

SELLING LUMENS- A NEW APPROACH TO ELECTRIFICATION OF REMOTE VILLAGES

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SMALL HYDRO BACKGROUND

Hydroelectricity is among the most mature forms of the renewable energy. This source of energy caters around 20% of the total consumption of electricity world over. Most of the electric power is generated from large hydroelectric power plants. However role of Small Hydro Power plants for the population scattered in remote areas is significant. In China more than 18,000 MW of power of electricity is produced from thousands of small hydro units. While in India it is expected that small hydro locations identified so far, will produce only around 10,000 MW of electric power. Share of Uttaranchal in this figure is about 1500MW. Small Hydro System is defined as capable of producing electricity from 2 MW to 25 MW of power. This division is tabulated below:

Classification	Capacity in KW
Micro Hydro	Up to 100
Mini or Very Small Hydro	101 to 2000
Small Hydro or SHP	2001- 25,000

Micro Hydro Systems, which are designed for the output from few watts to around 20 KW, are called Pico Hydro Systems.

WATERMILLS or GHARAT IN UTTARANCHAL

Watermill is the oldest industry in the regions like Uttaranchal. As per the revenue records there were about 2956 operative gharats in Uttaranchal in the year 1922. This number increased and touched the figure of the order of 60,000 by the year 1960 but since then it is on decline and now, there are only 15000 gharats exist in Uttaranchal. Also, out of these, the number actually working is not even half. Some of the obvious reasons for this declination are:

- a. Less efficiency
- b. Only seasonal availability of water
- c. No versatility and monotonous job by nature,
- d. No standardization of parts, which hampers the repairs & maintenance and makes them expensive
- e. Expert persons not available for installation, repair & maintenance,
- f. Less revenue earning due to low speeds and hence unattractive for the youths.

However, it is also clear that there are more than 50,000 sites available in Uttaranchal which can be used for the installation of watermills or very small hydro (Pico hydro) electric plants.

CAPACITY OF WATERMILLS IN UTTARANCHAL

Watermills or Gharat or Ghatt are the ancient water driven systems, used chiefly to grind the grain for whole of the village requirement. Traditional watermills could produce power equivalent to around 3 KW, which if converted to electricity can deliver few hundred watts only. Whereas improved water mills with same water diversion, can produce as high as 5 KW of mechanical power which can be utilized directly for running different appliances or can be converted to electricity. But If watermill is designed with proper planning, technology and enterprise, many of these water mill sites can produce as much as 15 to 20 KW of power. It is important to note that, this much of power is sufficient for the lighting needs of a villages, particularly at higher altitudes in Uttaranchal. With the model proposed here, even 5 KW of electric power may be enough for about 50 households.

UTTARANCHAL POWER SECTOR PROFILE

Status of Electrification

As per the Survey Conducted by AHEC/ UREDA during recent past it was found that total villages which are un-electrified are 1125 in numbers, but this figure does not includes the small clusters of houses (Toks) which are still un-electrified and there are many other villages through which electricity HT line is passing but none of the house have taken the electric connection. So it is safe to conclude that there are at least 2000 community either un-electrified or having an un-acceptable level off availability.

(Tok or Thok are the cluster of houses situated near the main village, these are the part of village but may have distance more than one kilometer)

As per the website of Power Ministry, Government of India, power sector profile and status of village electrification of Uttaranchal, as on 31.05.2005, is given below:

Installed Capacity:	332.00 MW
State Sector:	974.55 MW
Private Sector:	0.00
TOTAL	1306.55 MW

Status of rural electrification, as per CEA data, as on 31.03.2005 is as under:

Status of Village Electrification

Total Inhabited Villages (1991 Census):	15681
Villages Electrified (As on 31.03.2005):	13783
Percentage of electrification:	85 %
Balance Villages to be electrified:	1898

Rural Household electrification (as per 2001 census)

- i) Total No. of rural households : 11,96,157
- ii) Households electrified : 6,02,255
- ii) % age of electrified rural households : 50.35%

REC financed programme

Cumulatively, REC has disbursed Rs. 348.18 crore as loan assistance to the State of Uttaranchal up to March, 2005. The cumulative sanction of loan assistance up to 31.3.2005 is Rs. 353.24 crores.

