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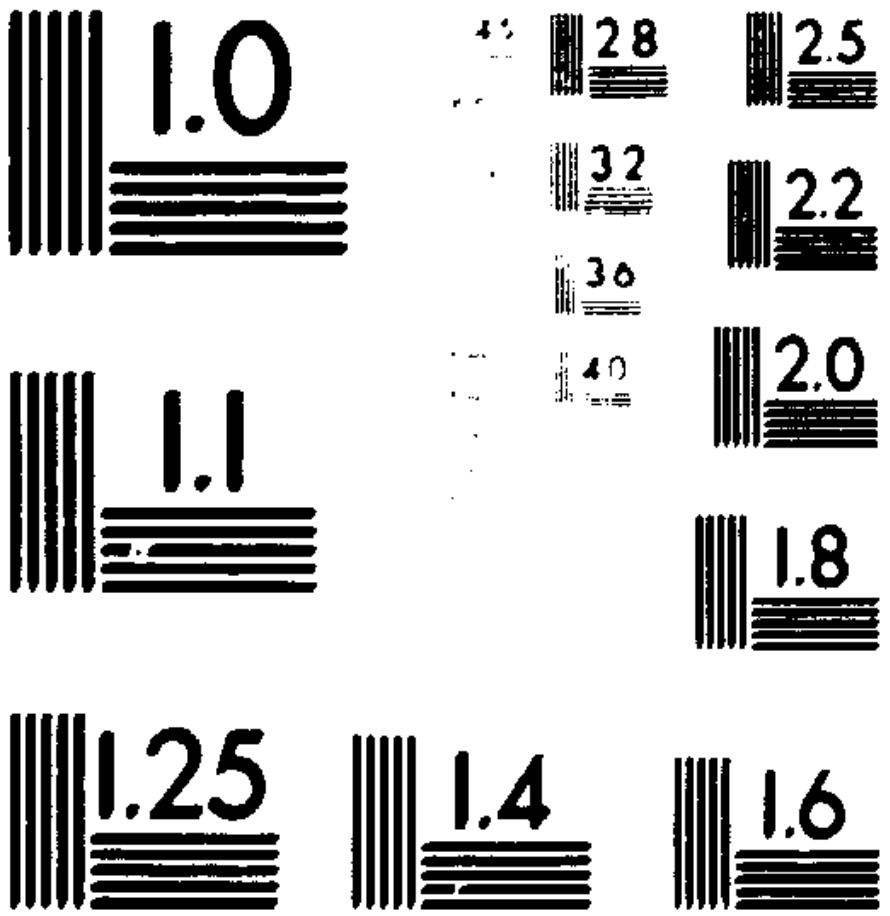

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ESCAP Regional Energy Development Programme (REDP)
Regional Network for Small Hydropower (RN-SHP)

Technical Advisory Group (TAG)
First Meeting

Hangzhou, China, 11 - 13 December 1984

REGIONAL NETWORK FOR SMALL HYDROPOWER CONSULTATION MISSION REPORT*

Prepared by

Interim Co-ordinator of the
Regional Network for Small Hydropower

Xiaozhang Zhu

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Mission members

Zhu Xiaozhang, Director of HRC, Interim coordinator, RN-SHP Secretariat

Chang Eugene, Assistant to the Director, TOKTEN Consultant

Wang Qi (Ms), Acting Head, External Liaison Division, HRC; Staff Assistant, RN-SHP Secretariat

RN-SHP Focal Points visited and host organisations

1. Oct.26--Nov.1 : National Energy Administration (NEA), Bangkok, Thailand (Mr Prapath Premmani, Secretary- General); ESCAP-REDP, Bangkok (Dr.F. Harahap, REDP, Senior Coordinator).

2. Nov.1-Nov.9: Small Hydel Board (SHDB), Kathmandu, Nepal (Mr. A.K.Shrestha, Project Director).

3. Nov.9-Nov.15: ESCAP-REDP, Bangkok (Dr F. Harahap).

4. Nov.15-Nov.20: Mini-Hydro Development Office, National Electrification Administration, Manila, Philippines (Ms. Z. Santos, Executive Director).

Summary and Conclusions

a) The three-person Mission received a warm reception from national focal points, UNDP offices and related organisations in the three

countries visited: Thailand, Nepal and Philippines. We wish to record our gratitude to all those who helped us during our visits,especially in arranging last-minute changes which proved necessary.

b) In each country, the major organisations involved in SHP were contacted and a greater understanding of their activities and needs was obtained. Similarly, the Mission was able to review the past few years' work in setting up the RN-SHP and to discuss future plans for greater involvement of focal points in the network's activities.

c) Each focal point expressed support for RN-SHP activities, and provided new research + development proposals for discussion at the TAG meeting in Dec.1984. They all supported the work of HRC as Secretariat, and noted that HRC had resources of manpower, buildings and equipment already available.

d) The idea of decentralization of RN-SHP activities was discussed and keenly welcomed by the focal points. In this way, HRC could concentrate on organization and co-ordination of activities.

e) The Mission was able to assess and compare the relative strengths of focal points in SHP technology. This would be useful when deciding upon the extent of decentralization of RN-SHP activities.

f) The newsletter " SHP NEWS " (1st issue) was welcomed by all, especially by those who were actually mentioned in it. Dr. Harahap also commented that both technical and policy issues should be covered, and that fine arts specialists could help in improving the appearance.

g) There were impressive plans for SHP development in the 3 countries but the degree of actual implementation varied according to financial resources available. However, common points were firstly problems of high unit installed cost per kW, especially for stations below 100 kW; secondly, encouragement was given to local manufacturers, consultants and contractors; thirdly each country had limited resources both in the public and private sector to carry out R + D work to improve the technical and economic level of SHP stations.

h) It is recommended that such Consultation Missions are continued in future, with participation from not only HRC staff but also relevant personnel from other Asia-Pacific countries, so as to continue this exchange of first-hand experience within the Network. In particular, India should be included in the next mission.

