Abstract

The dissertation presents the novel health index for preliminary assessment of the condition of power transformers based on commonly performed oil diagnostic procedures. The developed method consists of three components, which include the evaluation of the physicochemical properties of the oil, the content of dissolved gases in the oil, and the aging degree of solid insulation. The specific design of the algorithm was aimed at achieving the greatest possible sensitivity to changes in input parameters within the assumed diagnostic ranges.

The study was conducted on a transformer population consisting of 233 units subjected to multi-year assessments, from which 1133 electrical oil diagnostic reports were obtained. The age span of the devices in the study group ranged from newly introduced in service to 50 years in operation in the power system. Due to the different work regimes, four subpopulations – generator step-up, electric arc furnace, transmission, and industrial transformers – were distinguished for analytical purposes. The health index output was calculated and analyzed for each of the specified groups and the entire population.

Thereafter, the subject of the variability of health index values between successive checks was addressed, including simulated calculations of increase rates, determination of population average changes, and analysis of the largest increases and decreases recorded for the test group. The scope of the research made it possible to determine evaluation guidelines for changes in health index values by establishing alarm and pre-failure thresholds.

The final section presents case studies of various operating scenarios with the use of the proposed method. Examples of normal operation, accelerated aging or malfunctions, factory defects, and the impact of on-site oil treatment procedures are described. Results obtained from the population analyses and conclusions from the studies on the variation of health index values were utilized to discuss real cases.

The results obtained in the study indicate that the magnitude of the changes in the results is a reliable complementary indicator for assessing the technical condition of the transformer and that limiting the parameters of the health index procedure only to key oil diagnostics fulfills its role as a preliminary diagnostic tool.

Keywords

Transformer oil diagnostics, power transformers, health index, asset management