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MODELLING OF DIELECTRIC RESPONSE OF GENERATOR STATOR INSULATION

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Service life of a generator stator winding mostly depends on the condition of its insulation. Therefore, condition assessment of stator insulation is very important to prevent unexpected failures of generators. Non-destructive tests are usually conducted to assess the condition of such stator insulation, and among them, Frequency Dielectric Spectroscopy (FDS) measured in the frequency domain, has been proven as an effective test method to obtain the dielectric response of the insulation. This work aims to increase the understating on dielectric response of generator stator insulation under drying, wetting and ageing conditions. This paper presents modeled results representing the dielectric response based on FDS measured on aged and non-aged asphalt-mica, polyester-mica and epoxy-mica insulated winding samples.

In the ageing tests, 40 cm long asphalt-mica and epoxy-mica samples (two each) were electrically stressed at 300% of their nominal voltage in a cyclic behavior (each day stressing and resting as 12/12 hours.) for more than 1800 hours. For the non-ageing test an asphalt-mica winding was dried at 80°C inside an oven (2.6 m x 1.7 m x 0.8 m) for 72 hours. For wetting, a polyester-mica winding was dipped in a water bath for 168 hours at room temperature. The FDS measurements were conducted on the samples every 168 hours. All tests were done at 200 V from 1 kHz to 0.1 MHz with a three electrode system using Insulation Diagnostic Analyzer (IDA200). In the modeling part, first the complex permittivity ($\varepsilon = \varepsilon' - j\varepsilon''$) was obtained from the measured FDS results. The dielectric response function was obtained from the inverse Fourier transform of real part of the susceptibility. The DC conductivity (σ) was also calculated from the permittivity and the Kramers – Kronig (K-K) relationship. The dielectric response function was modeled by Curie-Von Schweidler (At^{-n}) model. Thus for each FDS results the dielectric response is characterized by permittivity (ε), conductivity (σ) and dielectric response function A and n.

It was found that the condition of stator insulation can be modelled by dielectric response parameters. Further, the dielectric response function shows good agreement with all tested cases whereas the conductivity clearly highlights the variation in cases of ageing and drying.