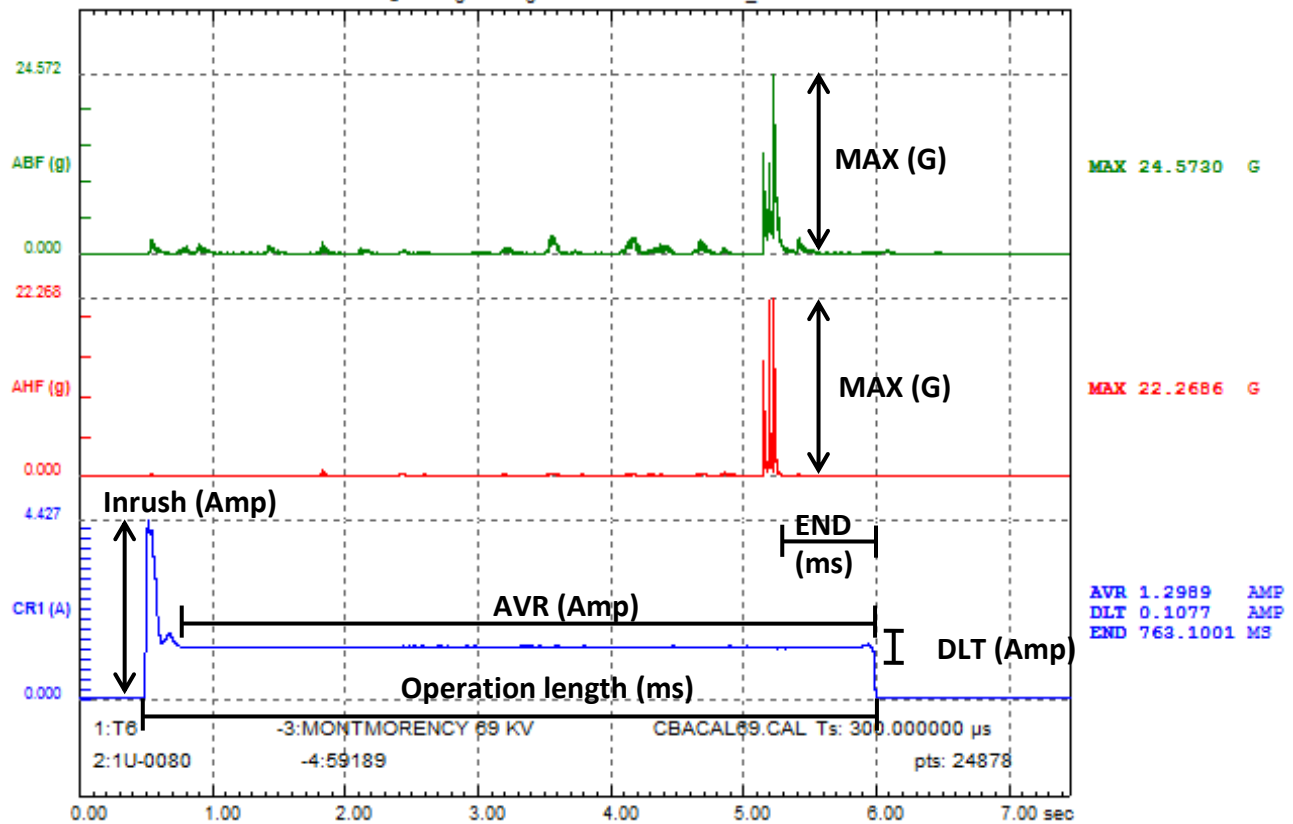
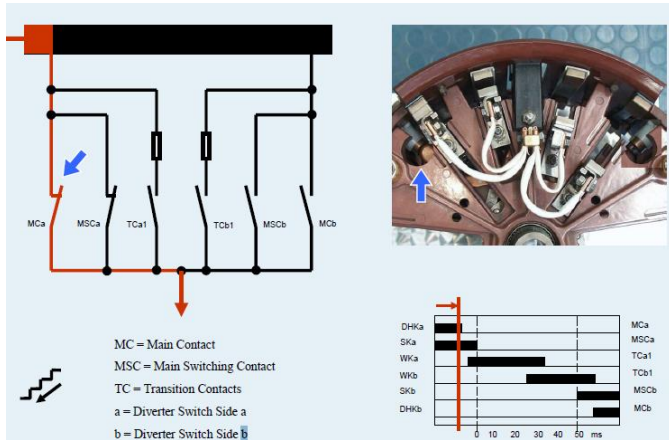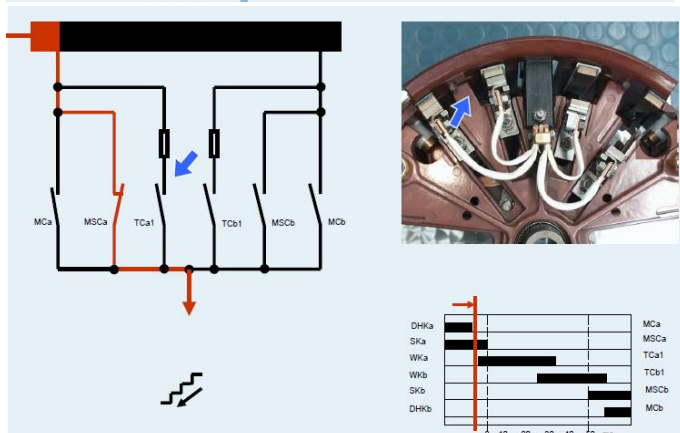## C3. Attempt to associate the impacts with the OLTC mechanism:

Example in preparation: MR Reinhausen M-type tap changer.

