

Study Committee A3 Transmission and Distribution Equipment

Paper 10876_2022

Benefits of high-resolution/high bandwidth acquisition of conventional voltage and current transformers for controlled switching: illustration with latest generation of controller

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Motivation

Controlled switching performance

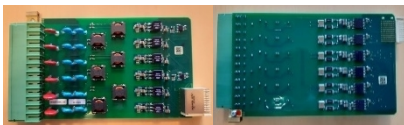
- Growing number of controlled switching applications
- Interest / need for accurate indicators
- Comparison between circuit breaker type test records and real life in the network
- Post operation analysis, fast transients review
- Focus on high voltage quantities

Controlled switching integration

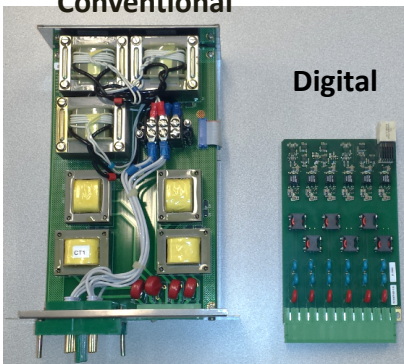
- Footprint, compact and lightweight design

Method/Approach

- Use of modern digital technologies / electronics
- Measurement of 6 voltages
- Increase accuracy of voltage and current measurement inputs connected to conventional VTs and CTs, to get the most of this information
- Sampling rate 40kHz - Analogue bandwidth 10kHz
- Galvanic isolation ! EMC !

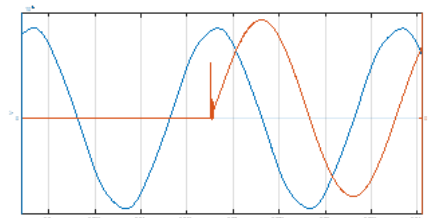
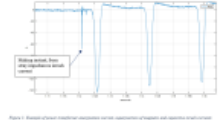


Conventional



Experimental setup & test results

- Power transformer switching
- Shunt reactor switching
- Capacitor bank switching



Example of shunt reactor energization: source (sync)voltage and load current

Discussion

- Set indicators based on HV quantities, not only mechanical -> power quality, voltage dips
- Making time accuracy
- Reignitions detection, NSDD, chopped current -> adaptive arc time
- Inrush current amplitude and frequency -> accurate electric wear measurement
- Comparison between service life and type tests

Conclusion

- Fine tuning eased during commissioning
- Improved performance
- Long term follow-up (10000+ records)

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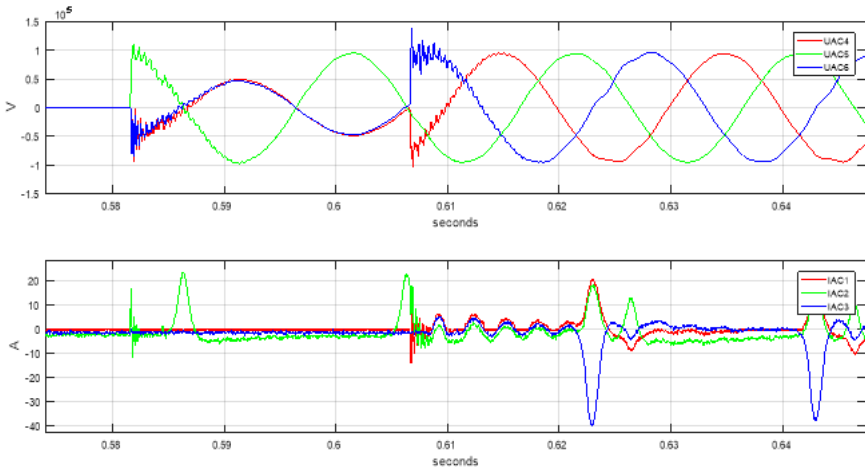
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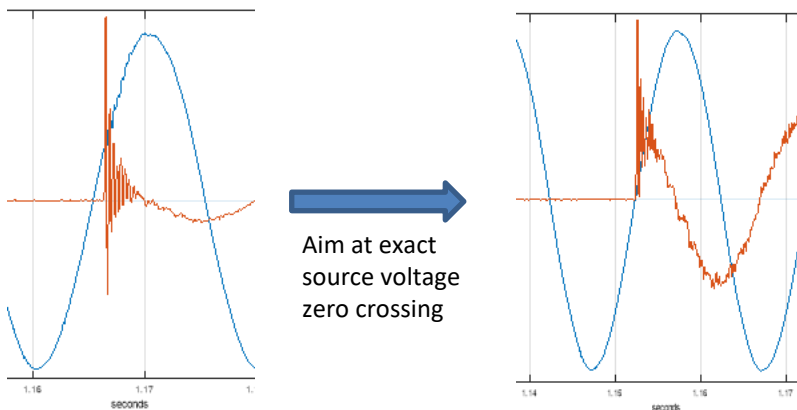
Typical example of power transformer energization (field measurement)

- V_d : first phase closed near peak voltage, subsequent phases one quarter of a period plus dead period later
- Making times visible both on load voltages and currents (stray capacitance inrush...)



Example of capacitor bank energization improvement (field measurement)

- Source voltage and load current
- Making times visible both on load voltages and currents (stray capacitance inrush...)

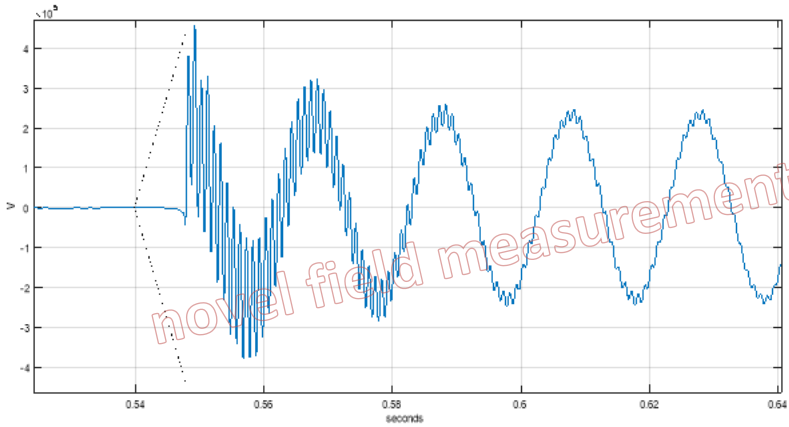


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Shunt reactor de-energization (field measurement)

- Voltage across circuit breaker
- TRV peak correctly recorded → direct comparison with circuit breaker capability (RRDS)



Shunt reactor de-energization (field measurement)

- Chopped current (~10A)

