Design and Calibration of a Full-Scale Active Magnetic Bearing-Based Test Facility for Investigating Rotordynamic Properties of Turbomachinery Seals in Multiphase Flow

The recent move towards subsea oil and gas production brings about a requirement to locate process equipment in deepwater installations. Furthermore, there is a drive towards omitting well stream separation functionality, as this adds complexity and cost to the subsea installation. This in turn leads to technical challenges for the subsea installed pumps and compressors that are now required to handle multiphase flow of varying gas to liquid ratios. This highlights the necessity for a strong research focus on multiphase flow impact on rotordynamic properties and thereby operational stability of the subsea installed rotating machinery. It is well known that careful design of turbomachinery seals, such as interstage and balance piston seals, is pivotal for the performance of pumps and compressors. Consequently, the ability to predict the complex interaction between fluid dynamics and rotordynamics within these seals is key. Numerical tools offering predictive capabilities for turbomachinery seals in multiphase flow are currently being developed and refined, however the lack of experimental data for multiphase seals renders benchmarking and validation impossible. To this end, the Technical University of Denmark and Lloyd's Register Consulting are currently establishing a purpose built state of the art multiphase seal test facility. This paper provides details on the design of the novel test facility and the calibration of the Hall sensor system employed to measure AMB forces. Calibration and validation results are presented, along with an uncertainty analysis on the force quantification capabilities.
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