



IEEE C57.12.00 –
DGA / DRM ON TAP-CHANGERS
FOR ROUTINE TESTS

MR

IEEE C57.12.00

Scope of Tests defined in C57.12.00 (Tap Changers)

Section	Test	Tap-Changer Positions	Comment
Table 18	(Static) Resistance Measurement	Min / N / Max	only with first unit of new design
Table 18/ 8.3.1.	Ratio Test	All	Variable supply voltage, no load
Table 18/ 8.3.2.	Impedance voltage and load-loss test	Min / N / Max	Determination of u_k , I_0
8.3.2.1.	Impedance testing	Min / N / Max	Which test setup ?
Table 18	No-load losses at 1.0 and 1.1 x U_N	N	Determination of no-load losses, I_0
Table 18	Operational test	Sequence N–Min–Max–N	Verification of mechanical and electrical function

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Scope of Tests defined in C57.12.00 (Tap Changers)

Section	Test	Tap-Changer Positions	Comment
Table 18	(Static) Resistance Measurement	Min / N / Max	only with first unit of new design; method has been voted out (Fall 2013)
Table 18/ 8.3.1.	Ratio Test	All	Variable supply voltage, no load
Table 18/ 8.3.2.	Impedance voltage and load-loss test	Min / N / Max	Determination of u_k , I_0
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Proposal for Additional Tests

Transformer	Test	Pass criteria
De-energized	One complete cycle of operation at 85% auxiliary supply voltage	<ul style="list-style-type: none"> ▪ All tap changes shall be completed successfully with no signs of abnormal motor sounds
Energized	No-load condition at nominal rated voltage (U_N): One complete cycle of operation	<ul style="list-style-type: none"> ▪ Oil samples taken from the main tank before and after the test shall not indicate any dissolved gas increases ▪ Oil samples taken from the Diverter compartment before and after the test shall not indicate any dissolved gas increases for tap changers of the vacuum switching type ▪ Voltage on the open side and no-load current I_0 show uniform pattern throughout the range (step curve) ▪ Sound shall be uniform through all switching operations
	Transformer in Load Loss connection with minimum 80% of the maximum nameplate current I_N in the regulated winding: One complete cycle of operation	

(introduced by T.Ansari, J.Foldi, Fall 2013)

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	Transformer in Load Loss connection with minimum 80% of the maximum nameplate current I_N in the regulated winding: One complete cycle of operation	<ul style="list-style-type: none"> Voltage on the open side and no-load current I_0 show uniform pattern throughout the range (step curve) Sound shall be uniform through all switching operations

⇒ These tests should be introduced to PC57.12.00 (Table 18) or Section 8.3

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DGA on Tap Changers is not recommended for Routine Tests !

