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REGIONAL RESEARCH AND DEVELOPMENT AND TRAINING CENTRE FOR MINI-SMALL HYDROPOWER GENERATION

DP/CPR/81/004

PEOPLE'S REPUBLIC OF CHINA

TERMINAL REPORT*

Prepared for the Government of the People's Republic of China
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Zhu Xiaozhang**

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* This document has not been edited.

** Director, Hangzhou Regional Centre (Asia-Pacific) for Small Hydropower.

V.89 56101

Title:	**Hangzhou Regional Centre (Asia-Pacific) for Small Hydropower**
Project Number:	**RAS/80/033 and CPR/81/004**
Funding Agency:	**UNDP**
Executing Agency:	**UNIDO**
Government Implementing Agency:	**Ministry of Water Resources**
Starting Date:	**October 1981**
Completion Date:	**December 1988**
UNDP Inputs:	**US$669,832 (RAS) and $352,000 (CPR)**
Government Inputs:	**R.M.B. Yuan 10,000,000.**

Contents

I. Project Objectives and Functions

The project RAS/80/033 was prepared in conjunction with the project CPR/81/004 as two mutually supportive inputs to the Hangzhou Regional Centre for Small Hydropower (HRC). As defined in the two Project Documents signed in November 1981 by UNDP and the Government of the People's Republic of China, the Hangzhou Regional Centre for SHP will act as a catalyst with the following development objectives:

(a) To undertake scientific research and technical development in the field of SHP;
(b) to exchange technical information on SHP;
(c) to carry out technical training in SHP of personnel from developing countries; and
(d) to provide technical advisory services and assistance in SHP to developing countries.

The immediate objectives of HRC were to assist the Government of China in setting up a Regional R&D and Training Centre for SHP to be used as a focal point in a network of national SHP organizations and/or institutions designated in the individual member countries of the region.

The expected output of this project is a well equipped R&D and Training Centre for SHP, capable of providing training facilities for trainees from other countries in the region.

One of the special features of HRC is its relationship with the Regional Network for Small Hydropower for Asia/Pacific (RN-SHP). The HRC was designated as the Centre for the RN-SHP. The development objective of the RN-SHP is to provide a framework for those directly engaged in SHP within the region, to establish contacts between and among each other and to utilize such communications as the basis for promoting co-operative activities of a mutually beneficial nature.

The main objectives of the Asia-Pacific RN-SHP were identified by the Senior Expert Group Meeting in July 1982, in Hangzhou, China, as follows:

(a) Organization of an information system
(b) provision of training
(c) implementation of joint R&D projects
(d) organization of meetings for the benefit of the Network
(e) establishment of links with relevant institutions outside the Network.

The RN-SHP was not to be considered as an institution, but as representing a co-operative arrangement for carrying out specific activities, as indicated by the First Session of the Steering Committee of the ESCAP-REDP held in Bangkok, May 1983.

II. Inputs

The actual inputs from UNDP and from the Chinese Government were over three times more than the original allocations in the Project Documents.

The total funds allocated under the project CPR/81/004 during 1981-1988 were US$352,000, while the original sum in the Project Document was US$150,000.

The total funding allocated under the project RAS/80/033 during 1981-1988 was US$669,832 in comparison with the original figure of US$150,000 in the Project Document.

The total financial support from UNDP through the above two channels to HRC during 1981-1988 was about US$1.02 million. The general breakdown of the HRC budget under different items of expenditure is given in Table 1.

As shown in Table 1, about US$450,000 out of US$1.02 million was used for equipment procurement for HRC. The list of equipment delivered and installed at HRC is shown in Table 2.

Table 1

Breakdown of HRC Budget from UN Funds 1981-1988[a]

Project No.	CPR/81/004			RAS/80/033			Total CPR+RAS	%
	1981-1984	1985-1988	Total	1981-1984	1985-1988	Total		
1. Equipment	150,000[b]		150,000	300,000	7,000	307,000	457,000	45
2. Training	67,000	132,000	199,000	24,000	88,000	112,000	341,000	34
3. TAG				15,000	30,000	45,000	15,000	1.5
4. Research					74,000	74,000	74,000	7.4
5. Personnel				3,500	30,000	43,500	43,500	4
6. Secretariat				30,000	30,000	60,000	60,000	6
7. Information					10,000	10,000	10,000	1
8. Videofilms					19,000	19,000	19,000	2
9. Miscellaneous	3,000		3,000	400		400	34,000	0.3
Total	220,000	132,000	352,000	382,900	288,000	670,000	1,022,000	100

Note: (a) amount in US Dollar
(b) in CPR/81/004, 1981-84, equipment US$78,000 out of US$150,000 was used for research (automation pilot project).

