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NVE
NORWEGIAN
WATER RESOURCES AND
ENERGY ADMINISTRATION

HYDRO POWER ACTIVITIES OF THE UNITED MISSION TO NEPAL

A MISSION REPORT

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Hallvard Stensby

NVE
NORWEGIAN
WATER RESOURCES AND
ENERGY ADMINISTRATION

NORAD
NORWEGIAN AGENCY
FOR DEVELOPMENT
COOPERATION

Title	No
Hydro Power Activities of the United Mission to Nepal *A Mission Report*	*5-91*
Executive Officer(s)	**Date**
Torodd Jensen *Hallvard Stensby*	*June 1991*

Abstract

This report gives a description of and comments on NORAD supported hydro power projects and hydro power related activities in Nepal.

The report concludes that the projects so far have been satisfactorily carried out. Only few objections to project solutions and project work are raised, and some recommendations have been given, also concerning environmental issues.

Subject Terms

Nepal
Hydropower Development

Project Co-ordinator

Egil Skofteland

NVE
Norwegian Water Resources and
Energy Administration

NORAD
Norwegian Agency
for Development Cooperation

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1 EXECUTIVE SUMMARY

Introduction

5-21 November 1990 a 2-member mission from NVE visited NEPAL as part of NVE's advisory role to NORAD concerning the Jhimruk hydro electric project. In addition to visiting Jhimruk, visits were also made to the industrial activities in Butwal, the Andhi Khola multi-purpose scheme and the Water Research Laboratory in Kathmandu.

The Jhimruk project

The Jhimruk project is located in Pyuthan district in the central western part of Nepal. It includes construction of a 12 MW hydro-electric power plant, 160 km of 33 kV rural transmission lines and 40 km of 132 kV transmission lines for connection to the main grid.

The on-site works at Jhimruk started in late fall 1989, with preparatory works including access road, housing, stores, etc. Construction works have recently started with tunneling at the power house site. The project is not technically complicated. The main challenge will probably be the headworks with the intake structures. There are some uncertainties related to rock conditions, which will be of decisive importance to the project costs.

Important issues concerning Jhimruk are those regarding the environment:

- Although cultivated land will on the whole be gained through the project, some people will loose their land.

- The power plant will, according to the project plans, divert all the water away from the river during the dry season.

People who are affected by the project should get full compensation. Those loosing their land might get new land where waste land is reclaimed, but it is uncertain if the Government will give sanction for this. Water for irrigation, drinking and washing should be secured.

Butwal electro/mechanical workshop

The Butwal industrial activities have so far been successful. The workshop is very important for all hydro power activities undertaken by UMN. The products for mini hydro power plants (cross flow units) are valuable for remote areas in Nepal. For export it is considered necessary to use steel of higher quality.

Experiences from training and production methods and products (poles for transmission lines) are valuable for other developing countries.

The Andhi Khola multi-purpose scheme

The Andhi Khola multi purpose scheme includes:

* Construction of a 5 MW hydro-electric power plant
* Rural electrification
* Irrigation project
* Development of agriculture
* Creating new, small enterprises

Construction work at the Andhi Khola hydro power scheme has been going on since 1984. The power plant will shortly be put into operation. Parallel to the power plant works a rural electrification programme has been run. The local population has been motivated to use electricity and learn how to use it. So far 450 households have been supplied with electricity.

The irrigation programme is in the starting phase. The basic ideas for this programme are quite new and unproven. A farmer organisation has been created, which will be guided by the principles of land redistribution through water shares earned by contributing labour during construction of the system.

The idea of establishing a credit fund for the purpose of creating new activities in the area involves a high degree of uncertainty.

The success of these new ideas will depend on proper and careful management of the projects.

Important in this relation is the recruitement of people with the necessary skill and experience to carry through the project.

Future projects

Of decisive importance for the continued growth of the Nepalese companies Butwal Power Company, Himal Hydro and Nepal Hydro and Electric is the possibility to take on new tasks in the near future.

Upgrading of the Tinau hydro power scheme should be mentioned in this connection. In addition, the companies should be active to gain contracts on new projects.

From a development point of view one should also investigate the possibilities for any type of new projects in the areas where hydro power development takes place. The Andhi Khola multi-purpose scheme is one example of how to create new projects. Through the infrastructure which has been built for the Jhimruk project, there has in fact been established a basis for new activities also in that area. It was our impression that UMN already has some ideas for possible future projects.

2 INTRODUCTION

2.1 Background

NORAD has supported a number of projects in Nepal through Den Norske Tibetmisjon, known as the Norwegian Himal Asia Mission (NHAM) in Nepal, which is a Non Governmental Organisation and the Norwegian branch of the United Mission to Nepal (UMN).

Projects earlier (and still) supported are :

- **Butwal,** including technical institute and different kinds of industrial activities.

Related to these activities were also the planning and construction of the Tinau hydro power plant (1 MW), the first underground power plant in Nepal.

- **The Andhi Khola Multi-Purpose Scheme,** including:

  * Construction of a 5.1 MW underground hydro electric power plant
  * Rural electrification
  * Irrigation project
  * Creating small agro- and non agro related enterprises

One of the main goals for the support is to establish a national Nepalese hydro power industry which should be able to cover all aspects of hydro power development.

The work carried out in Butwal and Andhi Khola is judged as quite successful. In order to strengthen the companies which have been established, it was necessary to take on larger tasks. This is currently going on through the planning, management and construction of

- **Jhimruk Hydro Electric and Rural Electrification Project (JHEREP)**

This project includes the construction of a 12 MW hydro power plant, 160 km of 33 kV rural transmission lines and 40 km of 132 kV transmission lines for connection to the main grid.

The Butwal Power Company (BPC) is responsible for the implementation of the Jhimruk project. BPC does the detail planning and the management of the project and will also be the owner of JHEREP during the construction period and the first year of operation. The power plant will then be handed over to the Nepalese government through the Nepalese Electricity Authority (NEA).

The relations between the parties involved in the Jhimruk project and their responsibilities are given in the following contracts and agreements:

1. Contract between The Royal Norwegian Ministry of Development Cooperation and The Norwegian Himal Asia Mission (Den Norske Tibetmisjon) concerning the Jhimruk hydro electric project. Signed 07.02.89. (Appendix 6).

2. Agreement between His Majesty's Government of Nepal, Ministry of Water Recources and The United Mission to Nepal on the Jhimruk hydro electric and rural electrification project. Signed 23.02.89. (Appendix 7)

3. Letter of Agreement between The Norwegian Water Resources and Energy Administration and the Norwegian Himal Asia Mission (Den Norske Tibetmisjon) on the Jhimruk hydro electric project, Nepal. August 1989. (Appendix 8)

2.2 UMN-related companies concerning hydro power development

- Butwal Power Company Pvt. Ltd., (BPC).

BPC was formed in 1965 for the purpose of building a hydro power project in the river Tinau. BPC has since developed, mainly through the planning and implementation of the Andhi Khola hydro power scheme. At present BPC is responsible for the planning and implementation of the Jhimruk Hydro Electric and Rural Electrification Project.

UMN and HMG are the main shareholders of BPC.

- Himal Hydro & General Construction Pvt. Ltd., (HH).

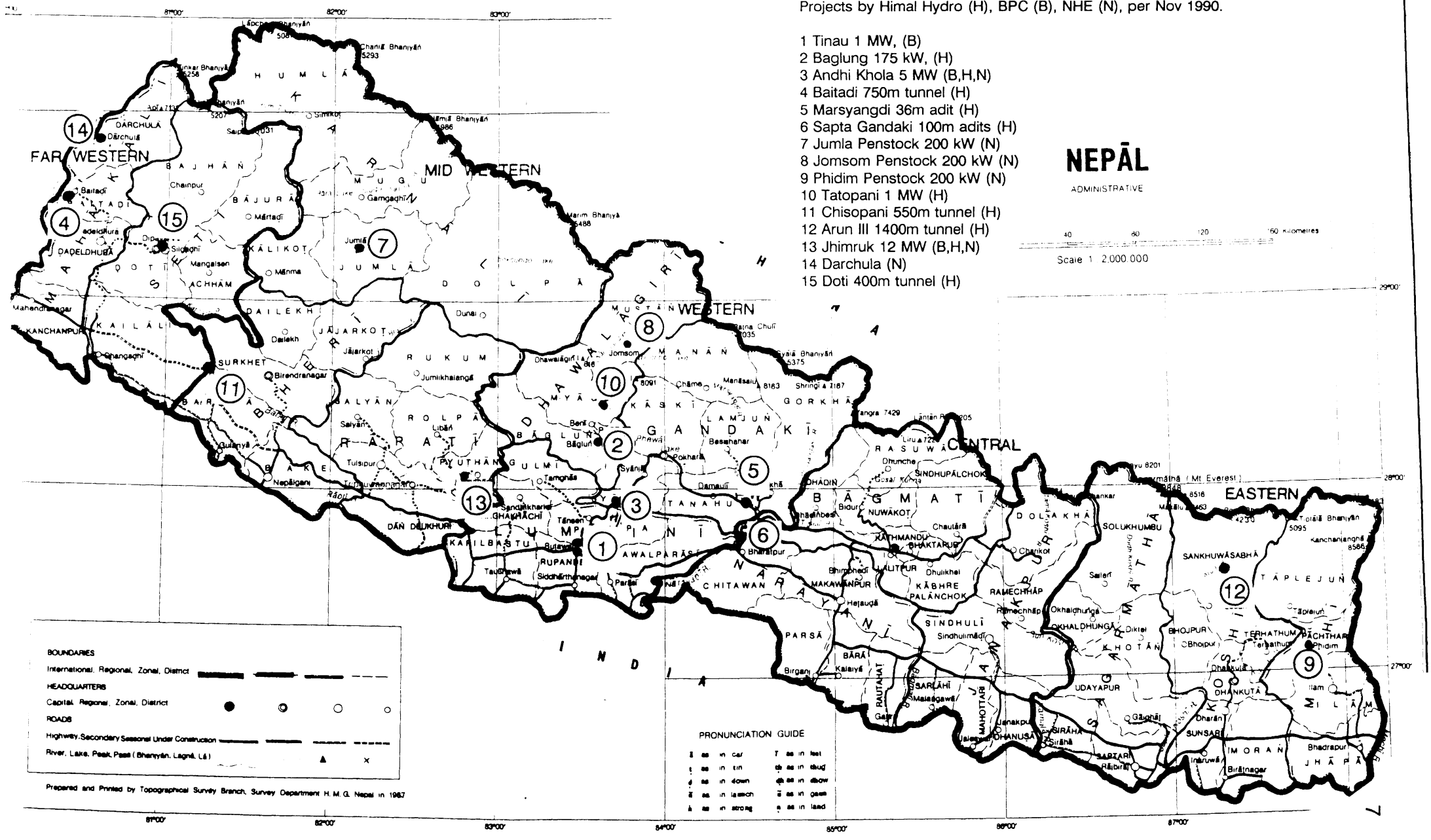
HH was established in 1978 as a contracting company specializing in small hydro developments, tunnels and irrigation schemes. HH was the contractor for civil works at the Andhi Khola hydro power project and is currently constructing the Jhimruk hydro power scheme.

UMN and HMG are the main shareholders of HH.

- Nepal Hydro & Electric Company Pvt. Ltd., (NHE).

NHE was established in 1986 for the purpose of manufacturing water turbines, penstocks, transmission poles and towers and electrical equipment. NHE is the manufacturer (though with a small private company as subcontractor) of poles for the Jhimruk project transmission lines. NHE will also, in cooperation with the Norwegian companies Kvaerner Eureka (KEU) and EB National Transformer (EB), construct the turbines and transformers for Jhimruk.

UMN, HMG, KEU and EB are the main shareholders of NHE.


Projects by Himal Hydro (H), BPC (B), NHE (N), per Nov 1990.
1 Tinau 1 MW, (B)
2 Baglung 175 kW, (H)
3 Andhi Khola 5 MW (B,H,N)
4 Baitadi 750m tunnel (H)
5 Marsyangdi 36m adit (H)
6 Sapta Gandaki 100m adits (H)
7 Jumla Penstock 200 kW (N)
8 Jomsom Penstock 200 kW (N)
9 Phidim Penstock 200 kW (N)
10 Tatopani 1 MW (H)
11 Chisopani 550m tunnel (H)
12 Arun III 1400m tunnel (H)
13 Jhimruk 12 MW (B,H,N)
14 Darchula (N)
15 Doti 400m tunnel (H)
NEPĀL
ADMINISTRATIVE
Scale 1 2,000,000
FAR WESTERN
MID WESTERN
WESTERN
CENTRAL
EASTERN
INDIA
BOUNDARIES
International, Regional, Zonal, District
HEADQUARTERS
Capital, Regional, Zonal, District
ROADS
Highway, Secondary, Seasonal, Under Construction
River, Lake, Peak, Pass (Bhanyān, Lagnā, Lā)
PRONUNCIATION GUIDE
Prepared and Printed by Topographical Survey Branch, Survey Department H.M.G. Nepal in 1987

3 NVE MISSION - CONCLUSIONS AND RECOMMENDATIONS

3.1 Mechanical workshop in Butwal

The Butwal Technical Institute runs a very important training activity which is the basis for all the industrial activities in Butwal.

Butwal Engineering Works (BEW) has been a pioneer within the design and production of especially adapted small crossflow turbines. To keep the costs down, the turbines are not high quality products. The cheap solution can be justified in Nepal, where the producer is not far away from the client. If the turbines are to be exported, however, it is considered necessary to use steel of higher quality.

Nepal Hydro and Electric Company Pvt.Ltd. (NHE) was established in 1986 for the purpose of manufacturing water turbines, penstocks, transmission poles and towers and electrical equipment. The new facility for equipment in the 100-10,000 kW range, developed in cooperation with Norwegian companies, represents a leap forward in technology in stark contrast to the 10-40 kW micro turbines built in the BEW.

Only parts of the activities had started autumn 1990, therefore experiences from the cooperation with Norwegian companies should be followed up by later missions.

The Electrical Poles Workshop produces steel transmission towers and tubular steel transmission poles. The designs of the towers and poles are standardized in modular concepts for easy portability and for as much adaptability to different conditions as possible.

The idea behind the production of tubular steel poles should be considered to be transferred to other developing countries. Except for the galvanizing plant, the production of the poles is very simple.

The results UMN has achieved in Butwal are impressive. Although there is a policy to Nepalise the activities, we got the impression that this policy cannot be successful if the changes go too fast. The experiences from the Tinau powerplant can be an example of this.

We also strongly feel that the activities are difficult to copy in other countries. As far as we understand the results are heavily dependent on the presence of UMN over decades.

3.2 The Andhi Khola multi-purpose scheme

Based on written project material and our site visit to Andhi Khola we got the following impressions of the activities:

<u>The hydro power scheme</u>

The technical solutions for the hydro power scheme seem to be satisfactory. At the time for our visit the plant was in a test operating phase and would probably be fully completed

within a short time.

There were some problems with rock scouring just downstream of the dam and erosion of the right river bank in the pondage area. Measures should be taken to avoid these problems.

The overall impression of the power scheme is, however, good.

The rural electrification

The construction of the electricity distribution system seemed to progress well. The participation of the local population has proved to be successful. This is satisfactory as it is considered very important to activate the people in the project work.

The people in the area seemed to be motivated to make use of the new energy source. A visit to a household which had been supplied with electricity gave the impression that they were familiar with the use of it.

The irrigation project

The construction of the irrigation system is in the starting phase. Some uncertainty is connected to the new ideas which this project is based upon, namely the earning of water shares through work contribution and to a little extent redistribution of land. Although people say that they are positive to the land redistribution programme, it turnes out that they often change their minds when theory becomes reality.

Also the earning of water shares by contributing labour is considered an uncertain process. At the time of our visit only little work had been done. However, experience from the construction of the rural electrification system indicates that people are motivated to make an effort to improve their way of living.

The risk of failure is obviously present. Especially the idea of land redistribution encroaches upon established socio-cultural and economic relations in the area.

Job-creating projects

The conclusions here are the same as for the irrigation project. The ideas are good, but failure might very well occur.

Key words for both the irrigation project and new enterprises should therefore be proper management and caution. One problem may be that the persons who have created the new ideas have now left Andhi Khola. The availability of experienced and skilled people for the project management is considered very important for the success of the project. Efforts should therefore be made to recruit the necessary expertise.

3.3 The Jhimruk hydro electric and rural electrification project

The site visit at Jhimruk and studies of project material have given an overall good impression of the project.

Project design

The waterway system with headrace tunnel and penstock is quite similar to what is usual in Norway. The success in implementation of this part of the project will to a large extent depend on rock conditions. Geological investigations and the tunnel works carried out so far indicate satisfactory rock conditions.

The main challenge at Jhimruk will probably be the headworks, including dam, intake and river training works. The Jhimruk river, as all rivers in these areas, carries lots of stones, gravel and other sediments during the monsoon and flood periods. The construction of an intake system which works under such conditions is difficult.

