2002 Sino-African SHP Training Workshop

The 2002 Sino-African SHP Training Workshop was held from 10 May to 18 June 2002 at Hangzhou Regional Center for Small Hydro Power(HRC). Attended altogether 9 participants from 5 African countries, i.e. Burundi, Nigeria, South African, Tanzania and Tunisia. This is the second training workshop on SHP that HRC conducted for African countries. Last Oct and Nov HRC held the SHP training for participants from Africa where the majority of the population has no access to electricity yet. Meanwhile, it is abundant in hydro power resources in Africa and around 10% of its hydro power potential has been harnessed according to the statistics available.

This training workshop was sponsored by Chinese Ministry of Foreign Trade and Economic Cooperation, as one of the technical collaborative projects among the developing countries. All the lodging, boarding, training, pocket money and the domestic transportation fees were borne by the Chinese government. This is part of the Chinese contribution to South-South cooperation.

Most of the teachers were from HRC, with some professors or experts invited from Nanjing. The subjects included procedures of SHP development, feasibility study, hydrological analysis, low-cost civil structure, turbo-generator units and auxiliary, electric equipment design, operation, maintenance, SHP policy aspects etc. Such special topics as the status of hydro power resources in China, SHP technical refurbishment, rubber dam, the pumped storage stations, foreign trade practices, letter of credit, export credit etc were also introduced and considered by the participants as beneficial.

In the hardware construction, HRC updated its facilities for the international participants early this year. The class room was decorated and living rooms renovated. New equipment including CD-writer and new advanced computer were purchased for the use of the participants.

Study tour was arranged to Shengzhou, Linai, Ningbo, Xiaoshan and Deqing where the participants visited some SHP stations

of various development types, combining the techniques of low-cost civil structures and appropriate automation controlling equipment. Visits were paid to Linhai Machinery Works and Linhai Electric Machine Works where participants were able to see the whole process of the hydropower equipment manufacturing. Director of Linhai Machinery Works, Mr.Hu pointed out: "there is so far no export of our electrical equipment to the African countries. However, the potential of SHP in African countries is in fact huge. It is expected that the SHP cooperation between China and Africa could be set up, either in our equipment export or establishing joint venture firms in African continent." Visit was also paid to Kvaerner Hangzhou Power Equipment Co Ltd, a joint venture set up in 1996 between Kvaerner Energy a.s. in Norway and Hangzhou Electric Equipment Works in Hangzhou, China.

Participants went to Ningbo, visiting a pumped storage station with installed capacity of 80 MW. This station was put into operation at the end of 1997 and was designed by HRC in the past few years. It has a big role to play for the station to provide energy to the grids at the peak hour and its financial record all these years after the commissioning is also impressive.

At the end of the training workshop, HRC provided a forum for the exchange of SHP experience and technology. The African participants were earnest to prepare and to offer their presentations. Altogether around 5 presentations were made by the participants, introducing the SHP development status, experiences and lessons learnt in the practice of developing SHP in their own countries. For instance, the presentation by the Nigerian participants gave a detailed description of what is required concerning the country's SHP development status, experience and potential of SHP international cooperation. Nearly all of the African friends were able to adopt the Power Point to give the presentation. Some of their presentations are being considered to be issued at the quarterly ***SHP News*** that HRC edits and publishes.

In addition to training and study tours, sightseeing programs at the weekends and sports competition were arranged by HRC. Participants were able to enjoy the natural beauty of some scenic spots in Hangzhou. The basketball match between the Chinese players and the African participants offered a glimpse of tenacious spirit manifested by the African participants. Also, two days were spent in the developing city, the largest city and port of China—Shanghai. With the opening and reforming policy set forth by the Chinese government some 20 years ago, tremendous changes have taken place in that city. A great number of skyscrapers pop up, with its modern and convenient transportation network. Participants naturally exhilarated to be in such a modern city like Shanghai. Many of the participants commented: 'We certainly did not expect that China is so much developed. We thought this is not in Shanghai, but in New York. Before we came to China, we had a delusion that China was a poor and backward country. The buildings there were shabby and indecent. People were suffering from hunger. China has set a very good example for the other developing countriers like those in Africa to follow in its economic development'.

HRC is committed to stimulating the development of SHP-a re newable and environmentally sound energy by conducting SHP training programs each year. In 2003 HRC will implement at least two small hydro power training workshops including one for African countries and the exact time of implementation will be announced later this year. It is hoped that more hydro power resources could be tapped in future so that the living standard of the local people could be improved and their local economy could be boomed in the numerous African countries. ■

Speech at opening ceremony of 2002 Sino-African SHP training workshop

Dr. Chen Shengshui, Director of HRC

Good morning!
Dear colleagues,

I am honored to be with you this morning. You all came far away from Africa to Hangzhou! On behalf of all HRC staff, I'd like to extend my warm welcome to you for attending the 2002 Sino-African SHP Training Workshop.

This training workshop has been sponsored by Chinese Ministry of Foreign Trade and Economic Cooperation, as part of China's contribution to South-South Cooperation or TCDC activities. TCDC means technical cooperation among the developing countries, to share the expertise, the facilities and the financial cost among the developing countries.

HRC has been active in promoting the global SHP development in the past years and you have become part of this process! So far 589 international participants from over 60 countries attended the training programs that HRC conducted. Our SHP missions for SHP feasibility study, design or construction supervision have been implemented over 30 countries in the world.

Recently, I have been appointed by the Chinese government as Director of HRC and I will do my best with my colleagues including you-our African friends committed to promoting the SHP construction in the developing countries.

China is vast and rich in hydropower resources, accounting for 680 mil kW, of which 380 mil kW is the exploitable resources. The SHP exploitable resource is around 87 mil kW. However, the installed capacity of SHP exploited only reached around 30% of the total exploitable SHP resource. The three batches of constructing over 600 counties of primary rural electrification program in China have been completed. Now, Chinese government has decided to set up 400 rural electrification counties during 2000 and 2005 as the fourth batch. With the increase of SHP installed capacity and the development of local grids, the SHP in China has become a new and proven industry with unique features. In the recent years, the State advocates reducing the electricity price for the rural farmers and reforming the electricity supply as a commodity into market oriented operation. A series of favorable policies that the Chinese central and local governments adopted to stimulate the exploitation of SHP have resulted in the large-scale SHP construction, rural grid improvement, SHP station technical renovation and cultivated the market of SHP technology and equipment.

China and the African countries belong to the developing countries. With the holding of Sino-African Forum in Beijing two years ago, Sino-African ties have been strengthened considerably. In 2001, the first Sino-African SHP training workshop was run at HRC and altogether 9 participants attended. It is much expected that with your active participation, more SHP cooperative projects could hopefully be set up between HRC and the African countries.

Participants, Hangzhou is a well-known city of long standing in China and it served as capital of China for

OPENING ADDRESS TO 2002 SINO-AFRICAN SHP TRAINING WORKSHOP

Mr. Zhu Xiaozhang, Honorary Director of HRC

Good morning!
Dear Colleagues,

I am pleased to be here to give an opening address to this important training workshop specially designated for our African friends, which shows the sincere friendship between China and African countries. I'd also, together with our Director Dr. Chen, express my congratulations to you for your participation in the workshop.

I believe that most of you are SHP-professionals, but I wonder if you are well aware of the history and prospect of international cooperation in the SHP sector. As the former Director of HRC, I'd like to take this opportunity to tell you some stories about this subject.

These stories include historical background and three milestone meetings for SHP international cooperation. Up to mid –1970s, the electric energy supply in the world was mainly from fossil fuel generation, only about 1/5 from hydropower. In early 1970s, the price escalation of petrol pushed people to focus attention on new and renewable sources of power production. These revitalized the worldwide interest for SHP development which has almost been given up during the past several decades. Since then, both developed and developing countries paid importance to the development of SHP. A series of international conference have been held for exploring ways and means of strengthening the international cooperation in the SHP-sectors. Here I'd only mention 3 milestone meetings:

—The 1st one is the Kathmandu Meeting organized by UNIDO in 1979 in Nepal's capital Kathmandu. This was the 1st international meeting after the oil crisis in 1970s, and was attended by 68 representatives from 23 developing countries (including Africans) and 10 developed countries and several UN's organizations. One of the important results of this meeting was

over 200 years in the Chinese history. With the implementation of reform and opening policy during the past 20 years in China, tremendous changes have taken place around the city. Apart from your study of SHP technology to serve your own country in the promotion of SHP development after going back, you'll have chances to see and experience what is going on in Hangzhou and in the other Chinese coastal areas.

Over one month study here at HRC is not long, however, I do hope you could benefit from the exchange of SHP experience and technology, and strengthen the international cooperation of SHP among various countries. We share the same objective: To stimulate the exploitation of SHP which is a renewable and environmentally sound energy appropriate for the vast rural areas in the developing countries.

