A Survey of SHP Development in China

Hangzhou Regional Centre (Asia-Pacific) for Small Hydro Power(HRC) , Hangzhou, China

1 The three phases of development

Rural hydro in China has developed in step with the overall social and economic progress in China. The development of rural hydro can be divided into three phases.

(1)The first phase: SHP is mainly used for domestic lighting (1950s—1970s)

In this period from the founding of the People's Republic of China in 1949 to the primary period of reform and opening up, rural hydro was mainly developed as a solution for domestic lighting for rural, hilly and poor areas. SHP, small hydropower, was essentially developed under the mode of a planned economy. With the guidance and encouragement of government policy, the local government and rural population were motivated to build up SHP, thereby making possible substantial developments in rural hydro.

Before 1949, the exploitation of SHP was rather backward in China. The earliest SHP station was the Guishan SHP Station at the Danshui River tributary in Taiwan in 1904 with an installed capacity of 500 kW. In mainland China, the first SHP station was Shilongba SHP Station near Kunming in Yunnan province. Up to 1949, the installed capacity of all the hydro power stations in China was over 360 MW, and the installed capacity per capita was less than 1 W, with an annual power generation of 1.2 billion kWh. There were only 52 SHP stations each with an installed capacity below 500 kW, totaling 5,916 kW in all.

After 1949, with the development of agriculture and rural hydro projects, SHP advanced quickly. The National Agricultural Development Program issued in the 1950s pointed out, "Wherever appropriate to develop hydro projects, try every possible way to construct medium and small hydropower stations so as to gradually solve the problem of rural energy supply." Since the 1950s, a large number of SHP stations were built nationwide. By the end of 1960, 8,975 SHP stations had been built, with installed capacity of 252 MW. The 1950s were the initial period of rural hydro and electrification. Its features were mainly to supply energy for domestic lighting and agricultural by-products processing. The local population called rural hydropower a "night pearl". At that time, the installed capacity of the SHP stations was very small, with an average of 28 kW only, and most of them were in isolated operation. The equipment was simple, mainly adopting wooden or wood-iron turbines produced by agricultural machinery factories. These were run by the local people, and financially and technically aided by the government. Some SHP stations of bigger installed capacity were essentially invested and built by local governments.

During the 1960s, the State (national) grid developed rapidly, and extended to the suburbs and rural areas. Some isolated SHP stations were substituted by the State grid and others were abandoned; the total installed capacity and rate of development of SHP therefore decreased. However, there was still a large potential for development, owing to the demands of industrial and agricultural growth and improvement in people's living standards. The annual average installed capacity reached 58 MW, and the definition of SHP was upgraded to refer to hydropower stations with installed capacity of 3,000 kW.

In 1969, the State Planning Commission held a "Meeting on Small Hydropower Projects for the Hilly Areas in South China" in Yongchun county, Fujian province and some policies were worked out including "Mainly small-scale, run by the local people and with locally-made equipment ", together with the incentive policy of State assistance in funding and materials for SHP development. Thus, SHP exploitation was formally listed in the national development plan. The implementation program of small basin development and coordinated distribution of local equipment manufacturing were proposed, thereby promoting the large-scale development of SHP. Afterwards, the State set timely measures to protect and assist SHP with funds, technology, key materials, and so mobilizing everybody's initiative in constructing SHP stations.

Then, in 1975, 1978, 1979 and 1980, national meetings on SHP were conducted respectively in Guangzhou, Wuchang, Beijing and Chengdu to summarize the experience and problems in various phases, thus pushing forward SHP development. The definition of SHP was upgraded to 12 MW, and the average annual increase in installed capacity was 580 MW, with a maximum of 1,120 MW in 1979. In this period, SHP supply was used for domestic lighting, processing, drainage, irrigation and township enterprises. In the whole country, there were over 60 turbine and complete package manufacturers with an annual production capacity of 1 million kW. Serialization of the turbine products from 250 kW to 12, 000 kW was prepared. Automatic regulation of turbine speed could be performed in key stations. Some counties with fast SHP development formed local SHP-based 35 kV grids. SHP stations developed from isolated operation to connected operation with unified dispatching. During this period, overall surveys and investigations were carried out for SHP resources, essentially clarifying the exploitable SHP potential in China.

After some 30 years of SHP exploitation since 1949, SHP supplied power to over half of the territory for domestic lighting, thereby solving the electricity supply problem for 300 million people.

(2) The second phase: SHP is mainly used for poverty-relief in poor areas (1980s & 1990s)

Since the wide application in China in 1980 of the contract system of responsibility linked with production, tremendous changes took place in the rural economy and great achievements were made. Electricity demand increased with economic development, living standards improved and there was a boom in township enterprises. This led to a sharp imbalance between power demand and supply. The severe shortage of electricity became the main obstacle to the development of the rural economy. In order to meet the needs of rural development and to quicken the pace of poverty-relief in the rural areas, the State decided to speed up the rural electrification program, and to include it in the two key strategies of national agricultural modernization and national energy construction.

In Nov. 1982, with the personal support of Deng Xiaoping, the central authorities proposed that wherever SHP is available, SHP should be developed, putting the rural electrification program at the core of resolving the poverty-relief issue in remote, minority, old revolutionary and hilly areas. The State Council issued a document to publicize the 100 counties for primary rural electrification. In all, 100 million Yuan was allocated for subsidies every year and the 100 counties for rural electrification were to be completed by 1990. SHP development started to be included in the rural electrification program. After years of efforts, the progress of the pilot counties for rural electrification was swift. By the end of 1988, 48 counties reached the target in advance and passed inspection. By the end of 1990, the first batch of 109 counties had passed inspection for primary rural electrification.

With the advancement of rural electrification counties, the rural hydropower scope increased and more key SHP stations appeared. The definition of SHP was increased as well, from installed capacity of 12 MW to 25 MW. Local grids were established, with around 78% of the capacity in connected operation. The previous defect of isolated operation was overcome and unified dispatching set up at the county level. Furthermore, reservoirs were built at many cascade stations, thus increasing regulating capacity. The management system and equipment were improved constantly. Generally speaking, local SHP corporations at the county level were created and efficiency increased. By the end of 1988, the installed capacity of SHP in the whole country reached 11,790 MW, with annual power generation 31.6 billion kWh and 683,600 km of high voltage transmission lines, 1.52 million km of low voltage transmission lines and total transformer capacity of 44.413 million kVA. In the whole country, 717 counties were mainly supplied by SHP. With the development of SHP installed capacity and expansion of the local grids, SHP in China became a new sector with unique business features.

In the 1990s, to cope with the opening up and reform policies as well as local economic development, SHP leapt forward in scope, management, policies, science and technology. The features were: based on the foundation of continuous construction of SHP stations, emphasis was placed on key medium-size hydropower stations. The definition of SHP was increased from 25 MW to 50 MW installed capacity. The trend was from single SHP stations to cascade developments of a whole basin. Based on improving the county grids, local trans-county grids started to develop. The voltage grade increased from 35 kV to 110 kV. In some regions, substation projects of 220 kV were constructed.

The second batch of 208 (versus 200 in the plan) counties for rural electrification was constructed based on the experience of building the first batch. In 1995, the implementation of the third batch of 300 counties for small and medium hydropower based on rural electrification was started. In terms of management, a shareholding system was adopted, setting up the modern enterprise system of "Clear ownership of property and responsibility, separation of government and enterprise, plus scientific management". In some areas, based on local grid construction and basin exploitation, a group of regional power corporations and basin development groups with major ties of property linkage and production cooperation were set up, having multilayer structures, and features of parent and subsidiary company as the main entity. Funds were collected for developing SHP stations and the capital-raising mechanism has been transformed. The advantages of having a cluster of entities were brought into full play, so as to realize a mutually complementary effect, increase efficiency and consolidate the SHP sector.

By the end of 1996, the total installed capacity of all power stations under the Chinese Ministry of Water Resources was 24.295 million kW, of which hydropower accounted for 21.643 million kW. Of this total, two sites were of large hydro with installed capacity of 1.225 million kW, 21 sites medium hydropower with installed capacity of 1.217 million kW, and 45,174 SHP sites with installed capacity of 19.201 million kW, representing 24.3% of the exploitable resources. The annual power generation from SHP amounted to 62 billion kWh. Nationwide, there were 1576 counties with SHP stations built, of which, 780 counties representing 48% of the total land area and with a population of 300 million mainly depended on SHP supply. With the progress of small and medium hydropower, the local grids managed by the hydropower sector also constantly developed and were improved.

The Water Resources Sector is responsible for the power supply and management for 754 counties and possesses 878,000 km of high voltage transmission line of 10 kV and above, of which 35 kV transmission lines account for 97,000 km and 110 kV 20,000 km. There were 4,503 substations over 35 kV, with a transformer capacity of 29.08 million kVA. Around 800 local grids at the county level were formed with 43 trans-county grids. In order to increase the reliability of the local grids and increase the output in the dry period, the Water Resources Sector made use of small local coal mines to construct 360 medium and small thermal plants with installed capacity of 2,416 MW. Meanwhile, 3,035 sites of wind power plants were built to make use of wind resources with an installed capacity of 8.8 MW. There were 1,216 sites using other power resources with a total installed capacity of 226.5 MW that operate in co-ordination with SHP. The rural hydropower greatly improved the rural infrastructure and economic structure, leading the way forward for economic development in the hilly rural areas. The development mode of "Water generates electricity and electricity supports electricity" was formed. So, the development of rural hydropower has become an important means of boosting the rural economy, increasing local revenues and enriching the local farmers so they can escape from poverty.

(3) The third phase: SHP used mainly for protecting and improving the ecological environment and boosting the local economy (entering the 21st century)

Entering the 21st century, while rural hydropower continues to promote local economic development, it starts to play a more and more important role in improving the ecology, protect the environment and promote rural modernization. With the progress of the social economy, the ecological environment is put into a more prominent position. The <Recommendations for Making the Tenth Five-Year-Plan of the National Economy and Social Development> at the Fifth Plenary Session of the CPC's Fifteenth Central Committee pointed out that China should strengthen ecological construction and environmental protection, return arable land to forest and grass in a planned and sequential way and improve the production and environmental conditions in the western part of China. In 2001, former Premier Zhu Rongji pointed out several times during his inspection tour in Hunan, Sichuan and Guizhou that SHP should be developed on a large scale so as to resolve the fuel and energy problems for the farmers. The return of arable land to forest should be promoted to protect and improve the environment, the local economy should be developed, farmers' income should be increased and the process of poverty-relief for the poor farmers should be speeded up. Support must be provided. The refurbishment of the rural grids should be combined with SHP development. All these instructions by former Premier Zhu, viewed from his strategic vantage point, pointed the way for the directions, objectives and tasks in the new era of SHP development, guiding it towards new areas for exploitation and broader prospects for SHP development.

Remarkable achievements were made in the development of rural hydro and electrification in 2002, with 1.88 million kW newly added installed capacity, breaking the previous record. By the end of 2002, the accumulated total hydropower capacity installed by the water resources sector reached 35.86 million kW, representing 42.4% of the national hydropower installed capacity. The annual power generation was 113.4 billion kWh, representing 41.8% of the national hydropower output. Of the 35.86 million kW, the installed capacity of rural hydropower was 31.04 million kW with annual output 103.7 billion kWh. In 2002, the total annual power generation from this rural hydropower reduced the amount of coal to be burnt, equivalent to a reduction of emissions of 90 million tons of CO_2 and other harmful gases. There are in all 20 million households in the SHP supply areas where the residents use electric cookers in differing degrees, thereby reducing felling of forests over an area of 130,000 hectares annually, saving 9 million m^3 of timber, protecting the forest, and preventing soil and water erosion, thus improving the environment. Many of the medium and small hydropower stations together with their reservoirs in China have become local ecological and tourist resorts, realizing the policy of "building one SHP station, boosting the economy of one region and beautifying one area of the State land".

The installed SHP capacity and its annual output vs. its proportion of the total installed capacity and annual output of hydropower in China are shown in Table 1.1 below.

Table 1.1 Installed SHP capacity and its annual output vs. its proportion of the total installed capacity and annual output of hydropower in China

Year	SHP		SHP as a percentage of total hydropower capacity and generation	
	Installed capacity (MW)	Yearly output (TWh)	Installed capacity ratio (%)	Yearly output ratio (%)
1950	3.70		2.20	
1955	7.00		1.40	
1960	251.40		13.00	
1965	330.00		10.90	
1970	1019.00		16.40	
1971	1536.20	3.00	19.70	11.80
1972	1830.80	3.40	21.00	11.60
1973	2200.70	4.10	21.40	10.40
1974	2593.50	4.90	21.90	11.80
1975	3083.20	6.70	23.00	14.10
1976	3601.40	7.10	24.60	15.70
1977	4315.20	8.50	27.40	17.90
1978	5266.50	10.00	30.50	22.40
1979	6239.50	11.90	33.10	23.80
1980	6925.50	12.70	34.10	21.90
1981	7573.60	14.40	34.50	22.10
1982	8079.70	17.20	35.20	23.20
1983	8504.70	19.90	35.20	23.10
1984	9066.60	20.80	35.40	24.00
1985	9521.00	24.10	36.00	26.10
1986	10095.10	24.40	36.60	25.90
1987	11106.30	29.10	36.80	29.00
1988	11792.30	31.60	36.10	29.00
1989	12934.30	34.70	37.40	29.30
1990	13180.00	39.30	36.60	31.10
1991	13853.40	37.30	36.60	29.80
1992	14419.10	44.20	35.40	32.20
1993	15055.30	47.00	33.80	35.70
1994	15776.60	50.90	32.20	30.50
1995	16646.10	55.40	32.70	32.60
1996	19201.80	62.00	34.50	33.20
1997	20519.60	68.34	34.36	35.13
1998	22024.18	71.34	33.85	34.92
1999	23480.69	72.01	32.18	33.82
2000	24851.72	79.98	31.32	32.90
2001	26262.40	87.10	31.70	33.80

2 The Ecological Protection Programme to Replace Firewood with SHP

In 2002, the State Council and CPC Central Committee issued <Opinions on Doing Agriculture and Rural Work Well in 2002> (Document No. 2 in 2002), in which rural hydropower was listed as part of the basic small and medium scale infrastructure that should be accessible to the majority of rural households and bring direct benefits to farmers. Therefore, more investment was needed in this sector. That was the first time that rural hydropower had appeared in the CPC Central Committee's documents, and reflects the new tasks and requirements set in the new era for rural hydro development. It also shows the full confirmation given by the Party and the State for the position of rural hydropower in the national economy and social development. In 2003, another document issued by the central authorities <Opinions on Doing Agriculture and Rural Work Well in 2003> (Document No. 3 in 2003) further emphasized that more investment be given to construction of the medium and small infrastructure of the farmers, increase the items of construction, start pilot projects to replace firewood with SHP and consolidate the work of returning arable land to forest.