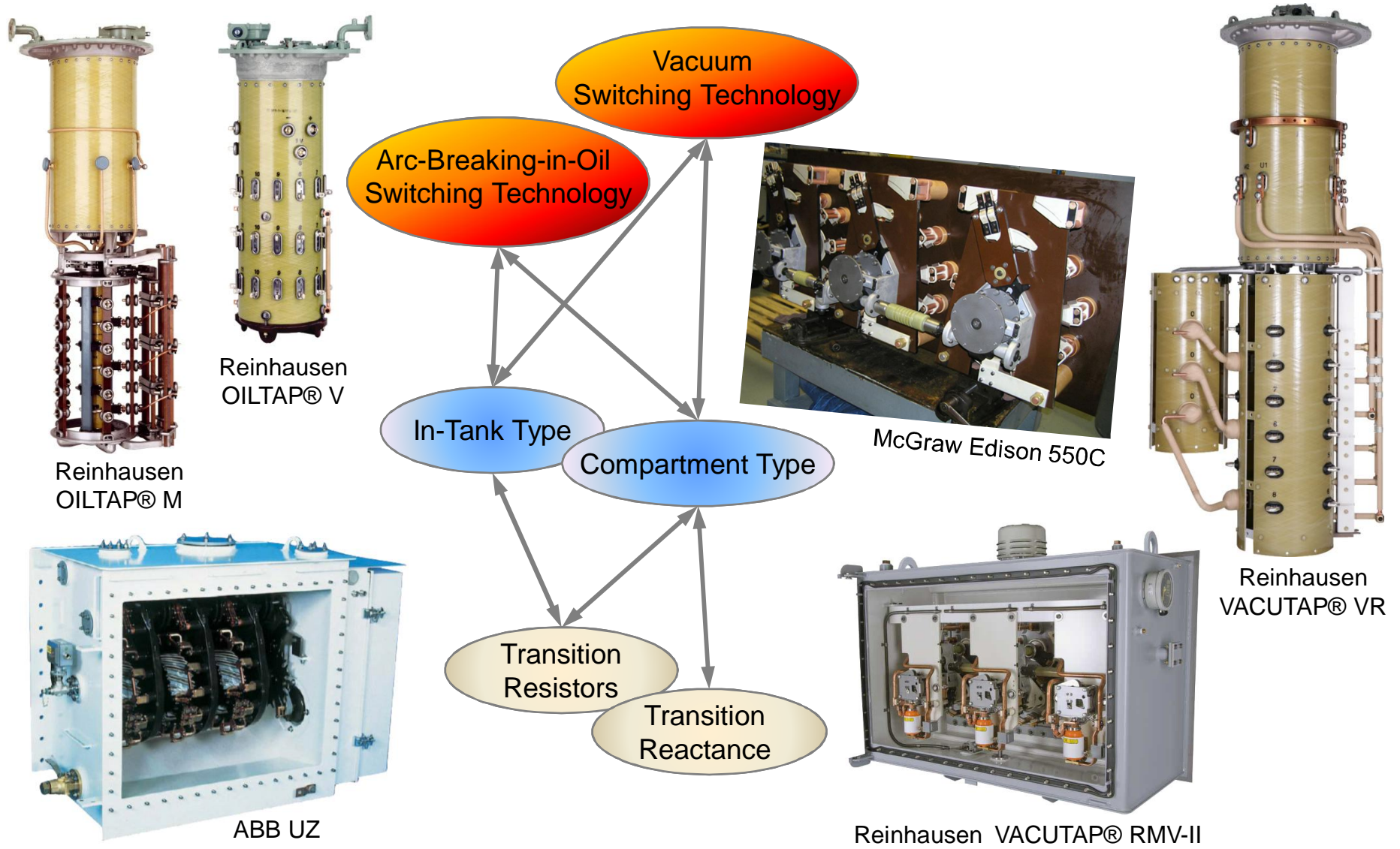
- During the test, the oil heats up and produces dissolved gases, due to heating and/or catalytic effects
 - ⇒ Gas patterns before and after the test(s) *cannot* be the same !
- DGA on Tap Changers is meaningful only for vacuum switching LTC types
 - ⇒ conventional arc-switching LTC types cannot be tested this way
 - ⇒ IEEE Standard is not generally applicable
- Limit values for DGA are type-specific
 - ⇒ Different data sets, one for each tap-changer type/family/brand
 - ⇒ Potential source for misinterpretation !
- Gas generation depends on application parameters
 - ⇒ "Normal" values vary with every application
 - ⇒ Values which are normal for one type may indicate a fault for another type

Example:

Reactance type vs. Resistor type LTC:
Resistor type LTC may generate some heating gases;
but the reactance type NOT !

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Tap Changer Population – Big variety of types/models



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DGA on Tap Changers

When can it be helpful ?

- Monitoring of LTC aging process
- Detection of irregularities during LTC Life

What does it need ?

- Trained personal for sampling, analysis, interpretation
- Regular sampling ⇒ building up a history / trend analysis
- Initial sample after commissioning ⇒ “Base line” data
- Individual interpretation rules, depending on LTC model / brand / operational parameters (see PC57.139)
- Guidance by LTC manufacturer is recommended

