Fuzzy Logic-Based Approach to Predict Fault in Transformer Oil Based on Health Index Using Dissolved Gas Analysis

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Abstract : Transformer insulating oil is a key component that can be utilized to detect incipient faults within operating transformers without taking them out of service. Dissolved gas-in-oil analysis has been widely accepted as a powerful technique to detect such incipient faults. While the measurement of dissolved gases within transformer oil samples has been standardized over the past two decades, analysis of the results is not always straightforward as it depends on personnel expertise more than mathematical formulas. In analyzing such data, the generation rate of each dissolved gas is of more concern than the absolute value of the gas. As such, history of dissolved gases within a particular transformer should be archived for future comparison. Lack of such history may lead to misinterpretation of the obtained results. IEEE C57.104-2008 standards have classified the health condition of the transformer based on the absolute value of individual dissolved gases along with the total dissolved combustible gas (TDCG) within transformer oil into 4 conditions. While the technique is easy to implement, it is considered as a very conservative technique and is not widely accepted as a reliable interpretation tool. Moreover, measured gases for the same oil sample can be within various conditions limits and hence, misinterpretation of the data is expected. To overcome this limitation, this paper introduces a fuzzy logic approach to predict the health condition of the transformer oil based on IEEE C57.104-2008 standards along with Roger ratio and IEC ratio-based methods. DGA results of 31 chosen oil samples from 469 transformer oil samples of normal transformers and pre-known fault-type transformers that were collected from Indonesia Electrical Utility Company, PT. PLN (Persero), from different voltage rating: 500/150 kV, 150/20 kV, and 70/20 kV; different capacity: 500 MVA, 60 MVA, 50 MVA, 30 MVA, 20 MVA, 15 MVA, and 10 MVA; and different lifespan, are used to test and establish the fuzzy logic model. Results show that the proposed approach is of good accuracy and can be considered as a platform toward the standardization of the dissolved gas interpretation process.

Keywords : dissolved gas analysis, fuzzy logic, health index, IEEE C57.104-2008, IEC ratio method, Roger ratio method

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