Alternative layout

At the time NVE was assigned to the project, the decision of overall design had already been taken, and NVE's role is as technical/economic adviser on the project as it is now designed. We would, however, like to mention one alternative layout which was discussed in the pre-feasibility report, but dropped: About 3 km downstream of the dam site the valley narrows. Technically this could have been a more favourable site for dam construction than the chosen site. The problems with inundation and drought of land would have been considerably reduced and the impacts of reduced water flow downstream of the dam would have been less.

The reasons for dropping this alternative were:

- The length of the headrace tunnel would increase
- Reduced head
- Difficult access to a power house furter downstream in the Mardi valley

Socio-cultural and environmental aspects

Social anthropologists have several objections to the project. Some of these objections are, however, based on a pre-feasibility design which has since been considerably changed.

The main environmental impacts of the project as it is now designed are :

1) Lack of water for irrigation, drinking and washing downstream of the dam during the low flow periods.

2) Loss of land for some people

People who are affected by the project should get full compensation. Those loosing their land might get new land where waste land is reclaimed. Water for irrigation, drinking and washing should be secured either by releasing water from the dam, by drilling wells or in other ways, if there are any.

As a whole, the project will gain new farmland.

Compensation for land

So far money is given as compensation to those loosing their land. A better solution is probably to give other areas of land as compensation. Reclaimed government land may be available in the area. It was said that bureaucratic difficulties made it unrealistic to give this land to the people affected by the project. An effort should be made by UMN towards the Nepalese Government to make it possible to give land as compensation instead of money. After our visit we have been informed that a Secretary of the Government was positive to those ideas which probably would be the best for the population. It is, however, uncertain if the Government as a whole will give sanction for this.

ABBREVIATIONS

BPC : Butwal Power Company Pvt. Ltd.

HH : Himal Hydro and General Construction Pvt. Ltd

HMG : His Majesty's Government

NHAM : Norwegian Himal Asia Mission

NHE : Nepal Hydro and Electric Pvt. Ltd.

UMN : United Mission to Nepal

NVE : Norwegian Water Recources and Energy Administration

NORAD : Norwegian Agency for Development Cooperation

BEW : Butwal Engineering Works

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Visit to Nepal, November 5th to 21st 1990

APPENDIX 1

Hallvard Stensby and Torodd Jensen, NORAD/NVE

TERMS OF REFERENCE

Background

The reason for the visit to Nepal is NVE's role concerning the Jhimruk hydro power project, which is financed by NORAD. NVE has the follow-up responsibility for the project on behalf of NORAD. This visit will be the first one made by NVE personnel to the project area.

Scope of Work

The visit will be organised by the UMN and BPC.

During the stay in Nepal the representatives of NORAD/NVE shall carry out the following:

1. Site visit to the Jhimruk hydro power project.

   In addition to the construction site, the upstream (pondage) area and the downstream area shall also be visited. The need for additional investigations on technical, environmental and sosio-economic issues shall be considered.

2. Visit the hydro-dynamic laboratory in Kathmandu. Here information will be given by the laboratory staff about the model studies carried out on the Jhimruk project.

3. Visit the workshop in Butwal where the Norwegian companies EB and Kvaerner are involved.

4. Visit the Andi Khola hydro scheme.

   This visit includes the hydro power scheme, but information about the irrigation project is also important.

5. Visit The Norwegian Embassy in New Dehli and give information about the Jhimruk Project.

A written report by the mission shall be presented in English, not later than February 1st 1991.

APPENDIX 2

BUTWAL ELECTRO/MECHANICAL WORKSHOP

1 Introduction

United Mission to Nepal (UMN) started the industrial activities in Butwal in 1963, as part of the challenges for UMN to be in at the beginning of industrial growth in Nepal. This was largely born out of the vision and determination of one man, Mr. Odd Hoftun.

One reason for choosing Butwal as a site for the UMN's industrial and training work was that the local Tinau River offered an opportunity for a hydro-electric power project. The Tinau hydro power station has been extended several times and includes today three Francis turbines in an underground power station with maximum capacity 1 MW. The Francis turbines are second hand turbines from Norway. Lack of proper maintenance has made a need for refurbishment or replacement of the electro mechanical equipment as well as the turbines in near future. Repair work at the intake and in the tunnel should also take place to reduce headloss and loss of water. The work is necessary if Tinau shall be a reliable source of electric power. The work connected to the refurbishment of Tinau would be valuable for the Himal Hydro and General Construction Co. Pvt.Ltd. (HH) which needs activities for training purposes in near future.

Training and industrial activities are closely linked together in an area where there are few job opportunities for trained people and lack of skilled labour to support the establishment of industrial estates.

Today the training and industrial complex in Butwal includes several activities. Engineering and furniture making are two main components, established as Butwal Engineering Works Pvt. Ltd. (BEW, founded 1978) and Butwal Wood Industries Pvt. Ltd. (BWI, founded 1978).

The activities serving the need for electrification are described below.

2 The Butwal Technical Institute

The Butwal Technical Institute (BTI, founded 1963) links the different industries together in a training programme. Four-year courses start in February each year as about 300 boys aged 14-16 apply for about 25 places.

After a six-month initial training period in the Institute's own workshop, the boys then go into the various industries to start on-the-job training. They work alongside the skilled workers for the full working week (44 hours). Outside working hours they have their classes of up to a total of ten hours a week in subjects like English, Maths, Science and their own trade theory.

The Engineering Works and the Wood Industries have about 40% and 30% of their staff as trainees. This shows their commitment to training, but is a real burden for these companies. The training has so far been self financing and to reduce the burden to the companies some kind of direct subsidy per trainee should be included in the future.

3 Butwal Engineering Works

Butwal Engineering Works (BEW) has been a pioneer within the design and production of especially adapted small crossflow turbines. The company is today one of Nepal's leading manufacturers of penstock pipes. BEW now serves as a subcontractor to NHE (further description below).

Nepal has removed the need to license any electrical generating industry under 100 kW capacity. As a result installations have become more feasible and BEW offers solutions between 5-100 kW by the production of simple crossflow units. Head and discharge range are 2-80 m and 20-1000 litres/sec. respectively. The solutions can be used for electric generation, or for direct power for mills or agro/cottage industries. Generators to fit the turbines are imported from India.

Investment costs for a mill or electric generating varies between NOK 20,000 and 50,000 depending on site.

The products are simple and manufactured for activities in the rural areas. To keep the costs down, the turbines are not produced in high quality steel, hence the turbines are normally delivered with a spare runner for easy replacement. The cheap solution can be justified in Nepal, where the producer is not far away from the client. If the turbines are to be exported, however, it is considered necessary to use steel of higher quality.

BEW has now started with the production of Pelton turbines for higher head.

BEW also offers installation work through the Development and Consulting Services (DCS). This services deals with appropiate technology within the following main areas:

* Food processing machinery
* Development of building materials, presently concentrated on fibre concrete roofing tiles.
* Hydraulic ram pumps for drinking water

DCS is responsible for the Small Turbine and Mills Programme which offers the service of installing water turbine driven mills and installation of village electrification. In 1990 11 schemes were commissioned.

4 Nepal Hydro and Electric Company Pvt. Ltd.

4.1 General

Nepal Hydro and Electric Company Pvt.Ltd. (NHE) was established in 1986 for the purpose of manufacturing water turbines, penstocks, transmission poles and towers and electrical equipment. It represents a leap forward in technology in stark contrast to the 10-40 kW micro turbines built in the BEW.

The Norwegian industrial companies Kvaerner Eureka and EB Energy are shareholders in the company which biggest task up to now will be to deliver turbines and transformers for the Jhimruk project.

Altogether 65 persons will have their income from NHE, and approximately 40 are employed at the workshop which includes a turbine production plant, an electrical production/repair plant and a hot-dip galvanizing plant which allows the production of steel transmission towers and tubular steel transmission poles.

NHE together with BPC and HH,when working together as a consortium, can offer a full hydropower package to Nepal as it seeks to utilize this resource to the full and to remove its dependency on foreign imports.

4.2 NHE Turbine Workshop

The workshop, grown out of the Butwal Engineering Works, has been set up to provide a manufacturing and installation facility for water turbines and associated equipment in the 100-10,000 kW range. The technology behind a 100-10.000 kW workshop will be transferred from Kvaerner Eureka and EB Energy over several years. It will start by importing parts (runners etc.) from KEU and manufacturing the rest under license, or second-hand equipment will be imported and refurbished in Nepal.

The turbine production plant is equipped with heavy duty lathes, milling and drilling machines as well as precision tools. The machines are purchased second hand in Europe and fitted for use by the trained people from Butwal. Equipment and instruments for quality control on hydro power turbines and governors are available.

The workshop building with machinery had recently been completed when we visited Butwal. It was therefore too early to describe experience from the cooperation with the Norwegian companies.

4.3 NHE Electrical Workshop

The electrical department is another main activity. Currently it handles installation and repair services for electrical and electronic equipment used in hydropower plants (Panel boards and certain components).

Current plans call for steady expansion in the range of electrical equipment manufactured in Nepal. The collaboration with EB National Transformer in setting up a transformer workshop for repair and manufacture of distribution transformers up to 33 kV level is part of these plans to be more self reliant within this field some time in the future.

The workshop building was under construction at the time we visited Butwal, and the purchased second hand machinery was in containers. Description of the experiences from the establishment of the electrical workshop as well as the mechanical workshop should therefore be a task for later missions to Nepal.

4.4 NHE Electrical Poles Workshop

The Electrical Poles Workshop produces steel transmission towers and tubular steel transmission poles. A hot-dip galvanizing plant gives long-life protection to these and other products.

The designs of the towers and poles are standardized in a modular concept for easy portability and for as much adaptability to different conditions as possible.

The economic design for high tension lattice transmission line towers is well suited for the long spans often faced in a mountainous country like Nepal.

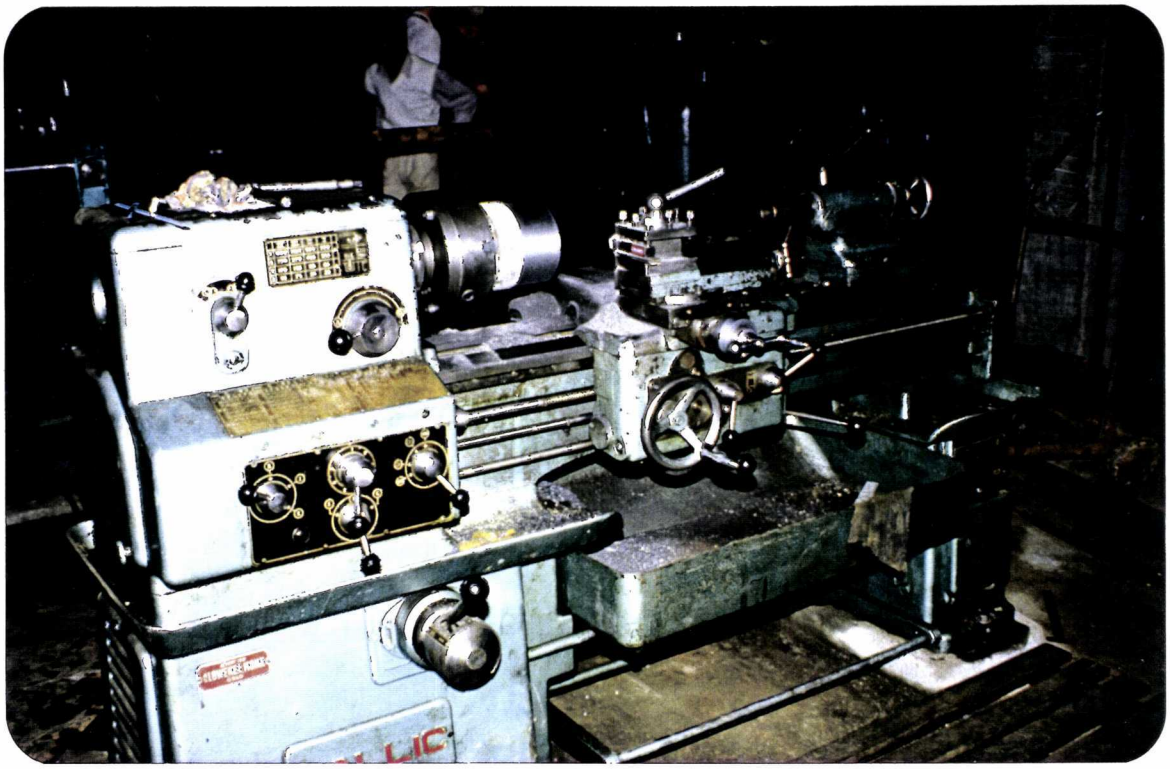
The tubular steel poles are made up of several conical steel modules, which can be placed inside each other to form a compact package for storage and transport. The modules are light enough to be carried by porters to remote sites.

NHE undertakes the supervision of the production from the bending of steel plates, welding and galvanizing to storage at the workshop. Part of the bending and welding work has been transferred to private local companies which has reduced the production time and cost. These companies often have workers which have their training period from the Technical Institute.

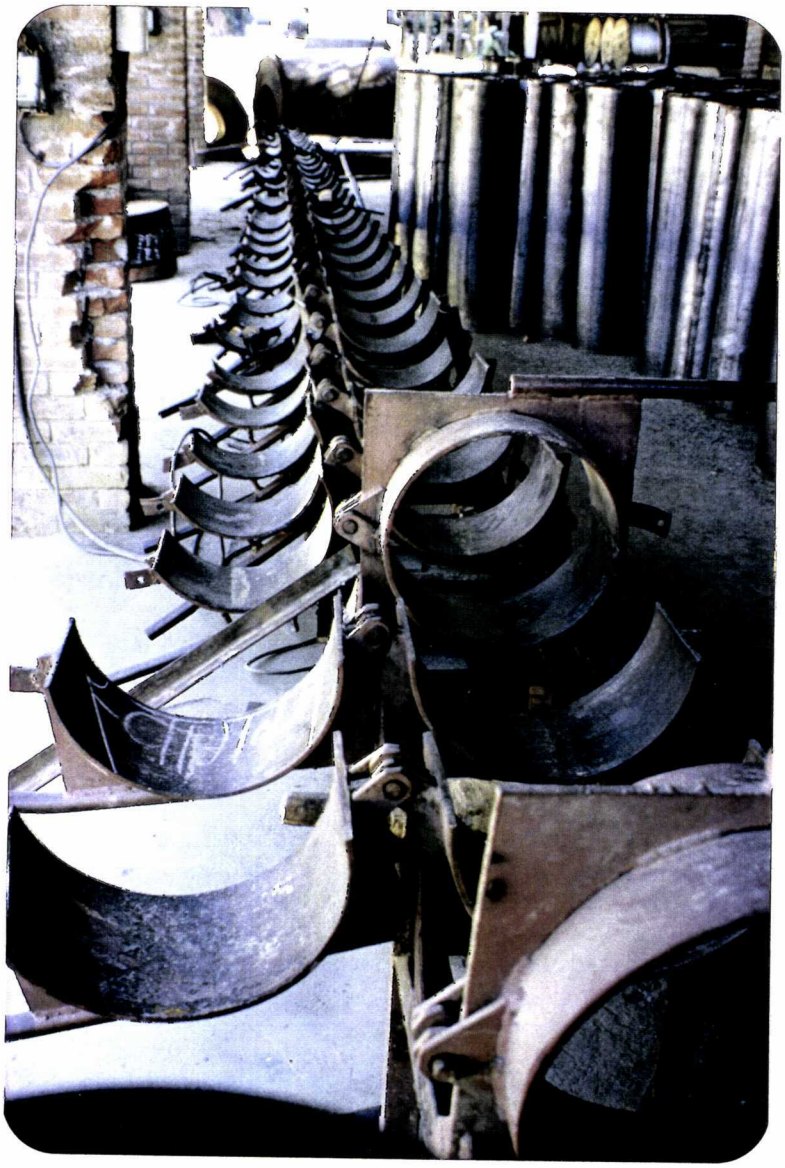
The idea behind the production of tubular steel poles should be considered to be transferred to other countries where NORAD is engaged within the electrical distribution field. Exept for the galvanizing plant, the production of the poles is very simple.

