عنوان مقاله:

Numerical and Experimental Investigation on Unsteady Flow and Hydraulic Radial Force of Low-Head Axial Flow Turbine

محل انتشار:

دوماهنامه مکانیک سیالات کاربردی, دوره 16, شماره 4 (سال: 1402)

تعداد صفحات اصل مقاله: 20

نویسندگان:

Y. Sunsheng – National Research Centre of Pumps, Jiangsu University, Zhenjiang ۲۱۲۰۱۳, China

I. Enema Ohiemi – National Research Centre of Pumps, Jiangsu University, Zhenjiang ۲۱۲۰۱۳, China ۲. Department of Mechanical Engineering, University of Nigeria, Nsukka ۴۱۰۰۰۱, Nigeria

P. Singh – Centre for Sustainable Technologies, Indian Institute of Science, CV Raman Road, Bangalore, India, ۵۶۰۰۱۲

Y. Li – National Research Centre of Pumps, Jiangsu University, Zhenjiang ۲۱۲۰۱۳, China

A. Ali – National Research Centre of Pumps, Jiangsu University, Zhenjiang ۲۱۲۰۱۳, China

F. Osman – School of Energy Science and Engineering, Harbin Institute of Technology, Harbin ۱۵۰۰۰۱, China

خلاصه مقاله:

Radial force in low-head axial flow turbines (AFTs) is an influential factor in their operational stability. To explore the transient operating behavior of the radial force in low-head AFTs under different blade numbers, transient numeric computations were executed with the shear stress transport (SST) k-w turbulent model. Turbine performance was numerically computed and compared with results from experiments. Furthermore, the unsteady flow field pulsations were experimentally verified by means of pressure sensors. The radial forces on the runners (z = ۲, ۳, and ۴) were each numerically studied in time, frequency, and joint time-frequency fields. The result reveals that the radial force acting on the runner varies with time, since periodic radial forces reflect the vane number on the stay vanes with minimal runner effect. Moreover, the amplitude of the radial forces is directly proportional to the flow rate. Furthermore, the spectral analysis shows that the radial force frequency is close to the blade passing frequency and also increases radially outward since peak values were recorded in this region. Minimal radial force amplitudes were recorded when z = ۳, across all flow conditions, making this configuration suitable for smooth and reliable operation. The unstable pressure and force pulses that affect the noise and vibration produced in the turbine are instigated by the flow exchange that occurs between the guide vane and the runner. In order to optimize turbines for increased operational dependability, the acquired data would be crucial references for noise and vibration analytical investigations.

کلمات کلیدی:

Axial flow turbine, Radial force, Blade number, Unsteady flow field, Performance, Pressure pulsation