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Advanced CFD Methods Applied to Kaplan Turbine Refurbishment

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Abstract

In this article the method of hydraulic design optimisation based on comprehensive CFD simulations without a model test is described for the Kaplan runner replacement in the Mascarenhas power station. It is shown how, in order to handle the uncertainties of CFD, the CFD set up is validated by comparing the simulation results to a reference case for which experimental data are available. In the refurbishment project presented one propeller curve was simulated by applying CFD simulations of the guide vane, runner and draft tube, including the blade tip gap. The CFD results were compared to a reference case with the measured performance curve. In the present case, the CFD based optimisation study revealed the benefit of a modification of the discharge ring which was put into real in the power station. A site test after commissioning of the upgraded turbine confirmed that the ambitious power guarantees are met by the new design and that the new turbine operates very smoothly. Obviously, the hydraulic optimisation led to a significant reduction of pressure pulsations and vibrations in the turbines.