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EVALUATION OF NO-LOAD LOSSES IN DRY THREE-PHASE TRANSFORMERS

Electric energy normally passes on the way from generation to consumer several transformers. Although individual transformers mostly do have high energy efficiency, in total the transformers nevertheless cause a few percent of energy losses in the T&D chain [1].

Distribution transformers play an important role in achieving the ambitious energy efficiency targets set by many countries in the world. Distribution transformers are of high value in terms of energy efficiency because of the number of installed units. In this context, energy efficiency metrics have been introduced and programs are on-going dealing with transformer losses [2].

Dry-type transformers do not contain any inflammable liquids, they are safe and reliable and expected to strongly increase their market penetration, as distribution transformers.

The energy efficiency requirements for transformers are either maximum load loss and no-load loss or a minimum “Peak Efficiency Index” (PEI) [1,4].

The use of PEI provides scope for further reduction in losses as it allows the transformer to be designed to match the load, either minimizing copper or iron losses as appropriate. This is typically achieved by specifying the minimum PEI with load and no-load loss capitalization values. Using PEI method, peak efficiency for all the designs is the same, whereas the load at which the peak efficiency occurs can be adjusted according to the loss capitalization values.

The no-load loss of a power transformer is the active power loss in the power transformer when it is energized but not supplying a load. It consists primarily of a core loss. These losses can represent a significant operating expense for a utility, especially if its energy costs are high [3].

The distribution transformer efficiencies steadily increased with the introduction of improved materials and manufacturing methods [5].

Of the various materials required to build a transformer, the electrical steel comprises the largest investment. But also important is the design of the magnetic core and the methods and quality of assembly of this design [6]. The disadvantage of reduced transformer loss is the need for an increased amount of material or the usage of more expensive materials. The no-load loss of a transformer can be reduced by either increasing the core cross-section, reducing the magnetic flux density, or by using electrical steel of a higher, more expensive grade.

In today’s realities, where the price of a dry-type transformer is one of the key factors, while energy efficiency remains the same, it is the search for new solutions in the design of the magnetic circuit that is central to further research.

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