Finally, I wish your study fruitful and your stay pleasant! ■

the "Kathmandu Declaration". It was appealed that: "Exchange of information, knowledge and experience is felt to be of basic importance for promotion of this SHP technology, not only between developed and developing countries, but also among the developing countries themselves". This statement indicated the earliest concept of South-South cooperation, which has then been expanded in a very broad way and deep senses, during the past 2 decades. As you have seen, our training workshop here is just a kind of South-South cooperation project called TCDC program. OK, back to the Kathmandu Declaration which further stressed: "The Participants of the Meeting therefore decide to underline the need for the strengthening of international cooperation in a systematic, efficient and effective manner".

—The 2nd one was a similar meeting held in Hangzhou, China and Manila, Philippines in 1980 also organized by UNIDO. Together with the 1st meeting, it also strongly recommended the setting up of a center or centers of excellence relevant to SHP.

—The 3rd one I want to inform you is the UNCNRSE held in 1981 in Nairobi, the Capital of Kenya in Africa. This grand conference was directly organized by the UN Secretariat and attended by 124 countries with 1400 delegates in which 90 were leaders at minister level or higher. According to the "Program Action" of the Conference, a series of centers of excellence for new & renewable, including R+D, demonstration, dissemination, training and information were anticipated to be set up.

Thus, HRC has just been established from this background under the sponsorship of Chinese government and UNDP/UNIDO.

Due to time limitation, I could not mention too much here. Anyhow, a lot of conferences and activities for international cooperation have then been held over the past 20 years. In the mean time, there was also relevant expansion of SHP-market worldwide, especially in the equipment supply and project construction sectors, which has correspondingly been extended from only relying on western developed countries into South-South Cooperation. Today as we are facing globalization of economy, the worldwide cooperation for SHP development would surely from an important sector. This is especially true as for as technical aspect is considered. I assume you are well aware that common consensus has been attained internationally that SHP is an appropriate technology instead of advanced one. As an appropriate technology, SHP is most properly for and could easily be managed by developing countries. In fact, rich experience has already been accumulated in some developing countries. As you have just heard from our Director, Dr. Chen's introduction about China's success on SHP development, and after listening to all the lectures in the up-coming workshop, I hope you will understand that China is an excellent example in this field. I don't want to repeat too much in this connection, but I have to point out that the SHP technology in China is mature and proven, which is wrapped up through construction of more than 40,000 SHP-stations. Furthermore, as China's SHP-technology is also plentiful and versatile, it is suitable for other developing countries. Of course, what I mean "suitable" here mainly indicates those pure technical issues, such as:

—indigenous material for dam construction;
—reasonable standard for power plant design;
—reliable and cost-effective production of turbine-generators with reasonable efficiency level;
and—environmentally friendly consideration of reservoir construction, etc.

For those social, economic and administrative issues, I believe you will certainly differentiate what is suitable and what is not suitable to your countries, according to our different political, economic and social systems.

Finally, I'd stress that following the tendency of globalization of economy and China's entry into WTO, it is predictable that the economic and technical cooperation in the SHP-sector between China and African countries will have more space to expand and bilateral trade will also be further promoted. Our colleagues participated in this workshop will be expected to act as a bridge and initiators for the future cooperation. I will be glad to offer my contribution to you with respect to knowledge, experience and information that may be of help to your business. For this purpose, I will give a presentation of international cooperation for SHP development to you by end of this workshop. As a follow-up action after that, we may sit together to explore the potentials of our future cooperation and discuss relevant issues that may be of concerns to both sides and hopefully, even make certain commitment of intention on some specific items.

I'd finish my address today and thank you for your attention. ■

Small Hydro Power in Nigeria

Messr Idris Mohammad *(National Electric Power Authority, Nigeria)*

Ikpo Kalu Ochu*(Electrical Inspectorate Services, Federal Ministry of Power & Steel, Nigeria)*

In partial fulfillment of the requirement for the completion of the training course on SHP, this presentation is made to briefly introduce our representative countries, the availability of SHP in our countries, training experience and possible areas of co-operation in SHP. The importance of SHP projects (to be initiated in our countries) cannot be overemphasized. This renewable approach to power supply is a lucrative and promising future prospect of energy development that deserves a closer attention. As we deliberate along we will discover a few suggestions that would add more flesh to the entire presentation.

1 BRIEF INTRODUCTION OF NIGERIA

The total area of Nigeria is 923,770 square kilometers, bounded in the east by Cameroun (1690 km) and in the west by Benin Republic (773 km) and in the north by Niger Republic (1497 km) and Chad (8 km)bringing the total land boundaries to 4,047 km.

There are two seasons : the wet season which runs from May through October and the dry season which prevails from November to April.

Nigeria is rich with several highlands, lowlands, rivers, mountains, plateaux, with various vegetations from one season to another. Prominent among the rivers are River Niger and River Benue. About 65% of the population earn their living from the land , mainly as subsistence farmers . Agriculture has been the mainstay of the national economy until the discovery of crude oil in the late 50's. Petroleum has become the backbone of the nation's economy with Nigeria as the sixth largest producer of oil in the world.

Nigeria is a multi-ethnic secular state with a great variety of languages spoken in the country. There are about 230 tributes with over 250 dialets in Nigeria. The three major tributes are the Housas (north), Igbos (East) and the Yorubas(West). English is the official languages in Nigeria.

Nigeria is the GMT+ 1 hour time zone , with twelve months of 30 days (September, April, June, November) 31 days (January, March, May, August, October, December)and 28 days for February (or 29 days during leap years).Nigeria uses 220 volts norminal AC voltage at 50Hz frequency.

Nigeria's population is estimated at 124 million with average growth rate of 3.05% and the capital city of Nigeria is ABUJA . The head of state , commander in chief of the armed forces of Nigeria is Chief Olusegun Obasanjo. There are 36 state in Nigria apart from the Federal capital territory. Nigeria practices the presidenatial system of government. Elections are held every 4 years for new leaders to emerge. Next Nigeria election is due by the year 2003. There are 3 tiers of Government , namely executive, legislative and the judiciary. Members of the national assembley are elected from their constituencies by the electorates.

Nigeria is rich in tourism attractions. The Temperate climate during the two seasons affords tourist maximum comfort from the outstanding moderately cold plateau state (temp between 12℃ and 20℃) to the shiny northern and southern state (temp between 18℃ and 37℃) . Some tourists attractions and where the could be located in Nigeria are as follows.

(1) Obudu cattle ranching in Cross River state(East)
(2) Olumo rock in Abeokute , Ogunstate (West)
(3) Osun shrine in Oshogbo, Osun state (West)
(4) Ikogusi warm and cold water spring (Mid West)
(5) Argungu fishing festival , Kebbi state (North)
(6) Yankari games reserve Baauchi state (North)
(7) National Museum at Onikan , Lagos state (West)
(8) Kainji/ Jebba/ Shiroro dams Niger state (North Central)
(9) Mambila plateau – Taraba state (North East)
(10) National Theatre at Iganmu, Lagos state (West)
(11) Usman DanFodio tomb, Sokoto state (North)

There are about 7 major cities in Nigeria with average population of 5 million people in each . Hospitality industries are ridily available , from the luxurious Hilton and Sheroton hotels to the tourist – class hotels. All tourist hotels offer a choice of modern hotels with state-of-art communications facilities.

The local currency in Nigeria is the Naira made up of 100 Kobo = 1. There are denominations of (500, 200, 100, 50, 20, 10 and 5) naira notes. Visitors may import unlimited amount of foreign currency , providing declarations of such currency is made to customs officials on arrival. Visitors are able to change unused Nigerian currency back to the foreign currency of their choice before departure at the airport in company of currency declaration form and receipt for exchange transactions.

2 AVAILABILITY OF SHP STATIONS IN OUR COUNTRY

Though our report is suppose to be in small hydro power which is not available in our country we have taken Shiroro hydro power as a case study.

Shiroro hydro electric power station is one of the 7 power stations in Nigeria. It belongs to national electric power authority(NEPA), which is situated in Niger state, 550m down stream of the confluence of Kaduna River with its tributary , the Dinya River about 60km north –east of Minna , the state Capital.

HISTORY

The story of the hydro electric project in Nigeria dates back to 1951 when with the growth of industries and rapid urbannisation the demand for electricity was rising faster than the suppler. The decision to build a dam across , river Kadnna in the area of Shiroro –a small farmers village near minna in niger state that gives its name to the gorge where the project is located –has its origin in the survey carried out in 1951 and relevant to the exploitation of the energy potential of the Nigeria river system. As a result of the reports of the survey, the niger dam project committee (made up of representatives of the Federal government , the government of the former northern Nigeria and the former electricity corporation of Nigerai) recommended that an initial development near Kurwasa followed by development at Shiroro and Jebba would be most beneficial to Nigeria. The Shiroro power station in the Kaduna river is of 600 MW.

The final design of the whole project was prepared for NEPA by chas T main international inc. of Boston Mass , USA who were also responsible as Engineers for the supervision of all the contracts required for its implementation while the contracts for the construction of the civil works was awarded by NEPA to an Italian firm TORNO SPA towards the end of 1978.

