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United Nations Industrial Development Organization

Seminar-Workshop on the Exchange of
Experiences and Technology Transfer
on Mini Hydro Electric Generation Unit

Kathmandu, Nepal, 10-14 September 1979

DRAFT REPORT

ON THE UNIDO/ESCAP/RCTT JOINT MEETING*

* With the support of the Government of Nepal through the National Council of Science and Technology, Nepal, and the Research Centre for Applied Science and Technology, Tribuvan University.

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I. INTRODUCTION

A. Background Information

Decentralization of power generation is now being generally accepted as a potential and expedient way of development of energy resources to meet the integrated rural requirements as well as to support projects and programmes for rural industrialization and decentralization of industries in developing countries. Efforts to achieve these objectives through the extension of centralized national grids in the past seem not to have always achieved the desired and expected results.

Most of the developing countries have rich and hitherto often not fully exploited hydrological resources in terms of scattered streams, rivulets, waterfalls, etc. It is felt that these resources could be profitably exploited through the establishment of decentralized mini hydro electric generation capacities. A number of developing countries have established such capacities generating power up to 1 MW or so and have thus been able to extend the benefits of modern technology to the rural areas. A number of other developing countries have long-term plans to establish such mini hydro electric generation capacities and have taken effective steps in this direction. There is yet a third category of countries which, although they have the necessary potential, have not considered, or were unable to develop their resources due to lack of requisite technical capabilities, and/or the need of external assistance in this regard. There seems to be much to gain from an interaction and exchange of experiences among these three categories of countries.

In connection with the development of a programme of activities of the ESCAP Regional Centre for Technology Transfer (RCTT), UNIDO, in co-operation with ESCAP and the ESCAP-RCTT, organized a meeting of Directors and Officers-In-Charge of the RCTT Focal Points of the ESCAP Region at the RCTT Headquarters in Bangalore, India in April 1978. The meeting identified as one of the priority areas of interest the utilization of hydraulic resources and the selection of mini hydro electric generating units. The meeting recommended that UNIDO and the ESCAP-RCTT take appropriate steps to find the ways and means of organizing a seminar-workshop focussing on this specific subject matter.

UNIDO in co-operation the the ESCAP-RCTT and with the support of His Majesty's Government of Nepal through the National Counoil for Science and Technology and the Research Centre for Applied Science and Technology has accordingly initiated plans to organize such a seminar-workshop. The plans could be implemented through the financial support of the Government of Norway through NORAD, the Government of Sweden through SIDA, the UNDP as well as the utilization of the available resources of UNIDO. Accordingly, the seminar-workshop took place at Kathmandu, Nepal from 10-14 September 1979.

B. Objectives

The objectives of the seminar-workshop were:

1. To discuss technological alternatives of the mini hydro electric generation system available and their relevance to specific conditions of application including their socio-economic implications, particularly in the developing countries.

2. To disouss few case studies and on-going projects in developing oountries with a view to projecting their problems and prospects in other developing countries.

3. To exchange information and experience on the availability of equipments and their applications as well as the possibilities of local manufacturing of the equipments and components in the developing countries.

4. To develop the basis of compiling a technological reference handbook on the development and application of mini hydro electric generation systems.

5. To establish a technological network of information exchange and co-operation among institutions and governmental organizations on a sub-regional, regional and interregional basis.

C. Organization of the Seminar-Workshop

The seminar-workshop was attended by 41 representatives from 23 developing countries and 27 representatives from 10 developed countries. Also present was a representative from OLADE. Representatives of the host organizations

NCST, RCST of Kathmandu and UNIDO, Vienna, ESCAP, Bangkok and ESCAP/RCTT, Bangalore were also present to organize and manage the seminar-workshop as well as to substantively participate in the discussions. The list of participants are attached as Annex 2 to this report.

The Seminar-Workshop was opened at the Conference Hall of Hotel Blue Star, Kathmandu, on 10 September 1979 with a welcome address by Dr. Ratna, S.J.B. Rana, Chairman, National Council for Science and Technology, Kathmandu. He stressed that in View of the growing concern for energy all over the world, this seminar was of great relevance to all developing countries and the subject of tremendous significance in that context. He felt that the organization of the seminar was timely as well as appropriate.

Dr. D.A. Butaev, Director of the Industrial Operations Division made a statement of behalf of UNIDO. He stated that the main idea of the seminar-workshop was to bring together many experts in mini-hydro power plants and to enable them to exchange their experience and knowledge on the design, construction and operation of these plants. He mentioned that UNIDO was engaged in a number of mini-hydro power generation-related programmes, and a study tour on mini-hydro generators was recently conducted in China by UNIDO. Also OLADE had requested UNIDO's assistance in the field of mini-hydro power units and more requests for assistance and proposals for co-operation were coming from developing and developed countries. UNIDO was confident that the results of this seminar-workshop would contribute favourably to strengthen national capabilities on the establishment of mini-hydro power units in many developing countries. Mr. John B. Melford, Resident Representative of the UNDP in Nepal, Mr. K.M. Dickshit of ESCAP and Dr. C.V.S. Ratnam of RCTT also made their statements.

His Excellency, the Honourable Minister for Water, Electricity and Irrigation, Mr. Marich Man Singh, stressed that in Nepal the development of hydro power generation was a condition of foremost priority and urgency in their efforts of development. Such localized power generation would be an expedient way of development of energy resources to meet the rural requirements as well as to support projects and programmes for rural industrialization. Minister Singh then officially inaugurated the seminar-workshop.

A vote of thanks was made by Dr. K.L. Shrestha, Member-Secretary-NCST and Executive Director of RECAST, Kathmandu.

At the plenary session the seminar-wrokshop elected as Chairman Mr. B.M. Singh, Chief Engineer, Department of Electricity, His Majesty's

Government of Nepal, and as Rapporteur Mr. W. Choudhari, Chairman, Power Development Board, Bangladesh.

In order to assist the workshop Rapporteur, Messrs. Premani of Thailand, A.N.S. Kulasinghe of Sri Lanka and U. Kyaw Thein of Burma were elected as friends of the Rapporteur. Furthermore as the seminar-workshop was to go into three working groups, the following Chairman and Rapporteurs were proposed and nominated.

Group I - Technology Aspects

Chairman - Mr. A.N.S. Kulasinghe, Sri Lanka

Rapporteur - Mr. E.M. Indocochea, Peru

Group II - Economic Aspects

Chairman - Dr. S.B.T. Englessen, Sweden

Rapporteur - Mr. D.L.B. Kamara, Sierra Leone

Group III - Policy and Institutional Aspects

Chairman - Mr. A.G. Vinjar, Norway

Rapporteur - Mr. E.R. Piamonte, Philippines

After adopting the Work Programme (Annex 3), the seminar-workshop then proceeded by hearing summary presentations of the country papers and case studies prepared and submitted by the participants. The outline of these presentations are given in Part II of this report.

On the second day of the seminar-workshop, the group had the opportunity to visit a mini hydro electric generation site in Gajuri, approximately 64 km. from Kathmandu. The Gajuri rural hydro electric station with a generation capacity of 25 kWs. in situated in the village of Gajuri with a population of 7,000 on the left bank of river Trisuli. The project was implemented with the active participation of the local population and with the minimum financial implications (Rs. 2,71, 641=81).[1/] The participants found the visit most useful for the disoussions which were to take place, particularly in respect of the conceptual approach and method of implementation of mini hydro generation projects.

The seminar-workshop then proceeded into group discussions by dividing the participants into 3 working groups. The discussions, findings and recommendations of the 3 Groups are provided in part III of this report.

The final plenary session was held on 14 September 1979 where each group report was presented and discussed. The final report was then adopted which included specific recommendations of action on high priority emerging from the discussions.

Also Resolution for International Co- operation was adopted, and decided to be referred to as THE KATHMANDU DECLARATION which is attached as Annex 1 of this report.

1/ Exchange Rate Rs. 11-90 to US dollar

II. SUMMARY OF COUNTRY PAPERS

A. Developing Countries

ESCAP Region

1. Bangladesh

At present there is no mini hydro development in the country, although possible locations exist in the northern as well as eastern part of the country. At present, planning and institutional arrangements are not available for conducting studies related to the development of mini hydro plants. Assistance from friendly countries as well as UNIDO would be necessary in the development of such institutional factilities. The existing manufacturing capability in the country could also be geared up for production of mini hydro electric equipment training and other mini hydro development is proposed in non-grid areas. It is therefore felt that, with some assistance from friendly countries and aid giving agencies, it would be possible to build up an organization to conduct thorough surveys and implementation of mini hydro projects.

2. Burma

The hydro power potential in Burma is estimated to be around 24,000 MWs out of which only about two percent has been exploited. Presently a capacity of 1,000 kWs or less is being considered as mini hydro power plants and some are being considered for implementation by the Electric Power Corporation (EPC). The Government has given the guidelines to take up such a programme on technically feasible locations in the non-grid area, only where a community is under-developed and accessibility is difficult. Presently 29 sites have been under study and a programme has been taken up for implementation of these projects.

3. People's Republic of China

The Chinese Government has attached great importance on hydro power development and the present plan envisages the establishment of a 10 MW capacity of mini hydro plants in countries. The manufacturing capacity of China can add 1,000 MW annually. All hydro as well as mini hydro equipment has been standardized. Presently China is fully capable of manufacturing hydro plant equipment up to 12,000 MW capacity. Over 8,000 mini HW plants have already been completed in the country which are mostly

owned by communes. The Government has taken the initiative for development of such plants to meet the needs of domestic and other agro-based industries within the communes. This has also accelerated simultaneous development of agriculture as well as fisheries in rural areas. The mini hydro generation has been found to be very reliable, durable and very simple in maintenance with high efficiency.

China is presently capable of providing guidance to other developing countries in this respect and heartily welcomes visits by experts of other countries. The development of large scale hydro potential was possible due to soft financing to the communes of the Chinese Government so that increased production of plant and equipment provided an incentive for rural electrification.

4. India

In India power is a state subject. There are 23 states and some union territories, where power development has been made with the assistance of the central government. The power and irrigation being a state subject, the states have their own Electricity Boards, who do investigation, execution of projects, transmission and distribution of power in their respective states. However, the entire planning of development of power plants, technical sanction and clearance of power projects is done by the Centre through Central Electricity Authority, Ministry of Energy. The CEA also gives consultancy services to Union Territories and other states when asked for. Presently 32 mini hydro plants are under construction in different regions and more than 100 units are in operation. The country is completely self-sufficient in the design and manufacture of all types of electrical and mechanical equipments. The cost per kW of mini hydro installation has been found to be between Rs.8000 and Rs.14000 per kW of mini as well as micro power development and is mostly confined to hilly regions in different states. The design of such plants are constantly reviewed by the CEA with a view to bringing economy as well as improvements. The manufacturers in the country have also developed standard designs with inbuilt flexibility for diverse hydraulic conditions as well as equipment input. While designing such plants, manufacturers have laid emphasis on fool-proof operation and maintenance with little training to local operating personnel.

Although the quantum of power available through such stations is small, the contribution to the total energy generated from MHG and socio-economic aspects in the backward area of the country should be recognised. It is felt that technology transfer could take place on an international basis. The technology and expertise developed in India has reached a stage where it can assist other developing countries and such assistance has since been given to some developing countries like Bhutan, Afghanistan, Fuji, etc.

5. Iran

The paper states that many areas in the country are still deprived of electricity since national grid is limited mainly to urban areas. The mini hydro can potentially meet the requirements of at least part of such areas. It was suggested that proper soil and water survey is very important to make use of surface and underground water in various parts of the country. Assistance from international agencies would go a long way in the development of isolated regions through electrification.

6. Malaysia

The participant stated that development of rural electrification has been given utmost importance by the Government. A programme has been taken by the National Electricity Board (NEB) to double the generating capacity by 1980. The rising cost of fuel has now switched over to the development of mini hydro plants. Assistance from other countries would be needed on technical and economic aspects of mini hydro electric generating plants. A workshop like this would go a long way to help developing countries.

7. Nepal

It is stated that since 60% of the population in Nepal live in remote hilly regions, His Majesty's Government has given emphasis for integrated development of the remote areas with a view to developing agro based industries, animal husbandry, dairy farming, sheep breeding etc. Priority has been given to rural electrification by developing mini hydro potentials. Two mini hydrostations are already in operation. The Government had already taken up 1 " projects with a total capacity of 2850 kWs, which are expected to be completed by 1983. It has been felt that cost benefit ratio may not be taken as sole criteria for such development, since participation of local people and usage of local materials are considered of prime importance.

The Government has established an autonomous board with the responsibility for constructing mini hydro stations in the remote hilly regions.

There is also Rural Electrification Division under the Department of Electricity dealing with microplants constructed with people's participation and also does rural electrification of the areas which are not covered by the corporation and are not economically feasible. The dependence on import components, on such schemes, is proposed to be reduced to a minimum, and further cost reduction is envisaged by minimizing civil works and manufacturing electro-mechanical components within the country. In this context assistance from various aid giving agencies has been sought. The Butwal Technical Institute, Nepal, has also developed the design of a cross-floor turbine suitable for local manufacture by adapting to local conditions. While planning mini hydro plants, it is thought that, at present, full utilization is considered to be possible within two to three years.

