



Endeavoring with Faith on a Long Journey Ahead, A Promising Future Will Come on the Belt and Road

—An Overview on HRC's Engagement in South-South Cooperation to the Belt and Road Initiative

Hangzhou Regional Center (Asia-Pacific) for Small Hydro Power (HRC)

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Abstract: From South–South Cooperation to the Belt and Road Initiative, HRC has made great achievements in international cooperation in small hydropower with developing countries. HRC has hosted with success 95 training workshops, seminars, ministerial-level seminars on small hydropower, rural electrification, water resources, renewable energy, climate changes etc. for over 2000 technicians and officials from 113 countries, including countries along the Belt and Road. HRC's foreign-aid trainings have successfully been upgraded in training venues from home to overseas, in training forms from multi-lateral to bilateral, in training languages from English to English, French, Russian, etc. in level of training from workshop to seminar to ministerial level, in contents of training from small hydropower technology to water conservancy, renewable energy, etc. In response to the Belt and Road Initiative, cooperation from joint research, technology transfer to pilot projects has been carried out for shared development. HRC has successfully offered services including supply of electromechanical equipment, installation services, consultation and design for over 100 projects in 50 countries, which fuels and effectively facilitates the development of clean energy, rural electrification and production capacity cooperation in

small hydropower, benefiting both the local government and its people. Following the guidelines of Belt and Road Technical Innovation Action Program, HRC is progressively planning and implementing a new strategic layout and action strategy for the international small hydropower exchange. HRC is going to undertake to substantialize the function of the four overseas centers and scale up them step by step under support of the Chinese government and international organizations.

Preface: *Hangzhou Regional Center (Asia-Pacific) for Small Hydro Power (National Research Institute for Rural Electrification, briefed as HRC), as the only specialized research institute of promoting and providing technical services for the development of rural hydropower and electrification in China, was founded in 1981 with the co-sponsorship of Chinese government and UN organizations including UNDP and UNIDO. It serves as an important window for international cooperation with other countries in small hydropower field.*

for international exchange and cooperation. Backed with and China’s governmental foreign-aid policy and capital, HRC has long been in international scientific and technologic cooperation with the other developing countries in renewable energy and rural electrification, offering technical and consultancy services in small hydropower to developing countries based on its professional advantages. The foreign aid training programs have helped capability building for countries along the Belt and Road. From *South-South Cooperation to the Belt and Road Initiative*, HRC has made great achievements in international cooperation in small hydropower with developing countries.

In the past nearly 40 years, entrusted by Chinese Ministry of Commerce, Ministry of Foreign Affairs, Ministry of Water Resources, Ministry of Science and Technology, NDRC, UNDP, UNIDO, FAO, ILO, the ASEAN Secretariat, etc., HRC has hosted with success 95 training workshops, seminars, ministerial-level seminars on small hydropower, rural electrification, water resources,

renewable energy, climate changes etc. for over 2000 technicians and officials from 113 countries, including countries along the Belt and Road in Central Asia, South Asia, Eastern Europe including Uzbekistan, Kyrgyzstan, Tajikistan, Pakistan, Vietnam, Laos, Cambodia, Thailand, Myanmar, Malaysia, Indonesia, the Philippines, India, Bangladesh, Turkey, Poland, Romania, Bulgaria, Serbia, Montenegro, Macedonia as well as countries in Africa including Egypt, Ethiopia, Kenya, etc. The contents of training workshops mainly cover small hydropower planning, design, feasibility study, hydrology, geology, water conservancy, electromechanical equipment, automation, economic appraisal, environment evaluation, operation and maintenance of power plants, investment and financing of small hydropower, micro hydro and containerized hydropower plant, etc. as well as hybrid energy system, green ecological hydropower, water resources management, flood control and disaster mitigation, dam construction and management, water-saving irrigation, greenhouse gas,

I Foreign Aid Training with a Long History and Remarkable Success

As time passes by, it has been nearly 40 years since HRC got involved in South-South Cooperation in the field of small hydropower. The accumulation of international resources and talents has laid a great foundation



Figure 1. Distribution of training participants

energy transformation and climate change, etc. Distribution of training participants refers to *Fig. 1*.