Other components of the project where awarded to different companies , which included the Austrian firm VOESt ALPINE for the supply and installation of the hydraulic turbine and governs, INGRA RADE KONCAR of the federal republic of Yugoslavia for the supply and installation of the generator and exciation system, MITSUI/TOSHIBA of Japan for the generator –transformers and GEC of UK for the projective relay and control equipment . High voltage switchgear and other switchgear equipment where supplied by Siemens AG of the Republic of Germany while CEI of Italy handled electrical installation and auxillary plant Items. A Spannish company, BYNSA supplied the project cranes. In a similar vein both the power intake and spillway gates together with the associated electro-hydraulic control equipment were supplied by Tampella of Finland.

DAM

The Dam is of a rock-fill type and stands 115m high above the original river bed-elevation, across Shiroro gorge for a crest length of 700 metres. The width of the dam at its toe is over 300 metres whilst its crest, which accommodates a service road is 7.5m wide. The crest of the dam has a heavy re-inforced concrete parapet wall, more than 5 m high, which is also designed to protect top of the dam from the waves that will build up in the lake under wind pressure.

POWER INTAKE

The 60m high reenforced concrete tower of the power in take with a 44m by 15m rectangular plain is located on the right bank in the proximity of the spillway's structure. At the bottom the are four openings 5.50 m wide and 10m high through which, and a transition area in the concrete structure , the water from the reservoir enters the circular penstock to be finally conveyed to the turbines in the power house. The bottom of the tower has 1.5m diameter water release out let to maintain the flow when the turbines are not turning to be used by people living along river down stream from the dam.

The intakes can be short by means of gates operated by hydraulic hoists located on the chamber of the top of the tower which is accessible from the dam crest, through a steel bridge.

SPILL WAYS

The spillway is at the right abutment of the dam and is a reinforced concrete structure about 100m long on its center line, which includes 4 openings 15m wide and 16.65m high. The openings are controlled by means of hydraulically operated tainter gates. The capacity of the spillways is 7,500 cubic metres per second. Downstream from the structure a concrete chute 50m wide and 360m long built within the right bank , takes the spilled water to the

bucket at its end and finally into the plunge pool which has been provided by the excavating the existing river bed.

PENSTOCKS

The penstocks are made up of steel barrel with a diameter of 6.3m and have a total developed length of 1,400m in four lines of varying individual lengths , the total weight is 4000 tons. The penstock lines, partly horizontal and partly inclined are fully encased in reinforced concrete.

POWER HOUSE

The main building of the power house, which is 100m long and about 40m wide house the 4 × 150MW units. It is a massive reinforced concrete structure most of it within the rock with a structural steel superstructure which supports the roof as well as the rails of the 210 tons over head traveling cranes used for the erection of the turbines and generators and for their major maintenance. The maximum height of the building from the foundation level to the roof top is 51m. From the power house the water flows back into the riverbed a downstream from the dam, through steel lined draft tubes and eight opening which can be short by means of the gates , controlled by another gantry crane of 30 ton capacity.

INSTALLED CAPACITY

Shiroro hydro power has a total capacity of 600MW from the 4 generating units rated at 150MW each at a head of 97m, each unit comprise of a vertical francis hydraulic turbine unit controlled by an electro hydraulic governor. The turbine drives a synchronous generator of salient pole construction having a net output of 150MW. The generator is excited by a static self excitation system. The speed of rotation for the unit is 150 rpm. These turbine generators are capable of independent operation.

GENERATION

Power is generated at 16kV voltage levels. A generator-transformer steps up the voltage to 330kV level for connection to national grid via the agency of a 330kV switch yard. The national grid constitutes a power pool to which all the power stations and load centers are connected. The stations annual energy generation is 2230GWh. This accounts for a plant utilization of about 42%.

TRANSMISSION

Shiroro power station has 4 × 200 MVA, 16-330kV power transformers through which 4 short span feeders. Fed two(2) 330kV buses 1 and 2. In between these buses 1 & 2 are a breaker and half system comprising of SF6 circuit breaker and motor operated disconnect switches (Isolators). From the 2 buses emerge 4 × 330kV feeders(2) between Shiroro and Jebba and (2) between Shiroro and Kaduna. The arrangement of the buses allow for multiple sources of power utilizing the 4 lines. Provision for double circuit to Abuja has been made and partially equipped for future supply to Abuja at 330kV. Within the switch yard there is a provision of 2×150MW , 330/132/33 kV auto grid transformers for the provision of the following transmission voltage levels.

a) 132 kV transmission lines

i)Double circuit 132 kV to Minna which also supplies Suleja, Abuja and Bida.

ii) Single circuit 132 kV Shiroro Tegina which also supplies Contagora substation.

b) 33 kV transmission lines

i) Single circuit from Shiroro to Gwada and Kuta.

ii) 33 kV supply to 2×15 MVA 33/11 kV transformers.

c) 11 kV distribution network

i) 2 × 11 kV feeders to the power station for power station auxiliaries.

ii) 1 × 11 kV feeder to the senior camp.

iii) 1 × 11kV feeder to the operators and junior camps with T-off to Zumba resettlement village.

iv) 1 × 11kV feeder to the switchyard auxiliaries.

v) 11 kV Supply to the supplementary National Control Center.

SPECIAL FEATURES OF SHIRORO

a) The station runs on 4 No Francis Turbines which are suites for the medium head reservoir operation of Shiroro lake.

b) Quick start from cold and quick load pick-up are also special features of the machine in the Shiroro power station.

c) Each of the 4 Shiroro machines can boost power supply to the National Grid by 150 MW in just 6 minutes.

This is one of the most important special features of Shiroro power station which makes the station vital in handling emergencies resulting from sudden increases in load demand or sudden loss of the machine in another station.

UNIQUE ACHIEVEMENTS AND AWARD WINNING PERFORMANCE

a) Shiroro power station has remained the most reliable power station in the country's electricity network.

b) Shiroro power station operates at 100% capacity.

c) Its units are the fastest in boosting power supply to the National Grid.

d) In emergencies National Electric Power Authority (NEPA) of Nigeria falls balk on Shiroro power station for bulk production of electricity.

e) It generates 25% of Nigeria electricity demand.

IMPACT OF THE DAM ON ITS ENVIRONMENT

Although the power station project involves the relocation of families, it also offers benefits to the local communities. The creation of the dam led to the change of climatic condition in and around the lake area. It modified the relative temperature of the catchment area resulting in cold/warm zone in the Shiroro local government area. The northern area where the lake is situated has a colder temperature than the southern part of the local government.

1) ECONOMIC & SOCIAL IMPACT

a) The dam and the switchyard constitutes a tourist centre where people from all works of life visit for tourism during holidays and weekends.

b) The presence of the dam has created job opportunities at various levels for the indigenes and non-indigenes as well.

c) The indigenes feel a sense of belonging by way of contributing to national development through power generation from Shiroro power station.

d) The station represents a unique engineering firm for students on excursion and provides a good training ground for industrial training of students of engineering and allied courses of study.

e) The station contributes immediately towards science education by providing higher institutions with instructional materials like old transformers, electric motors, pumps e.t.c..

f) The construction of Shiroro dam has resulted in improved revenue generation for the state and local government through taxis from civil servants and various levies from other settlers.

2)FISHING

Fishing activities around Shiroro dam on the river Kaduna was almost none existent before the creation of the dam. After the construction of the dam , fishing has since commenced resulting in more than forty fishing villages located along the banks of river Kaduna and its major tributaries mainly rivers Munye, Sarkinpawa, Dinya and Guni. The creation of the dam has attracted immigrants from distant areas such as Edo state, Sokoto state, Borno state, and even Niger and Mali countries outside Nigeria.

The construction of Shiroro dam has therefore given rise to the following.

a) Commercial fishing activity.

b) Improved nutritional value on the diet of the villagers.

c) Alternative commercial activities and source of income instead of the usual farming activity alone .

d) Improved social status since additional income is generated .

e) Improved social interaction with the immigration of people from far and wide settling among the local people.

3)AGRICULTURE

Before the impounding of the lake, the vegetation of the land along the Kaduna river was mainly savanna, with patches of few wood lands along its tributaries of Guni, Muye, e.t.c. . However , the construction of the dam has improved the following agricultural activities in large scales.

a) Livestock production.

b) Fadama farming.

c) All year round farming by irrigation from the lake.

d) Normal raining season farming, the major crops grown in the lake catchment area include maize, rice, yam, cassava,millet, potatoes and guinea corn. The Fadama area yields the following crops : sugarcane, vegetables, tomatoes, pepper, e.t.c. .

