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REGIONAL PROGRAMME OFFICE, BALTISTAN

*An Evaluation of Micro-Hydel Units at Baghicha & Dassu*

by

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# MICRO-HYDEL UNITS IN BALTISTAN

## —An Evaluation

### Introduction

Micro-Hydel units were first introduced in Baltistan in 1988, on an experimental basis. The main objective of this research is to produce a cheap power source for villages in Baltistan where only 50% of the villages are electrified.

### Micro Hydel Development: The Role of AKRSP

Over the last few years the Engineering section has given great emphasis to the development of power generation in Baltistan. Mainly in response to the demand of the VOs, research has been conducted on the development of low cost, simple micro-hydel systems which can supply power to the VOs and are easy to maintain. The aim is not to replace the ongoing large scale government power generation programme but to complement it by providing power to remote and inaccessible villages which would normally be missed by a large scale power generation programme. The results from AKRSP research would allow agencies and even VOs to see for themselves the possibilities of generating power cheaply. For instance, the cost of a unit of KVA of power generated by AKRSP schemes is nearly one fifth of that for similar schemes initiated by the conventional approach.

### Micro Hydel Units in Baltistan

There are 7 micro hydel units in Baltistan of which 3 are operational. The first unit was installed in 1988 at Baghicha in Skardu. The 2nd to be installed was at Dassu, Shigar in 1990 and in 1991 a micro hydel unit was set up at Gamastar in sub division Shigar. Although the Engineering section's records indicate that all three units are operating successfully, MER felt it necessary

to visit these village organisations in order to see if; 1) the micro-hydel unit was serving the purpose for which installed i.e providing electricity to the village households and to see if all VO households were benefitting from the project, to see if the unit had been put to other end uses such as saw mills, flour mill etc. 2) Management of Micro-Hydel Units. 3) Maintenance costs and other costs incurred and finally to see the 4) Problems/difficulties faced by the VO in operating and maintaining the unit.

#### Micro-Hydel Unit at Baghicha

The VO was visited by MER and Engineering sections in the last week of June to inspect the Micro-Hydel unit which was installed at Baghicha on October 15th 1988. No formal questionnaire was prepared to interview VO members, only a check list was used to gather information regarding utilization and operation of the micro-hydel unit, informal discussions were held with members of VO Baghicha including the office bearers.

#### Power Generation and Per Unit Costs

AKRSP provided a grant of Rs. 1,38,000 for the micro-hydel unit at Baghicha whereas all unskilled labour was provided by the VO itself.

It is claimed that the cost of a unit of KVA of power generated by Micro-hydel units is nearly 1/5 of that for similar schemes initiated by the conventional approach. However, in the case of Baghicha costs are Rs. 1 per KW per hour as compared to Rs. 0.55 per KW per hour provided by the government water and power department. Two things must be remembered in this regard; firstly a very small percentage of villages receive any electricity from NAPWD and the ones that do get electric power are subject to load shedding at peak hours. Secondly, in Baltistan electric power supplied by the Government is heavily subsidized. The high per unit

cost in case of MHUs is mainly due to the sub optimum levels of output of only 2.1 KW as compared to 10 KW capacity of the micro hydel unit.

### Electric Charges

There are 18 households in Baghicha and all receive electricity through the micro hydel unit. Electric power is switched on for an average of 4 hours daily; from six pm to ten pm. Electric charges are Rs. 5 per bulb. There are 47 bulbs at Baghicha; 20 bulbs of 60 watts, 25 bulbs of 40 watts and 2 tube lights of 20 watts each. The village also has 3 fans; 1 of 200 watts and 2 fans of 40 watts each. For the fans the VO charges rent of Rs. 10 per month. Majority of the households have bulbs in rooms that are in use most often. In winters living is confined to one room only plus the kitchen whereas in summers it is extended to two or three rooms. Majority of the hhs have one bulb at the front door.

The VO charges higher rates from commercial enterprises at Baghicha that are also benefitting from the micro-hydel unit. Two hotels, the Union Council hall and one Government office pays Rs. 10 per bulb. These earnings are contributed towards the upkeep and maintenance of the micro-hydel unit. The VO collects on an average Rs. 2,500-Rs. 3,000 per year in rental charges. This amount is kept separately from VO savings and is spent solely on the upkeep and maintenance of the micro-hydel unit.