In recent years, HRC has not only conducted many training programs entrusted by Chinese Ministry of Commerce, Ministry of Science and Technology, Ministry of Foreign Affairs and NDRC, but it has also applied for China-ASEAN Cooperation Fund, APEC Fund and UNDP Perez-Guerrero Trust Fund for many multi/bilateral training workshops or seminars. Meanwhile, HRC offers trainings of operation, maintenance and management as well as technical support for Chinese enterprises running business in overseas market. HRC's foreign-aid trainings have successfully been upgraded in training venues from home to overseas, in training forms from multi-lateral to bilateral, in training languages from English to English, French, Russian, etc. in level of training from workshop to seminar to ministerial level, in contents of training from small hydropower technology to water conservancy, renewable energy, etc. Besides, HRC has innovated the mode of education/training by means of virtual technology, cloud technology and internet plus to enhance the width and depth of capacity building for developing countries. Moreover, the scale of education/training has been expanded gradually. In collaboration with ASEAN and African Union, HRC plans to set up training centers in Indonesia and Ethiopia, and a research and training center on renewable energy technology in Uganda.

II Fruitful Achievements in Production Capacity Cooperation in Small Hydropower

In response to the Belt and Road Initiative, and based on the international resources accumulated from the international training and cooperation in the past years, HRC has offered services including supply of electromechanical equipment, installation services, consultation and design for over 100 projects in 50 countries. In addition, it has designed power plants for clients from Vietnam, Indonesia, and Mongolia, provided electromechanical equipment and installation services for partners in Pakistan, Turkey, Peru and other countries, and conducted preliminary planning of hydropower resources for companies from Serbia, Laos, etc. Those projects have promoted industrial cooperation, created great social and economic benefits, and pushed the export of small hydropower technology and equipment especially in Zhejiang province. Meanwhile, it effectively facilitates the development of clean energy, rural electrification and production capacity cooperation in small hydropower, benefiting both the local government and its people. Refer to *Table 1*.

III Building a Bright Future on The Belt and Road

1 Joint Research for Mutual Benefit and Win-Win Cooperation

Under the framework of

governmental cooperation, HRC has taken advantage of its technical strength and industrial influence to implement multi/bilateral technical cooperation in the field of small hydropower and other renewable energy. HRC has successively carried out technical exchange and international cooperation with America, Canada, Australia, Italy, Pakistan, Nepal, Vietnam, Indonesia, Malaysia, Laos, Serbia, Macedonia, Turkey, Ethiopia, Rwanda, Uganda, Kenya, South Africa, etc. in the field of small hydropower technology, hybrid power generation system and off-grid solar power generation technology. Besides, many provincial and state level projects have also been accomplished including China-Pakistan Joint Research Center for Small Hydropower, Water Flow Type Generator Technology, Distributed Power Supply and Equipment of Hydro-based Hybrid System and Research & Sharing on Rural Electrification Mode Based on Clean Energy.

Over the past years, HRC has made remarkable achievements in the development of renewable energy including small hydropower and the construction of rural electrification through joint research, pilot projects construction, technology transfer and popularization, Cooperation goes well with water conservancy and hydropower research institutes and universities in Laos, Mongolia, Egypt, Macedonia and other countries for joint research and pilot projects in fields of off-grid renewable energy, low-head hydropower generation technology, oasis region water resources development and management, containerized small hydropower station technology, and

Table 1. HRC Overseas Small Hydropower Projects (incomplete statistics)