3 EXPERIENCE DURING THE TRAINING COURSE ON SHP IN CHINA

1)LECTURES

TECHNOLOGY

Small hydro-power is a new technology which has not been praticed in our country. During the training the technological aspect of SHP were thoroughly taught and understood. Areas covered under SHP were hydrology, geology, power, protection, control , construction and metering systems. All these aspects were taught by different research engineers/specialists in details theoretically and later followed by practical explanation during site visit outside HRC training center.

The Automation of electrical energy is also an important aspect that was taught. This automation made technology easier operationally, though it has a disadvantage of creating unemployment in the country. Since research is the back bone of any developing country, redundant workers caused by automation can be transferred to reaserch centers in order to discover more technologies or improve on the existing ones.

INTERNATIONAL TRADE

The main aim of this training is technical cooperation which cannot be achieved without international trade among developing countries. During the training some of the international trade terms were highlighted and explained in details. These terms assist both the import /buyer and the exporter or seller. Some of these terms are FOB,FCA,CPT,CIP, etc. All these terms are provided to guide both the importer and exporter, so when ever our country is ready to import something from China, we have been taught during this train-

ing how to make use of these terms. If these terms are properly defined by both the importer and exporter at the beginning of the business the would be no difficult in resolving dispute if it occur at the end of the business. For example if CPT(carriage paid to destination) agreement is made and exporter failed to pay for the carriage, CPT term would be refered to and law will be enforced on the exporter to fulfill the agreement.

GENERAL

There are other experiences or trainings acquired during this course period apart from technology and international trade experience.

During the site seeing, it was discovered that Chinese government converted some wonders of nature in and outside Hangzhou to recreational and tourist centers. This attracts many people within China and other parts of the world to come as tourists or for recreation. It also provides revenue for the government and job opportunities for the citizens. There are natural places like those of China in our country which could be utilized in the same way or even better. From the knowledge we have acquired through the training, this will be conveyed to our country and similar recreational centers shall be constructed. Some of these places are West Lake, Fish/Animal zoo, where rocks were excavated to house animals and fish. There are other places visited outside Hangzhou where footpath was provided over a long hill of about 2km which also has water falls at different elevations. This also brings revenue to the government as one of the recreational and tourist centre in China.

2) NEW DIMENSIONS

Small hydro construction has led to new dimensions in the field of technology . Presently there is no SHP in our country, but from the knowledge acquired we have seen the importance of SHP and some new dimensions taken by China in the field of technology. Some of these new dimensions include pumped storage power stations, used to balance loads at base and peak periods . This could also be used to maintain generation at low water head in the dam by pumping water from the down stream to the upstream of the dam.

The decentralization of power control and independent power stations practiced in China is also something that brings about the stability of power supply in the country. This is possible because of the construction of many SHP stations at different localities to supply particular or specific communities. This will prevent a whole nation from experiencing total blackout due to failure from a station or line. SHP can be as many as possible because it is pollution free and has lower maintenance costs than others.

3) WELFARE IN CHINA

In the area of welfare, HRC has done a lot to make us comfortable at all times both in and outside HRC. Site seeing was regularly organized from time to time in and outside Hangzhou city. The co-ordinators of the course were always ready to accept our complaints. Whenever we required anything outside HRC premises, they would describe the place to us and many times accompany us to the place. None of the HRC staff has ever frowned at us despite our continues request of one thing or another, instead they laughed and joked with us, thereby making us to always fill at home. We shall really miss all of our co-ordinators after departure to our various countries, because they treated us like their own brothers especially messrs Pan,Yan, Shen,and Zhao. We promise to continue communicating with them after returning to our respective countries, and probably make a visit /business trip to China via HRC.

4) RECOMMENDATIONS

The knowledge acquired during the training on SHP has exposed us to many fields of technology. The following recommendations are therefore important for our country to be implemented.

a) Construction of SHP projects to improve the stability of power supply.

b)Construction of pumped storage hydro power stations to minimize non-generation due to water shortage .

c) Decentralization of national control centre to minimize total blackout due to loss of a unit or line.

d) Construction of independent SHP stations at different localities to supply particular or specific communities.

e) Sending personnel to developed or developing countries to participate in the construction of SHP stations.

4 POSSIBLE AREAS OF CO-OPERATION ON SHP BETWEEN OUR TWO COUNTRIES

The training programme on SHP in China can be described as an eye opener. The availability of the much needed electrical energy through SHP exploitation in China provides a great lesson to be learnt by an inquiring mind. The need to preserve our much treasured forests and wild life by providing alternative means of fuel for daily domestic uses, the need to pull our resources together to fight desert encroachment in the northern part of our country through construction of SHP dams, and the need to establish cottage industries in the rural areas as abundant SHP energy will be readily available, thereby decreasing rural-urban drift make it abundantly necessary that areas of possible co-operation

between our two countries should be diligently sought and established. This measure will in the nearest future make Nigeria benefit from the gains of SHP projects that is being enjoyed by China presently.

1) CO-OPERATION THROUGH EDUCATION

Information dissemination

The two countries can co-operate to a great extent depending on the level of information that is available to both the government and the governed. Information on availability of small hydro power alternatives and its gains will normally rouse attentions especially if the present means of power supply is unsatisfactory.

Creating awareness through the media or radio/TV adverts, newsletters and publications will greatly afford everyone an opportunity to compare and contrast, and thereby make positive contributions towards the establishment of SHP protects in the country.

Educational materials in form of journals, correspondence courses and possible integration of SHP courses in the curriculum of Nigerian higher institutions will greatly enhance co-operation on SHP between the two countries.

2) TECHNICAL CO-OPERATION

Special technical training programme may be signed between the two countries whereby technical personnel will be sent to China from Nigeria to be trained on the rudiments of SHP technical know-how. These trained personnel subsequently work closely with experts from China in the course of consulting, planning, construction and execution of SHP projects in Nigeria. This aspect of possible co-operation will also involve equipment supply and maintenance. Since China has fully developed and automated the manufacture, operation and control of SHP technology, it becomes a lot easier to also train some team of technical personnel from Nigeria within the same industries in China.

There is possibility of systematic technology transfer in the area of SHP exploitation in Nigeria from China since the latter has a complete and comprehensive package of this lucrative renewable energy. Provision of spare parts , useful result-oriented solutions and proper maintenance culture will not pose any problem. China is fully equipped and appears ready for any proposals from our country.

3) GOVERNMENT POLICIES

The government of Nigeria is known for polices that are both people oriented and intergovernmental-friendly. As a democratic government , the welfare of the governed constitutes the major aspect of the government's programme. Provision of steady and uninterrupted power supply has been one of the outstanding feats the present government seeks to achieve. Introduction of such policies in China (to the government of Nigeria) that created enabling environment for SHP projects and supply to thrive is a very useful tool that can bring about real co-operation on SHP.

The policies of government of Nigeria greatly favour foreign investments in Nigeria. Chinese government can fully use this opportunity to invest on SHP in Nigeria and become a major shareholder. This will be a most desirable venture in Nigerian economy. Chinese government stands to gain a lot form this joint venture co-operation.

4) ECONOMIC CO-OPERATION

Goods and services abound in China of which our two governments can co-operate,SHP project being a priority presently. Economic liberalization in Nigeria opens doors for this exchange of goods and services between the two countries.

The volume of economic transaction between the two counties will further increase public confidence in future areas of co-operation, this time around, on small hydro power generation.

More bilateral agreements could be advocated between the two countries on such areas as project executions, intermediate technology development or other aspects of technical co-operation.

5) CONTINUITY OF CO-OPERATION

The consolidation and sustenance of the different possible areas of co-operation between the two countries so far discussed will further create greater opportunities. This means that the co-operation enjoyed by the present generation will be transferred to the next. This continuous co-operation will gradually transform into inter-governmental co-operation of unimagined proportion.

This will bring about lots of mutual benefits between the two countries.

5 CONCLUSION

China has gone a long way in establishing an SHP industry and its subsidiaries. The prospects are very high for China to exploit the abundant opportunities for constructing SHP stations in Nigeria.

The Nigerian Government attaches a lot of priority to stable and un-interrupted power supply. These two Governments can cooperate at this level to enable China deliver her packaged energy potentials on the one hand, and afford Nigeria the opportunity of realizing her dream of abundant power supply for economic prosperity on the other hand. These cooperations in our opinion should take immediate effect. ■

Small Hydro Power and Rural Electrification in Tanzania

H.Boby;

D.Mashauri

(Tanzania Electric Supply Company Ltd.)

1 TANZANIA IN BRIEF

The United Republic of Tanzania was formed in 26th , April 1964. It consists of the mainland, formerly known as Tanganyika and Zanzibar Island. The capital is Dar es Salaam and the official administrative capital is Dodoma.

It is located in Eastern Africa, bordering the Indian Ocean to the East, Kenya and Uganda to the North, Rwanda, Burundi and Democratic Republic of Congo (Zaire) to the West, Zambia and Malawi to the Southwest and Mozambique to the South. Geographic Co-ordinates are 02 00 S-11 00 S and 30 00 E-40 00 E.