Background

Since its formal establishment in mid-1983, the RN-SHP has engaged in a number of research, training and information activities. Up to the present time, most of these activities have been organised by the Interim Secretariat located at HRC (Hangzhou Regional Centre), with backstopping by UNIDO and ESCAP-REDP.

As the range of activities widened, and the required degree of involvement of focal points in ESCAP member countries increased, so it became increasingly apparent that a Secretariat Consultation Mission would be of value to sound out opinions for the RN-SHP Work Programme, exchange views on technical matters of mutual interest and to establish personal contacts as a basis for strengthening ties and inter-linkages in the Network.

Thus, part of the REDP funding under phase II for RN-SHP activities has been allocated to this Mission. The original plan was to visit four countries, but the trip to India had to be cancelled at the last minute.

Objectives of the Mission

Since the formal start of RN-SHP activities in 1983, 10 focal points have been nominated. The objectives of this Mission were to strengthen ties within the Network by reviewing past activities and exchanging views on the 1985-1986 Work Programme with selected Focal Points. Also, site visits and exchange of views on aspects of SHP technology were part of the Terms of Reference, details of which are given in Appendix 1.

Thailand

1. Contact Persons

Mr. Nakagawa, Deputy Executive Secretary, ESCAP.
Mr. Wanasinghe, Chief, Technical Cooperation Division, ESCAP.
Dr. Harahap, Senior Coordinator, REDP, ESCAP.
Dr. Fan, Chief, Natural Resources Division, ESCAP.

Dr. Koide, Coordinator, BSW Network, ESCAP.
Mr. Premmani, Secretary-General, NEA.
Mr. Singh, Director, Energy Policy & Planning Division, NEA.
Mr. Chartdanai, Energy Policy & Planning Division, NEA.
Mr. Adul, Engineer, NEA.*

2. Discussions with ESCAP

The Mission made a courtesy call on Mr Nakagawa, Deputy Executive Secretary, who noted that HRC was an active regional centre and that the Chinese government had given much support to ESCAP activities in general. In another brief meeting, Mr Wanasinghe, Chief, Technical Cooperation Division, expressed his firm belief that the Network approach was the best way for information dissemination and technology transfer.

In discussions with REDP Senior Co-ordinator, Dr F. Harahap and Dr L.Fan, Chief, Natural Resources Division, Mr Zhu reviewed HRC's activities since its establishment in November 1981. Some video films were shown introducing HRC and its research and training work. As regards the future work programme, Mr Zhu thanked REDP for their support under phase II for RN-SHP activities, now sub-contracted to UNIDO for implementation. The most immediate item was the first TAG (Technical Advisory Group) meeting scheduled for 11-13 Dec. 1984. Dr Harahap gave the Mission a copy of the 2nd REDP Steering Committee report, and hoped a similar report could be produced after the TAG meeting.

The Natural Resources Division was keen to co-operate in RN-SHP activities where appropriate and asked to be kept fully informed. Their "ESCAP Energy News", part of the Biogas, Solar and Wind Energy Network activities under its Co-ordinator, Dr S. Koide, could help publicise RN-SHP activities, and could exchange information with "SHP News". Views were exchanged on how to improve "SHP News", and how to further use graphic design experts.

Furthermore, Dr Fan gave the Mission the report of the High-level Consultative Meeting (Sep. 1984, Bangkok), listing priority items for funding. All six proposals submitted by HRC had been discussed, and further action on three was now being pursued.

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All parties concerned agreed that the question of RN-SHP and HRC's institutional management and legal status should be borne in mind and resolved step-by-step.

3. Discussions with NEA

Mr Zhu introduced HRC's work to NEA staff including Mr Prapath Premmani, Mr Mohar Singh, Mr Chartdanai, and Mr Adum (former HRC Training Workshop participant); he showed some video films, and invited comments on the proposed 1985-86 Work Programme.

Mr Premmani gave his support to the programme, and commented that as regards future Training Workshops, NEA would particularly welcome inclusion of appropriate feasibility studies for SHP; low cost civil engineering structural design, especially for headworks and headrace which could account for 80% of civil costs. He supported the idea of revolving training courses, and noted that NEA had a training school where they hold micro-hydro operators courses. They were working on improved designs of medium head Turgo and low head propellor turbines. NEA was willing to co-operate on the electronic load controller (ELC) co-operative reserch project, and also to contribute to "SHP News".

