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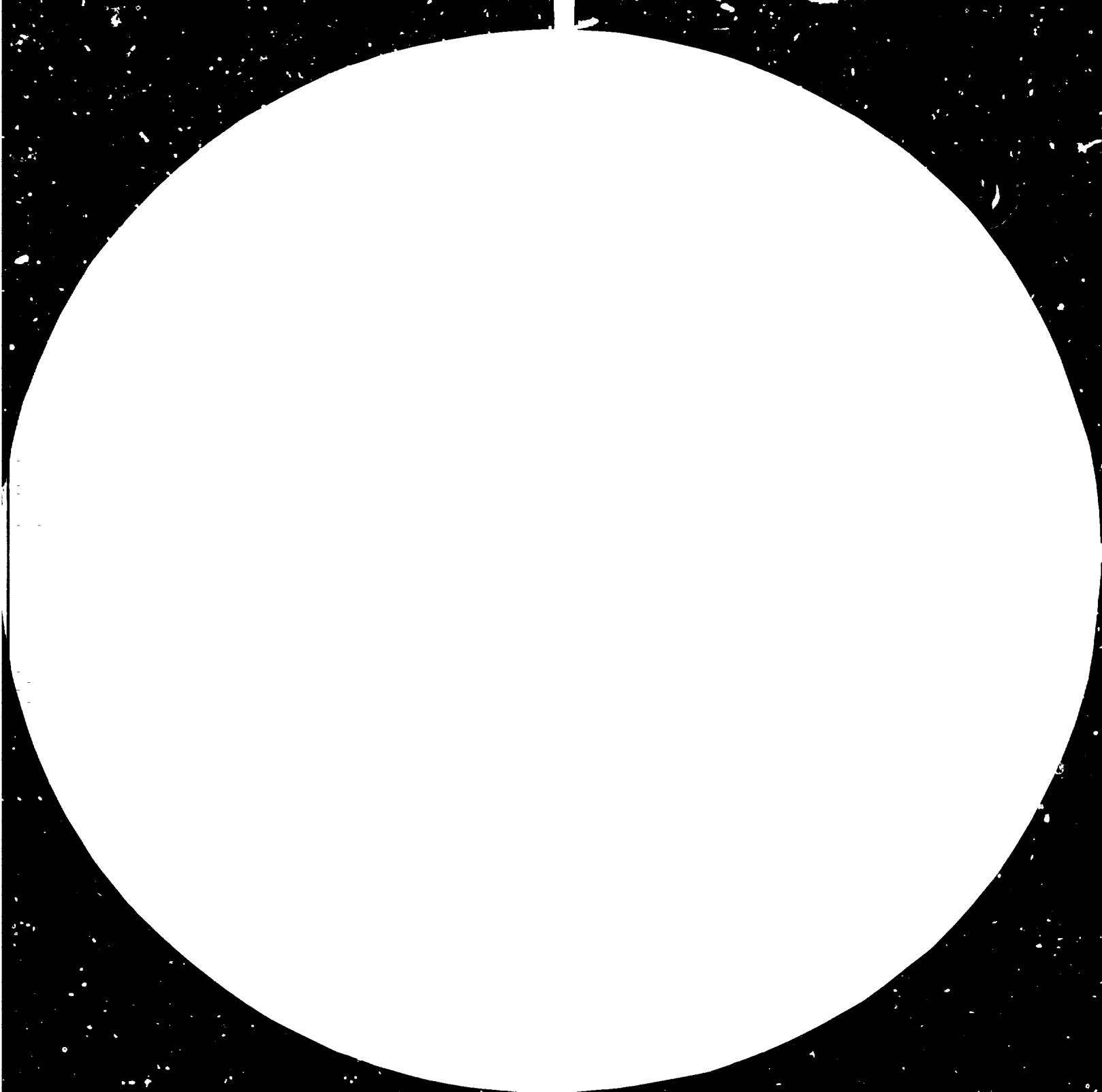