Natural resources exist in the country include hydropower, tin, nickel, phosphates, iron ore, coal, diamonds, gemstones, gold and natural gas.

The history of Tanzania goes back over one and half million years. The remains of the earliest known man were discovered at Olduvai Gorge, Northern Tanzania in 1959. There is evidence of at least six civilisations, which have left traces of their culture and history. Excavations have revealed Roman coins and Chinese pottery.

1.1 Salient features

Coverage 945,090 sq. km
Inland Water Area 59,050 sq. km
Protected Wildlife Area 247,550 sq. km
Coastline 1,424 km
Population 32,000,000 (2001 estimate)
Language Kiswahili and English
Highest Elevation 5,895 masl (Mt. Kilimanjaro)
Deepest Point 773 mbsl (Lake Tanganyike bed)
Electricity 220Volts, 50Hz

1.2 Topography and Climate

The country rolls from forested mountains in the North and South, through the great central plateau of rich brown savannah grasses and bushes, down to the tropical coastline in the East. Extremes of topographical relief of African continent lie within Tanzania territory. Mount Kilimanjaro has a permanent ice cap at 5,895 masl, and the deepest point lies in the Tanganyika Lake bed at 773 mbsl. The significant geological structure is the East African Rift valley, its escarpment being the most favoured terrain for hydropower potential.

The coastal areas are hot and humid, with average day temperature of 30℃. The central plateau (~1,200 masl) has hot days and cool nights. The Northern and Southern highlands has temperate climate. The rainy seasons extend from November to May and dry seasons from June to October.

1.3 Hydrology and Environment

Tanzania is the country of the Great Lakes. It is bounded in the North by Lake Victoria, the source of River Nile, in the West is Lake Tanganyika, and the second deepest lake in the world and in the South is Lake Nyasa. There are also inland lakes mainly, Rukwa, Manyara, Eyasi and Natron.

Tanzania main river basins are: Rufiji, Kagera, Malagarasi, Ruvuma, Pangani, Wami, Mara and coastal rivers, of which all have hydropower potentials most of them undeveloped.

Environmental issues include soil degradation, deforestation, desertification, destruction of coral reefs threatens marine habitats, unreliable rainfall affects marginal agriculture.

1.4 Economy

The economy is mainly dependent on agriculture, which accounts for 56% of GDP, provides 85% of exports, and employs 90% of the work force. Topography and climatic conditions, however, limit cultivated crops to only 4% of the land area. Industry accounts for 15% of GDP and is mainly limited to processing agricultural products and light consumer goods. Services account for the remaining 29%.

2 ENERGY

The Ministry of Energy and Minerals is responsible with all energy-related matters in Tanzania. Under the Ministry, Tanzania Electric Supply Company Ltd.(TANESCO), a

state owned company, was formerly the only company responsible for generation, transmission and distribution of electricity. Other institutions involved are Ministry of Water(MoW) and The University of Dar es Salaam(UDSM). Recently, the energy sector has been reformed to allow private investment. Currently there is only one IPP thermal power plant with installed capacity of 100 MW.

The main source of energy is biomass (fuel wood), which accounts to 85% of the total energy consumption. Fossil fuel and Electricity accounts to 9% and 6% respectively.

2.1 Electricity

Electricity consumption by the end of year 1999 was 1911 GWh, out of which, 87GWh were imported from Uganda. The current energy production does not meet the demand, this call for a development of the hydropower potential sites, which are at feasibility stage (Upper Kihansi, Ruhudji and Rumakali) and add more gas turbines. Currently there is a short-term plan to import more energy from Zambia. The current installed capacity is as shown in table 1.

2.2 Electricity Generation

The current status is that thermal amounts to 12.10% and hydro 87.90% of total country generation. However, the installed capacity is 41% and 59% respectively.

2.3 Hydropower Potential

Total hydropower potential is 4002 MW, out of which, 70 MW is Small Hydropower. The current developed hydropower makes only 14% of the total hydropower potential, and the developed small hydropower is 16% of the total Small Hydropower potential.

Table 1

GRID INSTALLED CAPACITY	
HYDRO	
POWER STATION	INSTALLED CAPACITY (MW)
KIDATU	204.00
KIHANSI	180.00
MTERA	80.00
NEW PANGANI FALLS	68.00
HALE	21.00
NYUMBA YA MUNGU	8.00
TOTAL HYDRO	*561.00*
THERMAL	
DIESEL	152.00
GAS TURBINE	112.00
IPP	100.00
TOTAL THERMAL	*364.00*
TOTAL GRID CAPACITY	*925.00*
ISOLATED INSTALLED CAPACITY	
HYDRO	0.75
THERMAL	28.00
TOTAL ISOLATED	*28.75*
TOTAL INSTALLED CAPACITY	*953.75*

2.4 Small Hydropower

The capacity range of small hydro power plants is not exactly defined, however in Tanzania the following classification is used: small-scale hydropower plants 2.0-10.0 MW, mini hydropower plants 0.5-2.0 MW, micro hydropower plants＜0.5MW.

Presently there are five developed small hydropower stations and only one (Nyumba ya Mungu) with installed capacity of 8.0 MW is connected to the grid. Three stations (Kikuletwa, Tosamaganga and Mbalizi) currently are not working. The last one (Uwemba) is isolated from the gird with an installed capacity of 0.75 MW, supplying power to Njombe district (county), in Southern Tanzania.

2.5 Rural Electrification

Tanzania is currently involving herself in a rural electrification program, whereby all district headquarters and load centers should be electrified. Through this initiative, development of small hydropower is very important. The existing non-working small hydropower plants will be refurbished and some of 23 studied small hydropower potential will be developed, pending on availability of funds.

2.6 Conclusion

It is estimated that in the developing countries alone, it would be an economic proposition to put about 200,000 MW of installed capacity to use by means of small-scale hydropower plants. This provides an ample scope for rural electrification on the basis of renewable energy. Joint effort and International Corporation (Technology Transfer, Consultancy, Information Sharing, Business Corporation) among developing countries is needed to harness the abundant potential. ■

Small hydro Power in Burundi

NTUNZWENIMANA Gagarine,

NIYONGINGO Nehemie

(REGIDESO, Burundi)

BURUNDI has very good cooperation with CHINA especially in technique and Economy.
- From 1972, CHINA has promised to construct the first national SHP plant on the MUGERE river near Bujumbura (8 MW). In 1982, this SHP began to output electricity.
- Actually CHINA has accepted to finance the MPANDA SHP project (10.4 MW).
- CHINA has also accepted to build a technical university at Bujumbura to increase technical engineer staff.
- There is many other works: health, textile industry, roads construction.

This good and effective cooperation has been especially confirmed through the two last regular complete revisions of the MUGERE SHP even if some times the security on the field was disturbed. The last one has been supported by the CHINA Government (more than 400,000 US $). Also, two Chinese staffs assisted by three Burundian operators are going on with preventive and curative maintenance of the equipments of this SHP plant.

Burundi geographic informations and economic situation informations are shown in table 1 and table 2.

1 SHP in Burundi

1.1. Historic

- 1959: An overhead electrical line 70 kV from RUZIZI I SHP plant of CONGO supplied Bujumbura.
- 1982: The first national SHP plant (MUGERE 8 MW) constructed by the CHINA Government has also supplied Bujumbura since May, 12. 1982.
- Since that date to 1988, eight (8) other SHP plants have been constructed progressively to supply the main centers inside the country, as showed on the national electric network map.

This network is actually supplied by- 9 national SHP with a total installed capacity of 30.9 MW,- 2 foreign SHP plants (one of SNELCONGO with 4 MW, another of SINELACCEPGL 13.3 MW) by two overhead HV lines.

All these 11 SHP assume the BURUNDI electricity supply by HV electrical lines: 110 kV, 70 kV, 35 kV, 30 kV and 10 kV.

There is a thermal power station of total installed capacity 5.5 MW (2 ×1.5 MW, 2×1.25 MW) which has been constructed in June 1996 for scour supply of the capital Bujumbura.

Actually there are 4 national interconnected SHP (RWEGURA, MUGERE, RUVVYIRONZA and NYEMAGA) and 5 isolated SHP (GIKONGE, MARANGARA, KAYENZI, BUHIGA and SANZU).

1.2. SHP

See the table 3.
As presented through this table,

Table 1 Burundi Geographic Informations

1	Geographic situation	- Near the west lift valley, beside the Tanganyika lake - In the middle of Africa (Great lakes Region) - In South of the Equator line (3 degree)
2	Neighbor counties	TANZANIA (East and South-East), CONGO (West and South-West) and RWANDA (North)
3	Seasons	Two seasons - Rain season (October-May) - Dry season (June-September)
4	Area and surface	- In general, a mountainous area in the middle - With two very narrow plains in the West and in the East - Surface: 27800 km^2
5	Population	6,000,000
6	Water	- In general the all area has some small rivers. - The Tanganyika lake is the biggest reservoir for water supply to the capital Bujumbura and other nearby cities. - There are in the North 4 very small lakes.