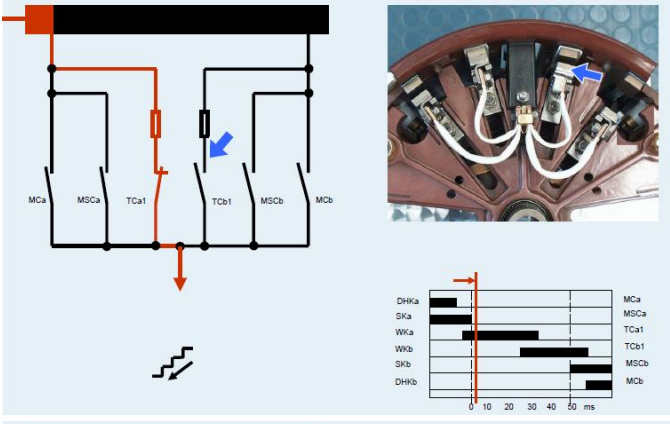This presentation allows to highlight the electrical, mechanical events and recorded impacts.
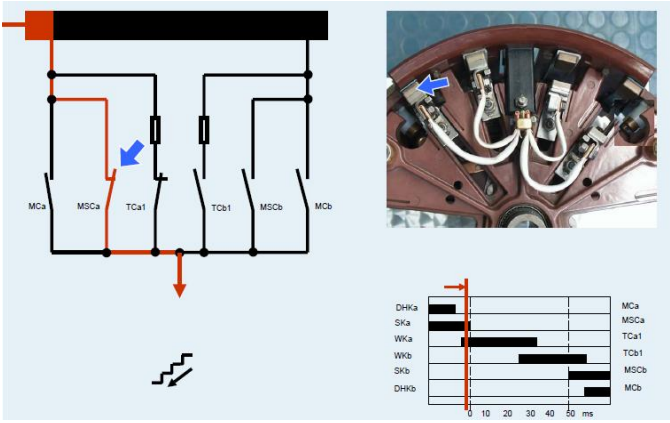
MC = Main Contact
MSC = Main Switching Contact
TC = Transition Contacts
a = Diverter Switch Side a
b = Diverter Switch Side b

CURVE OF THE IMPACT ASSOCIATED

CURVE OF THE IMPACT ASSOCIATED

	DHKa					MCa
	SKa					MSCa
	WKa					TCa1
	WKb					TCb1
	SKb					MSCb
	DHKb					MCb

0 10 20 30 40 50 ms

CURVE OF THE IMPACT ASSOCIATED

0 10 20 30 40 50 ms

CURVE OF THE IMPACT ASSOCIATED

Ic

0 10 20 30 40 50 ms

CURVE OF THE IMPACT ASSOCIATED
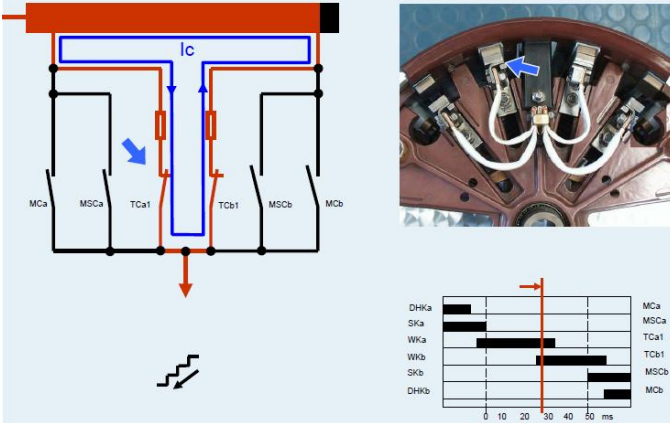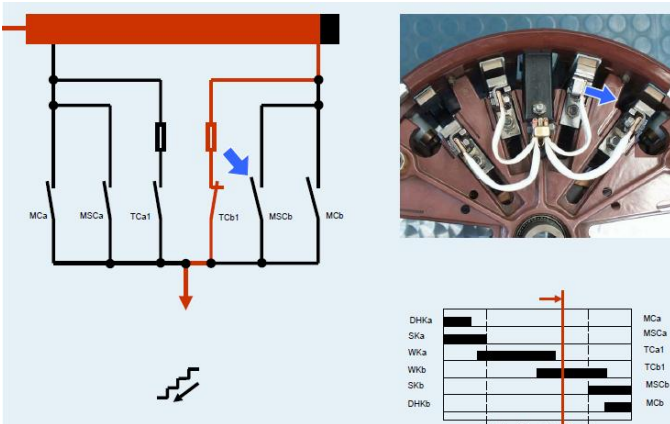

