NUMERICAL SIMULATION OF SWIRLING FLOW IN COMPLEX HYDROTURBINE DRAFT TUBE USING LARGE EDDY SIMULATION

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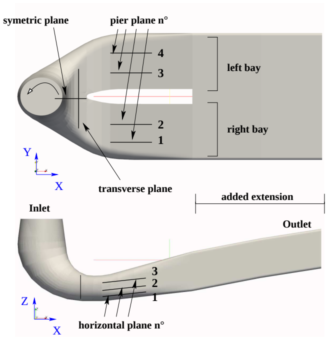
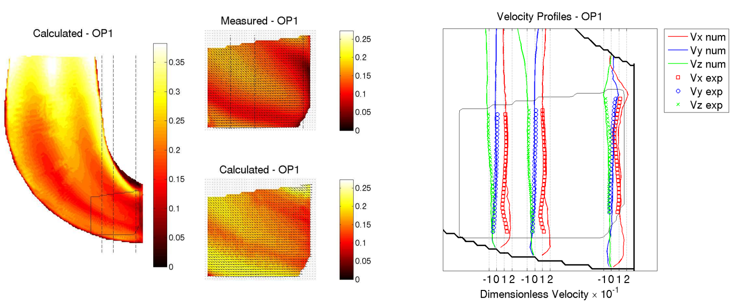
ABSTRACT

Hydroturbine draft tube, which consists of a strongly curved 90^o elbow and one pier, see left figure, acts to convert a maximum of kinetic energy, loosed by the runner, into static energy. The flow in the draft tube is an unsteady swirling turbulent flow exiting the runner. Reynolds number of the present configuration, based on the turbine diameter, is close to $Re = 2\ 10^6$. To perform accurate numerical simulations of this complex flow, we propose to use large eddy simulation (LES) approach. Due to the high Reynolds number, a wall model is used to reduce the grid cost in vicinity of the wall, taking into account both shear stress an streamwise pressure gradient phenomena [1]. In LES approach, the main part of the unsteady phenomena is explicitely computed. Thus, conversely to a RANS computation, unsteady inflow has to be imposed in LES. In this work, the time-averaged imposed part of the inflow is based on experimental measurements performed downstream the runner [2]. One operating point close to the best efficiency condition has been performed. A comparison between computations and 2D3C-PIV and LDV measurements is done to validate the methodology. Because validation from experiments is the most independent and complete approach, validation will be done for both time-averaged velocity and global parameters such as mass flow average in the bays and pressure recovery factor, an engineering parameter which characterises the efficiency of draft tube. As exemple of results obtained, right figure shows comparaison along the symetric plane localized on the left figure. Therefore, calculation shows good agreement with experimental measurements for three components of time-averaged velocity. During the conference, flow topology from LES calculation will be presented.





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