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Report on a Three Week Mission in Sagarmatha National Park World Heritage Site, Nepal

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Namche Micro Hydro Project Activities

Introduction / Summary

Upon arrival at the project site in early November, 1984, the Namche Micro Hydro Project had been shut down for a period of four months due to marginally low water flow. In July, electrical demand had exceeded the maximum capacity under current water flow conditions by only a few hundred watts, causing the low-voltage relay to reject the load, up to a maximum of five times per night. The Sagarmatha National Park warden and the Electrical Management Committee decided to shut down the facility pending an increase in water flow, in light of consumers' inconvenience in the lighting and extinguishing of kerosene lamps, and the difficulty of encouraging consumers to switch off unneeded lights, to reduce load.

The consultant's arrival roughly coincided with an increase in flow of the Namche spring, and the system was placed back on line without modifications or technical problems. The equipment was checked, the powerhouse operation and maintenance logs were inspected, and discussions were held with the Warden, Electrical Management Committee members and consumers. These observations and discussions yielded information that should be pertinent and valuable to planners, managers, and operators of similar small rural power stations, and are summarized in the Conclusion.

110 low-wattage light bulbs were donated by the Philips Co., and were installed in Namche households. A volunteer survey assistant arrived to collect and collate data on load usage, firewood savings and social impact of the facility. Discussions were held with the staff and engineers of the Thamo 700 kilowatt hydel project concerning underground wiring and intertieing with the Namche grid. Measurements for a solar-powered electric fence were made, and equipment procured. Construction of a stone wall reforestation enclosure was completed.

Low-wattage light bulbs installed

The Philips Company of Holland donated 110 Philips "SL" 9-watt light bulbs and 39 18-watt bulbs to the project. These were transported to the site and installed over a period of one month. The Electrical Management Committee decided that the consumers would have a choice of one 18-watt bulb or two 9-watt bulbs per house, and established a rate for their use based on

light output in comparison to incandescent bulbs, and on expected gross income. Consumers have been universally pleased with their brightness. Most importantly, the bulbs have yielded a savings of 3.6 kilowatts capacity (while simultaneously providing more light), more than sufficient to preclude overload from monsoon low water conditions, even in the case that this is more severe in future years. During March and April of 1985, previous to the installation of the new "splitflow" turbine, the system was operating at full voltage and frequency, with load demand below capacity. Only three residences in Namche have not been wired for lighting load. The Philips Company has obligated an additional donation of 48 SL 9-watt bulbs, to complete the conversion from incandescent to flourescent of main-room lights for all 115 houses, which will further save electrical capacity.

The Philips bulbs have demonstrated remarkable operating characteristics, and they or similar products deserve full attention in the planning of rural electrical systems in particular. Most notably, based on their current quoted delivery cost to a remote location in Nepal and assuming continuous replacement of bulbs over a thirty year period (the estimated lifespan of a rural power facility), their savings yield in terms of capacity was found to be equivalent to $ 946 US per installed kilowatt.

Other important advantages of Philips bulbs over flourescent types of Indian manufacture are:

1) Flickering and dimness do not occur even with relatively extreme fluctuations in voltage and frequency (they were found to retain original characteristics even at 170 volts and 39 hz. frequency).

2) They are rated to last 5,000 hours.

3) They emit a soft, pleasant light.

4) Observers agree that an 18-watt bulb yields a light output similar to a 100-watt bulb of Indian manufacture, higher than the Philips Company rating.

The economic advantages of these bulbs are calculated in Appendix I, copies of which have been distributed to the SHDB, the Butwal Engineering Works, the Ministry of Water and Power Resources, the Philips distributor in Kathmandu and other interested parties that have expressed interest.

New turbine

Perhaps the most encouraging development during the mission was the world premier of a new design of turbine, the "splitflow", designed by Swiss mechanical engineer Alex Arter and built at the Balaju Yantra Shala, Kathmandu. The splitflow, a variation of the crossflow, utilizes a primary horizontal axis runner which splits the entry canal flow and deflects it to a secondary runner fixed on the same axis. Mechanical efficiency is theoretically improved because the profile of the blades of each stage can be independently optimized -- the crossflow must necessarily compromise its blade geometry. In order to test this new design at a small site with the

highest available head, Namche was selected. The Department of National Parks contracted to fund transportation and labor costs ($2,010 US), with the agreement that BYS would increase power capacity (at identical flow) by a minimum 10%.

A V-notched stream flow measuring weir was erected in the tailrace to measure discharge, first with the old turbine. When the new turbine was tested at identical discharge, after some on-site modification, it produced a surprising 80% increase in power. Part of this power increase was due to the lower design discharge of the new turbine (turbine efficiency increases as the flow approaches the design discharge). At design discharge, the new turbine yielded about 80% + 2% mechanical efficiency, compared to 68% maximum efficiency for the original turbine. It is expected that the splitflow design will attract worldwide attention among small and micro-hydroelectric power specialists. The consultant and BYS mechanical engineers are now preparing an article describing the test results and experience with the Namche splitflow turbine, for Water Power and Dam Construction Magazine. The splitflow will also be featured at an international small hydro conference in Hangzhou, China in April, 1986.

Maximum capacity of the new turbine was measured at 32 kilowatts, at a flow less than 5% above the average winter flow. At a flow that has remained constant for 7 months, 28 kilowatts was measured. It is estimated that the absolute minimum monsoon (low) flow should generate at least 22 kilowatts, double the capacity of the original turbine during the previous monsoon. Additional load is now carefully being installed, taking into account future load demand. Most importantly, it is clear that with the increased firm power capacity, resulting revenue increases will allow the facility to operate in the black, with 10-20% retained for long-term maintenance. An important reason why the cooking grid was not operated for much of 1984 was that at the perceived market value of electricity for cooking, there was not enough capacity to do more than cover the operators' and assistants salary. Villagers are now allowed to have more lights, with no rate increase forseeable.

Management and operation

A meeting of the Electrical Management Committee was held, chaired by the Warden, and the following issues were decided upon:

1) A per-month, per-bulb rate schedule, based on wattage. The operating cost of a 60-watt (or 9-watt SL) bulb now compares to that of a small kerosene wick lamp.

2) A stiff penalty schedule was suggested and approved, covering tampering, thievery and late payment of bills. A rule was passed that the operators must show sufficient cause for any shutdown.

3) It was recognized that although kilowatt-hour meters would theoretically allow consumers to save money by turning off unneeded lights, the project was only barely profitable (and designed to remain so, through rate adjustments); thus, income sufficient to recover expenses would have to be

recovered regardless of any possible savings to individuals.

A new manager for the electrical facility was trained and hired half-time. He also keeps the books for the Tyangboche Cultural Heritage Committee.

Electrical cooking stoves and heaters were again plugged in at five locations, and operated without technical problems. Virtually all of the stove operators complained that the stoves were difficult to use because their temperature was not adjustable. When it was explained that temperature-controllable stoves are available, but would cost about Rs. 1,800/-, as compared to Rs. 100/- for a set, most respoonded that it would be worth it if they are truly controllable. All expressed a desire to see and try such stoves. Recommendation was made to the Warden that a system for the purchase of standardized controllable stoves be arranged, for resale to the stove and heater line consumers.

Because of the severe cold in the SNP headquarters during the winter, it is hoped and projected that the office heaters will actually improve productivity of the office staff, who are often unable to remain in the offices for extended periods. Because many of the headquarters buildings are well-sealed, it can be dangerous to operate charcoal braziers, their traditional heating source, without proper ventilation.

In April, Namche saw the introduction of a commercial video "parlor" at a centrally-located lodge. Warden Lhakpa Norbu enjoined that under no circumstances will video be allowed to operate from the Namche electrical grid. The video operator now powers his system from a portable petrol generator. The video appears to be having a profound effect on Namche youth in particular, and officials of the Northern Border Area Administration are reviewing its operation and licensing. In one form or another, however, video may be there to stay. It should be noted that there is no indication of a causal connection between video and the advent of electricity. In other relatively wealthy rural areas where electricity was not supplied before 1981, video entertainment generally arrived first.

Survey assistance

In the spring of 1985, a student of the School for International Living, M.E. Valyo, volunteered to assist the project by conducting two surveys and two measurement studies relating to villagers' adaptation to electricity (and video) in Sagarmatha National Park. Her report on this study is currently in preparation, and will be forwarded to UNESCO for attachment to this report as an appendix. This study was not intended to be comprehensive, nor is it rigorously scientific, but it does address issues that have been of interest to visitors and park management personnel, and may be relevant to similar development projects in environmentally or culturally unique areas. The data and findings from these study and survey topics are summarized below, with a brief introduction describing their objectives and methodology.