8. Pakistan

The paper states that in Pakistan mini and micro hydro potential exists in the mountainous regions on small rivers and streams, and in the plains on the canals. Investigations carried out by the Government Agencies has resulted in the development of mini and micro hydro sites ranging from 1 kW to 400 kW. In 1974, the Government of Pakistan purchased 100 standard sets of 50 kW and 100 kW for installation at various locations. The generators and other ancilliary equipments of these sets are made in Pakistan. While developing micro hydro schemes of up to 10 kW the partioipation of the local population is taken and managerial and technical services are provided by the Government Agencies; except for the turbine-generator plant which is provided by the Government, the local community is made to provide most other necessary inputs for development of such schemes. At present the country is self sufficient in the matter of planning and designing of such plants. Most of the equipment is locally manufactured except some portions which are imported; however, external assistance is sought for maximizing local manufacture.

9. Philippines

Mini hydro plants to be developed are considered to be of five MW and below capacity, and the development of such plants has been entrusted to the National Electrification Administration directly under the office of the President of the Republic of the Philippines. The high cost of fuel has resulted in the emphasis on mini hydro development in the country. At present such potential numbering 847 sites with capacity of 838 MW have been surveyed, 29 of which are planned for immediate development. The Philippines initially depend upon imported types of machinery connected with hydro power development.

It was also mentioned that the Philippines has been chosen as a model in the development of rural electrification programmes, through organization of electric co-operatives comprising of local communities.

10. Sri Lanka

The country has developed many large and mini hydro plants especially in tea gardens. Plans are afoot to identify and investigate new mini hydro locations. The major rivers as well as small tributaries are possible locations for mini hydro sites. With the development of pilot plants, ways and means will be investigated by the Government to make mini hydro plants more economic by simplifying civil works and local manufacture and fabrication of electro-mechanical equipments. An electronic govenor is being developed for the mini turbines. Steps have also been taken to manufacture improved BANKI and simplified TURGO turbines for sites with high head. The absence of oil or coal in Sri Lanka is the main reason for hydro development

11. Kingdom of Tonga

The electricity development of the Kingdom of Tonga is of recent origin. Present activities are confined to diesel generations. Due to high cost of fuel oil the Government has considered seriously alternative energies and has given importance to maximum utilization of local water resources by developing mini hydro sites with assistance from friendly countries. It is felt that training programmes must be developed to meet the local requirements within the context of the Pacific region.

12. Thailand

With the rise in the cost of fuel, generation of electric power in remote areas of the country has become very expensive. The Government has therefore given emphasis on the replacement of diesel sets by mini/micro generations. Some parts of the northern, western, eastern and southern regions of the country have substantial potential for mini/micro hydro development. Already seven projects are completed and three are under construction. The participation of people and local community in the development of micro hydro projects is necessary in order to reduce the investment burden of the Government, to give a sense of belonging to people and to bring maximum benefit from the projects to the rural community. The operation aspect of micro hydro plant needs proper demonstration and training in association with people and the local community. Further reduction of development cost is proposed by locally fabricated equipment and materials.

ECA Region

1. Ethiopia

In Ethiopia, hydro generation is a major source of power, although diesel generation is in existence in non-grid areas. Due to the high price of oil, greater emphasis has now been given to mini hydro development. The country is short of engineers, technicians and maintenance personnel. Assistance from friendly countries as well as agencies of UNDP are sought for imparting training to local personnel.

2. Kenya

The country has large hydro potential although presently it contributes to about 17% of total generation, the balance is produced by oil. Recently the Government took steps for development of hydro potential with a view to minimizing the import of oil. Geothermal potential also exists in the country. Assistance from outside agencies is needed for development of hydro potential.

3. Mali

The representative of Mali said that the mini hydro stations were already functioning in his country and plans were made for establishing around 20 new stations. There were plans to establish hydro stations in association with neighbouring countries.

4. Sierra Leone

The Government has shown some concern for rural electrification. All electrical generating plants are diesel driven and there are no operating MHG units. Efforts are being made in the Faculty of Engineering of the University to develop suitable MHG plant for use in rural areas. Assistance would be necessary for this group to improve the necessary infrastructural facilities with a view to local manufacture of some plant components.

5. Tanzania

The paper states that the country has put stress on self-reliance and development of agriculture and agro-based industries. The high costs of fuel is giving priority to mini hydro development. There exists a number of mini hydro stations which were developed by missionaries for their own requirements. Hydrological surveys are soon to be carried out to identify suitable areas for mini-hydro development. Financial, technical and manpower assistance is required from outside bodies and countries.

6. Zambia

The paper states that lack of finance has retarded the development of isolated regions and rural areas of the country. Mini hydro development of 1000 kWs and below are in existence in different rivers of the country. The Government of Zambia has already taken up programmes to build 10 diesel power stations.

ECLA Region

1. Colombia

Due to the rise of fuel oil costs, emphasis is given to the development of micro hydro stations. At present 27 sites have been identified which would develop a total of 57.5 MW generating capacity in the course of the next 15 years. The developments would be mostly composed of small capacity units.

The Colombian educational institutions and the "Las Gaviotas" programme collaborate in the development of technologies and mechanical equipment appropriate for the micro-hydroelectric units.

2. Panama

The paper states that the cost of power in non-grid areas is 28% higher because of the usage of distillate fuel. The Government has already taken up a programme for mini hydro plants with a view to replacing diesel generating units. Two mini hydro plants which are presently under construction could be completed soon. In addition, 15 mini hydro plants have been planned for implementation during the next five years. The high cost of equipment as well as the remote location of villages have created problems for quick development. The development of mini hydro plants will be conducted with assistance from USAID and UNDP and financing of construction will be arranged through the InterAmerioan Development Bank, IDB.

3. Peru

The paper states that about 212 mini hydro generating plants have already been developed besides some developed by small mining concerns. During 1979,39 projects have been developed.

Peru is executing a technology research programme for the development of equipment manufacture in the oountry.

The co-ordination between the institutions responsible for planning, and execution of investment projects and development of equipment technology is done through an ad hoc commission.

ECE Region

1. Romania

The country is quite industrialized and it has a capacity to manufacture heavy electrical equipment as well as hydro electrical machineries. A potential of up to 1 MW is considered as mini hydro development and is included in both grid and non-grid areas. Romania is also in a position to provide equipment, expertise servioes to developing countries. The mini hydro turbines are standardized two classes couplans deposit only.

B. Developed Countries

1. Finland

Finland has old traditions in developing its hydro power resources. It has developed its own technology which in many cases have proved its efficiency. A case study of the 1.2 MW "Kaarni" power station is presented. This station was constructed for about US $1,300/kW.

2. Japan

The paper reviews development of mini hydro plants in international oontext especially for underdeveloped countries where import substitution and export promotion is of utmost importance. Besides meeting human needs and creating job opportunities, the development of mini hydro plants will go a long way to minimise the dependence on oil importation and to the boosting of utilization of local resources in the developing oountries. Japan has a traditional background of hydro development since the last century and has presently reached a saturation point on both mini and large hydro developments. The country has now a highly developed industry to provide all sorts of equipment connected with hydro power development as well as technology transfer coupled with training, export servioes etc.

The Engineering Consulting Firms Association (EFCA) conducted researoh on technology transfer to developing countries. Japan has recently diverted its attention to developing micro hydro potentials of around 5223 MW.

3. Norway

The country has mostly developed its hydro potential during the last one hundred years. The country is capable of providing technology equipment, training as well as all sorts of assistanoe to developing countries for implementation of hydro projects. The paper mostly relates to the teohnological development aspects in the country. A oase study has also been submitted.

4. Sweden

It has also mostly developed its hydro potential. It is also capable of providing teohnology, equipment, services, as well as training facilities to developing countries. The paper discusses the typioal mini hydro plant detailing technological aspects of turbines, generators, switchgears etc. These turbines would also operate as a pump to feed

back the water during off-peak hours for further usage.

5. Switzerland

The Swiss Association for Technical Assistance (SATA) is presently assisting His Majesty's Government in Nepal on mini hydro development. The paper states that the participation of local people, with their skill coupled with additional training by foreign experts would go a long way to implement, operate and maintain such development. Guidelines have also been framed on construction of civil structures, feasibility studies for such projects. While designing such a plant, emphasis is normally given to minimise import components, construct plants and to make it simple and fool-proof with regard to operation and maintenance. Overall cost of economy, hydro development in Nepal has been found in the ranges of US $1,250 to US $2,500 per kW. In order to ensure maximum contribution of MHG towards reestablishment of an ecological balance and rising of the living standard of rural population, the MHG should be put in a productive context. It is also found that rural electrification is a psychological instrument which stops migration of people besides improving socio economic conditions of the community.

6. West Germany

The paper mostly deals with the development in the country which dates back for centuries. The country has proven technology backed by industries and can provide assistance to other developing countries. At present there are 500 big and 10,000 mini hydro plants in FRG.

7. United Kingdom

The paper deals with development of mini hydro plant under private initiative on the theme of "Technology Transfer to Developing Countries". It states that the cost of the project is important and not the size of the plant, beoause major distribution and civil engineering aspects consume a substantial portion of the oost estimate.

8. U. S. A.

A suggestion was made by the participant on the organization of energy requirements, skill of local people, environment and social conditions. He stated that the energy requirement of mini hydro development should be

worked out on the basis of cost benefit, as compared · integrated system and the multipurpose benefits derived from mini hydro plant. The institutional barriers should be resolved through assistance from friendly countries.

C. International Organizations

1. OLADE

The high cost of fuel hampers energy development in Latin America. Therefore a model study is absolutely necessary for exploiting the energy resources of these countries. It is felt that the problems of energy shortage could be resolved by mini power development. The application of technologies appropriate to the specific conditions of the countries concerned and the participation of local communities is very important for the acceptance and the development of non-conventional energy sources that will contribute to solve the energy crises.

United Nations Organizations

1. UNIDO

a) The Issue Paper of UNIDO was presented to the Seminar-Workshop to serve as an expanded agenda. It was intended to spell out the issues that werefelt most relevant to the subject matter, grouped into three main categories: technical, economic and policy and institutions. The Issue Paper is attached to this Report as Annex VI .

b) Short presentations were made concerning the various activities of UNIDO, directly and indirectly related to the MHG programme. Within the scope of the technology transfer programme, it was explained that UNIDO provided assistance to developing countries through technical assistance plus advisory services on information exchange, institution building, training and fellowships, promotion of R and D, etc. The organization of expert group meetings, seminars and workshops as well as the undertaking of surveys and studies was also considered to be a useful means of promoting international co-operation berween developing and developed countries and among the developing countries themselves in the field of application and implementation of MHG projects.

The activities of UNIDO's Investment Co-operation Programme Office (ICPO) in the promotion of investments in industrial projects were explained to the workshop. ICPO is now paying special attention to projects in the

field of energy production from renewable sources (solar, water, wind, etc.), and specifically to projects for the local manufacture of equipment. ICPO assists the developing countries, at their request, in identifying partners interested in providing the resources required by projects in developing countries. Such resources include financing, technology, management, etc. For this purpose, ICPO seeks to identify potential partners in both the developed and the more advanced developing countries. Assistance can be extended to both public and private sector projects, but in relation to a specific investment opportunity or project.

UNIDO's Energy Task Force regards hydro power generation aspects of its energy related activities as one of the essential elements of energy programme of the Organization. The results of the seminar-workshop held in Kathmandu would be used in the preparatory work for the UN Conference on New and Renewable Sources of Energy (1981), of which a technical panel on hydro power generation would be hosted by UNIDO during the pre-conference period.

2. **ESCAP**

The paper states that mini hydro plants up to 200 kW capacity could be developed by local institutions after carrying out proper soil and te terrain survey and assessment of load requirement. A complete project has to be identified first and proper programmes should be made which will include detail layout, distribution lines etc. Funds could be arranged either through the local body or government agency for proper implementation. After completion of the project, a proper institution should be built up for education and maintenance.

The presentation of country and other papers was followed by a general discussion. Questions about the reduction of civil engineering costs, the possibility of getting bilateral and other types of aid to promote this industry in developing countries were also discussed. The types of aid available for organizations like NORAD and SIDA and U.N. organizations such as UNIDO, UNIDO-ICPO, ESCAP and RCTT were elucidated.

III. GROUP REPORTS

A. Group I - Technology Aspects

The Group - I devoted to technological aspects and there was lively participation in the discussions in all the sessions. For the purpose of discussion in the group, it was decided to adopt the following classification according to size of unit.

1)	Micro Hydro Powe Stations	up to 100 k.W.
2)	Mini Hydro Power Stations	100 - 1000 k.W.

It is recommended that UNIDO studies this aspect with a view to bringing out a classification which will be applicable on a wider basis. The subject on technological aspeot was divided into the following headings.

