

**PENGARUH PENAMBAHAN PLTM BAYANG NYALO PADA  
SISTEM DISTRIBUSI 20 KV PAINAN TERHADAP  
KESTABILAN SUDUT ROTOR DAN WAKTU PEMUTUSAN  
KRITIS**

**UNIVERSITAS ANDALAS**

**TUGAS AKHIR**

Karya Ilmiah sebagai salah satu syarat untuk menyelesaikan jenjang strata satu (S-1)  
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| Judul                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Pengaruh Penambahan PLTM Bayang Nyalo pada Sistem Distribusi 20 kV Painan Terhadap Kestabilan Sudut Rotor dan Waktu Pemutusan Kritis | Andromeda Ahbar Musabbih |
| Program Studi Sarjana                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Departemen Teknik Elektro                                                                                                            | 2110951024               |
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| <p style="text-align: center;"><b>ABSTRAK</b></p> <p>Pertumbuhan konsumsi energi listrik yang pesat mendorong sistem tenaga listrik untuk tidak hanya andal dan efisien, tetapi juga mendukung transisi menuju energi bersih. Salah satu upaya yang dilakukan adalah penambahan pembangkit tersebar berbasis energi terbarukan ke dalam jaringan distribusi. Penelitian ini bertujuan untuk menganalisis pengaruh penambahan PLTM Bayang Nyalo terhadap kestabilan sudut rotor pada sistem distribusi 20 kV Painan serta menentukan nilai <i>critical clearing time</i> (CCT) sebagai acuan setting sistem proteksi. Simulasi dilakukan menggunakan DIgSILENT PowerFactory 15.1 dengan gangguan tiga fasa pada berbagai lokasi saluran dan variasi waktu pemutusan, serta dengan kondisi sistem sebelum dan setelah penambahan PLTM Bayang Nyalo. Respon sudut rotor PLTM Bayang Nyalo, PLTM Induring, dan PLTMH Salido Kecil dianalisis setelah gangguan. Nilai CCT diperoleh melalui metode iterasi hingga toleransi <math>\leq 0,001</math> detik. Hasil penelitian menunjukkan bahwa momen inersia total sistem dan posisi lokasi gangguan terhadap posisi pembangkit memengaruhi nilai CCT. Nilai CCT terkecil sebelum penambahan PLTM Bayang Nyalo terjadi di saluran inc GH Painan sebesar 0,325 detik, sedangkan setelah penambahan PLTM Bayang Nyalo menjadi 0,303 detik. Selain itu, PLTM Bayang Nyalo menunjukkan sensitivitas tinggi terhadap gangguan di saluran terdekat dan cenderung cepat terlepas dari sistem. Penelitian ini menjadi rekomendasi penting dalam pengaturan sistem proteksi sistem distribusi 20kV Painan.</p> <p>Kata kunci: Kestabilan sudut rotor, pembangkit tersebar, gangguan tiga fasa, waktu pemutusan kritis, sistem distribusi 20 kV</p> |                                                                                                                                      |                          |

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| Title                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Impact of Bayang Nyalo Mini Hydro Power Plant Integration on the Painan 20 kV Distribution System's Rotor Angle Stability and <i>Critical Clearing Time</i> | Andromeda<br>Ahbar<br>Musabbih |
| Undergraduate Study Program                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Electrical Engineering Department                                                                                                                           | 2110951024                     |
| Engineering Faculty Andalas University                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                             |                                |
| <p style="text-align: center;"><b>ABSTRACT</b></p> <p>The rapid increase in electricity consumption requires power systems to maintain not only reliability and efficiency but also to support the transition towards clean energy. One of the efforts made is the integration of distributed renewable energy-based generators into distribution networks. This study aims to analyze the effect of integrating the Bayang Nyalo Mini Hydropower Plant on rotor angle stability in the 20 kV Painan distribution system and to determine the <i>critical clearing time</i> (CCT) value as a reference for protection system settings. Simulations were conducted using DIgSILENT PowerFactory 15.1 software by applying three-phase faults at various feeder locations with variations in clearing times, both before and after the addition of the Bayang Nyalo Mini Hydropower Plant. The rotor angle response of Bayang Nyalo Mini Hydropower Plant, Induring Mini Hydropower Plant, and Salido Kecil Micro Hydropower Plant was analyzed after disturbances occurred. CCT values were determined through an iterative method until reaching a tolerance of <math>\leq 0.001</math> seconds. The results showed that the total system inertia and the location of the fault relative to the generators affected the CCT value. The smallest CCT value before integrating Bayang Nyalo Mini Hydropower Plant was 0.325 seconds at the Inc GH Painan feeder, which decreased to 0.303 seconds after the integration. Furthermore, the Bayang Nyalo Mini Hydropower Plant exhibited high sensitivity to faults on nearby feeders and tended to lose synchronism earlier than other generators. These findings provide an important recommendation for configuring the protection system in the 20 kV Painan distribution network.</p> <p>Keyword: Rotor angle stability, distributed generation, three-phase fault, <i>critical clearing time</i>, 20 kV distribution system</p> |                                                                                                                                                             |                                |