S.N	Project	Installed Capacity	Service Scope	Completion
1	Kota Hydropower Station in Malaysia	2×2000kW	Hydro Equipment Supply&Design	1997
2	Moco-Moco Hydropower Station in Guyana	2×250kW	Hydro Equipment Supply&Design	1999
3	Corojo Hydropower Station in Cuba	2×1000kW	Hydro Equipment Supply&Design	1997
4	Moa Hydropower Station in Cuba	2×1000kW	Hydro Equipment Supply&Design	1997
5	Micro Hydropower Station in Vietnam	3000 + sets	Hydro Equipment Supply&Design	1999
6	Micro Hydropower Station in India	1×60kW	Hydro Equipment Supply&Design	2000
7	Tea-plantation Power Plant in Sri Lanka	1×200kW	Hydro Equipment Supply	2005
8	Dao and Pei MHPs in Philippines	1×40kW+1×30kW	Micro Hydro Equipment Supply	2006
9	Basaran Hydropower Station in Turkey	2×300kW	Automatic control system	2006
10	Gera-II Hydropower Station in Peru	1×1950kW	Hydro Equipment Supply	2005
11	Tashir Hydropower Station in Mongolia	3×3450+1×650kW	Hydro Equipment Supply&Design	2006
12	Wanique Hydropower Station in Fiji	2×400kW	Hydro Equipment Supply	2007
13	Sandia Hydropower Station in Peru	1×1200kW	Hydro Equipment Supply	2007
14	Yalnizca Hydropower Station in Turkey	3×5000kW	Hydro Equipment Supply	2007
15	Pinar Hydropower Station in Turkey	3×10000kW	Hydro Equipment Supply	2007
16	Keklicek hydropower station in Turkey	2×4500kW	Equipment Supply	2007
17	Akcay Hydropower Station in Turkey	2×11500kW+1×5500kW	Hydro Equipment Supply	2007
18	Khe Dien Hydropower Station in Vietnam	2×4500kW	Automatic control system	2008
19	Garzan-I Hydropower Station in Turkey	2×21000kW	Hydro Equipment Supply	2008
20	Kizkale hydropower station in Turkey	1×250kW	Equipment Supply	2008
21	OTLUCA-I hydropower station in Turkey	3×12.296MW	Equipment Supply	2008

(continued)

S.N	Project	Installed Capacity	Service Scope	Completion
22	OTLUCA-2 hydropower station in Turkey	3×1936kW	Equipment Supply	2008
23	BOĞUNTU hydropower station in Turkey	3×1107kW	Equipment Supply	2008
24	SARACBENDI hydropower station in Turkey	4×5918kW	Equipment Supply	2008
25	YUVARLAKÇAY hydropower station in Turkey	2×1655kW	Equipment Supply	2008
26	AMLICA-III hydropower station in Turkey	3×9052kW	Equipment Supply	2008
27	Kartalkaya Hydropower Station in Turkey	3×2700kW	Hydro Equipment Supply	2009
28	MuratI Hydropower Station in Turkey	3×8410kW	Hydro Equipment Supply	2009
29	Murat II Hydropower Station in Turkey	3×3416kW	Hydro Equipment Supply	2009
30	Kale Hydropower Station in Turkey	3×11700kW	Hydro Equipment Supply	2009
31	Osmancik Hydropower Station in Turkey	2×4850kW	Hydro Equipment Supply	2010
32	Chichekli Hydropower Station in Azerbaijan	3×1000kW	SDJK-2000	2010
33	Hillan Hydropower Staion in Pakistan	2×320kW	DZWX-2000	2010
34	Rangar-I Hydropower Staion in Pakistan	2×320kW	DZWX-2000	2010
35	Halmat Hydropower Staion in Pakistan	2×160kW	DZWX-2000	2010
36	Getik Hydropower Station in Armenia	2×2000kW+1×1600kW	SDJK-2000	2010
37	Vietnam Thai An Hydropower Station	2×50MW	Hydroelectric Design	2010
38	Sena Hydropower Station in Turkey	2×10800kW	Hydro Equipment Supply	2011
39	Turija Mini-Hydro Station in Macedonia	1×160kW	Containerized Micro Hydro Units	2011
40	Gikira Hydropower Station in Kenya	2×200kW	Hydro Equipment Supply	2011
41	Ozluce Hydropower Station in Turkey	2×18900kW	Hydro Equipment Supply	2011
42	Vietnam Thai An 220kV substation	Rated capacity of transformer: 160/160/50 MVA, transformation ratio: 225±8×1.25%/115/10.5kV	Hydroelectric Design	2011