1. Specific technical aspects about equipment involved in mini hydro plants:

The following items were considered in this discussion.

i) The turbine.
ii) The frequency control sustem.
iii) Materials of construction of penstock.
iv) Generators

The oonclusions arrived at after thorough discussion on those aspects are as follows:

Considering suitability of turbines of different types, it was concluded that turbines and cross-flow turbines are the most suitable for low and medium head applications in mini and micro hydro electric stations. For high heads the Pelto and the Turzo turbines were considered most suitable.

Francis Turbines are also suitable for Medium heads but there are certain problems which arise in their application to micro units. These should be studied with a view to making them more suitable for such applioations in terms of operation and cost. There could be other designs which were developed in the past but did not oome into general usage which under the changed circumstances of the viability of mini and micro units could be investigated as further alternatives.

It was agreed that speed regulation for frequenoy control is in general desirable, except in the case of applications where direct drive to mechanical devioes in which speed variations can be tolerated.

For the purpose of speed regulation various alternatives must be further investigated to determine their suitability.

It was agreed that where accurate speed control is necessary in independently operated units the hydro mechanical governors form an acceptable solution. Variation to this type of governors form an acceptable solution. Variation to this type of government is the electronic electric or the electronic-hydraulic where the speed sensing would be carried out by an electronic device which will actuate and electrical or hydraulic servomotor making use of low pressure fluid to actuate the volve for speed control.

The other devices which appear to be very suitable in cases where a fixed quantity of water has to be discharged irrespective of the load is the electronic unit which switches a part of the generated power to an external devoce when the load falls below the generated power so that the total power generated by the unit is kept constant and therefore the speed constant for the particular flow.

Generators:

Synchronous machines are used generally for the micro and mini hydro power units but a synchronous (inductor) machines should be considered for use under the following conditions for reasons of economy.

1. Connection to the grid if approved by the supply authority.
2. Operation in parallel with a synchoounous alternator especially for increase in installed capacity.
3. Connection to a mini grid for unattended operation.
4. Independent operation with a suitable excitation system.

It is also recommended that standard machines of four pole construction be used to reduce costs.

Penstock and Civil Works:

It was concluded that the materials for construction of penstock should be reviewed as there are number of alternative materials to steel for penstock construction. Among the alternative materials are PVC, polyethelene, concrete, asbestos cement, ferro-cement, wood stave and wooden pipe made out of wood veneer wound and glued. It was generally agreed that these alternative

materials may present advantages over steel depending on the hydraulic conditions, local conditions, and cost structure.

One should be aware that civil works normally represent a considerable cost component. It is therefore important to examine carefully the possibility of cost reduction also of this part of a plant especially by making maximum use of local human resources and by adopting technology familiar to the local community.

2. Research and Development:

There was agreement that there should be grater cooperation and communication between R anf D institutions particularly in the developing countri s to enable th R and D work in progress to proceed at a greater speed and with greater success. Regional organizations like the ESCAP Regional Centre for Technology Transfer (RCTT) and Latin American Organization for Energy (OLADE) should promote the formation of such a network. The National Engineering Research and Development Centre of Sri Lanka and some institutions in Nepal, India and Thailand may be willing, in the ESCAP region, to join such a network. In the Latin American region institutions in Peru and Colombia may be willing. There may be other institutions in tne ESCAP region and in Latin America which would like to come into such a network. To organize inter regional co-operation, it was requested that UNIDO should take an active role. The Governments and institutions in the developed countries were requested to provide resources in the shape of equipment for R and D work considered necessary by the institutions in the developing countries for carrying out R and D work and finanoes required for organizing meetings and experts visits to other developed and developing countries, organising inter regional and regional meetings and financing training programmes and construction of prototypes in these countries.

3. Information:

A large number of oountries in different parts of the world are greatly interested in research and development and the establishment of mini hydro units in their countries. In order to promote exchange of information and technical knowledge among different groups working in various countries of the world, it was felt that there was urgent need

for the publication of a News Letter containing information on planning and programmes, research and development work, design and manufacture of equipment and such other developments as are taking place in this important area of development. For this purpose the ESCAP RCTT could publish a periodic technical News Letter. Eventually other regional institutions in other parts of the world could also be doing this. There was need for establishing necessary coordination between these organizations ultimately.

The group also felt the need for a list of experts and institutions of excellence involved in research and development and other aspects of mini hydro electric stations in the world. The regional institutions under the U.N system could undertake this work immediately.

The UNIDO could assist the regional institutions to bring out a global compendiem. The list could also contain the training facilities available in the area of mini hydro electric plants.

The group felt that there was need for R and D institutions in developing countries to have an open attitude in the matter of exchange of technical information in this area so that there would be speedier development of this industry in their countries.

4. Technology Transfer:

It was agreed that the development of technology in the field of mini hydro plant should take place within the developing countries themselves. However, when such development is not practicable for various reasons, technology should be purchased preferably from within the group of developing countries engaged in this work but where this is also not practicable such technology should be obtained from developed countries which are in a position to sell such technologies.

In this process it is important to differentiate between technology transfer by means of commercial arrangements from normal aid programmes from the developed countries to developing countries. The programme of aid from aid giving organizations should be directed towards the development of technologies within the developing countries themselves. It was also felt that in the process of commercial technology transfer certain restrictive practices like limitation of production programmes and the continuation of royalties should be given reasonable consideration. In the process of

technology transfer it should be ensured that the expertise in designs and construction should adequately transferred.

It was decided that due to the apparent low profit potential of the manufacture of mini and micro hydro plants, the Governments of the countries concerned should take an active part in the establishment of the manufacturing industry for this purpose and sponsor such industrial projects. Particular attention should be given to financial and technical assistance aspects.

Training:

The subject of training was considered to be a very important aspect in the development of mini micro hydro plants. For this purpose it was essential that most of the training should be carried out within the assistance of regional and international organization under U.N system and organizations and the developed countries and developing countries. Developing countries are requested to orient the curricula for technical schools and universities to suit their programmes of research and development design, manufacture of equipment and construction and operation of mini hydro plants in their countries. The government could consider establishment of operator schools to train people from rural areas to man mini hydro electric stations as this could have considerable advantages in implementing this programme.

5. Standardisation:

After considerable discussion it was agreed that the matter was complicated. UNIDO was requested to take the initiative in this matter and organize a study so that eventually a standardisation of the range of equipment and components for micro and mini hydro plants is accomplished in view of the importance of standardisation if large scale programmes of establishing mini hydro plants in the developing countries and manufacture of equipment in those countries, are to be carried out. The discussion revealed that the problem was a compliated one.

In the area of Civil Engineering connected with mini/ micro hydro power development such standardisation is considered difficult. However, action should be taken to the extent possible to evolve standard and typical dimension and details for such Civil Engineering structures.

B. Group II - Economic Aspects

INTRODUCTION

For the purpose of making the task of economic analysis easier, it was decided that micro / mini scale hydro plants should be categorised as follows:

Micro-hydro plants ---------- up to 100 KW
Mini-hydro plants ---------- 100 - 1000 KW

These definitions are important because generally costs per unit of installed plant capacity will depend on the size of plant installed.

Even those countries which had plased out MHG units are now engaged in rehabilitating these installations due to changed circumstances. By simplifying regulating equipment etc. and by standardisation, it seems possible to make MHG unit competitive to other alternatives.

1. Total cost breakdown of different MHG systems

In addition to the above definitions, it was pointed out that although these definitions do provide some bases for economic evaluations, key issues that do have a direct bearing on the economic feasibility of the scheme could form a more appropriate basis for economic evaluations. Such issues include:

a) Resource analysis e.g. as quantifying the head and minimum flow at a certain distance.
b) Standardised specifications of the system including civil works and their effect on other considerations.
c) Lowest cost per KW of installed capacity.
d) The effect on employment at the village level.

These would be more appropriaye bases for a check-list approach considering all issues be it economic, technological or otherwise.

It was however agreed that since these issues can best be analysed as a unit during the plenary sessions, the agenda as outlined in the UNIDO issue paper must be adopted. Two additional topics were suggested and agreed

upon to be added to the agenda its feasibility studies and tariffs. In addition, it was agreed that prices and cost evaluations must be considered first for a developed country where manufacturing and testing facilities are more adequate and these evaluations related to prices and costs if the units were manufactured in a developing country. Manufacture of some plant components in the developing country would best be effective in achieving sufficient cost reductions to make the wider application of small-scale hydro plant in the rural areas of developing countries most feasible. This could be achieved by setting up adequate R and D programms to develop technology for design and manufacture of the equipment required for Micro and Mini Hydro Power stations, in the countries that consider themselves capable to do so. This could also be achieved by first importing prototypes into the developing country and the manufacturing capabilities and facilities of these countries improved adequately and gradually to make it possible for local manufacture and research. Such a transfer of technology could go with other beneficial side effect e.g. job creation, improved organisational and managerial abilities, upgrading of local technical capabilities etc.

It is difficult to give any figures for any project, the problem being that the topographical features of sites vary and the available infrastructural facilities also do vary from place to place. HOwever, indicative figures could provide a useful starting point and could be modified to take into account the realities of the size and infrastructural facilities available.

Total capital cost components must include:

i) transmission costs
ii) cost of civil works
iii) cost of electro-mechanical equipment.

The percentage breakdown of cost between these three components changes from plant to plant depending on the characteristics of the site. Which determines inter alia its length of transmission lines, length of penstock et.

2. Economic Comparisons of different systems of electricity generation

In making economic comparisons of different systems of generations, the following should be taken into account:

i) Position of power station in relation to the area of demand.
ii) The cost of fuel at the generation site
iii) The cost of construction materials, mechanical and electrical equipments at the generation site.

In addition to these points, a specific case from Nepal was included as a typical example. The possibility of these units being connected to a grid system at a later stage may also be of significance. In connection with this careful thought must be given to the choice of generator e.g. synchronous or asynchronous. Multipurpose uses of water in a hydro scheme must also be taken into account for these comparisons.

3. Cost reduction scheme:

a) Standardization of other equipment.
b) Use of local materials. Other alternatives should be explored e.g. burying penstocks instead of supporting them of pillars.
c) The schemes could serve other purposes e.g. canal water can be used simultaneously for irrigation purposes etc.

Other considerations include the simplification of governing systems by simple designs of turbines in connection with electronic regulators together with efforts to improve the load factor i.e. to keep the load as near constant and as near to full capacity as possible so as to minimise the need for governing. In so doing, the statutory limits (tolerances) to be adhered to should be born in mind. For remote applications, these limits must be strictly adhered to. The possiblilities for cutting down on civil works also exist, but careful consideration should be given to the possibility of the risk of floods causing damages especially to canals and reservoirs; and to extreme dry seasons when there might not be sufficient water to run the plant. Precautions must be taken to ensure that these adverse conditions do not arise. The investigations can be considerably less expensive by the use of hydrological models thus reducing the number of monitoring samples.

4. Electricity Demand:

The use of electricity is of high concern in planning for the rural community. It is important to involve and get rural inhabitants interested right at the start of the project.

Consideration must be given to efforts that would encourage and or increase the demand at the rural level. Tariff policy may play an important role. In particular, the planning must be taken into account the possibilities of increasing this demand e.g. by introducing some industrial activities in the rural area and by developing end-use applicances suitable for use in rural areas.

In forecasting electricity demands, it must be taken into account, the possibility (as some experiences in Panama has shown), that the introduction of this amenity in rural areas would greatly increase the demand. The realisation of its potentialities will encourage an increase in the number of customers.

5. Economic Benefits:

For assessing the economic benefits of mini / micro hydro projects, factors for consideration would include rates of return, number of jobs created, the effect on rural incomes and income distribution.

These considerations could provide a criteria on which an individual can make as assessment of the socio-economic benefits to be expected. They could also determine other indirect benefits e.g. providing lighting for schools, health and community centres etc. The weights of the different aspects can best be felt by the local inhabitants themselves. Other economic benefits include the possibility of local inhabitants actually being employed in a manufacturing industry as a result of this development and involvement on a large scale e.g. a turbine manufacturing company in Butwal, Nepal now employs many local inhabitants. This is more likely for larger installations in the small scale hydro range.

6. Social factors

Provision of electricity supplies from small-scale hydroplants in rural areas would discourage rural-urban migrations. In India, such provision has not had any adverse effects on family structure or living habits. But there has been improvements in adapting to the new environment. It is clear that rural inhabitants are indeed very conservative to radical changes. There are many indirect social benefits that cannot exactly be quantified e.g. introduction of television for education etc.

RECOMMENDATIONS:

i) It is recommended that UNIDO assist developing countries to obtain expertise from both developed and relatively advanced developing countries to survey and assess their potentials for small-scale hydro generating units leading to feasibility studies for particular projects.

ii) It is also recommended that UNIDO maintains close contacts with Research and Development institutions as well as with manufacturers of equipment and operators of small-scale hydro generators in both developed and developing countries with a view to:

1) assisting developing countries to set up R and D facilities in order to develop, design and manufacture technology in these countries.
2) Assisting developing countries in identifying potential joint venture partners who could promote an increasing local technical and manufacturing capabilities.
3) assisting in the formulation of viable small-scale hydro generation projects and in obtaining the required financing for the implementation of such projects.