Mr Chartdanai then gave a brief introduction to SHP development in Thailand which had started up vigorously in the wake of the 1973 oil crisis, and was now progressing at a steady pace. In the current 5-year plan (1981-86), NEA plans to have 92% of the villages electrified, with 75 micro-hydro stations (less than 200kW) and 25 mini-hydro stations (201kW to 6MW). So far, 20 stations, total installed capacity 5MW had been commissioned. Local participation, in both civil construction and equipment manufacture was a new trend. Furthermore, NEA is doing development work on the ELC to use it as a speed sensor which then drives a DC motor to actuate the turbine guide vanes or nozzle. This novel approach had been successfully tested in the laboratory and could widen the application of ELC's. Their experience with locally assembled ELCs showed that they were cheaper than imported Chinese-made mechanical governors and about half the cost of imported ELCs.

Typical breakdown of costs for an SHP station in Thailand was:

civil works	40%
electromechanical equipment	25%

distribution	25%
administration	10%

4. Site visits

Mr Chartdanai accompanied the Mission on site visits to 4 stations near Chiang Mai (see Map 1):

a) 1250 kW station (Mae Sarieng) built to high technical specifications using imported equipment, and buried steel pipe, diameter 1.8m, for the 3.8km long headrace resulting in an investment cost of about US$4000/kW, which is high for Thailand.

b) Huai Mao station, 20kW, 80m head, under construction with local participation, serving 102 households (420 people).A low wooden dam was being constructed, and 30% of construction costs was being contributed by local labour and materials. The labour was valued at the going rate for unskilled labour which was about US$2 per man-day. End-uses for this village-level project included cooling water for mushroom plantations, coffee grinding, and bamboo splitting.

c) Mae Tong Long, 35kW, 90m head, was built with a locally-manufactured crossflow turbine and imported governor, all housed in a simple wooden powerhouse,(fig.3). The station served 156 households, and was used mainly to meet lighting needs. The unit installed cost was US$3300/kW.

d) Pang Pong, 12kW, 55m, using locally-assembled ELC which cost US$1150.This ELC had been made with core parts supplied by ITDG and had been running for 2 years.

The Mission was impressed by the move to involve local villagers, along the lines practised in China, to reduce the Government burden and transfer technology to rural people.

Nepal

1. Contact Persons

Mr. A.K.Shrestha, Project Director, SHDB.
Mr. P.M.Pradhan, Acting Superintending Engineer, SHDB.

Mr. R.B.Shrestha, Director, Central Regional Office, SHDB.
Mr. B.K.Pradhan, Executive Secretary, Water & Energy Commission,Nepal.
Mr. H.M.Shrestha, Chief Engineer, Dept. of Electricity, Ministry of Water Resources.
Mr. A. Delaporte, Asst. Resident Representative, UNDP Kathmandu.
Mr. A. Bachmann, UNICEF.
Mr. E.A.Fry, Training Adviser, Inst. of Engineering, ILO.
Mr. E. Kramer, Himal Hydro.
Dr. K.L.Shrestha, Executive Director, RECAST.
Mr. A. Arter, Technical Manager, BYS.
Mr. K. Denghal, Engineer, IDS.
Mr. N.L.Shrestha, Dean, Inst. of Engineering.
Mr. M.R. Tuladhar. Asst. Dean, Inst. of Engineering.
Dr. Aryal, Director, Western Regional Office, SHDB.*

2. Discussions with SHDB and other Government offices.

The Mission had several discussions with SHDB officials including Mr A.K.Shrestha (Project Director), Mr P.M.Pradhan (Actg Superintending Engineer) and Mr R.B.Shrestha (Director, Central Regional Office). The latter two are former HRC Training Workshop participants.

SHDB was set up in 1975 to exploit the huge small hydro potential in Nepal. However, progress was hampered by the lack of trained manpower and unfavourable geographical conditions which make access difficult. These factors lead to high investment costs of US$4000/kW and upwards. His Majesty's Government of Nepal considered SHP a priority area, and SHDB was seriously interested in participating in RN-SHP activities. At present, 9 stations of total installed capacity 1.7MW were in operation. In the 7th 5-year plan starting July 1985, SHDB would concentrate on stations in the mini range i.e. a few hundred kW and above, leaving the micro end (less than 100kW) to private entrepreneurs. The latter included the possibility of converting about 25,000 old water mill sites using multi-purpose power units for electricity and shaft power.

SHDB was keen for RN-SHP to include work on cost reduction, such as appropriate project selection methodology, rationalised design process, including computerization to cut down design time and optimize designs, improved hydrological estimation for ungauged rivers (a particularly

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acute problem for Nepal where not only are flow records scarce, but flow variations are extreme, say 1 to 3,000 between wet and dry season flows). Their aim was to reduce the unit installed cost from the current range of US$4000-7000/kW to a range of US$2000-3000/kW.

Mr A.K.Shrestha thought the revolving training courses a good idea, as also future consultancy visits either to assess Nepal's resources or using Nepali experts to visit other S.E.Asian countries. As regards the ELC project, however, there was no suitable site in Nepal for conducting field tests, since most stations had reservoirs.

The Mission also met Mr B.K.Pradhan, Executive Secretary of the Water and Energy Commission, who explained that only 126MW out of a theoretical potential of 83,000MW had been exploited so far. Another two stations totalling 98MW were under construction, but Nepal had no substantial home power market as yet, with 91% of energy demand being met by fuelwood and biomass. By 1990, 40 SHP stations would be in existence with total installed capacity of 13MW. Village participation in construction would be difficult in Nepal because of lack of local expertise and economic constraints on donating labour free of charge.