China has very abundant SHP resources. According to the latest statistics, the exploitable SHP potential in China is 120 GW, No.1 in the world. By the end of 2002, 31.04 GW had been exploited, representing 26% of the total, and providing advantageous conditions for implementing the Ecological Protection Programme to Replace Firewood with SHP. Currently, residents who use firewood for cooking and for heating are mainly distributed in the central and western parts of China, especially in the upper reaches of the Yangtze River and mid reaches of the Yellow River where areas have been designated for "returning the arable land to forest", natural resources protection zones, natural forest protection areas, and key areas of water & soil loss treatment. These areas essentially are also in the regions of SHP resources. These resources and their zonal distribution could stably meet the needs of fuel supply for the farmers living in the planned areas for a long period of time. Over 1,600 counties have developed SHP in China and more than 40,000 SHP stations have been built, with over 800 rural hydropower local grids capable of self-generation and self-supply at the county level. With the rural grid reform, the rural grids could meet the requirements of SHP for the Ecological Protection Programme. Experiments have been made in some areas for exploring the ways of replacing firewood with SHP and some achievements have been made. These have laid a good foundation for the implementation of the Ecological Protection Programme.

The Ecological Protection Programme is a new historic mission of SHP conferred by the new era. It has strategic significance in the adjustment of the rural energy structure, ecological protection and sustainable development.

(1) The Ecological Protection Programme is a strategic measure to consolidate the work for returning arable land to forest.

Felling at will or felling at hill slopes caused severe natural disasters like erosion of water and soil, barren land, drought and water logging. The central government made the decision to carry out ecological construction with the focus on returning arable land to forest. After the implementation of the decision, the problems of felling by forest enterprises and felling at the hill slopes by the local farmers were basically solved. However, the problem of felling by the farmers for firewood was not solved. In 2001, the amount of firewood burnt by the farmers reached 228 million m^3, far exceeding 64 million m^3, the quota for farmers' firewood consumption set by the State Council, and also far exceeding 223 million m^3, the quota for felling in the whole country. To solve the problem of chopping firewood by the farmers, one must solve the problem of fuel for the farmers. The practice of replacing firewood with SHP for the farmers would reduce the amount of firewood consumed by at least 149 million m^3 every year, a 65% reduction of the firewood previously consumed by the farmers. The amount of firewood chopped by the farmers was reduced to close to the quota of 64 million m^3 set by the State Council to protect 340 million mu (15 mu is equal to 1 ha) of forest stably over a long period of time. So, the Ecological Protection Programme could fundamentally solve the firewood problem of the farmers and consolidate the work of returning arable land to forest.

(2) The Ecological Protection Programme is a great contribution to the alleviation of the greenhouse effect that attracts global attention

According to the<Kyoto Protocol>, the amount of CO_2 emission of the industrialized countries worldwide in 2012 should be decreased by 5 percentage points based on the amount of 1990. In case of failure, penalties would be imposed. The amount of CO_2 emission in China represents 13.2% of the world total, listed as the second largest after the USA. In 2002 China ratified the <Kyoto Protocol>. Presently, the emission amount of CO_2 in China is 3.13 billion tons every year. After the implementation of the Ecological Protection Programme, a reduction of 200 million tons of CO_2 emissions could be realized yearly, i.e. a reduction of 6%. The benefit, which is equal to 34 billion Yuan, is very evident. Recently, an UNEP, United Nations Environment Programme, report pointed out that at 14 km above the earth's surface in Asia there was a layer of brown cloud 3 km thick, which was called "Asian Brown Cloud". The UN organized over 200 scientists all over the world and reached two important conclusions after 5 years of research. One was that the layer was composed of dust, smoke, acid elements and other harmful aerosols, most of which were from the smoke and dust created after burning firewood by farmers in the Asian region. Thus, the main reason for the "layer of brown cloud" above the Asian area was the burning for cooking and heating by the Asian farmers. The second conclusion was that the "layer of brown cloud" caused climate abnormality, diseases and severe natural disasters in some areas of Southeast Asia. This "layer of brown cloud" now endangers global environmental security. In reducing the greenhouse effect and securing global environmental safety, the implementation of the Ecological Protection Programme is a concrete measure put in practice to realize the commitments made when China solemnly declared its ratification of the <Kyoto Protocol> to the world and is China's significant contribution to global environmental safety.

(3) SHP stations for fuel ecological protection are scattered here and there, covering thousands of rural households to benefit the numerous farmers directly

The farmers may directly participate in the implementation of the Ecological Protection Programme. That will create job opportunities as well as increase the income for the farmers. It could reduce stably and for the long term the hardship of suffering from smoke while burning firewood- a way of living since ancient times-and it can change the conditions of production and life. Out of 2400 counties in China, 1,600 counties have built SHP stations, among which, there were 886 counties with plans for SHP stations for fuel ecological protection already compiled. There were 25 provinces (regions and cities) and the Xinjiang Production and Construction Corps that have compiled the provincial plans. The Chinese Ministry of Water Resources has compiled the national plan, involving a population of 300 million, an area of 3.5 million km^2, and installed capacity of 24.04 million kW to be newly increased.

(4) SHP stations for fuel ecological protection have significance in increasing domestic demand and developing the rural market

The implementation of SHP stations for fuel ecological protection could stimulate the development of machinery, construction, electronics, materials, steel and iron, transportation, electric goods etc. It would increase farmers' income, create job opportunities and stimulate the rural consumption market.

(5) The building of SHP stations for fuel ecological protection forms part of the infrastructure which could develop the hilly water resources industry with rural hydropower as the "dragon head" enhancing the ability to prevent floods and fight against drought

Rural hydro is an inseparable and the most vigorous part of water resources infrastructure. It is an important part of comprehensive utilization of water resources and comprehensive treatment of the rivers. The implementation of the Ecological Protection Programme would newly construct SHP stations with an installed capacity of over 20 million kW, forming the new developing structure of water resources with rural hydro as the "dragon head", electricity supplementing water, as well as water resources and hydropower promoting each other. That will push forward the comprehensive treatment of medium and small rivers, but also promote cascade development, increase the ability to prevent floods and droughts as well as lead to comprehensive water resources utilization. Thus, the comprehensive capacity of the water resources to serve agriculture and the rural economy is considerably augmented.

The planning area for implementing SHP stations for fuel ecological protection involves 25 provinces, autonomous regions and the 886 counties with a total area of over 3.5 million km^2 and 80.8 million households with 273 million inhabitants, of which, SHP stations for fuel ecological protection could be implemented for 28. 3 million households, 104 million people with a total installed capacity of 24.06 million kW and annual energy consumption 34 billion kWh. According to the planning, the implementation of this project could save the consumption of 189 million m^3 of timber, and protect 340 million mu (15 mu equals 1 hectare) of forest area, so that an ecological benefit of 36 billion Yuan could be achieved, creating enormous social and economic benefit.

3 Facing new challenges

As rural hydro plays an important role in the supply of rural energy, improving the environment, poverty-alleviation and promotion of the rural economy, it has been gradually developed to cover half of the land and one fourth of China's population, with over 40,000 SHP stations, an installed capacity of 26.26 million kW, and an annual output of over 90 billion kWh, representing 30% of China's rural electricity market share.

However, SHP is small in production scale, with the contradiction between the rainy and dry periods, and sometimes with inadequate technical facilities and low-level management. Meanwhile, there are occasionally difficulties in selling out electricity, unsatisfactory electricity tariff mechanism, slow market development, constraints of public benefit and other unfavourable external factors, under the condition of the power reform and market competition with "separation of power plant and the grids, competitive bidding for selling to the grids". During the transition period of China's planned economy to a market one, SHP is confronted the following new issues, mainly:

First, the existing management mechanism is not in agreement with the development of the market economy. In the whole country, 80% of rural hydro adopts a management system with the county level as the main force, and assisted and guided at the province level. Policy and measures were usually made by various administrations. There was a great deal of difference among the SHP entities in the extent to which they enjoy many of the preferential policies. As there are multiple main investors, it is difficult to optimize the allocation and restructuring of resources that definitely leads to inability to compete or reduce risks in the market. Quite a few of the local SHP companies depend on the large grids to subsidize them so as to continue to survive.

Secondly, there is a shortage of funds. The rural hydropower potential in China is rich and after decades of SHP exploitation, by means of attracting foreign funds, financing or fund mobilization etc in particular, a great deal of funds has been mobilized for construction. However, the current proportion of SHP exploitation is only around 20% and there is a severe shortage of funds for exploitation. Rural hydropower is constrained by the region and large grids, the financial rate of return is not high, and is hardly likely to become a hot spot for investment in society.

Thirdly, management methods are backward. Presently, rural hydropower enterprises in many of the areas adopt a traditional and crude means of management. The phenomenon of stressing construction and ignoring management is prevalent. The quality of the working staff still has to be improved and over-staffing in a large number of rural hydropower enterprises exists. Due to the demerits of the management, costs are increased and the efficiency low, prolonging the period for capital accumulation and circulation and causing slow development and expansion through self-generated funds.

The present monopoly will be broken after the restructuring of the power market. After restructuring, the potential and market competitiveness of rural hydropower will be demonstrated. It could become a powerful competitor in the power market in a new way. The restructuring of the power market not only offers rural hydropower opportunities for development, but also presents it with serious challenges.

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Contact : SHP NEWS Editorial Office, PO Box 1206 Hangzhou ,310012, China
Email: shpnews@hrcshp.org

(Continued from page 13) someforest companies stopping felling and succeeded restructuring for other sector by means of developing SHP for firewood. In Anhui province, the SHP was developed to such a degree that no money was spent on SHP for firewood project and over 1200 Yuan RMB as dividend was given yearly to each household on average. The practice shows that the development of SHP and the implementation of SHP for firewood are multi-functional and have a key role to play in solving the issue of hay for the farmers, supplying rural energy, consolidating the ecological construction foundation, protecting the ecological environment, resolving the issues of "agriculture, farmers and villages" and improving the living conditions of the farmers.

It is known that <Planning of Small Hydro Power for firewood Ecological Protection Project> has been evaluated and approved by China International Engineering consultation Corp. It concluded that the construction of Small Hydro Power for firewood Ecological Protection Project is the valid approach to resolving the firewood issue in the rural areas and it can play a special role in improving the ecological environment, reducing the green house emission and promoting a well-off society. The <Planning> essentially reaches the depth requirement at this stage. The <Planning> regards it rational to solve the issue of firewood for 104 million rural farmers of 2830 households, to newly install SHP for firewood 24.038 million kW with the annual power generation 78.12 bill kWh. The <Planning> considers the project feasible. The total amount of the distribution of SHP potential could satisfy the requirement in the <Planning>. The distribution of SHP resources is mainly in agreement with the distribution of the rural farmers relying on hay to cook and heating. The SHP projects are featured by the simple engineering, shorter construction period, quicker effect, low cost, proven technique, reliable operation, little inundation, pollution-free, low operation cost and longer use for the farmers as affordable energy for firewood. SHP exploitation is a viable part for mid and small basin comprehensive development, beneficial for rational use of hydro power resources and increase of the ability to prevent floods and droughts. Meanwhile, SHP is internationally recognized as the green renewable energy appropriate for wider application and is in conformity with the orientation of China's energy structure adjustment. The farmers could afford the price of electricity to the houses by the SHP for firewood. With the increase of the rural economy and farmers' income, the capability of the farmers against the price of electricity by the SHP for firewood will be increased accordingly. The evaluation holds that all the preliminary work for the pilot projects are ready for starting the construction.

It is introduced that in 2003 the State selected 26 "Small Hydro Power for Firewood" ecological protection projects to initiate mainly in mid and western key ecological construction areas rich in hydropower resources, densely populated as SHP for firewood and with urgent need of the farmers for firewood, covering 5 provinces and 26 counties. ■ *(D.Pan, HRC)*

HRC's Annual Report for 2003

Hangzhou Regional Centre (Asia-Pacific) for Small Hydro Power(HRC) , Hangzhou, China

I International SHP training

The 2003 TCDC (Technical Co-operation among Developing Countries) SHP Training Workshop was held from 9 Oct to 18 Nov 2003 by HRC. Attended altogether 37 participants from 24 countries, covering Asia, Africa, Latin America, Eastern Europe and Oceania. This is the first training workshop on SHP that HRC conducted since the establishment of HRC for so many participants from so many countries.

This training workshop which is the 37th international SHP training workshop conducted by HRC was sponsored by Chinese Ministry of Commerce, as one of the technical collaborative projects among the developing countries. All the lodging, boarding, training, pocket money and the domestic transportation fees were borne by the Chinese government. That is part of the Chinese contribution to the South-South cooperation.

