Paris Session 2022

cigre
For power system expertise

Reasons why not to rely only on numerical simulation…

A2-PS3: Question 3.8:

"Considering the technical difficulties to apply short-circuit testing, but also manufacturing tolerances, and unknown parameters of the transformer design and materials, is it possible to rely only on numerical simulation to assess the short-circuit withstand ability?"

Christian Schmied, Switzerland

WEIDMANN

Reasons why NOT to rely only on numerical simulation…

- The design parameters e.g. material characteristics getting described better and better but still need further research work

- More sophisticated material models will be used in numerical simulation tools

- But: To which extent do the models and simulation tools really reflect the built unit? - with regard to materials used, manufacturing tolerances, applied and remaining clamping forces etc.

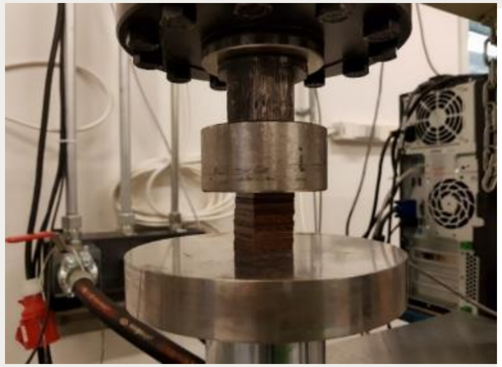
- Also, even though not related to the topic above: The change of material during service (i.e. aging, short circuit impacts) may not be considered in simulations, but should be.

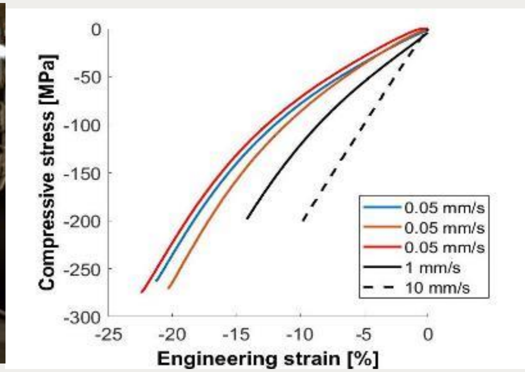
Reasons why NOT to rely only on numerical simulation…

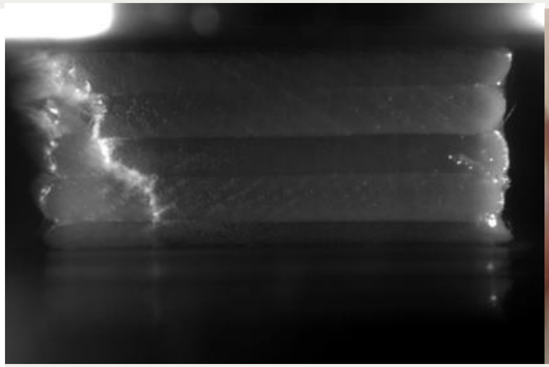
- Simulations are needed, are very useful and cost is on low level. However, simulations only, will always have inferior validity when compared with real short-circuit testing: there are always things to learn when evaluating the results from the real test.
- To simulate the reality the deviations from nominal must be known, which are available after manufacturing and processing only.
- Particularly, the static clamping forces are not known precisely as the transformer leaves the factory: typically, the final clamping is mostly done when the active part is exposed to the factory environment in a transient temperature cooling-down condition, after the vapor-phase drying.
- To model the tolerances a broad parameter sweep of geometry, material parameter and boundaries will be necessary and complicates also the evaluation due to amount of obtained data.

Improving safety regarding short-circuit strength …

- Improved knowledge about the material characteristic is essential for proper simulation results (see esp. CIGRE WG D1.65 - results will be published later this year)







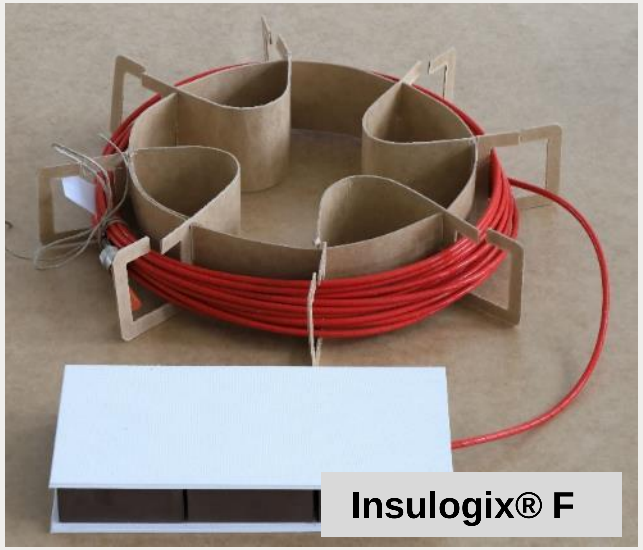
- The currently running joint project "DynaLoad" investigates the clamping pressure variation of a 40 MVA transformer in the field, which is equipped with novel sensors suitable to record clamping pressures on-line.

Chr. Schmied, Weidmann AG, GDM A2 Q 3.8

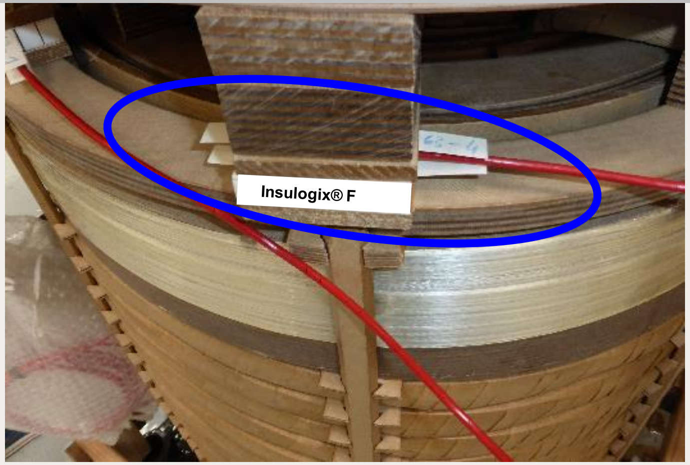
Improving safety regarding short-circuit strength …

- "Dynaload": Built-in pressure sensors give proof of actual levels of clamping pressures as the transformer leaves the factory and indicate any pressure changes during service
- Short-circuit testing of transformers may be less frequently advisable if actual clamping forces are close to design values / requirements

Built-in fibre-optic-sensors at the winding top of a transformer



Clamping pressure sensor:
Range 0-10 N/mm^2



- The sensors allow continuous online monitoring/recording of the clamping force in service.
- First results will be published later this year.