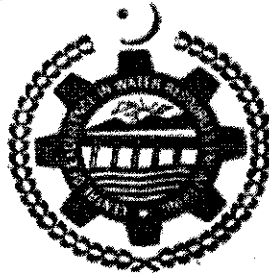


THESIS

**HYDRAULIC ANALYSIS OF BUNJI DAM SPILLWAY
USING CFD MODEL**



By

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ABSTRACT

Bunji hydropower project planned in Gilgit-Baltistan province of Pakistan on Indus River is 83 km east of Gilgit city and 314 km upstream of the proposed Diamer Basha Dam Project. Along the river, the distance between dam and powerhouse is 45 km whereas the power tunnels connecting dam and powerhouse are about 8.5 km long each. By constructing a 200 m high RCC gravity dam above the bed rock, a hydraulic head of 440 m will be developed to generate 7100 MW with plant discharge 1900 m³/s. Bunji Hydropower Project is the biggest capacity hydropower project among all other projects included in WAPDA vision 2025. Keeping in view the energy crises being faced by Pakistan one can easily understand the importance of this project. Presently this project is at review stage from WAPDA after completion of its detail design by Bunji Consultants.

Spillway is a rigid passage from where excess water could be spilled over. It is pertinent part of every storage project/reservoir to keep water levels up to desired levels and keep the dam and other structures safe. In other words spillways are devices to keep in hand control of storage capacity/volume, area and reservoir levels of the project. In power generation projects by controlling the head water levels, spillways improve the efficiency of power houses and hence the power output.

Spillway of Bunji Dam comprises of six gated bays and is designed against 19400 cumec at a reservoir level of 1689 masl. Hydraulic Analysis of every hydraulic structure is compulsory before its implementation.

Hydraulic analysis of spillway may involve Interpolation/Extrapolation from design curves by USACE OR USBR, Physical Modeling or Numerical Modeling.

Bunji Consultants designed Bunji Dam Spillway then finalized its design with Physical Modeling conducted at Hydraulic Research Station Nandipur!

The objectives of this study performed in this thesis are to develop discharge rating curves for free and gated flow conditions along with flow profiles by using Numerical Modeling technique. A three dimensional software package Flow 3D by Flow Science was used for this purpose.

3D Solid geometries were created from available 2D drawings and then imported in Flow 3D after converting them to stl file format. Water was selected as fluid and a mesh around spillway geometry was created. Appropriate boundary conditions were set and RNG method was selected as solver.

Initially comprehensive simulation was performed but results were not accurate so partial modeling was adopted and this time better results were achieved. At reservoir level of 1685; against discharge of 13606 m³/sec discharge obtained was 13468 m³/sec and at reservoir level of 1689; against discharge of 19400 m³/sec discharge obtained was of 19326 m³/sec.

Results showed that Flow 3D is an appropriate code for simulating spillway flows. Discharge rating curves can be obtained by using this technique. More over comparison showed that it is sustainable and it involves less effort, time and cost as compared to physical modeling. However sensitivity analysis of other parameters like velocity and pressure should also be checked along spillway profile.