In pursuing HRC's quality principle excellence, improvements were made in many aspects for the training workshop. New study tour routes were developed and optimized including Qinshan Nuclear Power Plant and Chint — the model of China's large private enterprise. Around 95% of the lecturers used Power Point to give presentations. For the first time HRC provided for participants with a CD-ROM which contains the details of every participants, presentations of HRC lecturers, Hangzhou's scenic photos and one-hour long selected traditional Chinese music. Participants paid visit to the packaged hydropower units in Nanjing Hydraulic Research Institute and its Tiexinqiao Hydraulic Experimental Base which is China's largest hydraulic experimental base. The packaged hydropower units visited are appropriate for the energy supply to the farmers in the decentralized vast rural areas in the developing countries, and the equipment is reliable in operation and low in price.

HRC's new lab and restaurant are being constructed in HRC and we believe that the participants in our upcoming training workshops on SHP will surely able to make use of the better environment and facilities in HRC.

In 2004, HRC plans to conduct two international training workshops on SHP. The TCDC training workshop on SHP Equipment planned will be implemented in Oct and Nov. The other TCDC training workshop on SHP multi-purpose development for African participants either in Sept or in June 2004 is now under consideration and it will be fixed by the end of Feb.

II International conferences

1 Director of HRC, Dr. Chen Shengshui went to Japan to attend the 18th Sino-Japanese Conference on River and Dam Engineering and presented a paper titled "Featured Design for SHP Stations in China". Dr. Chen conducted discussions with Japanese experts on the hydro power informatization in the information era, water ecological recovery, water environmental protection and the prospect of hydro power science and technology, etc.

2 Ms. Cheng Xialei, Deputy Director of HRC, as one of the 52 experts of the Chinese delegation, participated in the Third World Water Forum, which was opened in Kyoto, Japan in March. She presented a paper titled "Water vs Rural Energy", introducing the achievements and experience in rural hydro power development in China, sharing the abundant experience and new ideologies on water resource development with the peers all over the world.

3 Invited by the World Bank officials, Mr.Li, Deputy Chief of International Cooperation, attended the International Workshop on Attracting PPSP in Infrastructure and presented a paper titled "Framework of China's Private Enterprises for Participation in SHP Development". The presentation was evaluated highly by the World Bank experts and leaders in Yunnan province government. With the implementation of opening and reforming policy in China, more private and more investors are now participating in the exploitation of SHP in China to meet the growing market demand.

4 HRC assisted the Chinese Ministry of Water Resources to conduct the promotion conference on international advanced water and power products on the internet in May. Altogether 48 items of water and power technology from 14 countries were promoted.

5 Contacts were made with the World Bank and ESCAP for jointly holding the international conference on small hydropower in the future.

III Global SHP cooperation

1 The 5th Conference of Sino-Vietnamese Science and Technology Joint Committee was held on 18 March 2003 in Beijing, with the small hydropower development and SHP station automation system listed and approved by the Chinese Ministry of Science and Technology as the long-term cooperative project between China and Vietnam during the Conference. HRC has been designated as the implementation organization on the Chinese side.

As the renewable and environmentally sound energy playing an important role in poverty relief and global environmental protection, SHP development has drawn the attention from both Chinese and Vietnamese governments.

The objective of the project is to explore the mode of SHP development, SHP equipment and automatic system which are appropriate for the SHP situation in Vietnam with the aim to promoting the SHP development in Vietnam. The duration of the cooperation is three years (from May 2003 to May 2005). In Oct the agreement was reached and the contract signed. The automation lab is one of the items for SHP cooperation as jointly approved by the two sciences and technology ministries of China and Vietnam. The establishment of the lab will hopefully promote the wide application of SHP unmanned automation technology in Vietnam.

2 The SHP technical cooperation with Powerbase of Canada was strengthened. In July, a Chinese delegation composed of Ms. Cheng Xialei, Deputy Director of HRC, Mr. Xu Jincai, Chief of the New-Tech R&D Center of HRC, and some other experts with the Zhejiang Provincial Department of Water Resources, paid a visit to Canadian partner Powerbase Automation System Inc., for discussing further cooperation on Automatic Control System for SHP. The kind cooperation between HRC and Powerbase dates back to 1996, when the advanced technology on the Unmanned Control System for SHP was introduced from Powerbase, as the implementation of one of the "948" projects consigned by the Chinese Ministry of Water Resources. The system was mainly developed for the hydropower stations connected to power grids. Being demonstrated, studied and indigenized, the technology has been applied and popularized in dozens of SHP stations nationwide with fruitful results. Moreover, with joint efforts, an upgraded simple automatic control system for the isolated SHP stations is developed successfully, with competitive advantages both in function and price.

In order to further improve the SHP automation in China, HRC nd the Zhejiang Provincial Department of Water Resources applied together in 2003 for carrying out the "948" project entrusted by the Ministry of Water Resource, which plans to introduce the simple automatic control system from Canada, and demonstrate in Jinhua, Zhejiang province. It is expected that the pilot project will be installed and commissioned soon and put into operation earlier in 2004.

3 HRC has undertaken the design and complete equipment supply for Corojo and Moa SHP stations in Cuba, both these projects belong to the Chinese aid programs to foreign countries. HRC dispatched two experts who stayed in Cuba for 9 months in assisting the equipment installation. More experts from HRC will be going to Cuba for technical assistance in 2004 when newly ordered electric equipment arrives in Cuba.

4 In August, a group of 6 Indian members paid a visit to HRC. After the briefing on HRC and SHP in China, the Indian guests expressed keen interest in SHP training that HRC conducts every year for international participants and micro packaged units that Chinese manufacturers produce. Inquiries were addressed around the supply of micro packaged units and the related expenses on SHP training. The 6 members were at Hangzhou attending 2003 Bamboo Cultivation, Processing and Production Seminar organized by UNIDO. India is a country badly in need of energy. In 2001-2002 there was a shortage of energy by 7.5%.

5 HRC has completed the feasibility study for the Ulaanbaatar Power Storage Plant in Mongolia. This project is likely to be implemented when its electricity price is to be further negotiated by the Mongolian side as reasonable.

6 Invited by the Mongolian side, one HRC expert went to the northwestern part of Mongolia. Site trips were conducted to SHP resources, load demand, mode of SHP exploitation, installed capacity and development arrangement at the two villages. Preliminary comments have been presented to the Mongolian side in regard with SHP resources, load demand, mode of SHP exploitation, installed capacity and development arrangement. The Mongolian side expressed that survey work and collection of data concerning topography, geology, discharge, temperature, construction materials etc would be completed within two months, and the related data will be sent to HRC. Based on that, HRC will complete the feasibility study work.

7 During the visit paid to HRC in April by Mr.Polglase from Hydro Tasmania, a company specialized in hydro power international consultation with its headquarters in Australia, both sides conducted friendly and detailed talk on the containerized mini hydro technology and identified the work in the next phase. Also, the utilization of the latest renewable energy like wind power and battery technology were discussed. Meanwhile, information on the SHP investment both home and abroad was exchanged. The prospect for the bilateral cooperation was felt promising.

8 Cooperation with ESCAP was strengthened. Entrusted by ESCAP, HRC has submitted to ESCAP the paper titled "General Situation and Operation Mechanism for Private Enterprises to participate in Rural Hydropower Development" together with the "A Case Study of Chinese Private Enterprise Investing into Rural Hydropower Construction".

IV Information dissemination

1 HRC continued to publish the two magazines, i.e. the bimonthly <Small Hydro Power> in Chinese and the quarterly <SHP News> in English, distributing to over 90 countries and regions.

2 HRC's homepage has been improved steadily and it received over 70,000 clicks during the year, becoming the window of HRC to the outside world. More columns of the homepage will be developed so that more exchange among the SHP peers worldwide could be realized.

3 The book titled "Rural Hydropower and Electrification in China"
was completed and the printing will be finished in Feb 2004. It gives a comprehensive and in-depth introduction to the main experience and technology of rural hydropower and electrification in China, as a reference for global colleagues working in the hydropower sector. It is a valuable attempt in international SHP exchange and Mr. Suo, the Vice Minister of Water Resources took pleasure to write the preface for the book.

4 All together 28 technical papers by HRC staff were published
domestically and internationally during the year, much more than the previous year.

V Certification for ISO 9001:2000 Quality System

The working group with the China Quality Certification Center undertook the on-site examination & approval on three independent certification systems respectively for National Research Institute for Rural Electrification, Hangzhou Yatai Hydro Equipment Completing Co. Ltd. and Hangzhou Yatai Supervision & Consultation Co. Ltd. The examination was focused on the capability for realizing the quality principle and the quality objective, as well as the competence of continuous improvement; the reliability for the inner checking; the accordance between the concrete implementation and the ISO9001:2000 standards & the quality management system document and the implementation validity of the quality management system.

It was concluded by the working group that, HRC is recommended for certification after the on-site examination & approval and with the rectifying measures & effective implementation. The rectifying measures concerned are to be taken recently, and the certification will be soon completed successfully. ■

Attachment: Foreign guests hosted by HRC in 2003

No 1	Visit Time 14-16Feb	Organization\ Country	No of Delegate	Details
		National Research Institute for Water Resources of Vietnam	9	Discussion on the bilateral cooperation of SHP automation
2	21 Mar	Ecuador	3	Understanding the SHP development in China and exploring the potential cooperation
3	15 April	Australia	1	Discussion on the bilateral cooperation of renewable energy and containerized mini hydro power technology
4	24 June	Mongolian Parliament	1	Discussion on the bilateral SHP cooperation and agreement of HRC's sending expert to Mongolia for free SHP mission within the year
5	2 Aug	Japan	2	Discussion on the bilateral cooperation of SHP equipment to the Japanese market
6	11 Aug	India	14	Exploring the bilateral cooperation of China's micro hydro power units to India
7	12 Sept	The World Bank	2	Discussion on inviting HRC's experts in providing SHP presentation in Yunnan and other service
8	20-27 Oct	National Research Institute for Water Resources of Vietnam	4	Signing of the contract on supply SHP automation lab equipment to Vietnam
9	10 Oct	India	4	Discussion on exporting China's micro hydro power units to India
10	1-2 Nov	Germany & India	3	Understanding the micro hydro power development in China and exploring the potential technical support including equipment supply from China
11	Nov	India	4	Discussion on exporting China's micro hydro power units to India
12	27 Nov	Canada	1	Discussion on the bilateral cooperation of SHP automation

"SHP (Small Hydropower) for Firewood" Project Launched in China

In order to consolidate results of the "returning arable lands to forests" project and the natural woods protection project, and to well protect the ecosystem in Yangtze River basin, in 2004 an overall starting up of "SHP for Firewood" project is put on a high agenda in China.

Director Cheng Huizhou with the Bureau of Rural Electrification and Hydropower Development of MWR (Ministry of Water Resources) remarks that, last year the "SHP for Firewood" project had ever been implemented in a certain scope and remarkable achievements scored. So this year the project will be carried out extensively and intensively, and there should be more important breakthroughs in the scope, administrative level and governmental support, with aims to prevent forests from being chopped down and help people use clean energy. It fully incarnates compensation to farmers and ecological benefit.

As he introduces that, in the vast middle & west China with the poorest ecological conditions, presently there is still a population of over 100 million people mainly depending on wood and straw for the fuel, and each year 420-560 million m^3 timber or 23.33 million hectare bush turned into ash.

A Vice Minister of MWR named Mr. Jing Zhengshu points out, on the upper reach of Yangtze River where water source originates, over deforestation worsens ecological environment in this basin, with water & soil erosion, desertification and land slide taking place frequently, and it also leads to disastrous damages to ecological environment on the lower reach. For instance, Ganzi Tibetan Autonomous Prefecture of Sichuan province poured into Yangtze River silt with a amount of over 700 million ton in the past each year.

He continues that, in China the total installed capacity of SHP stations is up to 24,850MW, almost the total amount of SHP capacity in other countries. Farmers who always relied on firewood have already found an alternative energy by means that local governments encourage local people to build up SHP stations, and up to now it is accumulated that over 300 million farmers living in hilly areas are supplied with electric power.

In recent years, SHP in Qinghai, Gansu, Sichuan and other provinces develops very rapidly, and in the whole western China 10,360MW SHP has already been exploited, accounting for 56.6% of the total in China. This plays a key role to protect the ecological environment in west China, especially the Yangtze River basin. In the 1980s, the "SHP for Firewood" project was initiated in Kangding county of Ganzi Tibetan Autonomous Prefecture in Sichuan province, which uprooted the bad habit of felling trees and forests gradually recovered. According to statistics, by the end of last year totally 1.5 million households had already targeted the goal of "SHP for Firewood" project in 104 primarily-electrified rural counties of Sichuan. If each family consumes 6,000kg firewood every year, in Sichuan province over 4 million m^3 timber can be saved every year, which equals to preserve a forest with an area of 40,000 hectare.

For a long term, the prevailing habit of taking wood for fuel seriously damages forests and vegetation at the origins of main four tributaries (Xiang river, Zi river, Yuan river and Li river) of Yangtze River in Hunan province. Statistics shows that, during 1957-1984 the forest rate in these four basins was decreased from 57% to 35%, and the forest storage was reduced by 100 million m^3. Two years ago, the "SHP for Firewood" project began to be implemented gradually at the origins of these four tributaries, and with measures taken to develop SHP and set up areas where chopping-down is forbidden etc., the conservative habit of farmers firing timber was gradually altered. Now, the forest and vegetation in these basins come to restoration, and it is estimated that presently the silt amount poured into Dongting Lake is reduced by almost 40% each year, compared with the past years.

