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A REVIEW ON JET OF A PELTON TURBINE

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Abstract - *Pelton turbines are impulse turbines used for high head and low discharge. Various factors affect the performance of Pelton turbine. One of the main factor is the shape of water jet striking the Pelton bucket. In the present paper a basic review on different jet shapes for Pelton turbine and use of CFD for various hydraulic machine components has been carried out.*

Key Words: Pelton turbine, Jet shape, CFD modeling, Bucket, Nozzle

1. INTRODUCTION

For high head, Pelton turbines are used. The quality of water jet striking the Pelton bucket affects its performance under part and full load conditions. A lot of work has been done for predicting the performance of Pelton turbine and effect of various parameters on its efficiency.

2. LITERATURE REVIEW

Zh Zhang et.al., in "Experimental studies of the jet of a pelton turbine"[1], has used Laser Doppler anemometer for details of flow distribution and experimental investigation on jet flow of pelton turbine. CFD has also been applied to the jet flow in pelton turbines.

B. Zoppé, et.an., in "Flow Analysis Inside a Pelton Turbine Bucket"[2], have experimented and analyzed flow in fixed bucket of pelton turbine. The head, jet incidence, and flow rate have been varied to cover a wide range of the turbine functioning points. The experimental analysis provides measurements of pressure and torque as well as flow visualization. The numerical analysis is performed with the FLUENT code using the two-phase flow volume of fluid method. A detailed analysis of torque and thrust helped evaluating the losses due to the edge and the cutout of the bucket. For obtaining best result they have optimized the process of the design of Pelton turbines.

Michael Marek et.al., "CFD modeling of turbulent jet mixing in a water storage tank"[3], describes the results of three-dimensional URANS simulations of the flow and entrainment processes in a jet-mixed tank. Several variations of jet velocity, nozzle diameter and nozzle angle have been investigated, and two differencing schemes with different accuracies to approximate the convective fluxes are applied. They have developed a CFD code that can be used as a flexible modeling tool for the design and optimization of water storage tanks including the effects of varying water depths and density stratification.

Yodchai Tiaple et.al., "The Development of Bulb Turbine for Low Head Storage Using CFD Simulation"[4], The software FLUENT is selected for determining flow pattern. Hydro Turbine for Lower Mae Ping dam has been designed considering the existing civil structure of the dam, the flow regulation for irrigation and the limitation of water level that can effect to the efficiency of hydro power plant at upper dam. The optimizations for all purposes have been considered.

Maryse FRANCOIS in, "Developments of Recent Projects for Hooped Pelton Turbine" [5], has described is about the improvement of Pelton Turbine using CFD software. All Pelton turbine components are analyzed and optimized by calculation.

T. Kubota in " Observation of jet interference in 6 nozzle Pelton turbine" [6], has visually observed jet interference in buckets and jet disturbance outside the buckets. Water leaving out of the bucket which was received by first jet is deflected by the second jet leading to efficiency deterioration.

T.R.Bajracharya et al., in "Sand erosion of Pelton turbine nozzles and buckets: A case study of Chilime Hydropower Plant" [7] has discussed about the problem of erosion of nozzles of Pelton turbine in Himalayan region. Study along with analysis was carried out by the authors. Flow nets diagrams were drawn and wear rate for the needle and bucket have been analysed.

Kotousov in "Measurement of the Water Jet Velocity at the Outlet of Nozzles with Different Profiles" [8] has studied 4 convergent nozzles with varying inlet diameters. Experiments were carried out and it was concluded that the density of jet at outlet of nozzle decreases.

V.Gupta et al. in " Performance analysis of nozzles used in impulse hydraulic turbine using CFD" [9] has simulated water streamlines and pressure distribution in three different shapes of nozzles at various openings. It was concluded that Computational Fluid Dynamics (CFD) is very good tool to predict the performance of different shape of nozzles at different mass flow rates and nozzle openings in least time.

V. Gupta and V.Prasad in " Numerical computation of force for different shapes of jet using CFD" [10] modeled three different shapes of jets and found out the force exerted by jets on the flat plate numerically and compared the results with theoretical values. It was concluded that the flow is uniform for circular jets.

V. Gupta and V.Prasad in "Numerical investigations for jet flow characteristics on Pelton turbine bucket" [11] compared the flow characteristics on Pelton bucket with circular and rectangular jets using numerical multi phase flow simulation. Numerical and theoretical results have been compared for typical bucket profile and both bear closed comparison.

V.Gupta et al. in " Numerical Modelling For Hydro Energy Convertor: Impulse Turbine" [12] validated the results of numerical simulation of water jet on curved plates with different flow angles at outlet. Steady state numerical analysis based on two phase homogeneous model for free surface turbulent flow with standard k-ε turbulence model is done using ANSYS-CFX.

V.Gupta et al. in " Numerical simulation of six jet Pelton turbine model" [13] did multiphase flow analysis in Pelton turbine using water and air as working fluid to estimate the efficiency, blade loading, velocity and water distribution over the bucket at different operating regimes of the turbine. The effect of mesh size, turbulence model and time step is also studied for transient multiphase flow simulation.

V. Gupta et al. in " Effect of jet shape on flow and torque characteristics of Pelton turbine runner" [14] studied the effect of four different jet shapes on the flow and torque characteristics of Pelton turbine runner through numerical simulation. It was found that circular jet was the most efficient and flow distribution is also uniform.

V. Gupta et al. in "Effect of jet length on the performance of Pelton turbine: Distance between nozzle exit and runner" [15] has discussed the effect of length of jet on the performance of Pelton runner. It was found out that the jet with less distance had greater impact than longer jet.

V. Gupta et al. in " Performance Evaluation of Pelton Turbine: A Review" [16] briefly discussed about the applications of CFD for performance prediction, design optimization of Pelton turbine Irjet Template sample paragraph .Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

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