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Limits of off-line PD measurement to assess quality and condition of HV insulation windings for rotating electrical machines

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Abstract

Wouldn't it be fantastic to have an assessment method for HV insulation windings of rotating machines, which illustrates the level of quality after the production process, lifetime for new bars or coils and residual life time for components already in operation for many years?

Amongst dimensional, visual, electric and dielectric tests - for instant dissipation factor, insulation and armour resistance or high-pot test for one minute - partial discharge (PD) measurement have become very popular for off-line and on-line measurements to assess the quality and condition of the winding insulation. Weighted magnitude or largest magnitude recorded by measurement systems with a defined PD pulse repetition rate and pulse train response according to IEC 60270 are often used and limited in technical specifications for hydro generators. But does it really make sense to scrap a bar with 2002 pC, if the limit is defined with 2000 pC?

How serious is it to measure PD phase by phase of an old generator in order to judge its condition or even give an indication for the residual life time of the HV winding, since it is a core component of the electrical rotating machine?

With this paper, the author and his co-authors present results of corona probe measurements of each of the 144 individual slots of a generator, which has been in operation for 45 years, and try to find correlations between PD levels and residual life time. As well for a new 18 kV winding 18 bars after production have been separated and used for testing: 6 with lowest, 6 with most average and 6 with highest PD level. These bars have been electrically aged, some even additionally thermo-cycled in order to prove evidence of a potential correlation between PD level and operational quality meaning life time combined with thermos cycles.