Kutir jyoti Programme:

Under Kutir Jyoti Programme of Govt. of India, cumulatively, grant amount of Rs.729 lakh has been provided to UP and they have reported release of 40450 Kutir Jyoti connections up to 31.3.2004. This programme is being covered under the AREP from the year 2004-05.

Electrification of BPL HH under AREP (RGGVY)

During 2004-05, a grant of Rs. 7.2 crore for electrification of 40000 nos. BPL HH was sanctioned. A grant amount of Rs. 3.6 crore was drawn by the state for electrification of BPL households during 2004-05.

(All above data has been collected from the official web sites of the Ministry of Power, Government of India)

CAUSES FOR NON-ELECTRIFICATION

There are around 2000 villages and toks that are still deprived of grid electric power. There are many reasons for this non-electrification. Major causes are given below:

- Remoteness and low population density of the region, makes the grid electrification economically unviable.
- In case of Uttaranchal, many habitations are situated at such remote locations that repair and maintenance of the existing lines is always a problem. Therefore most of the time quality of electricity is very poor. It is either not available at all or available at very low voltage.
- State of Uttaranchal is covered with dense forests but these forests restrict the entry of power lines for small villages within the forests. There are many villages that are not far away from the grid but due to their situation in side the forest, these are deprived of grid electricity.
- In many cases main villages are electrified by the grid connectivity but many toks associated with the village are neglected because of their distance from the village.
- Installation and Maintenance cost of grid lines at high altitude areas makes it a very expensive proposal.

NEED FOR VERY SMALL HYDRO PLANTS

- There are thousands of sites available which can be tapped for the production of at least 10 KW of electric power, just at the close vicinity of the villages or toks. None of the remote village in Uttaranchal requires more than 10 KW of electricity for their lighting requirements.

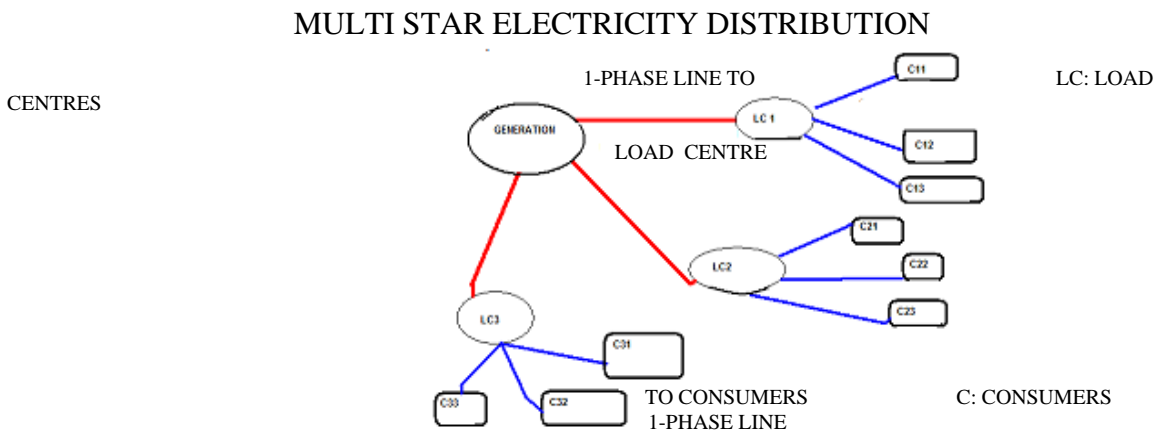
SALE OF LIGHT in PLACE of POWER- A new approach for economic viability of Electrification of isolated small communities.

All electricity utilities are charging fixed cost plus variable cost of consumed KWh, by the consumer. Where as to make the watermill based VSHP, more attractive and enterprising it is suggested that monthly charge from the consumer should be fixed on the basis of wattage of electric lights installed by him. This procedure of charging will compel the user to install high efficiency, high Lumen and low wattage lamps e.g. CFL. The CFLs can produce around 60 Lumens per watt; based on this, 9 watt CFL for domestic and 11 watt CFL fixture for street light would be enough for proper lighting.

Thus 3,000 Lumens will be more than sufficient for about 4 light points and can be made available at a fixed cost of Rs 100/- pm. Even including losses one KW will be enough for 10 house holds and 5 KW electric generation will generate a revenue of about Rs 5,000 pm. This is in addition to any other revenue from mechanical power use during day time.