The Mission paid a courtesy call on Mr H.M.Shreshta, Chief Engineer, Dept of Electricity, Ministry of Water Resources. He repeated the need to reduce the cost of SHP and to train personnel in maintenance and operation of stations, and hoped the activities of RN-SHP would take this into account.

3. Discussions with other organisations

SHDB arranged several meetings with interested parties covering a wide range of organisations.

3.1. UNDP/UNICEF/ILO

The Mission met the UNDP Assistant Resident Representative, Mr A.Delaporte and briefed him on HRC's activities. He in turn arranged meetings with Mr A.Bachmann, UNICEF, with whom HRC had previously had correspondence, and Mr. E.A. Fry, ILO.

Mr Bachmann's main concern was at the micro scale, and he presented the Mission with booklets on multiple purpose power units. Furthermore,

he encouraged HRC to send "SHP News" to consultants and equipment manufacturers in Nepal.

Mr Fry, Training Adviser to the Institute of Engineering, Tribhuvan University, requested HRC to provide practical training in China for one or two Nepalis for a period of a few months. These people would then return to the University to train future SHP engineers and operators.

3.2. Himal Hydro

This is a local contractor formed by the Dept of Electricity and United Missions to Nepal. Mr Ed Kramer introduced their work, saying their main strength was in tunnelling. The main difficulties they faced were in hydrological design, design procedures for SHP and simplified construction methods. Methods adopted in China were discussed.

3.3. Research Centre for Applied Science + Technology (RECAST)

Dr K.L.Shreshta, Executive Director, explained how RECAST carried out R + D in fields relating to national development. They were concentrating on renewable energy sources, and in the field of micro hydro, they had worked on multi-purpose power units, 15-20kW turbine packages and turbine-pumps. They were keen to improve dissemination of SHP information, and welcomed the publication of "SHP News".

3.4. Balaju Yantra Sala (BYS)

Mr Arter, technical manager of this equipment manufacturing company set up by the Government and SATA (Swiss Agency for Technical Assistance), explained how BYS made only crossflow turbines up to 150kW and 100m head, with a guaranteed efficiency of 75%. He discussed problems of crossflow turbine design, operating problems at remote sites and the lack of reliable governors or load controllers. He also raised several topics that could form the basis of RN-SHP Co-operative research projects:

a) development of an improved water-actuated mechanical governor

b) prototype manufacture and testing of a high head, high efficiency crossflow turbine of up to 200kW

c) setting up of an independent turbine performance test facility in the Asia-Pacific region.

3.5 Integrated Development Systems (IDS)

This private consulting firm was established in 1979 and concentrated primarily on socio-economic development work. However, they had an interest in civil engineering design through their Mr K.Denghal and had previously carried out some work for SHDB on computer optimisation of SHP design. At present, each SHP station has to be individually designed, thus requiring a large team of engineers. Even if engineers were available, it is difficult to produce an optimum design because of the huge number of factors that have to be considered. IDS's proposal is to evaluate these factors by a computerized system which uses advanced dynamic optimization techniques. SHDB submitted a research proposal based on this work for further program development, documentation and printout of rationalised designs. The following modules are proposed, of which 16 have already been prepared:

1. Retaining walls
2. Slope stability
3. Earthwork quantity calculation
4. Hydraulic design of various canals
5. Structural design of intake structures
6. Structural design of saddle piers
7. Structural design of anchor blocks
8. Hydraulic design of intake structures
9. Hydraulic design of forebays
10. Structural design of forebays
11. Structural design of aqueducts
12. Hydraulic design of desilting basins
13. Structural design of desilting basins
14. Design of penstock pipes
15. Rating curves
16. Reservoirs
17. Different types of crossings
18. Power houses
19. Tailrace
20. Gravel trap
21. Lateral spillways
22. Study of construction materials
23. Analysis of rates for different mountainous regions

24. Hydrologic design

Mr Zhu said he would follow this matter up at the coming TAG meeting.

3.6 Institute of Engineering, Tribhuvan University

Mr. Zhu gave a presentation on SHP in China, and supplemented this with video tapes. The Mission was then shown round the Institute and its laboratories.

4. Site visits

The Mission went to Pokhara, a 5-hour drive from Kathmandu,see Map 2, and was hosted there by Dr Aryal, head of the SHDB Western Regional office and also former HRC Training Workshop participant.

Some time was spent at three sites:

Pokhara Water Conservancy, Irrigation and Power Project

This project was designed and built by the China International Water and Electric Corp, (formerly HECC) and included a 3X500kW powerhouse which utilised the 23m head drop on an irrigation canal. The headworks consisted of a diversion weir on the river Sedi, sluice gates, intake gates and desilting basin. The main canal capacity was 11m³/s, serving an area of 1030 hectares, and 8.9m³/s was available for power generation. The length of the whole canal system was 40km. The project was administered by the Dept of Irrigation. Construction started in Nov.1981 and the turbines were now undergoing commissioning trials including parallel operation.