4.5 NHE Penstock Workshop

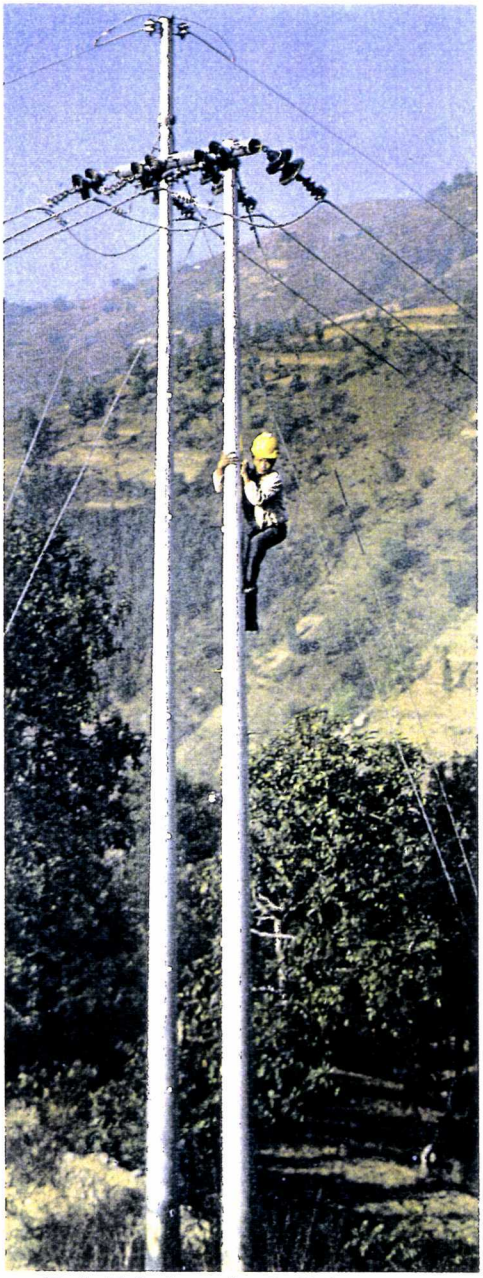
The Penstock Workshop is fully equipped to produce steel penstocks from steel plates. The workshop includes storage of steel plates, sandblasting, bending, welding and painting facilities. Quality control can be made by the use of instruments purchased for the Turbine Workshop.



Butwal. Secondhand workshop equipment.



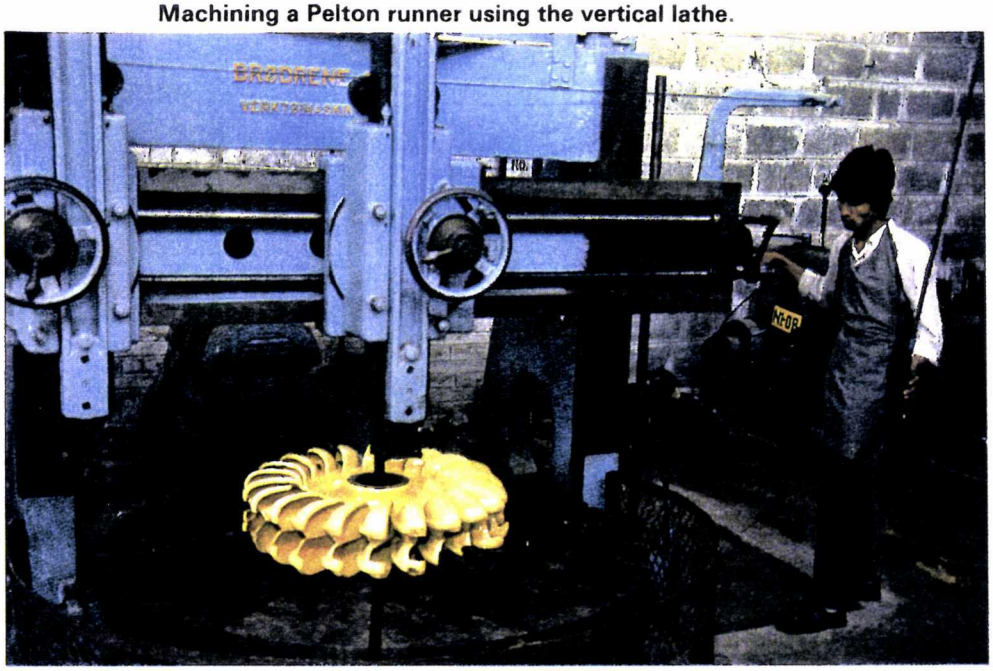
Butwal. Production of tubular transmission poles



Twin Tubular poles in Galyang, Syangja District.

Porters can easily manage even the heaviest sections.

Machining a Pelton runner using the vertical lathe.



5 Conclusion

The Butwal Technical Institute is a very important training activity which is the basis for all the industrial activities in Butwal.

Butwal Engineering Works (BEW) has been a pioneer within the design and production of especially adapted small crossflow turbines. To keep the costs down, the turbines are not high quality products. The cheap solution can be justified in Nepal, where the producer is not far away from the client. For export it is, however, considered necessary to use steel of higher quality.

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The idea behind the production of tubular steel poles should be considered to be transferred to other developing countries. Except for the galvanizing plant, the production of the poles is very simple.

The results UMN has achieved in Butwal are impressive. Although there is a policy to Nepalise the activities, we got the impression that this policy cannot be successful if the changes go too fast. The experiences from the Tinau powerplant can be an example of this.

We also strongly feel that the activities are difficult to copy in other countries. As far as we understand the results are heavily dependent on the presence of UMN over decades.

APPENDIX 3

ANDHI KHOLA MULTI-PURPOSE SCHEME

1 Introduction

The Andhi Khola project area lies in the southern part of Syangja district in west central Nepal. The project area consists of a low ridge lying between the Andhi Khola river to the north and the Kali Ghandaki river to the south. Pokhara lies 80 km to the north and Butwal the same distance to the south. The area is densely populated and intensively cultivated, with little forest and no major sources of water other than the two rivers.

The project area location is shown on page A3-10 and the project site layout is shown on page A3-11.

The Andhi Khola project is planned as an integrated rural development project consisting of

- a hydro electric power plant (5 MW)
- a rural electrification programme
- an irrigation scheme
- development of agriculture
- creating agro- and non agro based employment opportunities in the area.

2 The Hydro-Electric Power Project

2.1 Overall Design

The power project utilizes the difference in water level of about 250 m between the Kali Gandaki river and its tributary, the Andhi Khola river, at a point where the two rivers come within a distance of about 2 km from each other. Andhi Khola is a run-of-river project with daily storage provided during the dry season by flashboards on top of a 6 m high dam. The dam is a 60 m long concrete gravity type with an ogee crest and flip bucket spillway. An open canal leads from the intake to a desilting basin where there is a fish ladder to allow migrating fish to pass the dam. A 1.3 km long headrace tunnel leads the water from the desilting basin through the 300 m high ridge separating the Andhi Khola and the Kali Gandaki valleys. Water is then conveyed to an underground powerhouse through a 250 m long vertical steel penstock to three 1.7 MW Pelton turbines, and then along a 1 km long tailrace tunnel to the Kali Ghandaki river. Access to the power house is through a 250 m deep vertical shaft containing the penstock. Almost all the electro-mechanical equipment has been obtained from Norway at virtually no cost, apart from packing and shipping. The three 1.7 MW Pelton turbines were installed in the Mesna power station 1919 - 1926 and removed when the station was uprated. The crane at the shaft head had been ordered for a shipbuilding yard, but was never put to use. It has been modified in Nepal to meet project requirements.

Main Data for Andhi Khola Hydro Power Project

Design Output:	5 MW
Project Site:	South Syangja District
River Diverted:	Andhi Khola
Catchment Area:	444 km^2
Minimum River Flow:	1.4 m^3/s
Design Flood for Plant Operations:	1000 m^3/s
Diversion Weir Type:	Concrete Gravity
Weir Height:	6 m
Weir Length:	65 m
Daily Pondage With Flashboards:	43,000 m^3
Particles Removed by Silting Basin:	0.3 mm and Larger
Headrace Tunnel Length:	1340 m
Headrace Tunnel Section:	4 m^2
Surge Tank:	12 m^2 Surface Area
Vertical Entrance Shaft Depth:	240 m
Penstock Diameter:	1.1 m - 0.9 m
Gross Head:	246 m
Design Head:	238 m
Design Flow:	2.7 m^3/s
Power House Cavern Floor Area:	250 m^2
Turbines:	3 X 1.7 MW Pelton
Alternators:	3 X 2.2 MVA/5.3 KV
Tailrace Tunnel Length:	1040 m
Tailrace Tunnel Section:	5.2 m^2
High Tension Transmission Lines:	Approximately 80 km
Access Road:	1.6 km
Total Project Cost:	Rs 51 million

The main data have been taken from the Andhi Khola Feasibility and Preliminary Design Report, dated January 1982, /5/. The total costs have by now reached Rs 130 million, of which NORAD's part is appr. Rs 70 mill. (NOK 24.9 mill.).

2.2 Dam and Intake

The location of the dam is approximately 650 m upstream from the lower Galyang Bazaar footbridge. Narrowing of the river and visible rock made this point very favourable for dam construction.

The dam is a 6 m high and 60 m long concrete gravity type with an ogee crest and flip bucket spillway. The crest is designed for a 7 year return period flow. 1 m high flashboards are mounted on the top of the dam for the purpose of providing daily storage during the dry season.

The intake structure is on the left side of the river. It consists of a 2 x 2.5 m radial-gate-controlled undersluice, an intake grill with vertical bar elements and an intake chamber excavated in the left bank for settling out and flushing of sediments larger than 5 mm diameter.

The water is conducted through an intake tunnel and canal from the intake chamber to the desilting basin, 60 m downstream of the dam. The desilting basin is 21 m long by 5 m wide by 3 m deep and is diverted longitudinally by a concrete wall. Stop log slots at both ends of each side of the basin facilitate operation while the other is being cleaned or maintained.

A new concept for sediment cleaning will be tested at Andhi Khola. The concept is based on the uplift and gravity principle. A tube is placed at the bottom of the desilting basin and covers the openings through which the sediments shall be removed. The tube is filled with water. When cleaning is going to take place, water is let out of the tube. The tube is then lifted gradually, the openings become uncovered and the sediments can be flushed away through a canal under the desilting basin. When the cleaning process has been completed, water will again be filled into the tube which then will fall down and cover the openings. The advantage with this concept is that cleaning can take place while the power plant is in operation and at constant high water level.

Just downstream of the dam the water is directed towards the rock at the right river bank. This has caused some scouring.
It is difficult to say what the consequences will be if the process continues. To be safe, a concrete wall should probably be built to protect the bank from further erosion.

The dam has created a small intake reservoir. A former path has been inundated, which is of inconvenience to the population. Construction of a new path should be considered as compensation. Further, the farmers claim that a stretch of the river bank has been increasingly exposed to erosion due to the changes in upstream flow conditions. According to NVE experts on fluvial processes, this situation could be expected. The reason is a change in the natural conditions. Even though the riverbed were unstable with changing channels, the sediment budget were in balance. After the construction of the dam, the upstream gradient has decreased and more materials have been accumulated. Additionally, the base of erosion has been lifted. Therefore, the erosive forces attack the sides of the river at a higher level, where no natural armouring layer can prevent further erosion. The consequence is some loss of land.

Use of gabions should be considered for protection of the land. Only a limited stretch of the river banks would have a need for protection and the costs will be relatively small.

2.3 Waterways

From the desilting basin a 1340 m long 4 m^2 headrace tunnel conducts the water to the surge tank. The tunnel is fully masonry lined. From the surge tank the water is taken to the powerhouse through a penstock in the entrance shaft. The penstock is made of welded steel with a diameter of 1.05 m. Three branch tubes of 0.5 m diameter each carry the water to the turbines.
The tailrace tunnel is 1040 m long with 5.2 m^2 cross section.
This tunnel will also provide for ventilation of the powerhouse and serve as an emergency exit for powerhouse personnel if the entrance shaft exit should ever be blocked. The tunnel will therefore have a free water surface.

2.4 Power Station

The dimensions of the underground power plant are 90 m^2 cross section and 28.5 m length. Entrance to the powerhouse is through a vertical shaft which also contains the penstock.

The turbines are three 1.7 MW double-jet Peltons, each being designed for a flow of 0.9 m3/s. The turbines are directly coupled to three generators, each with a capacity of 2.2 MVA. Power will be carried up through the entrance shaft via three-phase 5.3 kV busbars to the ground surface where 5.3 kV/33kV transformers are located as well as control panels and different kinds of instrumentation.

3 Rural Electrification

One of the main purposes for the Andhi Khola project is rural electrification. The target area has a population of about 150,000 people.

Two 33 kV high tension lines have been constructed from the power plant. The line going south to Tansen connects Andhi Khola to the national grid and will hence provide a market for surplus power.

From the 33/1.0 kV step down transformers (usually 100 kVA), 1 kV distribution lines with small (1-2 kVA) single phase transformers are constructed for local electricity distribution. So far 450 households have been connected to the grid. The first area that was electrified was the Galyang Bazaar and next the Asardi village at the south side the Khali Ghandaki. Until the Andhi Khola power plant is put into operation, the supply comes from the main grid.

The Asardi electrification is a pilot project in the sense that the local population actively participate in the project and also in terms of technology, methods and tariffs used.

A users' organization has been created for the purpose of assisting in the construction of the distribution lines. The supply of and raising of wooden poles have been done by the

Andhi Khola. Dam and intake canal.

Use of electricity for low voltage cooking at the Asardi village.

help of the members of this organization. The value of this contribution has been calculated at 5.7% of the total cost for the Asardi installation. The users' organization is also responsible for collecting the electricity charges. Only small problems have so far occured.

The experience from Andhi Khola is therefore that the concept of an Electricity Users' Organization has proved to be useful for carrying out rural electrification.

Income from sale of surplus energy to the national grid will finance further rural elecrification in the area, on the basis of experiences gained from the pilot project.

4 Irrigation Project

Irrigation is one of the sub-projects of the Andhi Khola multi purpose project. The target area for the irrigation project consists of the hills south of Galyang Bazaar. The area initially planned for irrigation was 700 ha. Because of unfavourable ground conditions, the area currently planned to be irrigated is about 300 ha.

The following project description is taken from :
Project Proposal: AHREP Irrigation Scheme - UMN Nepal, /7/.

To implement the irrigation project, the Andhi Khola Multi Purpose Users' Association (AKWUA) has been created. Though the project will work with all the people in the target area who are interested in cooperating by becoming members of AKWUA, the primary beneficiary group will be that part of the people living below subsistence level. The total population in the area is estimated at approximately 15,000. Of these some 9,500 have signed as members of AKWUA and must be regarded as part of the beneficiary group.

The basic ideas for the Andhi Khola irrigation project are quite new and unproven:

- Water shares earned by contributing labour during construction of the irrigation system

- A limited land redistribution

Investments in traditional irrigation schemes tend to benefit only those owning land irrigated by the scheme. Having water rights linked to the size of the land contributes to an increased income gap. In order to counteract this weakness and ensure that investments in the irrigation scheme contribute to the objective of sharing the benefits among the target population at large, a system of water rights tied to the individuals rather than areas of land has been planned.

Briefly the system calls for issuing of water shares that give the holder of such shares the right to purchase a given share of the water that at any time flows into the irrigation system. The shares are in principle available to all individuals within a given area, regardless of any landholding, and can be leased for a period or traded. By limiting the amount of water any one person can take out of the system to approximately the water required for an agricultural production that feeds an individual, those owning more land

than required for subsistence will be in need of leasing or purchasing shares from those who have more than required. A share can thus become a stable source of income which in principle includes an inflationary adjustment.

In the case of this project, where financing of the scheme includes a substantial labour contribution on the part of the population, the initial cost of the share is valued in terms of man-days of personal labour or the monetary equivalent according to standard rates. By giving priority to the target population in selecting paid labour, it is anticipated that those with less wealth will receive an additional benefit. The same advantage will apply to this group in case of maintenance.

An important activity of the project so far has been to introduce this idea and develop it together with the population in the area. A major part of this work was already done by 1985 by including these elements into the constitutions and by-laws of a users' association (AKWUA) formed at this time. Some modifications of these constitutions and by-laws have since then been considered necessary.

About 10-15% of the households in the area own more than twice what is required for maintaining their families at subsistence level. Those households should, according to specific rules, sell up to 10% of their land to AKWUA. The poorest people should then have the opportunity to buy this land at cost price. However, it is not expected that those offered land will be in a position to raise funds to pay for this land. Providing funds to AKWUA in order that this institution can assist individuals or households with soft loans is an activity which has been regarded necessary to reach the objective of providing landless and marginal farmers with land for subsistence farming.

Construction of the irrigation project

Water for the irrigation system is taken from the headrace tunnel of the hydro power plant. A maximum of 1.3 m3/s is available for irrigation. The water is conveyed to a water chamber through a branch tube from the top of the penstock. Two main canals lead from this chamber, one to the east,the other to the west. The water is taken from the main canals into secondary canals at distribution points, for supply of individual- or groups of households. The distribution constructions have been designed so as to give exactly the right amount of water for each shareholder.

The extent of the main canals are 5.1 km to the east and 1.5 km to the west. So far 370 m to the east and 280 m to the west have been completed. Some work had also been made on the secondary canals. Total estimated need for work is 125,000 man-days, of which 3238 so far had been carried out.

5 Motivation and Training

Of the most important issues in a development programme are the motivation and training aspects. Considerable effort has been laid on this in Andhi Khola.

Introduction of electricity makes a need for training of the population of how to use it. It is, however, not only a question of mastering the technique. The new energy source may create conflicts with local culture and tradition. Information, motivation and teaching are

therefore key words in this context.

Important in the work are the motivators; local people who have been trained through cources given by UMN, and thereafter work among the population. Their work is not limited to the electricity sector, but includes also health, nutrition, sanitation etc.
The main target group for this work are the women.