Table 2 Burundi Economic Situation Informations

I.	*Natural resources*	
1	Ores	- Very few, not enough to be exploited by companies - Only there is a Nickel exploitation project in preparation - with a South-African company ENDOVER.
2	Soil fertility	In general, the soil is not very fertile.
3	Agriculture	- The most part (>95%) is a family small agriculture for direct consumption. - A little part is for exportation: Coffee, Thee and Cotton agriculture.
4	Forest and Reforestment	-There are some natural forest and the Government encourages the peoples to reforest.
II.	*Breeding and Fishing*	
		- There is familial breeding of Cows, Pork, Goats, Sheep, Chickens, ….(for fumier, meat and milk resources). -Fishing is especially made in the Tanganyika lake (very good quality fish).

* Two foreign SHP contribute to supply in electricity the Burundian interconnected grid:

- RUZIZI I: belongs to SNEL CONGO company (total installed capacity 39.7 MW, power part to BURUNDI 4 MW) by a 70 kV overhead electrical line.
- RUZXIZI II: belongs to SINELAC CEPGL (BURUNDI, CONGO, RWANDA) company (total installed capacity 45 MW, power part to BURUNDI 13.3 MW) by a 110 kV overhead electrical line.

* Five SHP projects are presented.

- 2002 to 2005: MPANDA SHP (10.4 MW) and KABU 16 SHP (20 MW).
- After 2005 two other SHP are projected: Jiji 003 (15.5 MW) and MULE 34 (16.5 MW).
- The 5th is RUSUMO FALLS MHP plant (61.2 MW) which will belong to the OBK (BURUNDI, RWANDA, UGANDA, TANZANIA) international organization.

Moreover, our company, REGIDESO, is constructing HV lines to prepare for few years the interconnection of all it's SHP. So, the BURUNDI will be electrically supplied by one interconnected grid more reliable.

1.3 Electricity and Water

The electricity and water production and distribution are assumed by a national company, REGIDESO.

- Total staff: 1200 persons,
- Service duration: 40 years. From this 30th of June will be the 40th anniversary.

There is another small public department (DGHER) which supply water and electricity in rural small cities to promote the development of the rural areas.

III.	*Transport lines to foreign countries*	
		- Water line though the Tnganyika lake to reach the nearby ports of TANZANMIA (Kigoma), ZAMBIA (Lusaka), MLAWIA (Mpulungu) and some small others of CONGO - sea area, no sea transport line - Roads: there are roads to reach the neighbor countries but two of them are the most important roads for tank truck and transit goods carrying to reach Dar-es-Alam (ANZANIA) and Mombassa (KENYA) ports. - Air lines: from the Bujumbura international airport
IV	*Tourism*	
		There are beaches (on the sides of the lakes), sceneries, small parks, natural reserves, mountains, falls and small hydrographic establishments.
V	*Industry or manufacturing*	
		- Most of them are in the capital Bujumbura. But some others are in the rural area. - Drinks manufacture: BRARUDI, BRAGITA - Coffee manufacture: OCIBU, SODECO - Cotton production and manufacturing: COGERCO,COTEBU,RAFINA - The production and manufacturing: OTB - Sugar manufacturing: SOSUMO - Many other small manufactures and workshops
VI	*Trading*	
		The importation is greater than the exportation. The importation concerns the foreign manufactured products from China, Taiwan, Japan, France, Germany, Italia, …. The exportation concerns especially the coffee, the thee, the cotton.
VII	*Energy resources*	
		Hydro-energy is the most utilized. The total potential HP capacity is 300MW and the total already installed capacity is 30 MW (10%). The petrol is imported (1l cost: 0.8 $ US), Wood for heating (70 % of the all used wood). Sun lotion is no exploited until now. Peat: used especially for cooking in big people center as schools, camps ….

2 Our Benefits in This Training Workshop

2.1 SHP

In our companys, we are in two technical electrical services: power Production(Mr NTUNZWENI-MANA Gagarine) and network design and planning (Mr NIYONGINGO Nehemie). As technical staff, this training workshop has given us many detail knowledge's as follows.

- The different structures of a SHP from design, construction until exploitation;

- The different inspections to prepare the revisions or the refurbishments;

- The abilities of CHINA (it's companies and research centers, in particular HRC) to promote the SHP inside and in foreign countries;

- The CHINA cooperation about SHP promotion very useful for developing countries (especially African countries);

- Complete case study presentation, our own case study: MUGERE SHP (near Bujumbura);

- The comprehensive exploitation of dams (water supply, irrigation, power generation, flood protection, fishing, sightseeing …).

2.2 Reception, Visite and Tourism

CHINA (HRC) has made us a very good reception to be considered as example. The manufactures visited (KVAERNER, LMMW) have given us opportunities to realize the Chinese potential SHP partners to BURUNDI (REGIDESO). Tourist sites, rural ar-

Table 3 SHP Description in Burundi

Position	SHP	Location	Start year	Number and type of turbine	Installed capacity (MW)	Guarantee power (MW)	Mean energy (GWh/year)	Guarantee energy (GWh/year)	Discharge (m^3/s)	Head (m)
1	Mugere	Bujumbura	1982	4 Pelton	8	2.2	40	19	0.944	274
2	Rwegura	Cibotoke	1986	3 pelton	18	4.6	55	35.7	1.52	480
3	Ruvyironza	Gitega	1980	3 Crossflow	1.275	1.2	11	10.5	3.2	17.4
4	Gikonge	Muramvya	1982	2 Crossflow	0.85	0.24	6.8	2.1	2.15	27.3
5	Marangara	Ngozi	1984	2 Francis	0.24	0.22	2	1.9	0.29	60
6	Kayenzi	Muyinga	1984	2 Francis	0.8	0.15	1.3	0.31	1.91	26.4
7	Buhiga	Karuzi	1984	1 (+1) Crossflow	0.24 (0.48)	0.15	1.2	0.95	1.1	26
8	Sanzu	Ruyigi	1982	1 Crossflow	0.072	\	\	\	\	\
9	Nyemanga	Bururi	1988	2 (+2) Pelton	1.4 (2.8)	1.4	12.2	12.2	0.37	226
10	Ruzizi I	RD Congo	1959	4 Kaplan	4	4	34	34	\	\
11	Ruzizi II	RD Congo	1989	3 Francis	13.3	5.4	73	47	\	\
12	Mpanda	Bubanza	Proj	2 Pelton	10.4	3.7	34	30	\	874
13	Kabu 16	Cibitoke	Proj	2 Francis	20	8	111.7	70.08	6.425	181.5
14	Jiji003	Bururi	Proj	3 Pelton	15.5	\	\	\	1.87	375
15	Mule 34	Bururi	Proj	3 Pelton	16.5	\	\	\	2.85	235
16	Rusumo Falls	Tanzania-Uganda	Proj	\	61.2	\	\	\	\	\

eas and cities visits have been for us opportunities to see the East CHINA human activities and environment which are very good examples to our country.

This training workshop has given us more knowledge and attention to pay on SHP also the CHINA's ability to promote these stations among developing countries. This is a very important thing to our country BURUNDI (and our company REGIDESO) which use almost only SHP to produce electrical energy. It is sure that this will be very useful for the already being and future hydropower.

3 Conclusion

Began by a very good reception, the SHP training workshop has been successfully made. HRC has used all the means to disponibilize highly qualified and experimented teachers to give us their knowledge in SHP: technical design, business and trading.

It is sure that this improves for us how to serve our country (particularly our company REGIDESO) when we will be back.

This contribution effort among developing countries has merited our greatest congratulations to CHINA People Republic Government, particularly to HRC.

About these training workshops, we would like to express the following recommendations.

- May such training workshop go on until outreach the all (developing) countries> It is also a way to increase their development.

- It is desirable to be created a HRC internet site for technical works, publications. This will be very useful for us and for others even if fare we are. It will be a great contribution to develop the all world especially our country (among developing counties) in Hydro Plants.

Last but not least, we could not finish our presentation without expressing our sincere thanks to CHINA, especially HRC and all it's staff, for all the effort used to receive, to accompany and to teach us from the beginning until the end of this training workshop. We go back with the very distinguished fruit of your laborious work that we carry very honestly to our country. It gives us more ability to the works of our company.

To end, we thank to all the representatives of CHINA People Republic Government, TCDC, the representatives of HRC, all the HRC's staff and our friends trainees. ■

ENROLMENT INFORMATION

2002 TCDC Training Workshop on Small Hydro Power

Sponsored by the UN and China, Hangzhou Regional Center for SHP (HRC) aims at promoting the SHP development in the world. China has most SHP stations and has gained much experience in SHP development. In order to disseminate SHP technology, HRC has already held with success 34 training workshops for 589 participants from 60 countries.

1.Objectives: To master the basic theory and principles of SHP development, feasibility study, operation, maintenance etc.

2.Date: From 9 Oct. to 18 Nov. 2002, Hangzhou, P.R. China.