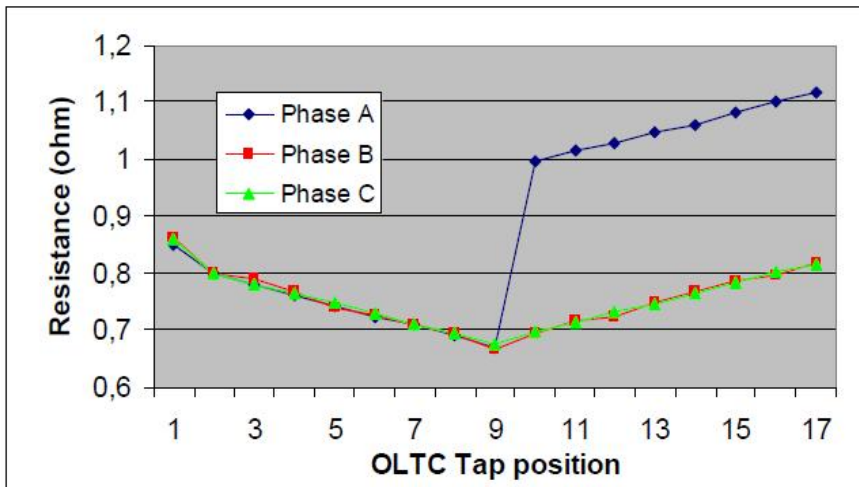


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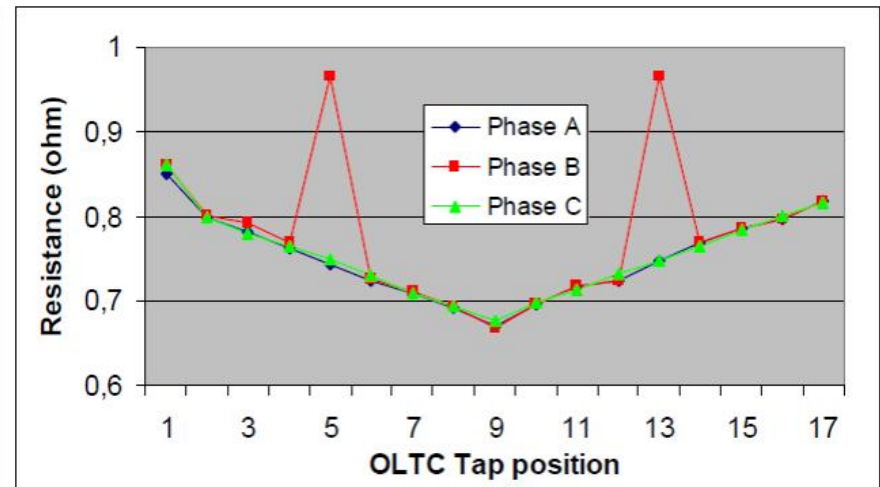
Winding Resistance Measurement

When can it be helpful ?

- In field service
- Finding contact problems



Change-over selector problem



Fine tap selector problem

Source: Hydro Quebec, CIGRE 2006 Publication A2-102

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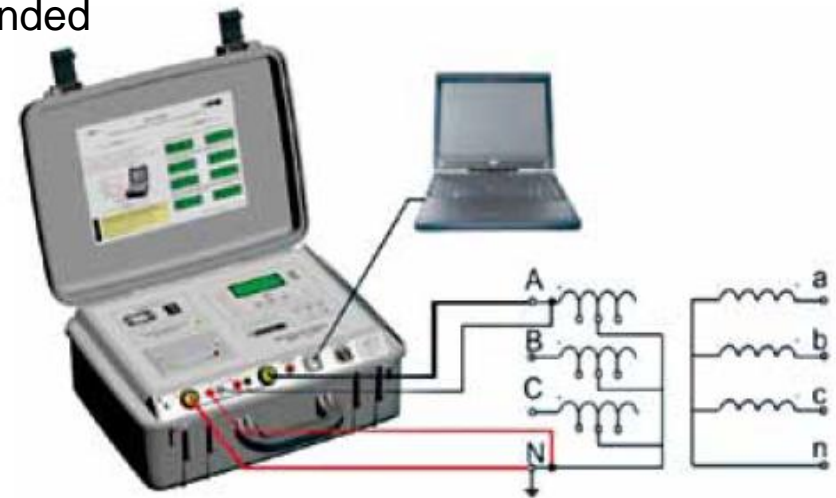
Dynamic Resistance Measurement (DRM)

When can it be helpful ?

