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Expansion & Efficiency-added Renovation of SHP in China

The average development rate of SHP resources in China has already exceeded 55%, some areas even reached 80%. 22000 SHP stations under operation were commissioned before 1995 with a total installed capacity around 18 GW, among which 5700 SHP stations have renovation potential of 8 GW.

I Background of the renovation

1. Main problems of old stations

(1) Technology out-of-date and equipment ageing

The current average comprehensive efficiency of China-made SHP T-G unit is about 85%, of which some exceeds 93% under optimal working conditions, while the comprehensive efficiency of SHP T-G unit put into operation before 1995 is around 75%. The efficiency drops year by year, most of which is below 65% currently, almost half of the units have reached or exceeded the discard time limit. The accessory electrical equipment is of low degree of automation, high energy consumption, and more failure, the electricity loss caused by equipment fault reaches 8% every year.

(2) Low efficiency of hydropower resources utilization

Suffering from improper design, insufficient hydrological data and incomplete series of electromechanical equipment at that time, the SHP T-G units couldn't be selected suitably and had to operate in deviation from optimal working condition for a long time with heavy loss and low efficiency. Restricted by the economic development level and electricity load, installed capacity was on low side and water was wasted during flood season. The joint dispatch for the cascade SHP stations was absent, and the overall generation potential was not well developed.

(3) More hidden peril on safety

With limitation of design level and construction technique, many problems such as flood discharge facilities damage, water retaining and diversion facilities disrepair, and pressure pipeline aging and rust, etc. had occurred which frequently resulted in public safety accidents.

(4)Multi-purpose function declined

In order to keep safe, SHP stations with ailing reservoir have to operate under low water level, not only the power generation capability decreases obviously, but the function of flood control, irrigation and water supply is also partly or completely lost.

(5) Ecological environment affected

With limitation of economic development level and eco-environment ideologies at that time, eco-flow was not taken into the consideration in design of all diversion type power plants.

2. SHP renovation needs special support from the state

(1) Heavy public welfare task

The old SHP stations either country or collectively invested before 1995 were mostly combined with river regulation, flood control, irrigation and other public welfares, and many old SHP stations couldn't get enough return for rolling development because most of depreciation cost had already been used for personnel payment and daily maintenance.

(2) Not covered by existing support scheme

The schemes of the "*New rural SHP electrification*" and "*Substituting SHP for fuel*" are mainly for establishing new SHP stations rather than SHP renovation.

(3) Urgent necessity for eliminating safety risks and protecting public security

In 2010, the *Typhoon Fanapi* caused break of tailing dam in Yinyan Tin mine of Zijin mining Co., but the

downstream Qianfeng hydropower station intercepted the debris flow for more than 900,000 m^3 and protected two villages of more than 2000 villagers from drown disaster.

3. Expected benefit

(1) Consolidating and increasing generating capacity

SHP renovation will increase an annual electricity of 10.5 TWh, and assuming the average annual generation hour is 3000 hours, an equivalent of 3.5 GW installed capacity could be added and 22.6 TWh of energy will be stabilized as well.

(2) Promoting energy conservation and emissions reduction

Substitution of 33.1TWh SHP energy for coal-fired power generation equals to reduction of nearly 11 million tons of standard coal each year, carbon dioxide emissions by nearly 28 million tons, and sulfur dioxide emissions by more than 200 thousand tons.

(3) Promoting combined dispatching for cascade SHP stations

Encourage joint dispatching in a same river and area and water resources comprehensive utilization.

(4) Improving ecological environment

Additional eco-flow pumps, culverts, holes and gates can keep the basic discharge flow and maintain river's ecological environment.

(5) Improving multi-purpose function

Consolidating and recovering total reservoir storage to 29 billion m^3, and irrigation area to 0.54 million hectare, thus effectively improving flood control ability of small and medium sized rivers.

II Implementation of the SHP renovation project

In 2011, Ministry of Finance and Ministry of Water Resources decided to provide investment appropriation for "***efficiency improvement and capacity additions to existing SHP***" (SHP established before 1995 is planned to be retrofitted) in two phases:

• Pilot phase:2011~2012. Pilot projects were carried out in Zhejiang, Chongqing, Hubei, Hunan, Guangxi, Shaanxi province, in which Zhejiang and Chongqing were comprehensive pilot.

•Full implementation phase: 2013~2015. Based on the pilot experience, SHP renovation is going to be implemented throughout the country.

Central government provides financial subsidies for SHP rehabilitation based on installed capacity post-renovation: east area is subsidized of 700 yuan/kW, middle area 1000 yuan/kW and west area 1300 yuan/kW. The central government appropriation shall not exceed half of the total renovation project investment. Local governments shall also arrange investment support for SHP rehabilitation. Local financial support is a key factor to get the implementation plan approved. Provincial subsidies are prone to farmer-favored small projects in poor areas. Use of provincial subsidies are adjusted by provincial water resources department under negotiation with provincial financial department.

1. Project compliance standards

(1) Specific investment should be lower than 4000 yuan/kW, with highest limit of 6000 yuan/kW. An explanation is needed when the investment is over 4000 yuan/kW.

(2) Additional electricity investment should be lower than 5 yuan/kWh, the highest limit not exceed 7 yuan/kWh. An explanation is needed when the investment is over 5 yuan/kWh.

(3) The additional electricity post-renovation should in principle exceed 20%. Those SHP stations that can obviously favor farmers or have multiple function should not lower than 10% either. An explanation is needed when the additional electricity is around 10% and 20%.

(4) The additional capacity should not be more than five times of the former capacity in principle, and rehabilitation should mainly for E-M equipment refurbishment for those with 5 times addition and new building nature.

(5) The comprehensive efficiency of SHP T-G unit under rated working condition should reach the standard as below:

•single-unit capacity less than 3000 kW: >75%;

•single- unit capacity between 3000~10000 kW: >81%;

•single- unit capacity more than 10000 kW: >88%.

2. Pilot projects

733 SHP stations in 6 provinces have completed renovation. The previous capacity was 867 MW, and the post-renovation capacity is 1142 MW; the former annual electricity generation 2.72 TWh, and post-renovation energy 4.12 TWh.

From 2011 to 2012, the central government has invested 1.2 billion yuan in SHP renovation from the renewable energy development fund and brought along 2.5 billion yuan from the local government finance.

The renovation pilot projects eliminate the hidden trouble of power plant and consolidated or recovered 1470 million m^3 of reservoir volume. The multiple function of irrigation, flood control and water supply is reinforced. 338 rivers' environment has been obviously improved. The pilot projects also spur production value of electrical and mechanical equipment manufacturing and installation for more than 3 billion yuan, and creates more than 20000 jobs.

All the renovated projects have taken many engineering and non-engineering measures to guarantee the basic eco-flow. In Longtoushan hydropower station in Ankang City of Shaanxi province, the original construction holes were re-opened and two drainage holes were added to guarantee the basic eco-flow.

The renovation project improves the automation level and many SHP stations realize the "*unattended with few guards*" mode. Jiubujiang power station in Hunan province had 34 operators, after renovation, 16 were transferred to other power stations, which can save more than 500 thousand yuan a year.

In 2013 the former Minister of MOF together with Minister of MWR have made a written report to the State Council on the situation of SHP renovation pilot project and the next step arrangement.

Premier Li Keqiang's written instruction: " Please continually extend the renovation scope on the basis of pilot projects to fully attend comprehensive benefit".

3. Full implementation

Based on the written instructions of the State Council leader, MOF and MWR unveiled the policy to further extend the SHP renovation project.

• Guangdong, Hunan and other 20 provinces started the SHP renovation project in 2013. 3500 SHP stations are involved and planned to reach capacity of 7540 MW and generate electricity 29.4 TWh, which is respectively 19.3% and 44.7% higher than before. The total investment is 19.8 billion yuan, in which 7.14 billion yuan comes from the central government subsidy and 3.48 billion yuan comes from the local government co-finance. Fujian and other 7 provinces will complete the rehabilitation in 2015, and Hebei and other 13 provinces will complete the renovation in 2014.

• Liaoning and other 5 provinces started the SHP renovation project in 2013 and 177 SHP stations are involved and planned to reach the capacity of 3640 MW and generate the electricity to 1.5 TWh, which is respectively 23.5% and 58.4% higher than before. The total investment is 950 million yuan, in which 380 million yuan comes from the central government subsidy and 220 million yuan comes from the local government co-finance. The SHP rehabilitation of these 5 provinces will complete the renovation project next year. During the "12th Five-Year", 28 provinces and Xinjiang Production and Construction Corps have carried out SHP renovation project.

• For provinces started renovation project in 2013, 90% of the central subsidies have been appropriated, and 40% to the provinces started in 2014.

4. Expected benefits after full implementation of SHP renovation

• 3700 old SHP stations will be rehabilitated.

• The installed capacity will be increased from 6600 MW to 7900 MW, and annual generation from 21.3 TWh to 30.9 TWh.

• The investment of 20.8 billion yuan will be realized in which about 7.5 billion yuan from central subsidy.

III Project acceptance and performance evaluation

1. Project acceptance

The SHP renovation project acceptance is divided into three stages: T-G start-up acceptance, completion acceptance and final acceptance according to:

(1) The provincial implementation plan approved by MOF and MWR, and relevant procedures, specification and technical standards;

(2) The approved preliminary design documents;

(3) Declaration form of SHP renovation project;

(4) Materials and documents of fund raising, budget issued and fund usage management;

(5) Work reports and technical documents.

2. Performance evaluation

The management service of local water administration and finance department is the first performance evaluation object and the renovated project itself is another performance evaluation object.

(1) The content of the management service of local water administration and financial department includes:

• Organizing, implementing and managing capacity.

• The fund disposition and use.

• Measures that farmers can be obviously benefited from.

• Long-term mechanism set up.

• Technical service.

• Archives management and statistics.

(2) Project performance evaluation

• Renovation effects.

• Project construction management.

• Project funds management.

• Project work schedule and acceptance situation.

• Effects of strengthening and benefiting farmers.

• Sustainable development ability.

(3) Results and utilization of performance evaluation

The performance evaluation of the local management service accounts for 25 points out of 100, and the project performance evaluation holds 75 out of 100. The total points include both local management and project parts, of which 85 pts is excellent, 60~84 pts is qualified, and below 60 pts is unqualified.

Any following circumstances is unqualified:

•Falsification in the process of local management service performance evaluation.

•The performance evaluation scores of the project spot checked by MOF and MWR are 20 pts less than that rechecked by provincial level.

The performance evaluation results directly links to the central financial subsidy:

• Under circumstances of fund fraud, fund interception and misappropriation, or of failing to complete the rehabilitation, central financial subsidy shall be fully deducted back. If the mandatory procedure were violated, safety accidents occurred or falsification in the local performance evaluation happened, 10% of the central subsidy should be deducted.

• Provinces with excellent performance evaluation result will be appraised and awarded 1% of the central financial subsidy funds.

• Provinces with unqualified performance evaluation result will be criticized and 10% of the financial subsidy funds will be deducted.

Performance evaluation of SHP renovation pilot:

Based on the provincial performance evaluation of various pilot provinces, MOF and MWR have completed the spot check in 6 pilot provinces. Zhejiang and other 4 provinces were evaluated excellent, and one province was evaluated qualified. The excellent provinces were rewarded of 1% of the financial subsidy funds of 11.36 million yuan.

(Source: Presentation to UNIDO Expert Group Meeting on Sustainable Small Hydro, Vienna, November 2014) ■

Construction of Green SHP in China

Ⅰ Background of green SHP construction in China

Chinese government has been giving impetus to the ecological civilization construction and made commitment that up to 2020, the non-fossil energy should account for 15% of the primary energy consumption, and the CO_2 emission per GDP should be 40%~45% lower than that of 2005. The proportion of clean energy in 2015 should arrive at 11.4% as the binding goal of the "*12th-Five Year*".

"U.S.-China Joint Announcement on Climate Change" proposed that China is to achieve peak value of CO_2 emissions around 2030 and to increase share of non-fossil fuels in primary energy consumption to around 20% by 2030. The United States is to reduce its emissions by 26%-28% on the basis of 2005 level in 2025.