The motivation and training work in Andhi Khola is judged as being a success, and the experiences gained will be very useful also for other development projects.

6 Job-Creating Projects

In addition to agriculture production, which is of most importance for the population in the area, it is also considered necessary to create new job opportunities. These can be agro- or non agro-related.

Even though the projects normally are small, the investments needed are higher than what is normally available in the community or with individual entrepreneurs.

The philosophy behind the establishment of new enterprises is that they should be economically viable. UMN is of the opinion that undue advantage should not be given to individuals by providing direct grants.

Credit fund

Based on the ideas mentioned above UMN has therefore decided to establish a credit fund for development of irrigation schemes and small enterprises under the name of Irrigation and Enterprise Development Fund (IEDF).

The objective of the IEDF is to provide credit and services to the poorer part of the population. The risk for bad debt is obviously present. To ensure sustainability IEDF must establish a different system for assessment of credit worthiness than traditional credit institutions. Social anthropological factors have to be taken into account.
The IEDF system will base its evavaluation on factors as :
- ability to save
- viability of business concepts

The credit given to new enterprises should start with small loans which gradually be increased, so as to reduce the risk of losses.

7 Conclusion

Based on written project material and our site visit to Andhi Khola we got the following impressions of the activities:

The hydro power scheme

The technical solutions for the hydro power scheme seem to be satisfactory. At the time for our visit the plant was in a test operating phase and would probably be fully completed

within a short time.

There were some problems with rock scouring just downstream of the dam and erosion of the right river bank in the pondage area. Measures should be taken to avoid these problems.

The overall impression of the power scheme is, however, good.

The rural electrification

The construction of the electricity distribution system seemed to progress well. The participation of the local population has proved to be successful. This is satisfactory as it is considered very important to activate the people in the project work.

The people in the area seemed to be motivated to make use of the new energy source. A visit to a household which had been supplied with electricity gave the impression that they were familiar with the use of it.

The irrigation project

The construction of the irrigation system is in the starting phase. Uncertainty is connected to the new ideas which this project is based upon, namely the earning of water shares through work contribution and to a little extent redistribution of land. Although people say that they are positive to the land redistribution programme, it turnes out that they often change their minds when theory becomes reality.

Also the earning of water shares by contributing labour is considered an uncertain process. At the time of our visit only little work had been done. However, experience from the construction of the rural electrification system indicates that people are motivated to make an effort to improve their way of living.

The risk of failure is obviously present. Especially the idea of land redistribution encroaches upon established socio-cultural and economic relations in the area.

Job-creating projects

The conclusions here are the same as for the irrigation project. The ideas are good, but failure might very well occur.

Key words for both the irrigation project and new enterprises should therefore be proper management and caution. One problem may be that the persons who have created the new ideas have now left Andhi Khola. The availability of experienced and skilled people for the project management is considered very important for the success of the project. Efforts should therefore be made to recruit the necessary expertise.

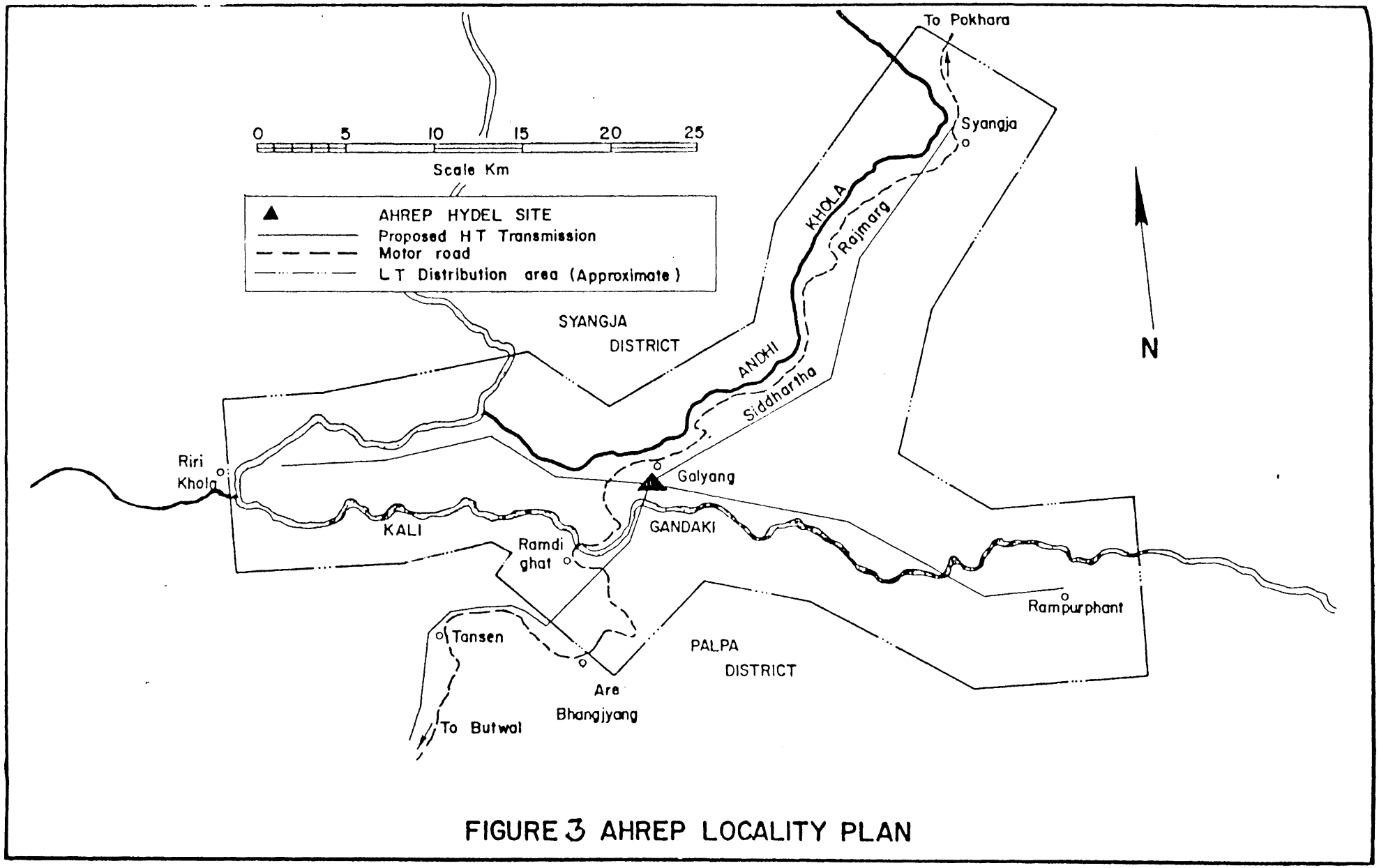

FIGURE 3 AHREP LOCALITY PLAN

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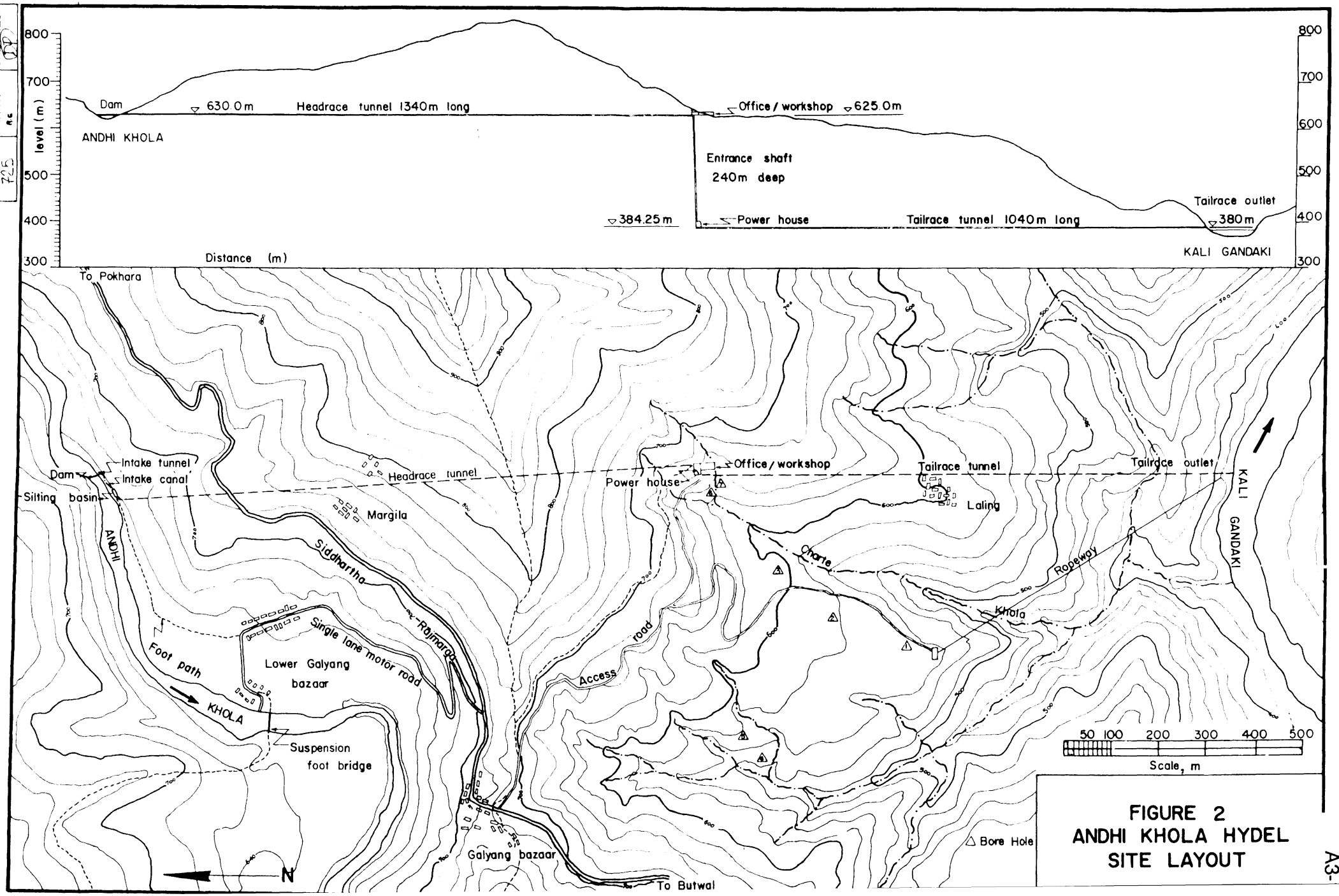


FIGURE 2
ANDHI KHOLA HYDEL SITE LAYOUT

APPENDIX 4

JHIMRUK HYDRO-ELECTRIC AND RURAL ELECTRIFICATION PROJECT

1 Introduction

The Jhimruk hydro-electric power project is located in Pyuthan district in the central western part of Nepal.

The project includes construction of a 12 MW power plant, 160 km of 33 kV rural transmission lines and 40 km of 132 kV transmission lines for connection to the main grid.

The main purposes for the Jhimruk project are:

1) Provide electricity, mainly peak power, for the national grid.

2) Connect the centres in four hill districts to the electricity grid. These districts are Pyuthan, Gulmi, Arghakhanchi and Rolpa.

3) Strengthen the Nepalese companies BPC, HH and NHE through the planning and construction of Jhimruk.

At feasibility level the total cost for the project was calculated at USD 20.170 mill., of which USD 19 mill would be grants from NORAD. The remaining USD 1.170 mill. would be financed by HMG and should mainly cover the compensation costs to the local population for land aquisition and local taxes.

The main data for the Jhimruk hydro electric power project are given on the next page.

Main Data for the Jhimruk Hydro Electric and Rural Electrification Project

Project site:	Pyuthan District
River diverted:	Jhimruk Khola
Catchment area	645 km2
Long term average flow	25.32 m3/s
Average minimum flow	3.2 m3/s
Spillway design discharge	2500 m3/s
Diversion weir type	Concrete gravity
Weir height	3 m
Weir length	275 m
Daily pondage with flashboards	82,000 m3
Height of flashboards	0.5 m
Headrace tunnel	D-shaped concrete lined
Headrace tunnel length	1045 m
Headrace tunnel cross section	7 m2
Surge tank cross section	7 m2
45° inclined shaft, length	265 m
Horisontal part	115 m
Penstock diameter	1.50 m
Gross head	210 m
Design head	201.5 m
Design flow	7 m3/s
Turbines	3 x 4 MW Francis
Generators	3 x 5 MVA
33 kV transmission lines	160 km
132 kV transmission lines	40 km
Total project costs (feasibility study, 1987)	USD 20.170 mill

2 Mobilisation, Access

Access to the project site is by road from the Butwal-Nepalganj highway at Lamahi, via Ghorahi. The road from Lamahi to the project site is a seasonal road, and especially the distance from Ghorahi to Jhimruk is in very poor condition and almost impossible to drive on during the monsoon. A new road is under construction from Bhalubang to Devistan.

The mobilisation area for the Jhimruk project is on the west side of the Mardi river. The mobilisation consists of:

- Housing for the BPC staff
- Housing for the HH staff
- Housing for the workers
- A guest house
- Workshops
- Stores

Access to the project site is over a suspension bridge which has been constructed across the Mardi river. Vehicles have to be taken across on the river bed when the water flow is low. A bridge will be constructed some distance downstream of the power plant site, near Devistan, as part of the Devistan - Pyuthan road. A ropeway has been constructed across the river for transport of light equipment, e.g. cement.

Offices both for BPC and HH have been built on the east side of the Mardi river, near the location of the power station.

Housing for BPC and HH staff

Houses of permanent and good standard have been built for BPC and the HH site personnel.

Housing for the workers

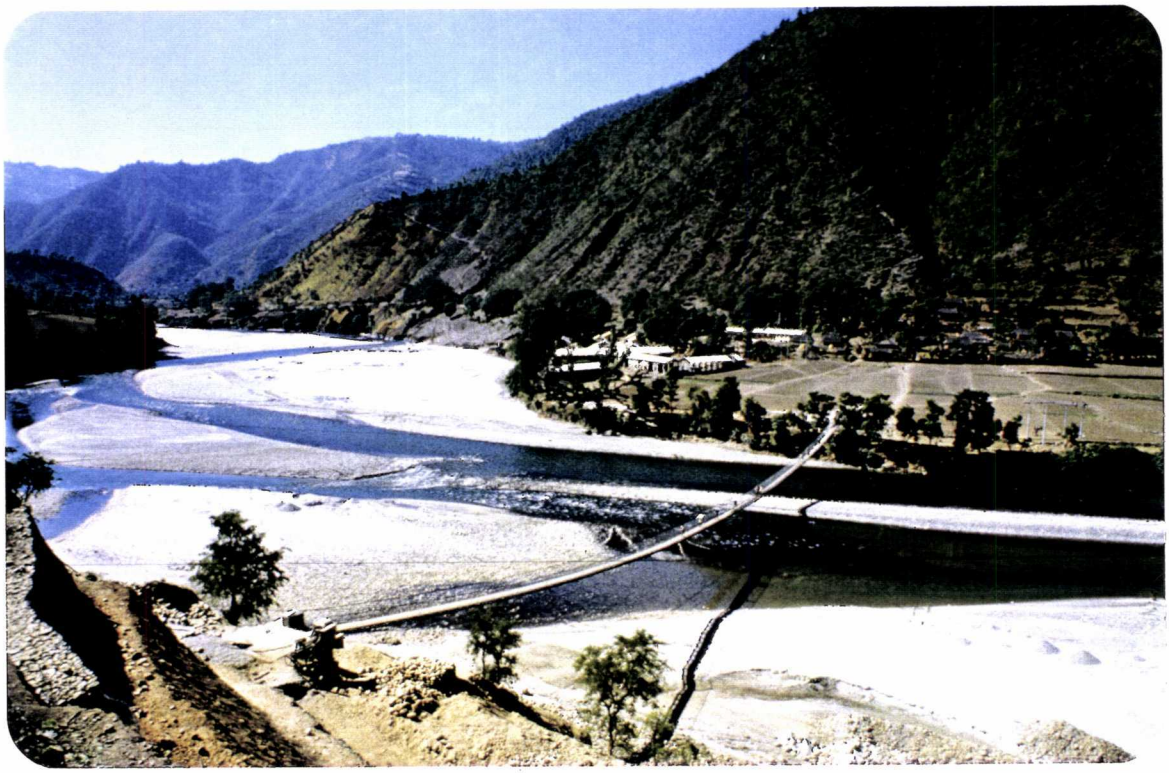
About 500 people are now working at the Jhimruk project site, of which some 200 are from outside areas. Some of these workers live in temporary houses, while others live in houses which have been hired.

Guest house

A guest house has been built at the site. It contains:

- 1 family room (flat)
- 4 rooms with 2 beds in each
- Kitchen
- Dining room

The standard is good



Mardi valley. Mobilization area with the suspension bridge in the foreground.

Mardi valley. Power house site.

Workshops, stores, etc.

The workshops and stores are in the project description said to be temporary. However, they are built of "permanent" materials, such as concrete blocks in the walls and reinforced concrete in the floor (vehicle workshop).

