

ABSTRAK

Mohammad Suharto. Penerapan Sistem Synchron CBE (Close Before Excitations)

Pada Diesel Generator Konvensional. Dibimbing Oleh

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Penelitian ini menganalisis kinerja sistem sinkronisasi generator set (genset) menggunakan metode dead bus Close Before Excitation (CBE) dibandingkan dengan metode live bus, serta mengevaluasi respons dinamis genset melalui pengujian block load dalam system UPS terhadap beban, tuning PID, dan burning test. Hasil pengujian menunjukkan bahwa metode sinkronisasi dead bus CBE memiliki waktu sinkronisasi rata-rata 9 detik, lebih cepat dibandingkan metode live bus yang memerlukan waktu 18 detik, sehingga diperoleh efisiensi waktu sekitar 50%. Efisiensi ini berdampak langsung pada peningkatan keandalan sistem backup dan pengurangan ketergantungan terhadap baterai UPS. Pengujian block load menunjukkan bahwa genset mampu menerima beban 0–50% dengan respons tegangan dan frekuensi yang baik serta memenuhi standar ISO 8528-5, sedangkan pada block load 0–100% terjadi voltage dip hingga –19% dan frequency dip –9% dengan waktu pemulihan 5,5 detik, yang dikategorikan konsisional. Hasil tuning PID pada Digital Automatic Voltage Regulator (DAVR) dan governor terbukti memperbaiki respons transien, mengurangi voltage dip, dan meningkatkan stabilitas sistem selama sinkronisasi dan pembebanan yang tiba-tiba. Hasil burning test menunjukkan bahwa genset mampu beroperasi secara kontinu pada beban tinggi dengan tegangan, frekuensi, dan parameter termal yang stabil tanpa gangguan proteksi. Secara keseluruhan, penelitian ini membuktikan bahwa penerapan sinkronisasi dead bus CBE pada genset konvensional yang didukung digital governor, DAVR Digital Voltage Regulator dengan tuning PID yang tepat mampu meningkatkan kecepatan respon, stabilitas, dan keandalan genset sebagai sumber daya cadangan untuk beban kritis.

Kata kunci: Generator Set, Sinkronisasi Dead Bus, Close Before Excitation(CBE) PID Tuning

ABSTRACT

Mohammad Suharto .Implementation of the Close Before Excitation (CBE) Synchronization System on a Conventional Diesel Generator. Supervised by Prof. Dr. Ir. IWA GARNIWA MULYANA K., M.T., IPU., ASEAN Eng.

This study analyzes the performance of a generator set (genset) synchronization system using the dead bus Close Before Excitation (CBE) method in comparison with the live bus method, and evaluates the dynamic response of the genset through block load testing, PID tuning, and burning tests. The test results show that the dead bus CBE synchronization method achieves an average synchronization time of approximately 9 seconds, which is faster than the live bus method requiring approximately 18 seconds, resulting in a time efficiency of about 50%. This improvement directly enhances the reliability of the backup power system and reduces dependence on UPS battery capacity. Block load testing indicates that the genset is capable of accepting 0–50% load with stable voltage and frequency responses that comply with ISO 8528-5 standards. However, under 0–100% block load, a voltage dip of up to –19% and a frequency dip of –9% were observed, with a recovery time of approximately 5.5 seconds, which is categorized as a conditional pass. The results of PID tuning on the Digital Automatic Voltage Regulator (DAVR) and the governor demonstrate significant improvements in transient response, reduced voltage dip, and enhanced system stability during synchronization and sudden load changes. Furthermore, the burning test results confirm that the genset can operate continuously at high load levels with stable voltage, frequency, and thermal parameters, without triggering any protection faults. Overall, this study demonstrates that the implementation of dead bus CBE synchronization, supported by proper PID tuning, effectively improves response speed, system stability, and operational reliability of gensets as backup power sources for critical loads.

Keywords: *Generator Set, Dead Bus Synchronization, Close Before Excitation (CBE), PID Tuning*