

THESIS

STUDY OF TURBINE SELECTION CRITERIA FOR HIGH HEAD
HYDROPOWER PROJECTS



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ABSTRACT

Hydropower supplies nearly one-fifth of the world's electricity. Hydropower also represents energy independence for many countries. Hydropower as an energy supply also provides unique benefits to an electrical system. Economic, social and environment change is inherent to development. Recent thinking often relates renewable energy to electricity from wind energy, solar energy or geothermal energy. Pakistan economically viable hydropower potential is about 40,000 MW.

Hydraulic power project development requires careful study and investigation to enable selection of the best-adapted equipment. The selection of type, size, setting and number of units for a particular hydropower site is an important part for planning and design of a hydro power plant. The word turbine has emerged from Latin word Turbot means a whirling object in the nineteenth century.

The specified research study enables the planners, contractors and consultants to decide which type, how many number of units and what is the size of the turbine runner. Turbines had been selected on different options in Pakistan. The data relating to turbine selection is in scattered form and not in organized standardized format and different literatures have to be reviewed in selection of turbines. Therefore, a need was felt to carry out the present study so that user-friendly criteria for selection of turbine for high head hydropower projects in Pakistan can be established.

For the specified research study a comparison between different types of turbines have been critically reviewed showing all the necessary features. A method has been discussed to critically review the different alternatives. The high head Allai Khwart Hydropower project has been selected for the specific research study which is located in NWFP, the capital of Peshawar, a left bank tributary of Indus river.

The factors influencing the type of turbine such as efficiency, output variations, specific speed, head, discharge, cost, quality of water, quantity of water, setting of turbine, part load operation has been critically reviewed and analyzed.

Different parameters such as limiting power with respect to technical development, amount of investment for different units, assurance of biological minimum, condition of power system with units included, energy loss due to maintenance, probability of outage, standardization of units, transport conditions, necessary reserve in a power system, hydraulic relation between power exploiting and significance of power plant in the system and difference of production as a function of operating coefficients have been critically analyzed to determine the number of units for the said research.

All the empirical formulae used in the turbine selection criteria are presented in simplified and standardized format and also a Microsoft Excel sheet has been developed to analysis various alternatives for different hydropower projects. Several alternatives have been discussed in connection with the use of water of Allai Khwar Hydropower project. Keeping in view the merits and demerits of different alternatives for the specified

hydropower project, the best alternative regarding the type of turbine, the number of units, number of jets (Pelton turbine), the sizing of turbine runner, setting height of the runner i.e. vertical or horizontal, specific speed, runaway speed, discharge per unit and power has been evaluated. The selected alternative results for the specified research study were compared with the results given by WAPDA in collaboration with GTZ and found to be satisfactory. Finally some recommendations, which were important from point of view of the research topic, have been pointed out.