Survey Topic 1: Tourist Survey

100 tourists were interviewed to elicit their impressions of how electricity in Namche affects their appreciation of the area, whether or not overhead lines (planned by the SHDB project in Thamo) would affect their decision to trek in the area, and whether they would be willing to pay a higher entrance fee to the park if the proceeds could be earmarked for underground wiring. The question on their views on the impact of a recently-installed commercial video parlor generated the greatest number of responses, which will be summarized at greater length in the report by Ms. Valyo. The profile of interviewees included a majority of U.S. citizens (the most common country of origin of trekkers, though normally less than 30% of the total tourist profile):

USA	57
Australia	9
Canada	7
Norway	7
Switzerland	4
Other	16

1) "If you were planning to trek in Nepal and you knew that there were overhead power lines in the Everest area, would this affect your decision to trek there?"

- no	37
- yes	19
- yes, but I'd still come	26

2) When asked whether or not they would be willing to pay an additional Rs. 10/- ($0.55 US) or more for the entrance fee, virtually all those questioned agreed that they would. An increase in income of Rs. 60,000/- per year from 6,000 tourists would be nearly sufficient to support the additional cost of underground electrical cable for the SHDB project in Thamo (see the attached revised cost estimate for underground cable for this project, Appendix II). Some additional comments: "I'd pay more than Rs. 10/- for underground power lines and litter collection." "Yes, if it were explained why an additional charge were being levied." No, underground power lines are Nepal's responsibility, not the tourists'". "I'd pay Rs. 10/- to not have electricity at all." "I would normally say no, but I see how much they need electricity and deserve it." "I would rather pay to have electricity expanded to other places."

3) Do you stay up later in Namche because there is electricity until 10 p.m.?

- yes	38
- no	45
- (haven't stayed overnight)	17

4) What effects do you think video will have on Sherpa culture and the residents of Namche?

- bad	45
- good	4
- its inevitable	20
- its their decision	18

Note: This question generated the greatest amount of discussion. Most comments reiterated that video (primarily Hindi cinema) will inexorably lead to gradual degeneration of Sherpa culture, they may become lazy, it is expensive, etc. A fair number added that whether video should stay or go should be their decision. The handful of respondents replying that video could be beneficial mentioned that it may keep young people from moving away from the village, and that it can have educational value.

Conclusions

It appears that the majority of trekkers planning to come to Sagarmatha National Park would continue their plans regardless of overhead power lines, but comments generally suggest that they would be saddened by the visual blight. 20% claimed they might change their plans, which could have significant economic impact. It would be useful if a methodology quantifying the economic impact of aesthetic blight (and video) could be developed, perhaps as part of an anthropology or economic study.

There does appear to be interest in, and a noticeable lack of objection to the concept of increasing the National Park entry fee if further services could be provided and the environment perhaps better protected. However, administrative and legal considerations concerning entry fees might preclude the possibility of rate structure changes in the near future.

Most trekkers in Namche stay up later than they do at other overnight stops along the route, but this circumstance may be skewed by the social and more developed nature of the town itself. One woman who had been in Namche in 1979 said that trekkers stayed up just as late and were just as social then as they are now.

The trekkers in Namche generally do not watch the Hindi cinema programs shown on the private commercial video, and are concerned with its impact on the culture. They are relieved to hear that video is not a direct product of electricity in Namche, as the video owner does not have permission to operate from the electrical grid.

Results from this, or hopefully a more comprehensive study would be useful in attaching a monetary value to aesthetic concepts, if possible.

Survey Topic 2: Villager Survey

50 heads of Namche households were interviewed with questions relating to how their habits have changed since the introduction of electricity, and

their views on the effect of electricity and video on Sherpa culture. As one would expect, objective answers were not always provided, but the anecdotal comments collected in the course of this survey do shed light on villagers relationship with and adaptation to electricity and video. The issues surrounding video in particular that villagers mentioned are under discussion by the warden of Sagarmatha National Park and the Border Area Administration Office staff in deliberations on what control, if any, should be applied to commercial video parlors.

1) In your opinion, since electricity has come to Namche, have there been many changes?

- many changes, very different	25
- no changes	7

Notes: In general, most people answered that "the lights are good".

2) What changes has electricity brought?

- easier	14
- no changes	14
- brighter	12
- cheaper	6
- cleaner house	6
- children read more	1
- kerosene has become cheaper (?)	2
- can work longer at night	2
- village has developed	2

Notes: One of the village blacksmiths stressed that the electric lights are especially useful for him, since he very often works until late in the night, and his work is of fine enough detail to require a good lighting source. He also mentioned that since the lights are turned off at 10 p.m., he still needs to use kerosene to work by. One villager responded that "electricity is change".

3) Are the changes good or bad?

- good	40
- no changes	10

Notes: A couple of villagers responded that they still need to use kerosene after the lights are turned off, and one villager complained that the (subsidized) wiring installation charge was too high (-- shortly after installation in his house).

4) With electricity, do your children now study more?

- study less	0
- study more	31
- (no children or too young/old)	17

Notes: Some villagers responded that the light from kerosene mantle lamps is bad for their children's' eyes.

5) Do you think that electricity wires are better placed overhead or underground?

- underground	33
- above ground, on poles	3
- doesn't matter/ don't know	14

Notes: A summary of some of the villager comments: wood poles waste wood; poles allow street lights (good); poles give Namche more of a feeling of city life (good); poles are difficult to maintain and possibly dangerous to children; the electrical lines in Kathmandu are a mess. Underground lines are better because the scenery is not affected and they are safer.

6) Are electric lights cheaper or are kerosene lights cheaper?

- kerosene cheaper	8
- electricity cheaper	33
- the same	5
- don't know	3

7) Since electricity has come, do you go to sleep earlier or later?

- later	7
- earlier	1
- same time as before	20

Notes: "Since there is a fixed rate for electrical consumption, I should stay up later to get my money's worth." "I always go to bed late, and wish the lights would stay on longer to work without using kerosene."

8) What else might electricity be good for, other than lighting and cooking?

- nothing	16
- radio	4
- mixing machine	1
- sewing machine	1

9) Do you think that for tourists above-ground lines are better, or underground?

- underground	24
- above-ground	3
- doesn't matter/ don't know	23

Notes: The far western side of town sees fewer tourists than the center of town, and the bulk of the "don't know" answers came from this side.

10) Do you think video is a good thing for Namche?

- good	11
- bad	21
- too expensive	12
- don't know what video is	13

Notes: A summary of villagers comments on the new video "parlor" in Namche: "It is good for the young, but not for the old." "At least people here can see something." "It is too expensive for us to see it." "It will be bad for the village girls; they will marry outside of the Sherpas." "Now, children stop me on the trail and beg money from me so they can see video." "Buying food is better than paying for video."

11) Do children now study more or study less, due to video?

- study less	20
- study a little bit less, perhaps	3
- don't study less	2
- study the same	4

Notes: Summary of villager comments on the effect of video on studying: "Now with video, they don't work, either." "I won't give them money to go." "If I don't give my children money for video, they refuse to go to school."

12) Do you think that video in Namche has had an effect on Sherpa society and culture?

- yes	5
- no	10
- bad effect	8
- don't know what video is	13

Notes: "Video is bad for our culture and economy." "Once a month would be fun, but every night is too much." "Children steal money to see video." "Children now imitate all the cinema actors, and don't do traditional things such as dancing." "Sherpas will be happier with video" (19-year old girl).

Conclusions

Villagers are pleased with electricity and noted few substantive changes beyond convenience and saving. Some informants volunteered that their children study more with electricity, and informal observation indicates that there is more space available for studying, with less eyestrain.

It is noteworthy that many Sherpas appreciate underground wiring, if only because they know that foreigners prefer it. Most have seen dangerously-strung lines in Kathmandu. For most villagers, electricity is cheaper than or competitive with kerosene. Only in houses burning a single wick lamp does kerosene compete with electricity for lighting. Interestingly, this is at an electrical consumption rate double that of Kathmandu, or $0.11 US per kilowatt-hour, a high rate anywhere in the world.

Most Namche residents claim they do not stay up later at night due to the electricity. Interestingly, there were few creative suggestions for productive (non-domestic) uses for the load other than cooking. This indicates that there should be few competing interests for the use of the daytime electricity, a convenient situation since the project was designed for cooking. The SNP management will continue to control productive uses of the grid electricity.

Also, despite the near-universal attraction of video throughout Asia, elder Namche residents are divided and somewhat pessimistic about the advent of video movies, mainly because of the recognized impact on the study habits and culture of Sherpa youth.

