Paris Session 2022

Effective Insulation Condition Assessment of HV and EHV Bushings under Critical Environmental and Operational Conditions

D1 Materials and Emerging Test Techniques
PS1 – Testing, Monitoring and Diagnostics
Question 10: What conclusions can be drawn from the results for use in the field of critical environmental and extreme operational conditions?

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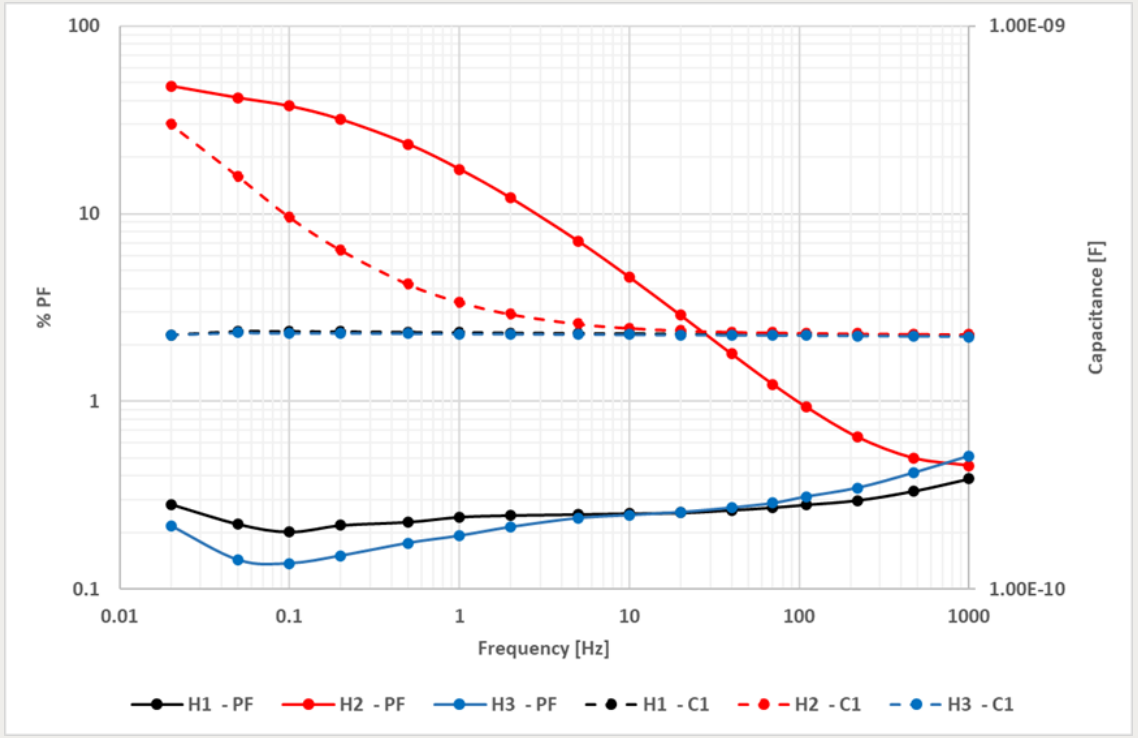
Assessment of HV and EHV bushing under critical operational and environmental conditions

