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Stability Analysis of the Vortex Rope Formed in Draft Tubes
GIRISH KUMAR RAJAN, JOHN CIMBALA, The Pennsylvania State University
— Studies on draft tube surge have shown that there are undesirable effects in the form of violent pressure fluctuations caused by a helical vortex (often called the vortex rope), formed in the draft tube due to a shear layer produced by a central stalled region with lesser axial velocities, and the swirling main-flow. The vortex rope is formed when hydroturbines operate away from the best efficiency point, and affects the efficiency of the turbine severely. Thus, in order to reduce these undesired effects of the vortex rope, a proper understanding of its structure and stability is necessary. This project, which is in progress, involves a numerical investigation of the vortex rope and its elimination, and a mathematical analysis that could possibly throw some light on the stability of the rope. Several cases have been simulated in ANSYS-FLUENT with the draft tube geometry obtained from the FLINDT project. It is then possible to obtain the vortex rope parameters as functions of the discharge coefficient. In addition, the simulations are also expected to provide information on the mean velocity field in the draft tube. These relations might also be of some help in the stability analysis, which should identify the modes that are unstable.

Girish Kumar Rajan
The Pennsylvania State University

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