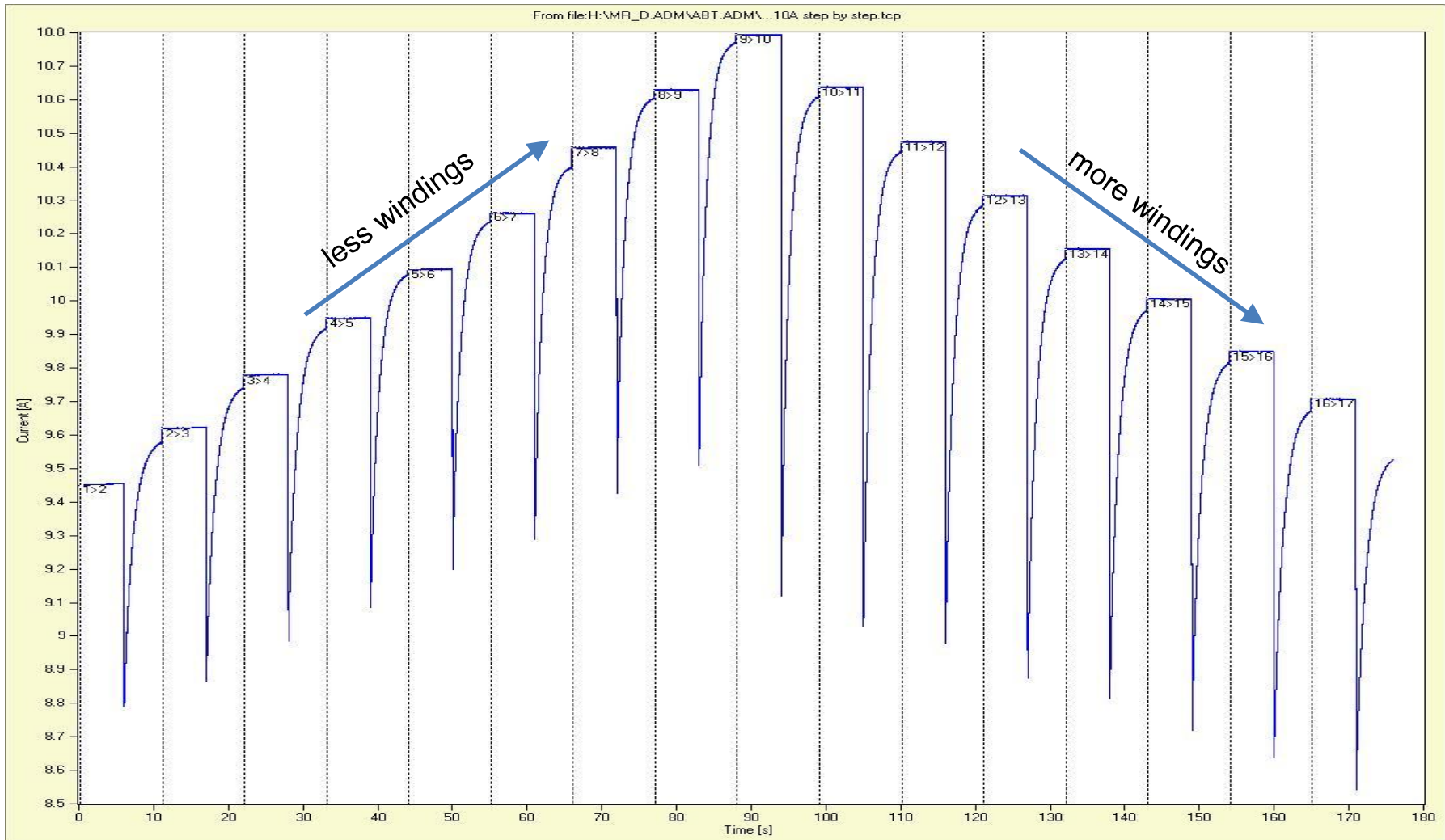
- In field service / maintenance
- Finding contact problems
- Check of timing of tap selector AND diverter switch

What does it need ?