Table 2

List of Equipment Delivered and Installed
(by the end of 1988)

(Only equipment with unit cost higher than US$5,000 is listed individually)

No.	Equipment	Purchasing Order No. of UNIDO	Price (US$)
I.	Duplicator & Offset Printing		53,680
	of which:		
	SELEX-AIR	B0211	24,193
	Offset printing	B0396	11,150
	MP-270	B1562	6,800
II.	Typewriter, Telex and IBM Word Processor		17,593
	of which:		
	Telex	B1230	5,896
	IBM Word Processor	B0624	9,299
III.	Micro Computer	B1093	12,620
IV.	Apparatus & Meters:		24,588
	Microfilm Camera-processors	B1175	8,423
V.	Vehicles:		21,060
	Coaster	B0204	14,854
	Car	B1360	6,022
	Sedan Car	DIR-8301502	5,581
VI.	Projector, Classroom Overhead Projector		9,070
	of which Transparency Maker	B1359	5,772
VII.	Audio Visual:		153,600
	First Batch of Equipment	B1244	75,803
	Second Batch of Equipment	B1518	56,718
VIII.	Simultanaeous Interpretation facilities	B0329	13,600
IX.	Language Lab facilities	B1214	35,808
X.	Camera, Colour Film Enlarger		42,660
	of which Colour Film Processor	B0539	32,597
XI.	Equipment for Telemetry		
	Demonstration	B1393	
	Small Hydropower Cascade	B0249	78,000

The input from the Chinese Government through the Ministry of Water Resources and Electric Power (MWREP) has been successively increased since 1981. The total funds allocated from MWREP during 1981-87 to HRC was equivalent to US$3 million (according to official rate for respective period) for capital investment of the buildings, salaries and overheads. The 14-floor main building with auxiliary buildings totalling about 10,000 m^2 as well as all the training facilities have been completed and put into operation.

The staff members of HRC, which is now based on a domestic National Research Institute for Rural Electrification, number about 110, of whom 70 are engineers of various technical specializations for SHP and rural electrification.

III. Outputs - Activities Performed

All the work programmes elaborated and agreed upon at the Technical Advisory Group (TAG) Meetings of the RN-SHP for the period 1983-88 were successfully carried out, which will be described as follows:

1. Training

During 1983-88, 14 training workshops were held and attended by about 170 participants from 18 member countries of the RN-SHP in the Asia-Pacific and some countries outside the region as well.

The names of the workshops and participation of member countries in the workshops held at HRC are shown in Table 3 and 4.

These workshops covered all the technology aspects of SHP, including planning, feasibility study, hydrology, civil works, electromechanical equipment, operation and maintenance, etc. Two workshops for water-lifting devices sponsored by FAO were also included.

Table 3
Participation in Training Workshops in HRC from Developing Countries

Country	Training Workshop Number																	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Afghanistan		1																1
Bangladesh				2														2
Burma				3														3
Cook Islands						1						1		2				4
Fiji	1	1				1		1				1	4	1				10
India		1			2	2		2	2			2						11
Indonesia	2				2							2		2				8
DPR Korea								2										2
Korea		1																1
Malaysia	2	2			1	3			2			2						12
Micronesia					1									1				2
Mongolia		1																1
Nepal	2	1	1	2	2	2		2	2	4		2		2				22
Pakistan	2		2						3		3	2		2				14
Papua New Guinea								1				1		2				4
Philippines	2	2		2	4			3	3			2		2				20
Solomon Islands					1							2		2				5
Sri Lanka	1			2	2			1	1									7
Thailand	2	2		3	2			2	2			2		2				17
Vanuatu					1				1			1		2				5
Western Samoa					1									1				2
Turkey													2					2
Morocco							3											3
Sudan							3											3
Tunisia							2											2
Chile													2					2
Total	14	11	1	16	19	9	8	14	16	4	3	20	8	21				164

*In addition, Chinese participants attended all training workshops.