0 10 20 30 40 50 ms

CURVE OF THE IMPACT ASSOCIATED

CURVE OF THE IMPACT ASSOCIATED
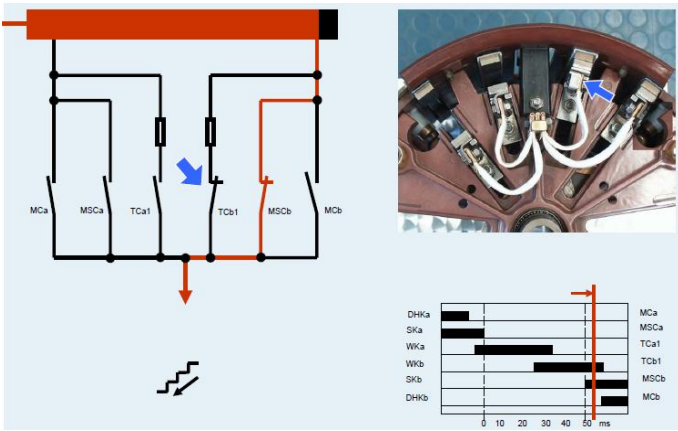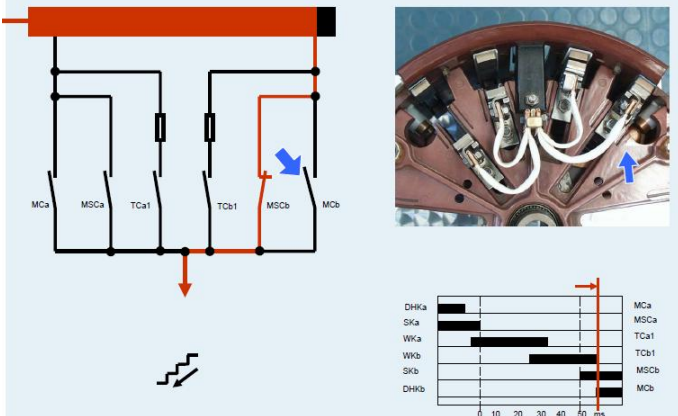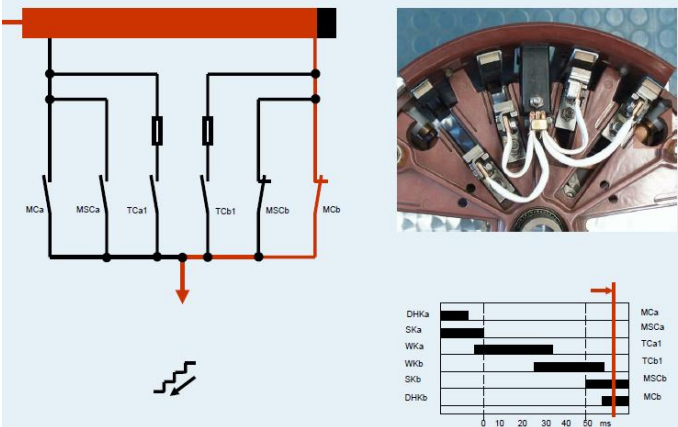

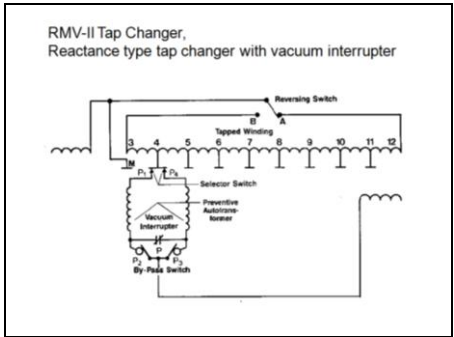**CURVE OF THE IMPACT ASSOCIATED**

CURVE OF THE IMPACT ASSOCIATED

Example: Reinhausen RMV-II Tap Changer

RMV-II Tap Changer,
Reactance type tap changer
with vacuum interrupter

Acoustic signature of tap changers
with 33 positions or 17 positions

1/12

RMV-II Tap Changer,
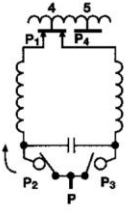Reactance type tap changer with vacuum interrupter

2/12

RMV-II Tap Changer,
Sequence of impact recorded in the acoustic signature

First event

By-pass switch P3 is
open to force the
load current through the
vacuum interrupter.

This event cause a
small acoustic impact.

Timing: ~ 0.3 – 0.4 sec
(after motor current
inception)

3/12

RMV-II Tap Changer,
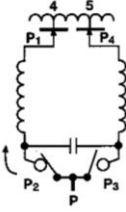Reactance type tap changer with vacuum interrupter

Second event
Vacuum switch
is open interrupting
the current in
P4 selector.

Vacuum switch
operation cause a
large acoustic impact.

Timing: ~ 0.6 – 0.7 sec

4/12

RMV-II Tap Changer,
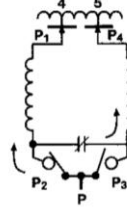Reactance type tap changer with vacuum interrupter

Third event
Selector switch P4
moves from tap 4 to
tap 5.

No current is
interrupted.
Operation of selector
switch cause practically
no acoustic impact.

Timing: ~ 0.9 - 1.6 sec

5/12

RMV-II Tap Changer,
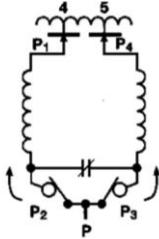Reactance type tap changer with vacuum interrupter

Fourth event
Vacuum switch is
closed to connect tap 5
in parallel with Tap 4.