CONCLUSION:

The cost breakdown of this project is done on the basis of rate analysis carried out by civil Design Division. According to Rate Analysis of the project, in civil works the percentages for Material, Skilled labour and costs comes to be Rs.33,71,435 and 61:94 respectively and the same percentages are adopted in preparatory works. As per the report of this project the total labour cost in Electro-Mechanical works is taken as a whole 5, 51, 14% and this percentage is divided into 4% for skilled labour cost and 1.514% for unskilled labour cost. For transmission and distribution works, the breakdown adopted is 88%, and 4% materials, skilled and unskilled labour costs respectively.

N.B.

Though 3 units are proposed for installation, the above cost given does not include the cost of the third unit. In the first phase, only two units will be installed. Cost per KW for installed capacity is calculated only for 1st phase.

C. Group III - Policy and Institutional Aspects

Basis for the discussions:

Mini hydro generating sets (MHG) can also be an element in electrification schemes in rural areas. It is presumed that in all countries the government is having planning to have a policy aiming at electrification of the country including rural areas. It is further assumed that the socio economic benefits which fall on all society members from electricity supply either directly or indirectly as an important imput in industrial production is fully emphasized. However, it has been noted that not all governments nor rural communities put the same priority on the electricity sypply as part of the total infrastructure.

1. Policy on MHG

It is recommended that MHG schemes are implemented to supply or supplement electric power to existing or new systems in view of the shortage and the price increase of oil and natural gas and particularly develop the underprivileged areas of a country. Where such an approach is consistent with government policy, publication is recommended.

2. Institutions related to electrification and MHG

A national policy means establishment of adequate institutions which will implement or help to implement the policy plans. Such institutions is to be formed in agreement with the government policy at central level as well as local levels. On the central plan it is recommended that the government should set up a new institution / authority or preferably assign an existing one to study the need and possibility of constructing MHG within the country. The task of this institution is to help also in the implementation of such schemes and see that funds are available subject to national policy priorities.

An important task of this institution would be the collection of necessary data regarding potentials for installation of MHG. This could be done by involving local authorities and people to assist in collecting information about local resources and potentialities. The local

communities should be encouraged to engage themselves as much as possible in the electrification of their area and the implementation of such schemes.

One way to induce the local population to get involved is to propagate the benefits that will accrue to them on construction of MHG and the use of electricity for small scale industries.

The institutional setups related to electrification varies from country to country. As the policy adopted in this respect appears to be similar in all countries irrespective of political systems, it may be possible to present some common guidelines to follow for the success of the programme. It may be appropriate to cite 24 examples of the set up existing in various countries with different political systems. Of the countries represented in the discussion, (taking place particularly on the institutional aspects) particular interest was shewn in the set up of the People's Republic of China and the Philippines. In China the very rapid electrification of rural areas by development of small scale water power is handled by institutions organized on central as well as on county levels and within the people's communes. Central institutions provide 24 expertise to help the people's communes to identify the possibilities of making use of the hydro power resources in their area. The implementation of projects is done by the communes themselves and they become the owner of the plants of the completed projects. Production of electrification materials and equipments are made locally or in centralized manufacturing plants depending upon technical complexity and size of equipment. Further details are given in the Chinese country paper.

In the Phillipines two central organizations exist — one on a big scale power production from plants bigger than 20,000 KW and for the main transmission system of the country; the other — The National Electrification Administration (NEA) in charge of rural electrification by organizing electric co-operatives throughout the country and handling small scale power generating units including MHG. By various means the NEA helps the co-operatives in organization, to finance construction costs, to supply materials from bulk purchases and to provide technical advice and assistance.

Common to both the Chinese and the Phillipines models are the ownership of the local member consumers of the rural electricity supply system and the very rapid implementation of the electrification of such areas. The Chinese as well as the Phillipines approach on rural electrification might be studied by other developing nations for possible adaptation.

Financing institution

Government financial institutions should provide soft loans or total financing to MHG projects and related electrification schemes so as to get full socio-economic benefits.

Training institutions

At central level, training should be initiated pertaining to construction, installation and operation of MHG and related electrification project. This should also involve training in the manufacture of mechanical and electrical materials in the country. Training may be implemented in universities, vocational schools and other institutions. The Chinese rural electrification scheme includes training in colleges and vocational institutions in all aspects of hydraulic machines. Engineers are supposed to work in factories alternating between design work and manufacturing.

In the Philippines training in rural electrification is initiated by NEA at its head office and/or with the co-operatives in the rural areas.

From Nepal an interesting institutional set-up for vocational training was reported. At Butwal Technical Institute, youths living in rural areas get on the job training in wood working, in mechanical and in electrical field. This training is provided transport of production work in commercial workshops established as part of the institute and staffed largely by eftrainees of the institute. A large variety of work, including the manufacture and repair of hydraulic turbines and electrical equipment is carried out in this programme.

Development and Transfer of Technology

It is convenient that developing countries establish adequate policies regarding research and development conduotive to the implementation of technologies appropriate to the specific conditions of the countries conoerned.

Standards and Norms

The Government should adopt standards and norms worked out by the international standa·dization organizations and see that this is implemented by central and local bodies. Precautionary measures were made that too strong emphasis from central authorities on specific standards may hamper very small scale hydro electric development because it may cause hindrance in initiating and developing remote areas. The government should have a policy on standards and norms.

Statistics and Data

It is recommended that institutions at central level be designated with the task of collecting data on hydro power potentials hydrology and electrical installations including MHG.

Laws

Laws pertaining to MHG and rural electrification should be included in the legal set up of the country in accordance with the national policy and should involve laws with the aim of securing public safety and interest.

Industrial aspects

To the extent possible, developing countries should look for ways and means to utilize own resources for local manufacturing of equipments and oomponents for MHG and electrification sohemes and help establish appropriate manufacturing firms or units according to government policies.

Transfer of Technology between developing countries
and between industrialized and developing countries

In the case of developing countries, technology transfer could take place in several ways: 1. between developing countries and 2. between developed and developing countries.

Such transaction could be of a oommercial and non-oommercial type. Governments have to make their ohoice of either one or two or both, depending upon the ciroumstances.

Transfer of technology in the field of MHG and electrification in general may follow these lines. Most developing countries have c[illegible]siderable experience in traditional water technology. Regarding training, it is recommended to include this technology as far as possible when adopting imported technologies in this field.

Measures should be taken to prevent trainees and students from developing countries to remain in the industrialized country after completing their training in order that their home country benefits from their acquired knowledge. Developing countries are urged to create necessary improvement in their countries to attract and retain their trained personnel.

Some industrialized countries have entered into institutional collaboration arrangements, i.e. an agreement by the participating governments on collaboration directly between an institution in the industrialized country and a similar institution in the developing country. The universities and other educational and training institutions may be usefully involved in this.

International Institutions

Emphasis was put on the benefits of transfer of technology between developing countries, particularly on the MHG technology and electrification of rural areas. Many countries have considerable hydro power potential, but are lacking the required technical capabilities and need external assistance in this regard. It is recommended that developing countries should activate the MHG programmes and elaborate the request for external assistance so that bilateral and international organizations may assist. It was felt important to have an international organization to exchange experiences and to co-ordinate the assistance. The Chinese representative proposed that the setting up of some sort of such an international organization to deal with small scale water power technology should be considered.

It was also pointed out that, while the electricity supply is considered a basic need in almost all countries and organized in specific bodies on central and/or local levels, a similar body does not exist in the form of a specialized UN agency (similar to, for instance, the ITU). Electricity matters are handled by several agencies as UNIDO, UNDP, FAO, and UNESCO in addition to regional commissions.

It is recommended that the existing regional and international organizations in the system should take urgent steps to promote all activities connected with MHG in developing countries.

D. Other Recommendations

On benalf of someone who made a proposal furing the discussion in the Working Group III. UNIDO was asked to approach industrialized oountries concerning any arrangements regarding aid to developing countries for the promotion of MHG and rural electrification.

Generally, electric power generated in mini/micro hydro electric stations has to be utilized in the vicinity of the station. Therefore it is imperative that developing countries, while planning and implementing programmes of establishing mini/micro hydro electric status, should pay ample attention to the problem of establishing in the neighbourhood of their nations power causing industry and the problems such industries will have regarding finance, technical assistanoe, manufacture and marketing.

The seminar-workshop recommends that U.N. organizations and others should pay special attention and preferential treatment to least developed, small land-locked and island oountries, in view of this urgent need to develop energy resources, especially mini and mioro electric stations and the technioal oapabilities of their oountries to implement such programmes.

ANNEX 1

Resolution for International Co-operation of the Seminar-Workshop

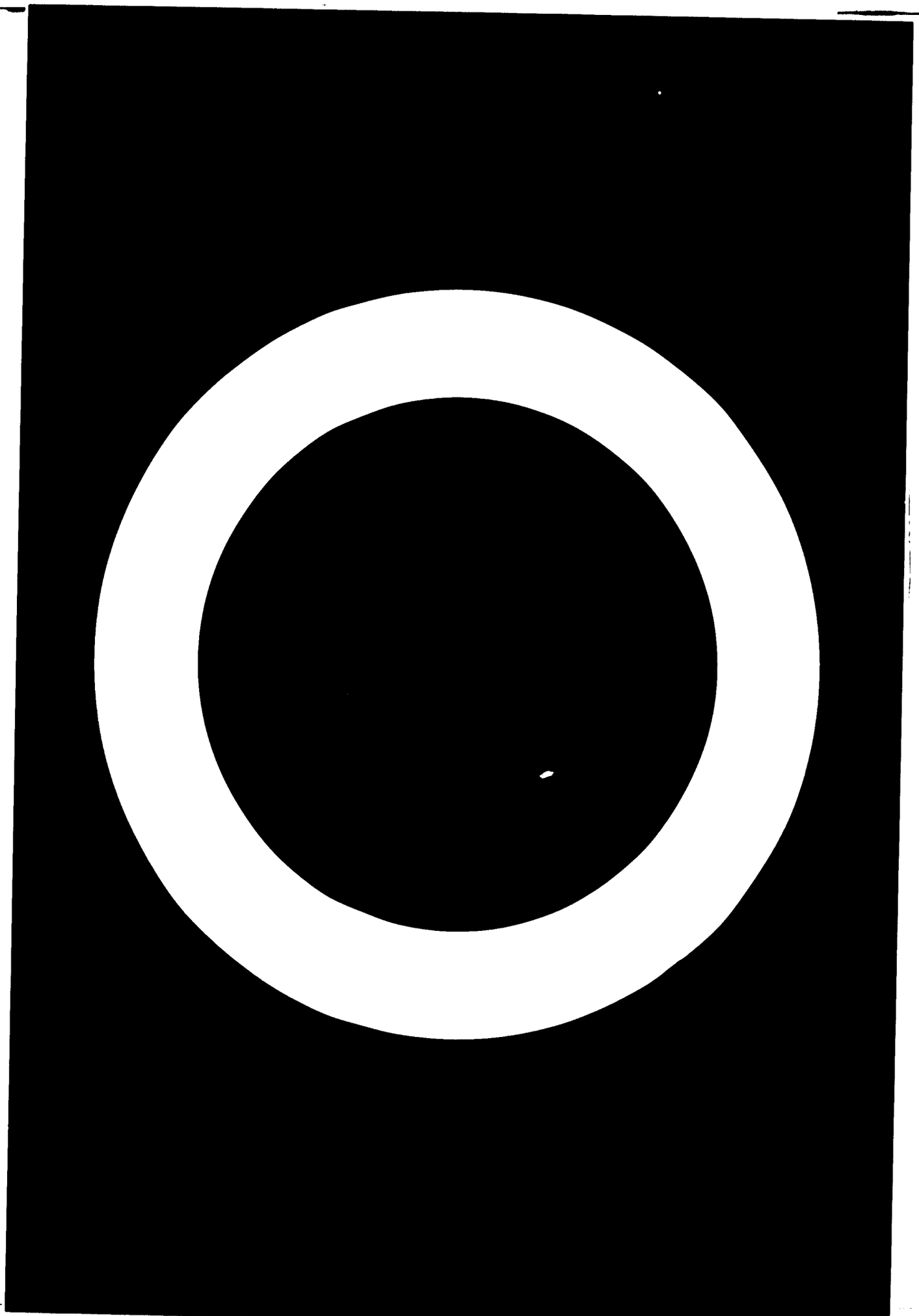
Proposed by representatives of Nepal, People's Republic of China, Colombia Norway, Sweden and Tanzania.

The Seminar-Workshop on the Exchange of Experiences and Technology Transfer on Mini Hydro Electric Generation Units organized by UNIDO/ESCAP-RCTT in co-operation with the NCST and the RECAST of Nepal from 10-14 September 1979 in Kathmandu has demonstrated the interest in and the importance of this subject.

