

Study of Pump Turbine Impeller Performance According to the Specific Speed

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Abstract : Hydropower is a clean energy which reduces the consumption of fossil fuels. Pumped storage hydropower is the solution of storing electric energy (pump mode) and generating electricity (turbine mode) to meet the power grid demand for flexible regulation. The pump turbine impeller is the core equipment of pumped storage hydropower, which directly influences the performance of the pump-turbine system. The pump turbine impeller shape design is related to the specific speed of the pump turbine. With the increasing significance of pumped storage in the power system, there is a growing emphasis on improving the hydraulic performance of pump turbines at off-design conditions. When the pump-turbine operates at the off-design conditions, hydraulic losses in the pump-turbine components increase significantly. Theoretical and numerical analysis was used to evaluate the hydraulic losses of the pump-turbine components in turbine mode. The magnitude of hydraulic losses varies according to the operating conditions and impeller shape design. Hence, the hydraulic losses in the pump-turbine components are calculated based on specific speeds and flow conditions. Pump turbines with specific speeds (N_s) 30, 40, and 55 are designed to evaluate the hydraulic loss at various flow conditions. At partial and high flow rates, the hydraulic loss in each specific speed pump turbine is significantly higher than the best operating point. Especially in this study, at the partial flow rate, the $N_s=55$ pump turbine showed a comparatively lower loss magnitude than that of the $N_s=30$ pump turbine in turbine mode.

Keywords : pump turbine, specific speed, turbine mode, off-design range

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