Study Topic 1: Wood Consumption

The curtailment in the supply of electricity during the installation of the replacement turbine afforded an opportunity to weigh the amounts of firewood consumed for cooking and heating when no electricity was provided, and again when it was, to determine the amount of firewood saving. Two lodges with cooking electrical supply were chosen, and their firewood weighed over a period of three days with electricity and three days without. Variables such as the number of hot showers provided, the number of trekkers staying in the lodge and special cooking needs were also recorded.

It was found that roughly 15% less firewood was consumed when electric cookers were provided. This figure should not be taken as an indication of the firewood-replacement capability of electric stoves, however, for two reasons, discovered during the course of this study: 1) The lodge owners were still not fully comfortable or familiar with the operation of the stoves (they were not operating for much of 1984), and were reluctant to use them for cooking foods where their initial try had been unsuccessful (burned food, etc.). 2) The large cooking demands Namche lodges require that stoves be temperature-controllable, as in effect their firewood stoves are.

Study Topic 2: Kerosene Light Enumeration

A methodology was also developed to roughly gauge whether Namche residents are staying up later on nights when electricity is provided than on nights when there is no electricity. This information would be useful in indicating, though not conclusively, whether or not more or less firewood is burned domestically, assuming the validity of the speculation that as residents stay up later, they burn more wood to keep warm. Namche residents generally do not switch off their lights when they retire for the evening, so it was not possible to merely count, at various hours, the numbers of houses with lights burning. Nor was it practical to investigate the houses individually. As a rough measure, the number of houses were counted with kerosene lights burning, (from two vantage points), for five nights when electricity had been provided until 10 p.m., and again for five nights when no electricity had been provided at all (during replacement of the turbine). Enumeration was done at 10:15 p.m. on all nights. For the results of this

counting to be significant, it was necessary to make three assumptions: 1) that the number of non-electrical (kerosene) lamps burning is roughly proportional to the number of residents who have not retired for the evening, 2) that firewood is not burned (to keep warm) when residents have retired, and 3) the difference between those who retire at 8 p.m. and those who retire at 9:45 is disregarded. Because of the high cost of both kerosene and firewood, and traditional Sherpa habits, these assumptions are reasonable but may suffer from a significant margin of error.

The survey results showed that a total of 127 non-electrical lights were counted at 10:15 p.m. over five consecutive nights when no electricity at all had been provided, and a total of 117 were counted under the same conditions on five consecutive nights when electricity was provided until 10 p.m. There was a margin of error of about 20% due to weather and other factors.

Because of the small sample size, lack of control over some variables, and the weakness of the assumption that the counting of lights at 10:15 p.m. would indicate whether the bulk of the villagers were staying up later or not with electricity (e.g., it would not show whether residents who normally retire at 8:30 p.m. are now staying up until 9:30 p.m.), the results of this brief study cannot be considered definitive. On the other hand, they indicate that no more residents stay up later than 10:15 on nights with electricity than on nights without, corroborated by the villager survey. It was noted by many Namche residents that the lights have added order to their lives, "telling them when to go to bed". One of the most noticeable effects of lights on the village has indeed been how it has brought about a routine to retire at 10 p.m., including those who might normally stay up later, according to several villagers. Once the lights have gone out at 10 p.m., it is generally too late to think of lighting additional lamps. The lights are blinked from the powerhouse as warning each night at 9:50 p.m.

III Other Activities

Electric fencing

In the wake of news of the successful application of solar-powered electric fences for wildlife and domestic livestock control in India, the SNP headquarters compound at Mendelphu was measured for a prototype fence. The compound is 1.5 kilometers in circumference, and the existing wires and posts can largely be utilized with the addition of insulators. The World Heritage Fund-donated solar photovoltaic cell panel will power the fence charger (as well as the 2-way radio), to be donated by the Himalayan Trust.

There are several advantages of solar-electric fences over other alternatives, with few disadvantages:

1) One solar cell panel is sufficient, under proper conditions, to electrify over 50 kilometers of fence with enough charge to deter livestock and large predators,
2) In the case of a fault or a break in the fence, a staff person can see

this immediately upon checking the power source, and quickly determine the point of the fault. In SNP and other national parks of Nepal it can be difficult to get staff to walk the full length of a stone fence that may or may not be broken.

3) Although not a "traditional" fencing material, in terms of their aesthetic impact, electric fences are virtually invisible from a distance. Because they need not provide a mechanical barrier, fewer posts and fewer wire strands are needed.

4) The fences can consequently be moved much more easily than a stone wall. Once reforested seedlings have reached a height at which they are no longer endangered by livestock, the fence can be easily moved to an adjacent area for continued reforestation.

5) They have been proven safe, and yet are also somewhat effective at detering human access.

6) a large electric fence can be installed for 1/4 to 1/2 of the cost per running foot of stone barrier.

It is hoped that these advantages, particularly low cost and effectiveness, will allow the Parks Department to fence greater areas for reforestation in other parks and reserves, as well as SNP. An innovative approach for the introduction of electric fencing is to be proposed in Royal Chitwan National Park: A prototype fence will be given to a local farmer immediately outside the park boundary, to protect his herd from wild predators. Once he and his neighbors can see how effective and safe the fence is, it will be used for surrounding critical areas of the park itself. This strategy will hopefully mitigate a possible negative reaction toward the park among villagers if a stinging electric fence were to be erected, without their involvement, along the park boundary.

Thamo hydroelectric project

As follow-up to a letter of inquiry from the Director General of the Parks Department, discussions were held with the director and staff engineers of the Small Hydel Development Board concerning their plans for electrical distribution from the Thamo project to the villages of Thamo, Thame, Kunde, Khumjung, Namche and the Hotel Everest View. Surveys for the transmission and distribution lines have been completed, and installation of these lines is scheduled to begin within the next few months. It is apparent for technical reasons that the high-voltage transmission lines must be placed above ground. However, specifications for village distribution were provided by the SHDB to the consultant, and a cost estimate for underground distribution was prepared, based on experience from the Namche project and current retail materials prices (see Appendix II).

This conservative calculation shows that underground distribution can be achieved for an additional cost of not more than 2% of the total project cost. This does not include the advantages of safety, reduced maintenance and reduced opportunity for thievery. Conservative monetary values are

assumed for these latter benefits, and it is clear that underground electrical distribution would pay for itself within the first ten years of operation, likely much sooner.

Consulting engineers from Austria mentioned that they had urged the consideration of underground cables since the project's conception, and confirmed the validity of the revised cost estimate. The budgeting and decision for this part of the project, however, are under the SHDB, and they have not had prior experience with underground wiring elsewhere in Nepal. The ultimate approval for additional funds will need to come from the Finance Ministry, and may encounter difficulties as the project is already severely over budget. This consultant, The Parks Department, the Warden of SNP, a private Austrian filmmaker and others are still encouraging its approval.

Overall Conclusions

This mission elucidated several points concerning the operation of a rural electrical facility and consequent social impacts. Many of these observations may superficially appear to be "details", but they are details which have been, yet cannot afford to be, overlooked by development planners approaching a site with economics, effectiveness and aesthetics in mind.

1) Powerhouse operators for micro-hydroelectric systems can be trained locally, even if they have had no prior experience with electricity. Choosing local operators improves the chances for success of the system, as they retain the pride of being the operator, and are personally accountable to their own villagers (and relatives) if there is any operator error.

2) Local management of a micro-hydro facility can in fact work. Villagers and committee members are especially appreciative of the features of this:

- they control the destiny of the system (with the caveat that many are not always certain that they can),

- the books are open to anyone who has a question about the utilization of funds,

- the price per unit of electricity can be based precisely on the amount needed to recover operating and maintenance expenses,

- if operated at a profit, excess income can be used for village development projects.

Perhaps the major unvoiced reticence to undertaking local management is the political vulnerability of the body that enforces the regulations. The Pradhan Paanch (mayor) of Namche appeared to be reluctant to push for stiff regulations, realizing that he could be placed in the difficult position of having to enforce them. It was recognized by all, however, that strong regulations and penalties were essential to keep electrical use violations

from escalating out of control.

3) Micro-hydro systems that are designed for a fixed cooking load (to reduce governing problems and maximize load factor) will face the practical problem of consumers having to cook on a stove that is not temperature-controllable. In Namche, this has led to poor adoption of the stoves as an alternative to firewood. Controllable stoves of minimum two kilowatts each are essential if electrical cooking is to replace the firewood hearth. This point should be of particular relevance to the 700 kilowatt Thamo hydel project, as cooking will be their primary daytime load.