Table 4

Training Workshops

Name of Training Workshop	Volume of Teaching Material	Total number of pages
1. First Training Workshop for SHP (23 May - 22 June 1983)	9	845
2. Training Workshop for Hydrology (3-14 September 1984)	2	374
3. Fellowship Training in Field of Electrical Engineering (1 June - 22 August 1985)	1	78
4. Workshop on Water-Lifting Devices (21 April - 3 May 1986)	14	247
5. Training Workshop for Feasibility Study of SHP (9-16 June 1986)	3	215
6. Workshop for Civil Construction (19-26 August 1986)	3	163
7. Seminar/Study Tour in SHP for Arab Countries (4-27 September 1986)	12	67
8. Training Workshop of SHP Operation & Maintenance (5-14 November 1986)	5	135
9. Training Workshop on Electro-mechanical Equipment of SHP (7-15 January 1987)	4	84
10. Training Workshop on Water Turbine Pumps for Nepal (21 October-November 1987)	1	26
11. Training Workshop on Water Pumps for Pakistan (23 Nov - 4 Dec 1987)	1	26
12. Training Workshop on SHP Civil Works (26 October - 6 November 1987)	5	193
13. TCDC SHP Training Workshop (26 October - 23 November 1987)	10	203
14. Training Workshop on Site Selection and Hydrology (6-13 December 1988)	6	120
Total	76	2,776

The lecturers came mainly from HRC. For some special topics, professors and experts from universities and institutes all over China were invited. In addition, international experts (1 to 2) were invited as consultants from both developed and developing countries, including Norway, Canada, New Zealand, India, Philippines, Malaysia, USA, etc.

All the lectures and documentation were given in English. A large amount of teaching material was prepared by HRC, totalling about 76 volumes with 2,780 pages. In addition to lectures, there were also discussions and presentations by the participants and an exchange of information and technology among member countries.

In every workshop, site visits to SHP stations and electromechanical equipment manufacturers or even direct operation practices for the participants were arranged in order to increase the first-hand understanding of the participants.

All workshops attained the objectives outlined in the work programme of the Technical Advisory Group, and were highly appreciated by most of the participants, reflected in the questionnaires filled in by them at the end of each workshop.

The following are a few examples of reflections from the trainees.

Mr. P.L. Fairbairn, the Solomon Islands participant of the Training Workshop on Civil Works, 26 October - 6 November 1987, Hangzhou, wrote to HRC after the Workshop on behalf of the Permanent Secretary, Ministry of Natural Resources, that "the respective participants gained valuable knowledge from the very comprehensive and detailed lectures ... and hope that we will be able to participate in future workshops" (see Annex 2).

Mr. Paude of Nepal, a lecturer at Tribuvan University, received a special on-site training for operation and maintenance in 1985 in Zhejiang province, where HRC is located, and wrote back from home after a 2-month course that "I had a really nice time, now I realize how important it was to learn all those things ... It was really a valuable training I had received. I would really appreciate the teacher I had ... The programme was so nice and the arrangement was lovely... ".

In the Training Workshop for SHP Hydrology in 1984, the Norwegian lecturer Mr. Armodt, commented favourably on the content and design of the Workshop.

A number of the participants in workshops have been assigned as core staff or responsible officials for SHP development in countries like Nepal, Fiji, Thailand, etc.

2. Information

A quarterly publication, SHP-News, is edited and published by the Secretariat of RN-SHP and HRC, which keeps the Network lively through exchange of views and news, both administrative and technical. 17 issues have so far been published and disseminated to about 900 units/experts in 99 countries throughout the world. This SHP-News is appreciated and welcomed by most of the readers. Dr. Sutabutr, Deputy Secretary-General of the National Energy Administration, Thailand, wrote to us that "the publication is very instructive and informative and very useful to our work".

During 1982-88, about 40 papers were written or compiled by various experts within HRC, which are currently available at the HRC. These papers mostly introduce and describe in different aspects the experiences of SHP in China. Part of the papers were presented in various international conferences.

Staff at HRC also edited and published in co-operation with Intermediate Technology Publication of ITDG, UK, a book entitled "Small Hydropower in China: A Survey" in 1985.

In addition, HRC helped the "International Water Power & Dam Construction" journal organize a special issue for Small Hydro in China in February 1985.

An International Conference on SHP was also held by HRC jointly with the "International Water Power & Dam Construction" journal from 1-4 April 1986 in Hangzhou. Four delegates from RN-SHP member countries were invited to attend the Conference, in which 131 international participants and 96 from China attended and 36 papers on SHP technology were presented.

3. Research and Development

Two main projects were conducted during the period 1982-1988 as well as research on a variety of other subjects. A brief description of the two major projects is given below.

(a) SHP Automatic and Telemetry: in this project, a set of demonstration equipment for automation and remote control was set up in an existing SHP cascade in Zhejiang Province. Some advanced equipment (SCADA system and programmable controller PC) from USA was installed, using US$78,000 allocated from UNDP funding. The Chinese Ministry of Water Resources and Electric Power paid great importance to this project, took it as one of the major R&D schemes in the past 5-year plan and also allocated a lumpsum of funds to it (about R.M.B. Yuan 400,000). This project has been put into primary commission in May 1987 and passed an acceptance procedure organized by the Ministry in October 1988. A study on how to extend this technology on the basis of indigenization of the equipment manufacture is ongoing.

