

## ABSTRAK

Dengan memanfaatkan sumber daya alam yang melimpah, pemerintah Indonesia tengah aktif mendorong program hilirisasi, khususnya di industri nikel. Upaya ini menyebabkan peningkatan jumlah industri peleburan logam atau yang biasa disebut *Electric Arc Furnace* (EAF) khususnya di pulau Sulawesi sebagai sumber nikel terbesar di Indonesia. EAF merupakan beban industri non-linear yang dapat berdampak negatif pada sistem tenaga listrik, seperti penurunan kualitas daya dan fluktuasi tegangan.

Pada sistem Sulawesi Bagian Selatan milik PT PLN (Persero); tepatnya di Gardu Induk 150 kV Bantaeng Switching, terdapat industri EAF berkapasitas 390 MVA. Dari data operasi menunjukkan bahwa terdapat fluktuasi dan penurunan tegangan pada bus GI yang nyaris menyentuh batas minimum. Hal tersebut berdampak pada terkendalanya rencana industri yang akan melakukan ekspansi, sehingga dibutuhkan solusi perbaikan tegangan.

Pada penelitian ini dilakukan analisis pengaruh EAF terhadap stabilitas tegangan dan membandingkan efektivitas 3 jenis kompensator daya reaktif sebagai solusinya, yaitu *Fixed Capacitor*, *Static VAR Compensator* (SVC), dan *Static Synchronous Compensator* (STATCOM), beserta dampaknya masing-masing. Penelitian dilakukan dengan simulasi menggunakan DigSilent PowerFactory. Dari hasil simulasi menunjukkan bahwa STATCOM menjadi solusi paling efektif secara teknis dan investasi dibanding kompensator lainnya.

**Kata kunci** – *Electric Arc Furnace* (EAF), Fluktuasi Tegangan, *Fixed Capacitor*, *Static Var Compensator* (SVC), *Static Synchronous Compensator* (STATCOM)

## ABSTRACT

*The Indonesian government is currently actively involved in down streaming efforts, particularly in nickel, due to its abundant resources. This initiative is accompanied by an increasing number of operational arc furnaces, especially in Sulawesi as the biggest nickel resource. The Electric Arc Furnace (EAF) represents a high-power, non-linear industrial load that can have adverse effects on power systems such as power quality degradation and voltage fluctuations.*

*In Southern Sulawesi system, specifically at the Bantaeng Switching HV Substation, which operated by PT PLN (Persero), an EAF industry with a capacity of 390 MVA is in operation. Operational data indicates that voltage fluctuations and degradations at the substation bus are approaching the minimum allowable limits. This condition hampers planned industrial expansion, necessitating a voltage improvement solution.*

*This study analyzes the impact of EAF operation on voltage stability and compares the effectiveness of three reactive power compensation methods—Fixed Capacitor, Static VAR Compensator (SVC), and Static Synchronous Compensator (STATCOM)—along with their respective impacts. The analysis is conducted through simulations using DigSILENT PowerFactory. The simulation results demonstrate that, among the three compensators, STATCOM exhibits the best performance and investment.*

**Keywords** – *Electric Arc Furnace (EAF), Voltage Fluctuation, Fixed Capacitor, Static VAR Compensator (SVC), Static Synchronous Compensator (STATCOM)*