

EFFICIENCY ANALYSIS OF A 5 MVA POWER TRANSFORMER AT SOFIFI COAL-FIRED POWER PLANT, NORTH MALUKU

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ABSTRACT

Transformers are one of the vital components in power generation systems, especially in Steam Power Plants (SPP), which function to distribute electrical power efficiently. Transformer efficiency is greatly influenced by power losses, namely core losses and copper losses, as well as variations in operating loads. The Sofifi PLTU experienced load variations during performance tests, which included loads of 50%, 75%, and 100%, thereby potentially affecting the efficiency value of the power transformer. This study aims to analyze the efficiency of Generator Transformers (GT) at the Sofifi PLTU based on power loss calculations and actual load conditions using field operational data. The research methods used include literature studies and transformer operational data processing. The calculation results show that the efficiency of the transformer based on power losses is 99.47%, 99.48%, and 99.34%, respectively, while the actual efficiency at load variations of 50%, 75%, and 100% was 99.44%, 99.37%, and 99.32%, respectively. A comparison of the two approaches shows relatively comparable efficiency values with a small difference, which is caused by differences in the calculation approach and the effect of actual load conditions on current and copper losses. The highest efficiency was obtained at a load condition of 50%, which was 99.44%, indicating that the transformer was operating close to its optimum efficiency point. The results of this study are expected to provide an overview of the performance and efficiency of the GT transformer at the Sofifi PLTU as a basis for evaluating the operation and loading of the transformer.

Key Words : Transformer, Losses, Efficiency, Loading.

ANALISIS EFISIENSI TRANSFORMATOR DAYA GT 5 MVA PADA PLTU SOFIFI MALUKU UTARA

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ABSTRAK

Transformator merupakan salah satu komponen vital dalam sistem pembangkitan tenaga listrik, khususnya pada Pembangkit Listrik Tenaga Uap (PLTU), yang berfungsi untuk menyalurkan daya listrik dengan efisien. Efisiensi transformator sangat dipengaruhi oleh rugi-rugi daya yang terjadi, yaitu rugi inti (core losses) dan rugi tembaga (copper losses), serta variasi beban operasi. PLTU Sofifi mengalami variasi pembebanan pada saat performance test yang meliputi beban 50%, 75%, dan 100%, sehingga berpotensi mempengaruhi nilai efisiensi transformator daya. Penelitian ini bertujuan untuk menganalisis efisiensi transformator jenis Generator Transformer (GT) pada PLTU Sofifi berdasarkan perhitungan rugi-rugi daya dan kondisi beban aktual menggunakan data operasional di lapangan. Metode penelitian yang digunakan meliputi studi literatur dan pengolahan data operasional transformator. Hasil perhitungan menunjukkan bahwa efisiensi transformator berdasarkan rugi-rugi daya berturut-turut sebesar 99,47%, 99,48%, dan 99,34%, sedangkan efisiensi aktual pada variasi beban 50%, 75%, dan 100% masing-masing sebesar 99,44%, 99,37%, dan 99,32%. Perbandingan kedua pendekatan menunjukkan nilai efisiensi yang relatif sebanding dengan selisih yang kecil, yang disebabkan oleh perbedaan pendekatan perhitungan serta pengaruh kondisi beban aktual terhadap arus dan rugi tembaga. Efisiensi tertinggi diperoleh pada kondisi beban 50%, yaitu sebesar 99,44%, yang menunjukkan bahwa transformator bekerja mendekati titik efisiensi optimum. Hasil penelitian ini diharapkan dapat memberikan gambaran kinerja dan kondisi efisiensi transformator GT pada PLTU Sofifi sebagai dasar evaluasi operasi dan pembebanan transformator.

Kata Kunci : Transformator, Rugi-Rugi, Efisiensi, Pembebanan.