Mr. Li Qidao, a well-known SHP expert in China introduces that, SHP price is relatively cheap, much lower than the power price in cities, so it is a kind affordable to farmers. He continues that, as a clean and renewable energy, SHP is characterized with low development cost, low investment risk, easy maintenance and cheap operation expense etc., and with favorable policy supports of the government, local people are also highly zealous to develop SHP.

Vice Minister Jing Zhengshu has ever mentioned that, after enforcement of the "returning arable lands to forests" project and the natural woods protection project, how to prevent farmers from felling trees and permanently keep the ecological protection success is a top concern of Chinese government. It is truly difficult to keep farmers from chopping down forests by mandatory measures. SHP, as an alternative energy, provides persuasive measures to address this problem. So it can be concluded that SHP for Firewood is the most effective and fundamental approach to protect the ecological environment in Yangtze River basin. ■

Source: SHP NEWS Editorial office
http: //www.hrcshp.org

(Lin Ning, HRC)

"Small Hydro Power for Firewood" Ecological Protection Project Initiated, Kindling Another Bright Spot of Hydro Construction

—In Dec 2003, the launching ceremony of "Small Hydro Power for Firewood" Ecological Protection Project was started simultaneously in Sichuan, Guangxi, Yunnan, Guizhou and Shanxi of China, signifying the formal initialization of nationwide "Small Hydro Power for Firewood" Ecological Protection Project.

Both No 2 Document in 2002 and No 3 Document in 2003 from the Central Committee of Communist Party of China listed the rural hydro power covering thousand rural households and enhancing the income of the farmers as the important mid and small type infrastructure building, requesting to expand the scale of construction, to enrich the items of construction and to initiate the pilot projects of the "Small Hydro Power for Firewood" Ecological Protection Project. The No 16 Document of the State Council set forth further requirements for implementing "Small Hydro Power for Firewood" Ecological Protection Project in the pilot areas. The Chinese Ministry of Water Resources listed the "Small Hydro Power for Firewood" Ecological Protection Project as one of the "three bright spots" for hydro construction.

The third session of the 16th Central Committee of CPC pointed out that the principle of people oriented, comprehensive, coordinated and sustainable development must be persisted so as to stimulate the overall development of our economy, society and people. The rural hydro power is an important mid and small public infrastructure in the rural areas. The substantial exploitation of rural hydro power and implementation of "Small Hydro Power for Firewood" Ecological Protection Project will directly benefit millions of rural households — a wise decision made by CPC and the State Council at strategic height to protect the ecology, improve the living of the farmers and enrich themselves in the long run.

The development of the rural hydro power and implementation of "Small Hydro Power for Firewood" Ecological Protection Project are multi-functional. Salient social, economic and ecological benefits are to be achieved.

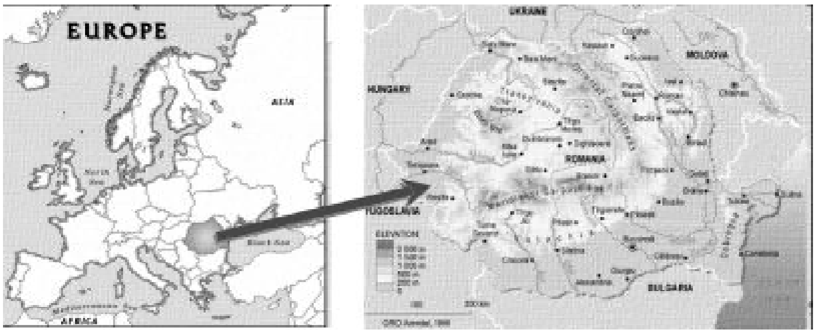
After the implementation, the problem of burning hay by around 104 million farmers could be resolved, reducing the consumption of burning hay 149 million cm, protecting 340 million mu (15 mu is equal to 1 ha) of forest, reducing the annual emission of 200 million ton of carbon dioxide and 920000 ton of sulfur dioxide. The implementation of the project could unfetter the rural productive forces, change the backward living and life status, alleviate the hardship of chopping and burning the hay, improve the living condition in the countryside and promote the coordinated development between the rural regions and towns.

The rural hydro power potential in China is abundant, with the exploitable around 130 mil kW which is listed No 1 in the whole world. In the recent years, the new installation of rural hydro power accounts for 2 million kW annually. By the end of 2002, over 1500 counties (cities) developed the rural hydro power and constructed 48,000 SHP stations with the total installed capacity 33000 MW and annual power generation 108.4 billion kWh, representing around 40% of the national total hydro power installed capacity and output. Half of the land, one third of the counties (cities) and one fourth of the population were mainly supplied by the rural hydro power. China's rural hydro power provided or provides supply to over 500 million rural population. Such result is remarkable, as it plays a special role in promoting the rural social and economic development. In many of the counties where the rural hydro power was developed to a full degree, the local economy was boomed and new look emerged. The experiments of Small Hydro Power for Firewood" Ecological Protection Project are going on in a number of provinces. The scenic regions like wulong and Jiuzhaigou in Sichuan province have become the zone of non-smokers and Kangding recovered its previous luxuriant conditions. In Abazhou, the towns of "Small Hydro Power for Firewood" Ecological Protection Project have reached over 50%. In Hunan province, *(Continued on page 8)*

Country Report on Small Hydro Power

ROMANIA

This presentation delivered by Mr. Mihai Alexandru Cristescu with Ministry of Economy and Commerce, General Division for International Economic Cooperation and Ms. Adriana Dadu with ICEMENERG S. A., Energy Research and Modernizing Institute at 2003 TCDC SHP Training Workshop (9 Oct.~18 Nov. 2003), Hangzhou, China.



- **Location**: Romania is situated in the south-east of Central Europe, in the lower Danube basin, bordering in East with the Black Sea
- **Population:** 21.6 mill. inhabitants
- **Gross domestic product**: about 40 bill. USD
- **Electricity**: total production 54.7 TWh
- 55.9 % - Thermo
- 29.4 % - Hydro
- 10.1 % - Nuclear
- 4.6 % - IPP

1 ENERGY SECTOR

General data (2002):

- Total installed capacity 19,972 MW of which:
  - 13,009 MW - Termoelectrica
  - 5,803 MW - Hidroelectrica
  - 700 MW - Nuclearelectrica
- Total electricity generation 53,860 GWh of which:
  - 31,461 GWh - Termoelectrica
  - 14,480 GWh - Hidroelectrica
  - 5,446 GWh – Nuclearelectrica
- Electricity transmission:
  - Transmission lines total length: 9,684 km
  - Overall installed capacity: 35,948 MW (77 stations)
  - Electricity transmitted in 2002: 32,600 GWh
- The distribution of electrical energy:
  - 8.5 customers in Romania
  - 858 substations
  - 65,660 substations

Main companies acting in this sector:

- TERMOELECTRICA SA - electricity generation and supply, heat generation, transmission, distribution and supply using coal or hydrocarbons as fuel;
- HIDROELECTRICA SA - electricity generation in hydro power plants and power supply;
- NUCLEARELECTRICA SA - electricity generation using nuclear fuel, nuclear fuel production;
- TRANSELECTRICA SA - electricity transmission and dispatching, organisation and administration of power market, international electricity transit;
- ELECTRICA SA - electricity distribution and supply, exploitation and development of distribution and telecommunication systems.
- The activity of these companies is carried on based on licenses granted by the National Energy Regulating Authority (N.E.R.A).

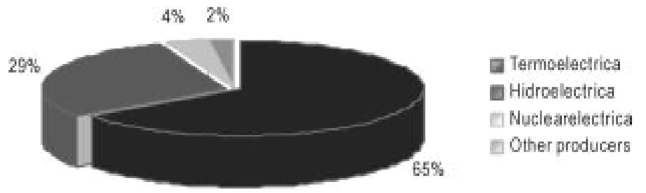


Fig.1 Energy sector

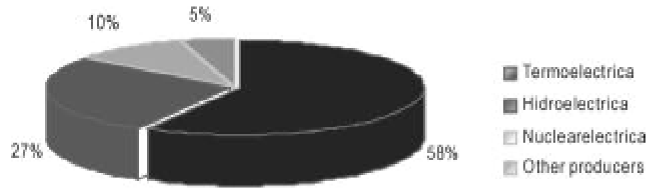


Fig.2 Electric power production in 2002

Main objectives of national energy strategy:

● Passing of the European Union regulations into the Romanian legislation regarding power efficiency and safety in the field of nuclear power;
● Restructuring energy sector;
● Ensuring the power needs of Romania at lower prices, by diversifying the sources and creating new infrastructures;
● Creation of integrated power plants, for which the sphere of activity shall include the electric and thermal power generation, based on coal as well;
● Operation of the national power system under safety and reliability conditions;
● Environmental protection by judicious use of the power resources;
● Interconnection of the national transport network to main European networks, and also to the infrastructure in construction.

Power sector privatisation:

● The privatization of the energy sector must take into account the development of an efficient energy market that would ensure the sustained growth of power generation at a high quality, in accordance with the European standards and the European environmental programs.
● In the field of electrical and thermal energy production is considered the privatisation of several plants with the participation of strategic investors through the following methods:
➢ Joint ventures - Public Private Partnership;
➢ B.O.T. (Build - Operate - Transfer);
➢ B.O.O. (Build - Own - Operate).

2 HIDROELECTRICA

S.C. HIDROELECTRICA S.A.

● Object of activity: generation and supply of electrical power;
● Installed capacity: about 5800 MW, with a productivity of 16 TWh / year in average, that means 40% from the total installed power possible to be achieved;
● Power generated in 2002: 14,500 GWh;
● Assets: 129 hydroelectric plants - 326 hydro aggregates;
● Economic feasible hydropower potential of Romania – 40,000 GWh / year.

Main objectives:

● Rehabilitation / modernisation of aggregates amounting to 985 MW, 196 Mill USD;
● New capacity development, about 800 MW, 1.3 bill. USD, as follows:
➢ continuing the works at the hydroelectric plants being under construction, for an installed power of about 200MW with an investment over 100 mill. USD;
➢ 21 objectives will be accomplished by attracting private domestic and international capital, under public-private partnership frames:
➢ joint ventures;
➢ B.O.T. (Build – Operate - Transfer);
➢ B.O.O. (Build – Own - Operate).

3 FROM THE BEGINNING…

The first starts as regards the flow energy use in our country could be found very long time ago, when Romans were ruling, the written documents describing the water tympanum and rotary cup as wheels to irrigate, the mill wheels or the crank falling mills to crush the minerals.

The first hydroelectric plant in ROMANIA which was documentarily attested was the Grozavesti plant built in 1889 on the Ciurel lake, BUCHAREST, having a 2×180 HP power. It has been in operation until 1912 when it was replaced with TPP Grozavesti.

The first mixed power plant in Romania, Sadu One, was built in 1896 in the Sadu Valley at 18 km from Sibiu town.

Twenty-one hydroelectric plants have been accomplished in Romania, having an installed power of 4550 kW, among which we mention HPP Sinaia I (4 ×250 kW) that has been in operation since 1898. Sinaia HPP is not important from the energetic point of view because it has no impressive power. But that time, it was the greatest power plant in Romania. It was then when it was achieved the first three - phased electric generation at 50 Hz. In 1889, Sinaia HPP was interconnected to Doftana TPP by an 8 kV line, on wood poles. It was the first interconnected operation of two power plant, the first interconnection line and in the same time the first 8kV line in Romania. Sinaia HPP operates even today, with three of the four groups initially installed, one of groups being replaced in 1927 by a new aggregate which had superior efficiency.

4 DEVELOPING…

During the period of 1900 - 1930 we continued to build hydropower plants (excepting the war period), therefore in 1930 the hydroelectric plants power was 30 MW, with a 75 GWh generation.

During the period of 1928 - 1930 Dobresti HPP was built and put in operation and it will remain the plant with the greatest installed power in the country until 1960, when the first hydro aggregate of Stejaru HPP was put in operation.

In 1933 it was carried out the first development schedule of the Romanian hydropower potential by Professor Dorin Pavel, which was published in the work entitled “Plan General d’Amenagement des forces hydrauliques en Roumanie”. Starting with the evaluation of the developing the Danube, the schedule presented in a unique and modern concept the development schedules and the technical - economic indicators of a number of 567 hydroelectric plants.

5 … FOR FUTURE

1961 - 1970: Stations summing up altogether 960 MW power installed were brought into operation 1971 - 1980: Were brought into operation at their capacity the Iron Gates HPP, Ciunget - Lotru HPP, the first power plants from the Olt river development, having a total power installed of 2130 MW;

1981 - 1990: A very large number of aggregates was brought into operation, 145~about 45 % of the entire number of aggregates being in operation at present in HPP, having Pi= 3.2 MW. The total power installed in this decade is about 2110 MW power plants;

1991 - 2000: 452 MW were brought into operation in power plants, the execution of which has started before 1989.

2001: It have been achieved the following commissions:

- HA 10 - 27,5 MW The additional power station Yugoslavia - Portile de Fier II;
- HA 1 - 3,8 MW CHE Dragoslavele - Dambovita Development;
- The accumulation of Cornetu - The development of Olt Defileu and the first rotation of HA 1 - CHE Cornetu.

2002: It have been achieved the commissioning of HA1 - 16,6 MW at CHE

- Cornetu and following the commissioning of HA II in Dec.

The total power installed of the hydroelectric plants in Romania reaches at present at 6017 MW, producing 17,262 GWh / year in the average hydrologic year.

