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Assessment of guide vane self-excitation stability at small openings in pump flow

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Abstract

A parameter study of self-excited pump turbine guide vane instability at small openings using a combined CFD-1DOF approach shows that clear tendencies are difficult to obtain. Two types of boundary conditions can be used in the simulations: prescribed mass flow and prescribed pressure. Simulations with both show results that – for one specific operating condition – are consistent with a self-excited guide vane incident at a prototype pump turbine. However, over a larger range of reduced velocities, the tendencies obtained with the two boundary condition types are not always consistent. Pressure boundary conditions may be the more realistic option. Results then show that with increasing reduced velocity, guide vanes will eventually reach static instability or divergence. This may not be problematic. In contrast, passing through a zone of dynamic instability during operation should and can be avoided.