(b) Application of Electronic Load Controller (ELC): in 1982, HRC collaborated with the Intermediate Technology Development Group (ITDG), UK, on a project on the application of a 60 kW electronic load controller. After 330 hours of field operation, it was concluded that the controller was technically very good, but produced some waveform distortion of the output voltage. The cost was a few times higher than a Chinese-made governor; however, the possibility of a licensing arrangement for local assembly of controller kits in China is being explored under a new project co-sponsored by UNDP/UNIDO/REDP/HRC and selected Asia/Pacific countries. The locally assembled controllers have been field-tested in China and will be tested in two other countries in the region, with particular emphasis on finding economic end-use for the ballast load. The first co-operative research group meeting was held from 15-21 March 1986 in Hangzhou, in which representatives from Nepal, Sri Lanka and ITDG, UK, attended. The participants of the meeting were in unanimous agreement about the usefulness of ELCs for speed control in SHP stations. Local Assembly in China had proven successful and had reduced cost below that of an imported ELC. A report of this meeting was prepared by HRC and submitted to UNIDO.

4. Consultation Missions

The first Mission was carried out from 26 October - 20 November 1984. The first Co-ordinator of the RN-SHP Secretariat, Mr. Zhu Xiaozhang, led two staff members of the Secretariat on a visit to 3 member countries: Thailand, Nepal and Philippines. The mission was a success. A mission report was presented to TAG-I, held from 11-13 December 1984.

In the TAG Special Session, 22-24 July 1985, it was agreed that the RN-SHP Co-ordinator should lead the Second Consultation Mission. It was also decided that this mission should involve participants from member countries. So the Second Consultation Mission was organized from 12 November to 14 December 1985, with the participation of delegates from India, Nepal, Sri Lanka and Thailand, and led by the Co-ordinator. The countries visited by the Mission were India, Sri Lanka, Malaysia and the Philippines. The mission report was also sent to UNIDO and all National Focal Points of the RN-SHP.

The Third Consultation Mission, held in 1986, was devoted to the Pacific region and concentrated on the development of a specific training programme on small hydro for the Pacific countries. This training programme has been submitted to various organizations in the Pacific region for funding.

5. Establishment and Extension of the RN-SHP

Apart from the implementation of specific activities, the Secretariat has devoted some time to seek nominations from ESCAP member countries for the appointment of national SHP focal points. 18 SHP national focal points have so far been nominated, representing most Asia-Pacific countries interested and active in the field of SHP.

6. High-Level Policy Group Meeting on SHP in combination with the Inauguration of HRC's Main Building

The Meeting was held from 25-27 June 1987. The objectives of the Meeting as proposed by the TAG of the RN-SHP were:

(a) Review of work of the Asia-Pacific RN-SHP since its establishment
(b) Discussion of nature, function and long-term tasks of the Network in relation to national SHP programmes and regional energy programmes as a whole;

(c) Discussion on the future direction of the Network;
(d) Exchange of experiences and views on policies regarding SHP;
(e) Official inauguration of the new 14-floor main building of HRC.

The Meeting reviewed the work of the RN-SHP and HRC and was unanimous that the objectives had been met. Recommendations were also made as to the future direction that both HRC and the Network should take.

IV. Evaluation of Project Performance

Referring to the set targets and objectives of the Regional Centre in the primary project documents signed in 1981, and reviewing the activities performed and results attained by the HRC during the past 7 years, the project is clearly a success.

1. A Regional Research and Training Centre for Small Hydropower has been completely set up, which is being used as a focal point in the Network or, as called by most of the participant of previous workshops, the SHP family. It is a well-equipped Training and Meeting Centre, capable of providing training facilities and services for trainees from the member countries in the region and for other activities in the region. A 14-storey main building with auxiliary buildings totalling about 10,000 m^2, including 2 floors of hostel room for accommodating the trainees, has been completed and put into operation. The Centre could act as a primary base for implementation of the work programme of the Network.

2. A Regional Network for Small Hydropower, RN-SHP, has been established with UNIDO acting as the executing agency with support from China, UNDP and ESCAP-REDP. The objectives and functions of the RN-SHP as indicated in the various project documents, have clearly been more than fulfilled.

3. The work programmes elaborated at various TAG meetings of the RN-SHP have all been satisfactorily completed, most of them with the direct involvement of the HRC.

4. The Hangzhou Regional Centre and the Asia/Pacific Regional Network have clearly promoted South-South co-operation in the field of small hydropower.