6 DEVELOPMENTS

Included developments	No.of plants and Pumping statipns	Installed power MW	Annual energy GWh/year
Lotru, Olt	26	1180,80	2751,36
Dunare, Portile de Fier I si II	3	1378,2	6561
Bistrita, Siret, Prut	81	667,73	1761,1
Somesul Cald, Cris, Dragan, lad	59	565,84	1096,39
Arges, Dambotita, Raul Targului	65	634,34	1281,89
Raul Mare	24	488,9	850,29
Sebes, Fenes	6	348,2	609,73
Cerna, Motru, Tismana, Jiu	17	206,2	504,9
Bistrita Marului, Cerna	11	164,37	303,7
Buzau, Canal Dunare-Marea Neagra	13	98,19	3017
Olt	8	379	889
Olt Sadu, Cibin, Tarlung	34	149,55	387,69
Total	**347**	**6260,78**	**17298,78**

Romanian hydro energetic potential is 40000GWh / year.
It is already installed about 40%, out of witch SHP about 4000 GWh / year.

7 SMALL HYDRO POWER

In Romania the first SHP’s are recorded at the end of 19th century, some of them being up to now under operation. Until 1975 those were considered uninteresting from economic point of view but later the SHP’s caught again the attention.

Today Romania’s hydropower producer HIDROELECTRICA operates 386 micro hydropower plants. According to sector analysts there may be about 5000 locations in Romania suitable for the construction of SHP’s

Conventionally, the sites comprised in the Romanian micro hydroelectric program had been classified having in view the installed capacity as follows:

- SHP with installed capacity from 200 up to 3600 kW
- MHP (micro hydropower plants) with installed capacity from 20 up to 200 kW
- AHP (artizanal hydropower plants) with installed capacity below 20kW

Type	Installed capacity (kW)	No. of units
SHP	200-3000	200
MHP	20 - 200	30
AHP	Below 20	No data

Applied constructive solutions:

The SHP and MHP development schemes had been adopted according to the specific hydraulic and topogeologic conditions for each site. As dominant schemes we meet cascade developments with diversions under pressure, no surge tank and equipped with one or tow units. The installed discharges are equal or higher than 2-2.5 times as the average discharge. Intakes are usually on the run of the river with compensating reservoir having a volume so dimensioned to ensure minimum half an hour operation at rated capacity.

In the aim to decrease the power stations investments and the construction periods the constructive solutions as the equipments are standardized as possible as much.

Turbine type and dimensions:

The following types and dimensions had been established in order to cover the heads from 2 up to 150m and discharges field from 0.63 up to 6.3 m^3/s.

1. EOS – helicoidally, horizontal with S shape circuit; rotor diameters: 500, 700, 900 and 1100mm;
2. FO – Francis horizontal; rotor diameters 390, 570, 640 and 720 mm;
3. Banki with diameters of 200, 300 and 400 mm;
4. MLU- micro units used at large scale- vertical helicoidally turbine with the rotor diameters of 250mm and metallic spiral chamber.

For the AHP horizontal Pelton turbines or pumps manufactured by AVERSA factory in Bucharest as series production had been used to.

The rotation speeds and the blades positions for EOS turbines had been so established function of the ratio head/discharge in the aim to ensure a stable operation at maximum efficiency of the appropriate turbine type.

Generator types and dimensions

For the standard turbines coupling mentioned before horizontal asynchronous generators carried out by RESITA Building Machineries Factory or motors manufactured by Bucharest Electric Machines Factory as series production had been provided. Their main characteristics are:

1. Speed range from 300 up to 750 rpm;
2. Power from 75 up to 800 kW.

Hydromechanics equipment types and dimensions

Both for hydropower plants and water intakes the main hydromechanics equipments are standardized.

Standard solutions for structures

Function of the turbines and generators type and dimensions, had been drawn up standard details for the hydropower plant structures.

The water intakes had been carried out as Tyrolean intakes standardizing their construction for the following sizes at cached maximum discharges: 0.63, 1, 1.6, 2.5, 4 and 6.3 m^3/s.

The constructive solutions for headraces and downstream joint to the river had been considered powerfully prevalent of the particular natural conditions of each development so they hadn't been comprised within standardization actions.

In case of developments carried out to the existent storages located in plain regions siphon type headraces are prevailing. At the beginning the Owners had required these solutions in the aim to do not affect the safety and the operation conditions.

8 INTERNATIONAL COOPERATION

ALGERIA: Drawing-up of projects and Technical assistance

Performance projects and technical assistance for the dams: Koudiat-Medaour, Sidi-Yacoub, El-Fakia; -Consultancy services and technical assistance for Electricite de France.

Bolivia: Preliminary studies and Investigations

Evaluatioan of energy resources and preparation of the national electrification program HPSs Rositas-Rio Grande , Iola, San Jose.

Central African Republic

Preliminary report on the hydropower development of Lobaye River (M'Baiki HPS).

Preliminary assessment of the hydropower potential of Sahgha-Mambere, Lobaye, M'Poko Rivers.

Columbia: Preliminary studies and Investigations

Organization of Colombian power sector, inventory of hydropower resources as an alternative for thermal power plants, long-term development of power system.

GERMANY: Technical assistance

Co-operation at the hydropower project in the third countries (Bataang Agam HPS-Indonezia, Mukungawa HPS –Rwanda).

IRAN: Preliminary studies and Investigations

Recognition and preliminary studies for water supply systems of towns: Ghom and Yazd; Shah Reza; Ardakan and Yazd; Irrigations in the Mazlagham plain.

Studies related to the possibilities of dam construction the Iranian-Turkish border rivers.

Drawing-up of projects

Feasibility studies, final project and contract document related to Vafregan (arch H=125 m), Noubaran (arch H=59,5m) Barun (earth H=77m) dams and Saveh HPS of 10 MW.

Tender evaluation and contract conclusion for the construction of Vafregan dam.

Updating of the feasibility studies, drawing-up of final design, tender documents for alavian rock fill dam (H=75m) and HPS (6MW), and Marun rock fill dam(H=175 m) and HPS (145 MW) .

Expertise related to the spillway refurbishment of Karun dams (16200 cm/s).

LEBANON: Drawing-up of projects

Feasibility studies related to the development of Oronte (11,6MW-Hermel HPS) and Yammouneh (11, 7MW-Chlifa HPS) water courses.

Expertise of the water supply system of Beirut town and technical assistance for drawing-up the performance design.

NEPAL: Technical assistance

Technical assistance services at Bhote Koshi dam through HARZA Engineering International-USA.

PERU: Technical assistance

Engineering geological studies and hydrotechnical structures related to the hydroelectric projects.

SYRIA: Preliminary studies and Investigations

Lay-out for development of dams and water storages in the coastal areas.

Performing of project and technical assistance during construction and commissioning of the raw water supply system of Banyas Rafinery.

TURKEY: Drawing-up of projects

Multiporpose development scheme of Seyhan river and fesibility report related to Catalan earth dam (H=94 m) and 155MW HPS, Imamoglu irrigation tunnel.

Engineering services related to delivery, erection and commissioning of the mechanical and electric equipment of Kapulukaya HPS (3×18.2MW) and Kilickaya (135MW switchaed, 35 kV indoor switchyard).

Consultancy services and technical assitance for HARZA Eng.Int.-USA for Boyabat development (Dam and HPS with 500 MW power).

9 ENERGY RESEARCH AND MODERNIZING INSTITUTE —ICEMENERG SA

ICEMENERG is specialized in the fields of power plants, substations and electric networks, performing two types of activities:

- Scientific Research and Engineering.
- Technical Assistance and Service.

As a part of a scientific research and engineering activity, prognoses, studies and research works are performed for the safe operations of the power generating equipment, as well as for the transmission, distribution and utilization of heat and power.

The institute develops research works for raising the technical level in the design, manufacture and operation of the power equipment and for increasing efficiency of power plants, substations and networks.

The Institute ensures technical assistance for commissioning and service for a wide range of electric and electronic equipment.

ICEMENERG is endowed with laboratories, workshops, test stands and up-to-date testing equipment and employs highly qualified personnel.

10 ENVIRONMENT – ENERGY CENTER

SPRTI – Policies, Regulation, Information Technology Department

- Policies, Regulations, System Methodologies.
- Methods for the determination of the service costs in the electricity transmission and distribution system.
- Economic mechanisms and instruments characteristic of the electricity market.
- Energy development strategies.
- SCADA systems for the power plants and high voltage electric substations management.
- Modern electricity and heat measurement / billing systems.
- Modern systems for the monitoring / measurement of the hydroelectric power plants.
- Consultancy and technical assistance in telecommunications fields.
- Hardware and Software Technical Assistance.

SME – Environmental & Echo technologies Department

De polluting Installations, Noxious Measurements and Environmental Protection.

LMN – New materials laboratory

New materials and technologies for sustainable energetically development and power equipment maintenance.

LUER – Energy efficiency & renewable laboratory

- Energy efficiency in industry, tertiary and domestic sector.
- Energy efficiency in buildings and for municipalities.
- Small and medium scale combined heat & power systems for industry, district heating and residential.
- Power management; energy efficiency quality and labelling.
- Procedures and facilities for energy efficiency certification of domestic appliances.
- Renewable energy sources: solar, wind, micro-hydro, geothermal, biomass.

11 TRANSMISSION AND DISTRIBUTION CENTER

SESR - Electric Equipment, Substation and Networks Department Electric Transformers and Apparatus.

LATP – Automation and protections laboratory.

ODE - Energy Documentation Office.

REFERENCES:

The Electricity and Thermal Power Generation, Transmission and Distribution Review (includes the Energy Information Bulletin).

The review of "National Electricity Company" – CONEL – presents the actual activities carried out for the NPS efficient operation, the causes of failures and events occurred in the plant enterprises and electric networks, labour safety and protection legislation, economic and organizational aspects, technical solutions for the energy sector retrofitting, repairs technologies, measures for the safe operation of the power installations, tariffs and costs of electricity and related services.

Power Standards Bulletin

The publication comprises the standards which are most frequently requested by the electricity and thermal power generators and users.

The Catalogue of the National Electricity company – CONEL

The catalogue includes the titles of the regulations in force for electricity and thermal power generation, transmission and distribution – design, operation, repairs and supply. The catalogue offers you general energy specifications, specifications for specific activities and installations, as well as internal regulations. The standards included in the catalogue are grouped according to works and installations types.

12 ELECTRICITY AND HEAT GENERATION CENTER

STM - Thermal & Mechanical Department.

SEDM - Metal Expertise and Diagnosis Department.

SAHME - Automations, Hydropower and Electrical Machines Department.

Automation in power developments:

Designing and implementation of computerized survey systems of processes in power plants and substation.

Expert's finding, diagnosis and determining the performances for all types of RAV's; REH's repairing and maintenance.

Execution of the power plants Teletype dispatching systems utilizing the real time computers.

Hydropower stations:

Commissioning, warranty and performance tests.

Analyses of the hydropower balance and prognosis of the spring floods, rain -drain.

Flood Wave passing over on hydropower plants waterfalls.

Optimisation the hydraulic turbines servo system.

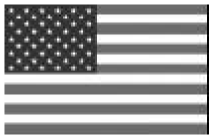
Development of optimum retrofitting, upgrading and maintenance solutions.

On-line monitoring and diagnosis algorithms and development of monitoring installations.

13 ICEMENERG INTERNATIONAL EXPERIENCE

1. Technical assistance for putting in operation of the water treatment plant (demineralization, softening) and boilers chemical cleaning, before putting in operation from:
   El-Mex Factory - Egypt
   Banias Rafinery - Syria
   Kirkalle - Turkey
   Sînjar – Iraq
2. Co-operation with ARIONEX - Switzerland Comp. for ion exchangers demi-water procedure MULTREEX;
3. Expertise of the 107 RH reactor material of the Bania – Syria refinery.
4. Design and development of a flow metering installation at Gezende hydroelectric power plant - Turkey.
5. Dielectric testing and commissioning test monitoring, as well as warranty tests at Rovinari ES together with GEC Alsthom - France. ■

UNITED STATES OF AMERICA



Report submitted by:

National Hydropower Association, USA

Announcement:

We only select Chapter 4,5,6 relate to small hydropower from the country report of United States of America here.

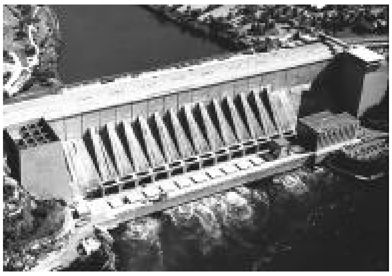
All the country reports including the published reports of Norway, Iran and Ecuador in SHP NEWS were originally published by the International Hydropower Association (IHA). We had made a "The Editor's Note"on page 20 in SHP NEWS, Summer, 2003 for our first reprinting.

4. HYDROPOWER DEVELOPMENT

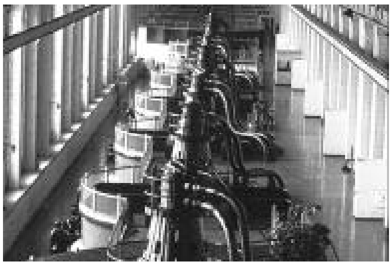
4.1 Overview and reliability

The USA leads the world with about 90 GW of installed hydropower capacity. In the 1700s, Americans recognized the advantages of mechanical hydropower and used it extensively for milling and pumping. By the early 1900s, hydropower accounted for more than 40%of the nation's supply of electricity. Niagara Falls was one of the first American hydropower sites developed for major generation and is still a source of electric power. Today, hydropower is the nation's leading renewable resource, providing enough electricity for more than 30 million homes.

The Federal Government is the largest producer of hydropower, followed by investor-owned utilities, publicly owned facilities and cooperatives. According to the American Public Power Association's 2002 Annual Directory & Statistical Report, the breakdown for ownership of hydropower capacity is as follows: Federal Government facilities: 40,787 MW, investor-owned utilities: 27,626 MW, publicly-owned facilities: 20,202 MW, and cooperative facilities: 1184 MW.