The proportion of non-fossil energy in the primary energy in China by 2013 is 9.8%, a 6.4 percent raise since 1978. According to commitment of 15% by 2020, 5.2 percent should be added up in 2013-2020 with an increase of 0.94 point each year.

According to commitment of 20% by 2030, 5 percent should be further added accumulatively an increase of 0.5 percent each year. Although the raise rhythm seems decline but more forward, more difficult.

In recent years, all walks of society attach more attention to ecological environmental impact from hydropower development. In Sichuan Min River, Fujian Jiulong River, Shaanxi Lan River, Gansu Bailong River and Hubei Shennongjia District, the news that the flow is reduced or intercepted in lower reaches of SHP stations brought about widespread concern. To some extent, it urges SHP to take further measures to improve ecological environment protection.

What is green SHP?

• Environmentally friendly: Attaching importance to the ecologically based flow, and water ecological environment improvement, biological protection, landscape coordination, soil and water conservation, and energy conservation and emissions reduction.

• Socially harmonious: Attaching importance to the migration settlements, benefiting local people's livelihood, and improving public service as well as multi-purposed function.

•Standardized management: achieving standardization, normalization and modernization.

• Reasonable finance: maintaining a long-term and stable operation.

Ⅱ Target for construction of green SHP

Firstly, scientific and reasonable plan and design. The plan layout should be in strict accordance with requirement of national plan in main body function zone and water function zone. Development is prohibited in the national forbidden zone; restricted in part of eco- fragile zone and important eco-function zone and only focused in the area with stronger environmental bearing capacity. Development mode and degree should reasonably be designed and cascade development scheme of the river should scientifically be formulated following the comprehensive plan of the river and coordinated with other professional plan.

Secondly, standardizing construction management. In accordance with the requirements of the state environmental protection laws and regulations, the design, construction and operation of the environmental protection facilities and main work should be done at the same time.

Thirdly optimizing production and operation. Carrying out an environmental friendly cascade dispatching mode and a production operation mode; setting up an information sharing mechanism for water regimen, operation condition and overhaul plan among cascade hydropower stations; formulating the optimal operation regulations to

guarantee the minimum discharge flow.

Fourthly, establishing an incentive and guarantee mechanism. Striving for supportive policy, such as central investment, preferential feed-in tariff, credit support and ecological compensation, paying attention to green SHP's science and technology innovation. MWR is going to formulate a green SHP assessment standard,etc.

III What have we done for green SHP construction

1. Plan first

In 2012, MWR carried out the plan formulation and revision of small and medium-sized rivers, requesting to take the environmental protection measures to ensure release of the eco-flow and reduce the land submersion. The plan also put forward suggestions for some existing SHP stations which made negative impact to environment to rectify, reform or even demolish.

2. Introducing policy

According to unified deployment by MWR, Zhejiang, Shaanxi, Guangdong, Jiangxi, Fujian provinces introduce the minimum discharging flow management advice. Explicit stipulations referring design and deployment of minimum flow devices and optimizing dispatching and operation have been made for hydropower stations at different development and operation stages.

Overall check up of minimum discharge flow irregularly has been made by Shaanxi province united with relative departments. Water-drawing licenses of those stations refusing to implement would be called off, and grid settlement be terminated. Fujian province brought the minimum discharge flow management into local government's performance evaluation. To those SHP projects seriously affecting the river ecological environment, Hubei province carry out "one-vote veto".

3. Formulating specifications

In recent years, MWR has issued a series of technical standards such as:<*SHP Environmental Impact Assessment Procedures*>,<*Environmental Protection Guidelines for Construction of SHP*>, <*Evaluation Guideline for Ecological Water Requirement for Rivers and Lakes*>, and <*Environmental Impact Assessment Procedures for SHP Planning*>.

4. Carrying out model cultivation and pilot project assessment

Combining with construction of water bio-civilization and on the basis of experience summary of promoting bio-environment protection by rural hydropower in various places, technical standard for green SHP assessment and management regulation was preliminary carried out. Assessment pilots of 117 hydropower stations in 17 provinces

have been put forward which made a good foundation for promoting construction of green SHP.

Ⅳ Main assumption on green SHP assessment

1. Pre-Conditions for assessment period

• No severe production safety accidents and hidden dangers ;

• No immigration disputes;

• No big water pollution and other water environment accidents;

• Acceptance of the final completion accomplished.

2. Green SHP assessment purpose

• Assessing the green SHP construction achievements;

• Result of environment protection as main content and social-harmonious, management-standardized and economy-reasonable as supplement;

• Station with its assessment adopted should enjoy rewards or incentives.

3. Green SHP assessment ways and means

• The qualitative assessment should combine with the quantitative one which should be the major cause.

• The assessment should be based on the existing data and materials with other collected materials.

• Assessment should offer standardized declaration and assessment files to increase efficiency.

• Green SHP assessment should have a validity period.

• Green SHP assessment should be graded and could be awarded when a certain level is achieved by national recognition.

Ⅴ Present and future plan of green SHP

1. Providing guidance for formulating "*13th-Five Year*" work program for green SHP in various places.

2. Promulgating green SHP assessment standard.

3. Cultivating a batch of green SHP stations based on the assessment standard.

4. Actively striving for incentive policies, encouraging various local government to issue support policies for green SHP within their own administrative region.

Zhejiang, Guangdong, Chongqing, Shaanxi, Shanxi and Liaoning province plan to provide award or policy support combined with renovation to construction of green SHP in them selves' administrative region.

Meeting the green SHP assessment standard will be a pre-condition or acceptance condition for application of the central subsidy.

With the help of Global Environmental Facility, several green SHP stations will be built up. Incentive policy for green SHP should be put forward, and a unanimously acknowledged green SHP assessment standard should come out for sustainable development of China's SHP.

(Source: Presentation to UNIDO Expert Group Meeting on Sustainable Small Hydro ,Vienna, November 2014) ■

NEW LAWS PROMOTE DEVELOPMENT OF SMALL HYDROPOWER PROJECTS

Jennings Strouss & Salmon PLC, Debbie A. Swanstrom and Andrea I. Sarmentero Garzón

Hydropower supplies about seven percent of the U.S. electricity demand and is currently the nation's largest source of renewable carbon-free energy. The operational flexibility that pumped storage hydropower projects provide to the grid, by responding rapidly to supply and demand imbalances and maintaining power system stability, is particularly beneficial. Yet, reportedly only three percent of the dams in the United States currently generate hydropower. Congress therefore decided to change existing laws to promote more expeditious development of small hydropower projects.

On August 9, 2013, President Obama signed into law two new Acts passed by Congress: (i) the Hydropower Regulatory Efficiency Act, PL 113-23 (August 9, 2013) 127 Stat 493 ("Hydropower Efficiency Act"); and (ii) the Bureau of Reclamation Small Conduit Hydropower Development and Rural Jobs Act, PL 113-24 (August 9, 2013) 127 Stat 498 ("Reclamation Act"). Both Acts streamline and expedite the regulatory approval process to facilitate development of small hydropower projects.

The Hydropower Efficiency Act

The Hydropower Efficiency Act: (1) expands the Federal Energy Regulatory Commission ("FERC" or "Commission") exemptions for small hydropower projects and conduits; (2) establishes a general exemption from Federal Power Act ("FPA") license requirements for certain hydropower projects (3) allows the term of preliminary permits to extend beyond three years; (4) directs FERC to investigate the feasibility of an expedited two-year licensing process for certain hydropower projects; and (5) directs the Secretary of the Department of Energy ("DOE") to conduct certain studies.

1.Expansion of Existing Exemptions

This new law expands the small project exemption, provided in the Public Utility Regulatory Policies Act and codified in 16 U.S.C. § 2705(d), by increasing the capacity of projects eligible for this exemption from 5 megawatts ("MW") to 10 MW. The new law also expands the existing conduit exemption, provided in the FPA and codified in 16 U.S.C. § 823a, by increasing the capacity of non-municipal projects eligible for this exemption from 15 MW to 40 MW. Municipal hydropower projects keep their prior 40 MW eligibility threshold for conduit exemptions. The new law maintains the FPA definition of "conduit" as any tunnel, canal, pipeline, aqueduct, flume, ditch or similar manmade water conveyance that is operated for the distribution of water for agricultural, municipal, or industrial consumption and not primarily for the generation of electricity.

2.General Exemption from License Requirements

The new law exempts from the FPA's license requirements small hydropower projects that meet the following criteria: (1) use for electric power generation only the hydroelectric potential of a non-federally owned conduit, (2) have a maximum installed capacity of 5 MW, and (3) are not currently licensed or exempted from license requirements.

The Hydropower Efficiency Act requires any person, state, or municipality proposing to construct a qualifying conduit hydropower facility to file with FERC a notice of intent. FERC recently posted a template of notice of intent on its website.

The Act also requires FERC to make an initial determination as to whether the facility meets the qualifying criteria within fifteen days after receiving such a notice of intent. If the initial determination finds that the hydropower project meets the

criteria for exemption, FERC must publish public notice of the notice of intent. If an entity contests whether the hydropower project meets the criteria for an exemption, FERC must issue a final determination within forty-five days after the date of publication of the public notice. If no entity contests whether the hydropower project meets the criteria for an exemption, then the project will be deemed to meet the criteria for waiver within forty-five days after the date of publication of the public notice without further FERC action.

3.Extension of Preliminary Permits

FERC is now authorized to extend the preliminary permit term for up to two additional years beyond the three years currently allowed if FERC finds that the permittee has implemented activities under the permit in good faith and with reasonable diligence. In the prior regime, there was no extension of time for expired preliminary permits. The permittee was and still is allowed to file another preliminary permit application for the same location but it is not guaranteed to keep its licensing priority because the second preliminary permit application, like the initial permit application, is open to potential competing applications by other entities.

4.Expedited Licensing Process

Currently, licensing processes for hydropower projects may take up to five years. To expedite the licensing of low impact hydropower projects, the new law directs FERC to investigate the feasibility of issuing a license for hydropower projects at non-powered dams and closed loop pumped storage projects in a two-year period. Significantly, the new law states that this two-year period shall include any FERC pre-licensing process.

FERC must hold a series of workshops to solicit public comment on how to implement the expedited licensing process and develop the applicable qualification criteria. On October 22, 2013, FERC held its first workshop under Docket No. AD13-9-000. On January 2, 2014 FERC issued a Notice opening a three-month window to file petitions for expedited hydro license under a pilot program starting February 5, 2014 and ending on May 5, 2014. The projects to be filed must comply with the following minimum criteria:

•Must cause little to no change to existing surface and groundwater flows and uses;

•Must not adversely affect federally listed threatened and endangered species;

•If the project is proposed to be located at or use a federal dam, the request to use the two-year process must include a letter from the dam owner saying the plan is feasible;

•If the project would use any public park, recreation area, or wildlife refuge, the request to use the two-year process must include a letter from the managing entity giving its approval to use the site; and

•For a closed-loop pumped storage project, the project must not be continuously connected to a naturally flowing water feature.

FERC will select the projects that best fit within these minimum criteria and initiate the pilot program to test the feasibility of an expedited two-year expedited licensing process. By February 2017, FERC must hold a final workshop to solicit public comment on the effectiveness of the tested two-year licensing process.

5. DOE Studies

The Hydropower Efficiency Act directs DOE to study: (1) the technical flexibility that existing pumped storage facilities can provide to support intermittent renewable electric energy generation, including the potential for such facilities to be upgraded or retrofitted with advanced commercially available technology; and (2) the technical potential of existing pumped storage facilities and new advanced pumped storage facilities to provide grid reliability benefits.

The Reclamation Act

The Reclamation Act: (1) provides that the Bureau of Reclamation ("Reclamation") Power Resources Office is the lead office of small conduit hydropower processes; (2) defines "small conduit hydropower" as a facility capable of producing 5 MW or less of electric capacity; (3) excludes small conduit hydropower projects from requirements under the National Environmental Policy Act of 1969 ("NEPA"); and (4) establishes a right of first refusal for the lease of power privilege to irrigation districts or water users associations.