Syangja SHP station

This 80kW station was designed, constructed, equipped and operated by SHDB in conjunction with local organisations,fig.1. BYS crossflow turbines were installed, together with their water-actuated governor,fig.2. The working pressure of this specially designed governor is supplied by the water head on the turbines (about 10m head is required). Regulation performance is only to within plus or minus 10%, response is slow and tuning of the governor is still rather difficult. Torque capacity is 10

to 20 kg-m. Nevertheless, the governor is simple and tough, with a quoted price of US$3000, twice the cost of the turbine. Further R&D on this device is considered to be of value to the Asia-Pacific region. The civil works included a 1km long headrace and daily regulation reservoir. Construction took 2 years, and so far 124 households (38kW load) have been connected to the power supply. Installed cost per kW was quoted as about $4000. There was local participation in construction but on a paid basis. 17 staff, including administration, operated the plant, with 4 persons per shift.

A BYS engineer was on site at the time to replace the crossflow turbine runner. Subsequent analysis in the lab showed that the blades had already undergone 24 million load changes before breaking. This greatly exceeded the limit of 6 million load changes to be expected if failure was due to fatigue stress. Thus,deficiency in material strength was not a cause of failure, and it was hypothesised that excessive impulsive forces may have been experienced due to flat stones entering the trashrack, especially as intake velocities were high when forebay levels were run low.This shows the importance of using a fine mesh on the trashrack when crossflow turbines are installed.

The engineer noted the problems of access to the site. Syangja was relatively favourable in this respect, with access by 1/2hr jeep ride on a bumpy dirt track followed by 15mins on foot, including crossing a simple hanging bridge over the river. Transport costs in extreme cases could account for up to 75% of a project. The cost of a bag of cement could be double or triple that at Kathmandu by the time it reached the site. Also, delays in maintenance could even force a station to shutdown for several months.

Phewa Lake SHP station

This was designed by Indian engineers and consists of 4X250kW turbines using 90m head. Water supply was from Phewa Lake which had been dammed primarily for irrigation purposes. Funding for the dam construction had come from UNCDF.

Philippines

1. Contact Persons

Ms. Z. Santos, Executive Director, Mini-Hydro Development Office, NEA.
Mr. E. Piamonto, Mini-Hydro Development Office, NEA.
Ms. R. Royeca, Mini-Hydro Development Office, NEA.
Mr. C. Ilustre, Group President, Machinery Systems Group, AG&P.
Mr. R. Villeneuve, Vice President, Machinery Systems Group,AG&P.
Mr. R. Limson, Manager Mini-Hydro & Electrical Section, Machinery Systems Group, AG&P.
Ms. E. Graham, Training & Information Coordinator, NRECA.*

2. Discussions with Mini- Hydro Development Office

The Mission had several discussions with Ms.Z.Santos, Executive Director and her colleagues, all conducted in a friendly atmosphere. As at previous meetings with SHP Focal Points, Mr Zhu outlined HRC and RN-SHP activities since 1981, exhanged technical literature and handed over a videotape containing 7 video films so that NEA could make a copy.

The SHP programme in the Philippines had an ambitious target of 300MW to be installed by 1991. 13 plants had so far been commissioned with total installed capacity of 12MW, and feasibility studies for 95 sites had been completed. However, because of the economic situation, a slowdown in the programme was being experienced. Turbines ordered from China under a loan agreement were in store, and they were seeking ways of converting the remainder of the loan to help in station construction.

On future activities, Ms. Santos noted that they were interested in capacities over 100kW, so that the proposed Electronic Load Controller co-operative project would not be suitable for NEA's needs. On video filming, they were keen to collaborate, and indeed had their own expertise in mass communications which could be made available. As regards training workshops, she emphasised that participants for these should come from countries at the same or similar stages of development. ASEAN countries had identified civil works as the main topic for their next training course.

Ms. Santos strongly supported the idea of decentralization of RN-SHP activities, and was keen to work hand in hand with HRC on this.

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As regards R + D work, they presented an outline of their needs and priorities. The Mini-hydro office had only limited experience but could collaborate in data collection for example. They considered geological investigation to be an important area, especially for design of headrace and penstock to be safe against erosion and landslides.

3. Discussions with other SHP related organisations

3.1. AG&P (Atlantic Gulf and Pacific), Machinery Systems Group.

The Mission received a hospitable reception from AG&P, visiting both their corporate headquarters and the Honiron Division which manufactures turbines under licence from CMEC (China Machinery and Equipment Corporation). So far, 9 turbines have been manufactured for 4 Philippine SHP stations and they are exploring markets in other ASEAN countries.

AG&P commented that they had participated in UNDP-sponsored training courses. They would convey their comments on RN-SHP activities to Ms Santos after reviewing the material presented by Mr Zhu.

3.2. Philec (Philippine Electric)

This company manufactures a wide range of electrical equipment for power generation, and also has a licence agreement with Barber (Canada) for turbines.

They also acted as contractors on the Batchelor SHP station, and Mr Zhu requested details of the fibreglass pipes used for the headrace at Batchelor.

3.3. NRECA (National Rural Electric Co-operatives Association), USA

The Mission met Ms E.Graham, Training & Information Coordinator, NRECA for a brief discussion on future co-operation in the field of training. NRECA had just completed their first course on SHP hydrology for the ASEAN region. They preferred to work on a sub-regional basis, with much emphasis on systematic development of course materials by lecturers who could meet several times during the course of preparing lecture materials so as to ensure continuity and to avoid duplication. NRECA were currently seeking funds for development of course materials for the second ASEAN training course.

Discussion then followed on how NRECA and RN-SHP resources could be combined to hold joint training courses for the Asia-Pacific region and elsewhere.