Power Distribution and Revenue Collection Strategy

In low capacity power plants it is always desirable that misuse or theft of electricity is minimized. To achieve this goal, **multi star distribution** strategy should be adopted. Under this scheme, independent cables are laid from generation point to various load centers. At each load centre, a different person will be responsible for distribution of electricity to the households of that cluster and responsible for collection of monthly charge from each user. Each user will be fed with an independent line so that monitoring of individual load may be performed at each load centre and in case of any misuse or fault, the line of the particular consumer may only trip and other users may get uninterrupted supply. Use of lamps with different ratings or use of other appliances may arise, but one way of minimizing such problems would be to adopt a turn-key approach for house wiring with special holders and provision of efficient lighting sources is done by the cluster operator.



Under this scheme generation unit is not directly feeding to each consumers load, but there are suitable numbers of intermediaries exists who serve the each load with single phase line. This intermediary will get power in bulk and pay against that. Collection of revenue from the consumers and maintenance of fixed load to each consumer is his responsibility. This approach allows for fitting MCBs at power station and cluster centre , rather than in individual households.

Additional Income: Installation of additional equipments may be another source of income. Since VSHP will be used for lighting during the nights only hence mechanical power so generated during days, can be used for other purposes such as power looms, rice huller, oil expeller, cotton combers or wooden lathes etc.

Extension of Supply

Most of the rivulets/ rivers at high altitude are capable of running more than one watermill within a span of around 1 Km. There may be a few such installations which can be used in synchronization with each other and bulk electric power can be sold to other nearby locality. For this the concept of **Local Grid** of 400/230V potential will come into consideration.

Larger plants

For plants generating 50KW or more, the plants should be operated by a community group as individual operator may not be able to have the resources for it. This group will enter into arrangement with Power Corporation for buying and selling of Power. It will also sell power to individual entrepreneurs in each of the villages in the neighbourhood. These, in turn, will work on the model proposed for small plants.

REQUIRED SUPPORT FROM GOVERNMENT

To begin with Central / State governments can do the following:

- Modification in Electricity Act and Rules to accommodate installation of very low power electricity generation and distribution within certain area, possible.
- Modification in water act,
- Realization of Local Grid at low voltage,
- Identification of at least 50 sites suitable for producing 15 KW to 20 KW of Electric power with least civil work requirement.
- Installation and commissioning of at least two such systems in two divisions of Uttarakhand to demonstrate the utility of such power plants.
- Standardization of core equipments such as Turbine, Generators and Load controller suitable for production capacities up to 20 KW only.
- Standardization of high lumens low wattage luminaires.
- Identification of two organizations, in two divisions to train the interested youths willing to undertake such enterprise.

REPAIR AND MAINTENANCE

At least two organizations are required in Kumaon and Garhwal regions of the Uttarakhand state to undertake major work of repair of such installations. The trained owner cum operators will do minor repairs and routine maintenance. A list of spares will be prepared and substantial numbers of spares will be kept at the plant site so that un-interruptible supply may be assured. Once the equipments, plant & machinery are standardized, repair and maintenance problem will reduce further. Modular approach for electronic parts will be adopted so that modules can be kept in stock for ready availability.

SUMMARY AND CONCLUSIONS

In brief, it is worth considering a model for electricity for lighting purposes only which will also be economically viable. The proposal made in this paper needs to be experimented with by actually establishing 2 or 3 such plants with government support. As expected, if the approach appears viable, some extension and publicity work will also need to be done. A proposition which can generate a net income of about 3,000/- Rupees per month should find a good response.

SOURCES/ REFERENCES:

1. Renewable Energy (*Akshay Urja*) : Bi-monthly magazine from Ministry of Non-conventional Energy Sources; Sep-Oct-2005
2. Information Technology Development Group (ITDG): Paper available on the Web
3. Upgrading Traditional Watermills: Web publication of Water Millers Manual
4. Hydronet: Different issues of magazine dedicated to Small Hydropower
5. Luminares: Luminares Manual of Philips India
6. Electrification of Un-electrified Villages: Survey Report of AHEC (IIT R) / UREDA
7. Management & Operational Manual for Micro-Hydropower Plants: Publication of ICIMOD, Nepal