1.Lead Office

The new Reclamation Act amends the Reclamation Project Act of 1939 to authorize the Secretary of the Interior (acting through Reclamation) to contract for the development of small conduit hydropower projects. Reclamation's Power Resources Office is established as the lead office of small conduit hydropower policy

and procedure setting activities. According to the Congressional Research Service' summary of the enacted bill, 113th Congress, 2013–2015. H.R. 678, (April 10, 2013) this "lead office" role is intended to exclude such activities from FERC's jurisdiction.

2.NEPA Categorical Exclusion

The new law requires the Bureau to apply its categorical exclusion process under NEPA to qualifying small conduit hydropower projects. This exclusion does not include the siting of associated transmission facilities on federal lands. The application of this categorical exclusion under NEPA means that these small conduit hydropower projects in Reclamation's conduits could be allowed to proceed without preparing NEPA environmental documents, such as an environmental impact statement.

3.Right of First Refusal

The new law requires that a lease of power privilege be offered first to an irrigation district or water users association operating or receiving water from transferred or reserved conduits. The law defines: (i) "reserved conduit" as any conduit included in project works whose care, operation, and maintenance has been reserved by Reclamation; and (ii) "transferred conduit" as any conduit included in project works whose care, operation, and maintenance has been transferred to a legally organized water users association or irrigation district.

If the irrigation district or water users association elects not to accept a lease of power privilege offer, Reclamation must offer the lease of power privilege to other parties.

Litigation Issues

The use of a categorical NEPA exclusion under the Reclamation Act and the expedited licensing process combined with the new exemption from license requirements under the Hydropower Efficiency Act is expected to reduce costs incurred by small hydropower project developers, including costs associated with long processes and protracted litigation.

These new streamlined processes and reduced bureaucratic and litigation costs should help induce construction of small hydropower projects. However, it remains possible that some environmental groups or third parties attempting to halt construction of specific hydropower projects challenge the implementation of these streamlined processes.

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(Source: http://www.lexology.com) ■

Colorado Senate Passes Small Hydro Legislation

DENVER – The Colorado Senate has approved bipartisan legislation to streamline development of small hydropower in Colorado. HB14-1030 passed the Senate on March 20 and is expected to be signed into law by Gov. Hickenlooper.

The bill compliments last year's streamlining of permitting requirements for small hydro at the federal level through the Hydropower Regulatory Efficiency Act and the Bureau of Reclamation Small Conduit Hydropower Development and Rural Jobs Act.

In essence, the new Colorado bill "makes it possible to simultaneously complete federal and state review at the same time," as quickly as 60 days for non-controversial small hydro projects, said Kurt Johnson, the president of the Colorado Small Hydro Association.

It also streamlines the electrical inspection process for small hydro in Colorado, using precedents set in the small wind industry decades ago.

The bill came out of an Oct. 10, 2013 Water Resources Review Committee hearing led by Senator Schwartz and was introduced in the House by Reps. Mitsch, Bush and Coram, with additional sponsorship from Reps. Fischer, Sonnenberg and Vigil. Senator sponsorship included Senators Schwartz and Roberts as well as Hodge.

With bipartisan support, it was unanimously approved by the House Transportation and Energy Committee on Feb. 5 and subsequently passed the House. On March 13, it was unanimously approved by the Senate Committee on Agriculture, Natural Resources and Energy.

Witnesses testifying in support of the bill on that day included representatives from the Colorado Energy Office, the International Brotherhood of Electrical Workers, Delta Conservation District, American Rivers, the Colorado Rural Electric Association and COSHA.

Matt Rice, Colorado Conservation Director for American Rivers, praised the bill's capacity to streamline state environmental review for small hydro projects "without weakening or changing any underlying state environmental requirements."

According to Johnson, Colorado currently has hundreds of hydro-related jobs, a number that has the potential to grow, thanks to the new legislation. "The National Hydropower Association has estimated 5.3 jobs created per megawatt of new hydro construction," he said. "COSHA estimates approximately 100 MW of potential new hydro development in Colorado, which would mean approximately 500 new jobs created in Colorado, including jobs for developers, engineers, attorneys and financiers as well as concrete workers, plumbers, carpenters, welders and electricians."

Some of the first small hydro projects that are likely to get built in Colorado thanks to the passage of HB14-1030 may be components of pressurized irrigation systems.

"There are currently incentives in place, in some cases substantial, to support putting in pipelines and replacing irrigation ditches," for water conservation purposes, Johnson said. "If putting in pressurized irrigation for water saving purposes is being massively subsidized, why not simultaneously put in hydropower? You have got pressurized water. Why not spin a turbine while watering your fields?"

A recent hydropower assessment conducted by the Colorado Department of Agriculture highlighted pressurized irrigation as the most cost effective near-term opportunity for agricultural hydropower development. The report estimated that statewide, the untapped capacity of pressurized irrigation systems is approximately 30 MW.

In the past, tapping into this capacity didn't make sense "because permitting costs rendered it ridiculous to consider," Johnson said. "But that has all changed because of the federal legislation last summer. Now [such projects] can get built without getting bogged down in federal and state red tape."

Johnson hopes that Colorado's new small hydro legislation will serve as a model for other states nationwide.

"If we can get something done in Colorado with a near-unanimous margin, it makes it easier for other states to do something similar, " he said. "This bill furthers Colorado's leadership in the innovation of small hydro policy."

(Source: http://www.smallhydro.co) ■

Micro-hydro Lights up Homes And Lives in Afghanistan

Eleven-Year-Old Mohamed Nasim, (On the Right), Taking a Computer Lesson in a Makeshift Classroom in Borghaso Village, Bamyan Province. (by Joel Van Houdt/Undp)

Eleven-year-old Mohamed Nasim, who is in sixth grade, wakes up at 5:30 every morning to take computer lessons in a makeshift classroom here in Borghaso village, Bamyan Province, northwest of Kabul. He draws a house in Microsoft paint, colors it, and types his name in the corner as his young teacher watches over his shoulders. The back of Mohamed's hands are dried and cracked by the cold weather.

Outside, just in the distance, farmers tend to their wheat, trying to bring in the harvest in preparation for the harsh winter ahead. The mountain peaks in the distance already gleam with snow.

Highlights

• In Bamyan province, UNDP has funded the construction of 18 micro hydroelectic power plants.

• The plants are currently generating a cumulative 196 kilowatts of electricity that is powering 2,163 households, benefiting more than 15,000 people.

• In 2007 only 7 percent of the population had access to electricity, according to Government data. Since then, that figure has risen to about 30 percent, thanks to an increase in imported electricity and the construction of micro hydroelectric and solar panel stations.

Nasim is one of 46 people – 28 children and 18 adults – benefiting from this computer class. The freshly built room was donated by a local elder, but what makes such initiatives possible here in Bamyan province, where there is no power grid, is the use of micro hydroelectric power plants.

Afghanistan has one of the lowest per capita rates of electricity consumption in the world. But though imported electricity has increased and provides more than half of the country's power, it does not reach Bamyan province.

As a result, UNDP has funded the construction of 18 micro hydroelectic power plants in Bamyan province, with a budget of US $997,000 generously provided in part by the Governments of Denmark, Japan, The Netherlands and Norway and the European Union.

These plants are not only bringing tangible improvements to the lives of the people who now depend on them for access to electricity, they are creating jobs for locals, improving relationships with the Government of Afghanistan and providing environmentally-friendly, and thus sustainable, sources of energy. And in a country where many people depend on kerosene oil, wood and cow dung for heat and lighting, they offer a clean and healthy alternative, eliminating indoor smoke. According to the World Bank, nearly 2 million people die prematurely from illness attributable to indoor air pollution from household solid fuel use.

Take the power plant in Borghaso. The local shura – a traditional assembly of tribal elders and religious scholars – took eight months to build it, at a total cost of $62,064. About 160 families, or 1,120 people, benefit from the 12.7 kW of electricity generated by the plant. Putting the shuras in charge of the projects ensures local ownership, and is the first step in guaranteeing that the plants will actually be useful and thus maintained by the communities who build them.

The shuras not only oversee and coordinate the construction, but they also put in place a tariff system after the plants open, ensuring that they pay for themselves. In Borghaso, the

Shura charges a monthly rate of about 90 cents per light bulb for electricity and $1.70 per television set. The tariff is collected by the Shura cashier. The two electricians manning the station – who were trained in the provincial capital through a 15-day UNDP workshop – are paid a monthly salary by the Shura, from the collected tariff. The rest of the money from the tariffs is put in savings to be used if the power plant malfunctions at any point in the future.

While electricity is now providing a cheap substitute to oil lamps and smoky woodstoves in the evenings – reducing household lighting costs by almost 90 percent in addition to indoor pollution – people using the plants are also trying to figure out creative ways to make use of the electricity during the off hours of the day. The computer class in Borghoso is one example, although for now the hefty monthly fee of $10 per student in this poor village keeps enrollment low.

"These days the world is one of knowledge and technology," said Mohamed Hakim, head of the Borghoso Shura; his daughter, a second grader, attends the computer class. "Yes, the fee is a bit much – but parents are willing to pay for it, because if not equipped with these skills, our kids won't make it in the work force."

(Source: http://www.undp.org) ■

Future of Hydropower in Small Packages

A prime example of the future of hydropower is perched in the rugged peaks outside the southwestern Colorado town of Silverton.

This is no behemoth new dam blocking one of America's rivers. It's a humming generator no bigger than a wheelbarrow, pulling in water from a mountain stream and making enough power to serve 10 homes.

"I think the days of the mega projects in hydropower are gone," said Boulder-based energy analyst Cameron Brooks.

Instead, a fledgling industry is taking shape, focused on putting small electricity generation on already existing non-powered hydro infrastructure. It's a flurry of new economic activity for which Congress can take much credit, and it's an issue with opportunity for further political compromise as Republicans take control in the U.S. Senate.

The San Juan County Historical Society operates the small generator near Silverton. It's attached to a water pipeline at a historic mill site that the group was given about 15 years ago. Millworkers used the pipeline in the early 20th century to help process gold and silver ore mined in the neighboring mountains.

Historical Society Chair Beverly Rich wanted to use the pipeline to generate electricity. Yet, the project stalled when she was told her generator would have to go through a federal licensing process akin to what would be required if the historical society wanted to build a new Hoover Dam.

In the summer of 2013, the Silver ton mill project was a poster child in hearings on legislation meant to showcase an overly-burdensome federal regulatory process for small hydropower. The hearing proved persuasive to lawmakers.

"Incredibly enough, in this horrible time of gridlock, it passed unanimously," Rich said of the bill.

President Obama went on to sign that and another major reform bill for small hydro. These laws dramatically streamlined the federal licensing process for projects like the mill. Brooks said the package of legislation hit a rare bipartisan sweet spot. For lawmakers on the right, the legislation shrank federal bureaucracy. On the left, it meant a win for renewable energy without building new dams.

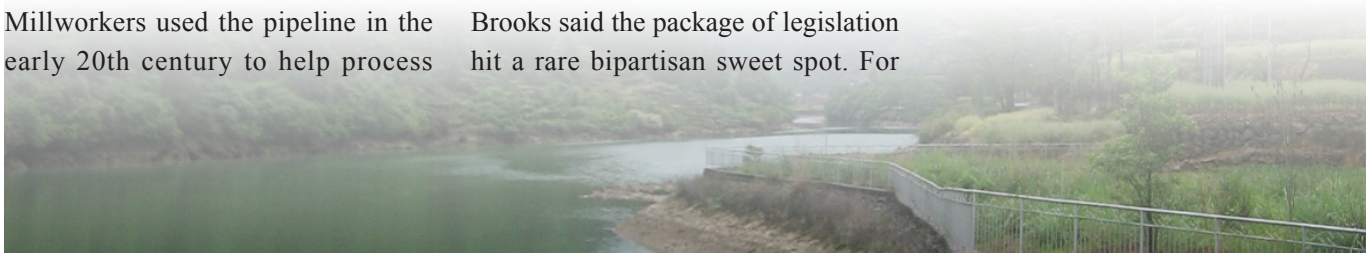
Fans of small hydropower are actually happy with Congress right now. Still, they are looking for more.