The dimensions of the stores and workshops are large compared to what is usual for a project of this type.
The reason for the standard and size was explained by the HH project manager Alan Butler:

There were no appropriate "temporary" materials available, so that the chosen construction materials were the cheapest solution.

It was considered necessary to have large store capacity because of uncertain/unregular supply of goods and equipment. During the monsoon period transport is obviously difficult. Experience has also shown that unforseen events are likely to occur. Examples are the trade blockade by India, strikes and unrest all over the country because of the political changes that have taken place and, as was the situation during our visit to Jhimruk, lack of diesel for some reason or another.

It was also said that the experience from Andhi Khola was important when dimensions and design of workshops were drawn up. At Andhi Khola all kinds of repair work had to be done outside, often in bad weather. It was not desirable to have a repetition of those conditions.

These are all sensible explanations of why the mobilisation looks the way it does. However, the mobilisation camp can in no ways be considered temporary. It is therefore important to think of how to use it in the future. This is a task for UMN.
The first step is to buy the land where the camp is located, and next to create suitable activities in the area. It was our impression that UMN already has some ideas for possible future projects.

3 Staffing

BPC

As the manager,detail planner and owner of JHEREP, BPC has several representatives on the site:

- The BPC Site Representative
  He is the main coordinator between BPC and the contractor.
- The BPC Deputy Site Representative
- 2 Civil Engineers
- 1 Senior Surveyor
- 2 Overseers
- 2 helpers

HH

Himal Hydro, the contractor for civil works, has a rather heavy staffing. The site organisation chart is shown in Annex 1.

There are many people in leading positions, probably too many to reach the optimal efficiency. The need for training of personnel was said to be the main reason for having so many leaders. One should, however, remember that the training aspect does not only include individuals, but also training of the whole organisation. In competition with other companies for contracts in the future it will be essential to have a smooth and effectively working organisation.

4 Construction Equipment

Compared to the construction of the Andhi Khola hydro power project, the construction methods used at Jhimruk are quite advanced. This is in accordance with one of the main purposes for the project, namely strengthening of the companies involved. By acquiring experience with modern machinery equipment HH will be strengthened for future tasks. BPC and HH have agreed that building up a stock of machinery equipment is to be a part of HH's profit. Furthermore, reference to experience with modern machinery, and ownership of such machinery, are prerequisites for being considered for larger contracts in competition with foreign contractors.

During our visit to the site, the following machinery equipment was at hand:

- 1 tracked excavator, (BPC)
- 1 wheel loader, (BPC)
- 2 diesel generators (BPC) + 1 (HH)
- 3 diesel compressors (BPC) + 3 (HH)
- 6 mixers (all HH)
- 2 tractors (BPC) + 2 on hire
- 4 4WD vehicles (BPC)
- 6 motorcycles, (BPC)
- Drilling equipment (pusher legs)

An Alimak rig will be used for the drilling of the inclined shaft. This rig has been used in Norway and has been bought from a Norwegian contractor company. It was now in Butwal waiting for transport to the project site.

2 dump trucks (BPC) are in transit, waiting to be taken to the project site.

The equipment marked as "BPC" will be turned over to HH as share investment in lieu of "profit" after the project has been completed.

5 Overall Design

Project lay-out is shown on drawing JHP /03/0001, page A4-14.

The Jhimruk hydro electric power scheme utilizes the head of approximately 200 m between Jhimruk Khola and Mardi Khola at a point where the two rivers come within a distance of about 1 km from each other, 25 km upstream of their confluence.

A 275 m long and 3 m high concrete dam will be constructed across the Jhimruk river. From the intake, the water is carried through a 1045 m long headrace tunnel and 380 m long penstock to the powerhouse. A tailrace canal takes the water to the Mardi river.

6 Dam Construction, Intake

Dam and intake design is shown on drawing JHP /04/2201, page A4-15.

The dam

The dam is a 275 m long gravity type about 3 m high. Detailed model studies have been carried out to decide the design of the dam. A brief description of the river laboratory and the studies carried out for the Jhimruk project is given in Appendix 5.

The dam will create an 82,000 m3 reservoir for daily pondage.
An area of about 16 ha will be submerged, whilst an additional area of land will be inundated.

The dam crest can be used as a road across the river except during flood periods.

Three gates with a total capacity of 300 m3/s will be installed in the dam, beside the intake structures. This will be sufficient to take all the water away most of the time under monsoon conditions.

The intake

The intake structures are located at the right river bank. From a side intake the water is taken into a desilting basin and then into the headrace tunnel. The sediments in the desilting basin will be removed through a flushing system.
The same concept for sediment cleaning which will be tested at Andhi Khola will probably also be used at Jhimruk.

Model studies have been carried out to decide the optimal design of the dam and intake structures.

Jhimruk valley. Area upstream of the dam.

Jhimruk valley. Dam site area.

7 River Training Works

The dam is located on a flat and wide river area where the river meanders. There might therefore be some difficulties in getting ahold of the water. To solve this problem a 1.5 km long canal will be constructed along the right side of the river and convey the water to the intake. The canal will be protected with gabions.

River training works will also be carried out downstream of the dam to avoid water flowing over the whole area.

8 Waterways, Tunneling

The waterway system consists of a 1045 m long headrace tunnel with 8 m^2 cross section, which conveys the water to the surge tank, and a steel penstock with a diameter of 1.5 m. The penstock is installed in an underground shaft with an inclination of 45°.

From the powerhouse the water flows through a tailrace canal into the Mardi river.

The tunnel works are to be carried out manually. Pneumatic, hand-operated equipment is used for rock drilling. An Alimak rig has been provided for the drilling of the inclined shaft.
Dynamite is used for the rock blasting.

An alternative to drilling and blasting of the shaft could have been to use a small tunnel boring machine (TBM). Rock conditions would probably be favourable to such a solution. Transportation of blasted rock from tunnel works at powerhouse level is made by the use of wheelbarrows. The barrows are loaded by using spades.

Rails will probably be laid for transport of rock out from the 1 km headrace tunnel.

Rock tip

The rock from the headrace tunnel will be placed in a gulley just outside of the admit tunnel. The masses will be formed in terraces with gabions in front on each level to keep them stable. A drainage pipe will be installed under the tip to protect against erosion.

9 Transmission Lines

The Jhimruk project includes construction of the following transmission lines:

1) An 85 km long 33 kV rural transmission line from Tansen to Jhimruk

2) 75 km of other 33 kV rural transmission lines

3) A 40 km long 132 kV line from Jhimruk to Lamahi for connection to the national grid

The Tansen-Jhimruk line will provide electricity for the project during the construction period. After completion, the Jhimruk power plant will supply the headquarters in four hill districts with electricity. These districts are Pyuthan, Arghakhanchi, Gulmi and Rolpa.

The manufacturing of poles and towers for the lines are carried out by NHE, while HH are doing the construction works.

10 Environmental/Socio-Cultural Aspects

10.1 General

The Jhimruk valley is a densely populated area where almost all the people make their living from agriculture. Most of the fields are located in the hills surrounding the valley, but there are also considerable areas of cultivated land on the valley floor. Most of these fields are completely dependent on irrigation water from the Jhimruk river. Many of the villages are also dependent on the Jhimruk river for supply of water for drinking and washing.

According to the project plans, all the water will be taken away from the river when the flow is less than the operation flow of the power plant.

An environmental study is currently being carried out on the Jhimruk project, /2/. This study focuses on the agricultural activities in the area and the use of water from the Jhimruk river for irrigation and water supply. The stocks of fish in the river are also registered, and possible impacts on the fish are evaluated. The study will be completed in summer 1991.

Socio-anthropological studies have also been carried out, /3/. A brief summary is given at chapter 10.4.

10.2 Destruction/gaining of land

Destruction of land

Approximately 16.5 ha of land of different quality will be submerged due to the dam construction and the creation of the small reservoir. An additional area of land will be inundated during floods. The exact amount of affected land will be given in the environmental study which is currently going on.

Gaining of land

The Jhimruk valley is wide and flat and the river is continously meandering. Areas available for agriculture change with time, and the lowest areas are often submerged during the monsoon and flood periods.

The intake canal and the canal downstream of the dam will be protected with gabions. The river will be diverted into the canals and the areas earlier exposed for flooding will thus be saved.

The net effect of the Jhimruk project is gaining of land. However, some people will loose their land, whilst others will get new land. Compensation to those loosing their land is taken care of by the Nepalese Government.

10.3 Irrigation, water supply

The lands dependent on irrigation water from the Jhimruk river and the villages having their water supply from the river must be ensured water also after the completion of the hydro power project. It is impossible by now to say exactly what will be the effects of the project as to downstream water flow conditions. There will probably be some leakages through the weir, but the volume is uncertain. Additional water must probably be provided, most likely by releasing the necessary amount of water from the dam. Another possibility which should be investigated is the drilling of wells. This could at least be a source of drinking water.

10.4 Socio-cultural aspects

Socio-anthropological studies on the Jhimruk project have been carried out by Um Gurung, Tribhuvan University and Dr. Harald Olav Skar, The Norwegian Institute of International Affairs, /3/. This study concludes that the project will have several negative impacts on the population in the area.
Um Gurung's report seems to be based on previous project design. The inundated areas of land are considerably less than stated in this report, and nothing is said about the gaining of land which will be the result according to the final project design. Another point focused on in Gurung's report is the lack of information to the people. They did not know what the project would mean to them and were therefore worried. The reason for this lack of information was, according to NHAM, that the plans were not completed at that time.

Skar's main objection to the project is that it is a straight- forward hydro power project with no elements of rural development related to it.

11 Projects which can be added in the future

Two of the main purposes for the Jhimruk project are electricity supply for the main grid and for four hill districts. Except for work possibilities during the construction period, the population will draw few benefits from the project.

From a development point of view , possibilities of creating new activities in the area should be considered. This should be an important task for UMN and it should also be in NORAD's interest to give financial support to new activities in the area.

Rural electrification to some extent should be considered and also small enterprises related to the availability of electricity. Experiences from Andhi Khola should be useful in this connection.

12 Conclusion

12.1 Project design

The waterway system with headrace tunnel and penstock is quite similar to what is usual in Norway. The success in implementation of this part of the project will to a large extent depend on rock conditions. Geological investigations and the tunnel works carried out so far indicate satisfactory rock conditions.

The main challenge at Jhimruk will probably be the headworks,
including dam, intake and river training works. Jhimruk, as all rivers in these areas, carries lots of stones, gravel and other sediments during the monsoon and flood periods. The construction of an intake system which functions under such conditions is difficult.

Alternative layout

At the time NVE was assigned to the project, the decision of overall design had already been taken, and NVE's role is as technical/economic adviser on the project as it is now designed. We would, however, like to mention one alternative layout which was discussed in the pre-feasibility report, but dropped: About 3 km downstream of the dam site the valley narrows.Technically this could have been a more favourable site for dam construction than the chosen site.The problems with inundation and drought of land would have been considerably reduced and the impacts of reduced water flow downstream of the dam would have been less.

The reasons for dropping this alternative were:

- The length of the headrace tunnel would increase
- Reduced head
- Difficult access to a power house furter downstream in the Mardi valley

12.2 Socio-cultural and environmental aspects

Social anthropologists have several objections to the project. Some of these objections are, however, based on a prefeasibility design which has since been considerably changed.
The main environmental impacts of the project as it is now designed are :

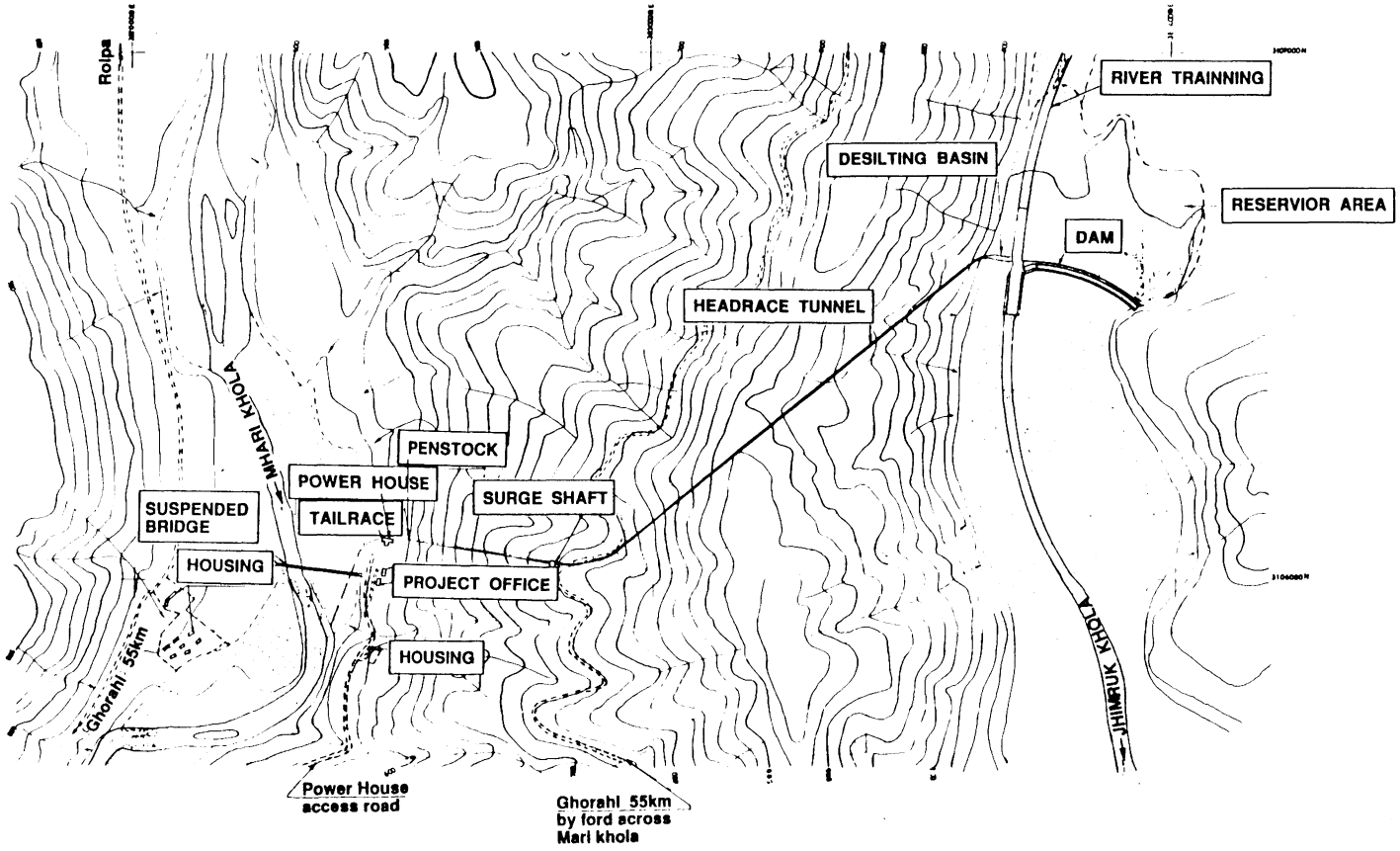
1) Lack of water for irrigation, drinking and washing downstream of the dam during the low flow periods.

2) Loss of land for some people

People who are affected by the project should get full compensation. Those loosing their land might get new land where waste land is reclaimed. Water for irrigation, drinking and washing should be secured either by releasing water from the dam, by drilling wells or in other ways, if there are any.
As a whole, the project will gain new farmland.

Compensation for land

So far money is given as compensation to those loosing their land. A better solution is probably to give other areas of land as compensation. Reclaimed government land may be available in the area. It was said that bureaucratic difficulties made it unrealistic to give this land to the people affected by the project. An effort should be made by UMN towards the Nepalese Government to make it possible to give land as compensation instead of money. After our visit we have been informed that a Secretary of the Government was positive to those ideas which probably would be the best for the population. It is, however, uncertain if the Government as a whole will give sanction for this.