Exchange of information, knowledge and experience is felt to be of basic importance for promotion of this technology, not only between developed and developing countries, but also among the developing countries themselves.

In this respect, parties carrying out activities in this field: governments and official and private institutions, as well as UN agencies and other international and bilateral organizations are invited to increase their supporting efforts to accelerate the electrification of rural areas by means of small scale power production including micro and mini hydro generation within the framework of rural development plans.

The participants of the Seminar-Workshop therefore decide to underline the need for the strengthening of international co-operation in a systematic, efficient and effective manner, and wants this to be referred to as THE KATHMANDU DECLARATION.



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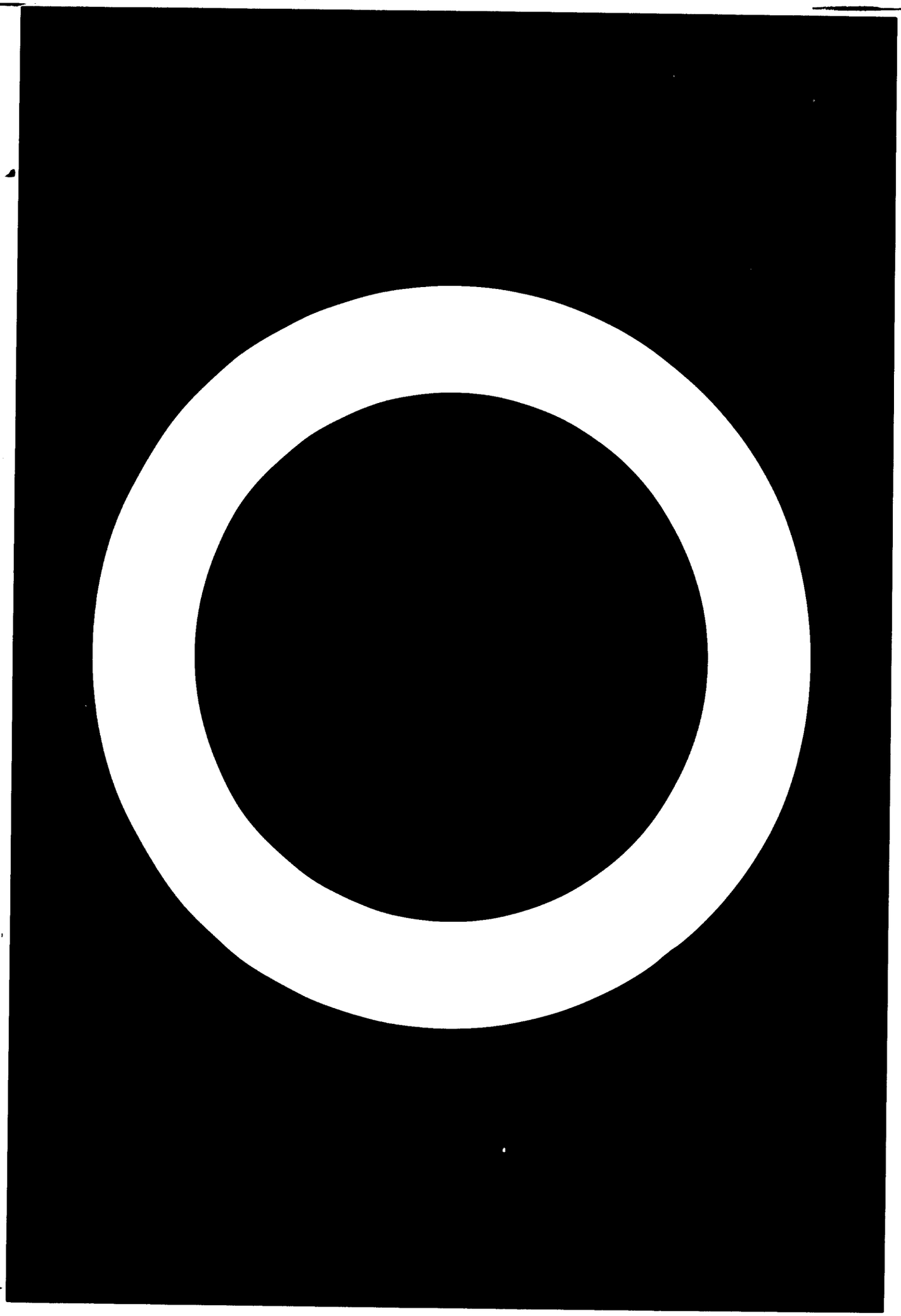

ANNEX 3

WORK PROGRAMME

Sunday, 9 September 1979	
18.00 - 20.00	Registration at 'Narayani' Hotel
Monday, 10 September	
08.00	Bus from Hotel Narayani tc Hotel Blue Star
08.15 - 10.00	Registration at Hotel Blue Star, Tirupureshwar
10.00 - 10.50	Opening Ceremony
	Welcome address by Dr. Ratna S. J. B. Rana Chairman - National Counoil for Scienoe and Technology
	Speech by Dr. A. Butaev, UNIDC
	" Mr. K. M. Dikshit, ESCAP
	" Dr. C. V. S. Ratnam, RCTT
	" Mr. John B. Melford, UNDP, Nepal
	Inauguration Speech by Hon'ble Minister for Water Electrioity and Irrigation Mr. Marioh Man Singh
	Vote of thanks by Dr. Kedar L. Shrestha Member-Secretary - NCST
10.50 - 11.10	Refreshment
11.10 - 11.30	Eleotion of the Chairman/Rapporteur
11.30 - 12.30	Presentation of Country Paper/Case Studies (10 min. each) Nepal/Colombia/Philippines/India Pakistan/Sri Lanka
12.30 - 14.30	Lunoheon
14.30 - 18.00	Presentation of Country Papers/Case Studies (10 min. each) Tanzania/Papua New Guinea/Zambia/ Cameroon/Kingdom of Tonga/Bangladesh/Thailand/Panama/ Kenya/Ethiopia/China/Peru/Sierra Leone/Romania/OLADE/ Norway/Sweden/Japan/Berlin/Finland/France/United Kingdom/ Switzerland/USA Coffee will be served at 16.00 during the session.
18.00	Bus from Hotel Blue Star to Hotel Narayani
18.45	Bus from Hotel Narayani to Hotel Shanker for dinner and oultural show
19.00	Dinner and cultural show at Hotel Shanker

Tuesday, 11 September

08.15	Bus to Hotel Blue Star
08.30 - 12.30	General Disoussion
12.40 onwards	Mini Hydro Generation site visit: visit to Gajuri. Participants are supposed to take lunch packet with them.

Wednesday, 12 September

08.15	Bus to Blue Star
08.30 - 12.30	Group Discussion (Coffee will be served)
	Group I: Technology Aspeot
	Group II: Economic Aspect
	Group III: Planning and Institutional Aspeots
12.30 - 14.30	Luncheon
14.30 - 18.30	Group Discussion (Coffee will be served)
18.40	Bus back to Hotel Narayani
19.30	Reception by UNIDO at Hotel Narayani

Thursday, 13 September

08.00 - 09.00	Bureau Meeting (for Plenary and Working Group Chairman and Rapporteurs only)
10.00	Bus to Blue Star Hotel
10.15 - 12.30	Working Group Session (Presentation and discussion of Working Group draft reports)
14.30 - 15.30	Plenary Session (Working Group draft reports presentation 20 mins. each)
15.30 - 18.30	Plenary Session (Disoussion of Working Group reports)
18.40	Bus to Hotel Narayani

Friday, 14 September

08.45	Bus to Blue Star Hotel
09.00 - 10.00	Plenary Session (Film of MHG)
10.00 - 12.30	Plenary Session (Presentation and discussion of Seminar Report and adaptation
14.30 - 18.30	Plenary Session and Closing Session (unless work drafted by 12.30 or 1.00 p.m. in the morning)

ANNEX 4

LIST OF PAPERS PRESENTED AT THE MEETING

1. Prospect of Mini Hydro Power Development in Bangladesh — ID/WG.305/3
   W. Chaudhari
   Power Development Board
   BANGLADESH

2. Mini Hydro Power Development in Burma
   U. Kyaw Thein
   Electric Power Corporation
   Rangoon,
   BURMA

3. Construction of the Water Power Stations on Beijingmiyum Diversion Canal
   Beijing Design and Exploration Bureau of Water Power,
   CHINA

4. An Introduction to The Development of Small Hydro Power Generation in China
   Deng Bing Li
   CHINA

5. Country Paper for Ethiopia
   Seyum Messele
   Addis Abeba
   ETHIOPIA

6. The Planning and Development of Minor Sized Hydro Electric Projects
   ESCAP

7. Modern Water Turbine Technology for Small Power Stations
   Timo Sal Ovaara, Oy
   Tampella Ab,
   FINLAND

8. Mini Hydro Electric Generation in Finland. — ID/WG.305/
   J.G. Wallen,
   IVO Consulting Engineers Helsinki
   FINLAND

9. Establishment of Mini Micro Hydel Projects — ID/WG.305/11
   P.K. Behl,
   Central Electricity Authority
   New Delhi
   INDIA

10. Development and Application of Mini Hydro Electric Generating Units in D.C.
INDIA

11. Some Consideration on Mini-Hydro Generation Units Development and Application . ID/WG.305/10
Jyoti Limited Board
INDIA

12. Micro Hydro Power Development
ECFA
JAPAN

13. Low Head Power Generation for Rural Economic Development in Kenya.
J.E.O. MWENCHA
Industrial Survey and Promotion Centre

14. Communication De L' U.P.D.E.A. Sur les Micro-Centrales Hydrauliques
Ministry of Commerce and Industry
UPDEA
Nairobik Kenya.
MALI

15. The Role of Hydro Power in Rural Development.
Development and Consulting Services, Butwal, Nepal.
NEPAL

16. Rural Electrification for the Development of Remote Areas of Nepal.
SATA/SHDB
Kathmandy, Nepal
NEPAL

17. The Need for an Integrade Approach in Rural Electrification in Nepal.
Peter Molinari Technology Adviser from SATA, Kathmandu, Nepal.
NAPAL

18. Problems encountered in Designing and Producing Small Scale Water Turbines in Nepal.
Reinhold Metzler
Butwal Engineering Works Pvt. Ltd. and Uniteed Mission to Nepal.
NEPAL

19. Mini Hydel Development Programme in Nepal (Case Study) ID/WG.305/12
P.P. Adnikari
NEPAL

20. Development of Equipment for Harresing Hydro Power on a Small Scale.
U.Meier
Balaju Yantra Sala and SATA
Kathmandy, Nepal
NEPAL

21. Micro Hydro Power Development
Engineering Consulting Firms Association
Japan and United Mission to Nepal
ECFA
JAPAN

22. Case Study of the Planning and Construction Of a Mini Hydro Power Plant
Norconsulting Engineers,
Architects and Economists,
P.O. Box 1322
Hovik Norway
NORWAY

23. Mini Hydro Turbines
Sorumsand Verksted A/S
N _ 1920 Sorumsand
NORWAY

24. The Electrification of Norway Over a Period of Years, in Particular the Utilization of Water Power.
Asborn Vinjar, Norwegian Water Resources and Electrificity Board
NORWAY

25. Hydro Electric Power Technology in Norway, with Special Emphasis on Small Scale Power Plants.
Torodd Jensen
Norwegian Water Resouces and Electricity Board on benalf of Sveral Authors.
NORWAY

26. Development of Mini and Micro Hydro Electric Power Stations in Pakistan.
Dr. Asad Asgnar Ali
Principal Electrical Engineer.
National Engineering Services (Pakistan) Limited - NESPAK
417, WAPDA House
Lahore, Pakistan
PAKISTAN

27. Panama's Mini Hydro Electric Plants Program
J. Pascal Irhe, Panama
PANAMA

28. Case Stydy of a Micro Hydro Pilot Plant in Peru. — ID/WG.305/7
Enrigque M. Indocochea
ITINTEC,
PERU

29. Mini Hydro Station from the Socialist Republic of Romania Equiped with Turbines of Romanian Products.
Chief Engineer D.E.Par hoi
ISPH (Institute for Hydro Electrical Studies and Designs)
Bucharest, Romania
ROMANIA

30. Mini Hydro Power Development in the Philippines
E.R. Piamonte
National Electrification Administration
Quezon City, Philippines
PHILIPPINES

31. ISPH Institute of Hydro Electrical Studies and Designs
ROMANIA

32. Iron Gates Hydro Electric and Navigation System
ROMANIA

33. Arges Hydro Electrical Development
ROMANIA

34. Some Considerations in the Introduction of Micro Hydro Plant in the Rural Areas of Sierra Leone.
D.L.B. Kamara
University of Sierra Leone, Sierra Leone
SIERRA LEONE

35. Establishing a Programme of Micro Hydro Electric Power Development for Rural Development in Sierra Leone.
David L.B. Kamara
University of Sierra Leone, Free Town West Africa
SIERRA LEONE