Kurt Johnson is a Colorado-based hydropower consultant who testified at a congressional hearing for the 2013 bills. He agrees that the new laws have been very helpful in spurring more development of small hydro. Yet, he describes them as a kitchen knife gently cutting the government's red tape, when what is really needed is a machete.

For Johnson, it shouldn't just be a matter of reducing the licensing process.

" If the projects are tiny and non-controversial," he asked, " why is the federal government involved at all?"

(Source: http://www.agjournalonline.com) ■



Key Facts of Hydropower Development in Some Developing Countries

Country	Theoretical Potential of Hydropower (MW)	Exploitable Potential of SHP (MW)	Total Electric Power Installed Capacity (MW)	Hydropower (SHP) Installed Capacity (MW)	Percentage of Population with Access to Electricity (%)	Main Problems and Difficulties
Antigua and Barbuda	/	/	/	/	98	1. High electricity tariffs; 2. Difficult geography, but containerized SHP might fit.
Benin	1,092	600~900	145.5	65	Urban area:65% Rural area: 15%	1. Lack of project investment and feasibility studies. 2. Disagreement during implementation of project
Burundi	1,700	300	5505	42	10	1. Sparsely populated; 2. Low income of the citizen; 3. Lack of funds; 4. Lack of information.
Cambodia	10,000	483	1368	681	57	1. Lack of policy, budget and framework; 2. Lack of data and information; 3. Lack of human resources, knowledge experience and funding. 4. No subsidy from Government 5. High investment costs
Central Africa	>500	320	40.5	20	7	1. Lack of funds, technology and construction capacity; 2. 3 thermal units have been shut down due to damage.
Cameroon	20000	/	1558	734(< 500)	25% Urban area: 45% Rural area: 5%	1. Road access 2.Lack of data base on SHP potential and power stations 3.The national grid, instead of being a Government institution as expected, is now conceded to a private company which is the main producer of the electricity 4.Poor regulation, especially for feed-in-tariff, grid/off-grid management and incentives measures for renewable energy in particular 5.Corruption 6.Long administrative procedures
Comoros	3	2.5	31.6	1.6	87	1. No potential studies of SHP; 2. High electricity tariffs. 3. Depend on petrol, high generating cost; 4. Old infrastructure.

Country	Theoretical Potential of Hydropower (MW)	Exploitable Potential of SHP (MW)	Total Electric Power Installed Capacity (MW)	Hydropower (SHP) Installed Capacity (MW)	Percentage of Population with Access to Electricity (%)	Main Problems and Difficulties
Côte d'Ivoire	/	/	1521	604	76	/
Congo	2,500	83.69	759.105	0	48	1. No policy of rural electrification; 2. Lack of investment.
Democratic People's Republic of Korea	20,000	10,000	9,000	500	100	1. Need refurbishment.
Djibouti	/	/	120	/	34	1. Lack of funds, training and feasibility study capacity.
Dominica	45	30	22.45	6.42	95	1. Lack of experts in SHP field.
D.R. Congo	100,000	20,000	2,590	277	9	1. Lack of information for potential sites; 2. Old equipments, grid damage of current sites; 3. Lack of experts, technology and funds.
Ethiopia	45000	3000	2268	1978(123)	54	1.High cost of initial investment. 2.Local skills to manufacture, operate and maintain the plants are not well developed. 3.Relatively low return in investment.
Equatorial Guinea	500	120.92	319.1	127.1	39.83	1. Lack of funds.
Equatorial Guinea	540	60	319.1	127.1	35	1. Government policy; 2. Difficulty of ungrounded system construction.
Egypt	193	23.54	25,705	1,500	91.6	1. Lack of technical studies, engineers, fund and investment.
Fiji	200	200	272.58	51.1	95	1. Lack of funding, design and civil experts. 2. 2. Fear of climate change.
Gabon	7,000	5739	346	171	/	1.Lack of planning and investment 2.Lack of power grid and maintenance
Georgia	12,500	7,500	2,500	28	99	1. 8% of power is imported in winter.
Guinea	6,100	5,260	238.36	51.7	12	1. Lack of funds.
Ghana	749.439	10	2,814	1580	72	1. High project cost; 2. Floating population and animals; 3. No appropriate policy and tariffs. Funding
Guinea Bissau	184	0	25	0	45	1. Lack of feasibility studies; 2. Economical problem.
Guinée	360	360	242	138,71	12	/

Country	Theoretical Potential of Hydropower (MW)	Exploitable Potential of SHP (MW)	Total Electric Power Installed Capacity (MW)	Hydropower (SHP) Installed Capacity (MW)	Percentage of Population with Access to Electricity (%)	Main Problems and Difficulties
Guyana	7,000	500	120	0	85	1. Lack of finance; 2. Possible distant sites.
Indonesia	76000	3047	46103	4057(235.5)	80	1. Delay in achievement of FC (Financial Close) with the Bank of Funding institutions 2. Problems of land acquisition 3. Licensing issues especially Permit Usage Forest Area requires a relatively long time 4. IPP developers less experienced 5. Disasters
Ivory Coast	12,000	2,500	1,391	55	74	1. Lack of funds.
Jamaica	/	/	820	/	97	1. Lack of finance.
Jordan	/	/	2845	/	99	- Resources are very Limited
Kenya	4,450	3,000	1,713.58	13.78	62 (urban);28 (rural)	1. Lack of hydrological data; 2. Lack of capacity of design, construction, operation and maintenance; 3. Damage of catchment areas; 4. Difficulty of use of land.
Kyrgyzstan	3,500	8,750	3784.5	42	100	1. Lack of finance.
Laos	26000	2000	1804	2540(70)	71.3%	1. Lack of an integrated national energy policy, 2.Lack of data and information of all sub-sectors of energy, 3.There is a lack of an integrated national energy policy and no clear or existing vision to cover all energy sub-sectors. 4.Lack of data and information of all sub-sectors of energy in the area of baselines and scenarios 5.Limitation of manpower with the knowledge of know-how, experience and skills in strategic planning and implementing.
Liberia	2,300	/	26	4	5	1. Poor transportation; 2. Fewer investors; 3. Operation period due to season; 4. Income shortage.
Malaysia	/	/	29143	2863.2(11.7)	99	1.Approval from the state government 2.Extreme weather such as flood and dry season and logistics
Macedonia	/	/	1,525	550	99	

Country	Theoretical Potential of Hydropower (MW)	Exploitable Potential of SHP (MW)	Total Electric Power Installed Capacity (MW)	Hydropower (SHP) Installed Capacity (MW)	Percentage of Population with Access to Electricity (%)	Main Problems and Difficulties
Madagascar	8,000	4,605	337	130	15	1. Incompetence; 2. Lack of investment.
Malawi	1335	350.8	422.263	350.8(4.5)	9	1. Weak Economy 2.Non-participation of private sector in Hydro Power Projects 3. Freezing of donor aid 4.Unmatured Technology
Mali	1,150	54.8	425.1	156	Urban area: 64Rural area: 18	1. Great loss during power distribution and transmission 2.Large proportion of thermal power (64%) 3.Lack of funds; 4. Lack of investors.
Mauritius	70	59.7	720	59.6	99.9	1. Flat geography; 2. Hugh investment for dams.
Morocco	4,000	337	6,405	337	98	1. Lack of funds in SHP projrcts.
Myanmar	100000	/	39708	2919(47.34)	32	1.In order to electrify more than 7.2 million households over the next 16 years (over 98% will be grid-based, 0.15% will be permanent mini-grids, and only 0.06% will be off-grid solar home systems.) 2. Strong institutional strengthening and reform is needed. 3. Collective contribution of resources ($5.8 billion) from consumers, the Government, its development partners and private sector
Namibia	240	/	578,5	330(20)	40	1.Weak economic 2.Lack of technology and Equipments 3.Non-participation of the private sector in energy development
Nepal	83,000	42,000	709	733.577(34.78)	56 (national)49 (rural)	1. Lack of electricity, need of SHP; 2. Incomplete infrastructure, lack of funds; 3. Electricity import from India.
Niger	>278	/	/	130 (in 2015 estimated)	8 (0.4 rural; 47 urban)	1. Weakness of final consumption per capita 2.Greatly reduction of catachment area
Nigeria	/	/	9,927.675	187.275	40	1. Lack of funding; 2. Lack of labor force; 3. Fear of the change of government policy.

Country	Theoretical Potential of Hydropower (MW)	Exploitable Potential of SHP (MW)	Total Electric Power Installed Capacity (MW)	Hydropower (SHP) Installed Capacity (MW)	Percentage of Population with Access to Electricity (%)	Main Problems and Difficulties
Pakistan	59,773	41,722	20,935	420	65	1. Inadequate infrastructure; 2. High capital cost; 3. Security issues; 4. Cost escalation risk; 5. Long transmission lines to load center; 6. Inadequate institutional capacity.
Palestine	0	0	982(fully depending on Israel)	0	95	1. High annual rate of electricity consumption 2. No power generation company in Palestine
Papua New Guinea	1,000	>500	230.9	147.2	20	1. Huge power demand; 2. Complicated geography, sparsely populated;
The Philippines	/	11223	16359	5468(1518)	76.9%	1. Obtaining Permits & Licenses from Government Agencies 2. Financing of Hydro-Power Projects 3. High Interest rate
R.D. Congo	100,000	/	2,710	71	9	1. Lack of electrification planning.
Singapore	0	0	12,861.2	0	100	Singapore is a small, heavily urbanized, island, city-state with a total land area of only 716km2. It is fairly flat (the highest point is only 165m) and lacks a major river system. As such, SHP is not feasible in Singapore.
Senegal	1,400	/	541	59.51	54	1. Excessive dependence on oil; 2. Increasing power demand; 3. Old grid; 4. Lack of funds, investment, and experience.
Sierra Leone	1,500	1,200	97.8	6	10	1. Resuscitation of 11-year war, slow economical development; 2. Lack of knowledge in SHP technology.
South Africa	17,390	250	44,175	45	85	1. Limited available sites; 2. Water license; 3. Strict tariff system.

Country	Theoretical Potential of Hydropower (MW)	Exploitable Potential of SHP (MW)	Total Electric Power Installed Capacity (MW)	Hydropower (SHP) Installed Capacity (MW)	Percentage of Population with Access to Electricity (%)	Main Problems and Difficulties
Sri Lanka	2000	500	3362	1361(282)	96.	1. System absorption limits (& interconnection cost) 2.Lack of detail studies and researches on new concepts (rubber dam) 3.conventional distribution system planning 4. Reviews / Amendments are slow 5.Environment issue 6.Transparency issue
Sudan	/	/	4,000	/	70	1. Lack of feasibility studies; 2. Lack of finance; 3. Lack of SHP sites; 4. Lack of investment in renewable energy.
Syria	/	/	9,078	20.8	99	1. Lack of feasibility studies; 2. Need of large hydropower more than SHP to meet increase demand.
Tanzania	4700	300-500	1,438.24	561.84 (0)	24	1. Rainfall pattern in the country which necessitates construction of small dams, has been receiving objections from environmentalists especially when resulting relocates many people. 2.The locations of most sites are very remote requiring construction of access (roads, bridges) and long transmission lines. 3.Completion of these small hydropower projects with reliable access opens up virgin land which attracts other economic activities. Some of these (i.e. irrigation) reduce water available for generation reducing energy production. 4.Water management in the country is yet to be understood by all stakeholders resulting in poor water utilisation. 5.Hydropower is capital intensive. Financing of hydropower project has faced difficulties in getting financing. In the past, this has caused delay in timing of projects as stipulated by master plan studies. 6.Unavailability of sound and reliable data due to poor hydrological and hydro meteorological data collection networks.

