

ABSTRAK

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Optimasi Aliran Daya Sistem Interkoneksi 500 kV Jawa Bali Menggunakan *Unified Power Flow Controller* Dengan Metode *Imperialist Competitive Algorithm*

Beban listrik yang semakin meningkat dengan bertambahnya jumlah konsumen harus diikuti dengan berkembangnya sistem tenaga listrik yang ada, agar listrik yang didistribusikan kepada konsumen memiliki kualitas yang baik. Sistem tenaga listrik yang berkembang mengikuti peningkatan beban listrik menyebabkan sistem semakin kompleks dan rentan terhadap gangguan, seperti profil tegangan yang tidak sesuai aturan dan rugi-rugi daya pada sistem. Salah satu cara mengatasi gangguan tersebut adalah pemasangan *Flexible Alternating Current Transmission System* (FACTS). FACTS merupakan perangkat yang mampu meningkatkan kestabilan transmisi tenaga listrik, memperbaiki profil tegangan dan keseimbangan daya reaktif. FACTS yang digunakan pada penelitian ini adalah *Unified Power Flow Controller* (UPFC) yang memiliki *load ability transfer* paling tinggi dan injeksi MVAR paling besar. Efektifitas pemasangan UPFC dipengaruhi oleh letak dan kapasitas pemasangannya, sehingga metode *Imperialist Competitive Algorithm* (ICA) digunakan dalam menentukannya. Hasil simulasi menunjukkan pemasangan UPFC dengan metode ICA mampu memperbaiki profil tegangan sesuai dengan aturan jaringan sistem tenaga listrik Jawa Bali ($0,95 \text{ p.u} \leq V \leq 1,05 \text{ p.u}$) dan menurunkan rugi-rugi daya. Hasil simulasi menunjukkan pemasangan 4 unit dan 5 unit UPFC memiliki hasil yang terbaik dikarenakan mampu memperbaiki profil tegangan sebesar 0,294 p.u dan 0,297 p.u serta menurunkan rugi-rugi daya aktif sebesar 223,772 MW dan 242,86 MW dan rugi-rugi daya reaktif sebesar 2571,149 MVAR dan 2767,018 MVAR.

Kata Kunci: Sistem Interkoneksi, *Flexible Alternating Current Transmission System* (FACTS), *Unified Power Flow Controller* (UPFC), *Imperialist Competitive Algorithm* (ICA).

ABSTRACT

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Power Flow Optimization of 500 kV Interconnection System in Java-Bali Via Unified Power Flow Controller Using Imperialist Competitive Algorithm Method

The increasing electrical load with the increase in the number of consumers must be followed by the development of the existing electric power system, so that the electricity distributed to consumers has good quality. The electric power system that develops following the increase in electrical load causes the system to be more complex and vulnerable to disturbances, such as the voltage profiles that are not in accordance with the rules and power losses in the system. One of the way to overcome these disturbances is the installation of a Flexible Alternating Current Transmission System (FACTS). FACTS is a tool that can improve the stability of electric power transmission, and also repair the voltage profile and reactive power balance. In this study, the FACTS used is the Unified Power Flow Controller (UPFC) which has the highest load transfer ability and the largest MVAR injection. The effectiveness of UPFC installation is influenced by the location and capacity of the installation, so the imperialist competitive algorithm (ICA) method is used to determine it. The simulation results show that the installation of UPFC with the ICA method is able to improve the voltage profile according to the rules of the Java Bali electric power system ($0,95 \text{ p.u} \leq V \leq 1,05 \text{ p.u}$) and reduce power losses. The simulation results show that the installation of 4 units and 5 units UPFC has the best results because it can improve the voltage profile by 0,294 p.u and 0,297 p.u and reduce active power losses by 223,772 MW and 242,86 MW and reactive power losses by 2571,149 MVAR and 2767,018 MVAR.

Kata Kunci: Interconnection System, *Flexible Alternating Current Transmission System* (FACTS), *Unified Power Flow Controller* (UPFC), *Imperialist Competitive Algorithm* (ICA).