Robert Moses dam, New York (New York Power Authority).



Safe Harbor dam generators, Pennsylvania (Safe Harbor Water Power Corp).

Non-Federal hydropower projects are subject to regulation by Federal and State governments and must receive a licence from the Federal Energy Regulatory Commission (FERC) to operate. There are 2162 FERC-licensed hydropower sites in the USA.

Generally there are five types of hydro project in the USA. They are: impoundment hydropower (using a medium to large sized dam on a river to store water); run-of-river (using the flow of water within the natural range of the river, requiring little or no impoundment); micro hydropower (with capacities of 100 kW or less); diversion hydropower (channelling a portion of the river through a canal or penstock); and, pumped-storage plants.

Hydropower is the USA's most efficient and reliable form of electricity. Well known for its clean and renewable characteristics, hydropower is less well known for its valuable contribution to the reliability of the nation's electricity networks. System operators rely on hydropower's speed and flexibility to meet momentbymoment fluctuations in electric power demand and to restore service after a blackout.

A good example of the importance of reliable electricity occurred in 1965 when 30 million people were without electricity in New England, New York and Ontario. Known as the Great Blackout of 1965, it stranded commuters at the height of rush hour and raised national consciousness as to the need for a more reliable electric grid. A cascading series of power outages made the public aware of the interconnectedness of the system and the need for improved power coordination and emergency response mechanisms. The modern system of regional reliability councils organized under the North American Electric Reliability Council (NERC) grew out of this episode.

But one little known fact is that hydroelectric power was essential to restoring system power after the

Blackout of 1965. Hydropower's black start capability (the ability to restart generation without an outside source of power) enabled system operators to provide auxiliary power to many thermal generation sources that take hours or days to restart. Hydro units were able to energize transmission lines, helping neighbouring systems get back on line. A Federal report on the failure said, "Systems having available hydroelectric generation were able to restore service more rapidly than those dependent solely on thermal generation."

Furthermore, the report to President Lyndon Johnson identified system inadequacies, including the lack of spinning reserves needed to make up for a sudden loss of generation. Although a faulty relay caused the initial outage, like most widespread disturbances, it alone should not have crashed the system. Rather, the failure to respond adequately to the sudden generation dip with reserve power precipitated a sequence of events that left much of the east coast in the dark.

The report concluded, "Our preliminary investigation makes clear that the type and distribution of generating reserves available may be as important as the amount, insofar as emergency use is concerned…. Hydroelectric generation (including pumped storage), and other generating sources with quick starting and load pickup characteristics, are better capable of absorbing sudden increases in load than steam power plants which have slower rates of production increases. We recommend that the factor of quick responsiveness in the event of an emergency should be given due consideration in the evaluation of alternative generating projects."

4.2 Historical review of hydropower

By using water for power generation, people worked with nature to achieve improved living conditions. The mechanical power of falling water is an age-old tool. It was used by the Greeks to turn waterwheels for grinding wheat into flour more than 2000 years ago. In the 1700s, Americans recognized the advantages of mechanical hydropower and used it extensively for milling and pumping. By the early 1900s, hydroelectric power accounted for more than 40% of the nation's supply of electricity. In the 1940s hydropower provided about 75% of all the electricity consumed in the West and Pacific Northwest, and about one-third of the USA's total electrical energy. With the increase in development of other forms of electric power generation, hydropower's percentage has slowly declined, and today provides about 10% of the nation's electricity.

Niagara Falls was the first of the American hydroelectric sites to be developed for major generation and is still a source of electric power today. The early hydroelectric plants were direct current stations built for power arc and incandescent lighting during the period from about 1880 to 1895. When the electric motor came into being, the demand for new electrical energy started its upward spiral. The years 1895 to1915 saw rapid changes in hydroelectric design and a wide variety of plant styles built. Hydroelectric plant design became fairly well standardized after World War I.

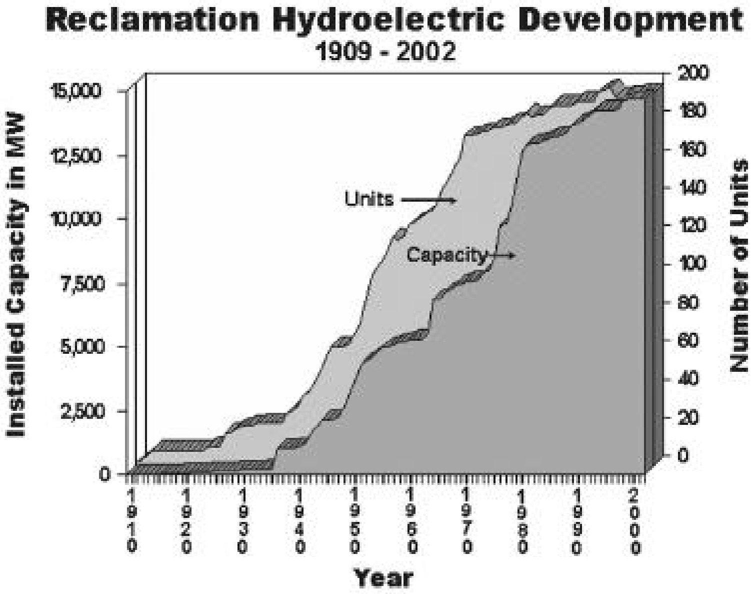


Fig. 1. Reclamation's installed hydro capacity and number of units.

The US Bureau of Reclamation became involved in hydropower production because of its mission to manage water resources in the arid western States. Reclamation dams are major producers of electricity. Hydroelectric power generation (although a by-product of water development) is an integral part of Reclamation's operations. Its hydro capacity is shown in Fig. 1.

In the early days of hydro development, powerplants were installed at the dam sites to support construction camp activities. Hydropower was put to work lifting, moving, and processing materials to build the dams and dig canals. Powerplants ran sawmills, concrete plants, cableways, giant shovels and draglines. Night operations were possible because of the lights fed by hydroelectric power.

When construction was complete, hydropower drove pumps which provided drainage of conveyed water to lands at higher elevations than could be served by gravity-flow canals. Surplus power was sold to existing power distribution systems in the area. Local industries, towns and farm consumers benefited from the low-cost electricity. Much of the construction and operating costs of dams and related facilities were paid for by this sale of surplus power, rather than by the water users alone. The electric revenues proved to be advantageous to irrigators who were struggling to survive in the west.

Reclamation's first hydroelectric plant was built to aid construction of the Theodore Roosevelt dam on the Salt River about 75 miles northeast of Phoenix, Arizona. Small hydroelectric generators, installed before the construction, provided energy for construction and for equipment to lift stone blocks into place. Surplus power was sold to the community, and citizens were quick to support the expansion of the dam's hydroelectric capacity. A 4500 kW power plant was constructed and, in 1909, five generators were in operation, supplying power for pumping irrigation water and furnishing electricity to the Phoenix area.

Power development, a by-product of water development, had a tremendous impact on the area's economy and living conditions. Power was sold to farms, cities, and industries. Wells pumped by electricity meant more irrigated land for agriculture, and pumping also lower water tables in those areas with water logging and alkaline soil problems. By 1916, nine pumping plants were in operation, irrigating more than 10,000 acres. In addition, Reclamation supplied all of the residential and commercial power needs of Phoenix. Cheap hydropower, in abundant supply, attracted industrial development as well. A private company was able to build a large smelter and mill nearby to process low-grade copper ore, using hydroelectric power.

The Theodore Roosevelt plant was one of the first large power facilities constructed by the Federal Government. Its capacity has since been increased from the original 4500 kW to more than 36 MW. Power, first developed for building Theodore Roosevelt dam and for pumping irrigation water, also helped pay for construction, enhanced the lives of farmers and city dwellers, and attracted new industry to the Phoenix area.

During World War I, hydro projects continued to provide water and hydroelectric power to western farms and ranches. This helped to feed and clothe the nation, and the power revenues were a welcome source of income to the Federal Government. The Depression of the 1930s, coupled with widespread floods and drought in the West, spurred the building of great multipurpose Reclamation projects such as Grand Coulee dam on the Columbia River, Hoover dam on the lower Colorado River, and the Central Valley Project in California. The low-cost hydropower produced by those dams had a profound effect on urban and industrial growth.

With the advent of World War II, the nation's need for hydroelectric power soared. At the outbreak of the War, the Axis Nations had three times more available power than the USA. The demand for power was identified in this 1942 statement from the War Programme of the US Department of the Interior:

"The war budget of US$56 billion will require 154 TWh of electric energy annually for the manufacture of airplanes, tanks, guns, warships, and fighting material, and to equip and serve the men of the Army, Navy and Marine Corps."

Each dollar spent for wartime industry required about 2.75 kWh of electric power. The demand exceeded the total production capacity of all existing electric utilities in the country. To produce enough aluminium to meet the President's goal of 60,000 new planes in 1942 alone required 8.5 TWh of electric power. Hydropower provided one of the best ways for rapidly expanding the country's energy output. The addition of more powerplant units at dams throughout the west made it possible to expand energy production, and construction pushed ahead to speed up the availability of power.

From 1940 to 1945, Reclamation powerplants produced 47 TWh of electricity, enough to make: 69,000 aeroplanes, 79,000 machine guns, 5000 ships, 7 million aerial bombs, 5000 tanks, and 31 million shells.

During the War, Reclamation was the major producer of power in the West, where the required resources were located. The supply of low-cost electricity attracted large defence industries to the area. Shipyards, steel mills, chemical companies, oil refineries, and automotive and aircraft factories all needed vast amounts of electrical power. Atomic energy installations were located at Hanford (Washington), to make use of hydropower from Grand Coulee.

While the power output of Reclamation projects energized the war industry, it was also used to process food, light military posts, and meet the needs of the civilian population in many areas. With the end of the war, powerplants were put to use in developing peacetime industries rapidly. Hydropower has been vital for the West's industries, which use mineral resources or farm products as raw materials. Many industries have depended wholly on federal hydropower. In fact, periodic low flows on the Columbia river have disrupted manufacturing in that region from time to time.

Farming was tremendously important to America during the War, and continues to be today. Reclamation delivers 10 trillion gallons of water to more than 31 million people each year, and provides 140,000 western farmers (1 in 5) with irrigation water for 10 million farmland acres which produce 60% of the nation's vegetables and 25% of its fruits and nuts.

Hydropower directly benefits rural areas in three ways:

• It produces revenue, which contributes towards repayment of the cost of irrigation facilities, easing the water users' financial burden.

• It makes irrigation of lands at higher elevations possible through pumping facilities.

• It makes power available for use on farms and for domestic purposes.

Reclamation is second only to the Corps of Engineers in the operation of hydroelectric power plants. Reclamation uses some of the power it produces to run its facilities, such as pumping plants. Hydropower which is excess to project needs is sold by federal power marketing administrations to preferred customers, such as rural electric power cooperatives, public utility districts, municipalities, and State and federal agencies. Any remaining power may be sold to private electric utilities. Reclamation generates enough hydropower to meet the needs of millions of people, and power revenues exceed US$700 million a year. Power revenues are returned to the federal treasury to repay the cost of constructing, operating and maintaining projects.

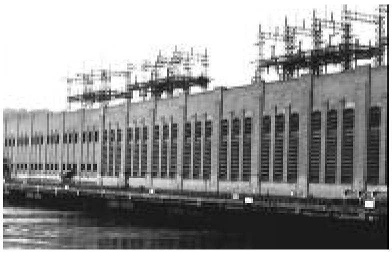
4.3 Use of hydropower

The energy potential of falling water in streams and rivers has been harnessed to produce electric energy for more than a century. Hydro projects provide the most efficient means of producing electric energy. The efficiency of today's hydroelectric plant often exceeds 90%. Hydroelectric plants are free from air pollution, projects have long lives relative to other forms of energy generation, and electric energy is immediately available. These favourable characteristics make hydroelectric projects attractive sources of electric power.

In 1920, hydroelectric power comprised about 30% of the USA's generating capacity and 40% of the energy supplied by electric systems. By the early 1960s, the USA relied more on fossil fuels and hydro's contribution was approximately 20% of electricity generation capacity. Hydro's portion of the energy mix now stands at about 10%.

4.4 Regulation of Federal hydro projects

Hydro projects built by the Federal Government are authorized by Congress and constructed primarily by: the US Department of the Interior, Bureau of Reclamation; the US Army Corps of Engineers; and the Tennessee Valley Authority. For most non-federal hydroelectric power projects, the Federal Energy Regulatory Commission must issue a licence authorizing construction, or in the case of an existing project, continued project operation. Many hydroelectric projects serve other purposes such as navigation, flood control, recreation, irrigation and flow augmentation.



Safe Harbor dam, Pennsylvania (Safe Harbor Water Power Corp)

4.5 Regulation of non-Federal hydro projects

Before passage of the Federal Water Power Act in 1920, project developers needed a special act of Congress to build and operate a hydroelectric plant on navigable streams, or federal lands. Congress authorized construction of the first hydroelectric project in 1884.

Demand for electric power increased substantially during World War I. In 1920, Congress responded to this demand by enacting the Federal Water Power Act, which established the Federal Power Commission (FPC). Composed of the Secretaries of War, Agriculture, and the Interior, the FPC was responsible for licensing non-federal hydroelectric power projects that affect navigable waters, occupy federal lands, use water or water power at a Government dam, or affect the interests of inter-State commerce. The Act also required the FPC to license only those projects that in its judgment were "...best adapted to a comprehensive plan for improving or developing a waterway or waterways..."

