ABSTRACT

Hydrate formation in deepwater gas production poses critical challenges, including pipeline blockages and operational disruptions. Mono-ethylene glycol (MEG) injection is widely employed to prevent hydrate formation; however, manual control of MEG dosage is prone to inefficiencies due to human error and delays in dynamic production environments. This thesis proposes an automated control system integrating an Adaptive Neuro-Fuzzy Inference System (ANFIS) with a Proportional-Integral-Derivative (PID) controller to optimize MEG injection rates in the MERAKES production field. ANFIS effectively handles multivariable inputs and non-linearities, while PID ensures stable system performance.

The system was modeled and simulated using MATLAB Simulink to evaluate the predictive performance of three ANFIS configurations—genfis1, genfis2, and genfis3. Performance metrics, including root mean squared error (RMSE), normalized RMSE (NRMSE), mean absolute percentage error (MAPE), and R-squared, were used to assess accuracy. Simulation results indicate that genfis3, employing fuzzy c-means clustering with hyperparameter tuning, outperformed other configurations, achieving an RMSE of 66.2294, NRMSE of 0.0379, MAPE of 4.48%, and R-squared of 0.9799.

These findings highlight the superior capability of the ANFIS-PID system to minimize hydrate formation risks while enhancing safety, operational stability, and cost efficiency in deepwater gas production. The proposed intelligent control system demonstrates significant potential for advancing hydrate prevention strategies in the energy sector.

Keywords: Hydrate, MEG injection, Adaptive Neuro-Fuzzy Inference System (ANFIS), Proportional-Integral-Derivative (PID), and Control System.