(continued)

S.N	Project	Installed Capacity	Service Scope	Completion
43	Muong Hum Hydropower Station	2×16MW	Hydroelectric Design	2011
44	Kemercayir Hydropower Station in Turkey	2×6435kW+1×3015kW	SDJK-2000	2012
45	Uchanlar Hydropower Station in Turkey	2×4950kW+1×2250kW	SDJK-2000	2012
46	Ucharmanlar Hydropower Station in Turkey	2×7380kW+1×2430kW	SDJK-2000	2012
47	Binek Hydropower Station in Turkey	2×2800kW	SDJK-2000	2012
48	Gangelas Hydropower Station in Angola	1×1004kW+1×250kW	Hydro Equipment Supply	2013
49	Toplec Hydropower Station in Macedonia	1×200kW	Containerized Micro Hydro Units	2013
50	Suoi Tan Hydropower Station in Vietnam	1×100kW	Containerized Micro Hydro Units	2013
51	PA Hydropower Station in Cuba	1×20kW	SDJK-2000	2013
52	GUIN Hydropower Station in Pakistan	2×125kW	Hydro Equipment Supply	2013
53	RANGAR-II Hydropower Station in Pakistan	2×225kW	Hydro Equipment Supply	2013
54	IKILER Hydropower Station in Turkey	2×3050kW	Hydro Equipment Supply	2013
55	GARZAN-I EK Hydropower Station in Turkey	1×3240kW	Hydro Equipment Supply	2013
56	SIRVAN Hydropower Station in Turkey	2×15MW	Hydro Equipment Supply	2013
57	MAYARI-R Hydropower Station in Cuba	2×1250kW+1×400kW +1×50kW	Hydro Equipment Supply & SDJK-2000、DZWX-2000	2014
58	MAYARI-L Hydropower Station in Cuba	1×1150kW	Hydro Equipment Supply & SDJK-2000	2014
59	Tara khola Hydropower Station in Nepal	2×190 kW	Hydro Equipment Supply	2015-
60	Ragati Hydropower Station in Kenya	3×3200 kW	R&D Design	2015
61	PAKKAT Hydropower Station in Indonesia	2×6.3MW	Hydroelectric Design	2015
62	Nam Ming Hydropower Station in Laos	2×6300 kW	Feasibility study design & EPC Intent Agreement	2016-
63	Butao HEPP in Philippines	2×800 kW	Hydro Equipment Supply	2017-

was awarded International Sci-tech Base of Renewable Energy and Rural Electrification of Zhejiang Province. Furthermore, HRC has established a center abroad of hybrid energy power generation, and the equipment and technology of hydro, wind and solar complimentary system has already been widely applied abroad.

HRC has applied and conducted “*Research & Sharing on Rural Electrification Mode Based on Clean Energy*” funded by China-APEC Cooperation Fund, and carried out exchange and cooperation with Vietnam and Indonesia in clean energy-based rural electrification and offered personnel training for the two countries, sharing advanced technology and successful experience in China’s rural electrification. The three parties have also formulated a cooperative plan.

HRC has maintained a friendly and trustful relationship with Institute for Hydro Power and Renewable Energy (HIR), Vietnam. Both sides have for many times applied successfully to their own governments for international sci-tech cooperation projects. In 2011, both sides successfully applied to Ministry of Science and Technology of both countries for the long-term intergovernmental exchange project, Emergency-supporting Technology for Rural Hydropower against Disasters Caused by Climate Change. Both sides have worked together to do research on “black start” of small hydropower and emergency safeguard technology of rural hydropower against disasters.