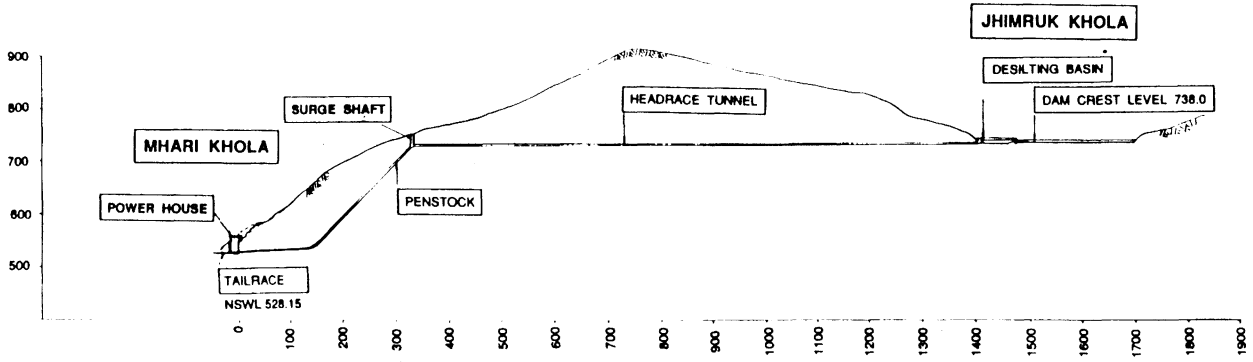
LEGEND

- Unsurfaced road
- Khalsa
- Bagar
- Khola

NOTES

1. ALL DIMENSIONS ARE IN METRES
2. LEVELS ARE IN METRES ABOVE SITE DATUM

PLAN



PROFILE

REV	AMENDMENT	APPD	DATE
A	RE - ALIGNMENT		NOV 1990

BUTWAL POWER COMPANY

JHIMRUK HYDRO ELECTRIC AND RURAL ELECTRIFICATION PROJECT

GENERAL LAYOUT

PLAN AND PROFILE

DATE FEB 1990 | DESIGN MDJ | DRAWN N

CHECKED MDJ | APPROVED CHH

ISSUED FOR CONSTRUCTION

By: Date:

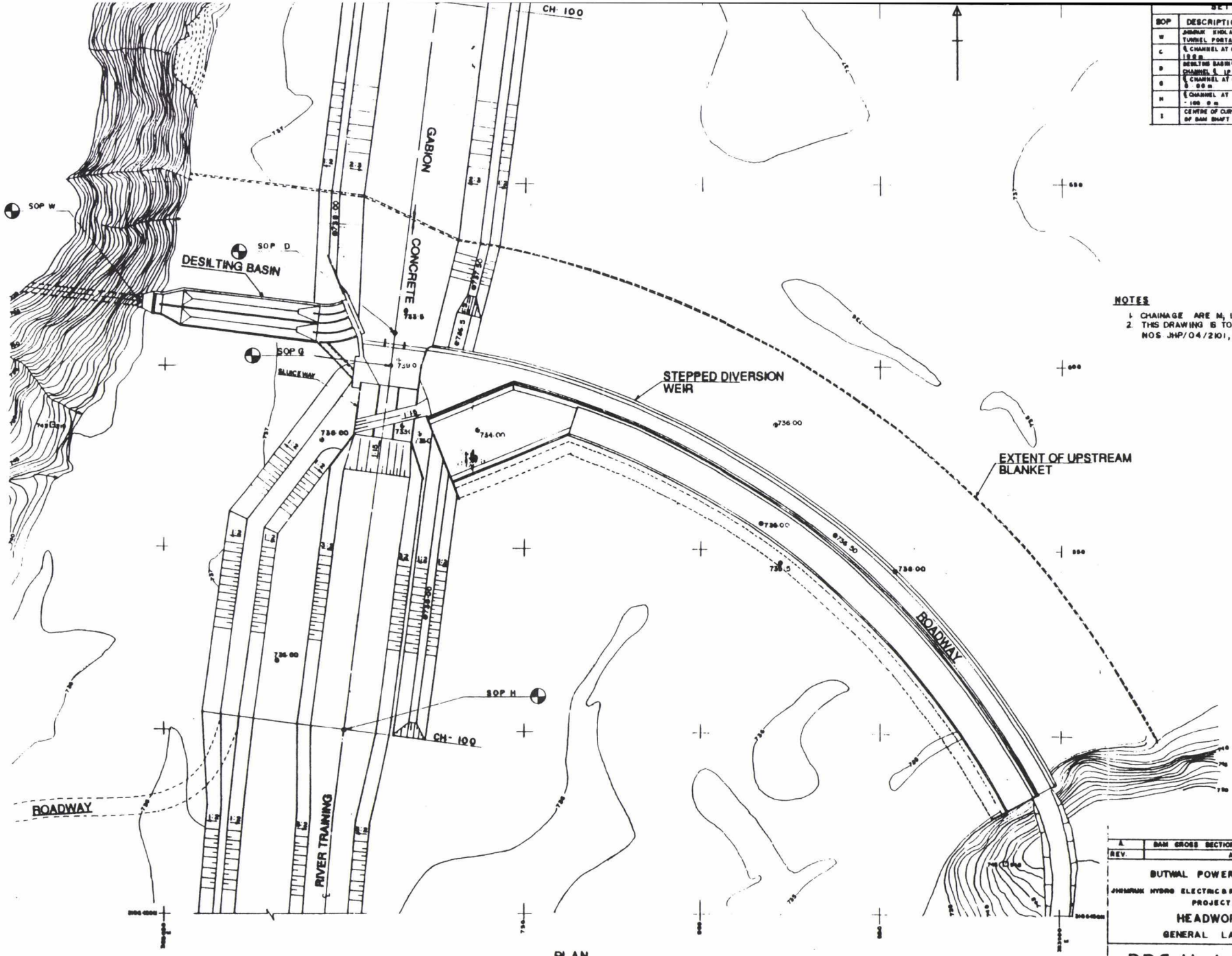
SCALE 1:5000

JOB NO JHP/03 | CONTRACT C3

DRAWING NO JHP/03/0001

BPC Hydroconsult
NEW ROAD
PO BOX 126
KATHMANDU
NEPAL TEL. 229021

A4-1



PLAN

SETTING OUT POINT

SOP	DESCRIPTION	NORTHING	EASTING
W	JHIMRUK KHOLA TUNNEL PORTAL	2906610.520	283642.634
C	℄ CHANNEL AT CH. 1980	2906690.540	283736.380
D	DESILTING BASIN ℄ & CHANNEL ℄ IP	2906680.600	283714.600
G	℄ CHANNEL AT CH. 0.00 m	2906860.640	283718.130
H	℄ CHANNEL AT CH. -100.0 m	2906699.640	283699.930
I	CENTRE OF CURVATURE OF DAM SHAFT	2906875.220	283686.400

NOTES

1. CHAINAGE ARE M, LEVELS ARE M ABOVE M.S.L.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH DRG. NOS JHP/04/2101, 2102, 2103, 2301.

REV.	AMENDMENT	APPD.	DATE
A	DAM CROSS SECTION SLUICEWAY		OCT. 1999

BUTWAL POWER COMPANY

JHIMRUK HYDRO ELECTRIC & RURAL ELECTRIFICATION PROJECT

HEADWORKS

GENERAL LAYOUT

DATE OCT 1999 | DESIGNED | DRAWN A | CHECKED | APPD.

ISSUED FOR CONSTRUCTION

By: Date:

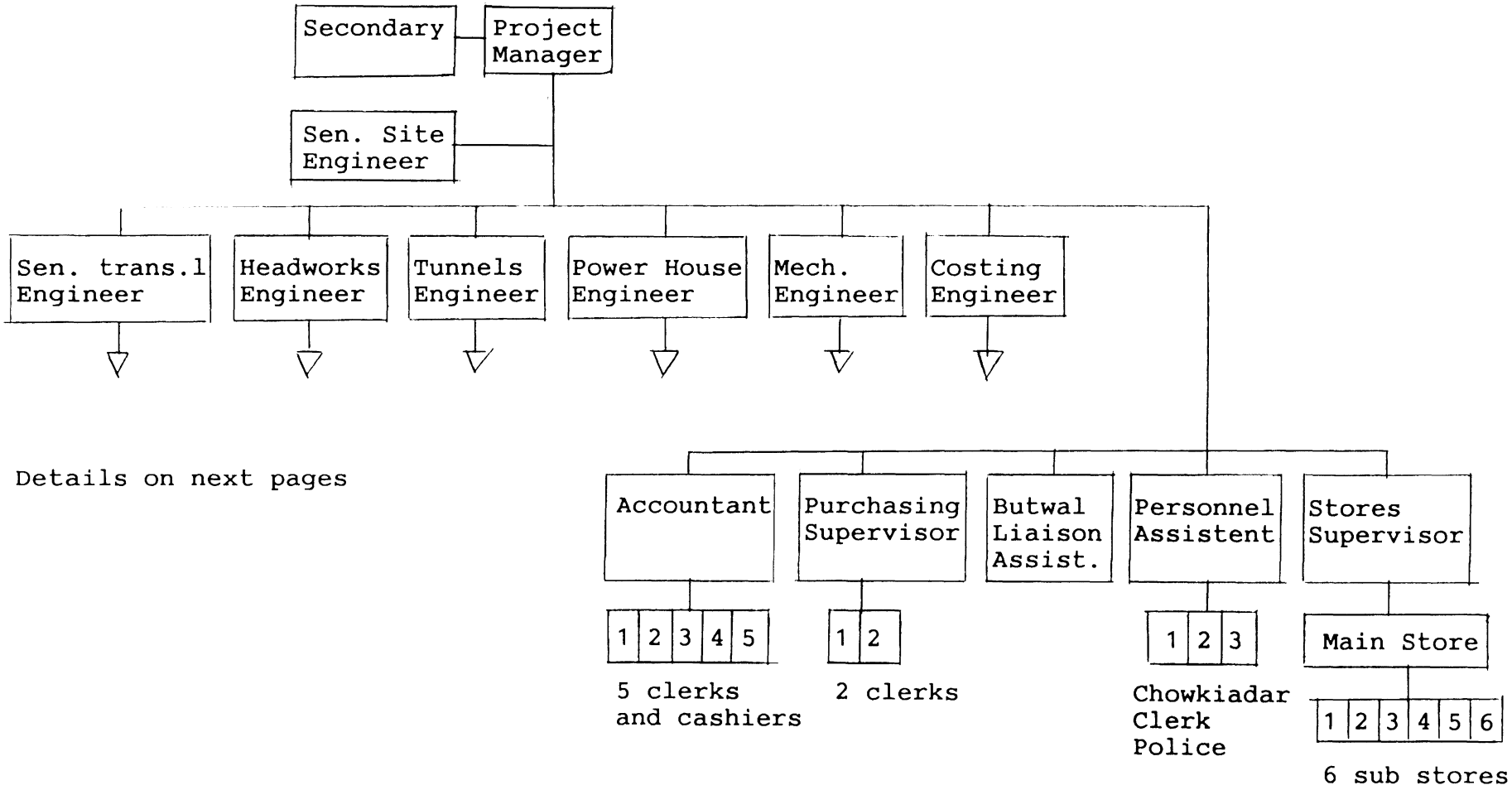
SCALE 1:500

JOB NO JHPY 04 | CONTR C3

DRAWING NO. JHPY 04/2201

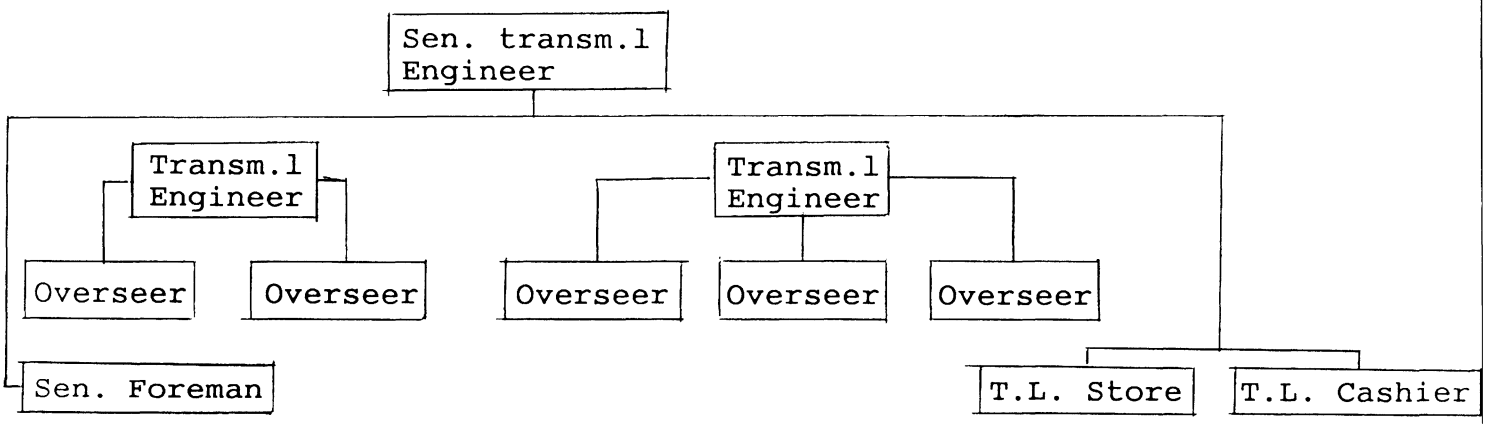
BPC Hydroconsult
NEW ROAD
P.O. BOX 126
KATHMANDU
NEPAL, TEL. 229031