(Source: Participant's country report of TCDC training workshop of HRC,Updated to 2014) ■

HRC's Annual Report on Foreign Affairs in 2014 and Work Plan for 2015

Hangzhou Regional Center (Asia-Pacific) for Small Hydropower (HRC)
National Research Institute for Rural Electrification, MWR

In 2014, led by the Ministry of Water Resources (MWR) and its affiliated Nanjing Hydraulic Research Institute (NHRI), and supported by the Ministry of Commerce (MOFCOM) and the Ministry of Science and Technology (MOST), HRC carried out and implemented the decisions and arrangements of the Central Committee of CPC on speeding up the reform and development of water resources. HRC staff earnestly studied the documents of the 18th National Congress of CPC and worked with high spirits, strict attitudes and in a practical way. They have actively undertaken international training projects, widely carried out international exchanges, successfully implemented multilateral and bilateral S+T cooperative projects, and strived to expand the international market thus attained fairly good achievement and created impressive social and economic benefits.

I International Training

In order to strengthen the foreign-aid human resources development, deepen the south-south cooperation, popularize Chinese SHP technology and equipment, while promoting exchanges and cooperation among the developing countries, HRC has successfully organized 5 international training workshops (seminars) in 2014, three of which are foreign-aid training programs of MOFCOM, and the rest are ASEAN-China Cooperation Fund (ACCF) project and Perez-Guerrero Trust Fund (PGTF) project respectively, with the participation of 78 officials or engineers in the field of SHP and rural electrification from 37 countries in total.

Regarding the three foreign-aid training programs sponsored by MOFCOM, the first was the Seminar on Rural Electrification for Francophone African Countries,

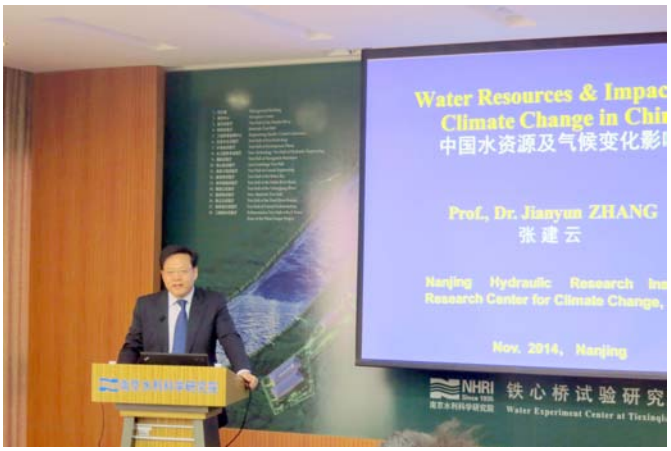
a 28-day training with the participation of 23 officials from 13 francophone African countries; the second was the Seminar on Rural Electrification for Asian Countries, a 28-day training with 15 officials from 8 Asian countries; and the third was the Training workshop on SHP Technology for English-speaking African Countries, a 42-day event with 17 officials and engineers from 9 African countries.

HRC, for the first time, also held two international training programs for ASEAN member countries in 2014. One was an ACCF (ASEAN-China Cooperation Fund) sponsored program called "*ASEAN-China Training Workshop on Small Hydropower and Solar Energy System for Rural Electrification*", with 9 officials from 7 ASEAN countries meeting in Hangzhou for this 7-day activity; the other one was a UNDP-PGTF program, called "*Technical Seminar on Small Hydropower among ASEAN Countries*", which was the first multilateral training program of HRC held out of China, and also HRC's first UNDP-PGTF sponsored program. This 3-day seminar was

held in Bandung, Indonesia with the involvement of 14 officials from 8 ASEAN member states. The "*Initiative on China-ASEAN SHP/ Solar Energy Cooperation*" and the "*Cooperative Initiative on Small Hydropower and Other Renewable Energies between China and ASEAN States*" were concluded respectively during the programs, both building a solid foundation for further cooperation in the fields of SHP, solar power and other renewable energies.

Meticulous guidance and great support were offered from the concerned governmental authorities to the international training programs. Mr. Li Ge, Deputy Director General of the Department of International Cooperation, Science and Technology of MWR attended the closing ceremony of "*2014 Training Workshop on Small Hydropower Technology for English-speaking African Countries*"; Mr. Fan Aihua, Division Chief of the Department of Commerce of Zhejiang Province,

delivered a speech at the closing ceremony; Mr. Zhang Jianyun, Academician of the Chinese Academy of Engineering, President of NHRI and international fellow of the Royal Academy of Engineering of UK, made a lecture entitled "*Water Resources in China and Impacts of Climate Change*"; Mr. Li Yun, Vice President of NHRI, was also present at the closing ceremony of "*2014 Training Workshop on Small Hydropower Technology for English-speaking*



African Countries". Mr. Sun Yan, Counsellor of the Mission of China to ASEAN, delivered a speech at the opening ceremony of "*Technical Seminar on Small Hydropower among ASEAN Countries*" held in Bandung, Indonesia.

During the seminars/training workshops, HRC invited Mr. Shen Jiangkuan, the former Chinese Ambassador to Rwanda and Djibouti, and Mr. Fang Zhimin, the former Economic & Commercial Counsellor of several Chinese Embassies in African, Caribbean and South-pacific countries, to give keynote presentations respectively in French and English, i.e. "*60 Years of China's Aid to Foreign Countries*", and "*China's Poverty-alleviation Policies*" in order to make the participants well understood about the history, policies, financing, management etc. of China's foreign-aid undertakings. The rare pictures and vivid presentations from the two diplomats have attracted every participant.

In 2014, the international trainings have been improved constantly, and HRC optimized lectures and study tours, and enriched cultural exchanges, which increased the participants' satisfaction rate dramatically. "*Seminar on Rural Electrification for Francophone African Countries*" scored 96 points, "*Seminar on Rural Electrification for Asian Countries*" got 98 points and "*Training Workshop Training workshop on SHP Technology for English-speaking African Countries*" touched 97 points. The other two ASEAN training programs have also been highly evaluated.

II Foreign Exchanges

1. Conferences and Meetings

(1) From February 23rd to 25th, HRC delegates attended the "*2014 Seminar/Review Meeting on Foreign-Aid Training*" hosted by AIBO (Academy for International

Business Officials) of MOFCOM in Jinhua, Zhejiang Province. HRC delegates joined the group discussion and came up with the suggestion of making full use of the foreign-aid trainings, deepening the international influence of China's SHP technology and equipment, and suggested that MOFCOM should strengthen the post-training support to training organizers, i.e. providing back-up fund for visiting trainees, helping to track follow-up projects and coordinating between organizers and the Economic and Commercial Counsellor's Offices of Chinese Embassies, thus maximizing the benefits of foreign-aid trainings.

(2) From June 16th to 17th, HRC delegate attended the second "*International Off-Grid Renewable Energy Conference & Exhibition*" which was held in Manila, the Philippines. Our expert emphasized the importance of SHP in solving the power shortage as well as the rural electrification, elaborated the policies and measures for rural electrification (RE) in China in different periods, and introduced the features and modes of current operation & management of SHP grids.

(3) From November 23rd to 25th, entrusted by the Department of International Cooperation,

Science and Technology of Ministry of Water Resources (MWR), HRC has successfully organized "*2014 Conference of Liaisons of Foreign Affairs of MWR*", with the participation of 83 officials, experts or scholars from different departments of MWR, local water resources departments and secretariats of international organizations. Ms. Cheng Xialei, Director General of HRC, was invited to attend the opening ceremony.

2. Foreign Guests Visiting HRC

In 2014, HRC received 12 delegations with 32 foreign guests in total, respectively from Benin, Nepal, Cuba, Italy, Pakistan, Kenya, Turkey, Uganda, Mexico and India, etc. (as per Appendix I). A number of cooperative agreements have been reached.

(1) From April 10th to 11th,

Dr. Grodfrey Nzamujo, Director of Songhai Center in Benin visited HRC, and had a meeting with HRC discussing the development of renewable energies in African countries. Songhai Center planned to establish a long-term cooperative partnership with HRC for the development of rural renewable energies, and popularize advanced technology and electromechanical equipment in Benin and other West African countries.

(2) From June 1st to 15th, the GM and his delegation of Energoimport of Cuba visited HRC, discussing the technical proposal of Mayari SHP Project with HRC. The guests also had a field trip to manufacturers for supplying the electro-mechanical equipment of Mayari project in Cuba.

(3) On November 5th, a delegation of six officials from Uganda paid a visit to HRC. The delegation included Ms. NABUGERE Munaaba Flavia, Minister of Environment, Mr. SHINYABULO James Anthony, Minister of Trade, Industry and Cooperation, and Mr. ARIDRU Ajedra Gadison, Minister of Financial Investment and Economic Development, etc. The guests spoke highly of the technical capability of HRC and advised to sign a MOU to jointly carry out potential projects ASAP.

(4) On November 9th and 14th, Mr. José, President of Mexico Federal Electric Commission, and Mr. Armando, GM of Mexico Tratamiento de Agua Hydrotech, visited HRC twice respectively, discussing cooperation in hydropower development. The guests briefed on the hydropower development and its implementation

procedures in Mexico, and would offer the detailed information on potential projects for further cooperation. Additionally, the guests hoped to send personnel to HRC for training, and invite HRC experts to Mexico for delivering hydropower expertise and technical training.

(5) On November 28th, Prof. A. Kumar from Roorkee University of India paid a visit to HRC along with his wife. In 1986, Mr Kumar attended HRC's international training on small hydropower and now becomes a renowned professor of SHP and RE in the university. Both sides exchanged opinions on SHP training, scientific research and international cooperation, hoping to strengthen SHP cooperation between India and China.

3. Outbound Missions

In 2014, HRC dispatched 6 delegations of 17 staffs respectively to Turkey, Macedonia, Ethiopia, Kenya, Philippines, Indonesia, etc. for E/M equipment installation, technical consultation, contract negotiation and China's foreign-aid training.

(1) From March 11th to 17th, Mr. Xu Jincai, Deputy Director of HRC, paid a visit to Ethiopia together with Mr. Dong Dafu, GM and Mr. Meng Ke from HRC's affiliated Hangzhou Yatai Hydro Equipment Completing Co., Ltd. for cooperation on renewable energy projects. The delegation visited Vice Prime Ministerial Coordinator and Minister of Communication and Information Technology, Minister of Water, Irrigation and Energy, Minister of Science and Technology, Chief Executive Officer of Ethiopian Electric Power Corporation etc., and both sides exchanged extensively on renewable energy planning, technical transfer and talent training. The delegation signed an MOU with the Sector Support and Capacity Building Directorate of Ministry of Water, Irrigation and Energy for comprehensive utilization of water resources and the regional power grid planning of a river basin in Ethiopia, and discussed the possibility of establishing African Training Center for Renewable Energy (ATCRE) with a senior policy officer of the Department of Infrastructure & Energy of African Union.

(2) From March 18th to 21st, Deputy Director of HRC, Mr. Xu Jincai, headed for Kenya with GM Mr. Dong Dafu and Mr. Meng Ke from HRC's affiliated Hangzhou Yatai Hydro Equipment Completing Co., Ltd. for undertaking SHP cooperation. The delegation met with Principal Secretary of

Ministry of Energy & Petroleum, and also paid a visit to two former participants of HRC's training workshops respectively from Ministry of Energy & Petroleum and Ministry of Environment, Water and Natural Resources. The delegation was informed of the development of renewable energy in Kenya, including hydropower, solar energy and wind energy.

(3) From October 23rd to November 4th, HRC delegation paid a visit to Turkey and Macedonia for negotiation of the E/M equipment export project. HRC and the Turkish side reached an agreement on E/M equipment supply for two SHP stations in Turkey, and signed a Letter of Intent.

(4) From December 4th to 14th, HRC delegation went to Indonesia for carrying out the UNDP-PGTF program called "*Technical Seminar on Small Hydropower among ASEAN Countries*". 14 officials from 8 ASEAN member countries, i.e. Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Thailand and Vietnam attended this significant event. The seminar aimed at providing a platform for ASEAN member countries and China to fully share technologies and experience for the development of small hydropower, solar energy, and wind power, so as to promote in-depth exchange and extensive cooperation among China and ASEAN member countries in the field of rural electrification and renewable energy. Following the training conducted by HRC in July of this year with the support of ASEAN-China Cooperation Fund

(ACCF), this technical seminar is another one funded by the international organization.

