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Application of Computational Flow Dynamics (CFD) Analysis for Surge Inception and Propagation for Low Head Hydropower Projects

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Abstract : Determination of maximum elevation of a flowing fluid due to sudden rejection of load in a hydropower facility is of great interest to hydraulic engineers to ensure safety of the hydraulic structures. Several mathematical models exist that employ one-dimensional modeling for the determination of surge but none of these perfectly simulate real-time circumstances. The paper envisages investigation of surge inception and propagation for a Low Head Hydropower project using Computational Fluid Dynamics (CFD) analysis on FLOW-3D software package. The fluid dynamic model utilizes its analysis for surge by employing Reynolds' Averaged Navier-Stokes Equations (RANSE). The CFD model is designed for a case study at Taunsa hydropower Project in Pakistan. Various scenarios have run through the model keeping in view upstream boundary conditions. The prototype results were then compared with the results of physical model testing for the same scenarios. The results of the numerical model proved quite accurate coherence with the physical model testing and offers insight into phenomenon which are not apparent in physical model and shall be adopted in future for the similar low head projects limiting delays and cost incurred in the physical model testing.

Keywords : surge, FLOW-3D, numerical model, Taunsa, RANSE
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