36. Mini Hydro Power PLants in Sri Lanka — Id/WG.305/1
A.N.S. Kulasingle
NERDC, Sri Lanka
SRI LANKA

37. Small Scale Hydro Turbine Program for Head Range 3-30 m and Output range 100 - 50,000
Bofors Nohab
SWEDEN

38. Small Hydroelectric Power Stations
"Mini Power Stations (100-1500KW)"
VAST
The Swedish Power Association Development Sec.
SWEDEN

39. Swedish Development of Mini Hydro Electric Capabilities for Assistance
Sixten Englesson
SWEDEN

40. Exploiting Mini Hydro Plants Potential for Rural Development in Tanzania — ID/WG.305/5
M.G. Massanali and R. Reichel
University of Dar Es Salaam
TANZANIA

41. Mini Hydro Electric Generation in Tanzania — ID/WG,305/4
S.A.M. Cogomoka
Tanzania Electric Supply Company Limited,
TANZANIA

42. Development of Mini Micro Hydro Plant
Thailand
Prapath Premmani
Director, Technical Division National Energy Administration
Bangkok, Thailand
THAILAND

43. UNIDO Issue Paper
UNIDO — ID/WG.305/13

44. Status Paper for the Workshops on Technology Transfer Problems in the Establishment of Mini Micro Hydro Units in the Kingdom of Tonga — ID/WG.305/9
Juan L Bernahe
Manager, Tonga Electric Power Board,
Nukua Loga
KINGDOM OF TONGA

45. "Prospect of Mini Hydro Power Development in Kingdom of TONGA"
KINGDOM OF TONGA

46. SEADAG Reports, Ad hoc Seminar on Science and Technology for The Development of Nepal,
The Asia Society, Inc.
SEADAG,
New York
USA

47. Seminar Report on Development Small Scale Hydro Electric POwer and Fertilizer Production in Nepal.
NCST, Nepal and The Asia Society (SEADAG)
New York
USA

48. Development of Small Scale Hydro Electric Process and Fertilizer Production in Nepal.
The Asia Society (SEADAG)
New York
USA

49. Potentials and Prospects of Developing Micro Hydro Electric Generation in Zambia — ID/WG.305/6
J. Kalolo Chanda
Ministry of Power Transport and Communications
ZAMBIA

50. Country Paper
J.K. Chanda
Ministry of Power and Transport and Communications
ZAMBIA

51. Mini Hydro Electric Generation in Iran
A. Tolou
Acting Director General
Ministry of Industry and Mines
IRAN

BACKGROUND REFERENCE MATERIAL SUBMITTED AT THE MEETING

1. Micro Hidro Power Plants Projects in Colombia.
   ICEC - Colombia
   COLOMBIA

2. Finish Trade Review 1/79 Energy
   The Finnish Foreign Trade Association, Finland
   FINLAND

3. Small Water Turbines
   Tampella Engineering Division, Finland
   FINLAND

4. IVO Consulting Engineers
   Imatran Voima Osakeyhito Finland
   FINLAND

5. Water Turbines Delivery List
   Tampella, Engineering Division, Finland
   FINLAND

6. Electrical Systems for Hydro Power Plants
   Oy Stromberg AB, Finland
   FINLAND

7. Mini Hydro Power Plants In the Federal Republic of Germany
   Ludwig Wbermeyar AKWIE
   Weldemav Pfortsch KONOLAN TV - Berlin
   WEST GERMANY

8. RCTT Newsletter
   Issue 3, August 1979
   RCTT, Bangalore, India
   INDIA

9. SOTUBA: Hydro Electrical Station of Mali
   Energy of Mali Bamako
   (Republic of Mali)
   MALI

10. New Technologies for the Development of Micro Hydro
    Intermediate Technology Development Group,
    LONDON U.K.

11. Preliminary Study on Regional Program on Small Hydro Electric Plants for Latin America
    OLADE, Latin American Energy Organization
    LATIN AMERICA(ILADE)

12. CompleteEquipment for Hydro Electric Power Station
    CMEC
    CHINA

13. Small Hydro Power Stations
Sonderdruck aus Energy Development

14. Rural Development Services
SS HG RD
U.K.

15. Small Scale Hydro Electric Manual
Crown Agents Development Division
U.K.

ANNEX 5 (i)

Welcome Address

By Dr. Ratna S.J.B. Rana

Chairman

National Council for Science and Technology

The National Council for Science and Technology feels priviledged to be able to organize this Seminar / Workshop in co-operation with the UNIDO, RCTT and ESCAP on one of the important areas of our concern, namely the harnessing of water resource through mini / micro hydel projects. It is, therefore, with the greatest pleasure that in my capacity as Chairman of this Council, and on my own, I welcome you all, especially those of you who have come here from outside the country.

As you are well aware, this Seminar / Workshop has been organized with the co-operation and support of UNIDO, ESCAP and RCTT. On this occasion, I would like to express our sincere thanks as well as gratitude to these agencies for making it possible to hold such a Seminar / Workshop in Nepal. I would also like to express here my appreciation of the active co-operation provided by the Research Centre for Applied Science and Technology of Tribhuvan University in the organisation of this seminar.

In view of the growing concern for energy all the world over, the subject of the seminar / workshop is of great relevance to us all and, in addition, the role of mini / micro hydro power generation is of tremendous significance in our context. Hence, the organisation of this seminar is timely as well as appropriate.

In the case of Nepal, hydro-power constitutes by far the most important energy resouce which needs to be developed. Further, the topography of the country has made it necessary for us to pay attention to the development and expansion of energy potential through small and decentralised hydro - electric system in order that the energy requirements of the remote hilly regions and other scattered rural areas could be met. In this context we are awaiting with enthusiasm and interest the outcome of the seminar which we hope will be able to suggest ways for solving problems associated with the establishment of mini / micro hydro schemes.

In this connection it is worth noting that small things need not always be bad or inferior and big things need not always be good or beautiful. Small hydro schemes, are generally branded as unecomonic on a per unit cost basis. However, economic pricing deals with scarce factor only and in cases where the same item is plentiful this logic perhaps needs to be reviewed. Likewise, efficiency consideration in engineering design perhaps also needs to be re-examined.

Following the recommendations of the seminar on Science and Technology held in September 1976 regarding the importance of mini / micro hydro power schemes in Nepal, the National Council for science and Technology on several occasions has been able to provide forum for discussion on the development of mini / micro hydro plants and on the problems associated with it. One of these was, for example, a seminar devoted exclusively to the development of small scale hydro electric power and fertilizer production in Nepal which was held in February - March 1977. I am pleased to take note that the present seminar / workshop will be a significant step in this area.

In conclusion, I welcome you all once again and hope that you will have a pleasant stay in Nepal. I wish you all success in the seminar / workshop.

Thank you all,

ANNEX 5 (ii)

Statement

on behalf of UNIDO

by Dr. D. Butaev,

Director, Industrial Operations Division

Excellencies,

distinguished participants,

ladies and gentlement,

On behalf of the Executive Director of the United Nations Industrial Development Organization, Dr. Abd. El Rahman Khane, I would like to convey to this distinguished and important meeting of experts his greetings and good wishes.

I would like to express UNIDO's gratitude to the Government of Nepal for providing our Seminar / Workshop with all facilities and supporting services.

Our thanks go to the UNDP Resident Representative, Mr. Melford for his continuing support and cooperation, and also to SIDA of Sweden and NORAD of Norway for their financial contribution to the United Nations Industrial Development Fund. This seminar / workshop is organised by UNIDO in cooperation wit ESCAP and RCTT as a part of UNIDO programme for Energy and as a result of appropriate recommendation of the workshop organised by these organizations in April 1978.

The main idea of this seminar / workshop is to bring together many experts in min-hydro power plants and to enable them to exchange their experience and knowledge on the design, construction and operation of these plants.

As UNIDO proceeded with the organization of the seminar / workshop, it received very enthusiastic response from not only ESCAP region but also from other regions. The geographical scope of the seminar / workshop was essentially broadened and today we are happy to see here representatives from all the continents. Unido is engaged

in a number of mini-hydro power generation-related programmes. Overall coordination of these programmes is being done by the Energy Task Force of UNIDO, implementation of the programmes is responsibility of the Industrial Operations Division. Technology Transfer aspects of the programmes are taken care of by the Technology group.

A study tour on min-hydro generators was recently conducted in China, Latin American organization for Energy Development (OLADE) had requested UNIDO assistance in the field of mini-hydro power units, and the programme of assistance has been initiated. More requests for assistance and proposals for cooperation are coming from developing and developed countries.

Coming to the specific objectives of tis seminar / workshop I would like to undeline the importance of energy development for all countries of the world. There is saying that "Energy is bread for Industry". It is correct, but not comprehensive, because energy is a very essential bread" for cultural, social, political development of the people. We should not refer the word "development" to production of material wealth only. The other components of development are not less, if not more, important.

Energy is light in the houses, in schoold, it is light of knowledge, of communications, mutual respect and understanding In this connection development of mini-hydro plants improves the utilization of water resources, has essential environmental advantages, improves agriculture, promotes and supports rural development, including industrial development. Development of mini-hydro power units increases the need for cooperation among developing countries.

Investigations of resources require joint efforts of neighbouring countries, because these resources are very often of the same origin and same character.

Hydraulic engineering work needs a lot of co-operation in utilization of local skill, traditional methods, traditional materials etc.

Equipment is basically simple and can be simplified within reasonable limits and in this area cooperation between developing and developed countries is very important. In this collaboration the specific conditions of every country should be very carefully taken into consideration.

National strategy is extremely essential at the very first stages of development, to provide better facilities for maintenance and repair of equipment. Maximum unification of designs, standards etc. should be developed to avoid difficulties we have sometimes in other areas.

Training of personnel remains our fundamental task if we intend that all this equipment works properly.

There are very essential economic considerations in this programme, since the initial cost of mini-Hidro units per installed kwt of powet are normally higer than in other types of energy generating units. This may require important decisions at the national policy levels in the best interest of overall development.

UNIDO is confident that the results of this seminar / workshop will fully help to strengthen national capabilities on the establishment of mini-hydro power units in many developing countries. UNIDO hopes that we all return to our respective countries and offices better equpped for practical work in the field of energy development.

UNIDO is always ready for further cooperation in this field. Our programme of technical assistance was around 54 million US dollars last year and is steadily increasing. This year we are planning to reach the level of 70 million US dollars and programme will grow further.

Once again our thanks to the Government of Nepal and other organizations and persons who had made the seminar /

workshop possible. I am sure, we will do our best to make it very practical and important for the development.

Thank you,

ANNEX 5 (iii)

STATEMENT OF MR. K.A. DIKSHIT, REPRESENTATIVE OF ESCAP AT THE UNIDO/ESCAP/RCTT/JOINT SEMINAR-WORKSHOP ON "THE EXCHANGE OF EXPERIENCE AND TECHNOLOGY TRANSFER ON MINI MYDRO ELECTRIC GENERATION UNITS", KATHMANDU, NEPAL, FROM 10 to 14 SEPTEMBER 1979

Distinguished Delegates, Ladies and Gentlemen,

On behalf of ESCAP, I am extremely happy to welcome you all to this Workshop on Mini Hydro Units. This Workshop is a joint undertaking of UNIDO, RCTT and His Majesty's Government of Nepal. At the outset, we would like to take the opportunity to express our appreciation for the support and contribution provided by UNIDO. We are also thankful to His Majesty's Government for the generous host facilities made available for this Workshop. We are confident that it will be rewarding for the participants and will also come up to the expectations, with which it has been sponsored.

The growing shortage of sources of energy is the most serious constraint on development that has emerged in recent years. The plight of the developing countries is particularly bad, because they are not in a position to pay for the high price for imported oil and, at the same time, they are themselves endowed with small known reserves of coal. The situation is represented most dramatically by a least developed, land-locked and mountainous country like Nepal. The setting in which this Workshop is taking place is a striking reminder of the urgent need for the development of all available non-oil and non-coal sources of energy. You will agree that this Workshop addresses itself to one of the most urgent needs of our times.

Energy is one of the priority areas selected by RCTT for its activities. This Workshop is the first specific activity generated in the area of energy. We expect that it will be

/only the

only the beginning of a series of programmes which RCTT will be able to evolve. We hardly need add that, in consonance with its network approach, the RCTT programmes in the field of energy will fully involve the relevant national institutions in the member countries. We are also confident that, as in its other activities, RCTT will have the benefit of collaboration and support from the bodies of the United Nations system, such as UNIDO, and above all from member governments in a greater measure to assist in its multifarious activities.

While our host country, Nepal, is a stark instance of extreme shortage of fossil fuels, it is at the same time fortunate in possessing some of the best sources of hydro electricity. We are happy that His Majesty's Government has been considering ambitious projects for harnessing these sources, not only for the development of Nepal, but as well for the benefit of the sub-region. We are hopeful that this country will receive the necessary inputs and that a reasonable arrangement would emerge in which the benefit of the projects will accrue for the development of Nepal. Apart from the major sources of hydro electricity, the country is also dotted with innumerable smaller sources of hydro electricity in the unconnected and far-flung areas. That is also the situation in several other developing countries. In view of the unending inflation of energy prices, the exploitation of these smaller sources has now clearly become economically viable. It has also acquired urgency for the development of the local areas, on which so much emphasis is being placed in the new policies and strategies adopted in the developing countries. It is not surprising, therefore, that the subject of

/this Workshop

this Workshop is of wide relevance to the developing countries, which is evident from the extent of participation in the Workshop.