Besides meeting the growing need for electric power by establishing an orderly means for developing hydroelectric power, Congress also wanted to protect the public interest in the use of a national resource (streams and rivers) for power generating purposes. In its first two years, the FPC received 321 applications involving the construction of about 15,000 MW of new capacity more than three times the capacity of then-existing water power projects. In 1930, the FPC was reorganized as an independent Commission, composed of five members appointed by the President with the advice and consent of the Senate.

In 1935, Congress amended and recodified the Federal Water Power Act of 1920 as Part I of the Federal Power Act. This legislation extended the FPC's authority to regulate the inter-State aspects of the electric power industry.

In the Department of Energy Organization Act of 1 October 1977, Congress created the Federal Energy Regulatory Commission (FERC) and abolished the FPC. The FERC inherited most of the work done by the FPC, including the licensing of non-federal hydroelectric power projects.

On 16 October 1986, Congress passed the Electric Consumers Protection Act (ECPA), which amended the Federal Power Act. Major changes to the Commission's hydroelectric power programme included:

• eliminating municipal tie-breaker preference in relicensing and establishing new procedures for processing relicense applications to increase opportunities for agencies, interested organizations, and the public to participate in the process;

• requiring the Commission to base its recommendations for mitigating adverse effects of a licensing proposal on the recommendations of Federal and State fish and wildlife agencies and to negotiate with the agencies if disagreements occur;

• requiring the Commission to give the same level of consideration to the environment, recreation, fish and wildlife, and other nonpower values that it gives to power and development objectives in making a licensing decision; and,giving authority to issue compliance orders and assess civil penalties up to US$10,000 per day for violations of rules, regulations, and terms and conditions of a licence or exemption.

On 24 October 1992, Congress enacted the National Energy Policy Act, which affected the Commission's hydropower programme by:

• prohibiting licencees from using the right of eminent domain in parks, recreational areas, or wildlife refuges established under State law;

• allowing applicants for a licence to fund environmental impact statements, referred to as third-party contracting; and,

• authorizing the Commission to assess licencees for costs incurred by fish and wildlife agencies and other natural and cultural resource agencies for studies required under Part I of the Federal Power Act.

4.6 The FERC hydropower programme

FERC's Office of Hydropower Licensing, located in Washington, D. C. and five regional offices throughout the country, is responsible for administering the hydropower programme. The Office consists of two divisions:

(1) The Division of Licensing and Compliance. This:

• processes and analyses applications for preliminary permits, licences (including relicences), and exemptions;

• monitors compliance with terms and conditions;

• takes actions to ensure compliance; and

• evaluates applications for amendment of a licence and other proposed project modifications.

(2) The Division of Dam Safety and Inspections, supported by staff in regional offices in New York, Atlanta, Chicago, San Francisco and Portland (Oregon). This carries out the dam safety and public safety programmes and assists in ensuring compliance with licence terms and conditions.

The Commission employs many specialists to evaluate all phases of construction, operation, and maintenance of non-federal hydropower projects. Specialists include: mechanical, civil, and electrical engineers; geologists; soil scientists; historians; fishery biologists; aquatic ecologists; wildlife biologists; outdoor recreation planners; economists; botanists; ecologists; and land use planners.

4.7 FERC's role

The Commission issues preliminary permits for a period of up to three years, authorizing potential developers to carry out feasibility studies while maintaining priority to apply later for a licence. No construction is authorized. The permittee must submit a status report every six months. A preliminary permit is not a prerequisite for filing a licence application.

The Commission issues licences for hydroelectric projects for periods up to 50 years, after:

• reviewing the engineering, environmental, and economic aspects of the proposal;

• preparing an environmental document that analyses the project's effects;

• making recommendations to mitigate for the adverse effects;

• reviewing the comments and recommendations submitted by other Government agencies, interested organizations and the public; and,

• determining that the proposed project is best adapted to a comprehensive plan for improving or developing a waterway or waterways for beneficial public uses.

When a licence issued to a private entity (for example a private utility, a manufacturing company or an individual) expires, the Commission may issue a new licence (relicence) to the original licensee, or to a new licensee. The Commission may also recommend federal takeover, if it determines that such action would better serve the public interest (this has never occurred). If a federal agency recommends takeover of a project, the Commission postpones its decision for two years to give Congress time to consider the recommendation. Licensed publicly owned (owned by States, cities, irrigation districts, or water conservation districts) projects are not subject to federal takeover. Competition for a project licence is allowed during all new licence proceedings.

For certain types of hydroelectric projects, the Commission issues exemptions from licensing.

4.8 Applications for original Licences

A potential developer of a non-federal hydroelectric project must file an application for a licence or for exemption from licensing (exemptions are discussed later) if the project is or will be:

• located on a navigable waterway of the USA;

• occupying US lands;

• using surplus water or water power from a US Government dam; or,

• located on a body of water over which Congress has Commerce Clause jurisdiction, project construction occurred on or after 26 August 1935, and the project affects the interests of inter-State or foreign commerce.

Before submitting an application for licence or exemption, a potential developer must follow the requirements in the pre-filing consultation process outlined in the Commission's regulations. Under this process, a developer must:

• consult appropriate federal, State, and local government agencies and Indian tribes; hold a meeting with the government agencies, Indian tribes, interested organizations, and local citizens; and,conduct scientific studies;

• request comments on the proposal; respond to the comments;

• hold a meeting with any government agency or Indian tribe which substantively disagrees with the developer's conclusions regarding effects of the proposal on the area's resources or proposed mitigative, protection, or enhancement measures; and

• file an application with the Commission and serve copies to all the consulted agencies.

The application for a licence must contain a complete engineering analysis, including dam safety, operation, and maintenance, and must address economic and financial aspects of developing the project. In addition, it must contain an environmental report describing the effect the project would have on fish, water quality, wildlife, botanical resources, geology, soils, botanical resources, recreation, land use, and socio-economic values. This report also must include proposed mitigative, protective, and enhancement measures.

After an application has been filed with the Commission, the Commission gives the public and interested organizations and government agencies several opportunities to participate in the licensing process. Through public notices and direct mailings, the Commission asks for any additional scientific studies that are needed to analyse the effects of the proposal, requests comments on the application and on the Commission staff's environmental document, and requests recommendations for mitigating for adverse effects. Also, before the Commission staff prepares an environmental document under the provisions of the National Environmental Policy Act and the Commission's regulations, they issue scoping documents and often hold scoping meetings. The scoping process enables interested agencies, organizations and local citizens to help the Commission in:

• identifying the significant issues;

• determining those issues requiring or not requiring detailed analysis;

• determining the depth of analysis required for each issue; and,

• identifying appropriate options to consider.

The Commission may prepare an environmental document (environmental assessment, environmental impact statement, or sometimes both) on a single project or several projects (both existing and proposed) in a river basin. In all cases, the Commission addresses any cumulative effects (combined effect of all proposals and existing projects) that would occur to the area's resources.

Before issuing a licence, the Commission must determine whether a proposed project is "best adapted to a comprehensive plan for improving or developing a waterway or waterways" for beneficial public uses. Among other things, the Commission must consider the extent to which a project is consistent with federal or State comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the hydroelectric project. Also, the Commission must weigh the competing interests, including both power and non-power uses, to ensure a proper balance is achieved between developmental and non-developmental interests in any licensing decision.

In all licences issued, the Commission includes terms and conditions (licence articles) that are the requirements a licensee must comply with to keep the licence in effect. These requirements include engineering, safety, economic and environmental matters. For example, they could include requirements for water quality monitoring, wildlife habitat creation, a public safety plan, an erosion control plan, and engineering design drawings and specifications.

4.9 New licences (relicences)

At least five years before a licence expires, the licensee must file a notice of intent declaring whether or not it intends to seek a new licence for its project. At least two years before the existing licence expires, the licensee must file an application for a new licence (relicence). The procedures for processing a new licence are practically identical to those for an original one.

In 1993, the Commission received applications for 157 new licences. This large number of applications resulted from previous Commission and court decisions and will not be repeated. The greatest amount of authorized generating capacity up for relicensing will occur in 2007: approximately 7420 MW.

4.10 Exemptions

The Commission issued regulations to simplify the filing and review requirements for certain types of projects. These types of applications are submitted for “exemptions”. Obtaining an exemption is a simpler process than applying for a licence.

Those receiving an exemption are exempt from the requirements of Part I of the Federal Power Act. Exemptions are issued in perpetuity, are made subject to mandatory terms and conditions set by Federal and State fish and wildlife agencies and by the Commission, and they do not convey the right of eminent domain.

The Commission issues two types of exemptions. One is for small hydro projects, 5 MW or less, that will be built at an existing dam or utilize a natural water feature for head, or an existing project that has a capacity of 5 MW or less and proposes to increase capacity. The second type is a conduit exemption that would be issued for constructing a hydropower project on an existing conduit (for example an irrigation canal). Authorized generating capacities must be 15 MW or less for non-municipal and 40 MW or less for a municipal project. The conduit must have been constructed primarily for purposes other than power production, andbe located entirely on non-federal lands.

4.11 Dam safety

Dam safety is a critical part of the Commission’s hydropower programme and receives top priority. In terms of the number of projects (dams) inspected (approximately 3036) the Commission’s dam safety programme is the largest in the US Federal Government. Moreover, more than two-thirds of these dams are more than 50 years old. As dams age, concern about their safety and integrity grows and a regular inspection programme is extremely important.

Before projects are constructed, the Commission staff reviews and approves the designs, plans, and specifications of dams, powerhouses, and other structures. During construction, Commission staff engineers frequently inspect a project, and after construction is completed, they inspect it on a regular basis, often every year.

These inspections: verify the dam’s structural integrity; identify required maintenance and remedial modifications; ensure that projects are properly maintained; and verify that licencees comply with the terms and conditions of their licences. Inspection visits are coordinated with resource agencies, State dam safety officials, and other interested agencies.

Connowingo dam, Pennsylvania (Susquehanna Electric Company).

The Commission staff also inspects projects on an unscheduled basis to investigate: potential dam safety problems; complaints about constructing and operating a project; safety concerns related to natural disasters; and, issues concerning compliance with the terms and conditions of a licence.

A licensee must retain an independent board of consultants to review the design and construction of major or complex hydropower projects. Every five years an independent consulting engineer, approved by the Commission, must inspect and evaluate projects with dams higher than 32.8 ft (10 m), or with a total storage capacity of more than 2,000 acre-feet (2.5 million m3). The board identifies any actual or potential deficiencies that might endanger public safety and the Commission requires the dam owners to correct them.

There is concern that seismic events will affect dams; therefore, the Commission retains the services of consultants to assist the Commission staff in addressing this issue at specific dams. Also, the Commission staff monitors and evaluates seismic research in geographic areas where there is concern over possible seismic activity. This information is applied in investigating and performing structural analyses of hydroelectric projects in these potentially affected areas.

The Commission staff, in a continuing effort, evaluates the effects of potential and actual large flood events on the safety of dams. During and after flood events, the Commission staff visits dam sites, determines the extent of damage, if any, and directs any necessary studies or remedial measures the licensee must undertake.

The Commission publishes "Engineering Guidelines for the Evaluation of Hydropower Projects" to guide the Commission's engineering staff and licensees in evaluating dam safety. These guidelines contain the criteria used in, and the analytical approach applied to, evaluating dam safety. Additional chapters are being prepared and existing chapters are frequently revised to reflect current information and methodologies.

The Commission requires licencees to prepare emergency action plans and conducts training sessions on how to develop and test these plans. The plans are designed to serve as an early warning system, if there is a potential of a sudden release of water from a dam failure or an accident at the dam. The plans include operational procedures that may be used, such as reducing reservoir levels and reducing downstream flows, and procedures for notifying affected residents and agencies responsible for emergency management. These plans are frequently updated and tested, to ensure that in emergency situations everyone knows what to do, thus saving lives and minimizing property damage.

4.12 Public safety

The Commission is very concerned about the potential for serious accidents at hydropower projects. The Commission can require an applicant or licensee to install, operate, and maintain signs, lights, sirens, barriers, or other safety devices to warn the public about fluctuations in flows from the project, or to protect the public when using project lands and waters. At many projects, licencees take the initiative and install safety devices, or implement safety measures.

The Commission staff's approach to public safety is project specific. Each project has unique conditions which require different measures, but the ultimate determinant is the level of danger to the public. Besides educating and informing the public of the dangers associated with hydropower projects, licencees use various safety devices and measures including: signs; lights; warning sirens; buoys; boat barriers; fences; safety nets; escape ladders; and guards.

4.13 Compliance and Administration

The Commission monitors and investigates compliance with the Federal Power Act, the Commission rules and regulations, and the terms and conditions of more than 1729 licenes, exemptions, and preliminary permits. The Commission's regional and Washington D.C. offices, government agencies, conservation organizations, and local citizens identify actual and alleged instances of non-compliance.

The compliance programme includes investigating actual incidents, or alleged instances of non-compliance, and taking actions if necessary to resolve them. Generally, the Commission tells the licensee what actions it must take to achieve compliance. In cases where a licensee violates or fails or refuses to comply, it is subject to up to US$10,000 a day in civil penalties. Ultimately, the Commission may seek redress in the courts.

Compliance histories are maintained and considered in determining what actions to take if violations occur in the future. These histories are also evaluated when a project is in the relicensing process, to help determine whether or not the licensee should receive a new licence and, if so, under what conditions.

To ensure that licencees, exemptees, and permittees comply, the Commission uses a computer tracking system. A multi-disciplinary transition group ensures that owners of recently licensed and relicensed projects clearly understand the terms and conditions of their licences, what they are responsible for, and the steps needed to achieve and maintain compliance. Another tool the Commission uses to achieve a better compliance record is the compliance audit. Teams of Commission staff specialists visit a project to help a project owner understand and comply with the requirements of its license or exemption.

