INTISARI

Penelitian ini membahas stabilitas sistem tenaga listrik pada Sub-sistem Ungaran 1,2 yang merupakan bagian dari sistem interkoneksi Jawa-Madura-Bali (JAMALI), dengan fokus pada respons sistem terhadap gangguan berupa trip pembangkit. Ketidakseimbangan daya akibat lepasnya pembangkit besar seperti PLTGU Tambaklorok berkapasitas 810 MW dapat menyebabkan penurunan frekuensi signifikan dan memicu ketidakstabilan sistem. Simulasi dilakukan menggunakan metode RMS (*Root Mean Square*) berbasis perangkat lunak DIgSILENT PowerFactory 2021 SP2 dengan pendekatan skenario kontingensi N-1 dan N-2. Teori yang digunakan meliputi konsep kestabilan frekuensi, inersia sistem, serta peran *governor* dalam pengendalian daya aktif melalui respon sinyal kecepatan rotor (ω) dan sinyal bukaan katup turbin (pt). Hasil simulasi menunjukkan bahwa sistem mengalami penurunan frekuensi hingga mencapai titik nadir 49,31 Hz setelah gangguan, kemudian secara bertahap dipulihkan oleh kerja *governor* pembangkit lain seperti Tambaklorok GT dan ST, yang meningkatkan daya aktif untuk menutupi defisit daya. Pembangkit berkapasitas kecil seperti PLTA Jelok dan Timo turut memberikan kontribusi terbatas sesuai dengan daya mampunya. Perbedaan karakteristik pembangkit menyebabkan variasi respon sinyal ω dan pt, menunjukkan dinamika pemulihan yang tidak seragam. Kesimpulan dari penelitian ini adalah bahwa sistem tenaga Sub-sistem Ungaran cukup rentan terhadap gangguan pembangkit besar, dan peningkatan ketahanan sistem dapat dilakukan melalui optimalisasi peran *governor*, peningkatan total inersia sistem, serta penguatan koordinasi antar unit pembangkit dalam menjaga kestabilan frekuensi.

Kata kunci: Stabilitas, Frekuensi, Sistem Tenaga Listrik, *Governor*

ABSTRACT

This study discusses the stability of the power system in the Ungaran 1,2 subsystems, which are part of the Java-Madura-Bali (JAMALI) interconnection system, with a focus on the system's response to disturbances in the form of power plant trips. Power imbalances caused by the loss of large power plants such as the 810 MW Tambaklorok PLTGU can cause a significant drop in frequency and trigger system instability. Simulations were conducted using the Root Mean Square (RMS) method based on the DIgSILENT PowerFactory 2021 SP2 software with an N-1 and N-2 contingency scenario approach. The theories used include concepts of frequency stability, system inertia, and the role of governors in controlling active power through responses to rotor speed signals (ω) and turbine valve opening signals (pt). The simulation results show that the system experienced a frequency drop to a nadir of 49.31 Hz after the disturbance, then was gradually restored by the work of other power plant governors such as Tambaklorok GT and ST, which increased active power to cover the power deficit. Small-capacity power plants such as Jelok and Timo also contributed limited power according to their capacity. Differences in power plant characteristics caused variations in the response of the w and pt signals, indicating non-uniform recovery dynamics. The conclusion of this study is that the Ungaran Sub-system power system is sufficiently vulnerable to disturbances from large power plants, and system resilience can be enhanced through optimizing the role of governors, increasing total system inertia, and strengthening coordination among power plant units to maintain frequency stability.

Key words: Stability, Frequency, Electrical Power System, Governor