We trust that the focus of this Workshop will be on the technology of the mini hydro units. The experts who have assembled here will make a critical review of the status of technology in this specific field. We hope that their review will disclose the technological gaps for the removal of which some R & D activities may be undertaken in the region on a network basis. We also expect that the Workshop will deal with the urgent problems of the least developed countries in acquiring the hydro units, skilled personnel for their operation and making arrangements for maintenance. The Workshop will presumably devote attention to the techno-economic aspects of dispersed production of hydro electricity on small scales.

We would, however, like to emphasize that the whole problem has to be viewed in a wider framework. It is our conviction that the exploitation of dispersed sources of hydro electricity and its utilization is possible only in a framework of development that extends to the grass roots. Unless the local communities are made active participants in the process of development and are provided with the necessary institutional support, instances of utilization of small sources of energy will remain sporadic and isolated. The few generating units planted by the central authorities can at best serve the demonstration purpose. They can hardly be integrated with the development effort of the local communities and their benefits would not percolate to the local people. We are, therefore, of the view that, in addition to examining the techno-economic aspects of generation of hydro electricity on small-scale, this Workshop should also consider the local

/institutional

institutional framework within which it can flourish.

We are happy that, with the efforts of UNIDO, several participants from outside the region are attending this Workshop. We shall benefit immensely from the fund of experience that they bring with them. We hope that the activities which will emanate from this Workshop will also have this element of inter-regional co-operation.

ANNEX 5 (iv)

UNIDO/ESCAP/RCTT Joint Seminar Workshop on the "Exchange of Experiences and Technology Transfer on Mini Hydro Electric Generation Units".
10-14 September 1979, Kathmandu, Nepal.

Speech by

Dr. C. V. S. Ratnam
ESCAP Regional Centre for Technology Transfer, Bangalore

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Hon'ble Minister for Water, Power and Irrigation, Mr. Marich Man Singh, Dr. Ratna Rana, Dr. Butaev, Mr. Melford, Mr. Dikshit, Dr. Shrestha, Your Excellencies, Ladies and Gentlemen.

On behalf of the ESCAP Regional Centre for Technology Transfer, it is with great pleasure that I welcome all of you to this inaugural session of the Workshop on the exchange of experiences and technology transfer on "Mini Hydro Electric Generation Units" being organized by UNIDO, ESCAP and RCTT and the Royal Government of Nepal.

We are deeply appreciative of the welcome received from the Royal Government of Nepal and their National Council for Science and Technology and its dynamic Chairman, Dr. Ratna Rana, who have provided the host facilities for this important workshop. They have spared no effort to provide all the necessary facilities for this purpose. We are also grateful to the Governments of Norway, Sweden and the UNDP for financing this workshop.

What is conceived by ESCAP, RCTT and UNIDO as a Regional Workshop, essentially covering the countries of the ESCAP region has now become, because of the importance of the subject, a global meeting There are participants in this workshop from the countries in Europe, Africa, North America and South America besides those from Asia and the Pacific. The importance of Mini Hydro Electric Generation Units in the development of countries of the ESCAP region is fully recognised. Such units have great promise in countries where hydro electric potential exists and for various reasons, large-scale generation units based upon different types of fuel cannot be established. Even where such large units can be established

there is still potential for mini hydro stations in areas which cannot be reached easily and in an economic manner. However, because of the limited amount of power generated in each unit, there is need for proper planning of utilization of power in the immediate neighbourhood of the unit. Therefore planning for area development so that power generated could be utilized in the most effective manner becomes very important. This workshop while assessing the progress already made in this field all over the world, will give pointers for future development of this technology and industry. It is also our desire that a technological sub-network could be organized in the ESCAP region so that countries would continue to exchange their experience with each other and institutions and organizations of excellence and departments engaged in the construction and operation of mini hydro units and the utilization of the generated power will maintain close contact with each other and solve for mutual benefit problems arising from time to time.

It may be pertinent to mention in this connection the activities of the ESCAP Regional Centre for Technology Transfer and how this organization, with assistance from other organizations in the UN system and the countries of the region,has already established technological sub-networks in relevant technologies and is engaged in assisting countries of the region in the development and transfer of relevant technologies.

The ESCAP Regional Centre for Technology Transfer, established in Bangalore, India was conceived on a network principle with intimate links with national centres and institutions of excellence of the region for assisting them and the countries in the development and transfer of relevant technologies and generally cater to their needs in areas of science and technology and technology transfer to promote development. The objectives of RCTT are:

1. Assisting countries in the ESCAP region in strengthening their national capabilities/capacities in the field of development of technology and its transfer;
2. Initiating co-operative programmes among the countries of the region for the development and utilization of technologies of mutual interest;
3. Assisting National Centres and countries in the assessment and evaluation of technologies required by them;

4. Assisting participating countries in identification of appropriate technologies;

5. Supply of need based information to national centres and countries;

6. Delivery of information services;

7. Unpackaging of technologies in use or proposed to be purchased;

8. Assisting National Centres and countries in negotiating for best terms while purchasing technologies;

9. Assisting National Centres and Governments in the development of appropriate technologies and their transfer;

10. Assisting National Centres and Governments in indigenization, absorption and development of imported technologies.

11. Instituting training programmes to help countries of the region in training their personnel in the area of technology development and technology transfer.

The work of the RCTT is now being carried out under six broad categories:

1. Providing assistance to the countries of the region in the establishment of National Centres of Technology Transfer or helping them to organize activities in the areas of science and technology for self-reliance. RCTT is engaged in sending missions in association with ESCAP, UNIDO and UNCTAD in helping the countries of the region in this important activity.

2. RCTT is establishing technological sub-networks initially in five areas of relevance to countries of the ESCAP region.
   a) Cement from rice husk and other agricultural residues
   b) Machine tools
   c) Mini-hydro electric plants
   d) Production of iron in the small-scale sector, including direct reduction processes and sponge iron
   e) Medicinal plants and essential oils.

RCTT in association with UNIDO, ESCAP and with the Government of Pakistan, organized in January this year a workshop in Peshawar on problems involved in the development of technology and its transfer in the area of rice husk cement. (A follow-up workshop will be held in Alor Setar, Kedah, Malaysia, 15-18 October 1979).

The first workshop on machine tools was held in Bangkok in July this year. Follow-up action on this is being taken to promote the establishment of this important industry in the countries of the ESCAP region.

The workshop on Mini-jydro plants is starting today in Kathmandu.

The workshop on sponge iron is expected to be held in November 1979 in Bangkok with assistance from UNIDO and UNDP.

We are planning to organize the technological sub-network in medicinal plants and essential oils early next year.

3. Promotion of TCDC among the countries of the ESCAP region.
   RCTT is engaged in many activities in promoting technology transfer among developing countries. Towards this end, it is organizing a publication programme and also workshops, group meetings, round table discussions etc. Rosters of experts and institutions of excellence in the ESCAP region in industries based on agricultural residues, solar energy, leather and machine tools are now under preparation.

4. Technological information network.

   RCTT has already started establishing a technological information network for assisting the countries of the ESCAP region in the problems of development especially in the areas of science and technology and its transfer. Three issues of the RCTT quarterly newsletter have already come out.

5. Training programmes for personnel from developing countries of the ESCAP region in the area of technology development and transfer.

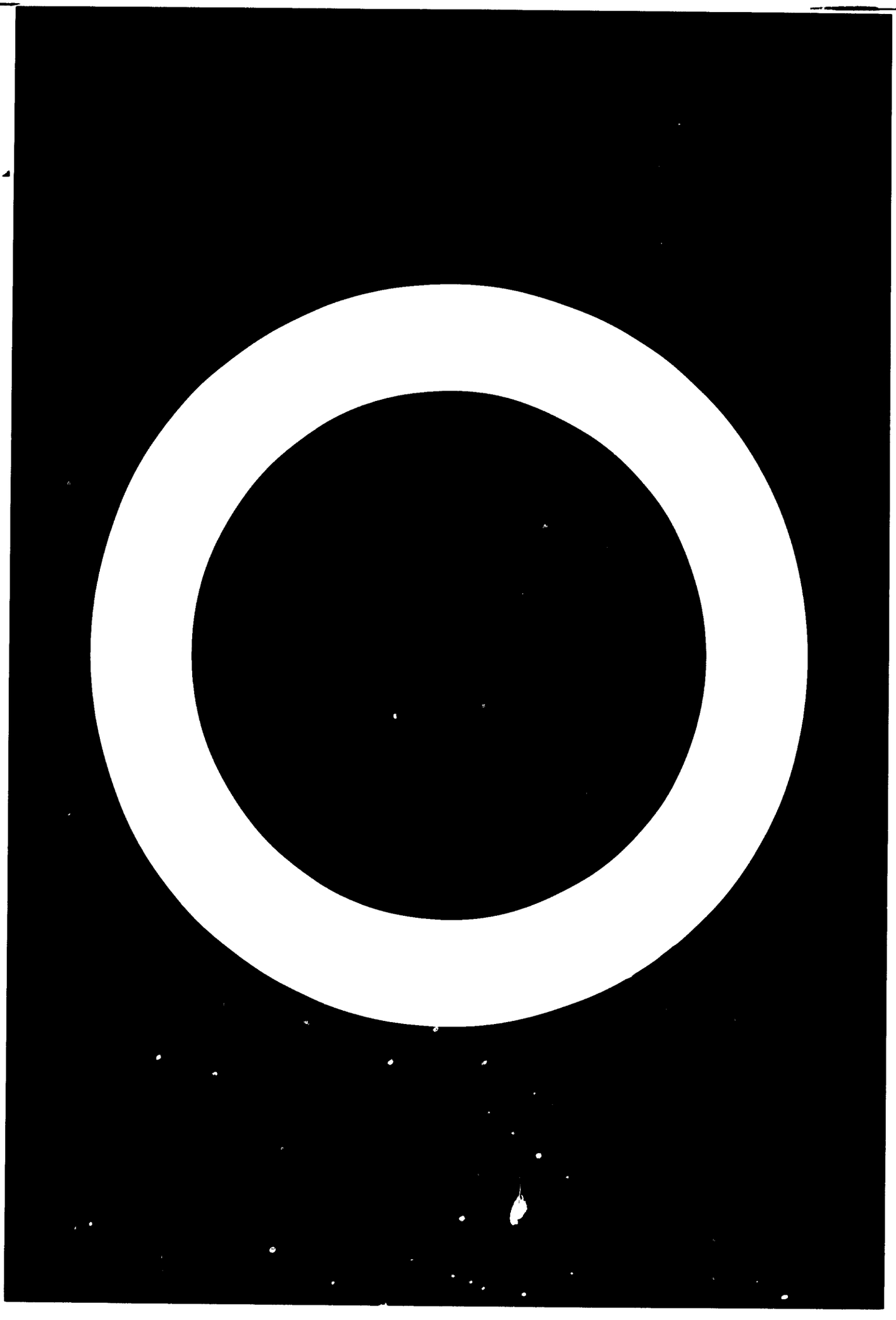
   Regional and national programmes for this purpose are being organized by RCTT in association with ESCAP, UNIDO and UNCTAD.

6. RCTT has started providing to countries of the ESCAP region technological information on specific problems in industry, technology development and transfer.

RCTT is a service organization devoted to meet the needs of countries of the ESCAP region. In the endeavours of the developing countries of the ESCAP region for the establishment of a new international economic order and for attaining self-reliance, RCTT will play its humble role.

I express my grateful thanks to the Royal Government of Nepal, to NCST, its Chairman, Dr. Ratna Rana, its Member-Secretary, Dr. K. L. Shrestha and his able colleagues for all they have done to make this meeting a success.

I, once again, welcome all the participants to this important workshop and hope that they will have a very fruitful and pleasant stay in this beautiful capital of Nepal.



ANNEX 5 (v)

Remarks made by Mr. John B. Melford on the Opening of the Workshop/Seminar on Mini-hydel Projects on Monday, 10 September 1979

It is a great pleasure to be here and to have an opportunity to say a few words at the opening of this important Workshop/Seminar arranged by HMG, UNIDO and ESCAP to discuss and exchange information on mini-hydel projects.

I think it is particularly fitting that the workshop is taking place in Nepal, which can offer some experience in the construction and operation of mini-hydel plants.

The provision of electricity through mini -hydel plants is, of course, especially important in mountainous countries, such as Nepal, where communities live in isolated valleys which can often only be reached by days or even weeks walking from the nearest road-point or STOL airfields.

The provision of electricity to towns and villages in the hills is important for both social and economic reasons.