- DRM equipment (different suppliers)
- Initial sample after commissioning \Rightarrow Reference curve (individual fingerprint)
- Trained personal for analysis and interpretation
! Different LTC types \Rightarrow Different signals !
- Guidance by LTC manufacturer is recommended

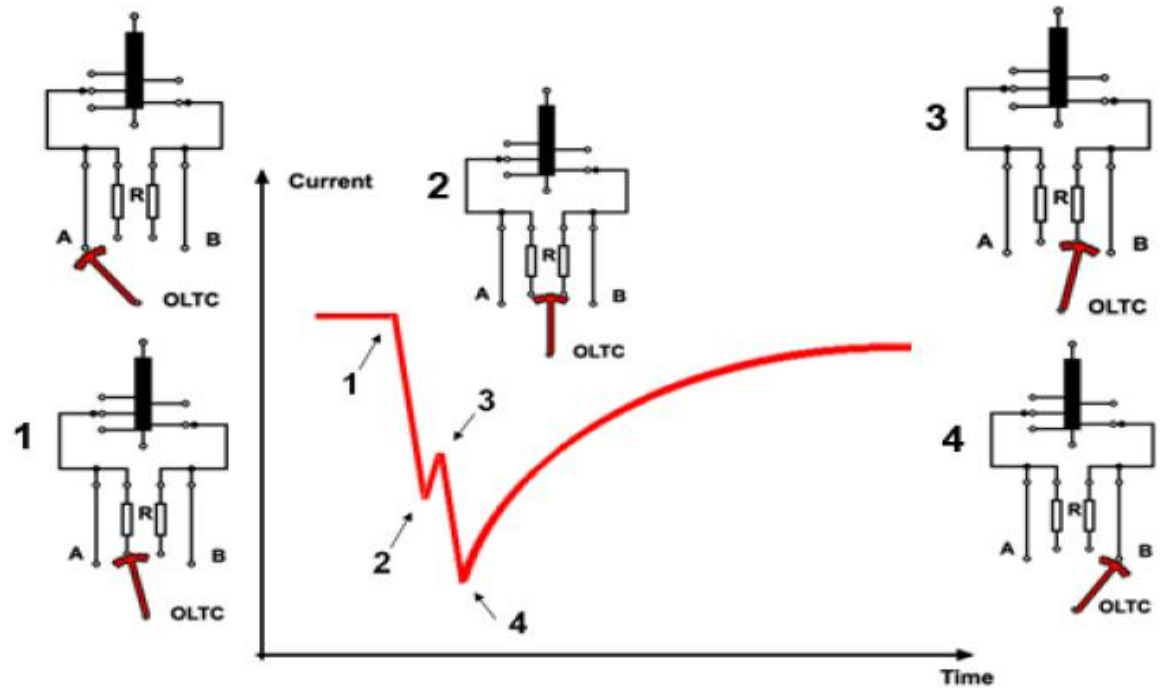
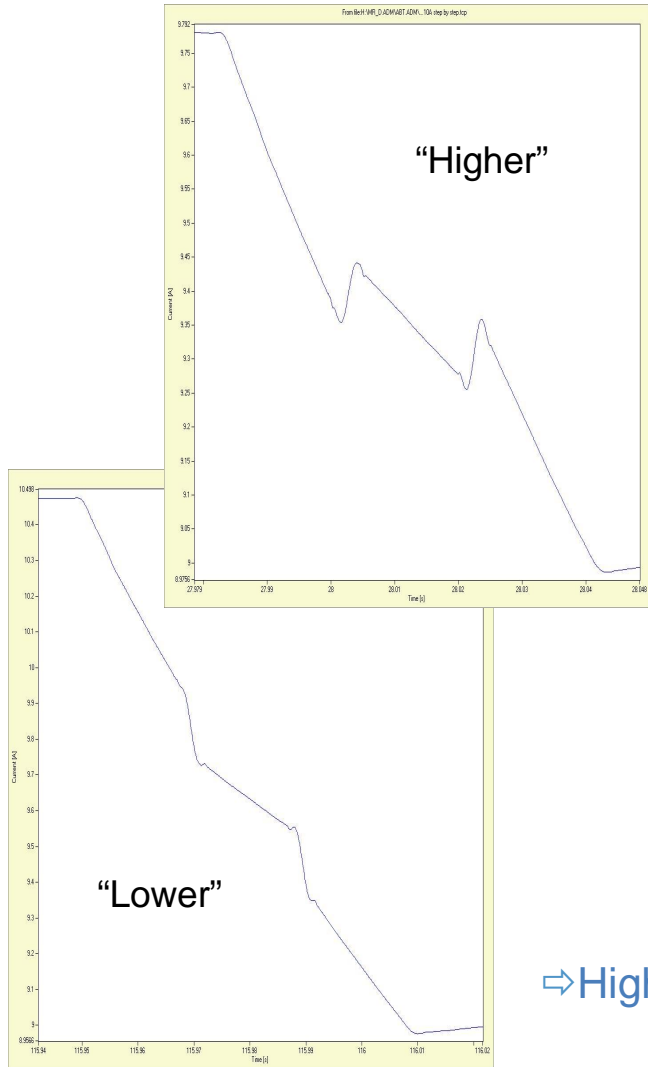


