Title:

Synthesis of methods for analysing partial discharges on high-voltage items of Power Grid for diagnostic tool building based on K-means type algorithms.

Summary

In the context of predictive maintenance, monitoring high-voltage substation insulation systems is crucial due to the critical nature of these systems. A failure almost inevitably results in a shutdown of the installations. Therefore, improving the performance of monitoring devices for these insulation systems remains a constant priority.

Various physical measurements are employed to assess the condition and estimate the probable lifespan of insulation systems (e.g., insulation resistance, dissipation factor, partial discharges). Depending on their type, these measurements can be performed either during operation or while the system is offline.

This paper focuses primarily on partial discharge (PD) measurements, as they serve as a common and currently the most reliable criterion for evaluating all high-voltage components during operation.

Although the physical phenomenon behind partial discharges remains consistent, measurement methods and data processing techniques vary significantly.

Three major types of components in a high-voltage network are considered: rotating machines, transformers, and cables. Monitoring the insulation of these components using partial discharge measurements is already well-established, with existing standards and extensive databases maintained by operators or their service providers.

However, the indicators derived from these databases are often heterogeneous in construction and information quality. This heterogeneity complicates automated processing and necessitates a preprocessor to harmonize the data before undertaking taxonomic analyses as part of a global online monitoring program for power grids.

In this paper, we first revisit the fundamentals of partial discharge analysis and then present the development of monitoring indicators specific to rotating machines, transformers, and high-voltage cables.

We detail the typology of each component, the degradation modes of their constituent parts, and their interpretation through online and offline partial discharge measurements. Emphasis is placed on the Phase Resolved Partial Discharge (PRPD) Pattern.

Once these fundamentals are established, we discuss the critical role of the preprocessor in enabling an automatic diagnostic process.

Using PRPD as an example, we illustrate the mathematical tools required to process data from disparate measurement systems while integrating bibliographic databases.

Finally, we propose a software architecture to incorporate partial discharge diagnostic tools into a comprehensive machine diagnostic system.