4) For rural locations such as Namche Bazaar, where transportation of utility poles is difficult and labor is relatively cheap, underground cable can compete with overhead wiring for electrical distribution. Other advantages of underground distribution such as preservation of aesthetic values, safety, reduced maintenance and reduced opportunity for thievery make underground wiring profitable in the long run. Namche has suffered virtually no thievery (although this would be difficult to compare, as there are no meters to steal from).

5) For Namche in particular, and presumably for other cosmopolitan (wealthy and heavily-touristed) rural villages in Nepal, electricity for lighting alone appears to have had little social impact. Villagers stress the improved convenience, and there have been few problems with lack of payment of electrical bills.

6) Far greater than the impact of electric lights, commercial video (showing Hindi cinema) has had a profound effect on Namche, and may grow as a divisive element, as many now recognize it.

7) The installation of overhead electrical lines in Sagarmatha National Park could possibly effect tourism negatively, and villagers were split between those not caring about it and those not in favor of it.

8) Namche villagers do not appear to stay up later at night now that electricity has been provided until 10 p.m.

9) Villagers did not use the fixed-load (non-tempertature-controllable) stoves provided at the beginning of the Namche Micro Hydro Project for the bulk of their cooking needs. Most stressed that they would be much more inclined to use them if the temperature was controllable. This point is especially important in light of the electricity to be provided within the next few years by the Thamo 700 kw project. Experimentation and fine tuning of specific types and brands of economical electrical hotplates should be conducted as soon as possible, as the SNP staff has recognized. This may be a relevant study for a home economist.

10) Low-wattage, long-life, high-performance light bulbs such as the Philips SL can potentially revolutionize small, isolated electrification designed for lighting as the primary load. Even at current retail costs and including financing over time, they are economical for consumers, and can make small hydro sites economical that would not otherwise be so.

The cost-effectiveness of Philips SL light bulbs compared to Indian incandescent bulbs of equivalent lumen output

Assumptions:

1) That the value of money (interest) is calculated at 12% per annum,

2) that equivalent light quantity (lumens) from different light sources has equivalent monetary value to consumers; based on villagers' observations of light equivalency, 9-watt Philips bulbs are compared to 60-watt incandescent Indian bulbs and 18-watt Philips bulbs are compared to 100-watt incandescent Indian bulbs,

3) that the bulbs are used only 5 hours per night (additional hours per night would improve their cost-effectiveness),

4) The current retail cost plus airfreight of bulbs from Holland to Namche (no duty) is based on the attached quotation from the Philips dealer, Kathmandu (1 Hfl. =Rs. 5/25 NC),

5) Although Philips SL bulbs are specified in this Appendix, they may be substituted by any product of like quality.

Specifications and cost figures:

	Phil. 9-w	Phil. 18-w	Inca. 60-w	Inca. 100-w
lifespan (hours):	5,000	5,000	833	833
actual wattage consumption:	13w	24w	60w	100w
retail cost in Rupees delivered to site:	138	140	10	10
holder cost, delivered:	13	13	7	7
total initial cost plus foregone interest on investment at 12% p.a. compounded quarterly for 3 years (reduced by delayed costs in the case of replacing incandescent bulbs only):	209	213	84	84
Adjusted monthly capital cost of bulbs:	5.81	5.92	2.33	2.33
monthly electrical bill per bulb at below-listed per-unit rates, in Rupees:				
-/80	1.44	2.88	6.67	11.11
1/--	1.81	3.61	8.33	13.89

monthly electrical bill per bulb at below-listed per-unit rates, in Rupees:

1/20	2.17	4.33	10.00	16.67
1/40	2.53	5.06	11.67	19.44
1/60	2.89	5.78	13.33	22.22

Present adjusted operating cost of Philips bulbs as a percentage of the present adjusted operating cost of incandescent bulbs at the below-listed rates per unit:

	9w Philips / 60w incandes.	18w Philips / 100w incandes.
-/80	80%	65%
1/—	71%	59%
1/20	65%	54%
1/40	60%	50%
1/60	56%	48%

Calculation of the value of 1 kilowatt capacity equivalent saved by the installation of Philips SL 18-watt bulbs:

3-year adjusted cost of a Philips 18-watt SL bulb:	Rs. 213/-
3-year adjusted cost of an incandescent 100-watt bulb:	84/-
Additional initial cost of Philips bulb over incandescent bulb, 3-year period:	Rs. 129/-
Adjusted additional expense required over a 30-year period to maintain (not operate) a Philips 18-watt bulb as an alternative to an incandescent 100-watt bulb:	Rs. 1290/-
Kilowatts saved per bulb:	.074
Number of bulbs needed to save 1 kilowatt of capacity:	13.5
Rupees needed to maintain 13.5 Philips bulbs, to save 1 kilowatt of capacity over a 30-year period:	Rs. 17,415/-

Dollar value of 1 kilowatt capacity equivalent savings

from Philips 18-watt SL bulbs ($1.00 US = Rs. 18/40 NC): $ 946

Note concerning the latter figure:

1) No salvage value is assumed for the Philips bulbs at the end of the 30-year period.

2) The adjusted additional expense of maintaining the Philips bulbs includes a 12% p.a. value of money (foregone interest, compounded quarterly).

3) This figure assumes a 5-hour nighttime lighting load.

4) This figure is compared to the capital cost per kilowatt of generation, but additional savings will also be realized in transmission and distribution through the subsequent use of lower-capacity lines and switchgear.

Conclusions

It is apparent from the above calculations that, for consumers of small rural electrical supply systems in Nepal, Philips 18-watt SL bulbs are economical when compared to incandescent bulbs of equivalent lumen output, even at electrical consumption rates of less than 80 p.($0.04) per unit (artificially low), and even if the additional initial cost of the bulb is covered by money borrowed at 12% per annum.

Further, planners of rural electrical systems dependent on a nighttime lighting load (the rule for most small systems in Nepal) should note that the inclusion of Philips bulbs or their equivalent in project planning can effectively "add" capacity at a capital cost of $ 946 per installed kilowatt. This can perhaps be achieved by requiring their use exclusively and subsidizing or financing their sale through an adjusted rate structure. For small and micro-hydroelectric systems, this is especially critical and useful at sites where available water would not normally be sufficient to meet minimal lighting needs. Partial lighting of a village (i.e. unequal distribution) is not generally feasible, politically. Thus, such bulbs have the potential to make many more sites, such as small streams adjacent to villages, technically, economically and politically feasible. As part of a petrol or diesel-powered lighting system (expensive throughout Asia), Philips SL bulbs will pay for themselves in a very short time.

APPENDIX I - 4

Bhajuratna Engineering & Sales (P) Ltd.

(Incorporated In Nepal)
Sole Distributor of Philips Products

Jyoti Bhawan
P. O. Box 133, Kantipath
Kathmandu, Nepal
Tel : 211490, 214327
Telex: 2264 JYOTI NP
Cable: BESMANI, KATHMANDU.

PHILIPS

Ref. 05B1/H/06-SNP/412

Date 24-01-1985

The Sagarmatha National Park,
Nepal.

1 Hfl. = 5/07 Rs. N.C.

Quotation
SL Lamp

1. SL18W Prismatic

Description	Qty.	Unit Pr. Hfl.	Total FOB Pr. Hfl.
SL18W Prismatic All versions	204	21.00	4284.00

Estimated seafreight including insurance to Calcutta for 204 pcs. SL lamp 18W — Hfl. 425.00 @ 117/

Estimated airfreight including insurance to Kathmandu for 204 pcs. SL lamp 18W — Hfl. 1100.00 @ 133/

2. SL18W Opal

Description	Qty.	Unit Pr.	Total FOB Pr.
SL18W Opal All versions	204	21.66	4418.64

The freight is as stated above.

Terms and conditions:

1. Price: The price quoted is based on FOB in Dutch Guilders.
2. Validity: Until the end of February 1985 there-after subject to our Principals' confirmation.
3. Delivery: (i) For 220V E27 versions (screw mount) - 6/8 weeks
   (ii) For 220V B22D versions (bayonet-pin mount) - 2/3 months.

(Co.2)

Photo Nos. 1-4: Technicians from the Balaju Yantra Shala, Kathmandu, engineering institute install the new "splitflow" turbine in the Namche powerhouse, after having removed the original turbine and draft tube. Electrical supply was curtailed for 5 days during this operation.