### Costs, Repairs and Maintenance of the Unit

From October 1988-1991, except for a few replacements of minor spare parts the VO faced no major problems with the unit. These were mostly taken care of by the then VO President, Ibrahim or Mohammad Hasan who runs a road side inn at Baghicha. Although they did not receive any formal training from AKRSP, they were present

at the time of installation and received instructions from the assistant engineer. As it was impractical to expect the VO President to remain in the village all year round, it was decided by the VO that each member would be responsible to look after the micro hydel for a total of 30 days. This arrangement has worked quite well with all members and all agree that it is better than any one person being solely responsible for the unit. The same arrangement did not work so well in another village organisation where a MHU was installed. (See Dassu).

In 1991, however there was a major breakdown due to breaking of the fan belt and the "bearing". These could not be replaced immediately, as a result of which the unit remained out of use for a whole month. Various reasons were provided for not purchasing the spare parts on time; lack of money, lack of transport to come all the way to Skardu. Hasan also explained that spare parts were not easily available in Skardu and have to be ordered all the way from Lahore which takes a very long time. As a result of which the machine remains out of use for fairly long periods.

Members informed us that the machine, on an average, breaks down 4 to 5 times a year for an average of 3 to 4 days. Mostly it is the bearing that wears out or the "dori" that breaks. The dori is available in Skardu and can be easily replaced. Unfortunately the micro-hydel was out of order at the time of this study. Upon inspection it was found that both the dori and the bearing were broken, the machine itself was rusty as a result of which all nuts and bolts had become loose.

Asked as to which parts of the machine need to be replaced the most and how often, members shared with us the following information:

- 1) To date the large bearing has broken has broken down 4 times. The Shaft is not properly adjusted and eats at the bearing. The middle bearing is still the original one but is also worn out and will have to be replaced in the near future. The small

bearing has been replaced twice and is now functioning satisfactorily.

- 2) The Dori which is usually replaced once every 2 weeks is either not replaced properly or not at all. As a result of which water seeps inside the bearing.
- 3) The unit vibrates due to faulty bearing.
- 4) Fan belt is replaced once a year.
- 5) Nuts and bolts become rusted and need to be replaced every three months. Nuts and Bolts available in Skardu bazaar are not genuine and fail to adjust properly.
- 6) Valve is broken and the rod is also weak. The shaft is also worn out.
- 7) As the switch board is out of order, the unit is connected directly to the generator.
- 8) The voltage supplied is 190 volts instead of 220V.
- 9) The generator produces less than its rated output because of the need to protect the synchronous generator from running into overspeed, which is done by running the turbine well above the speed for maximum output. Typical overall efficiencies are 10 to 15% .

One major problem for the VO is that of transportation at the time of procurement of spare parts. As the VO does not store the most commonly available/needed spare parts at Baghicha, time consuming and expensive trips have to be made to Skardu.

#### Recommendation for Baghicha

According to recommendations made by the Senior Research Officer from Eastern Electricity, "the central bearing needs to be replaced as soon as possible as it is very worn resulting in excessive vibration of the shaft, which will cause additional wear to the other bearings. Also the cotter for the impeller should be replaced with the correct size. It would be advisable to replace some of the higher wattage bulbs with tube lights."

### Micro-Hydel Unit at Dassu

The village Dassu has 30 households of which 25 are members of the Dassu village organisation. Although the unit is installed at Dassu, 5 households of the adjacent village of Gambagrang Chukil also receive electricity from the micro hydel unit. The remaining households live at a higher elevation where it has not been possible to carry distribution line. The beneficiary base of the project is 18. The 7 households of Dassu who have not received electricity are those who cannot afford to have electric fixtures in the house. The VO however, plans to provide them with electricity from the main line.

### Power Generation and Per Unit Costs

The VO received a grant of Rs. 1,45,000 for the MHU besides providing technical assistance at the time of installing the unit. All labour and wooden poles were provided by the village organisation.

As the generator produces only 3 KW as compared to the rated output of 10 KW, cost per KW per hour comes to Rs. 0.81 per unit per hour as compared to costs of Rs. 0.55 per unit per hour if supplied by NAPWD.

