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Comparison: on-design and off-design flow through a high speed turbo pump inducer RYAN CLUFF, RYAN LUNDGREEN, STEVE GORRELL, DANIEL MAYNES, Brigham Young University, KERRY OLIPHANT, Concepts NREC — A computational fluid dynamic comparison was performed between on-design and off-design flow rates through a four-bladed axial turbopump inducer. Using CD Adapco's Star-CCM as the CFD package an analysis of the two flow-rate cases was made. The simulations were run time-resolved and with two phases (water and water vapor). Turbulence employed the realizable k-epsilon model and cavitation was predicted using the Rayleigh-Plasset model. The solution discretization is second order accurate in space and first order accurate in time. The results show classical breakdown curves for both flow-rate cases. Breakdown is the condition where the entire flow path in the inducer becomes filled with vapor and the head rise over the inducer is decreased dramatically. Both cases experience breakdown at about the same cavitation number; however, because the off-design case generally has a larger head rise, its breakdown occurs at higher back pressures than the on-design case. Additionally, the off-design case experiences larger amounts of incidence that result in regions of reversed flow along the shroud and an increase of instabilities throughout the machine. Performance maps will be discussed comparing the two cases on head rise and efficiency.

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