2 Four Centers, An Overseas Layout

With support and guidance

of Ministry of Water Resources, Ministry of Commerce, Ministry of Foreign Affairs, Ministry of Science and Technology and embassies and consulates, HRC has cooperated with partners from Pakistan, Indonesia Ethiopia and Serbia in joint research and technology transfer in an aim to construct four overseas centers, i.e. *China-Pakistan Joint Research Center for Small Hydropower and Rural Electrification*, *China-Indonesia Joint Research Center for Hydro-based Rural Electrification Technology*, *China-Africa Technology Transfer, Research & Training Center on Clean Energies & Rural Electrification* and *China-Serbia Joint Research And Training Center On Renewable Energy Technology*. HRC are working to turn *China-Pakistan Joint Research Center for Small Hydropower to SHP R+D & Pilot Base for South Asia*. Following *China-Africa Technology Transfer, Research & Training Center on Clean Energies & Rural Electrification*, *China-ASEAN technology Transfer Center on Renewable Energy* centered in Indonesia will be initiated. Additionally, *China-West-Asia, East-Europe-Caucasia SHP Technology & Equipment Development Base*, a Serbia centered institute, will be established.

(1) In cooperation with Pakistan Council of Renewable Energy Technologies (PCRET), HRC has completed the foreign-aid project of Chinese Ministry of Science and Technology, *China-Pakistan Joint Research Center for Small Hydropower*, which received vigorous support from both governments. On April 20, 2015, Chinese President Mr. Xi Jinping together with Pakistani Prime Minister Mr. Nawaz Sharif

unveiled the nameplate for the center and other 7 projects cooperated by both countries during his state visit to Pakistan (Fig. 2).



Fig. 2 Chinese President Xi Jinping unveiled together with Pakistani Prime Minister China-Pakistan Joint Research Center for Small Hydropower and the other 7 cooperative projects



Fig. 3 Plaque with the China-Pakistan Joint Research Center for Small Hydropower

On July 8, 2017, the 18th Session of the Pak-China Joint Committee on Science and Technology Cooperation was held in Islamabad. China’s Minister of Science and Technology Wan Gang investigated operation of China-Pakistan Joint Research Center for Small Hydropower during his visit to Pakistan Council of Renewable Energy Technologies, and discussed follow-up in-depth cooperation in photovoltaic, hydropower, wind power and so on. Today, with the strong support of the Ministry of Science and Technology, HRC is actively committed to the Special Project of Strategic International Cooperation in Scientific and

Technological Innovation under National Key R&D Program - China-Pakistan Joint Research Center for Small Hydropower and Rural Electrification. It aims to level up and extend research scale and scope from the existing China-Pakistan National Joint Research Center for Small Hydropower Technology and build a pilot base; Innovative capability will be enhanced for Pakistan in renewable energy and rural electrification through cooperation and exchanges. Simultaneously, small hydropower and rural electrification technology and experience in china can be applied and disseminated in South Asian countries to create technology innovation exchange mechanism for small hydropower and rural electrification in South Asia with shared development and mutual benefit to promote international production capacity cooperation in clean energy and rural electrification. The project has been officially launched.

(2) On May 12, 2017, the second technology transfer and training center-Africa Technology Transfer, Research and Training Center for Clean Energy and Rural Electrification was inaugurated in Addis Ababa University of Science and Technology, Ethiopia. The Center is open to African countries, undertakes capacity building, joint research, technology transfer, pilot projects in clean energy and rural electrification and implements China-Africa cooperative programs including agricultural modernization, infrastructure, green development and poverty reduction, promoting China-Africa common development and achieving win-win cooperation.