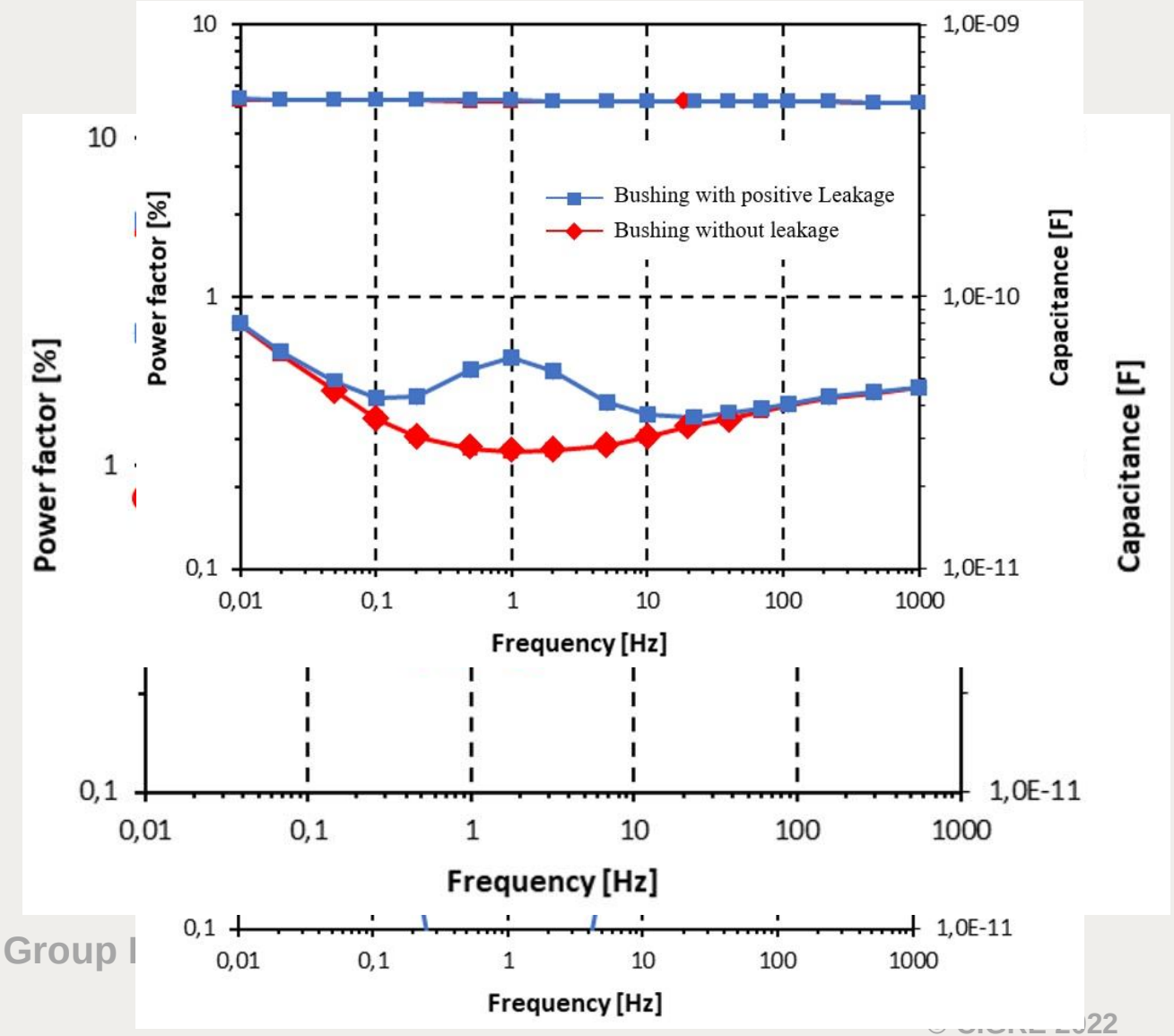
•*Thermal Conditions*

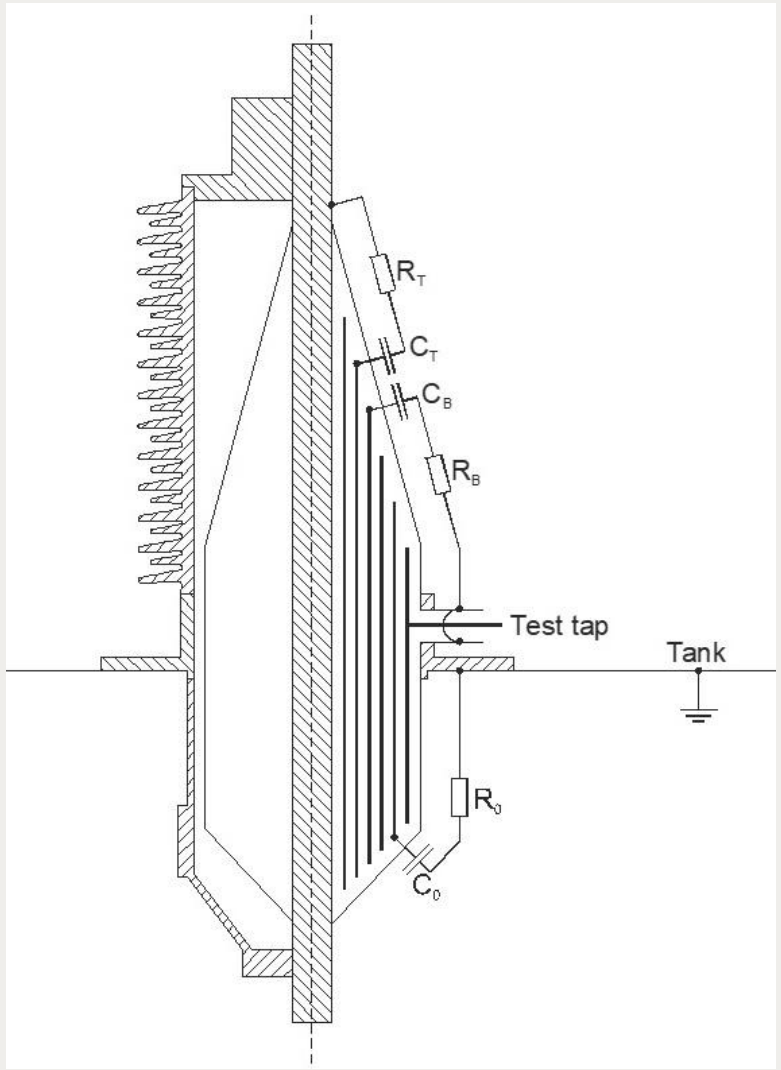
- Use the Individual Temperature Correction algorithm (ITC) based on the Arrhenius equation to normalize the dielectric response to 20 °C.
  - Compare line-frequency (50 or 60 Hz) %DF measurement against the nameplate value on the bushing.
  - Analyze the 1 Hz normalized %DF value.

Bushing Insulation Condition	1 Hz DF at 20 °C
As new	0.2 – 0.4
Good	0.4 – 0.75
Aged	0.75 – 1.25
Investigate	> 1.25



Modeling and simulation of bushing surface leakage currents





Conclusions

The analysis of the DFR response on HV and EHV bushings has been extended. Validation limits have been provided at 1 Hz.

DFR allows for proper temperature correction using the Individual Temperature Correction (ITC) algorithm and different frequencies can be used for assessment (50/60 Hz and 1 Hz). Limits provided.

The model and examples provided in this paper help explain and understand the effect of leakage currents flowing in internal and/or external surfaces of an HV bushing

Addition or subtraction of losses in the dielectric response is possible and it is not a reason to condemn an HV bushing.

It is also recommended to use HV DFR (1400 Vrms) for specimens with a capacitance below 1 nF (especially under high EMI in the field).

DFR is a reliable insulation assessment tool capable to work in the field under critical environmental and operational conditions even at temperatures below 0 °C.