

OPTIMALISASI SISTEM DISTRIBUSI LISTRIK 20 KV DENGAN PENAMBAHAN BEBAN 5 MVA PADA PT JICT

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ABSTRAK

PT Jakarta International Container Terminal (JICT) berencana menambah empat unit *Quay Container Crane* (QCC) dengan total kebutuhan daya sebesar 5 MVA. Penambahan beban tersebut perlu dianalisis karena sistem distribusi listrik 20 kV PT JICT disuplai oleh dua sumber, yaitu ST15-PLN PK228 dan ST13-PT EPI, dengan kondisi eksisting sumber PLN sudah melebihi kapasitas langganannya. Penelitian ini bertujuan untuk menganalisis dampak penambahan beban QCC terhadap profil tegangan, pembebanan sumber, pembebanan transformator, faktor daya, dan rugi-rugi daya, serta menentukan konfigurasi sistem yang paling optimal. Metode yang digunakan adalah simulasi aliran daya menggunakan ETAP 19.0.1 dengan metode Newton-Raphson pada lima skenario, yaitu kondisi eksisting, manuver ST17-ST18, penambahan 1 QCC, penambahan 4 QCC, dan kondisi optimal. Hasil simulasi menunjukkan bahwa pada kondisi eksisting pemanfaatan ST15-PLN mencapai 104,7%, sehingga berada dalam kondisi overload. Setelah dilakukan manuver ST17 dan ST18, pemanfaatan ST15-PLN turun menjadi 83,4%, sedangkan ST13-PT EPI meningkat menjadi 60,0%. Namun, saat dilakukan penambahan 4 QCC, ST13-PT EPI mengalami overload sebesar 116,9% dan masih terdapat alert under voltage. Konfigurasi optimal dilakukan melalui peningkatan kapasitas ST13-PT EPI menjadi 10,3 MVA, penambahan transformator NEW TR 15.1, pemasangan capacitor bank, dan pengaturan tap transformator. Pada kondisi optimal, faktor daya meningkat menjadi 94,22%, rugi daya aktif turun menjadi 148,4 kW, pemanfaatan ST15-PLN menjadi 88,7%, pemanfaatan ST13-PT EPI menjadi 74,0%, pembebanan TR 15.2 turun menjadi 79,7%, dan seluruh alert under voltage berhasil dihilangkan. Dengan demikian, konfigurasi optimal direkomendasikan untuk mendukung penambahan beban 5 MVA secara andal pada sistem distribusi listrik PT JICT.

Kata kunci: aliran daya, ETAP, Newton-Raphson, optimalisasi, Quay Container Crane, sistem distribusi 20 kV

OPTIMIZATION OF THE 20 KV ELECTRICITY DISTRIBUTION SYSTEM WITH A 5 MVA LOAD INCREASE AT PT JICT

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ABSTRACT

PT Jakarta International Container Terminal (JICT) plans to add four Quay Container Cranes (QCCs) with a total power requirement of 5 MVA. This additional load must be analyzed because PT JICT's 20 kV power distribution system is supplied by two sources. ST15-PLN PK228 and ST13-PT EPI and the existing PLN source is already operating beyond its rated capacity. This study aims to analyze the impact of the additional QCC load on the voltage profile, source loading, transformer loading, power factor, and power losses, as well as to determine the most optimal system configuration. The method used was power flow simulation using ETAP 19.0.1 with the Newton-Raphson method across five scenarios: the existing conditions, the ST17-ST18 maneuver, the addition of 1 QCC, the addition of 4 QCCs, and the optimal conditions. The simulation results show that under existing conditions, the utilization of ST15-PLN reaches 104.7%, indicating an overload condition. After performing the ST17 and ST18 maneuvers, the utilization of ST15-PLN dropped to 83.4%, while that of ST13-PT EPI increased to 60.0%. However, when 4 QCCs were added, ST13-PT EPI experienced an overload of 116.9%, and an under-voltage alert was still present. The optimal configuration was achieved by increasing the capacity of the ST13-PT EPI to 10.3 MVA, adding the NEW TR 15.1 transformer, installing a capacitor bank, and adjusting the transformer taps. Under optimal conditions, the power factor increases to 94.22%, active power losses decrease to 148.4 kW, the utilization of ST15-PLN reaches 88.7%, the utilization of ST13-PT EPI reaches 74.0%, the load on TR 15.2 decreases to 79.7%, and all undervoltage alerts are successfully eliminated. Thus, the optimal configuration is recommended to reliably support a 5 MVA load increase in PT JICT's electrical distribution system.

Keywords: 20 kV distribution system, ETAP, Newton-Raphson, optimization, power flow, Quay Container Crane