4. Site Visit

The Mini-Hydro Office and AG&P accompanied the Mission on a visit to Batchelor SHP station,fig.3, at Natividad, Pangasinan (see Map 3), where PANELCO (Pangasinan Electric Co-operative) III is located. Installed capacity is 3x250kW with turbine-generators imported from China, supplying 16,000 people in 3,000 households. In the Philippines, the NEA builds the SHP station, after which operation and management is handed over to the local co-operative made up of members from the consumers. Only 2 operators plus 1 co-ordinator were needed per shift.

The station was not operating since a recent typhoon had caused a landslide which had damaged a section of the exposed fibre glass headrace. Thus, supply was met by the grid, costing the co.operative 1.04 pesos/kWh, compared with their own SHP generating cost of 0.65 pesos/kWh.

The installed cost of this station was about $7000/kW.

Appendix 1

REGIONAL NETWORK FOR SMALL HYDROPOWER (RN-SHP)

"CONSULTATION MISSION"

TERMS OF REFERENCE

* * * * * *

I. Consultation with SHP focal points on the strengthening of the Networking mechanism:

a. Review activities of Phase I (1982-1983);

b. Present and exchange views on the Work Programme for Phase II (1984-1986);

(These two items will be supplemented by technical presentations, video films and technical literature as relevant)

c. Discuss actual needs and priorities identified by the national SHP focal points, towards elaborating practical programmes for the future;

d. Discuss increased involvement of national SHP focal points in decentralized activities in the future, e.g. undertaking joint R+D projects, organizing joint training workshops as well as the distribution of specific tasks;

e. Discuss topics for future collaborative research projects;

f. Establish regular channels for information exchange for SHP rosters, newsletters, etc.

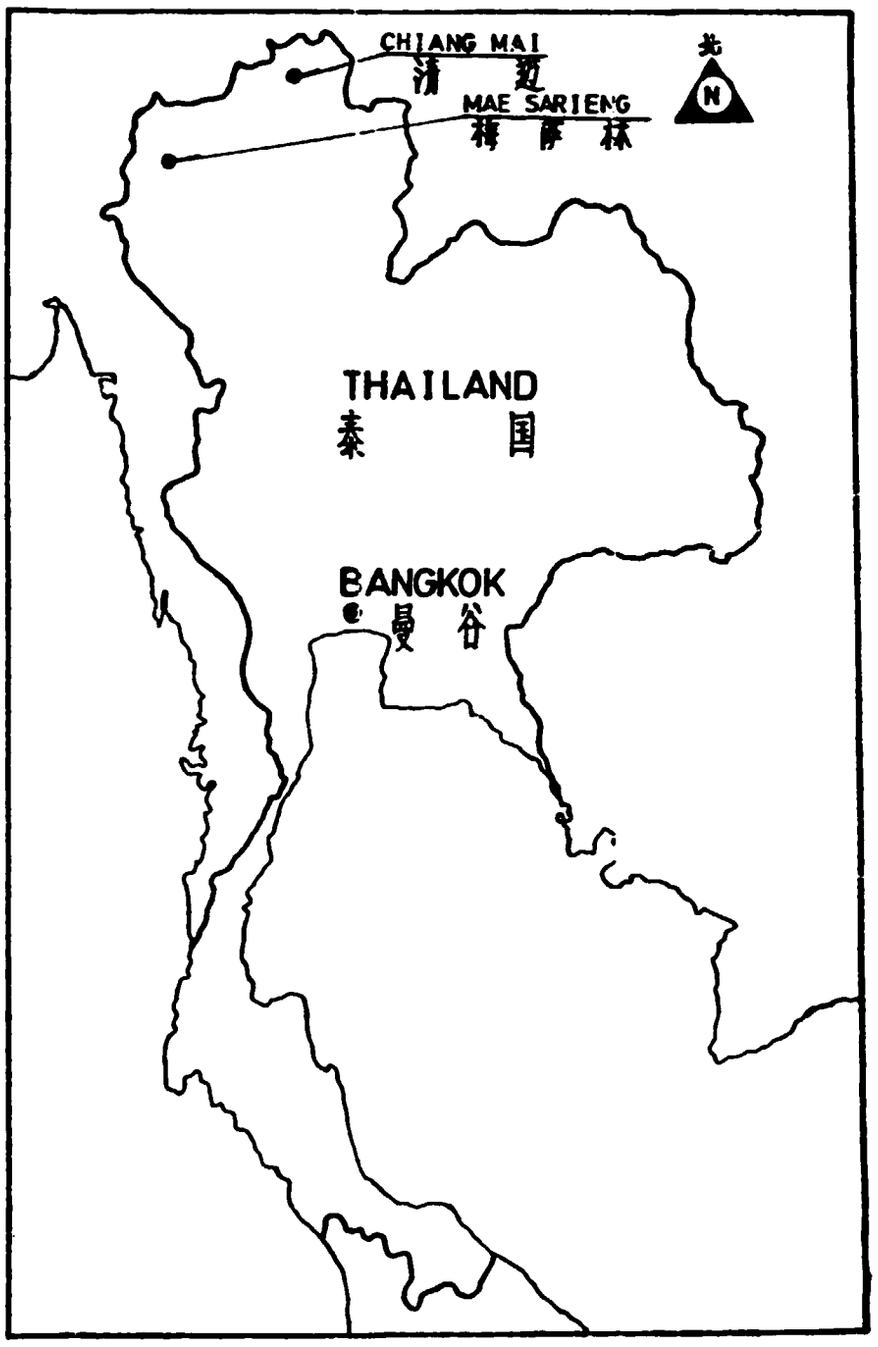
II. Through arrangement with the national SHP focal points, visits to relevant organizations and SHP sites:

a. Establish contacts with those organizations which have invited the Hangzhou Regional Centre (HRC) for discussions;