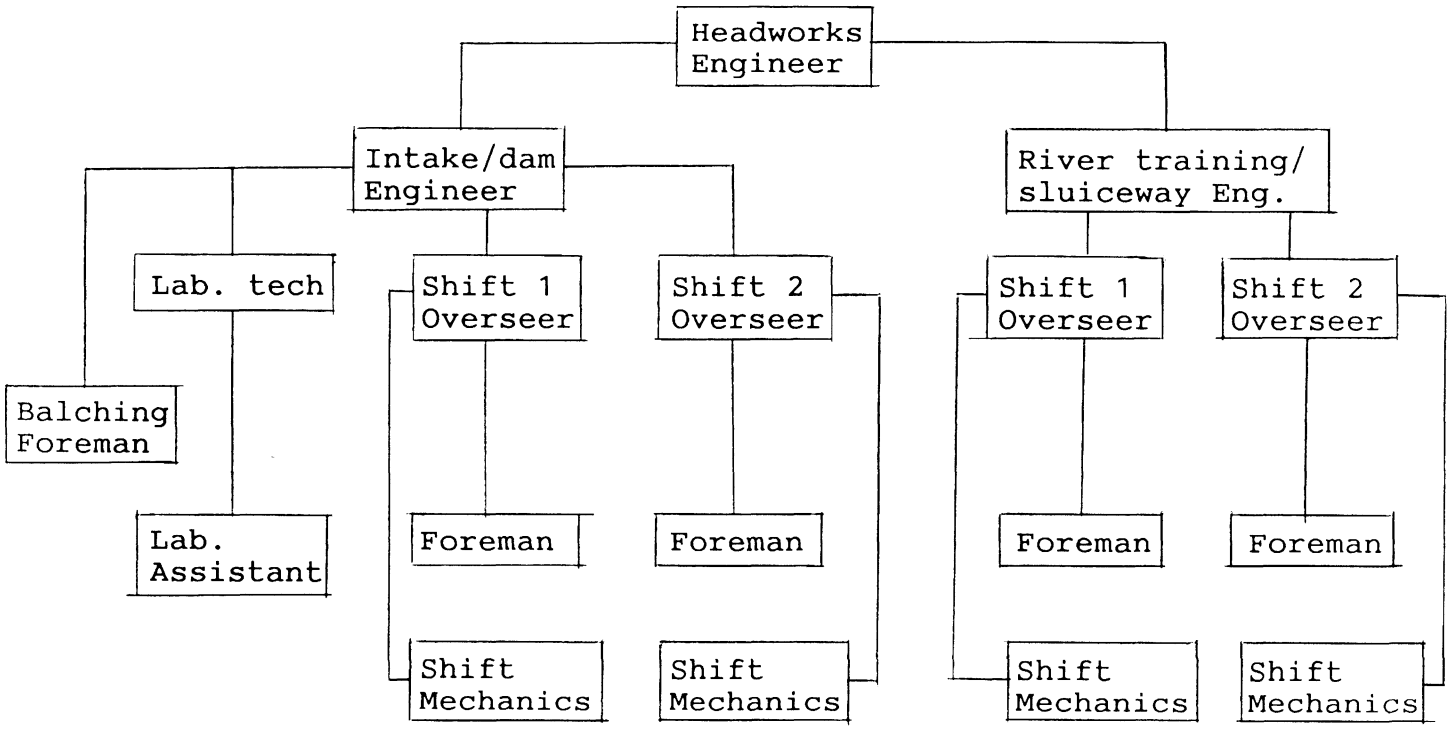
A4-15



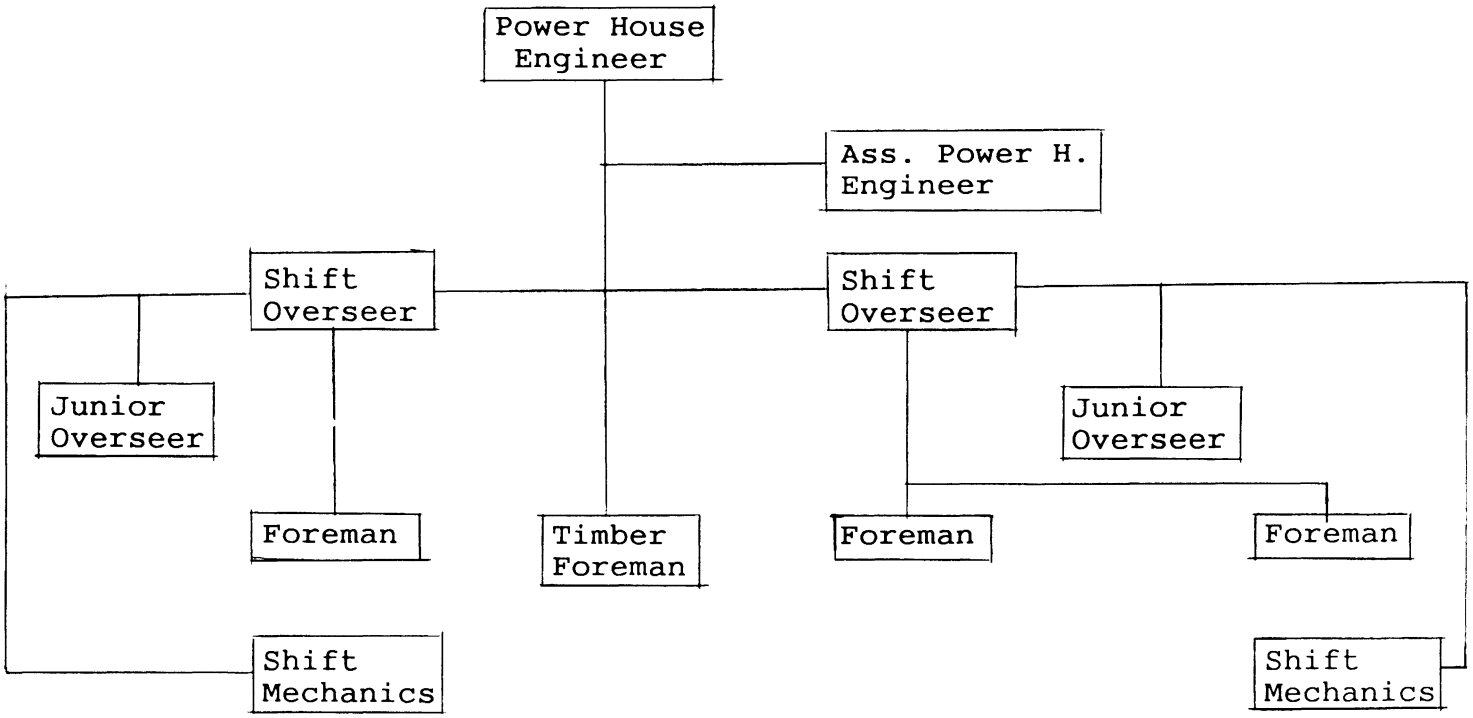
Project Organization
Main Structure

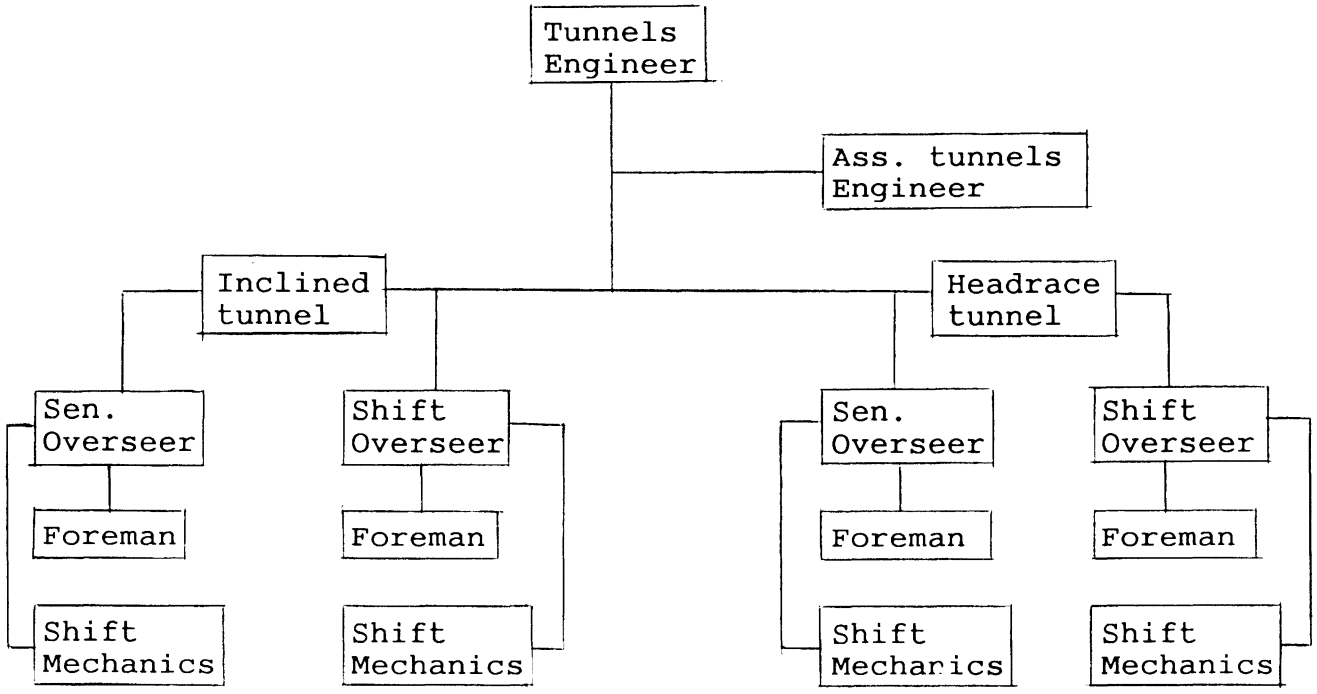
Annex 1
5 Pages



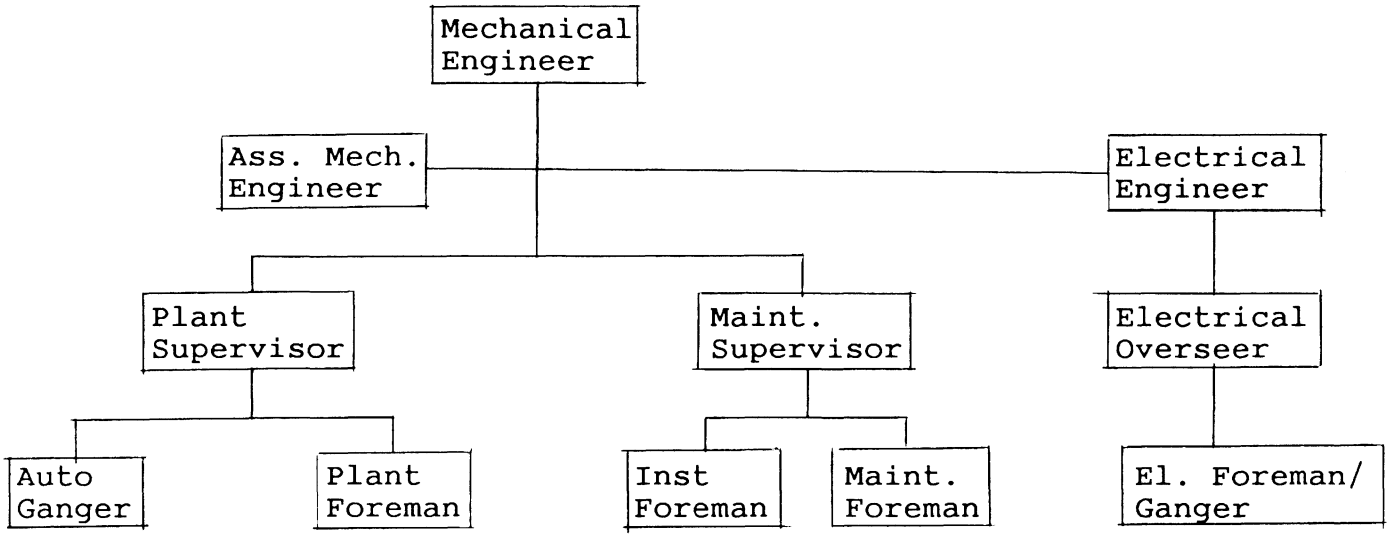


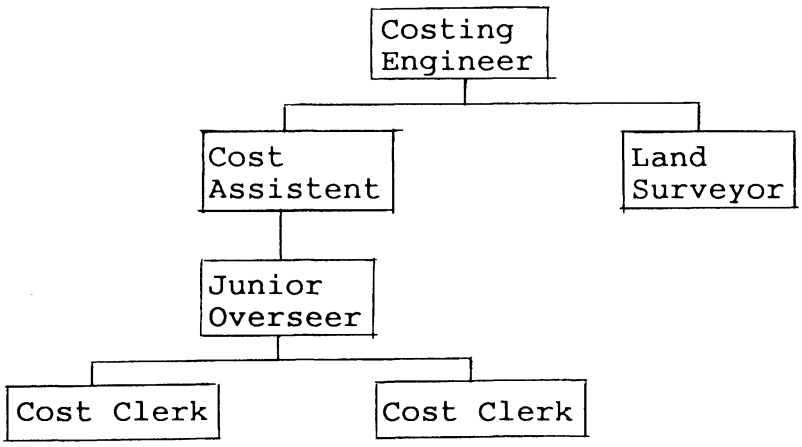
Organization
Transmission lines and headworks



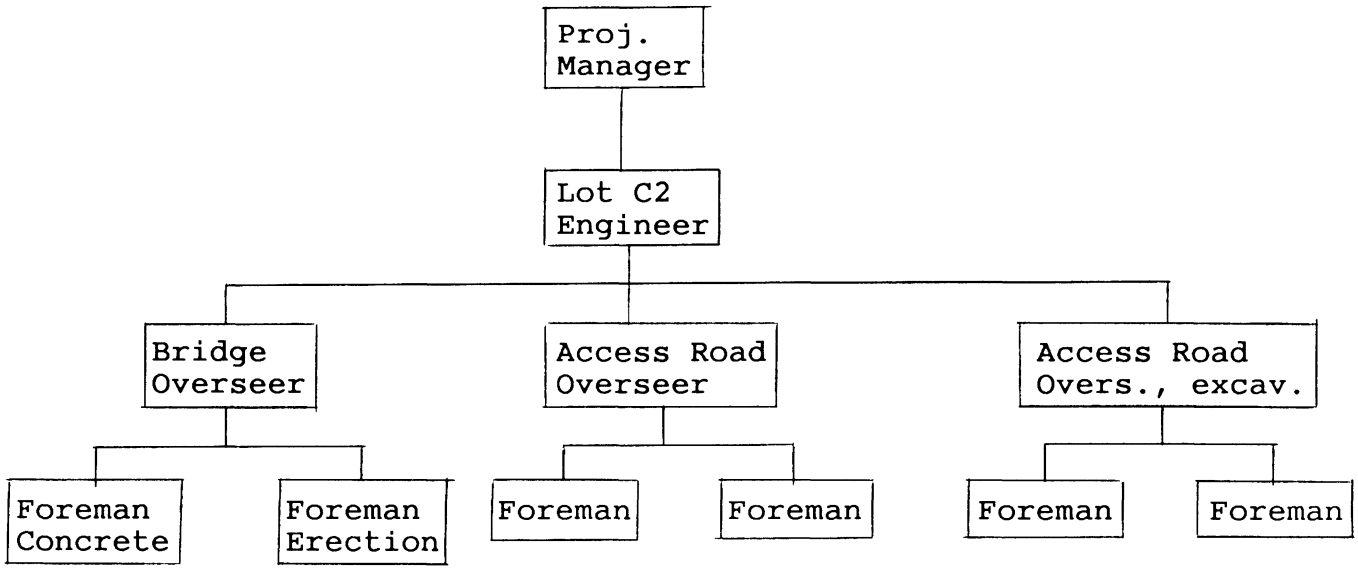


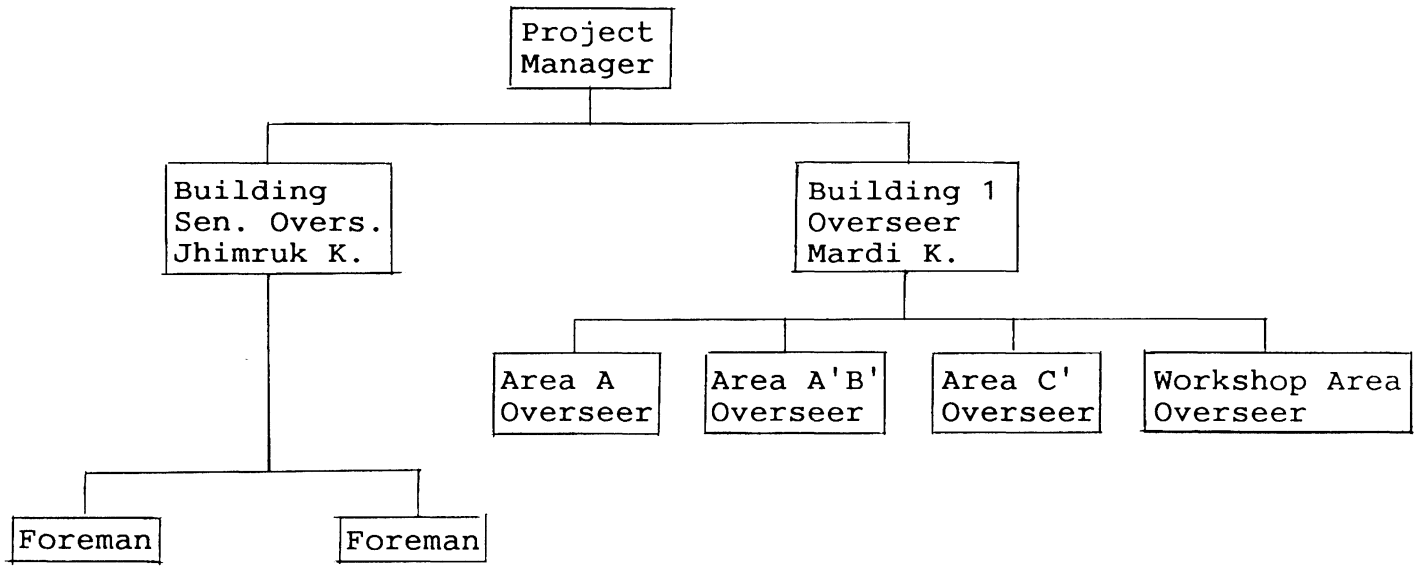
Organization
Power House and tunnels





Organization
Mechanical works and costing





Organization
Access road, bridge and buildings

APPENDIX 5

THE WATER RESEARCH LABORATORY IN KATHMANDU

1 Introduction

The water research laboratory in Kathmandu was constructed for the purpose of serving as a national laboratory. It has been financed by NORAD, and the Norwegian Institute of Technology (NTH) has assisted in the planning and construction works.

Jhimruk was the first project to be studied in the laboratory. The studies were managed by NTH pesonell and served as useful training for the Nepalese staff.

2 The Model for the Jhimruk Hydro Power Project

The Jhimruk model covers all constructions included in the headworks, and affected areas both upstream and downstream of the dam.

River training works upstream of the dam will be carried out by the construction of a retaining wall across the flood plain approximately 1.5 km from the dam site. The water will then be diverted into a channel which will be excavated along the right side of the river, down to the intake. The canal will be protected with gabions.

This solution will improve the conditions for the intake and reduce the periods of water inundating farmland on the left river side. Similar improvement for farmland downstream of the dam will also be studied, with the goal to gain new land also there.

A model demonstration was given with three different water flows :

1) 2500 m3/s (1000 year return flow)
2) 500 m3/s
3) 300 m3/s

The 2500 m3/s flow filled the pondage area with gravel whilst the intake was kept free. When the water flow decreased to 500 m3/s and later on to 300 m3/s the gravel was washed away, as it should.

A model for the desilting basin was also presented, although not demonstrated with water.

The question was raised if a rubber dam had been considered as an alternative to traditional dam construction. It had, but was found to be too expensive.

The model studies for Jhimruk have been run for quite some time, with many different designs both for the dam and the intake structures. The model presented to us is final, but additional studies may be carried out on upstream and downstream areas.

3 Future Use of the Laboratory

The studies on the Jhimruk project are almost completed. Discussions have been going on for some time about the future status of the laboratory. An agreement is at present in the final stage of processing. Parties to this will be the Tribhuvan University in Kathmandu, the Water and Power Authorities in Nepal and NTH.

APPENDIX 6

THE ROYAL NORWEGIAN MINISTRY OF DEVELOPMENT COOPERATION

C O N T R A C T

between

THE ROYAL NORWEGIAN MINISTRY OF DEVELOPMENT COOPERATION

and

THE NORWEGIAN HIMAL-ASIA MISSION (DEN NORSKE TIBETMISJON)

concerning

THE JHIMRUK HYDRO ELECTRIC PROJECT

The Royal Norwegian Ministry of Development Cooperation (hereinafter referred to as "the Ministry") and the Norwegian Himal-Asia Mission (hereinafter referred to as "the Organization") have agreed as follows:

1. The Ministry's obligation:

The Ministry shall, subject to Parliamentary appropriations, furnish the Organization with a sum of up to USD 19.000.000 (United States dollars nineteen million) (hereinafter referred to as "the Grant") which shall be utilized to finance the implementation of the Jhimruk Hydro Electric Project (hereinafter referred to as "the Project") which is described in Appendix I to this Contract.