Fig. 4 Distribution of 4 Overseas Centers to be built by HRC

Presently, the work to each stage is unfolding in an orderly manner.

(3) In 2017, HRC undertakes Zhejiang Belt and Road scientific and technological innovation cooperation program—China-Indonesia Joint Research Center for Hydro-Based Rural Electrification Technology Hydropower. Together with Indonesian PLN and Ministry of Energy, HRC established the joint research center to carry out hybrid energy based rural electrification technology development and initial equipment production, conduct human resources training and establish pilot power plant, promoting China’s hybrid (small hydropower, wind, solar) power technology and fully activating radiation effect of the research center to develop cooperation with other ASEAN countries, Laos, the Philippines, Malaysia, etc. On December 2017, a delegation of HRC went to Indonesia to promote HRC’s cooperation with ASEAN and paid a visit to Dr. Sanjayan Velautham, Director of the ASEAN Energy Center, conducting

an in-depth exchange of views, and an agreement on establishing a “China-ASEAN Clean Energy and Rural Electrification Technology Transfer & Training Center” and project cooperation reached. The delegation paid a visit to the Indonesian Electric Power Company to discuss the joint research and personnel training cooperation plan for the island’s clean hybrid energy technology and signed a memorandum of understanding. In the meantime, the delegation also discussed with the Brawijaya University, Indonesia about the technology cooperation on hybrid energy for seawater desalination and discussed with PLN Corporate University, Indonesia on personnel training and education cooperation.

(4) On May 2017, HRC signed a memorandum of understanding with the University of Belgrade, Serbia to discuss the exchange of small hydropower and other renewable energy technology development and pilot projects, deciding to establish *China-Serbia Joint Research and*

Training Center for Small Hydropower Technology as common goal.

Distribution of 4 Overseas Centers to be built by HRC refers to *Fig 4*.

3 Disseminating Chinese Standards Globally

Moreover, HRC plays an active role in formulating (revising) national standards and industrial standards in small hydropower, disseminates existing Chinese small hydropower english standards in production capacity cooperation., and vigorously organizes more translation for standards in fields of hydropower planning, design, consulting, construction, and operation and maintenance standards (including water conservancy and hydropower project construction contract and tender documents), as well as small hydropower equipment manufacturing standards, etc.. It is participating in and promoting process of internationalization of Chinese water conservancy and hydropower standards.

IV Perspective

The boat will eventually dock albeit enduring tempestuous waves and furious wind sometimes. On the new starting point to a new journey in the new era, following the guidelines of *Belt and Road Technical Innovation Action Program* and with work philosophy and approach of capacity building-joint research-production capacity cooperation, HRC will be dedicated to human resources training and technical development services for countries along *the Belt and Road* in water resources,

small hydropower, clean energy and climate change, working together with our partners for joint technology research and pilot projects to promote technology transfer and equipment manufacturing localization, promoting internationalization of Chinese standards and international cooperation in production capacity.

HRC undertakes to substantialize the function of the four overseas centers and scale up them step by step under support of the Chinese government and international organizations. Their services will radiate in scientific research and industrial cooperation, and appropriate technology, mature products and solutions for water conservancy, hydropower and rural electrification will be provided for countries on *the Belt and Road*. energy hybrid technologies based on photovoltaic, hydropower and wind power will be developed to promote technological progress, achieve production cooperation and benefit local people's livelihood.

Endeavoring with faith on a long journey ahead will lead to a promising future on the belt and road. With nearly 40 years of accumulation and experiences in training and international exchanges and cooperation, the team of HRC will be well prepared with energetic, glorious and, indomitable spirit to participate in *the Belt and Road Initiative* on a larger scale, in a higher standard and to a deeper level, and are convinced that the walk on the belt and road in a new journey of small hydropower international exchange and cooperation will be steady and enduring. HRC will contribute to realize rural electrification in

countries on the Belt and Road and cope with global challenges in energy, environment and climate change.

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