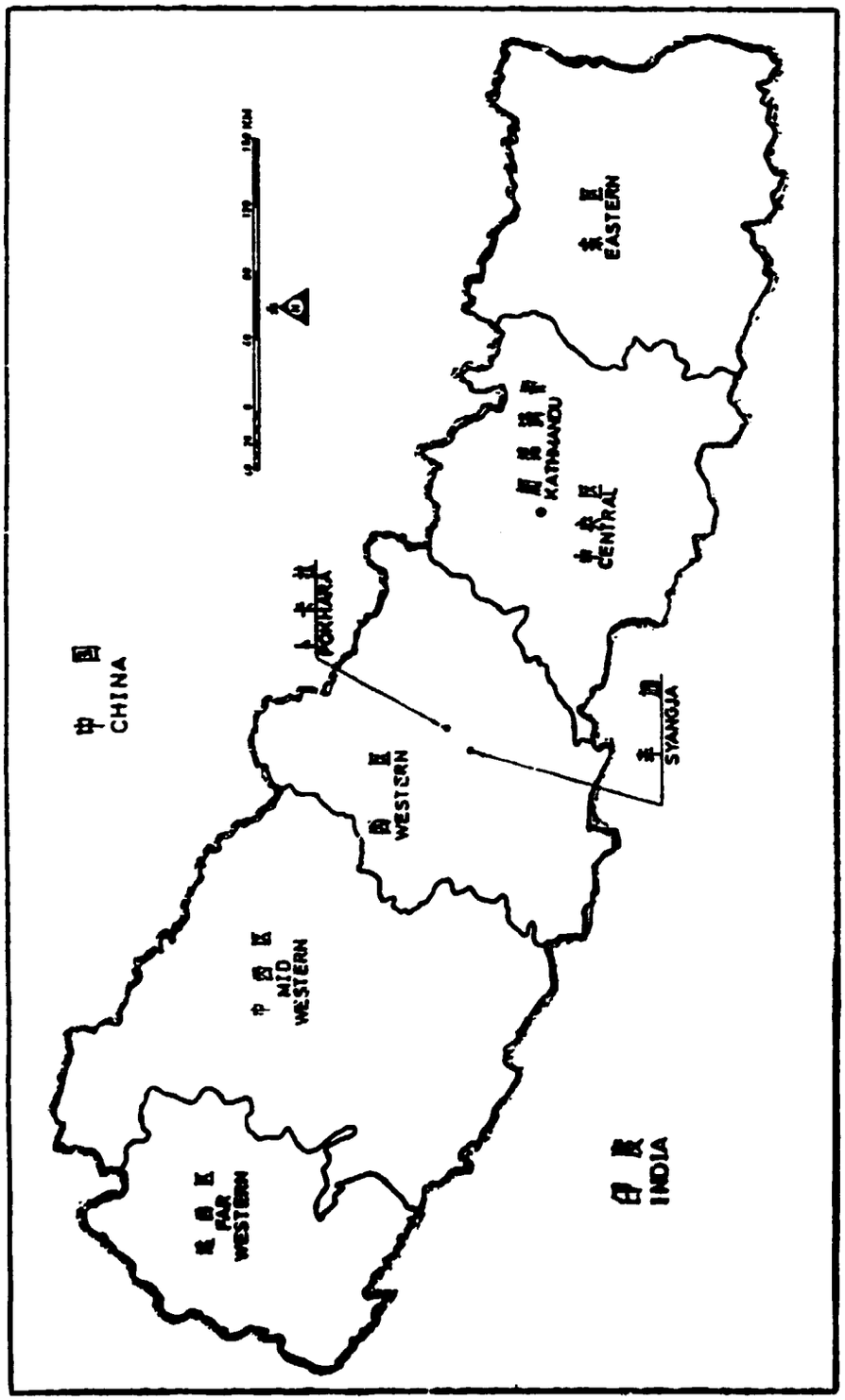
b. Visit other institutes or centres active in technical areas relevant to SHP as recommended by the SHP focal points;

c. Visits to selected small/mini/micro hydro stations, organized by the national SHP focal points;

