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Energy Efficiency and Flow Stability of an Axial Flow Pump under Variable Inlet Flow Angles

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Abstract. This study investigates key performance indicators of fluid machinery, with a focus on energy efficiency and operational stability. Performance is assessed through efficiency at both design and off-design conditions, surge and stall margins defining the operable flow range, vibration and acoustic characteristics arising from flow instabilities, and geometric compactness. To improve energy performance, the use of variable inlet guide vanes (VIGVs) is proposed as an alternative to traditional valve-based flow control. VIGVs regulate the inlet swirl velocity at the impeller eye, thereby modifying the head–flow characteristics and reducing power consumption over a broader operating range. A parametric analysis is conducted to evaluate the impact of varying inlet flow angles on pump performance curves and input power requirements. The results highlight the correlation between inlet swirl modulation and energy efficiency, and demonstrate the potential of VIGVs in extending the stable operating regime. Strategies for mitigating part-load flow instabilities are also explored to enhance overall operational reliability.

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References

[1] Yang, H., Eom, D.-H., Kim, J.-B., Lee, K.-Y., Chung, J.-T., & Choi, Y.-S. (2024). Analysis of flow characteristics by partial load in turbomachinery and control to avoid abnormal flow using variable control technology. *Winter Conference of The Korea Society for Fluid Machinery*.

[2] Son Y-J, Yang H-M, Kim Y-I, Lee K-Y, Yoon JY, Choi Y-S. Numerical study of performance curve incline and instability flow phenomena in low flow rates according to absolute flow angle change at axial-flow pump inlet. Advances in Mechanical Engineering. 2024;16(11).