THESIS

# NUMERICAL SIMULATION FOR OPTIMAL DESIGN OF SURGE TANK IN HIGH HEAD HYDROPOWER PLANT




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## ABSTRACT

## NUMERICAL SIMULATION FOR OPTIMAL DESIGN OF SURGE TANK IN HIGH HEAD HYDROPOWER PLANT

Surge tanks are usually installed at hydro installations to mitigate the effects of water hammer and enhance the operation of the turbine- generator set in electrical grid. Their fundamental action is to shorten the distance between the turbine and the nearest water surface. Water hammer is a phenomenon due to pressure change in closed pipes caused when flowing water in pipe lines is accelerated or decelerated by closing or opening a valve or changing the velocity of water rapidly in some other mean.

Sudden shutdowns of hydroelectric plants or change in water flow through hydraulic turbine may cause problems ranging from rupture of penstock due to water hammer, that cause the line current of the generators to vary from the desired frequency. The pressure rises resulting from water hammer can be limited by the use of relief valves or similar appliances. Although these appliances will limit pressure rise effectively on reduction of load, i.e on closure of the turbine guide vanes. They cannot assist in accelerating the water column on increase of load, i.e on opening of the guide vanes.

When the pressure conduit is of considerable length, therefore it frequently becomes desirable to introduce a surge chamber at a suitable point along the pressure conduit system.

The water hammer phenomenon was studied at CEWRE hydraulic laboratory. The purpose of the experiment was to study the characteristics of water hammer phenomenon.

The SURGE model was used for the hydraulic analysis of surge tank. Surge model developed by GTZ, German Agency For Technical Cooperation. SURGE model was applied to Gollen Gol hydropower project under two operational scenarios, i.e **complete closure and complete opening** of the turbine governor. The three different types of surge tank system were analyzed. The results of surge model were compared from the design result of Gollen Gol hydropower project. The SURGE model results of maximum upsurge and down surge were deviating 0.01% and 0.06% respectively. Hence the results were with in acceptable limits. The surge model is reliable.

Then the hydraulic analysis of the Satpara hydropower project was made under the same two above-mentioned operational scenarios. Three types of surge tanks, i.e surge tank with out chamber, surge tank with lower chamber, surge tank with two chambers were considered for analysis purposes. The surge tank with out chamber, surge tank with two chambers were producing the surge height of 3.65m and 3.69m. The surge tank with lower chamber produced the surge height of 3.37m. Hence the surge tank with lower chamber is the optimal design for Satpara hydropower project