Photo No. 2

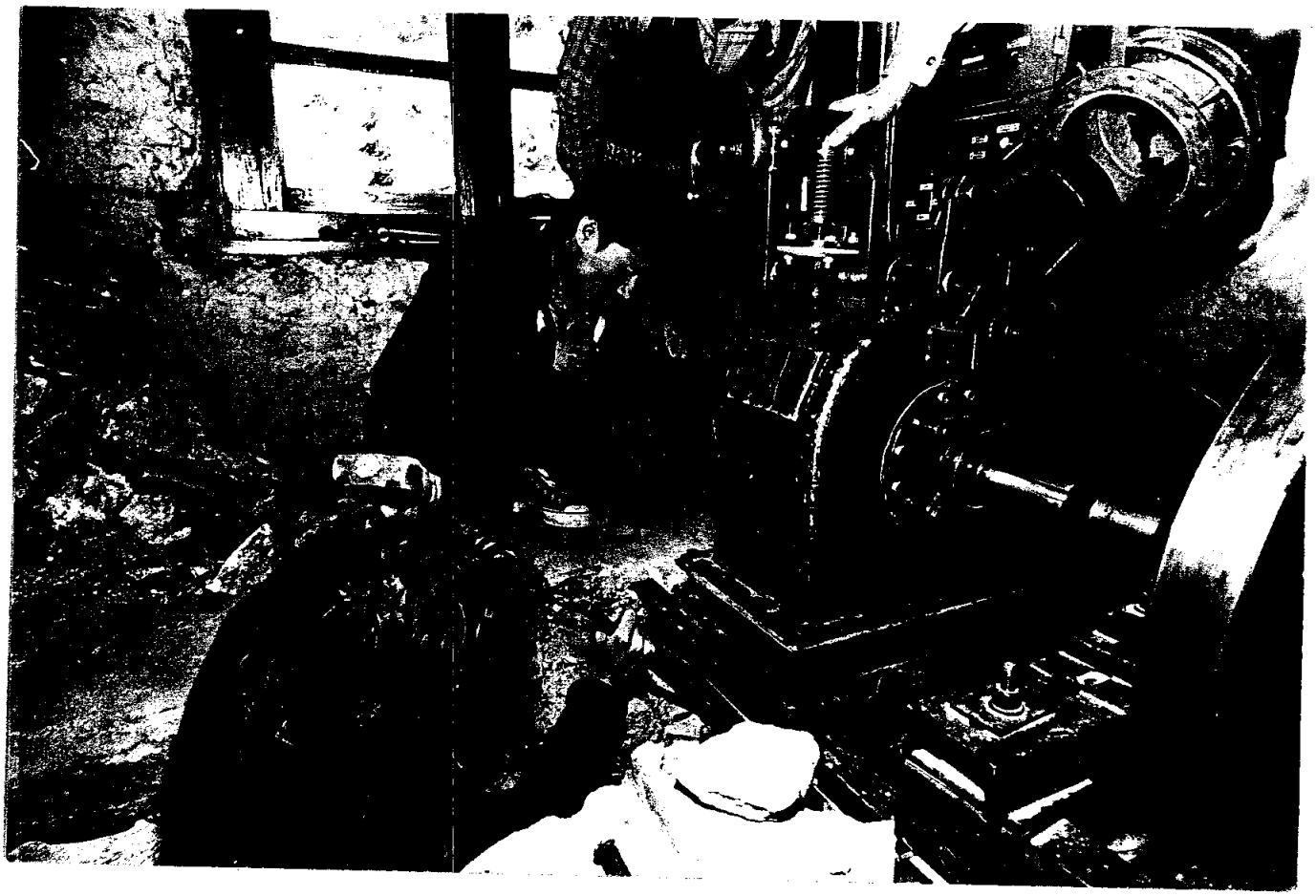


Photo No. 3

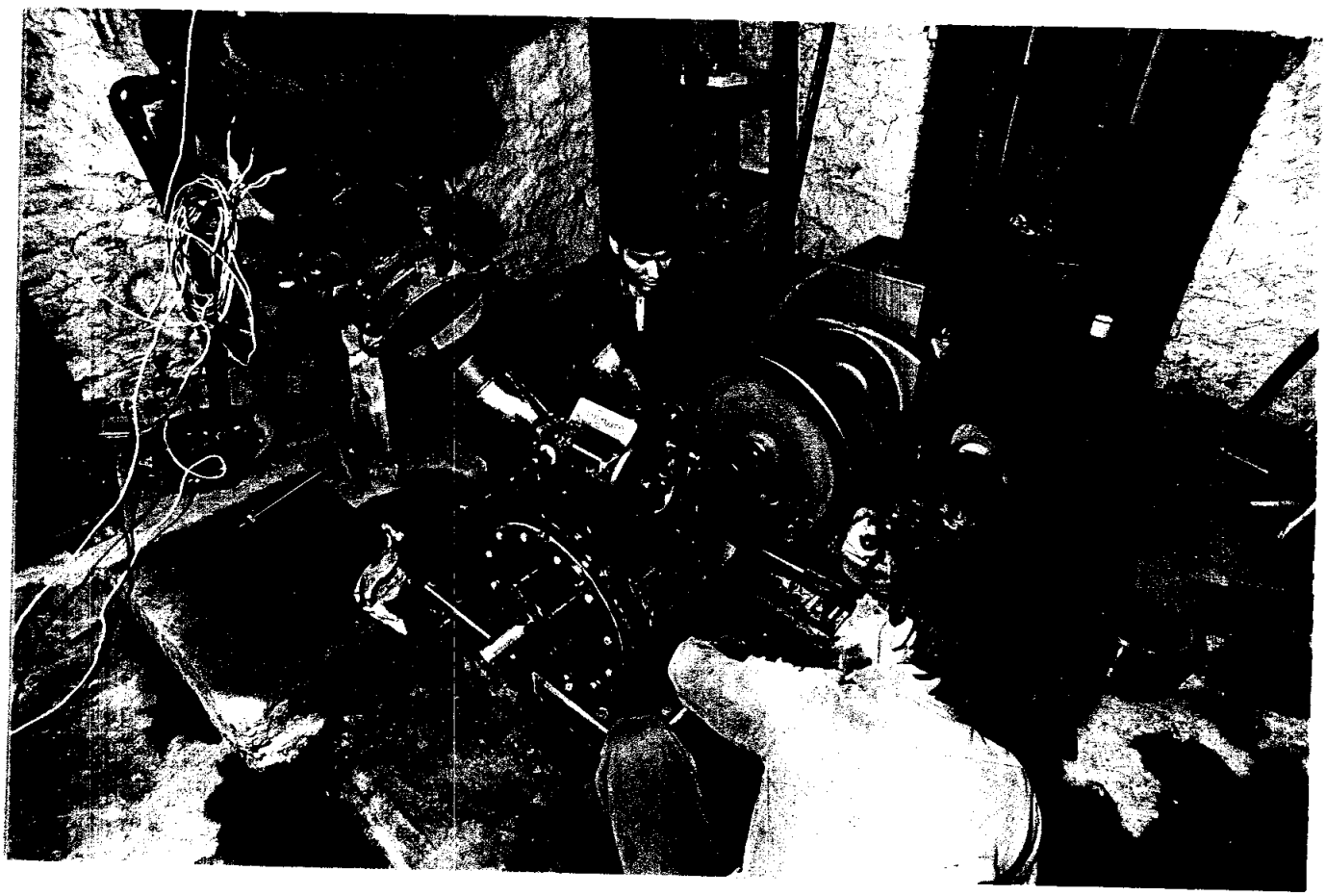


Photo No. 4

Photo No. 5: A 1500 watt space heater, now a standard part of the heating and cooking systems at 6 lodges and staff quarters in Namche.

