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Performance Analysis of Pumps-as-Turbine Under Cavitating Conditions

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Abstract : Market liberalization in the power sector has led to the emergence of micro-hydropower schemes that are dependent on the use of pumps-as-turbines in applications that were not suitable as potential hydropower sites in earlier years. These applications include energy recovery in water supply networks, sewage systems, irrigation systems, alcohol breweries, underground mining and desalination plants. As a result, there has been an accelerated adoption of pumpsas-turbine technology due to the economic advantages it presents in comparison to the conventional turbines in the micro-hydropower space. The performance of this machines under cavitation conditions, however, is not well understood as there is a deficiency of knowledge in literature focused on their turbine mode of operation. In hydraulic machines, cavitation is a common occurrence which needs to be understood to safeguard them and prolong their operation life. The overall purpose of this study is to investigate the effects of cavitation on the performance of a pumps-as-turbine system over its entire operating range. At various operating speeds, the cavitating region is identified experimentally while monitoring the effects this has on the power produced by the machine. Initial results indicate occurrence of cavitation at higher flow rates for lower operating speeds and at lower flow rates at higher operating speeds. This implies that for cavitation free operation, low speed pumps-as-turbine must be used for low flow rate conditions whereas for sites with higher flow rate conditions high speed turbines should be adopted. Such a complete understanding of pumps-as-turbine suction performance can aid avoid cavitation induced failures hence improved reliability of the micro-hydropower plant.

Keywords : cavitation, micro-hydropower, pumps-as-turbine, system design
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