### Electric Charges

The VO charges Rs. 30 per month of each household regardless of the number of bulbs in the house. This gives yearly earnings of Rs. 6,480 which is kept separately from VO savings and is spent strictly on the maintenance of the micro hydel unit. At the time of the survey, there were a total of 76 bulbs in the village. This includes 16 tube lights, 2 bulbs of 200 watts, 7 of 100 watts, 15

60 watts and 22 forty watt bulbs. The VO does not charge any rent on the 12 bulbs and 2 tube lights in the village Imambarghah, school and mosque. The VO allows households to play radios and tape recorders but strictly prohibits the use of electric heaters. Electricity is switched on for 3 hours in the evenings, from seven to ten. On special occasions power may be switched on for longer periods.

#### Costs, Repairs and Maintenance of the Unit

According to VO members there are frequent minor breakdowns that are easily handled by the VO manager who is familiar with the technical aspects of the micro hydel unit. There have been two major breakdowns for which AKRSP's assistance was needed. During 1991, repairs and maintenance costs came to Rs. 2,200 and during 1992 repairs have cost Rs. 750. Both these were easily covered by the rental charges paid by each household. It has been decided that in case the costs exceed the amount earned in rent, repair costs will be shared equally by each household. In addition to the above expenses, the VO has employed one member who is in charge of the day to day operation of the machine. He is paid Rs. 300 per month by the VO. Before this arrangement, each VO member was made responsible to run the unit and look after its general upkeep. This arrangement did not prove very successful as no one was willing to take responsibility at times of breakdowns and repairs. It was later decided to employ only one person as the overall incharge of the micro- hydel unit.

One interesting aspect of the project at Dassu is that once the village was electrified, VO members offered electric power to the Government rest house at Dassu. The offer, however, was turned down by the Resident Engineer and the Overseer. As a result, while the whole village of Dassu is lit at night, the rest house is the only place plunged in darkness !

## Recommendations For Dassu

The following suggestions were made by Arthur Williams, engineer and micro hydel expert: In

" A trashrack needs to be fitted to prevent sticks and leaves from blocking the turbine impeller. A trashrack on the inlet channel is preferred as this will not so easily become blocked as one directly on the end of the pipe.

The pulley on the generator should be replaced with one which has the correct bore to fit the shaft. The generator slip-rings should be cleaned with a fine emery cloth. The holes in the slipring covers should be covered over to prevent dust getting inside. The generator will not overheat as it is only producing 20% of rated output.

The pump should be fitted with a simple water splash-disc, in order to prevent water from entering the bearings.

In order to improve the voltage it is recommended that some of the incandescent lamps are replaced by 20 watt tube lights, which will reduce the overall load on the system."

## General Recommendations

### Spare Parts

As far as the maintenance of the unit is concerned, the most common problem faced by both VOs was the non-availability of spare parts when needed. Once the machine breaks down, it takes almost a week for members to purchase the spare parts from Skardu. One possibility is to purchase standard spare parts and store them in the village in order to avoid expensive, time consuming trips to Skardu. AKRSP can obtain good quality spare parts for onward sale to the VOs. This would eliminate the problem of sub-standard, low quality products generally available in Skardu.

## Training

One major problem is the lack of training course in basic maintenance and repairs. In both VOs, one or two people are familiar with the day to day operations of the machine but any major breakdown requires the services of trained experts. It is strongly recommended that a training course should be arranged for two or three VO members, refresher courses can also be arranged to update VOs on any new technology developments.

## Overall Design

According to Arthur Williams "the problem of low output of the generators could be overcome by the use of induction motors as generators with an overvoltage trip. These generators are less expensive than equivalent synchronous generators and can withstand much higher overspeed. This would enable the turbines to be run close to their maximum output improving overall efficiency by 2 to 5 times.

Improvements may also be made to turbine design by carrying out more detailed design calculations for each site, rather than relying on standard designs. The information is available with AKRSP engineers."

## Other Uses

Apart from lighting their homes, members seem unaware of other end uses the micro-hydel unit can be put to such as flour mills, saw mills etc. VOs should be encouraged to use the machine for other purposes besides electrification.