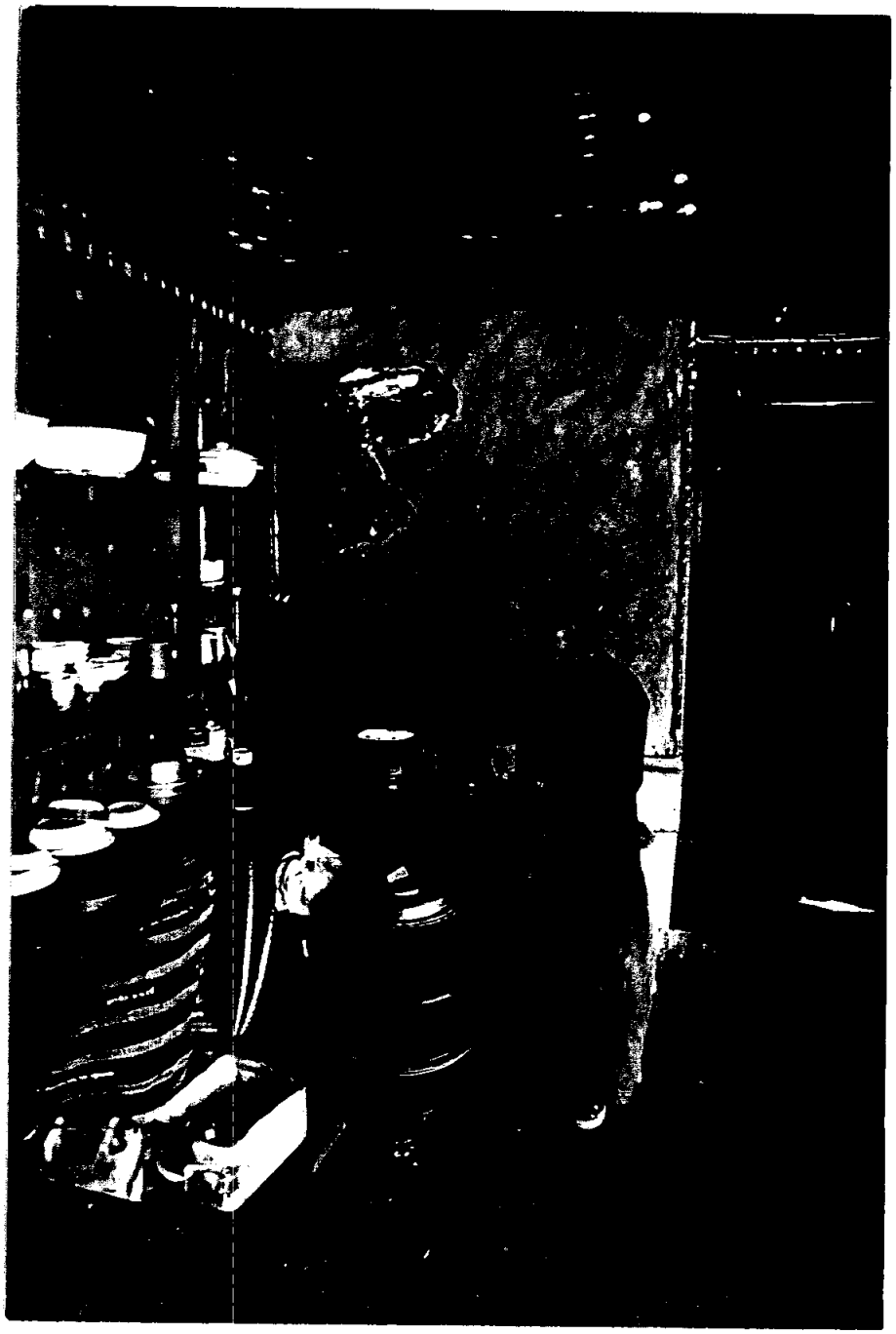


Photo No. 6: A Sherpa cook in Namche prepares food on a 2000 watt electric stove, in combination with a 500 watt stove.

Photo No. 6: A Sherpa cook in Namche prepares food on a 2000 watt electric stove, in combination with a 500 watt stove.

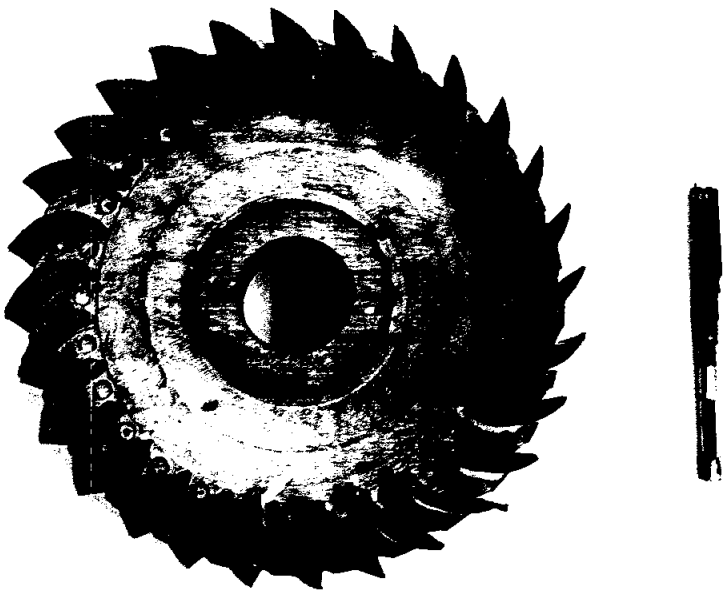


Photo No. 7: The wooden casting mold for production of the cast iron primary runner for the "splitflow" turbine, which replaced the original turbine in Namche.

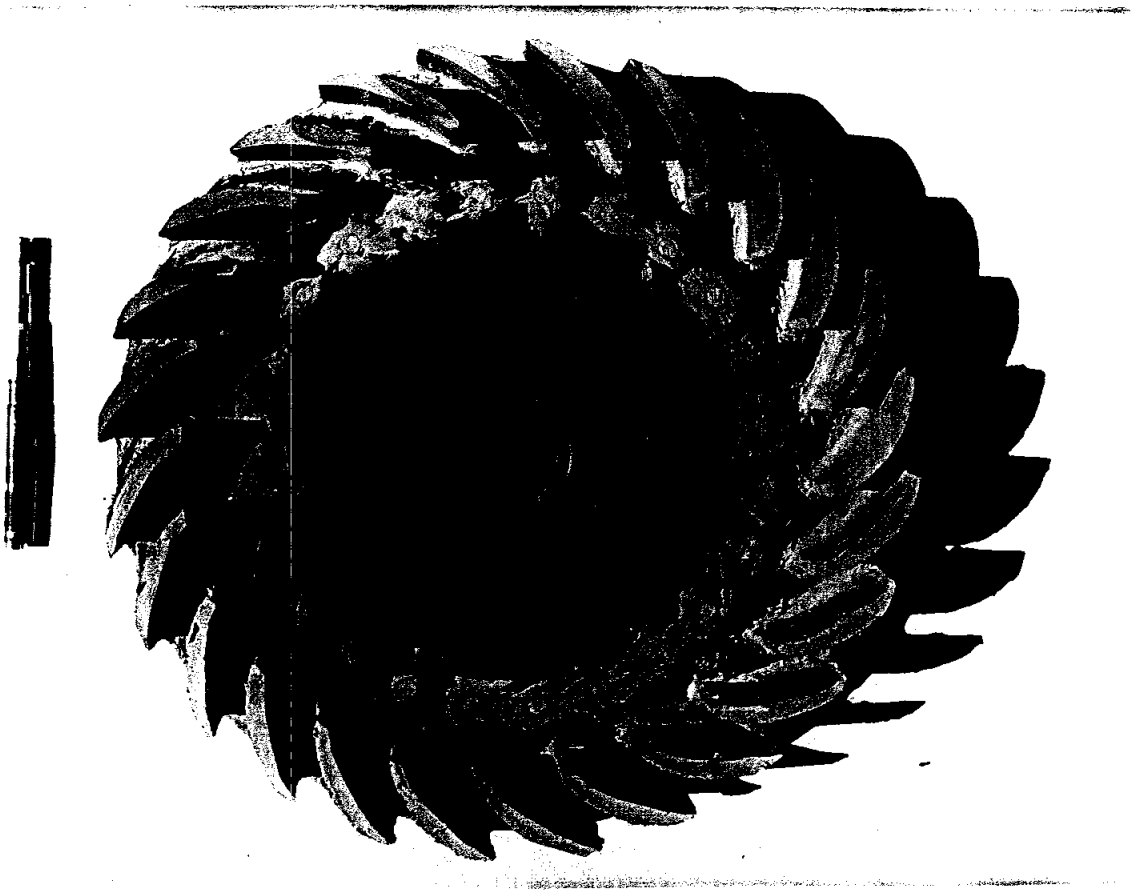


Photo No. 8: The wooden casting mold for production of the cast iron secondary runner for the "splitflow" turbine, which replaced the original turbine in Namche.

Photo No. 9: A partial view of the village of Kunde, one of five major load centers of the 500 kilowatt Thamo hydroelectric project. The SHDB is now seriously considering installing electrical distribution lines underground, in response to requests from the DNPWC and revised lower cost estimates.

The Rising Nepal,
June 10, 1985

Stress On Harnessing Energy Resources

By A Staff Reporter

[illegible] the Minister for Industry, Commerce, Culture, Tourism, Foreign Affairs and Parliamentary Affairs, Mr. Bhanubhakta Subba, has said that in view of the important role of energy in national development, special emphasis should be given to the harnessing and utilisation of energy resources in national development plans.