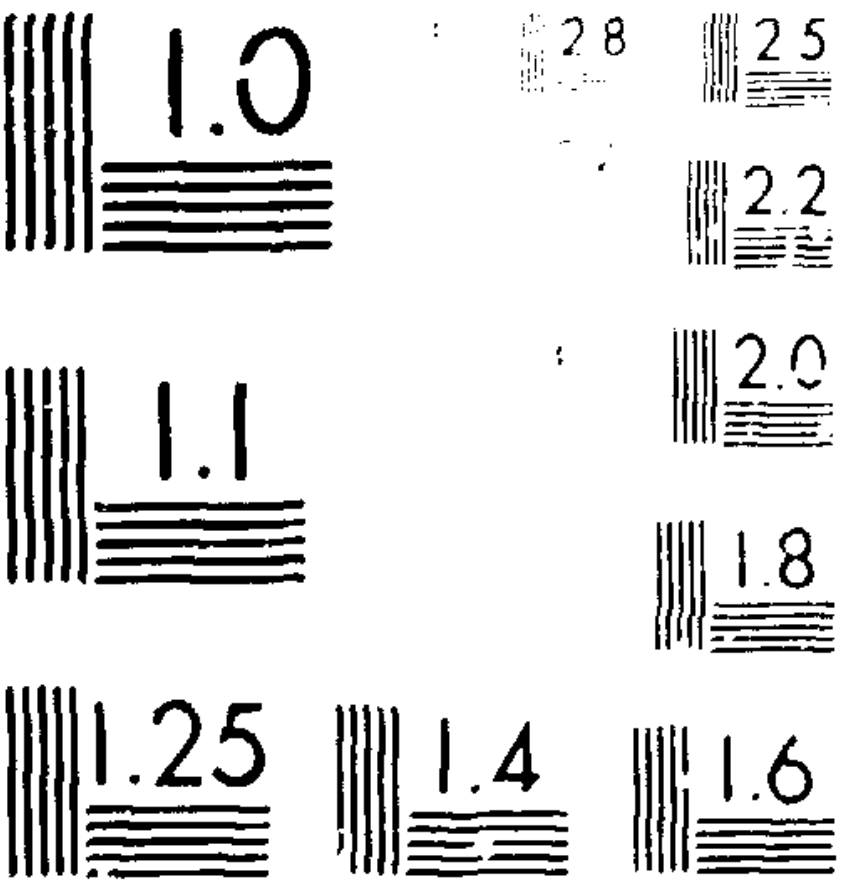
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UNITED NATIONS INDUSTRIAL
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POLICY, ECONOMIC AND TECHNOLOGICAL ASPECTS OF MINI HYDRO ELECTRIC GENERATION IN DEVELOPING COUNTRIES

WORKING GROUPS REPORTS

KATHMANDU DECLARATION*

000122

* Adopted by the Seminar-Workshop on the Exchange of Experiences and Technology Transfer on Mini Hydro Electric Generation Units, Kathmandu, Nepal, 10-14 September 1979.

80-43800

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 Council 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 discuss a few case studies and on-going projects in developing countries 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.

III. GROUP REPORTS

A. Group I - Technology Aspects

Group I was 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 or technological aspect 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 conclusions 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 applications in terms of operation and cost. There could be other designs which were developed in the past but did not come 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 frequency control is in general desirable, except in the case of applications where direct drive to mechanical devices 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 is the electronic electric or the electronic-hydraulic where the speed sensing would be carried out by an electronic device which will actuate the electrical or hydraulic servomotor making use of low pressure fluid to actuate the valve 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 device 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) machine 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 synchronous 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 greater cooperation and communication between R and D institutions particularly in the developing countries to enable th R and D work in progress to proceed at a greater speed and with greater success. Regional organizations like 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 the 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 for equipment for R and D work considered necessary by the institutions in the developing countries for carrying out R and D work ; for organizing meetings and experts visits to other developed and developing countries, interregional and regional meetings and financing training programmes and construction of prototypes in these countries.

3. Information:

A large number of countries 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.

UNIDO could assist the regional institutions to bring out a global compendium. 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 be 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 to organize a study so that the range of standardised equipment and components for micro and mini hydro plants be developed in view of the importance of this subject 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.

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 phased 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 appropriate 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 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 programmes to develop technolog 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 realitites 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 aoocunt:

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 take into account the possibilities of increasing this demand, e.g. by introducing some industrial activities in the rural area and by developing end-use appliances suitable for use in rural areas.

In forecasting electricity demands, it must be taken into account (as some experiences in Panama have shown) that the introduction of this amenity in rural areas could 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 connot exactly be quantified, e.g. introduction of television for education, etc.

RECOMMENDATIONS:

i) It is recommended that UNIDO assist develcping 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 Deve opment 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 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 the 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.

Although three 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 the first 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 has plans and policies 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 input in industrial production, should be fully emphasized. However, it has been noted that not all governments nor rural communities put the same priority on the electricity supply 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 are to be formed in agreement with the government policy at the 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 setup 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 shown in the set up of the People's Republic of China and the Phillippines. 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 regularly provide 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 MEA helps the co-operatives to organize 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 the central level, training should be initiated pertaining to construction, installation and operation of MHG and related electrification projects. 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-spot training in wood working, mechanical and electrical fields. Thus transport of products to commercial workshops (established as part of the institute and staffed largely by trainees of the institute) is accomplished. 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 conducive to the implementation of technologies appropriate to the specific conditions of the countries concerned.

Standards and Norms

The Government should adopt standards and norms worked out by the international standardization organizations and see that these are 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 the central level by given the task of collecting data on 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 their own resources for local manufacturing of equipment and components for MHG and electrification schemes 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 commercial and non-commercial type. Governments have to make their choice of either one or two or both, depending upon the circumstances.

Transfer of technology in the field of MHG and electrification in general may follow these lines. Most developing countries have considerable 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 behalf of someone who made a proposal during the discussion in the Working Group III, UNIDO was asked to approach industrialized countries 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 industries and the problems such industries will have regarding finance, technical assistance, 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 countries, in view of this urgent need to develop energy resources, especially mini and micro electric stations and the technical capabilities of their countries to implement such programmes.

KATHMANDU DECLARATION ON INTERNATIONAL CO-OPERATION IN THE FIELD OF MINI HYDRO ELECTRIC GENERATION*

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 want this to be referred to as THE KATHMANDU DECLARATION.

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*Adopted by the Seminar-Workshop on the Exchange of Experiences and Technology Transfer on Mini Hydro Electric Generation Units at Kathmandu, Nepal, 14 September 1979.