

## INTISARI

### OPTIMALISASI PERFORMA SISTEM KONTROL 3-ELEMEN LEVEL AIR *STEAM DRUM* MENGGUNAKAN *HYBRID FUZZY-PID* PADA PLTU PT PLN NUSANTARA POWER UP GRESIK

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*Feed Water Flow Control System* merupakan salah satu sistem kontrol utama pada PLTU PT PLN Nusantara Power UP Gresik untuk mengatur operasi *hot water boiler* dengan mode 1-elemen maupun 3-elemen. Mode 3-elemen menggunakan *input steam drum level, feed water flow*, dan *steam flow*, memberikan *feedback* yang lebih baik dibandingkan mode 1-elemen. Metode kontrol *existing*, yaitu *Proportional-Integral* (PI) dianggap kurang adaptif terhadap variasi beban daya *generator* (MW) tanpa *tuning* yang tepat dan berkala. Metode *Hybrid Fuzzy-PID* dianggap dapat mempercepat respon waktu dan meningkatkan stabilitas sistem.

Penelitian ini bertujuan mengoptimalkan respon waktu sistem kontrol 3-elemen level air *steam drum* melalui simulasi pada MATLAB dengan membandingkan *step response* yang dihasilkan oleh metode PI (*existing*), PD, PID, dan *Hybrid Fuzzy-PID* ketika diberikan *input* berupa *set point steam drum level*. Analisis respon waktu menggunakan parameter *rise time, settling time, overshoot*, dan *undershoot* berdasarkan *step response* yang dihasilkan dari hasil simulasi pada MATLAB.

Berdasarkan simulasi dan pengujian data uji yang telah dilakukan, metode *Hybrid Fuzzy-PID* memiliki performa yang baik dengan *overshoot* yang lebih rendah 81% hingga 89%, *undershoot* yang lebih rendah 27% hingga 40%, dan *settling time* yang lebih cepat 59% hingga 73% dibandingkan dengan metode kendali PI (*existing*), PD, maupun PID konvensional. Akan tetapi, metode *Hybrid Fuzzy-PID* memiliki *rise time* yang lebih lambat 127% hingga 191% dibandingkan dengan metode kendali PI (*existing*), PD, maupun PID konvensional. Dari hasil simulasi tersebut, metode *Hybrid Fuzzy-PID* mampu meningkatkan respon sistem kontrol level air *steam drum* sehingga dapat berpotensi untuk menurunkan kelembapan pada area turbin dan menjaga stabilitas efisiensi *hot water boiler* di PLTU PT PLN Nusantara Power UP Gresik.

**Kata Kunci:** Fuzzy-PID, Level, *Steam Drum*

## **ABSTRACT**

### **PERFORMANCE OPTIMIZATION OF 3-ELEMENTS STEAM DRUM WATER LEVEL CONTROL SYSTEM USING HYBRID FUZZY-PID AT PLTU PT PLN NUSANTARA POWER UP GRESIK**

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*The Feed Water Flow Control System is one of the main control systems at PLTU PT PLN Nusantara Power UP Gresik for regulating the operation of the hot water boiler using 1-element or 3-element modes. The 3-element mode, which uses inputs from the steam drum level, feed water flow, and steam flow, provides better feedback compared to the 1-element mode. The existing control method, Proportional-Integral (PI), is considered less adaptive to variations in generator power load (MW) without proper and periodic tuning. The Hybrid Fuzzy-PID method is believed to speed up response time and improve system stability.*

*This study aims to optimize the response time of the 3-element steam drum water level control system through simulations in MATLAB by comparing the step responses produced by the PI (existing), PD, PID, and Hybrid Fuzzy-PID methods when given an input set point for the steam drum level. The response time analysis uses parameters such as rise time, settling time, overshoot, and undershoot based on the step response results from the MATLAB simulations.*

*Based on the simulations and testing conducted, the Hybrid Fuzzy-PID method demonstrated superior performance with an overshoot reduction of 81% to 89%, an undershoot reduction of 27% to 40%, and a faster settling time of 59% to 73% compared to the PI (existing), PD, and conventional PID control methods. However, the Hybrid Fuzzy-PID method exhibited a slower rise time, being 127% to 191% slower than the PI (existing), PD, and conventional PID control methods. From these simulation results, the Hybrid Fuzzy-PID method is capable of improving the response of the water level control system in the steam drum, thereby potentially reducing moisture in the turbine area and maintaining the stability and efficiency of the hot water boiler at PLTU PT PLN Nusantara Power UP Gresik.*

**Keywords:** Fuzzy-PID, Level, Steam Drum