Minister Subba was inaugurating a five day regional workshop on "Wind Energy Utilisation" organised by the Research Centre for Applied Science and Technology (RECAST), Nepal, and UNESCO in collaboration with the Regional Centre for Energy, Heat and Mass Transfer for Asia and Pacific (RCEHMT), India, here Monday.

He said, in the light of our past experiences, use of local skills and resources were considered imperative for any effective formulation and implementation of development projects.

Stating that the energy crisis of the past few decades had put the renewable energy resources like wind energy in its correct perspective, he expressed the hope that the workshop would help to consider the manner in which the indigenous scientific and technological capabilities could be enhanced for the effective harnessing of local resources like wind energy.

Nepal possessed a huge hydro power potential but its large scale development took long time and required huge financial investment, he said.

[illegible] added it [illegible] necessary to develop [illegible] possible alternate energy resources and suggested that there were specific locations in the country with known wind energy potentials.

Minister Subba also expressed the hope that the workshop would help in charting a systematic course of action for the identification of potential of wind energy and for its effective utilisation in the country.

Secretary General of the Nepal National Commission for UNESCO, Dr. Narsingha N. Singh, remarked that Nepal had abundant potential of wind and solar energy and stressed the need for tapping it. UNESCO's help in this regard was [illegible] he said.

[illegible] the Rector of the Tribhuvan University, Mr. G.P. Gorkhali, opined that the development of wind energy would not only help cut down the ever rising energy import bill but also facilitate the development of small scale industries in the country.

Mr. B. Jainjogkit, programme specialist of UNESCO, said that the UNESCO would keep on assisting the research and other activities relating to new and renewable energy sources.

In his welcome speech, Dr. Kedar Lal Shrestha, the executive director of the RECAST, threw light on the objectives of the workshop and noted that although there were 25,000 traditional water mills in Nepal, the windmill was a recent advent.

The Rising Nepal, June 4, 1985

Unesco Study On Technologies For Rural Development

Within 20 years the rural population of the developing countries will have increased from 2[illegible] to 1,500 million. Despite the [illegible] growth of some cities, almost all these new [illegible] are destined to live in the underprivileged rural environment.

In the Third World countries, 70 percent of the population, mostly in rural areas, still subsist on the meagre produce of the land, lacking information, infrastructures and a technology adapted to their needs. In many rural communities living conditions are exhausting, there are no market outlets and scant possibilities of self supply.

The majority of these 800 million peasants have to survive on less than 365 a year. They can make little use of local resources because they do not have the requisite techniques and are often handicapped by inappropriate technology transfer. For example, over 30 percent of the grain harvested by farmers is lost through defective storage.

What type of technology then is best adapted to develop these areas? a study published by UNESCO on technologies for rural development emphasises that each situation should be assessed individually to determine the basic needs of the agricultural communities and to select the technology best adapted to each specific eco-system.

A high proportion of the labour force engaged in farming activities is illiterate, in some developing countries as much as 91 percent. So it is unrealistic to expect these rural workers to utilize complex techniques to manage their daily tasks.

Even today, there are some countries that still rely on the knife and hoe as the only farm tools. Production could be considerably improved by adopting intermediate, appropriate equipment. Yet in many cases, tractors and modern cultivators, industrial ploughs and large-capacity silos are not suitable for small-holdings in these countries. Indeed they are more a hindrance than a help be because of the high cost of initial investment and maintenance and the lack of spare parts.

The best solution for countries with weak technical structures is to make use of simpler but efficient techniques. The so-called applied technologies offer a whole range of flexible techniques based on low-cost equipment which the rural workers can in most cases afford. The bicycle, for example, has proved an invaluable aid in Africa in the context where grain-mills, threshers and oil extractors activated by the principle of bicycle power have been put into practice in Ghana and in Sierra Leone.

A country such as Guyana has to import 96 per cent of its needs in oil and natural gas at a cost of around $75 million for the year 1979. That amounts to 35 percent of Guyana's gross national product. Many agencies, coordinated by UNESCO, have for years been trying to find a better way.

For a country like Guyana, solutions based on renewable energy constitute an important secondary feature of the economy. Alternative energies—windmills, biogas or bicycle power—can significantly contribute towards improving rural conditions in developing countries. (RSS)

The Rising Nepal

Letters

Tiger Baiting

Recently, the tragic episode of yet another maneating tiger has been publicised in TRN. As citizens of a beautiful country with its diverse fauna, we would like to draw attention to the following.

'Bhange Bhale' was the fourth maneater of Chitwan in recent years. Except for the wounded one, all the other three tigers were in healthy condition and were restricted to the western end of the park where a tourist resort baits tigers daily with young buffaloes as one of their major attractions. TRN (Jan.5) reported expert claims that the tiger menance is a result of over population and heavy disturbances on the fringes of the park. As interferences do occur throughout the borders of the park, why have the gruesome activities of maneating tigers occurd around the baited area only? All the three healthy maneaters were frequent visitors of cafeteris feeding.

The Royal Chitwan National Park, one of the world heritage sites recently nominated by UNESCO, abounds with beautiful flora and fauna. There is no need to create an excrescent situation like baiting for excitement. The ever increasing number of visitors to the jungle lodges in the park proves this point.

Since there are sufficient elements that suggest maneating co relates with the artificial baiting of tigers, we plead to the concerned to stop immediately such unnatural baiting within Nepal which disturbs the whole eco-system.

It is about time that touristic organisations such as jungle lodges realise that they are there because the National Park is there and not vise versa.

Bepin, Innu and Friends,
Kalimati
Kathmandu

Govt. To Create Buffer Zones Around National Parks

By A Staff Reporter

His Majesty's Government [redacted] to create buffer zones around the national parks, strict nature reserves and wildlife reserves.

According to the Director General of the Department of National Parks and Wildlife Conservation, Mr. Bishnu Nath Upreti, villages will have limited access to some natural resources such as controlled livestock grazing in the buffer zones.

He also said that the need to include categories of biosphere reserve, biological reserve and buffer zones in the system of protected areas specially those bordering the private land was felt.

Biologically significant areas adjoining [redacted] and the [redacted] National Park are now being proposed for such buffer zone status, he said.

According to Mr. Upreti, once an integrated and comprehensive system of protected areas and buffer zones are established it could be hoped that the country's national parks and reserves would be able to enclose most of the representative ecosystems of the country.

There are at present six national parks, four wildlife reserves and one hunting reserve spreading over an area of about 11,000 square kilometres.

Appendix II

March, 1985

Revised Cost Estimate for Electrical Distribution for the 700-Kilowatt Namche Small Hydel Project, Thamo, Sagarmatha National Park

I Introduction

During 1985, a system of electrical distribution will be chosen for the village load centers of the 700-kilowatt Namche Small Hydel Project ("NSHP") now being constructed under the direction of the Small Hydel Development Board ("SHDB") of His Majesty's Government Ministry of Water and Power Resources. In response to inquiries and concern that the Department of National Parks and Wildlife Conservation ("DNPWC") and Sagarmatha National Park ("SNP") in particular have fielded from visitors relating to the proposal for overhead electrical distribution through this scenic area, the DNPWC asked a [illegible] energy consultant to SNP to investigate the feasibility and cost of placing electrical lines underground.

With experience gained from the installation of underground electrical distribution lines for the 27-kilowatt Namche Micro Hydro Project ("27-kw NMHP") funded by the DNPWC and UNESCO, it was shown that underground distribution was not only safe, scenic and maintenance-free, but was installed for an added cost less than 2% of the overall project cost. Original cost estimates for providing similar underground distribution for the NSHP load centers appeared to be prohibitive, but a revised estimate based on current costs and recent experience show that underground distribution of acceptable standards may be competitive with overhead lines, for this remote region in particular.

II Revised Costing Notes

Costs listed here are based on tentative retail quotations from Supreme Electric Pvt. Ltd., Kathmandu, and current transportation and site costs. Items are listed (including additions) as per the serial number on the original " Material cost estimate; distribution line materials (underground)" prepared by the SHDB for the NSHP, Appendix I.

This estimate includes modification of the original cement masonry-lined and covered "trench" design, to laying of armoured cable in a ditch, surrounded by 15 cm. of sifted earth (and sand, where necessary) and topped with selected rocks (see diagram), as per Indian underground electrical distribution standards, and experience gained with underground transmission and distribution with the 27-kw NMHP.

