THESIS

A CASE STUDY FOR DEVELOPMENT OF LOWER SPAT GAH HYDROPOWER SCHEME IN CASCADE SETUP

By

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ABSTRACT

Hydropower despite being accepted globally as the cleanest, cheapest and most sustainable source of energy, is underutilized globally. Potentially, Pakistan is a very fortunate country, blessed with tremendous water and power resources. One of the PPIB (Private Power & Infrastructure Board) report states ''Pakistan has a hydel potential of approximately 41722 MW". However, only about 16 % of this has been developed. This thesis is an effort for development of a high head hydropower scheme, located on the left bank of the Indus River in Kohistan district (NWFP). The main objective of this study is development and optimization of Lower Spat Gah (LS) scheme in cascade and simulation of energy generation at with and without addition of the Upper schemes of the cascade. For this purpose, not only in depth study of hydropower literature was done but detailed review of old studies is also carried out. After a conceptual study, by Lahmeyer / Knight Piesold for SHYDO in 1998, Palas Valley Spat Gah Hydropower Consultants (PSHC) carried out, Pre-Feasibility Study for hydropower development in Palas and Spat Gah Valleys for WAPDA 2007. This research thesis has taken maximum benefit from the latter report, data and maps for planning, and analysis required for this study. The Spat Gah-Gabarband Gah valleys run almost parallel in east west direction for about 30 km, up to their zenith at elevation 2800 m.

Water resource and hydraulic head across these small rivers can best be utilized if developed together in a cascade. For this purpose, a thorough review of different layouts was performed. GIS maps on 1:10,000 scale were used to configure various layout options. Comparative evaluation of different cascades with respect to

basin utilization, available head, waterway lengths was made. The finalized hydropower cascade consists of three stages namely, Upper Spat Gah (US), Middle Gabarband (MG), both with dams, and Lower SpatGah (LS) stage as a runoff river scheme.. The optimization of cascade achieved increase of catchments, 30% for US, 336% for MG and 29% for LS and 5.41 km saving in water way length. The simulation results showed that the mean annual energy improved by 14 % from alt. I to alt. II, the reliability of primary energy has also increased by 6%. For Optimization of reservoir operations, the main design parameters were Full Supply Level (FSL), Minimum Operating Level (MOL), Installed Capacity (IC) as well as the rated net head, the design discharge and the hydraulic loss coefficients. The input data and engineering characteristics were derived from the previous studies. After this, the numerical simulation showed the flows and energy generated with varying hydrologic inputs and operation of different plants of the cascade, one by one (i.e., alternatives I only LS operative to alternative to IV US reservoir operative). The reservoir operation and simulation of the scheme was done for optimum utilization of monthly inflows and management of outflows with the help of computer model HEC Res Sim under defined boundary conditions and constraints imposed by the operation rule curves.

The computer model determined the production of energy potential and water balance at the end of simulation period by keeping the reservoir volume with in the limit of active storage and due care to avoid the shortage of water. Besides providing information about the monthly water balance, the simulation runs showed power generation during peak and off peak hours which constitutes an important element in the economic evaluation of the scheme. The mean annual energy improvement from alternative I to alternative IV is about 17 % and the reliability of primary energy

increased by 8%. 4) The comparison of simulation results show that improvement of mean monthly energy pattern from Alt. I to Alt. II&III is 22GWh to 24GWh with an increase of 14% and 15%, respectively. However the increase in case of alternative I to IV has been found about 17%.