3.Venue: Hangzhou Regional Center for SHP, Hagnzhou, China.

4.Course Contents: Procedures of SHP development, feasibility study, hydrological analysis, low-cost civil structure, turbo-generator, electric design, automation, economic evaluation, operation, maintenance.

5.Training Methods: Lectures, discussions, field trips & seminar.

6. Medium of Instruction: English

7.Source of Trainees:SHP technical personnel or officials from developing countries.

8.Methods for Evaluation: presenting country report on SHP.

9.Participant's Qualifications and Requirements for Admission: The applicants should be under 45 years old, graduated from technical schools with two years' SHP practice, be in good health with no infectious diseases and not handicapped, be proficient in English; prepare a review paper or report on SHP development of the participants' country, not to bring family members to the training course, to observe all the laws, rules and regulations of P.R. China and respect the Chinese customs.

10.Training Expenses: The expenses of training, boarding and lodging, local transportation, pocket money of RMB 30 Yuan per person per day during the training period in China will be borne by the Chinese government and distributed by HRC. The international travel costs including round trip tickets, transit fares, the expenses of medical care, insurance for the participants are covered by the participants themselves.

11.Application and Admission: Nominated by their respective governments, applicants are requested to fill up the Application Forms, which should be endorsed by the departments concerned of their respective governments, and submit with valid Health Certificates provided by authorized physicians or hospitals to the Economic and Commercial Counsellor's Office of Chinese Embassy (ECCOCE) for endorsement; If endorsed, Admission Notices will be issued to the accepted participants by ECCOCE through the related government departments. With Admission Notices, participants should go through all necessary formalities with all the mentioned documents to China on the registration date.

12.Insurance: The training course organizer dose not hold any responsibility for such risks as loss of life, accidents, illness, loss of property incurred by the participants during the training period.

13.Liaison Address: Attn:Mr.D.Pan &Ms. Shen Xuequn

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Sino-Vietnam Cooperation for Water Conservancy & Hydropower Further Strengthened

Following the invitation of Vietnam Institute for Water Resources Research (VIWRR), the Chinese delegation from Hangzhou Regional Center for Small Hydro Power (HRC) headed by the deputy director of Nanjing Hydraulic Research Institute (NHRI), director of HRC, Prof. Chen Shengshui, has paid a visit to VIWRR from June 5 to June 9, 2002 to explore the possibility and fields of cooperation. The delegation consists of three members, i.e. Director of HRC, Prof. Chen Shengshui, Chief of automation division Mr. Xujincai and senior consultant Mr. Li Zhiwu.

During its stay in Vietnam, the delegation mainly held technical exchange and cooperative discussion with the Vietnam Institute for Water Resources Research (VIWRR) and its affiliated Hydro Power Center (HPC).

In the afternoon of June 5, the delegation arrived in Hanoi, and on June 6 the deputy Director of HPC introduced the multi-purpose hydropower project–Jinshan Lake station, as well as the basic profiles of other 6 stations under programming or feasibility study that carried out by HPC.

In the morning of June 7, the delegation visited the Vietnam Institute for Water Resources Research, and with the participation of Dr. Nguyen Tuan Anh, Director of VIWRR, the deputy Director and senior researchers from the Ministry of Agriculture and Rural Development etc., both sides conducted technical exchanges, and introduced the structures and the business scopes of their research institutes, the main achievements scored and the being executed scientific and research activities as well. Cooperative fields and the possibility were discussed among VIWRR, HPC, Nanjing Hydropower Research Institute (NHRI) and Hangzhou Regional Center (Asia-Pacific) for Small Hydropower (HRC).

In the afternoon of June 7, Mr. Hoang Van Thang, Director of HPC emphasized that Vietnam would quicken steps to develop the medium and small-sized hydropower, and planned that recently 40 medium and small-sized hydropower stations are to be tapped, among which there are 15 stations with the installed capacity of 0.5-7MW, and 25 stations with the installed capacity of 9-100MW. In the past, in Vietnam the medium and small-sized hydropower stations are all invested by the state, and now more fund channels are adopted including foreign fund and

Visitors from Bluemoon Fund to HRC

On May 29,2002, a delegation from the Bluemoon Fund(USA) paid a visit to HRC. The guests were Ms. Diane Edgerton Miller, the President, Mr. Ji-Qiang Zhang, the Vice-President, and Ms. Pat Jones Edgerton, the treasurer. It's their first time to HRC. Dr. Chen Shengshui, the director of HRC, Ms. Cheng Xialei, the deputy director and Mr. Zhu Xiaozhang, the honorary director received and held friendly discussion with them. Mr. Zhu Xiaohua from Division of Science, Mr. Lu Jianping from Division of Electromechanical and Ms. Shen Xuequn from Division of Training also attended this meeting.

During over two hours' cordial talk, the discussion was focused on the sustainable development for new and renewable energy; the mature technology and rich experience of SHP development in China; as well as the assistance on poverty-alleviation for rural people, etc. The Bluemoon Fund is originally known as Jones Foundation, which has been running for over 50 years, and enjoyed a high reputation in USA. Recently, the Bluemoon Fund planned to select sites in Yunnan Province, China and in Peru, to establish some special investment companies, to which excellent talents engaged in various fields will be sent for providing assistance on planning, evaluation, construction, operation as well as training. On this basis, it is expected to create favorable investment environment, attract local investment in various forms, and then have comprehensive development and utilization on local resources effectively and efficiently, such as the integrated development on water resources, rattan and bamboo resources as well as kinds of processing industries, therefore, to help local people to improve their living conditions and to be able to enjoy rich life finally. The Bluemoon Fund stressed that, distinguished from previous ways or from other foundations, they hope to be able to set up a kind of new and practicable developing mode, which will help the poverty-stricken areas find ways to increase income, and not only being undertaken as a simple one-time donation.

The Bluemoon Fund showed its high appreciation of HRC's contribution to the global SHP development, and expected possible cooperation and assistance from HRC on the above-mentioned proposal. Meanwhile, with respect to the "new concept aid" proposed by the Bluemoon Fund, which was featured as sustainable and comprehensive, HRC expressed its admiration as well as the willingness to offer technical support for the potential SHP projects. ■

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private investment.

On June 8, a field visit was organized to the pilot multi-purpose Jinshan Lake hydropower station, in which the dam, the powerhouse and the transmission lines have already been implemented, and turbine-generator units and the automation system waits to be equipped. The investment for this station is from VIWRR. After this visit, Chinese delegates believe that, this hydropower station is very close to Hanoi and the famous scenic area-Xialong Bay, only 40km away from Youyi Quan, which is endowed with beautiful natural environment, and other functions such as power generation, flood prevention, irrigation, fishery, environment protection, tourism and so on.

On June 9, the delegation introduced the Director of HPC with the basic thoughts of comprehensively developing the Jinshan Lake hydropower station.

After several rounds of friendly discussions and field trip to the proposed hydropower plant, a memorandum of cooperation agreement signed coveres the following fields.

◆ Experience exchanges on scientific studies and technology relevant to small hydropower works,automation, river training, coastal engineering, irrigation, drainage and reclamation, new building material and software for water resources;

◆ Cooperation in the program of providing hydraulic rams and small hydropower stations to mountainous area in Vietnam;

◆ Cooperation in the program of flood control and natural disaster mitigation.

A delegation of VIWRR will visit to the NHRI to exchange experiences and discuss the cooperation in consulting design a hi-tech experiment area of the VIWRR which is 27 km away from Ha noi.

Because Vietnam has great potential resources of SHP and is in rapidly development stage to explore SHP, the cooperation between VIWRR, HPC and NHRI, HRC will have a brighter future. ■

A Chinese Magazine "Small Hydropower" by HRC

The Chinese "Small Hydropower", a magazine that National Research Institute for Rural Electrification (NRIRE) and Hangzhou Regional Centre (Asia-Pacific) for Small Hydro Power has edited and published for 105 issues (bimonthly), allocated with the International Standard Serial Number ISSN 0256-3118, and China Standard Serial Number CN33-1204/TV. It was published in Chinese and with English titles. Special features are technical experience of SHP development in China. Information of international SHP activities and important events in the field of SHP have also been widely included.

This magazine has carried news, views and articles on all aspects of small hydro power. It is useful to those who are intersted in technical experience of SHP development in China.

"Small Hydropower" is the only professional publication on small hydropower in China, which is issued domestically and abroad. It is widely circled in all corners of China concerning SHP, and getting more and more popular in over 600 rural counties which is primarily hydro-electrified, more than 2,300 counties with hydropower resources, more than 50,000 small-sized hydropower stations, thousands of colleges or universities, research institutes and other administrative authorities on SHP. Advertising is welcome for any equipment manufacturer to target Chinese market on SHP construction, equipment purchasing or other businesses.

Subscription rates (1 year):USD40.00

The main contents of the 103th issue (2002 No 1) read as follow.

