Balaju Yantra Shala's Experience in MHP Technology Development

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Introduction

About 95 per cent of the total energy needs of the country are met by traditional sources, such as fuelwood, agricultural residues, and dung. The substitution of traditional energy by kerosene/coal in hill and mountain areas is a difficult task because of the high transportation costs involved. Therefore, the emphasis in these regions must be on renewable energy, e.g., hydropower on different scales.

Early Use of Hydropower in Nepal

The first hydropower plant in Nepal, the 500kW Pharping Plant, was commissioned in 1911. However, the pace of hydroelectricity development in Nepal has been very slow. Before the establishment of the first mechanical workshop, the Balaju Yantra Shala (BYS), in 1960, only four hydroelectric plants existed in Nepal, with a total capacity of less than five MW. The real growth of the power sector began in the sixties.

The Balaju Yantra Shala in MHP

Manufacturing

Nepal did not have welding technology until 1960, and there was almost no technical manpower available in the country. It was in 1960 that BYS was established as a joint venture project of the Nepal Industrial Development Corporation and Helvetas (then SATA - Swiss Association for Technical Assistance). In 1962, BYS built and installed its first propeller turbine to drive a five kW generator at the Godavari Fish Farm. It was the first Micro-Hydropower Plant (MHP) in Nepal.

Traditional water mills, powered by timber water wheels and used for grinding cereals in the hills, were not powerful enough to drive rice-husking machines. Thus, the farmers had to install diesel engines that ran on imported fuel for rice huskers and flour mills. Subsequently, BYS came up with the idea of producing water driven turbine mills. The technical drawings necessary for a propeller turbine were obtained from a Swiss turbine manufacturer. As there was no machine foundry in Nepal, the design was adapted to suit local manufacturing capabilities. Several propeller turbines were manufactured and installed for direct power drives. After some years, an assessment of the performance of these machines was carried out which led to the conclusion that more versatile turbines were needed in terms of output capacity and head range. Consequently, it was also realised that the new turbines should fulfill the following criteria.

14 General Manager of BYS.

i) The machine must be manufactured and based on welding alone as foundry technology is not available. The machine should be such that it can be locally produced.
ii) The weight of a single component should be less than 60kg so that it could be carried by a porter.
iii) The adaptation of turbine sizes to different heads and flows should be simple.
iv) The machine should incorporate a flow-regulating device so that the output can be adjusted to the consumer load.

Since none of the foreign manufacturers were ready to be involved, BYS had to carry on its own. After exploring all types of turbines, BYS selected the cross-flow type for adaption, especially because of its simplicity from the manufacturing point of view. The important features of the cross-flow model are: a) the whole machine can be constructed by welding; b) the runner blades can be produced through plate bending; and c) the machine can be adapted to various head and flow conditions by simply varying the runner blade.

The first model T1 produced was a hand-regulated straightforward design to mechanically drive a flat belt transmission for operating agro-processing machinery, such as rice huskers and oil expellers. BYS has gone through different phases to reach its present stage, with some improvements made at each phase. The models produced until now amount to 13 from the T1 to the T12 including the T3M model. Of these models, the T2, T5, and T7 models have become obsolete. The T4 model was the first turbine with an automatic governor control to be used in a village electrification project. The T12 model is based on experience with models in the past. It uses a new concept to ventilate the jet (free jet approach) and is especially suited for flow control.

Survey, Civil Works, and Installation

Besides manufacturing turbines, BYS has also taken the responsibility of undertaking site surveys and installing and commissioning MHP which are normally the low and medium head run-of-the-river types. The method adopted for choosing the site is basically visual investigation. Only one or two sites that best satisfy the requirements are surveyed in detail. The main components included for the survey are the canal, penstock, and powerhouse.

Constraints

Manufacturing: Since the turbines are to be designed to suit the site conditions and the requirements of that particular area, they cannot be mass produced. Special consideration must also be given to transportation by porters. The individual turbine parts are bolted together and kept in position by taper pins. The role of trained mechanics is very important because many tasks are performed by hand. It is not easy, however, to find such mechanics.

Marketing: Government support for indigenous MHP is not adequate and, therefore, BYS has to promote its product itself. BYS has been able to export its turbines to various countries, but these orders have been commissioned only through personal contacts. BYS has not yet been able to go in for expensive advertisements.

Hydrological Data: Data on small rivers/rivulets, on which MHP is to be developed, are not collected by the Department of Hydrology and Meteorology (DHM). Hence, MHP installation can be based only on a few flow measurements. This leads not only to under or over design, but also increases the risk of damage to the powerhouses by floods.

Raw Materials: All the raw materials required to manufacture the turbines are imported. The customs' regulations of the government do not encourage the manufacturers; the customs' duty on raw materials is 20 per cent, whereas it is only five per cent on imported turbines.

Summary

BYS contributes to national development by manufacturing turbines and installing them. It is committed to MHP development, especially through research into and development of cross-flow turbines. It has come a long way in this field and hopes to contribute further.