2. The Organization's obligations:

The Organization shall be responsible towards the Ministry for the carrying out of the Project, and to this end the Organization undertakes:

2.1 To make sure that the Project is carried out on the basis of the Project plans, time schedule and budget contained in Appendix I, as well as the annual workplans and budgets referred to in section 2.2 below. Revision of the plans for the Project may be proposed by either party to this Contract in the event of this being indicated by the experience gained or by changes in the assumptions on which the Project plans are based;

2.2 to forward an annual workplan and budget for approval by the Ministry within 1 November each year. The approved annual workplans and budgets shall be attached as appendices to this Contract;

2.3 to effect purchases for the Project in such a manner as to obtain the most favourable terms in regard to price, quality, delivery date and maintenance facilities;

2.4 to keep the Project insured as laid down in Appendix I,4;

2.5 to deposit funds advanced from the Grant in a separate interestbearing bankaccount in Norway. Withdrawals from this account shall be used solely for the purpose of meeting Project expenses within the budget in Appendix I, and the annual budgets. Transfer of funds to the Project in Nepal shall take place as required in order to carry out the work in an efficient manner without unnecessary cash build up in Nepal;

2.6 to keep the Ministry informed as to the name of the auditors for the Project. Norwegian and/or non-Norwegian auditors are to be chartered or registered accountants;

2.7 to carry out Project operations in such a manner as to benefit the local inhabitants irrespective of race, creed or opinions;

2.8 to inform the Ministry as quickly as possible of any unforeseen events or developments which may have detrimental effects on the Project;

2.9 to arrange for full operation and proper maintenance of the Project until hand-over to His Majesty's Government of Nepal (see section 5.1 below);

2.10 to submit to the Ministry reports and statements of accounts in accordance with section 4 below.

3. Disbursements

3.1 The Ministry will disburse the amount needed for Project implementation by 1 January and 1 July each year (or as soon as possible thereafter) upon reception of a request containing:

- summarized accounts for expenses incurred in the preceding six months' period
- a specification of the estimated expenses in the next six months.

3.2 The Organization may apply to the Ministry for permission to use interest earned for project-related expenses. Interest earned may not be used without obtaining the Ministry's approval in advance. After the Project is completed, any funds not used (including interest) shall be repaid to the Ministry by the Organization.

4. Control - Reports - Statements of accounts

4.1 The Organization shall assist the Ministry in carrying out such control measures as the Ministry thinks fit in order to appraise the use to which the Grant is put,

and to appraise Project operations.

4.2 The Organization shall forward to the Ministry quarterly progress reports.

4.3 Within 9 months after the end of the Nepalese financial year (i.e. 15 July), the Organization shall submit annual reports along with audited statements of accounts to the Ministry.

5. Organization - Cooperation

5.1 The Project shall be carried out in agreement with the authorities in Nepal. To this end, an Agreement between His Majesty's Government of Nepal and the United Mission to Nepal concerning the Project shall be entered into. A copy of this Agreement shall be forwarded to the Ministry for information.

5.2 A memorandum of understanding between the Organization and United Mission to Nepal shall be entered into. A copy of this memorandum shall be forwarded to the Ministry for information.

5.3 A list of the Nepali companies involved in the Project is given in Appendix I,1. The organizational relationships shall be regulated in the agreements referred to in section 5.1 and 5.2 above, and contracts to be entered into during Project implementation.

5.4 The Norwegian Water and Electricity Board will represent the Ministry at a professional level in an advisory capacity, and shall be kept informed on the progress of the Project by receiving a copy of all reports submitted to the Ministry (ref. section 4) as well as additional information when asking for it.

5.5 In November each year, representatives of the Ministry, the Norwegian Water and Electricity Board and the Organization shall meet in order to review the progress of the Project and discuss the proposed annual workplan and budget for the following year.

6. Breach of Contract

The Ministry will demand repayment of all or part of the Grant if the Organization wilfully or negligently fails to fulfil its obligations under this Contract.

7. Disputes - Entry into force - Termination

7.1 If any dispute arises relating to the implementation of this Contract, there shall be consultations between the parties with a view to securing a successful realization of the purpose of this Contract.

7.2 This Contract shall enter into force on the date of its signature and shall remain in force until both parties have fulfilled all obligations arising from it.

7.3 Notwithstanding 7.2 above, this Contract may be terminated by either party at six months' notice in writing before the end of the months of June and December respectively, provided that the parties to this Contract shall make a mutually acceptable arrangement with regard to the completion of the Project, taking into consideration the Organization's obligation towards His Majesty's Government of Nepal in connection with the Project.

This Contract is drawn up in duplicate, one for each party.

Oslo, 7 feb. 1989

For the Royal Norwegian Ministry of Development Cooperation

Oslo, 7 februar 1989

For the Norwegian Himal-Asia Mission

APPENDIX 7

A G R E E M E N T

between

HIS MAJESTY'S GOVERNMENT OF NEPAL

MINISTRY OF WATER RESOURCES

and

THE UNITED MISSION TO NEPAL

on

THE JHIMRUK HYDRO ELECTRIC AND RURAL ELECTRIFICATION PROJECT

Whereas His Majesty's Government of Nepal (hereinafter referred to as "HMG/N") and the United Mission to Nepal (hereinafter referred to as "UMN") in 1965 established the Butwal Power Company Pvt. Ltd., registered on 14, Poush 2022, (hereinafter referred to as "BPC") to serve as an executing agency for carrying out Hydro-electric Development Projects,

Whereas HMG/N and UMN have been undertaking various hydropower and irrigation development projects within the Kingdom of Nepal,

Whereas HMG/N and UMN are desirous to further confirm their co-operative efforts by undertaking new projects in the field of hydropower and irrigation development,

Now, therefore, His Majesty's Government, Ministry of Water Resources (hereinafter referred to as the "Ministry"), and the UMN have agreed to implement the Jhimruk Hydel and Rural Electrification Project (hereinafter referred to as the "Project") detailed out in the attached schedule, as follows:

Article I.
THE PROJECT

1.1 The Ministry and the UMN agree to cooperate in the implementation of the Project and that the project during the period of its implementation (planning, design, construction and commissioning) shall be owned and managed by BPC of which HMG/N and UMN shall during this period remain the major shareholders.

1.2 At the end of the period of implementation (as defined in the attached Schedule or as subsequently revised by mutual agreement) BPC shall hand over the Project with all its assets and liabilities to HMG/N without any compensation, and HMG/N shall be obliged to take over the Project and thus relieve BPC and its shareholders from any further responsibilities with regard to the Project.

Article II.
FINANCING OF THE PROJECT

2.1 The total cost of the Project has been estimated to be US$ 19 millions and Nepalese Rupees 30 million.

2.2 HMG/N shall contribute the cost of acquisition of land, electricity for construction, part of the cost of additional ground investigations and model study, taxes and duties in Nepalese Rupees and UMN shall contribute the balance.

2.3 The contributions by either HMG/N or UMN may be in cash, in kind or in service. Such contributions shall be received by BPC as the respective party's share investment, and be used for the implementation of the Project.

2.4 Any dividend earned by UMN on its shares in BPC shall be reinvested in the BPC.

2.5 The accounts of BPC relating to the Project shall be open for inspection at any time by person(s) appointed for this purpose by either HMG/N or the UMN.

Article III.
RESPONSIBILITIES OF UMN

3.1 A major part of UMN's financial contribution to the Project will be provided by the Royal Norwegian Ministry of Development Cooperation (NORAD), with the understanding that UMN, during the period of implementation of the Project, shall remain the majority shareholder of BPC and through its representatives on the BPC Board of Directors and at the General Meetings of BPC shareholders, will see that the implementation of the Project is properly carried out by BPC.

3.2 UMN shall to the extent possible make available qualified expatriate personnel to fill such posts in BPC and its related sister organizations mentioned in 6.1 as may be required in order to carry out the Project in a professionally satisfactory manner, and for the training of Nepali personnel at all levels and in all positions. The service rendered by UMN expatriate personnel shall be accounted for as a part of UMN's contribution to the Project as per clauses 2.2 and 2.3 above.

3.3 UMN shall make BPC technically responsible for planning, detail design, construction, supervision and commissioning of the Project, and cause BPC to obtain necessary expert service in Norway with regard to the design and execution of

the Project, and to submit plans and design to the Ministry for its review and comment prior to commencement of construction work.

Article IV.
RESPONSIBILITIES OF HMG/N

4.1 HMG/N shall issue or cause to be issued promptly the licenses and permits which are required for the implementation of the Project, particularly with regard to the supply of materials and equipment which are needed, whether to be obtained within the country (timber, cement, etc.) or imported from abroad.

4.2 HMG/N shall make available to BPC the necessary land and access rights, temporary or permanent, including access to and right to take out stone, sand, etc., as may be required for the construction of the hydropower plant and the transmission and distribution lines.

4.3 Completion of the partly finished motor road from Bhalubang along the Madi river to the Project site, with necessary bridges, would greatly facilitate transport to the Project, especially of heavy power machinery. HMG/N shall endeavour to programme through the concerned Department of HMG/N to have this road completed at the earliest possible time.

4.4 HMG/N shall through the concerned Agency supply electric power for construction from a suitable point in the existing net.

4.5 HMG/N shall give permission to BPC for use of telephone radio communication equipment needed for maintaining contact between the various work sites and BPC' offices in Butwal and Kathmandu.

4.6 HMG/N by itself or through Nepal Electricity Authority (NEA) shall, to the extent possible and practical, make available qualified personnel who will be deputed to serve in BPC under BPC' regulations, as may be desirable in the course of implementation of the Project, and its future operation and maintenance.

4.7 HMG/N shall as deemed necessary issue non-tourist visas for all expatriate personnel (and their dependents) of BPC and related companies mentioned in Article 6.1 who are working for the project.

4.8 HMG/N shall bear the expenses towards the operation and maintenance of the Project from the date when commercial generation starts up to the date of hand-over as per Article 1.2.

Article V
FACILITIES TO BE GRANTED BY HMG/N

HMG/N shall grant the following facilities to BPC and companies mentioned in Article 6.1 in connection with the implementation of the Project:

5.1 Exemption from payment and/or deposit of Import Licence Fee, Customs Duty, Sales Tax, premium and any other import duties or taxes in connection with the import of machinery and equipment (including trucks, motorcycles and upto five nos. passenger-vehicles), materials and supplies for use in connection with the execution of the Project.

5.2 Construction equipment leftover after the completion of the Project will be turned over to HMG/N free of charge, with the understanding that HMG/N will hand over the same to

Himal Hydro and General Construction Company Pvt. Ltd as HMG/N's share investment in kind.

5.3 Exemption from payment of Sales Tax, Excise Duty or royalties on goods purchased directly from the manufactures within the country for use in connection with the execution of the Project.

5.4 Exemption from payment of local taxes or royalties of all sorts in connection with the execution of the Project.

5.5 Issuance of visas free of charge for the expatriate personnel who are required for the execution of the Project.

Article VI.
MISCELLANEOUS

6.1 HMG/N and UMN agree that it is an important objective of the Project to give contracts to Himal Hydro and General Construction Pvt. Ltd. and Nepal Hydro and Electric Pvt. Ltd. of whom HMG/N and UMN are major shareholders in order that these two companies may become viable instruments for serving Nepal in the development of Nepal's hydro power resources. Such contracts will be awarded on the basis of terms and prices negotiated by BPC.

6.2 Quarterly progress reports concerning the Project, will be submitted by BPC to the Ministry and to UMN, and BPC shall inform the same immediately of any event or development likely to delay the completion of the Project.

6.3 A Project Monitoring Committee consisting of representatives of the Ministry, NEA, UMN and BPC shall be constituted to review the progress of the Project on a regular basis.

6.4 Any of the provisions of this Agreement may be amended when mutually agreed upon by the parties of this Agreement.

6.5 Any difference between the parties arising out of the implementation of this Agreement shall be settled amicably by consultation between the parties.

6.6 This Agreement shall come into force from the date of its signing, and shall remain valid throughout the period of implementation of the Project.

6.7 This Agreement shall be subject to the terms and validity of the General Agreement between HMG/N and UMN dated 26th May 1985, or to any subsequent Agreement between HMG/N and UMN extending or replacing it.

6.8 This Agreement shall in all respect be construed and subject to the prevailing law of Nepal.

Done in Kathmandu on February 23, 1989 in two originals in English.

For and on behalf of
HMG/N Ministry of
Water Resources

(B. K. Pradhan)
Acting Secretary

For and on behalf of
United Mission to Nepal

(Howard Barclay)
Executive Director
and Chief Executive

APPENDIX 8

Letter of Agreement

JHIMRUK HYDRO ELECTRIC PROJECT, NEPAL

Summary of the Project:

The Jhimruk hydel project in Nepal is a high head scheme of 12 MW capacity. The scheme consists of a 275 m diversion dam on Jhimruk River, a 1 km long headrace tunnel, an underground powerstation, a 45 km long 33 KV transmission line connecting the power plant to the central grid and 135 km of 33 KV distribution lines for rural electrification. The estimated cost is US $ 20 million, of which US $ 19 million is to be financed by a grant from Norway. The project is planned to be implemented in the period 1989-1994.

Organizational Arrangements:

The contract between the Norwegian Agency for Development Cooperation (NORAD) and the Norwegian Himal Asia Mission (NHAM) concerning the project is attached as Appendix 1. Section 5 of this contract specifies the organizational arrangements for the project. These are summarised in the organization chart attached as Appendix 2. As stated in Sections 5.4 and 5.5 of this contract the Norwegian Water Resources and Energy Administration (NVE) shall represent the Ministry on a professional level and, together with the Ministry, participate in annual meetings. NVE shall also be kept informed on the progress of the project by receiving a copy of all reports submitted to NORAD (ref. section 4 of the contract).

Cooperation between NVE and NHAM:

NVE may provide relevant services in Norway with regard to the design and execution of the project - either on request from NHAM or at NVE's initiative if NVE judge it professionally necessary.

To provide these services NVE may also call upon technical/ economical/environmental expertise which is not available within NVE.

In addition to the above, site visits by NVE will also be necessary. These visits shall be carried out in agreement with NHAM.

Expenses connected directly to NVE personnel will be paid by NORAD. Expenses related to experts engaged from outside NVE may (if these are large) be charged to the project, subject to agreement with NHAM.

We would be grateful if you would indicate your agreement to these terms by signing the enclosed copy of this letter which we kindly ask you to return to NVE.

Oslo, 1. August 1989
place date

Egil Skofteland

For
The Norwegian Water Resources
and Energy Administration

Oslo, 1st August 1989
place date

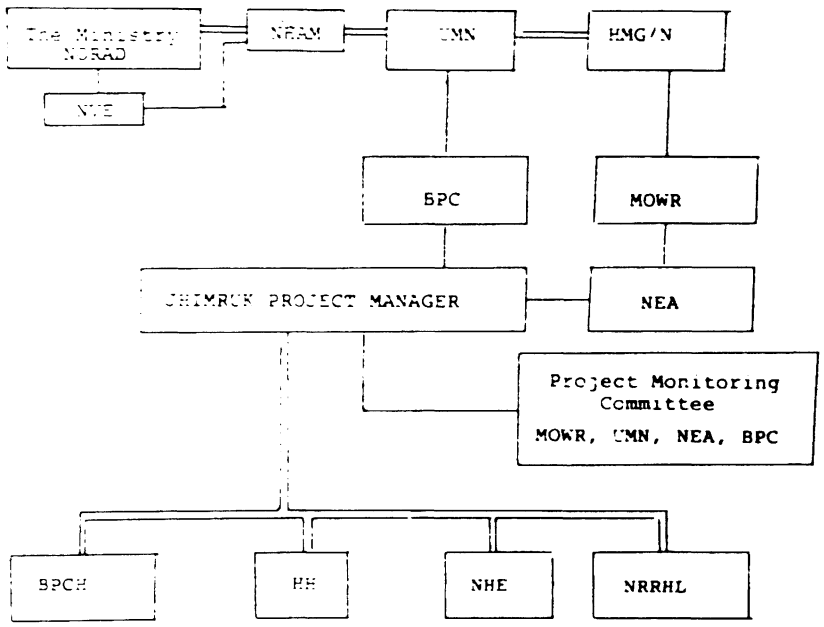
Einar Kippenes

For
The Norwegian Himal Asia Mission

APPENDIX 2

JHIMRUK HYDRO AND RURAL ELECTRIFICATION PROJECT

ORGANIZATION CHART



HMG/N:	His Majesty's Government of Nepal
MOWR:	Ministry of Water Resources
NEA:	Nepal Electricity AUthority
The Ministry:	The Royal Norwegian Ministry of Development Cooperation
NORAD:	Norwegian Agency for International Development
NVE:	Norwegian Water Resources and Energy Administration
NHAM:	The Norwegian Himal-Asia Mission
UMN:	The United Mission to Nepal
BPC:	Butwal Power Company
BPCH:	Butwal Power Company Hydro Consultant
HH:	Himal Hydro and General Construction Privat Limited
NHE:	Nepal Hydro and Electric Privat Limited
NRRHL:	Nepal River Research Hydro Laboratory

===== Contract/Memorandum of understanding

_____ Coordination/Control

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3.7.1991