The Role of Nepal Hydro and Electric Company and Butwal Engineering Works in Developing Hydropower Equipment

- Nawa Raj Shrestha[10]

Introduction

The Butwal Engineering Works (BEW) and the Nepal Hydro and Electric Company (NHE) are pioneering companies in the field of design, manufacturing, and installation of electro-mechanical equipment for mini- and micro-hydropower. Their focus is on equipment development. BEW and NHE were established in 1977 and 1985 respectively, both being under the same management. These companies were established with the aim of reducing Nepal's dependence on foreign equipment and technology for harnessing its vast hydropower potential. This paper highlights the experiences of these two companies.

Engineering and Production Capabilities

BEW was started with the help of expatriate engineers. Recognising its limitations in developing and producing a wide range of products, it established a joint venture company, the Nepal Hydro and Electric Co. (NHE).

After completion of work on the Tinau Plant and the establishment of a number of micro- hydropower projects, the company committed itself to the following strategic goals.

- To establish a new company in technical collaboration with foreign companies
- To build workshops capable of producing water turbines, governors, control panels, transformers, transmission line towers/poles, and related structures for the 10 to 500kW range
- To develop technical manpower capable of manufacturing the above equipment

The NHE shareholders represent three national companies: BEW, the Butwal Power Company (BPC), the Himal Hydro and General Construction Co (HH), and two Norwegian companies — Kvaerner Energy a.s. (KEN) and ABB National Transformer AS (ABBNT). KEN provides technical support for manufacturing water turbines, governors, and ABBNT supports the manufacture of control panels and the repair of distribution transformers. These two Norwegian partners have been providing on-the-job training to Nepali engineers and technicians. BEW and NHE together have the following capabilities.

---

10 Chief of the Electrical Division in Nepal Hydro and Electric Company (P) Ltd.

(i) Design and manufacture of:

- cross-flow turbines up to 100kW
- Pelton and Francis turbines up to 5,000kW
- Governors
- Electronic load controller
- Penstock pipes, gates, draft tubes, trash racks, and other heavy structures
- Control system panels
- Transmission towers (two- or three-legged lattice) up to 132kV and poles (tubular) up to 33kV.

(ii) Repair of valves and distribution of transformers with a capacity of up to 100kVA

(iii) Reconditioning and rewinding of AC and DC motors with a capacity of up to 300kW and generators of up to 500kW

(iv) Overhauling, refurbishing, and installing micro- and small hydropower plants.

Production Facilities

The production facilities of BEW and NHE include a mechanical division consisting of turbine and governor plants (including penstock pipes, gates, etc), a transmission tower section, a specialised plant for fabricating light-weight, tubular steel poles, a galvanising plant, and an electrical division (includes transformer, motor/generator, and control panel sections). These divisions/sections are equipped with: (i) heavy-duty vertical and horizontal lathes, (ii) a horizontal boring machine, (iii) milling and drilling machines, (iv) precision tools and control instruments, and (v) a modern repair workshop with test facilities for breakdown voltage tests of oil, insulation resistance, voltage ratio and polarity, winding resistance, no-load loss and no-load current, load loss and impedance voltage, separate voltage withstand, induced potential test at 100 HZ, and impulse (lightning) voltage test.

Quality Control

To ensure good quality, the finished goods are subjected to continuous quality control checks at every stage of the manufacturing process. Both companies strive to follow International Standard Organisation (ISO) standards in manufacturing, especially project equipment packages of above 100kW capacity. The companies also adhere to the specifications of KEN and ABBNT. For small project equipment packages of below 100kW capacity, a combination of ISO and Indian Standard Institute (ISI) is followed. For cross-flow turbines, the DIN(German [*Deutsche*] Industrial Norm) system is used. For quality control, non-destructive testing (NDT), including X-ray, magnaflux, ultrasound, and dye penetration are available.

Principal Experiences

Rehabilitation of the Tinau Hydropower Plant (1,000kW)

This included (i) overhauling and reconditioning three Francis turbines, spiral casings, governors; (ii) rewinding and replacing coils for rotor, reinsulating stator windings, rewinding DC exciters; and (iii) manufacturing new control system panels.

Sundarijal Hydropower Plant (640kW)

This included rehabilitation of two units of broken and worn out Pelton turbine runners.

Andhi Khola Hydropower Plant (3 x 1,700kW)

This included reconditioning powerhouse equipment imported second-hand from Norway. The principal tasks undertaken were: (i) manufacturing penstock pipes, manifolds, and branch tubes for 250 metre head, control panels, transmission towers/poles; (ii) overhauling Pelton runners, governors, alternators, and switchgears; and (iii) site erection of complete mechanical and electrical equipment.

Darchula Small Hydropower Project (250kW)

Work here included manufacturing a Francis turbine, governor, and control system panel. Design, installation, and commissioning of the plant.

Sikles (100kW) and Ghandruk (50kW) Micro-Hydro Projects

Work included manufacturing Pelton turbines, electronic load controllers, steel penstock pipes, and related structures.

Trishuli Hydropower Plant

Work included (i) fitting a 3,500kW Francis turbine runner to the shaft with new dwell pins, (ii) rewinding a 200kW AC motor, and (iii) removing old bearing metal and rebuilding it by depositing new metal for unit No. 7.

Panauti Hydropower Plant (3 x 800kW)

Work included overhauling and repairing two sluice valves and a DC exciter.

Jhimruk Hydropower Project (3 x 4000kW)

Work carried out included designing and manufacturing: (i) radial gates, slide gates, and trash racks; (ii) penstock lining, manifold and branch tubes; (iii) Francis turbines, excluding runners; (iv) electronic hydraulic governors, excluding electronic head; (v) draft tubes and auxiliary equipment; (vi) control panels for 6.6, 33, and 132kV systems; (vii) galvanised lattice towers for 45km of 132kV; and (viii) galvanised steel tubular poles 155km in length. In addition, the installation and commissioning of complete mechanical and electrical equipment packages were undertaken for the project.

Kulekhani Hydropower Plant (60,000kW)

The company participated in the site welding of steel penstock pipes damaged by the 1993 flood. The welding was carried out on high tensile steel plate according to DIN 17102 STE 460 and was confirmed by a 100 per cent X-ray.

Jhankre Mini-Hydropower Project (450kW)

Three units of 150kW Pelton turbines and control system panels are being manufactured.

Production Problems

To improve capability and quality, the introduction of larger and more sophisticated machines is necessary, but the availability of high quality work within the country is limited. Hence, it is difficult to keep these machines busy throughout the year, and, consequently, overhead expenses increase. Except for micro-hydro, the customers for hydroelectric projects in Nepal are mainly government and government-owned utilities. Since the government has a tendency to develop larger projects this leads to a fair amount of uncertainty concerning plan implementation, as well as adding difficulties because the government has to comply with terms and conditions laid down by financing institutions as well as donors. There is no assured market inducing companies to invest in the creation of facilities capable of manufacturing larger-sized products. On the other hand, local-level private entrepreneurs of micro-scale hydroelectric projects have a tendency to minimise initial investment costs and, therefore, it is difficult for the companies to compete with other local engineering workshops in terms of price.

The other factor is the difficulty in competing with Indian and other overseas' products because of high transportation costs on the import of raw materials and supplies and lower productivity per employee. In addition, strong government commitment to developing indigenous capabilities is lacking.

Conclusion

The formulation of a long-term policy by the government, aimed at encouraging the indigenous private sector to develop and uplift equipment manufacturing and design capabilities, will pave the way for harnessing the hydropower potential of the country at a reasonably low cost.