ABSTRAK

Penelitian ini bertujuan untuk merancang dan membangun sistem instrumentasi pada proses aliran fluida yang mampu memantau dan mengendalikan parameter tekanan fluida secara *real-time* guna memberikan peringatan dini saat terjadi kondisi abnormal melalui integrasi *pressure transmitter*, PLC Haiwell AC12M0R, HMI, dan SCADA berbasis protokol komunikasi TCP/IP dan Wi-Fi. Metode penelitian mencakup perancangan perangkat keras dan perangkat lunak, pemrograman *ladder diagram* pada PLC, serta pengujian unjuk kerja sistem dengan memvariasikan nilai *setpoint* untuk mensimulasikan berbagai kondisi operasi. Hasil pengujian menunjukkan sistem beroperasi sesuai desain, dimana alarm aktif ketika tekanan mencapai 6 Bar, *Pressure Control Valve* (PCV) mulai membuka secara proporsional saat tekanan melebihi *setpoint* 5 Bar, dan pada kondisi darurat (*high-high pressure*) 9 Bar, sistem *safety* secara otomatis mengaktifkan alarm, menutup *Shut Down Valve* (SDV), serta mematikan pompa. Waktu respon PCV tercatat 0.1-0.2 detik, sedangkan SDV menutup penuh dalam 5-6 detik, dengan seluruh data dan status peralatan dapat dipantau secara *real-time* melalui antarmuka HMI dan SCADA yang terintegrasi *cloud* untuk monitoring jarak jauh via *smartphone*. Dari hasil pengujian, disimpulkan bahwa prototipe sistem instrumentasi ini telah berfungsi sesuai dengan logika kontrol yang dirancang dan dapat bekerja sesuai penggunaannya.

Kata kunci: PLC, SCADA, SDV, PCV, aliran fluida

ABSTRACT

This research aims to design and develop an instrumentation system for fluid flow processes capable of monitoring and controlling fluid pressure parameters in real-time to provide early warnings during abnormal conditions through the integration of a pressure transmitter, Haiwell AC12M0R PLC, HMI, and SCADA based on TCP/IP and Wi-Fi communication protocols. The research methodology includes hardware and software design, ladder diagram programming for the PLC, and system performance testing by varying setpoint values to simulate various operational conditions. Test results indicate that the system operates as designed: the alarm activates when pressure reaches 6 Bar, the Pressure Control Valve (PCV) begins to open proportionally when pressure exceeds the 5 Bar setpoint, and under emergency conditions (high-high pressure) at 9 Bar, the safety system automatically activates the alarm, closes the Shut Down Valve (SDV), and shuts off the pump. The PCV response time was recorded at 0.1-0.2 seconds, while the SDV closed fully within 5-6 seconds. All equipment data and status can be monitored in real-time via the HMI and SCADA interface, which is integrated with cloud for remote monitoring via smartphone. From the test results, it is concluded that this instrumentation system prototype has functioned according to the designed control logic and operates as intended.

***Keywords**: PLC, SCADA, SDV, PCV, fluid flow*