Conclusions and Recommendations
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13. Conclusions and Recommendations

The Madian Hydropower Project (HPP) is located in the north of Northwest Frontier Province (NWFP) of Pakistan. The project area is located in the Swat District, north of Madian Town at a distance of approximately 200 km from Peshawar, the capital of NWFP and 60 km from Mingora, the district headquarters of Swat Valley.

Several studies for assessment of the hydropower potential of the Swat catchment were carried out between 1990 and 2006 resulting in the proposal to develop a cascade of four run-off river hydropower plants along the Swat River with Madian Hydropower Project being the most downstream located.

13.1 Conclusions

The Madian HPP is a run-of river hydropower project based on the concept of diverting flow from Swat River near Kedam village and exploiting the gradient of the Swat River of 11 m per km on average over a 13 km long river reach. By this concept some 154 m head can be obtained for power generation which permit an installed capacity of 3 x 60.8 MW, an available capacity of 3 x 52.43 MW ex transformer and a mean annual energy generation of 767.5 GWh at a project cost of 366.2 million US$.

The present Feasibility Study of the Madian Hydropower Project serves to answer three key questions:

(1) **Technical Feasibility:** Is the project technically feasible under consideration of the prevailing hydrological, topographic, geological, infrastructure, environmental and socio-economic boundary conditions?

(2) **Economic Feasibility:**
Is the project beneficial for the economy of Pakistan?

(3) **Financial Viability:**
Is the project profitable for the investor?

The three above stipulated aspects have been analysed at the required level of detail in this Feasibility Study. The first two questions can be clearly answered with: **Yes, Madian Hydropower Project is feasible** and it is worth to continue developing the Project till implementation.

Concluding statements regarding the third question can be given only when the Project Sponsor and the Power Purchaser have reach on the respective agreements. The potential that such an agreement can be beneficial for both parties has been demonstrated in this Feasibility Study.
13.2 Summary of Results of Feasibility Study

In accordance with the requirements of a bankable feasibility study and the corresponding terms of reference the Consultant conducted comprehensive field investigations comprising:

- Supplementary hydro-meteorological survey and field studies
- Detailed topographic survey of the project area
- Comprehensive geotechnical field and laboratory investigation program
- Study of conditions to access the project area
- Environmental Impact Assessment Study and Resettlement Action Plan in accordance with international standards

The hydrological Studies revealed a mean annual flow of Swat River of 118.5 m³/s which shows considerable variation around the year between the high flow season from May to September and the low flow season from December to March. The optimum design discharge for power generation was found to be 129 m³/s resulting in an installed capacity of 3 x 60.8 MW.

The design of alternative project layouts and the finally preferred alternative for the Madian HPP were elaborated based on the site specific conditions derived from the detailed geotechnical field and laboratory investigations as well as the topographic survey. The Project and its components were optimized applying unit rates which were verified with local and international market prices and rates of similar projects under development. The total cost of the Project is estimated to be 366.163 million US$ based on July 2008 price level.

The Consultant analysed the economic feasibility of the project in comparison with alternative thermal power generation and determined the Economic Internal Rate of Return of the Project being 15.8 % and the Benefit Cost ration 1.66 at a discount rate of 10 %.
The Consultant conducted a sensitivity and risk analysis which verified that the Madian HPP is economically feasible under most conditions, including higher investment cost and unfavourable hydrological conditions. Under extremely unfavourable assumptions/conditions such as comparison with thermal alternatives based on gas-generated energy and low local gas prices the Madian Project would not be economically feasible.

In the financial analysis the Consultant considered the legal and institutional framework for development of hydropower projects by private investors in Pakistan which is in the process of being established. Pursuant to NEPRA’s Tariff Standards and Procedure Rules a model for calculation of the power tariff was developed that permits the licensee to recover the costs incurred for power generation as well as provide a reasonable rate of return on the investment which reflects the risks assumed by the investor.

### 13.3 Recommendations – Project Implementation

For Project implementation, the following major activities are considered:

- **Stage I**: Pre-Construction Activities: 48 months
- **Stage I.1**: Feasibility Study
- **Stage I.2**: Tender Design, Pre-qualification and Contracts
- **Stage II.**: Construction Works, Commissioning, Testing/Training

After the approval of the Feasibility Study by PPIB and POE, the preparation tender documents can start. During or even ahead of the preparation of the tender documents some additional technical activities are recommended such as hydraulic model tests and additional geotechnical field investigations, e.g. exploration adits etc. The preparation of the tender documents consists mainly of the preparation of general and particular (technical) specifications of all project components, the preparation of the tender documents, pre-qualification of contractors and manufacturers, floating of tenders, evaluation of bids and finally assistance to the Project Sponsor in the contract negotiations.

The construction schedule is based on an estimated overall construction period of 4 years and 6 months. The critical path of construction works is defined by the excavation and lining of the 11.8 km long headrace tunnel.

Commissioning and testing of the electro-mechanical equipment is part of the construction program while training of staff takes place both during erection and during the first few months of operation.

The preliminary implementation period of Madian Hydropower Project can be summarized as follows:
• **Phase I: Pre-Construction Activities**
  Start: first quarter of the year 2007  
  Period: 48 month  
  End: first quarter of the year 2011

• **Phase II: Construction Work**
  Start: first quarter of the year 2011  
  Period: 54 month  
  End: end of second quarter of the year 2014

• **Phase III: Testing and Commissioning**
  Start: first quarter of the year 2015  
  Period: 4 month  
  End: end of second quarter of the year 2015

• **Commercial Operation of the Plant: mid 2015**