4. Information Dissemination

In 2014, HRC edited and published 6 issues of Small Hydropower in Chinese and the SHP News of 2014 in English. Besides, the training alumni database has been updated, and the website released over 100 pieces of news.

III International Scientific and Technological (S & T) Cooperation

1. Inter-governmental S &T Cooperation

(1) Having continually implemented the foreign-aid program on science and technology for developing countries called "*China-Pakistan Joint Research Centre for Small Hydropower*" which was sponsored by the Ministry of Science and Technology of China, HRC cooperated jointly with the Pakistan side to make research on the hybrid system of hydropower, wind power and solar energy, as to promote the demonstration and popularization of containerized hydropower equipment and the automatic control technology. Currently, the related equipment delivered to Pakistan is being installed on site by technical staffs of HRC.

(2) Having continually implemented the long-term exchange research program on science and technology cooperation between Chinese and Vietnamese governments called "*Emergency-supporting Technology for Rural Hydropower against Disasters Caused by Climate Change*", HRC has provided a set of container-type micro hydropower equipment to Vietnam, launching jointly the technical research on "*black start*".

(3) The APEC-funded program called "*Research and Experience-sharing on Rural Electrification Modes Based on Clean Energy*" has got the approval, and the contract also has been signed. At present, the preparation for "*Training Workshop on Rural Electrification Based on Clean Energy*" is initiated. Meanwhile, on the basis of the training workshop, HRC plans to do research and popularization on rural electrification technology based on clean energy with Indonesia and Vietnam.

(4) Having begun to undertake the project of 948 Plan of MWR called "*Introduction and Development of Key Technology on Canal Turbine System*", HRC plans to introduce the technology and equipment of canal turbine system from America, digest and assimilate the advantages of materials, the technique, the flow-passage characteristics, the relationship between flow and output, and other key technologies, and conduct trial-manufacturing in China. So far, HRC has signed the procurement agreement with the foreign side, and will dispatch a 3-person delegation to America for attending technical training and workshop inspection.

(5) Having applied to the Ministry of Foreign Affairs for the China-ASEAN Offshore Cooperation Fund project called "*Assessment on Island Energy Resources of ASEAN Countries and Research on Development Modes*", which will take Dioman Island in Malaysia as the major research for the fulfillments, i.e. to conduct the evaluation on water resource and power demand on the island, and compile related plan; to carry out the investigation on ocean energy (tidal energy and ocean current energy etc.), solar energy and wind energy, and to make research on development modes; to put forward the decentralized power supply mode of island with complementary energy sources, and carry out the simulation and experimental study. This project is to promote the exchange and cooperation in the

field of ocean energy and ocean environment between China and ASEAN countries, accelerate the development and utilization of island energy resource in ASEAN countries, thus gathering experience in jointly developing the "*Maritime Silk Road*" for countries concerned.

In addition, under the framework of governmental cooperation, HRC has carried out all-around cooperation with Ethiopia, Tanzania, South Africa, the Philippines, Bulgaria, Serbia and Venezuela etc. in terms of technical research, equipment manufacturing, and project demonstration and so on.

2. Setting-up of International S & T Cooperation Base

In 2014, HRC accomplished a large amount of work in international training, cooperative research, equipment introduction and promotion, based on which, HRC got the approval from the Department of Science and Technology of Zhejiang Province for awarding HRC as "*Zhejiang International S & T Cooperative Base of Renewable Energy and Rural Electrification*".

IV Electromechanical Equipment Supply and Technical Services

In 2014, much progress has been achieved by HRC in export of SHP technology and equipment, technical consultation provided for developing countries, and further exploring of international market, which mainly included the following.

1. Electromechanical Equipment Supply, Installation and Commissioning

(1) In Turkey, HRC has finished the equipment supply, installation and commissioning of automatic control system for SENA hydropower plant, accomplished the E/M equipment supply for the additional unit of GARZAN hydropower plant and for IKILER hydropower project. Now these two projects are under installation and are planned to be put into production in 2015. The E/M equipment supply for SIRVAN hydropower project is now being carried out smoothly.

(2) HRC has supplied the E/M equipment and finished its installation for TOPLEC micro hydropower station in Macedonia, which is also in production now. At the same time, the owner plans to develop other SHP stations recently.

(3) HRC had finished the E/M equipment supply and installation for GIKIRA SHP station in Kenya,

which was successfully put into production. The owner has been extremely gratified by the equipment and our technical services. Both sides have been making a joint effort to promote the implementation of other hydropower and renewable energy projects.

(4) HRC has finished the equipment supply, installation and commissioning for GANGELAS hydropower project in Angola, which is just put into operation now.

(5) HRC has finished the equipment supply, installation and commissioning for eight solar pumping systems of AMANTANI Island in Peru. All the pumping systems have been successfully put into operation and gained high appraisement from the owner. This is the first solar-energy project HRC undertook oversea.

(6) Cooperating with AVIC International, HRC took charge of design, E/M equipment supply, installation, commissioning and training for MAYARI hydropower project in Cuba. Currently, most of the equipment has been supplied, and on-site installation will be started in the second half of 2015. Together with Lishui Engineering Company Ltd. in Hunan Province, HRC won the bid for DIVUNE hydropower project in Papua New Guinea. The EPC contract has been signed between Lishui Engineering Company Ltd. and the owner, and next HRC is going to sign the sub-contract in terms of design, E/M equipment supply, installation, commissioning and other services.

Moreover, HRC has made a breakthrough in Nepalese market. Through the Agent in Nepal, HRC won the bid for TARA KHOLA containerized mini hydropower project. HRC will provide two sets of containerized micro hydropower units and carry out on-site technical services including installation, commissioning, testing and so on. Meanwhile, HRC's

subordinate company has signed with WaterGen Power Co., Ltd. in Italy a cooperative agreement, and both sides will take joint efforts in further promoting the containerized micro hydropower unit and other micro hydropower systems in Italy and other designated European countries, which has already got a great progress.

2. Hydropower Project Planning,Design and Consultation

HRC has successfully implemented the planning, design and consultation for numbers of hydropower projects for Vietnam, Papua New Guinea, Kenya, Indonesia, Malaysia, etc., which achieved favorable economic benefits.

So far, HRC has accomplished planning, design, consultation, equipment supply, installation and other technical services for hundreds of small hydropower projects in over 30 countries and regions, with the total contract of about hundred million US dollars. Nearly 50 small hydropower stations have been put into operation with the total installation of over 800MW.

V Work Plan for 2015

1. With the supports of the Department of International Cooperation, Science and Technology of MWR, HRC will apply to the Ministry of Commerce for "*National Foreign-aid Training Base for Small Hydropower and Rural Electrification*". Meanwhile, taking its advantage, HRC will undertake 5 foreign-aid training programs, i.e. "*2015 Seminar on Rural Electrification for Asian Countries*", "*2015 Seminar on Rural Electrification for English-speaking African Countries*", "*2015 Seminar on Rural Electrification for Francophone African Countries*", "*2015 Ministerial Seminar on Water Resources Management & Planning for Developing Countries*", and "*2015 Training Workshop on Small Hydropower Technology for Rwanda*". By highlighting the characteristics of ministerial seminar and the overseas training workshop in Rwanda, HRC will fully demonstrate the abundant experience in foreign-aid program and its excellent capability of training implementation and organization.

In addition, HRC will undertake the technical training for developing countries sponsored by the Ministry of Science and Technology of China, which is called "*Training Workshop on Small Hydropower & Rural Electrification Technology for South Asian Countries*". Meanwhile, HRC will continue to apply and undertake the programs sponsored by the PEREZ-GUERRERO Trust Fund and the China-ASEAN Cooperation Fund, thus developing a long-term mechanism for training/seminar on small hydropower and rural electrification in the ASEAN region.

2. HRC will continue to implement the foreign-aid program on science and technology for developing countries called "*China-Pakistan Joint Research Centre for Small Hydropower*" which is sponsored by the Ministry of Science and Technology of China, and carried out the follow-up application for further cooperation; to complete the long-term exchange research program for inter-governmental cooperation on science and technology between China and Vietnam called "*Emergency-supporting Technology for Rural Hydropower against Disasters Caused by Climate Change*"; to implement "*Research and Experience-sharing on Rural Electrification Modes Based on Clean Energy*" with Vietnam and Indonesia.

In addition, HRC has got the approval for "*Zhejiang International Science &Technology Cooperative Base of Renewable Energy and Rural Electrification*", by taking advantage of which, HRC will take on tasks as the international cooperation base and actively follow the strategy of "*One Belt And One Road*" developed by China, as to enhance the research on the ocean energy and the decentralized development of renewable energy on island, to cooperate with national research institutes of neighboring countries as Malaysia, Indonesia and the Philippines in implementing the "*China-ASEAN Offshore Fund Program*", to cooperate with Eastern European countries including Bulgaria, Serbia, Macedonia in conducting SHP demonstration projects, and to cooperate with African countries such as Ethiopia, South African in building up African training center of renewable energy.

3. To actively apply for the Poverty-relief Cooperation Fund for Indo-China Peninsula Countries as well as the China-

ASEAN Offshore Development Fund, HRC plans to establish a simulation & demonstration platform of hybrid system of small hydropower, wind power and solar power in the countries with rich resources, to conduct researches on complementary system and storage technology of multi-renewable energies, and to popularize the technology and equipment of containerized micro hydropower, and demonstrate, aiming at rationally promoting the development of small hydropower and effectively stimulating the development of rural electrification in ASEAN countries.

4. HRC will vigorously expand its business on SHP consultation, design and E/M equipment supply by taking the advantages of the platform of foreign-aid training. HRC is going to sustain the Turkish market and carry out the maintenance and spare parts supply for the built hydropower stations, to further develop African market on the basis of the finished Angolan and Kenyan projects. Based on the marketing preparations in Serbia and the demonstrations in Macedonia, HRC will increase its market share in East Europe, and on the basis of training workshop on small hydropower technology conducted for ASEAN countries, HRC will expand its market in Southeast Asia. With the reference of hydropower plants and the establishment of China-Pakistan Joint Research Center for Small Hydropower in Pakistan, as well as the implementation of training workshop on small hydropower & rural electrification technology for south Asian countries, the markets in Pakistan, Nepal and other South Asia countries shall be explored.

5. To fully take the advantage of HRC as the "*Family of Small Hydropower in the World*", the intensive and extensive exchange and cooperation shall be strengthened and promoted between HRC and other governmental departments or counterparts in SHP field worldwide. Meanwhile, the wide links with Word Bank, Asian Development Bank and other international financing organizations shall be further enhanced, thus expanding the scope of business and extending international influence of HRC itself.

6. Much attention shall be given to the full play of HRC's leading role in formulating and revising national and industrial standards, so as to popularize the standards related to project design, consultation and civil works construction, and translate the standards concerned, and finally popularize these standards abroad.

7. The foreign affairs management shall be improved, so as to streamline and standardize the work concerning the official outbound visits and the reception of foreign guests.