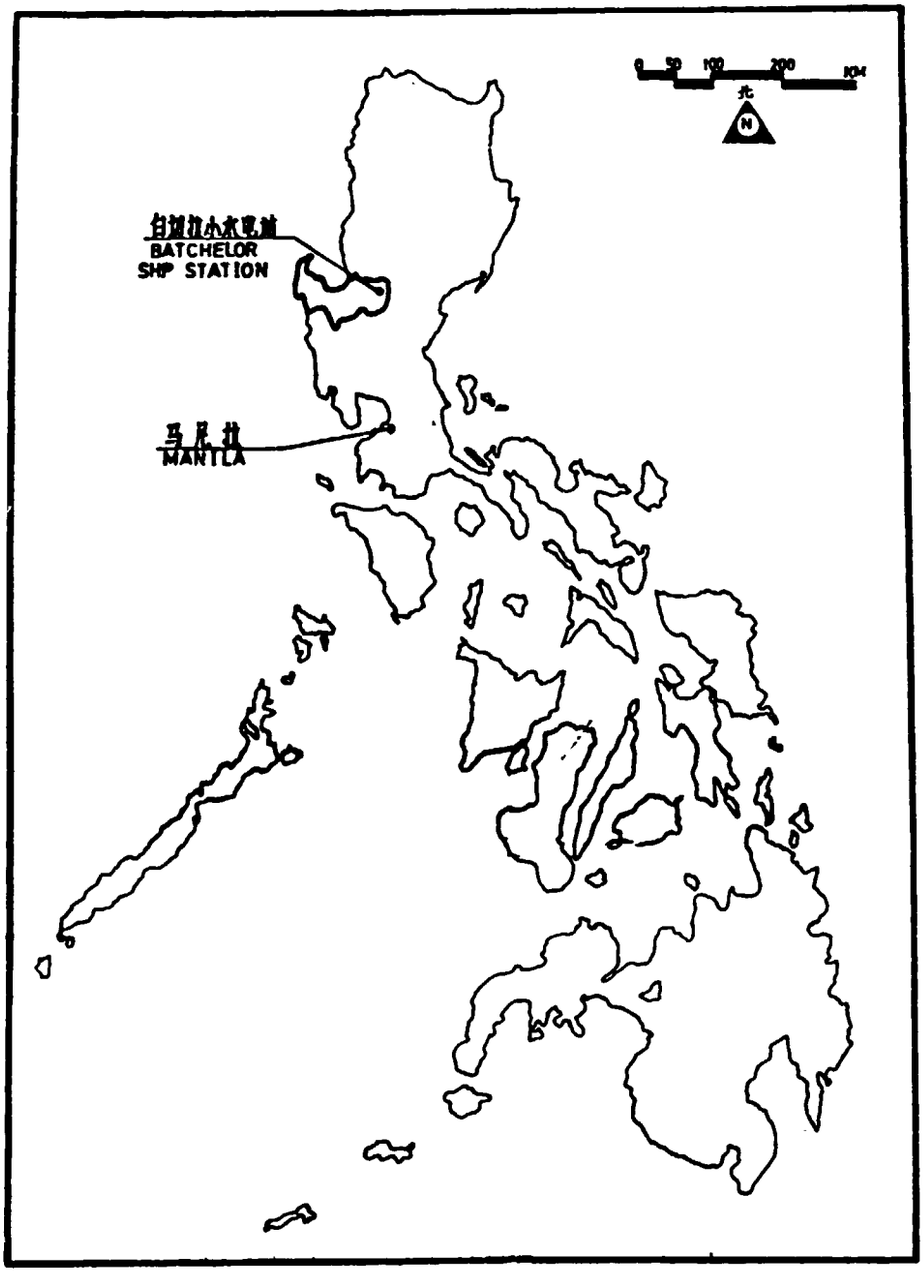
d. Visits to selected SHP equipment manufacturers to discuss possible regional co-operation; etc.



Map 1 THAILAND
图 1 泰 国



Map 2 NEPAL
图 2 尼泊尔



Map 3 PHILIPPINES
图 3 菲 律 宾

Figure 1: View of Syangja SHP station (80kW), Nepal, showing rugged terrain and difficulties in accessibility. (This site is relatively favourable by Nepali standards).

Figure 2: Novel water-actuated mechanical governor, designed and manufactured by BYS Ltd. Nepal and installed at Syangja.

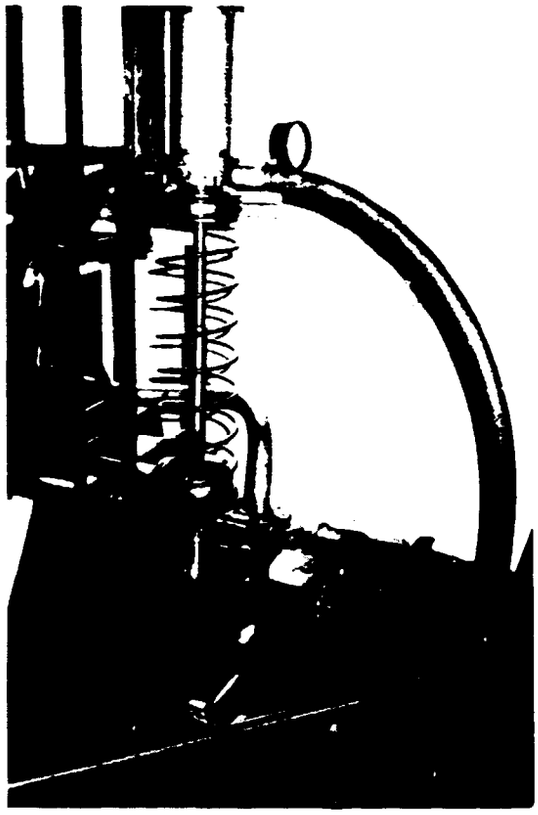


Figure 3: View of Batchelor SHP station, Philippines (750 kw) equipped with Chinese turbine-generators.