Working Research

Necessity of SHP used instead of firewood

Influence of annual operating hours analysed by SHP statistical data

Technology Exchange

Design of non-pressure tunnel used instead of diversion canal

Arrangements and drainage design of sunk basin in SHP of low head and axial flow turbine

Design of emergency gate of culvert pipe in Qihe SHP station

Mechanical and Electrical Equipment

Selection and renewal of storage cell and AC system in Shenzhen SHP station

Attrition test of runner wear ring

Improvement of water supply in low-head SHP station

Computer Application

Application of PC computer in turbine-generator electric stop

LH 2001 synthetical monitoring system applied to Nanwan SHP station

Renewal and Reconstruction

Enlarge benefits by replacing runner

Renewal of service dischange pump

Capacity increase of Lilin first cascade power station

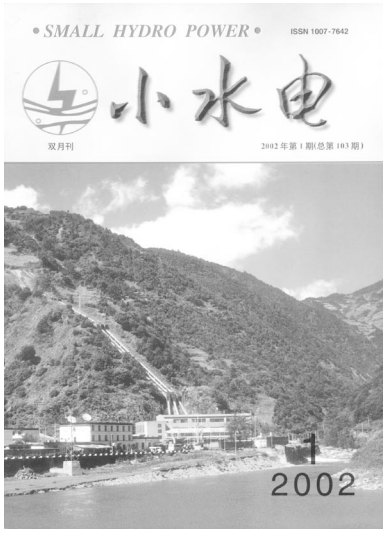
Service and Maintenance

Renewal of turbine top cover lifting and discharge

Effect of linking to network on Reactive Power in SHP station

Reason of shearing screw bolt of upper guide bearing block and its service

Acid removal of transformer oil in site



Cambodia rehabilitates Kirirom

The China Electric Power Technology Import & Export Corporation (CETIC) has signed a US$ 26M contract with Cambodia's Ministry of Industry, Mines and Energy (MIME) to rehabilitate the Kirirom 1 hydro project.

The 10MW plant which lies 110km southwest of Phnom Penh, was originally commissioned in 1968. However, it was abandoned in 1972 when the plant and its transmission line was damaged by warfare, denying power to Cambodia's capital city.

CETIC will be re-building one of three earthfill dams that were breached at that time, and will also install two new turbines and re-erect the 110kV transmission line. Work is expected to begin in mid 2001 and be completed by early 2003.

The contract signals the effective rebirth of Cambodia's state power sector. MIME oversees Electricite du Cambodia, which will soon be governed by a brand new electricity law and regulated by the Energy Authority of Cambodia.

Other hydro projects in the pipeline are Prek Thnot, Stund Kamchay, Stung Mnam 2 and the Stund Atay diversion. ■

China expreses interest in philippine hydro

MEMBERS OF A CHINESE trade mission which visited the Philippines in December 2000 have said they are prepared to invest up to US$19M in the Philippines' energy sector, and are particularly interested in hydro power projects.

In a meeting with the National Power Corporation(Napocor) the mission, headed by vice minister Chen Xiahun of the Ministry of Foreign Trade and Economy, expressed an interest in hydro power projects, especially in Northern Luzon. Chen said that the mission is also interested in establishing small thermal power stations and mini hydro projects.

Napocor's president, Frederico Puno, told reporters that his company is interested in China's expertise in developing hydro power plants. He said that China has particularly expertise when starting new hydro power in harsh or geographically remote settings.

Source:INTERNATIONAL WATER POWER & DAM CONSTRUCTION , FEBRUARY, 2001 ■

Test on the 30kW Vibrating Wave-power Station Accepted in China

To meet the demand of island residents on the electric power for their daily lives, a 30kW vibrating wavepower station, designed and built by the Oceanic Technology Research Institute of China National Bureau of Ocean, is presently conducted with test in Jimo city of Shangdong province, and accepted by China National Bureau of Ocean and China's Academy of Science. This project is one of the key scientific & technological items during the national 9th "Five-year Plan" period, and the design and construction of this station embodies very important meanings to the economic development of islands, utilization of island resources and the construction of national defense, which symbolizes that China has already achieved the advanced international-standard technology in the vibrating wave-power generation. ■

Hydro plants could fight Laos floods

CHINA IS PROPOSING THAT Laos contributes to the cost of damming the upper Mekong river, as the project could help relieve annual floods which devastate Laos.

Each year the Mekong river bursts its banks with greater force than the year before, but flooding could be relieved by the 300m high Xiaowan dam planned for China's Yunnan province. China is asking for Laos to help finance the project, but David Jezeph, chief of Water and Mineral Resources at the Economic and Social Commission for Asia and the Pacific said that countries in the lower Mekong basin are concerned that China could exert too much power over water resources. ■

Cascade 1 Hydropower Station Implemented on Woka River in Tibet of China

On October 12,2000 the representatives from all sides formally signed at the acceptance test for implementing cascade 1 hydropower station on Woka River in Tibet, which marks that the second largest one of China's national 62 assisting-Tibet projects is fully succeeded.

This station is a low-head diversion one, over 3,600m above sea level, with the installed capacity of 20MW. The effective generation amounts to 73GWh, and the investment totals RMB849.69 million. On September 10, 1999 the first batch of units started for generation, and in that October this station was put into trial operation, which was highly qualified. After the construction of this project, it provides urgently electric power to the power system in Laze prefecture of Tibet, and plays a significant role in promoting the local economy in Tibet. ■

Hydropower Development Strategy in Australia

Owing to some effective policies and strategies, the Australian government made its exploitation rate of hydropower resources more than 60% in a relatively short period. These strategies mainly include as follows.

1. According to the principles of market economy, priority given to the SHP development. Australia is very rich in resources for generating the electric power such as nuclear source, coal, petroleum and gas etc., especially among those eastern states where water resources are very abundant, the coal reserves accounts for over 80% of the whole country, and there is a good condition for coal quality, its production and transportation, with relatively low price. Generally, people think that it's a certainty to develop the local coal in these states, but after a comprehensive analysis on the economic benefit and the environment arising from those 3 power sources and their combination, conducted by the Federal Electric Power Commission and the state electric power commissions, it is concluded that it's more preferential to develop hydropower (for instance, hydropower from snow hills) rather than the local coal-generated power or other power sources to meet the power demand of the state and its districts. During the loan-Payback period the price of the corresponding peak load is US$1 .2 cent/kW•h, and after payment it is reduced to US$0.07 cent/kW•h, which is lower than the material (coal) cost of the thermal power, therefore, a strategy of giving priority to hydropower development is promulgated and pit into practice.

2. Considering the viewpoints of comprehensive economy, the special function of hydropower in the electric power system shall be fully used. One of the reasons for Australia developing hydropower, is mainly to fully adopt the dynamic effects and partially use the static effects of hydropower stations in the electric power system, and meanwhile, this viewpoint is considered to be the basic planning & design principle of hydropower projects, as to make each sole power grid integrated together, and enlarge the power-supply scope of the integrated power grids to take shape of a large power grid with high-voltage grade. So the whole hydropower station can fully perform its adjustment on frequency, phase and peak load etc., to guarantee the power-supply quality and reliability of the system and to achieve the comprehensive economic profits for social production and living improvement of the people. ■

NEW TURNKEY PACKAGE FOR MINI HYDRO LAUNCHED

Alstom Power's Hydro division on 22 June launched its Mini-Aqua range, as a turnkey approach to mini hydropower installation. Extensive work over the previous year-and-a-half has contributed to the development of an integrated package, comprising turbine, generator and a PC-based control system. The company noted that there was a 'rapid growth' in the mini hydro market, caused by 'the development of distributed power. . . and by the political will in many countries to increase significantly the share of renewable energy produced.'

Using standardized components, the package is designed to be suitable for a variety of heads, with applications rated from 0.5MW (the minimum end of the 'very low head' range) up to 15MW (the top of the 'high head' range). The standardized design can be automatically scaled to a given site by computer, with the turbine type varying with the different levels of head; Kaplan for very low (2-6 metre) and low (6-30 metre) heads, Francis for medium (20-300 metre) heads, and Pelton for high (150-1000 metre) heads. Alstom foresees that Mini-Aqua will cover 80-85% of its targeted hydro market. Orders for 15 systems have already come from Brazil, and two from Morocco. ■

Iran funds dam completion

Iran has signed a contract with unnamed foreign financiers for US$300M to fund two half-finished dam schemes, according to Tehran radio. The schemes are the Ostur dam in Mianeh in East Azerbaijan province and the Molla Sadra dam in Fars province. The Ostur dam will have a storage capacity of 2B m^3 and a 160 MW hydro power station. The dam will be completed by an Iranian company working with Swiss and Austrian assistance.

Molla Sadra will store up to 400M m^3 of water and generate 100MW. This dam will be completed by an Iranian company with Chinese assistance.

The Deputy Energy Minister, Rasul Zargar, said that the US$300M will be used to fund a water supply scheme in Kerman. ■