Vacuum switch
operation cause a
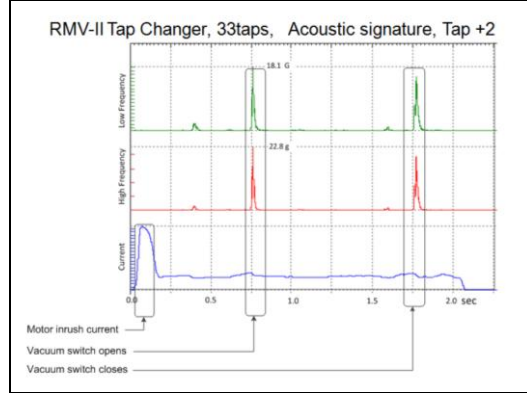**large acoustic impact.**

Timing: ~ 1.6 – 1.7 sec

6/12

RMV-II Tap Changer,
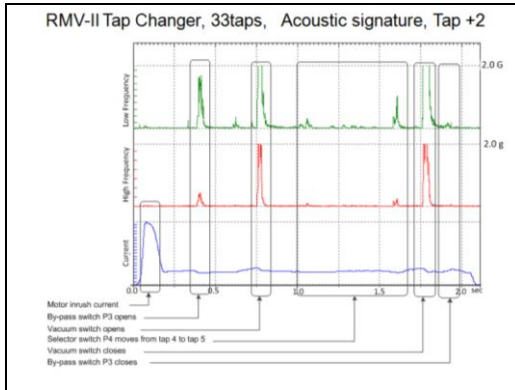Reactance type tap changer with vacuum interrupter

Fifth event
By-pass switch P3 is closed,
so that vacuum switch
do not carry any current
in normal operation.

This event cause a
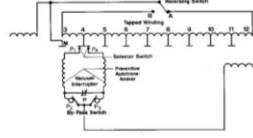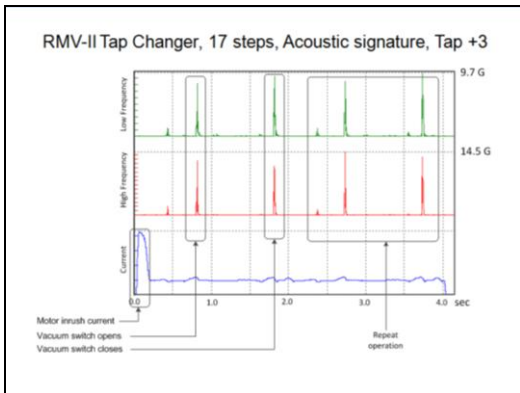**very small impact.**

Thus, Timing: ~ 1.7 – 1.9 sec

7/12

RMV-II Tap Changer, 33taps, Acoustic signature, Tap +2

Motor inrush current
Vacuum switch opens
Vacuum switch closes

8/12

RMV-II Tap Changer, 33taps, Acoustic signature, Tap +2

Motor inrush current
By-pass switch P3 opens
Vacuum switch opens
Selector switch P4 moves from tap 4 to tap 5
Vacuum switch closes
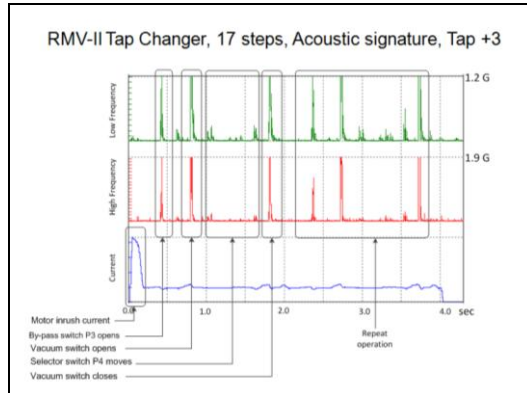By-pass switch P3 closes

9/12

RMV-II Tap Changer
17 Positions

- Same unit as tap changer with 33 position
- Control system is set to force two steps every time.

10/12

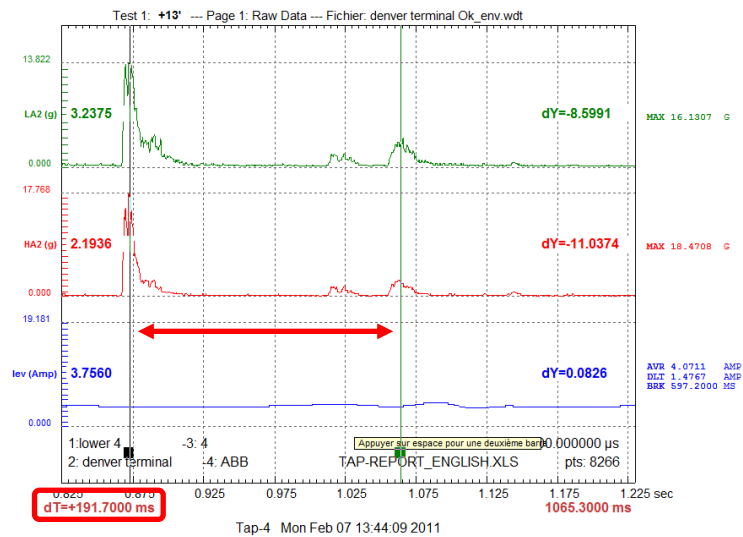RMV-II Tap Changer, 17 steps, Acoustic signature, Tap +3