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Resistor type LTC (on-site measurement, fault-free)

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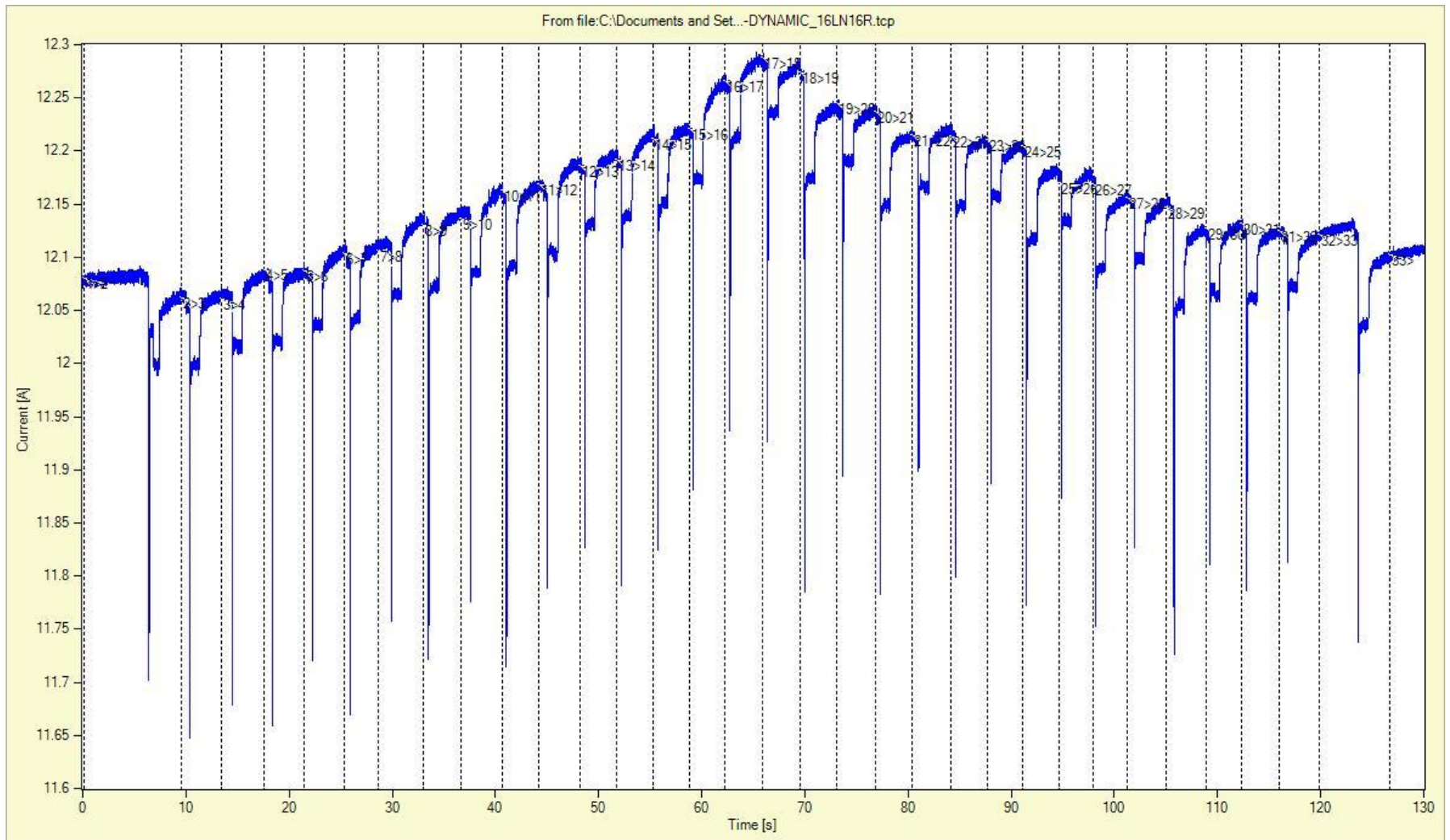