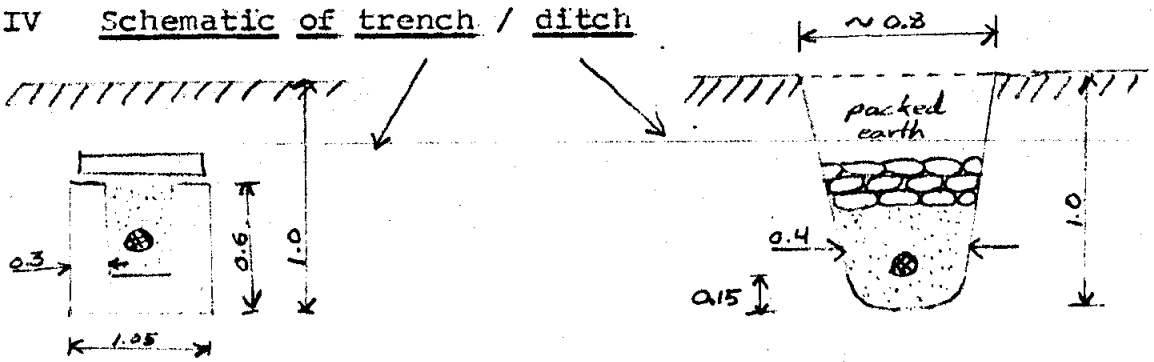
This estimate also includes replacement of "150 SQ. mm. o.4 KV grade 4-core underground armoured cable" specified in the original cost estimate (App. I) with 95 sq. mm. cable of like quality, justified by the attached endorsement from BYS Elektro (App. II). Costs are not included in the original SHDB estimate due to its proprietary nature in light of future tender solicitations.

IV Revised Cost Estimate

Ser. No.	Material's name	Unit	Rate, Rs.	Qty.	Rs. Total
1	95 sq. mm. 1.1 KV grade PVC-insulated 4-core aluminum underground armoured cable:	km.	1,33,000/-	4.5	6,31,000/-
1a	Transportation for 95 sq. mm. cable:	kg.	20/-	13,500	2,70,000/-
2	70 sq. mm. 1.1 KV grade PVC-insulated 4-core aluminum underground armoured cable:	km.	1,08,000/-	2.5	2,70,000/-
2a	Transportation for 70 sq. mm. cable:	kg.	20/-	6,250	1,25,000/-
3	(Same as original estimate)	no.	35/-	50	1,750/-
4	(Same)	kg.	200/-	15	3,000/-
5	(Same)	no.	30/-	25	750/-
6	(Omitted due to ditch instead of trench design)				
7	Fine sand	cu. m.	176/-	200	35,200/-
8	(Omitted due to ditch instead of trench design)				
	SUBTOTAL MATERIALS:				Rs. 13,36,700/-
Labor	(not included in SHDB estimate); 7,000 meters of ditch excavation, 1 meter depth; sifting, rock sorting, covering; at Rs. 42/- per meter (twice the actual cost of the 27-kw NMHP):				Rs. 2,94,000/-
	TOTAL:				Rs. 16,30,700/-

TOTAL, MATERIALS AND LABOR:	Rs. 16,30,700/-
20% Contingencies:	3,12,140/-
GRAND TOTAL, REVISED COST ESTIMATE:	**Rs. 19,56,840/-**

IV Schematic of trench / ditch



V Estimate of longterm cost savings acheived through underground distribution

It has been international experience that underground lines yield additional savings in the long term. Here, conservative assumptions are made, with justifications, to estimate these savings. Items a) and b) below are calculated for a return (savings) over a 7-year period, though the lifespan of underground lines should be indefinite, especially in the cold, dry, rodent-free ground environment of SNP.

a) Assumption: that routine maintenance and repairs to the distribution line will be halved with the placement of lines underground.

Justification: In fact, no maintenance or repairs whatsoever have been necessary during the first 1½ years of operation of the 27-kw NMHP system.

Total 7-year savings with underground wiring:

between Rs. 10,000/- and Rs. 60,000/-

b) Assumption: that underground distribution will yield a conservative 5% reduction in the loss of unaccounted-for electrical consumption attributable to thievery.

Justification: The nationwide average loss from this cause is about 15%. In Kathmandu, loss is over 35%. The 27-kw NMHP has suffered virtually no unaccounted loss.

Further assumptions:

1) a load factor of only 30%
2) 350 days operation per year
3) a Rs. 1/- per kilowatt-hour electricity tariff

Calculation:

.30 (load factor) × 700 kw (capacity) × 24 hours (daily operation) × 350 (days per year) × Rs. 1.00 (tariff) × .05 (percentage increase in income) × 7 years = Rs. 6,17,000/- savings in 7 years due to added protection from thievery.

Some additional important benefits are not given a monetary value here, but warrant consideration in discussions concerning underground vs. overhead electrical distribution for the NSHP:

c) Underground wiring is internationally considered to be safer than overhead, and lightening protection equipment is not necessary.

d) Section II.2, Policy 2.4 of the SNP Management Plan,1979 (DNPWC) states that: "The design of power schemes should meet the following criteria:...5. Transmission lines should be underground or concealed from use areas by topography." As this section was prepared by a person without electrical engineering background, it can be assumed that "transmission" includes "distribution", as in the layman's definition of the former term. This is in full keeping with the spirit of this policy.

e) Over 6,000 trekkers per year visit at least one of the villages included in the electrification plan. These visitors come from many countries of the world, and include journalists, photographers and others with public exposure. It is expected, based on numerous inquiries to SNP staff, that negative publicity will result from press and other foreign exposure of what westerners in particular consider to be unaesthetic electrical lines traversing scenic villages, in one of the most scenic national parks in the world, a UNESCO World Heritage Site. Consideration of the aesthetic effect and potential harmful impact on tourism of overhead lines should be of primary importance.

VI Conclusions

In informal conversations with personnel of the SHDB, it was said that their cost estimate for overhead distribution is in the neighborhood of Rs. 15,00,000/-, while the initial cost for establishing the same distribution network underground has been calculated at Rs. 19.60.000/-, including 20% for contin-

gencies. This represents a cost difference of about one percent of the overall project amount, and does not include potential long term savings that can be realized through reduction of unauthorized load.

It is recommended, in light of the benefits listed (which are mostly specific to the SNP region), that underground distribution be chosen in favor of overhead lines. Ultimately, intangible benefits such as preservation of the unique scenic beauty of this area may even eclipse what appear to be real economic advantages.

* * *

Prepared by

Broughton Coburn
UNESCO Energy Consultant
to Sagarmatha National
Park
c/o UNDP
P.O. Box 107
Kathmandu, Nepal

APPENDIX I

Small Hydel Development Board

Namche Small Hydel Project

Materials Cost Estimate
Distribution Line Materials (underground)

Ser. no.	Material's name	Unit	Qty.
1	150 sq. mm. 0.4KV grade 4-core PVC-insulated unsheathed underground aluminum cable:	km.	4.5
2	70 sq. mm. 0.4 grade 4-core PVC-insulated unsheathed underground aluminum cable:	km.	2.5
3	PVC joint boxes suitable for cable of items 1 and 2 (two-way):	nos.	50
4	L.T. insulating compound suitable for underground cable joints:	kg.	15
5	L.T. insulating tape suitable for underground cable joints of size 13 mm. x 25 mm.	nos.	25
6	Random rubble stones	cu. m.	3600
7	Fine sand	cu. m.	945
8	Stone plate of about 100 mm. thickness and 1000 mm. length:	sq. m.	7000

Note: Cost estimates have been omitted from this appendix due to the proprietary nature of costs previous to tender solicitations.

Appendix IC

बालाजु यन्त्रशाला ईलेक्ट्रो लिमिटेड

BALAJU YANTRA SHALA ELECTRO LIMITED

BALAJU, KATHMANDU

(MAJOR SHARE HOLDERS: NIDC & SATA)

ELECTRO: MANUFACTURERS, CONTRACTORS, CONSULTANTS,
DEALERS: INSTALLATION, REPAIR & MAINTENANCE.

ELECTRO LIMITED

4-1280
TEL. NO. :
P. O. BOX : 1413
CABLE : BYSE
BANKER :
NEPAL BANK LT

Our Ref. No. BYSEL/041/110

Date: 11th.March'8

TO WHOM IT MAY CONCERN

This is to certify that, according to A.C.S.R. Standards and tables, "95sq.mm 4-core PVC-insulated 1.1 KV grade aluminium armoured cable" can carry equivalent load, with no greater voltage drop, than 4 cores of "Rabbit" code name ACSR conducter of 52.21 sq.mm. equivalent area of aluminium, at less than 1.1 KV.

for, BALAJU YANTRA SHALA ELECTRO LTD.

(R. M. Pradhan)
B.Sc. Engg. (Electrical)
General Manager.