Motor inrush current
Vacuum switch opens
Vacuum switch closes

Repeat operation

11/12

RMV-II Tap Changer, 17 steps, Acoustic signature, Tap +3

Motor inrush current
By-pass switch P3 opens
Vacuum switch opens
Selector switch P4 moves
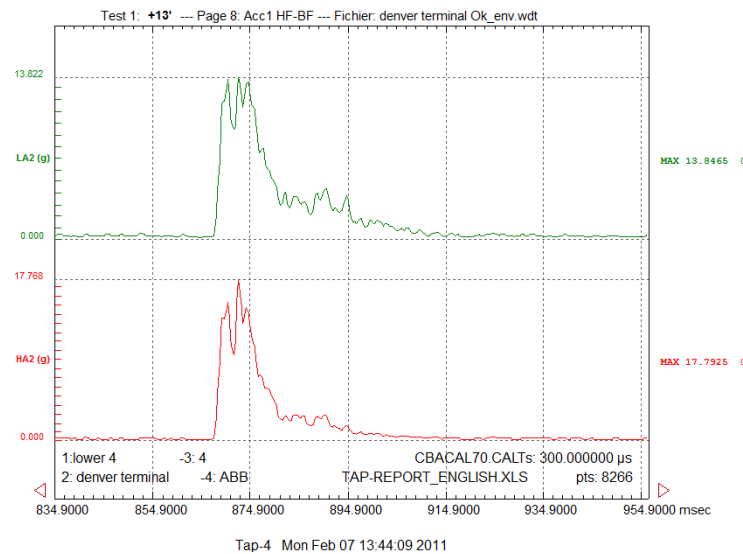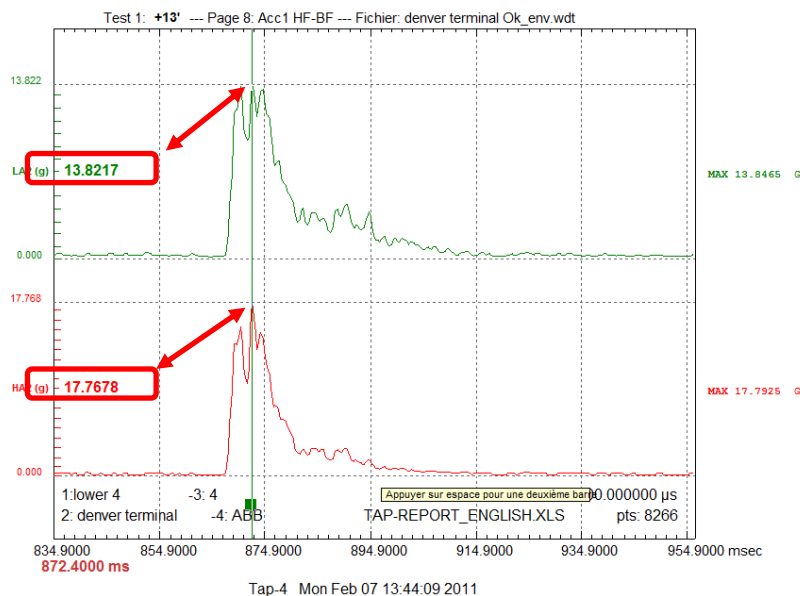Vacuum switch closes
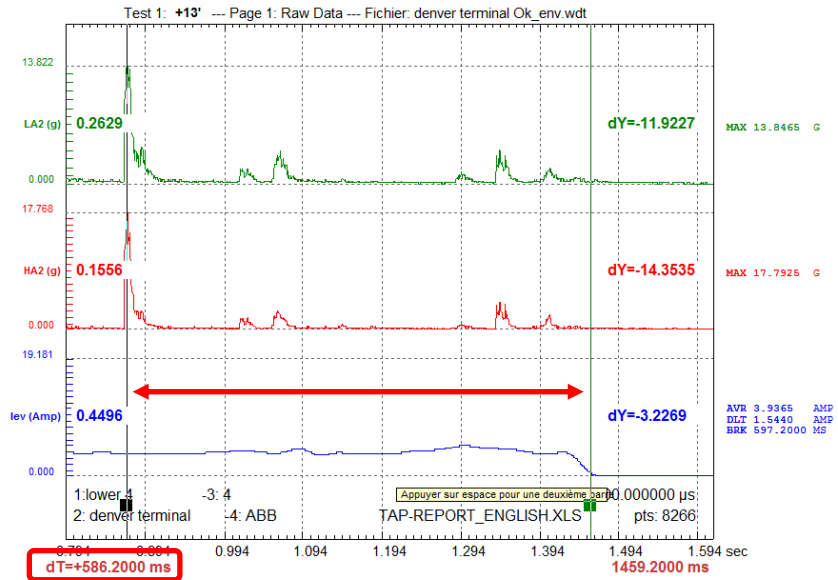
Repeat operation

