

INTISARI

Rugi daya aktif total saluran transmisi pada sistem tenaga listrik dapat diminimisasi dengan cara mengoptimalkan aliran daya yang melewati saluran dengan menggunakan *Pengendali Aliran Daya Terpadu* (UPFC). Perangkat UPFC dapat mengendalikan aliran daya melalui penyerapan daya aktif dan penginjeksian daya reaktif pada saluran transmisi.

Penelitian ini menyelidiki pengaruh kuat UPFC untuk mengendalikan aliran daya dan meminimisasi rugi daya aktif total saluran transmisi secara simultan. Model injeksi daya UPFC ke saluran transmisi dibuat dalam suatu persamaan aliran daya dan dapat digabungkan ke dalam solusi aliran daya metode Newton-Raphson. Batasan arus saluran transmisi dan kemampuan perangkat kendali UPFC dipertimbangkan untuk mengoptimalkan aliran daya yang melewati saluran transmisi dan kendali UPFC, agar menghasilkan injeksi daya yang dapat meminimisasi rugi daya saluran transmisi tanpa melampaui batas termal saluran dan rating perangkat UPFC.

Perangkat lunak *MATLAB* digunakan untuk mengeksekusi algoritma pengendalian aliran daya melalui penginjeksian tegangan seri UPFC ke saluran transmisi. Pengujian dilakukan melalui studi kasus pada suatu sistem tenaga listrik *standard IEEE 5-bus*. Hasil pengujian menunjukkan penginjeksian tegangan seri UPFC ke saluran transmisi dapat mengendalikan aliran daya aktif dan reaktif saluran transmisi. Meminimisasi rugi daya aktif total saluran transmisi dengan variasi perubahan aliran daya aktif saluran $\pm 50\%$ dari aliran daya aktif dasar $P_{12} = 89,3314$ MW sampai $-17,6951\%$ dengan besaran tegangan injeksi seri $0,0399 \text{ pu} \leq V_{pq} \leq 0,0570 \text{ pu}$ dan sudut fase $214,36^\circ \leq \mathbf{d}_{pq} \leq 228,37^\circ$.

Kata kunci : *injeksi daya UPFC, aliran daya metode Newton-Raphson, aliran daya saluran transmisi, minimisasi rugi daya total saluran transmisi.*

ABSTRACT

The power loss of transmission line on the electrical power systems can be minimized by optimizing of power flow through the transmission line using by the *Unified Power Flow Controller* (UPFC). The UPFC equipment can to control the power flow by active power absorbtion and reactive power injecting on the transmission lines.

The research investigate the great impact of UPFC to control the power flow and minimizing the total systems power losses simultaneously. The UPFC power injecting models to the transmission line made in an equation of power flow and can be incorporated with power flow solution of Newton-Raphson methods. Constraints of transmission line currents and UPFC equipment considered for optimal power flow through the transmission line and UPFC control, so that yields the algorithm of power injection which can be minimizing power losses of the transmission line without exceed thermal limits of the transmission line and UPFC equipment ratings.

Software *MATLAB* used to execute the algorithm of the power flow control by series voltage of UPFC injecting to the transmission line. Examination was done by case study at an electrical power systems of *IEEE standard 5-bus*. Examination result show the series voltage of UPFC injecting to the transmission line improve active and reactive power flow. Minimizing the total active power losses of transmission line with active power flow variation $\pm 50\%$ of normal condition the active power flow $P_{12} = 89.3314$ MW to -17.6951% by magnitude of series injection voltage variation $0.0399 \text{ pu} \leq V_{pq} \leq 0.0570 \text{ pu}$ and $214.36^\circ \leq \mathbf{d}_{pq} \leq 228.37^\circ$ phase angle.

Key word : *UPFC power injection, power flow of Newton-Raphson methods, power flow of transmission line, total power loss minimization at the transmission line.*