8. Measures shall be taken to improve the editing, translation and promotion of the two magazines, ***SMALL HYDRO POWER*** in Chinese and ***SHP NEWS*** in English, as well as HRC's website. ■

Appendix I

Foreign Guests Visiting HRC in 2014

No.	Date	Delegate(s)/Organization/Country	Objective & Achievements
1	10-11 April	1 delegate from Benin, Dr.Grodfrey Nzamujo, Director of Songhai Center	Establishing a long-term cooperation with HRC for development of rural renewable energies, and popularize the related technology and electromechanical equipment in Benin and other West African countries
2	25 April-1 May	2 delegates from Nepal, Mr. Raju Rimal, Managing Director of IDC, and Mr. Sudip Paudel, Executive Director of BDA	Exchanging proposals with HRC regarding project design, E/M equipment supply, project financing and technical training and signing an exclusive agency agreement with HRC
3	1-15 June	7 delegates from Energioimport of Cuba	Discussing the technical plan of Mayari SHP project in Cuba, and visiting the equipment manufacturer
4	11-13 June	4 delegates from WaterGen Power S.R.L of Italy	Visiting SHP manufacturers and establishing a long-term cooperation
5	23-28 June	2 delegates from DCEME, Nepal, including GM	Establishing cooperation with HRC and Linhai Machinery Works Co.,Ltd of Zhejiang
6	19-30 June	1 delegate from Union Electric Corporation Pvt. Limited of Pakistan, Mr. Sajid	Negotiating project technical plan
7	17-20 July	2 delegates from Power Technology Solutions Co.,Ltd. of Kenya	Consulting technical issues of Gikira SHP project in Kenya
8	29 Aug.-8 Sept.	1 delegate from FERNAS, Turkey, Mr. Taskin	Workshop inspection for Garzan and Sirvan hydropower projects
9	18-30 Sept.	2 delegates from ISKELER, Turkey	Discussing on the follow-up work for Ikiler hydropower project and visiting the manufacturer
10	5 Nov.	6 delegates from Uganda, including Minister of Environment, Minister of Trade, Industry and Cooperation, and Minister of Financial Investment and Economic Development	Carrying out bilateral exchanges as to proceed mutual cooperation
11	9&14, Nov.	2 delegates from Mexico Tratamiento de Agua Hydrotech	Exchanging opinions and seeking for cooperation
12	28 Nov.	2 delegates from Roorkee University of India	Exchanging on SHP training, scientific research and international cooperation, and hoping to strengthen SHP cooperation between India and China

Appendix II

HRC's Outbound Missions in 2014

No.	Date	Delegate(s)	Country	Objective & Achievements
1	13-26 March	3	Turkey	Negotiations on cooperation, and signing the LOI on two hydropower projects, with the working scope specified
2	6 April-4 July	2	Macedonia	Fulfilling installation and commissioning for Toplec micro hydropower project in Macedonia
3	23 Oct.-4 Nov.	2	Turkey &Macedonia	Negotiations on the electro-mechanical equipment supply for the projects in Turkey and Macedonia
4	4-14Dec.	6	Indonesia	Undertaking the UNDP-PGTF program called "Technical Seminar on Small Hydropower among ASEAN Countries" held in Indonesia, and signing the "Cooperative Initiative on Small Hydropower and Other Renewable Energies between China and ASEAN States"; Visiting PLN PUSHARLIS, a center for electricity maintenance under the leadership of the State Electricity Company of Indonesia, and signing an MOU

(Source:HRC) ■

HRC, A Way to Innovative and Sustainable Development

Lin Ning

Since its foundation in 1981 and entrusted by Chinese Ministry of Commerce, Ministry of Science and Technology, and the related UN organizations etc., Hangzhou Regional Center (Asia-Pacific) for Small Hydro Power (briefed as HRC) has until now, hosted 70 international training workshops or seminars on small hydropower (SHP) and rural electrification (RE) which embraced thousands of engineers, department heads, decision-makers and even ministers from over 100 countries and regions. The training programs are highly appreciated and widely welcome by the associated UN organizations and developing countries, thus winning HRC the title of "*Family of SHP in the World*". As one of the first centers that undertake the foreign-aid trainings, HRC serves as an important means of international cooperation on SHP and RE in China.

Closely focusing on foreign-aid training, HRC makes full advantage of his technical capability, and incorporates proven technology and experience of project planning, design, consultation, R+D, project showcase, E/M equipment procurement and supply, etc., therefore, it develops a new way of innovative and sustainable development by integrating technical and economic cooperation, instead of solely adhering to technical training.

I Extensive Sci-tech Coope ration between Governments

Over years, HRC has always been undertaking bilateral technical cooperation such as joint research and project demonstration etc. in the field of SHP and other renewable energies with supports of UN organizations and Chinese government. Many inventions have been achieved and patent rights also awarded to HRC, including "*Applied Research on ELC (electronic load controller)*", "*Automatic and Remote Control of SHP Plant*", "*Unattended Control Technology for Medium & Small-sized Hydropower*", "*Energy-saving & Loss-reduction Technology for Rural Power System*", "*Key Technology for Containerized Mini Hydropower Plant*" etc..

In July 2013, HRC and PCRET (Pakistan Council of Renewable Energy Technology) jointly applied to the Ministry of Science and Technology of their own countries for the establishment of China-Pakistan Joint Research Center on Small Hydropower Technology, which was marked as one of the national technical assistances of Chinese government to developing countries and very soon approved by both governments. In December 2013, a 4-person delegation of HRC visited Pakistan for this purpose and had a fruitful meeting with H.E. Mr. Zahid Hamid, the Minister of Science and Technology of Pakistan. During the visit, the project implementation agreement was also signed between HRC and PCRET, in which both parties are devoted to make deep research on a smart, hybrid power grid integrating hydropower, wind power and solar energy, as well as a demonstration of containerized mini hydropower and automatic control technology. The joint research center will be ultimately targeted to be a high-level national one between two

countries for R+D, demonstration and capacity-building etc. in the field of renewable energy. Great importance is attached to this joint research center from the Ministry of Science and Technology of China, and the MOU was signed between the ministries of both countries during the China visit of Pakistan president in February of year 2014. Currently, the related equipment delivered to Pakistan is being installed on site by technical staffs of HRC and this joint research center is expected to inaugurate in July 2015.

HRC and IHR (Institute for Hydropower and Renewable Energy) in Vietnam has long been in close contact and cooperation. Both sides have for many times successfully applied to both governments and accomplished medium and long-term international sci-tech cooperative projects, inclusive of small hydropower development planning and research on SHP automatic control system. Year 2011 and 2012 witnessed a success for awarding and implementing a project called "*Research on Emergency-supporting Technology for Rural Hydropower against Disasters Caused by Climate Change*", which jointly carried out the research on "*black start*" and emergency-supporting technologies for rural power grid. HRC has already supplied to Vietnam a set of containerized mini hydropower equipment, serving as a standby power source for "*black start*" so as to cope with the collapse of the local power grid during natural disasters.

The APEC-funded program called "*Research and Experience-sharing on Rural Electrification Modes Based on Clean Energy*" has got the approval, and the contract also has been signed. At present, the preparation for "*Training Workshop on Rural Electrification Based on Clean Energy*" is initiated, and meanwhile, the research and popularization on rural electrification technology based on clean energy is going on with Indonesia and Vietnam. Moreover, the exchange and cooperation in the field of ocean energy, ocean environment and utilization of island energy resource between China and ASEAN countries is going to be carried out. All these, in conformity with the "*One Belt and One Road*" initiatives, will obviously strengthen the bilateral ties and enhance regional cooperation.

In addition, under the framework of governmental cooperation, HRC has carried out all-around cooperation with Ethiopia, Tanzania, South Africa, the Philippines, Bulgaria, Serbia and Venezuela etc. in terms of technical research & transfer, river-basin planning and consultancy, joint-fabrication of E/M equipment, and project demonstration and so on, and based on all these activities, HRC was awarded as "*Zhejiang International Sci-tech Cooperative Base of Renewable Energy and Rural Electrification*" by the Department of Science and Technology of Zhejiang Province in 2014.

II Export of SHP Technology and E/M Equipment

Following the lofty guidance of the Ministry of Commerce of China, the scientific and technical cooperation with developing countries needs to be focused on the promotion of economic and commercial cooperation between China and others, so HRC actively practices the national "*going-out*" strategy. With the help of old training participants, we keep expanding the export business of both SHP technology and E/M equipment to countries globally including Turkey, Pakistan, Vietnam, Laos, Indonesia, Malaysia, Philippines, Macedonia, Serbia, Albania, etc., among which supplied containerized mini hydropower equipment to Macedonia, offered technical services of planning & design in Serbia, and accomplished engineering design, E/M equipment supply and site installation etc. for hydropower plants in over 30 countries including Turkey, Pakistan, Vietnam, Peru, Cuba, Malaysia, Philippines, Angola and Kenya etc.. Until now, HRC has successfully finished over 100 projects overseas with scope of services including E/M equipment supply, engineering consultancy and design and around 40 hydropower stations were completed and accepted by the local power authorities, with the total contract value amounting to 100 million US dollars. Not only does it bring profound economic and social benefits, but also expands an extensive and intensive cooperation from technical field to economic area,

thus greatly promoting the export of Chinese technology and equipment of SHP and other renewable energies, which also shows the technical competitiveness of China and displays the "*diversified effect*" brought by the international training.

Besides hydropower projects, year 2014 especially witnessed the accomplishment of equipment supply, installation and commissioning for eight solar pumping systems of AMANTANI Island in Peru. All the pumping systems have been successfully put into operation and gained highly appreciation from the owner. This is the first solar-energy project HRC undertook oversea.

III Plan of Follow-up Work

1. We will keep on organizing foreign-aid trainings for Chinese government so as to extensively disseminate the successful experience and practice on SHP and rural electrification, popularize the technology and improve the capability of neighboring countries in hydropower development.

Most of the China's neighbors are rich in SHP resource which is yet to be exploited, and the conflict between power shortage and economic growth shows prominent day by day. However, lack of SHP know-how and equipment-fabricating ability is an important factor that hampers the development of hydropower in all those countries. HRC will stay committed and dedicated to implementing the foreign-aid training programs entrusted by Chinese Ministry of Commerce, and meanwhile, will devote to extending the bilateral or multilateral technical trainings and seminars in ASEAN (Association of Southeast Asian Nations) countries at the urgent request of Southeast Asian countries for capacity-building in SHP field.

2. We will continue working on the extensive cooperation of joint research and project demonstration to establish SHP training base, SHP joint research center and SHP equipment manufacturing base, by means of inter-governmental sci-tech collaboration.

(1) Based on the concluded "*ASEAN-China Training Workshop on Micro Hydropower and Photovoltaic System for Rural Electrification*" sponsored by ASEAN-China Cooperative Fund and "*Seminar on Small Hydropower among ASEAN Countries*" subsidized by Perez-Guerrero Trust Fund of UNDP as well as the on-going APEC-funded "*Training Workshop on Rural Electrification Based on Clean Energy*", HRC is to establish a training base on SHP technology in ASEAN countries with the assistance of the Mission of China to ASEAN and the ASEAN Secretariat.

(2) With smooth cooperation between HRC and PCRET, HRC will finish the "*China-Pakistan Joint Research Center on Small Hydropower Technology*" as a high-level and national research center between two countries. Meanwhile,

the APEC-funded program called "*Research and Experience-sharing on Rural Electrification Modes Based on Clean Energy*" is expected to achieve fruitful results.

(3) On the basis of positive market feedback from Macedonia, Serbia, Albania, etc., HRC is to establish jointly a developing & manufacturing base of E/M equipment in Bulgaria, as to carry out trial-fabrication, technical research and popularization of E/M equipment etc.

3. We will pay much more attention to the standardization of small hydropower technology for engineering design, consultancy and CW construction, based on the leading role in national and professional standards compilation.

Although China has got a complete set of feasible national standards for small hydropower industry, other countries and the related hydropower organizations or authorities are not fully aware of or familiar with those standards, and the case is the same with foreign project Owners. So, we will organize to translate the Chinese standards including hydropower plant design, technical consultancy and CW construction (including tender documents) and SHP equipment fabrication in an effort to publicize them in overseas markets.

As a professional research and training organization of SHP in Asia-Pacific region and even in the globe, HRC is deeply aware of the existing trend and realizes the importance of the international cooperation in promoting China's opening to the outside world and enhancing China's image in international affairs etc. With the advantages that he enjoys, HRC is seeking to build up a new mode for South-South Cooperation and further carry out bilateral and multilateral cooperation, R+D, information sharing and technical training on SHP so as to constantly boost his brand name around the world. By sticking to the strategy of "*bringing in and going out*", HRC makes the world better understood about the overall Chinese SHP capability, contributes to the development of SHP among developing countries, and pushes China's SHP industry to the international arena, which is the ambitious goal that HRC will be in constant pursuit of.