12/12

C4. Suggested analysis:
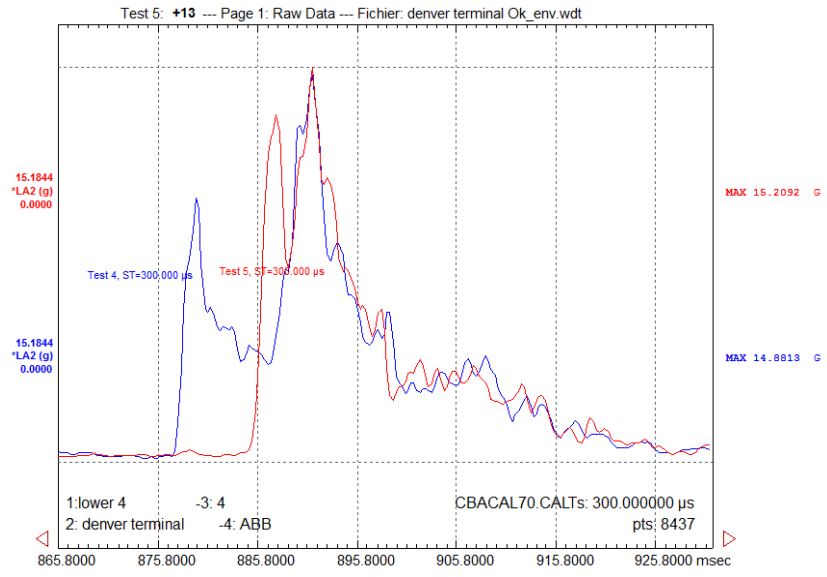

Time analysis between impacts
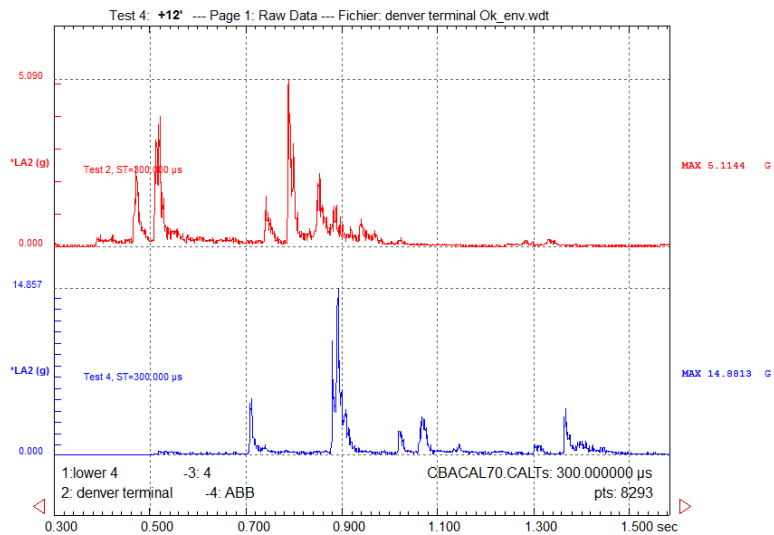

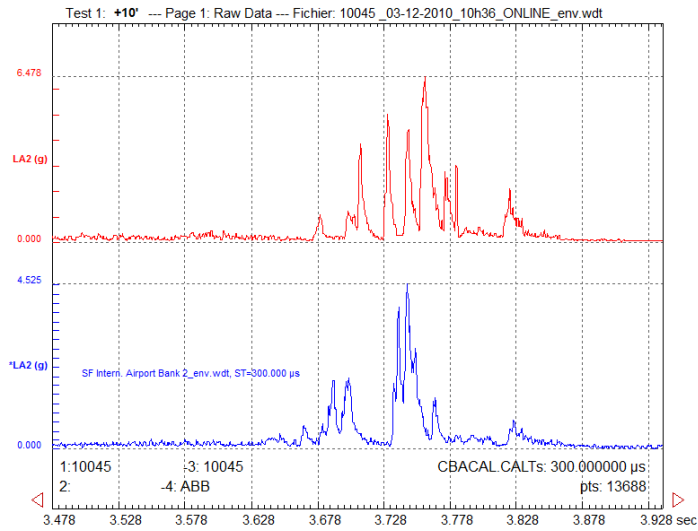
Shape analysis of impacts

Amplitude analysis of impacts

Time between impact and end of current
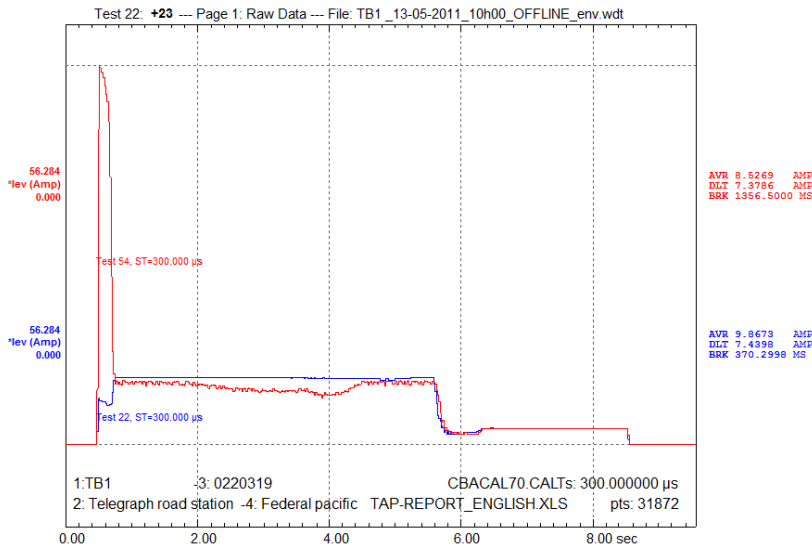

Superposition odd tap versus even tap

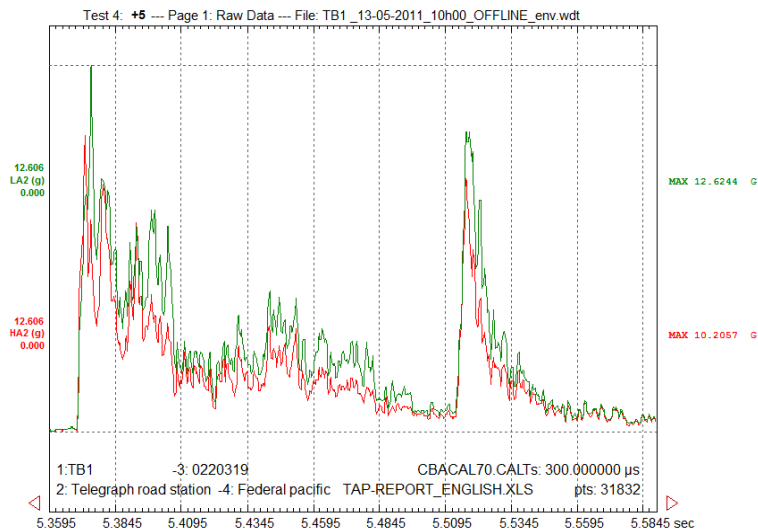