Diverter switch Resistor type LTC

⇒ High sampling rate shows switching sequence of Diverter Switch

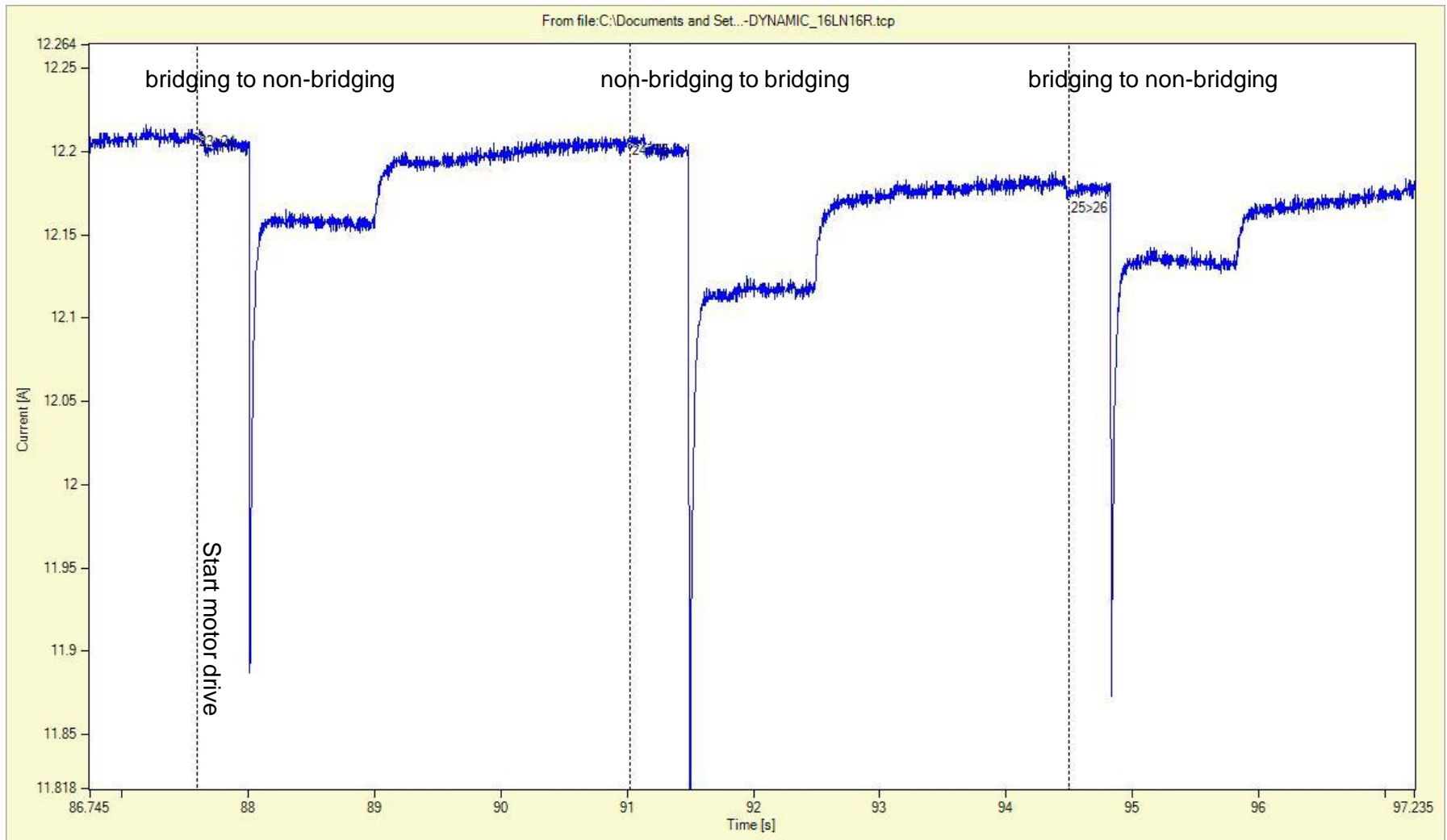
Source: Raka Levi, "Dynamic Resistance Measurement applied to On-Load Tap Changers"

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Reactance type LTC (on-site measurement, fault-free)

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