

FINAL PROJECT

**ANALYSIS OF CENTRIFUGAL PUMP
SPECIFICATION CALCULATIONS TO IMPROVE
PIPING SYSTEM EFFICIENCY IN
WATER TREATMENT INJECTION PLANT**

**Submitted as One of the Requirements for Completing
the Bachelor's Degree Program**

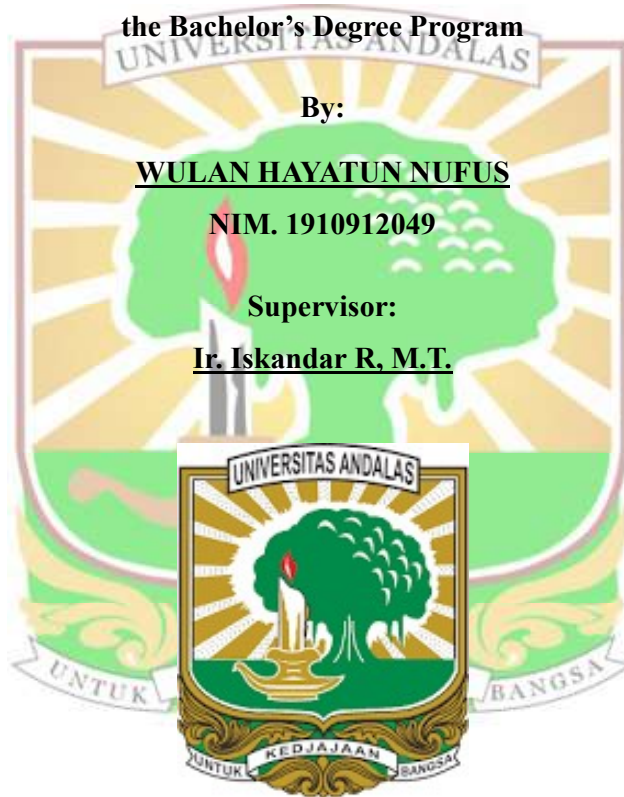
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ABSTRACT

PT Pertamina Hulu Rokan (PHR) operates a Water Treatment Injection Plant (WTIP) at Field Rantau as a supporting facility for the water flooding process in Enhanced Oil Recovery (EOR). The WTIP piping system consists of two centrifugal pumps operating in series: the Feed Pump (P-110), which transfers treated water from the storage tank to the filter, and the Injection Pump (P-111), which distributes high-pressure water to the injection wells. Accurate pump specification is critical as both pumps interact as an integrated series system, where incorrect specifications may result in energy inefficiency or cavitation risk.

This study performs analytical calculations of centrifugal pump specifications including Total Dynamic Head (TDH), Net Positive Suction Head available (NPSHa), pump power, and system efficiency, referring to API 610 standard. Calculations were performed for a design capacity of 6000 bpd (39.75 m³/h) with treated water as the working fluid at an operating temperature of approximately 38°C. The analytical results were validated using Pipe Flow Expert simulation software, and subsequently used as the basis for optimization scenario analysis of pump specifications and pipe diameter.

Analytical calculation results show that the Feed Pump (P-110) requires a TDH of 68.92 m with NPSHa of 11.06 m and shaft power of 12.48 kW. The Injection Pump (P-111) requires a TDH of 633.0 m with NPSHa of 11.04 m and shaft power of 114.0 kW. Both pumps are confirmed safe from cavitation risk as NPSHa exceeds NPSHr. Pipe Flow Expert simulation results show a deviation of 6.8% for the Feed Pump and 17.5% for the Injection Pump compared to analytical calculations, with differences attributed to conservative design margins applied by the engineer that were not modelled in the basic hydraulic simulation. The optimization scenario analysis shows that the combination of increasing discharge pipe diameter and improving pump efficiency from 60% to 75% yields total system energy savings of IDR 1.14 billion per year.

Keywords: Centrifugal Pump, Water Treatment Injection Plant, Total Dynamic Head, NPSHa, API 610, Pipe Flow Expert, Water Flooding, Enhanced Oil