By (Mr.) Lin Ning, Division Chief of Foreign Affairs and Training, HRC

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HRC's Achievements in China-ASEAN Cooperation in 2014

Zhang Tian, Hu Changshuo

Hangzhou Regional Center (Asia-Pacific) for Small Hydro Power (HRC), domestically called National Research Institute for Rural Electrification (NRIRE), was founded in 1981 in Hangzhou, China as a regional (Asia-Pacific) organization jointly sponsored by the Chinese government, UNDP and UNIDO. Over 30 years, HRC has always been committed to promoting development of small hydropower in the Asia-Pacific region and globally. Recently, with the establishments of diversified exchange channel and profound technical innovation, HRC has scored new achievements in its South-South Cooperation.

China and ASEAN are mutually dependent as linked by waters and mountains, and furthermore, they are strategic partners in various fields of cooperation, inside which energy is one of the prioritized. From traditional fossil energy to hydropower, wind energy, solar energy, biomass and other clean and renewable energies, both sides have cooperated extensively in energy trading, technical exchange and project construction so as to maintain energy security and support economic development. In 2014, supported by the ASEAN-China Cooperation Fund and the Perez-Guerrero Trust Fund (PGTF) for South-South Cooperation, HRC launched two projects cooperating with ASEAN member countries, with fruitful results achieved.

I Background Analysis

Most of the ASEAN countries are facing and constrained by the energy insufficiency. With the rapid development of economy, the shortage of electric power is getting more serious, and the power deficiency becomes a barrier for the further socio-economic development. Especially in remote, rural and hilly areas, the electrification rate is still low, which makes the local residents not accessible to power as a result of long-distance transmission and high power-tariff. The underlying cause of the problem is mainly associated with the issue of technology. There is lack of competent expertise for power sector in those ASEAN countries and the expertise not only includes the technology for project planning, design, consultation, R+D etc., but also includes the fine-of-the-art technology for equipment fabrication.

Small hydropower (SHP), as an environmentally sound energy, has been universally accepted by the international society and embraces obvious advantages such as rich resources, proven technology, economic viability, easy dispatching and high return rate. By the end of 2013, China has constructed 46,879 SHP stations, with an installed capacity of 72GW and the annual power generation of 223 billion kWh. With the development of SHP and the construction of small power grids, about half of the country's territory, one third of the counties and towns and a rural population of over 300 million people have access to electricity and the target of rural electrification has achieved. So far, China has built up more than 1000 rural electrification counties, and the electrification rate to household in rural hydropower supply areas has been raised from less than 40% in 1980 to 99.8% in 2013. The rural hydropower helps to increase energy supply, improve energy structure, promote local economy, better the rural production and living conditions, protect the ecological environment, reduce the GHG emission, and guarantee the emergent power supply etc., and achieve significant economic, social and environmental benefits.

II Cooperation Condition

Small or micro hydropower is less risky in investment and lower in operation cost, and it can fully use the local manpower, materials and other natural resources for an integrated development & utilization (i.e. aquaculture, irrigation, tourism, flood control, recreational activity and water supply etc.), thus targeting remarkable economic benefit in rural areas. SHP-based rural electrification not only alleviates poverty and

promotes economic growth, but also protects ecological environment, and accesses the remote regions with electric power. In general, it promotes local civilization, science & technology, and protects forests and improves local economy. Meanwhile, for the utilization of hydropower, increasing attention is attached to the development of smart hybrid system of hydropower, solar energy and wind power, which not only optimizes PV power supply and wind power supply, but also improves the regulation capability of hydropower to the power grid and the utilization rate of power transmission lines. A new era of renewable energy construction was also launched worldwide, which strongly requires to enhance the international exchange and cooperation, and China would like to spare no effort to make its contribution.

As the unique national research institute for rural hydropower and electrification in China, HRC has hosted dozens of training workshops for Asian developing countries in order to disseminate SHP technology, and trained lots of senior management personnel and professionals in the field of SHP and other renewable energy for ASEAN member countries. Meanwhile, with its technical advantages and professional influence, HRC carried out bilateral and multilateral cooperation, joint research and demonstration, as well as equipment trial-manufacturing and popularization under the governmental framework. Sound cooperative relationships have been built between HRC and relevant departments of ASEAN member countries over the years, such as water conservancy, agriculture, energy, environment departments and so on.

III. Cooperative Activities

Activity I: In July 2014, under the sponsorships of the Chinese Government and the ASEAN Secretariat, the *ASEAN-China Training Workshop on Small Hydropower and Solar Energy System for Rural Electrification* was held in Hangzhou, China, with the participation of 9 officials and experts from the fields of energy and power in 7 ASEAN member countries, i.e. Cambodia, Indonesia, Laos, Malaysia, the Philippines, Singapore and Thailand. The one-week training workshop, kicking off on 13th July and accomplishing on 19th July, was the first project fulfilled by HRC under the framework of China-ASEAN Cooperation, and also the 68th international training program implemented by HRC since its establishment.

This training workshop was designated to provide a platform for the ASEAN member countries to fully discuss and communicate in the field of rural electrification and renewable energy development, focusing on the exchange of updated technology and management experience of small hydropower and solar energy, so as to promote in-depth communication and vast cooperation among China and the ASEAN member countries in the field of rural electrification and renewable energy.

Although the one-week training workshop was short with a tight schedule, it was very productive. During the training workshop, the informative presentations were delivered, inclusive of *A General Survey of SHP Development and Rural Electrification in China, Renewable Energy Application in Rural Area of China, Exploitation Types for Small Hydropower Station, Small Hydropower Equipment for Rural Electrification in China, and Solar Energy Development and Application, etc.,* and the field visits

Opening ceremony

Discussion

Visiting a hydropower E/M manufacturer

Visiting a containerized mini hydropower plant

were paid to the typical power stations and the equipment manufacturers of small hydropower and solar energy. The updated technologies and rich experience were shared, the advanced equipment was demonstrated, and reliable operations were inspected, which enabled an integration of theories and practice. In addition, the in-depth discussions have been carried out cordially among HRC professionals and the participants from ASEAN member countries, with concerns about the status quo, problems and prospect of SHP and solar energy development.

Activity II: Sponsored by Perez-Guerrero Trust Fund (PGTF) for South-South Cooperation, HRC organized and fulfilled successfully *the Technical Seminar on Small Hydropower for ASEAN Countries* which was held in Bandung, Indonesia from 8th to 10th December. 14 officials from 8 ASEAN member countries, i.e. Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Thailand and Vietnam attended this significant event. A 6-member delegation headed by Dr. Xu Jincai, Deputy Director of HRC went to Indonesia for undertaking all the work concerned. Great support has been given to the seminar from Indonesian Ministry of Energy and Mineral Resources, ASEAN Secretariat, Mission of China to ASEAN, PLN (Indonesian State Electricity Company). All the participants were selected by ASEAN Secretariat. Mr. Sun Yan, Counsellor of the Mission of China to ASEAN, and Mr. Djoko, Division Chief of New and Renewable Energy of PLN of Indonesia were present at the grand opening ceremony and delivered a speech respectively.

The seminar aimed to make all the participants fully share technologies and experience for the development of SHP, solar energy and wind power, so as to promote in-depth communication and extensive cooperation among China and ASEAN members in the field of rural electrification and renewable energy. During the seminar, informative presentations were delivered, and a field visit was paid to a small hydropower station in the suburb of Bandung. The country reports were made by the participants, and discussions have been held friendly about the status quo, problems and prospect of SHP and other renewable energies.

Opening ceremony

Lecturing

Country report

Group photos

IV Fruits of Cooperation

In these rewarding events, officials and experts from different countries shared not only technology, but also development methodology and cooperation confidence, which will surely contribute to the China-ASEAN cooperation. Furthermore, the two training programs for ASEAN member countries in 2014 produced the conclusion and signing of two initiatives, i.e. the "*Initiative on China-ASEAN SHP/Solar Energy Cooperation*" and the "*Cooperative Initiative on Small Hydropower and Other Renewable Energies between China and ASEAN Countries*", which both build up a solid foundation for further cooperation in the fields of SHP, solar power and other renewable energies as well as rural electrification etc.

During the seminar held in Ban dung, HRC delegation visited PLN PUSHARLIS, which is a centre for electricity maintenance under PLN of Indonesia, and focusing on manufacturing and maintenance of mechanical equipment for power stations, technical rehabilitation and engineering service. With the advantages of both sides, HRC and PLN PUSHARLIS will enjoy a

prosperous prospect for widening cooperation in the fields of R+D,

Initiative Signing

application of decentralized power-supply technology and development of renewable-energy resources on islands, and a MOU was signed. Half a month later, 7 guests headed by Mr. Eman, GM of PLN PUSHARLIS, came to HRC for exploring the mutual cooperation. Through the exchange of visits, both sides believed that extensive hydropower cooperation would be promoted very soon.

Benefits:

• *Understanding energy situation and existing problems of most ASEAN member countries*

• *Dissemination and sharing of experience, technology and research findings of China and ASEAN countries in relevant areas of renewable energy*

• *Awareness of the great importance to develop SHP, wind, solar and other renewable energies technologies*

• *Enhancement of communication and cooperation among relevant governmental authorities of China and ASEAN member countries*

• *Establishment of a China-ASEAN cooperation platform in the field of renewable energy and rural electrification*

• *Promotion of technical transfer and cooperation on SHP and other renewable energies in order to meet common challenges, in particular, of on-going socio-economic development, urbanization and climate change*

V Work Plan on China-ASEAN Cooperation for 2015

1. HRC shall take advantage of the "*Sharing of Rural Electrification Mode and Technology Based on Clean Energy*" project subsidized by China-APEC Cooperation Fund to promote the establishment of a mutually beneficial mechanism for balancing regional electric-power supply and demand among ASEAN member countries relying more and more on clean energy;

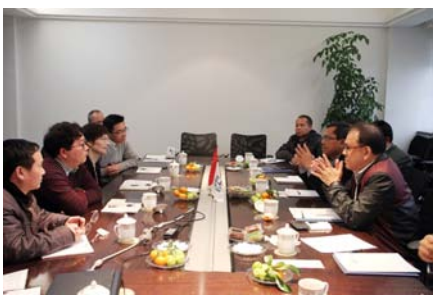
2. By virtue of good international environment between China and ASEAN members and with the back of incentive policies of all countries in the field of renewable energy, HRC shall make efforts together with relevant departments in ASEAN to win financial support from respective government and international organizations which shall be the powerful guarantee for substantial cooperation in the future;

3. HRC shall actively apply for the Indo-China Peninsula Poverty Reduction Cooperation Fund to launch bilateral and multilateral projects, in order to popularize the Containerized Mini Hydropower Plant (CMHP) technology and equipment to ASEAN member countries and then build demonstrative hydropower stations, to promote rational development of SHP, preserve ecological environment and intensify mutual cooperation, and to effectively improve rural electrification of ASEAN countries;

4. According to the actual situation in ASEAN member countries, HRC shall set up a simulation demo platform of hybrid system on SHP, wind energy and solar energy, and carry out research on the technologies of compensation of multi renewable energies and energy storage;

5. HRC shall further strengthen the research on ocean energy, decentralized power supply mode and renewable energy development on island, and jointly apply for a China-ASEAN Offshore Fund project with relevant research institutes of Malaysia, Indonesia, the Philippines and other ASEAN member countries involved inside.

Signing MOU



Meeting at HRC

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HRC's Training Opportunities for 2015

No.	Project Name	Time and Period	Countries
1	Training Workshop on Rural Electrification Technology Based on Clean Energy	March,7 days	Indonesia, Vietnam
2	2015 Seminar on Rural Electrification for Asian Countries	May-June, 21 days	Asian Countries
3	Training Workshop on Small Hydropower & Rural Electrification Technology for South Asian Countries	May-June, 20 days	South Asian Countries
4	2015 Training Workshop on Small Hydropower Technology for Rwanda	July, 20 days	Rwanda
5	2015 Seminar on Rural Electrification for English-speaking African Countries	August-September, 21 days	English-speaking African Countries
6	2015 Ministerial Seminar on Water Resources Management & Planning for Developing Countries	October, 7 days	English-speaking Developing Countries
7	2015 Séminaire sur l'Electrification rurale pour les Pays francophones d'Afrique	Novembre, 21 jours	Pays francophones d'Afrique