Water Resource Associates

A network of consultants in hydraulics, hydrology, groundwater & environmental issues

Project title: **Mangdechuu Hydroelectric Project**

Summary: Hydrological studies of yield and probable maximum flood for run-of-river hydroelectric scheme.

Client: Mangdechuu Hydroelectric Project	**Financed by:** NORAD (Norwegian Aid)
Period of assignment: 2001-2002	**Location**: Bhutan
Project Value:	**WRA services**: Specialist consultancy
In Association with: NORCONSULT	

Location of the Mangdechuu Project

Background

Bhutan is a very mountainous country, with seven major river valleys running north to south from the 7000m peaks of the Himalayas down to the floodplains of the Brahmaputra river at 300m above sea level. These large altitude differences, together with the monsoon climate, offer many opportunities for construction of hydropower stations. The population of Bhutan itself is small (600,000), so electricity demands are minor in comparison with those of the more populous states, such as West Bengal, Assam and Bihar, in India. Hydropower stations are therefore designed principally for future export of power to India. In 1989 only one such station, with capacity 336 MW, existed at Chukha on the Wangchhu river in western Bhutan.

During 1990-91 the Norwegian company Norconsult International prepared a Hydropower Master Plan, which identified the most promising 25 potential sites for large hydropower schemes, and subsequently conducted pre-feasibility studies of the best four.

In 1998 the Royal Government of Bhutan requested Norconsult International to conduct a technical and economic feasibility study of one of these 4 schemes located in central Bhutan on the Mangdechuu river at Trongsa.

Scope of work by Water Resource Associates Ltd

The scope included all those hydrological analyses normally undertaken for a major hydropower design study, including revision of rating curves, flow duration curves, low flow frequency, flood estimates at both the intake headworks and tailrace outlet, and examination of compensation flows in the river stretch downstream of the intake.

During the Hydropower Master Plan in 1991, a network of 15 primary river gauging stations had been constructed throughout the country, and the Hydata software (originally written by one of the WRA directors) installed to process these data. Data from 2 of these primary stations were used during this feasibility study, together with flows measured at a temporary station constructed 7 km upstream of the intake location. A reliable regression equation was found to exist between mean monthly flows at these stations, which allowed extension of the local daily record to a full 7 year period, for use in simulating the operating regime of the proposed hydropower scheme.

Results

Recommendation was given for a 360 MW high-head run-of-river scheme, with an underground power station. The intake headworks would be located at 1800 m altitude, with a 12 km long headrace tunnel, and penstocks 680 m high. There would be a small reservoir pond at the intake site, with sufficient storage to allow generation of power to meet twice-daily demand peaks.

Probable Maximum Flood (PMF) was estimated at the intake location, using annual maximum daily rainfall totals for 12 stations in the upstream catchment, and estimates of Probable Maximum Precipitation (PMP) obtained by the Herschfield technique. A unit hydrograph technique was used to convert PMP values to PMF estimates. One recommendation was to re-instate rainfall stations at high altitude up to 4000m, as many of the existing stations are found along the roads in the valleys.

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