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"A REVIEW ON TRANSFORMER COOLING SYSTEM"

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ABSTRACT

Transformer heating, offering valuable insights for researchers and practitioners in the field. Power transformers have immense importance in power system and this should work very efficiently for good results. Hotspot temperature plays a vital role in transformer's life expectancy. Temperature rise in a power transformer due to non linear load current is known to be most important factor in causing rapid degradation of its insulation. Core is one of the parts of transformer where hotspot temperature is effective. .There are many problems associated with Power loss in transformer but in this paper mainly focuses on efficient cooling system designed for overcoming heating and insulation losses. Ever since the invention of a transformer, we have been facing the trend of increasing its nominal power. Together with the increase of nominal power, losses in transformers increase as well, while a transformer's own capability of cooling decreases

Key Words: *Transformer, cooling, heating, core.*

I. INTRODUCTION

Transformer heating is a significant concern because excessive heat can degrade insulation materials, accelerate aging, and ultimately lead to failure or reduced lifespan of the transformer. It can also affect the efficiency and reliability of the entire power system. Therefore, understanding and managing transformer heating are essential for ensuring the safe and reliable operation of power networks.

Several factors contribute to transformer heating:

Load Current: The primary source of heating in transformers is the load current flowing through the windings. As current passes through the winding resistance, it generates heat according to Joule's law (I^2R). Higher load currents result in increased heating.

Core Losses: Transformers also experience magnetic losses in the core material due to hysteresis and eddy currents. These losses contribute to overall heating, especially in larger transformers operating at higher frequencies.

Dielectric Losses: Dielectric losses occur in the insulating materials (such as oil or solid insulation) due to the electric field stress. These losses can increase with higher voltages and frequencies.

Ambient Temperature: The surrounding temperature affects the transformer's cooling capacity. Higher ambient temperatures reduce the effectiveness of natural or forced cooling mechanisms, leading to higher operating temperatures.

Effective management of transformer heating involves several strategies:

Proper Sizing and Design: Transformers should be appropriately sized to handle the expected load conditions without excessive heating. Proper design considerations, such as selecting suitable materials and cooling methods, are essential

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to ensure optimal thermal performance.

Cooling Systems: Transformers are often equipped with cooling systems, such as radiators, fans, or oil circulation systems, to dissipate heat and maintain acceptable operating temperatures. Regular maintenance and monitoring of cooling systems are necessary to ensure their effectiveness.

Temperature Monitoring: Continuous monitoring of transformer temperatures is critical for early detection of hotspots and potential issues. Various temperature sensing technologies, including thermocouples, resistance temperature detectors (RTDs), and infrared thermography, can be used for this purpose.

Load Management: Managing transformer loads and avoiding overloading conditions can help reduce excessive heating and prolong transformer lifespan. This may involve load shedding, load balancing, or implementing smart grid technologies for efficient power distribution.

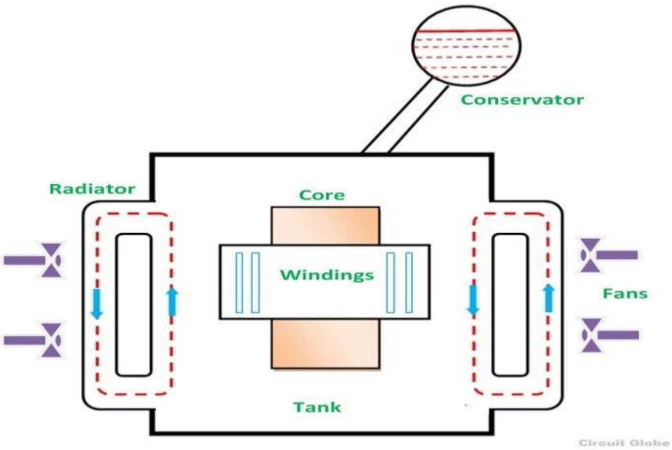

Fig.1 Transformer cooling system

II. Literature Review

A complete review of experimental approaches to the cooling of transformer coils by natural convection method performed by By E. D. taylor [1].

By Wenhao niu performed the experimental study of a novel cooling system of a power transformer in an urban underground substation [2].

Eleftherios I performed a distribution transformer cooling system improvement by innovative tank panel [3].

PLC based transformer cooling control system performed by Shreenivas Pai [4].

The transformer fault detection and protection system performed by Kowshik Sen Gupta [5].

D.V. Pushpa Latha control the temperature based on millienium 3 PLC by using LM 35sensor, [6].

Based on microcontroller the transformer cooling control performed by the Bhushan S. Rakhonde[7].

M. Anand worked on microcontroller based transformer monitoring and controlling system by using Zigbee[8].

By V. M. Monsinger performed bridgment of loading transformer [9].

Kamil Dursun performed the oil and winding temperature control in power transformers [10].

Armando Guzmán performed a current-based solution for transformer differential protection[11].

Numerical study of cooling solutions inside a power transformer by Nelu-Cristian Cherechesa [12].

New development in transformer cooling calculations performed by K. Eckholz. [13].

Transformer hotspot temperature calculation performed by Mohd Taufiq Ishak [14].

Study on simulation test device of transformer split type cooling system performed by Wei Bengang [15].

By O.E. Gouda performed the predicting transformer temperature rise and loss of life in the presence of harmonic load currents [16].

By L. Pierrat the Power transformer life expectancy under distorting power electronic loads performed [17].

M. Srinivasan performed the prediction, of transformer insulation life with an effect of environmental variables [18].

Analyzing the impact of ambient temperature indicators on transformer life in different regions of Chinese Mainland performed by Cui-fen Bai [19]

Determination of thermal life expectancy of overhead distribution transformers by Donald o Chaghead [20].

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III. Method

Modeling Techniques:
The authors present a range of modeling techniques, from analytical formulations to numerical simulations, elucidating their respective advantages and limitations. This diversity allows for a nuanced understanding of transformer heating under different operating conditions.
Implications:
Beyond theoretical insights, the paper offers practical recommendations for optimizing transformer design and operation to minimize heating effects. This applied focus enhances the relevance of the research for industry professionals and decision-makers.
Areas for Improvement:
Clarity in Presentation: While the paper covers a breadth of topics, some sections could benefit from clearer organization and presentation. Enhancing the flow of ideas and providing more concise summaries at the end of each section would improve readability.
Discussion of Uncertainties: Given the complexity of transformer systems and the inherent uncertainties in modeling, a more explicit discussion of uncertainties and sensitivity analyses would strengthen the robustness of the findings.

IV. Conclusion

Advances in Transformer Heating Modeling and Analysis" represents a commendable contribution to the field, offering a comprehensive exploration of transformer heating phenomena. By integrating theoretical, computational, and experimental approaches, the authors provide valuable insights with practical implications for the design and operation of transformers. While some areas for improvement exist in terms of clarity and addressing uncertainties, the overall quality and relevance of the research warrant its consideration by scholars and practitioners alike.

V. Future Scope

Advances in Transformer Heating Modeling and Analysis" represents a commendable contribution to the field, offering a comprehensive exploration of transformer heating phenomena. By integrating theoretical, computational, and experimental approaches, the authors provide valuable insights with practical implications for the design and operation of transformers. While some areas for improvement exist in terms of clarity and addressing uncertainties, the overall quality and relevance of the research warrant its consideration by scholars and practitioners alike.

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