On the social side it provides amenities for people who, particularly during the winter months, often lead a hard and difficult lives.

From the economic point of view, perhaps the most important result of bringing energy and power to communities in the Hills is that it can be a significant factor in stabilising the population in the hills by providing means to increase their incomes, which in turn would make it unnecessary for them to migrate to the plains.

An important consequence of this is that it relieves Government of the burden of resettling people.

The social and political consequences of providing the means to allow people to stay in their ancestral homes can hardly be overestimated. What after all would Nepal be without the hills and the people who live in them? Projects therefore cannot be judged purely in bankable terms.

The potential uses of electricity in conditions obtaining in the hills are, of couse, many. Let me just give a few examples:

Electricity can be come an important substitute for kerosene initially for lighting, but eventually perhaps also for cooking. This would also have an important bearing on the consumption of firewood, which is of course a major cause of deforestation.

Another obvious use of power is for cottage or small - scale industries such as weaving and agricultural processing. A good example here is the Langtang Cheese Factory (12,000 ft.) which will soon operate on electricity provided by a mini-hydel scheme. The scheme will also provide electricity for a tourist lodge built by the Parks Department with the assistance of UNDP.

It may also be feasible in some cases to use electricity during the slack period of demand to pump water uphill, where people live, for both drinking purposes and possibly also for small-scale irrigation.

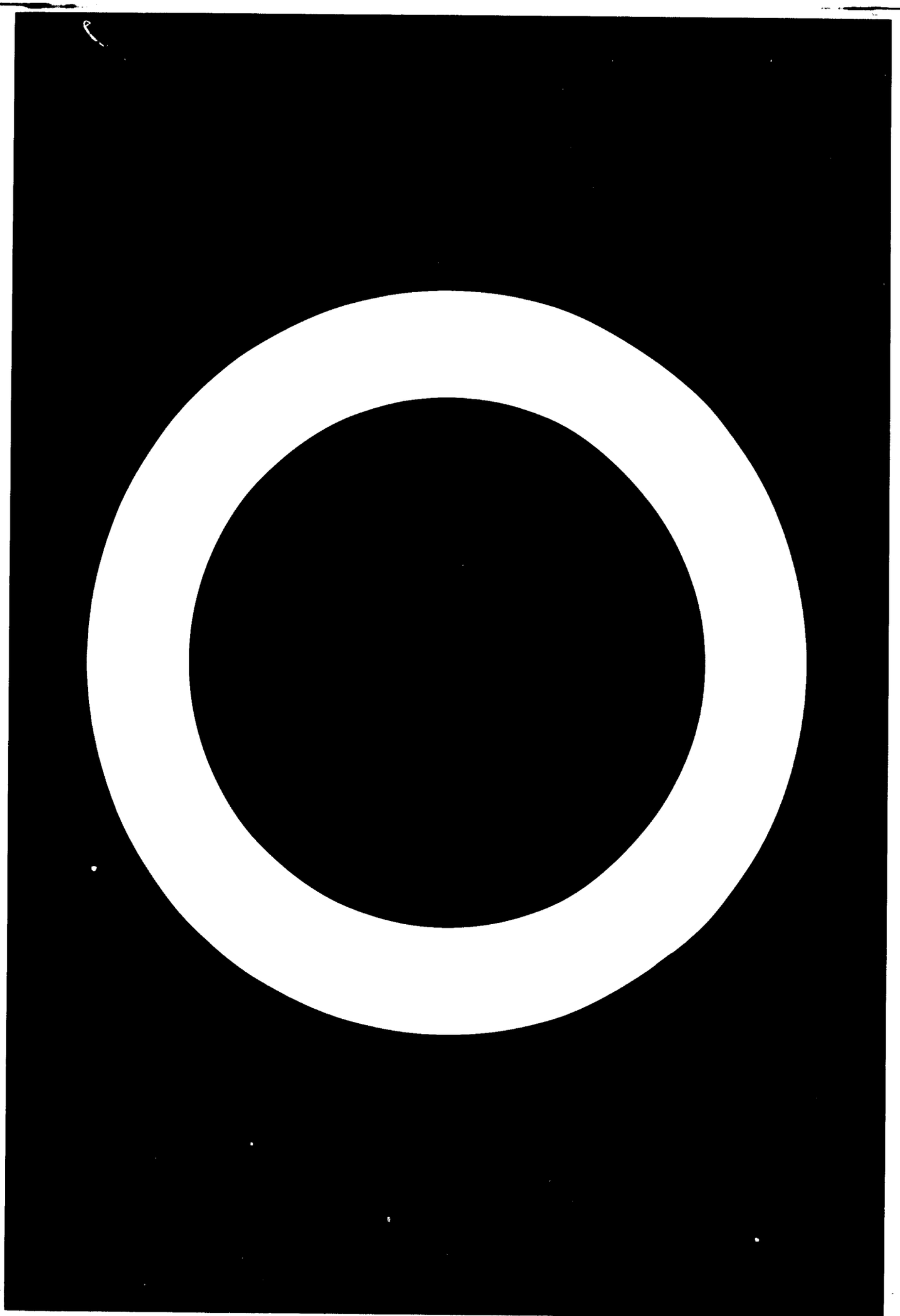
When it is realized that in many parts of Nepal (and this is most probably true in many hill regions in other countries) women and also children spend a good and possibly a major part of their day in fetching water and fuelwood for domestic consumption, it can readily be appreciated that the availability of light, power and water, all of which under ideal conditions can be provided by mini-hydel schemes, can bring considerable social and economic benefits to hill communities.

Here in Nepal there is, to my knowledge, at least one mini-hydel scheme in operation. It is located between Kathmandu and Pokhara, and I hope some of you will have an opportunity to see it. Other schemes are under construction. These include five mini-hydel projects in eastern Nepal funded by the UNDP/CDF at a cost of approximately $2 million, or about $400,000 each.

With the rising cost of imported fuel and the scarcity of wood/ together with the necessity to conserve existing and re-establish old forests to protect the environment (which is a problem common to many hill countries in the region) it is perhaps not too faciful to look forward to a time in the not too distant future when much of the energy, both for domestic and industrial purposes, will be provided through both large-scale and mini-hydel projects.

I am confident that outcome of your discussions will make a significanct contribution to the development of mini-hydel power and I wish you every success in your important endavours.

Thank you.



ANNEX 5 (vi)

Inaugural Speech by the Hon'ble Minister for
Water, Power and Irrigation Mr.Marich Man Singh
on the Occasion of the Opening of the
Seminar/Workshop on
the Exchange of Experiences and Teohnology Transfer
on
Mini Hydro Electric Generation Units
Kathmandu, September 10, 1979

Your Excellencies, Hon'ble Representatives of United Nations Agencies, Distinguished Participants, Ladies and Gentlemen,

I am grateful for the opportunity, you have given to me, to inagurate this Seminar on Micro Hydro Generation Unit. This is, no doubt, a subject of international importanoe, speoially, in the wake of the present world energy crisis. I highly appreoiate the choice of the time to hold this seminar in Nepal. We, in Nepal now acutely feel that the development of hyd· · power generation is condition of foremost priority and urgency in our efforts of development. Our topography and the water available in the rivers has provided us with immense opportunities and possibilities in this direction. The only form of commercial energy available at present, in our country is Hydropower. Our growing demand of energy for household purposes, as well as, for other development activities, has to be met from this source alone. As such, speedly development of hydro power has become imperative to fulfill the aspirations and objectives of our countrymen.

Although our hydropower potential is quite large and conspicuous its development, in a bigger scale, involves long gestation period as well as large financial input. The mini/micro hydropower generation has become very attractive for us, more particularly, in the remote hilly regions where the building and the maintenance of normal transmission lines is a costly affair and the transporation, a big problem.

As such, localized power generation, we believe, would be an expedient way of development of energy resouroes to meet the rural requirement, as well as, to support project and programmes for rural industrialization. Thus, His Majesty's Government of Nepal has attached

considerable importance to the establishment of mini/micro hydropower units in the different parts of the country. Efforts are being made to execute such projects with active participation of our local people, with local technology and available materials. This experiment has given us considerable confidence in our efforts and we are looking forward for another venture of attempting micro-multi-purpose projects in the hilly areas to incorporate irrigation, power and drinking water activities on a minor scale.

It is obvious that rapid and successful implementation of such schemes will depend largely on the local technological capability and competence in this field. Although waterwheels have been in operation in the different parts of the country for a long time. There is still a need for a systematic study and improvement of mini/micro hydroelectric generation in our country. However, a lot more could yet be learned from the vast experience your countries have gained in your endevour in this field. The development and technology transfer in the establishment of such mini/micro hydro-plants are of much importance to us. The exchange of experiences with the distinguished participaants during the courses of this week-long seminar will, I am sure, be very much useful in this regard.

I hope, that, as a result of the deliberations in the seminar and further discussions during the workshop, the problems associated with the mini/micro hydro-electric generation schemes will be identified in a clear way and alternative solutions to tackle the problems more effectively will be suggested. I wish you every success in your deliverations.

The United Nations Agencies have done a commendable job in this regard by persuing the subject matter to this stage. I earnestly hope that follow-up actions emerging from this seminar will be carried with equal vigour and support.

I now with your kind permission, declare this seminar/workshop open.

Thank you,

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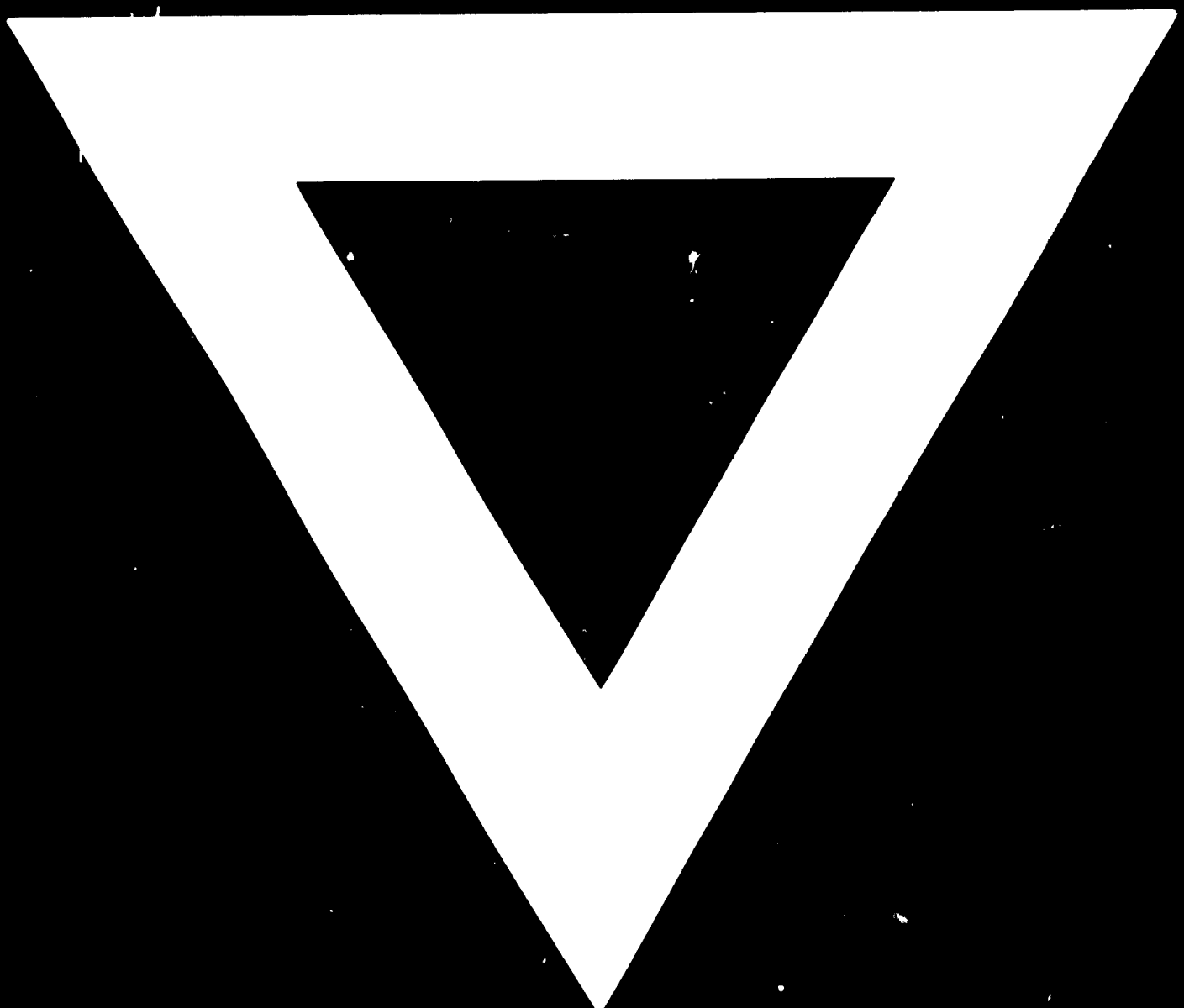

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