Comparison upward movement versus downward movement

Comparison of two tap changers of the same kind

Superposition current of an upward movement versus a downward movement

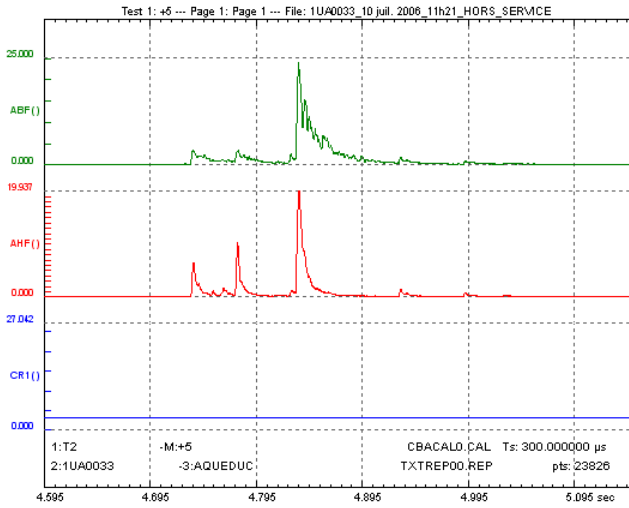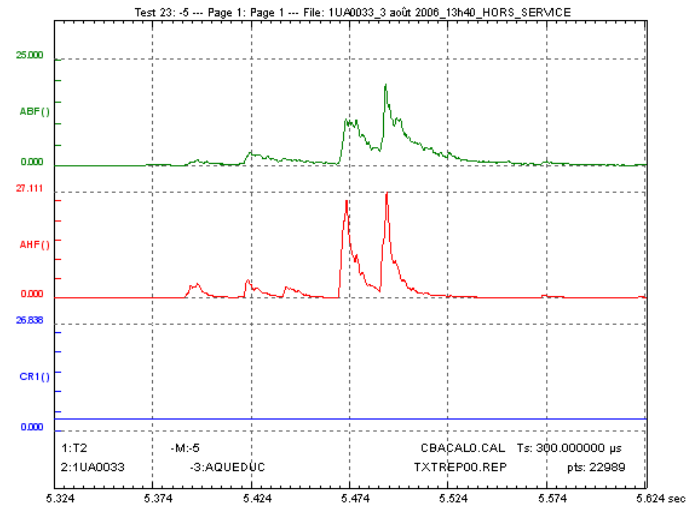Superposition high frequency versus low frequency
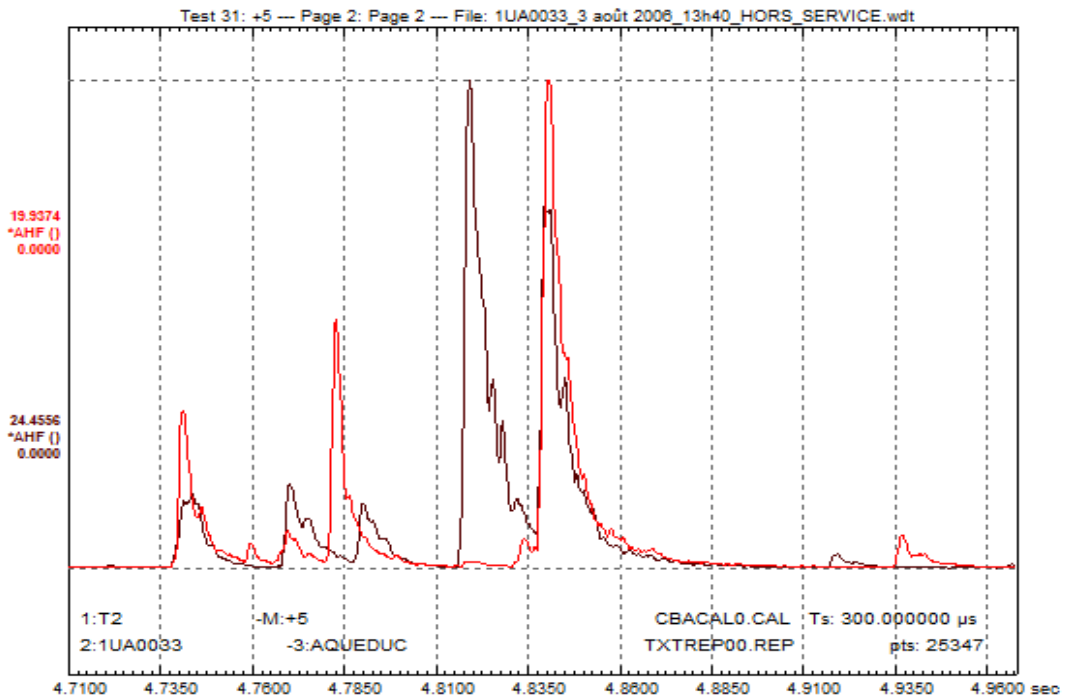
C5. Observation and identification of anomalies:

