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Dynamic mode analysis and control of vortical flows in pump sumps BYUNGJIN AN, Ebara Corporation, QIONG LIU, University of California, Los Angeles, MOTOHIKO NOHMI, MASASHI OBUCHI, Ebara Corporation, KUNIHIKO TAIRA, University of California, Los Angeles — Pump sumps are settling chambers for incoming flows prior to their removal by pumps. These pump sumps are widely used for drainage in pumping stations and power plants. During off-design operations, free surface and sub-surface vortices often appear in pump sumps, causing significant pump performance degradation and system vibrations. Modal analysis is performed to obtain insights to develop an effective and highly robust suppressing device of vortex for a scaled pump sump. Dynamic mode decomposition (DMD) is used to extract the dynamic features with respect to the vortical flow obtained from the large eddy simulation (LES). The dominant DMD modes are useful for understanding the complex vortex dynamics and developing a novel control device for the suppression of vortex formation. In addition to examining the complex flow in the pump sump, we also consider a wall-normal vortex model. Active flow control is considered for the attenuation of such vortex. The resulting increase in pressure at the vortex core suppresses the detrimental effects. A comparative analysis of steady and unsteady actuation methods is carried out through LES. The characteristics of the successful control mechanisms will be identified and discussed.

Byungjin An
Ebara Corporation

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