-Contact wear example:

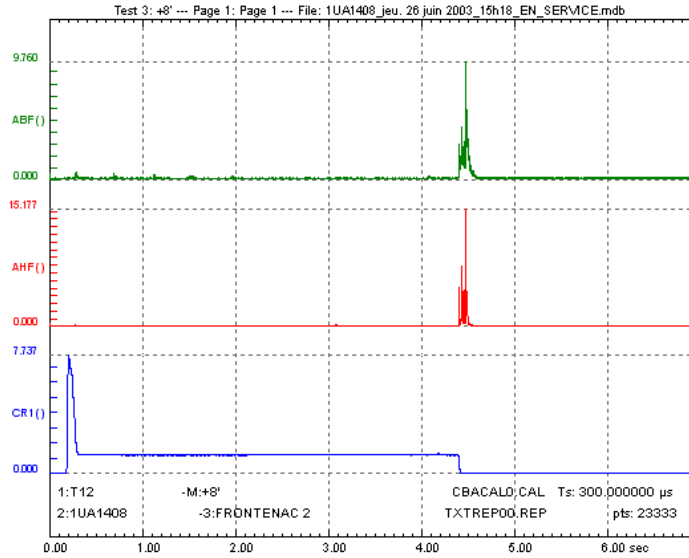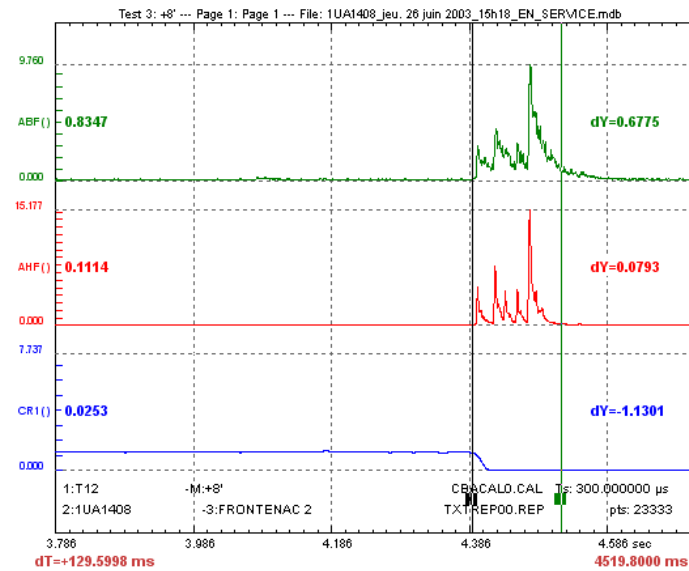| Amplification of the signature before inspection	Amplification of the signature after repair

Superposition of the new contact's signature versus old contact's signature.
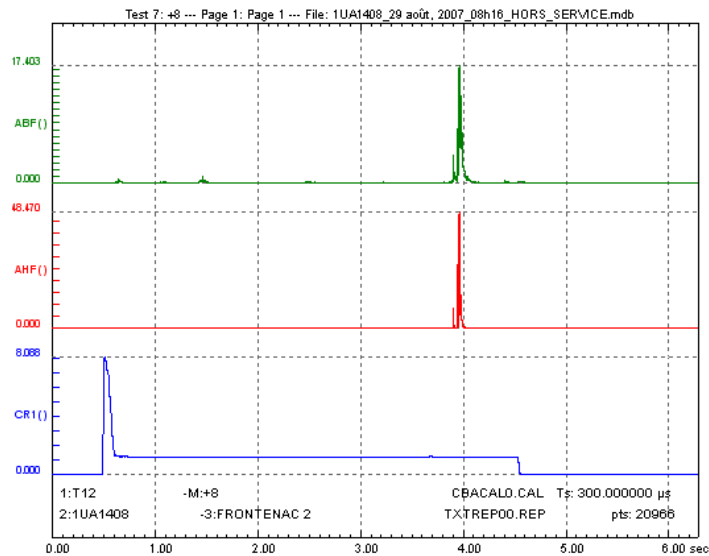
-Asynchronism example:

Recorded signals

Amplified signals

After repair: Signature without asynchronism

C6. Recommendations for future tests :

The impact's amplitude is very low. It would be preferable to change the location of the accelerometer for the next tests in order to have higher amplitudes.

C7. Transfer and sharing of data and pictures with ZENSOL on DB TAP:

YES.