4.14 Headwater benefits

In some cases, stream flow is regulated at federal reservoirs and licensed projects located in the headwaters of river basins. Downstream hydropower project owners derive benefits (additional hydroelectric generation) from the regulated stream flow supplied by these headwater projects. With the help of computer models, the Commission determines the charges to levy against the downstream owners benefited by federal headwater projects. Monies collected (averaging more than US$6 million each year) are returned to the US Treasury.

4.15 Recreational opportunities

Licence applicants have to review recreational needs in the area and licencees may be required to supply public recreational facilities during the term of the licence. Often included are facilities for: camping, picnicking, swimming, boating, hiking, fishing and hunting. At existing projects there are more than 28, 000 tent/trailer/recreational vehicle sites, more than 1100 miles of trails and 1200 picnic areas. The total reservoir surface area at licensed projects is more than 3 million acres.

5. PRESENT HYDRO DEVELOPMENT

5.1 Conventional hydro projects

Approximately 2358 hydroelectric plants were operating in the USA (as of January 1997) with 74,800 MW of conventional generating capacity and 18,400 MW of pumped storage capacity. Ownership of this generating capacity is: 44% federal; 35% private; and 21% non-federal public (for example irrigation districts, cities, and water districts). The Commission has authority over about 1016 licences and 617 exemptions.

Washington, California, and Oregon are the leading States in hydroelectric production.

In terms of generating capacity, Susquehanna Power Company and Philadelphia Electric Company operate a 512 MW hydroelectric plant on the Susquehanna river near Conowingo, Maryland, which is the largest privately owned conventional hydro plant in the country. The largest operating non-Federal, publicly owned conventional hydro plant is a 2515 MW plant operated by the New York Power Authority at Niagara Falls, New York.

The largest conventional hydro project owned by the Federal Government is the Grand Coulee project on the Columbia river in north central Washington state, with a capacity of 6180 MW.

5.2 Pumped-storage projects

The 1050 MW Helms pumped-storage project, operated by Pacific Gas and Electric Company in Fresno County, California, has a head of 1630 ft (497 m), the highest in the USA.

The largest operating, privately owned pumped-storage project is jointly owned by Virginia Electric & Power Company and Allegheny Generating Company in Bath County, Virginia. In addition, the largest non-federal, publicly owned pumped-storage project is part of the California Aqueduct Project and has a capacity of 1275 MW. It is operated by the City of Los Angeles. The largest federally owned pumped-storage project is the Tennessee Valley Authority's 1530-MW Raccoon Mountain project on the Tennessee River in Tennessee.

The construction of pumped-storage generating facilities peaked between 1960 and 1970. Trends in the growth of electric power requirements indicate that more pumped-storage capacity will likely be developed over the next ten years. Developers are evaluating sites in many areas, including the States of New Jersey, Washington, Oregon, California, Arizona, Colorado, Arkansas, Tennessee, Ohio, Pennsylvania and Vermont.

6. CURRENT SITUATION AND FUTURE

6.1 Overview

According to the Renewable Energy Annual 2001, recently released by the EIA, electricity generated in the USA from hydropower has dropped significantly. For the first time in ten years, hydropower was not America's leading renewable resource, as electricity consumption from hydropower resources fell 23 %. Overall, total renewable energy consumption fell 12%. These facts should greatly concern Federal and State policymakers, as well as America's energy consumers.

The decline in hydropower generation was primarily attributed to a lack of water resources in the western States, which is a problem that obviously ebbs and flows as a result of ever-changing climatatic conditions. However, there are other serious issues facing hydropower which worsen the impacts of dry years and diminish the positive effects of those years where water is plentiful. These issues include hydropower licensing reform, incentives for new hydropower generation and funding for new hydropower technologies.

Hydropower is a clean, renewable, domestic energy source which provides many power and non-power benefits. It is a vital component of the US energy portfolio and continues to provide clean, emissions-free energy to America's energy consumers. Fixing the licensing process and expanding the development of hydropower at existing dams and reservoirs would further contribute to the US renewable portfolio in a valuable way.

6.1.1 Hydropower licensing reform

To position hydropower more favourably in the US energy portfolio, the hydropower licensing process should be reformed to be more efficient, less complicated and less contentious. The Federal Energy Regulatory Commission is engaged in a rulemaking to resolve many important problems with the licensing process but legislative reforms are needed to complement the administrative reforms gained through the rulemaking. This is particularly important since, within the next 12 years, more than half of all non-federal hydroelectric capacity must undergo a relicensing process. This includes more than 300 projects in 39 States and more than 30,000 MW of

Non-Federal hydro capacity to be relicensed up to 2017

State	Number of projects	Total non-Federal hydro capacity (MW)	Capacity to be relicensed (MW)	Percentage of capacity to be relicensed
Alabama	7	1,640	1,367	83.4
Alaska	6	292	30	10.3
Arizona	2	15	10	66.7
Arkansas	1	897	65	7.2
California	49	10,160	5,829	57.4
Colorado	8	418	336	80.4
Connecticut	3	143	117	81.8
Florida	0	14	0	0
Georgia	8	1,721	346	20.1
Idaho	12	1,766	396	22.4
Illinois	1	57	4	7
Indiana	1	90	81	90
Iowa	1	7	3	42.9
Kansas	0	2	0	0
Kentucky	1	348	80	23
Louisiana	0	192	0	0
Maine	22	717	178	24.8
Maryland	1	513	512	99.8
Massachusetts	6	1,882	6	0.3
Michigan	14	1,985	41	2.1
Minnesota	5	258	97	37.6
Missouri	2	603	584	96.8
Montana	5	575	280	48.7
Nebraska	1	180	48	26.7
Nevada	0	204	0	0
New Hampshire	4	588	324	55.1
New Jersey	1	2380	365	15.3
New Mexico	0	49	0	0
New York	30	5,900	4,178	70.8
North Carolina	14	851	698	82
Ohio	1	1,627	2	0.1
Oklahoma	2	497	360	72.4
Oregon	14	3,424	3,282	95.9
Pennsylvania	6	1,990	1,447	72.7
Rhode Island	0	9	0	0
South Carolina	9	3,631	1,936	53.3
Tennessee	1	327	327	100
Texas	1	130	86	66.2
Utah	8	99	14	14.1
Vermont	9	161	62	38.5
Virginia	5	2,914	721	24.7
Washington	21	9,649	7,667	79.5

capacity, much of it in western States where power supply and water issues are major concerns.

While there are many perspectives, all stakeholders agree that the licensing process is in need of improvement. A multitude of statutes, regulations, agency policies and court decisions have made the process time-consuming, costly, contentious and duplicative. A typical hydropower project can take eight to ten years to make its way through the licensing process. Some projects have taken more than 20 years and cost millions of dollars in process costs. The end result is typically an erosion of operational flexibility and loss of generation capacity. It also frequently results in delayed environmental improvements.

6.1.2 *Incentives for new hydro at existing facilities and non-hydro dams*

Although there is a large amount of untapped hydropower capacity in the USA, hydropower development has been stagnant, almost non-existent, for a long time. Historically, most proposals designed to encourage new renewable energy growth have ignored hydropower and its increasingly marginal economic state because of regulatory costs and capacity restrictions.

A 1998 resource assessment by the Department of Energy concluded that 21,000 MW of additional power from hydroelectric resources could be developed by 2020, none of which would require the construction of a new dam or impoundment. Of the 21, 000 MW, more than 4300 MW of “incremental hydropower” could be developed, meeting today’s environmental standards, at existing hydropower facilities through capacity additions and efficiency improvements. This is enough power for approximately four million homes, clearly a significant contribution to the nation’s energy supply.

Unfortunately, almost none of this potential is being developed. Bringing new hydro generation online is a capital-intensive process. While the costs vary from project to project, new hydro generation (depending on the type of upgrade) runs from US$650 to US$2500 /kW. Hydro’s disadvantages, while not the same as those encountered by other renewable industries, hold equal merit and thus demand similar policies designed to encourage the development of renewable sources of power.

Providing financial incentives for hydro producers, a concept supported supported by 74% of registered voters, will encourage hydropower development at existing sites, allowing the USA to rely more on this clean, domestic resource. Further, it will encourage the deployment of new hydropower technology which will improve the operational performance of hydropower in low water years and address environmental issues more effectively. Without financial incentives, unused hydropower capacity will undoubtedly continue to sit unused.

6.1.3 Appropriations for Advanced Hydropower Technology

For years, the hydropower industry has been working with the Department of Energy to design, develop, test and deploy a new generation of hydropower turbine which will improve fish passage, addresses other environmental impacts of hydropower and improve the efficiency of hydro turbines. This cost-shared programme, the Advanced Hydropower Turbine System (AHTS), has been partly funded by Congress through Energy & Water Appropriations legislation. Industry, which has spent more than US$270 million on R&D since 1994 (with more than US$60 million devoted to fish passage), has also worked with the DOE to address other important hydro R&D issues. While the hydropower programme has shown significant gains towards achieving its valuable goals, full funding from Congress would allow the programme to complete and allow for deployment of valuable new hydro technology soon. ■

Seminar on Financing CDM Projects in China conducted

In 17-18 Feb Seminar on Financing Clean Development Mechanism (CDM) Projects in China was jointly conducted in Beijing by Tsinghua University, Delphi and Faber Maunsell. Present were participants from Development & Reform Commission of China's State Council, Ministry of Science & Technology, China State Environmental Protection Administration, China Energy Conservation Investment Corporation, representatives of UNDP, GEF, UK, Holland and Canadian Embassies in Beijing, the World Bank, international consultancy companies, China's CDM experimental provinces and etc. Invited by international companies, representatives from HRC were also present.

The CDM is one of several "flexibility mechanisms" authorized in the December 1997 Kyoto Protocol. The potential benefits to the developing countries include: promoting the investment for environmentally sound projects/technology from the industrialized countries and financial entities so as to achieve the sustainable development of the developing countries. In accordance with the Protocol, all the countries are grouped into two: The annex I parties consist of those industrialized countries and the non-annex I parties mainly of those developing countries.

CDM in China has not yet been widely publicized and the application procedures complicated. The progress seems a bit slow so far, if compared with such country as India. Some participants commented: "The training is now leaving and you have not got on the train". The officials from Development & Reform Commission of the State Council and Ministry of Science & Technology expressed to speed up the extension process.

The emission reduction effect of SHP is remarkable, which has been fully confirmed by the participants. ■

Source: ***SHP NEWS Editorial office***
http: //www.hrcshp.org

The 8th Annual Meeting on South-South Cooperation conducted

The 8th Annual Meeting on China's South-South Cooperation was conducted in 4-6 Jan in Kunming. HRC's deputy director, Ms. Cheng and HRC's training coordinator Mr.Pan went to participate. In all 32 delegates from 16 member organizations attended.

Chief of China's South-South Division, Mr. Zhao presented the report of "Strengthen China's South-South Cooperation Network to Promote its Development", briefing the status of China's South-South Cooperation development. During the meeting, the following four items were discussed:

1. The resource advantage of China's South-South Cooperation Network;
2. The strategy of developing China's South-South Cooperation Network in the new situation and South-South Cooperation modality;
3. The ways to strengthen the cooperation between China's South-South Cooperation Network and the related institutions in the developing countries;
4. The work plan for 2004.

HRC submitted the report of "SHP International Cooperation: An Important Part of South-South Cooperation. ■

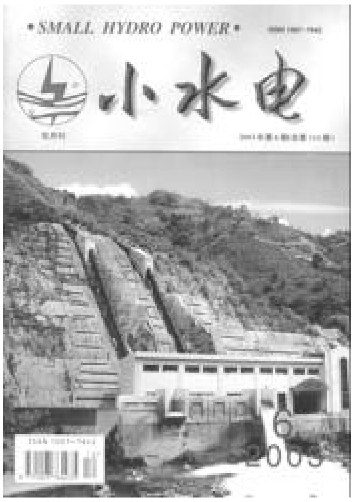
A Chinese Magazine "Small Hydropower" by HRC

The Chinese "Small Hydropower", a magazine that National Research Institute for Rural Electrification (NRIRE) and Hangzhou Regional Centre (Asia-Pacific) for Small Hydro Power has edited and published for 115 issues (bi-monthly), was allocated with the International Standard Serial Number ISSN 1007-7642, and China Standard Serial Number CN33-1204/TV. It was published in Chinese attached with title of articles in English. Its special features are technical experience of SHP development in China. Information of international SHP activities and important events in the field of SHP have also been widely included.

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

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

The main contents of issue No.114 (2003 No 6) read as follow.



Rural Electrification

Making SHP a thriving industry in Gansu province

Technology Exchange

Private funds accelerating the property right reformation of SHP enterprises

Seepage calculation and selection of protective options for the upper reservoir of Huilong pumped storage power plant

The role of electric preventive test in SHP stations

Application of shrinkage inter-joint

Application of PVC pipe in the technical renovation of old culvert pipe inside a reservoir dam

Computer Application

The design of computer-based automatic supervision & control system for Gaohu hydropower station

Application of the layered supervision & control system at Dishan hydropower station

Electro-mechanical equipment

Automatic control of the lubricating device for the speed increaser of Tubular units

Application of the new-type speed governor in SHP station

Renovation

Capacity-enlarging renovation of the turbine-generator unit for Changtan hydropower plant

Operation and Maintenance

The cause and countermeasures of the SCR puncture of BL-1 type excitation system for the generator

Key issues for the maintenance of the slide ring the the carbon brush support

International Exchange

Role of hydropower in sustainable development (3)

Power on tap

Environmental Protection and Hydro:Forming a Partnership

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Add.: P.O.BOX1206, Hangzhou, China
Zip code:310012
Tel.:86-571-88082848 Fax.:86-571-88062934
E-mail:shpnews@hrcshp.org
hrcshp@hotmail.com
http://www.hrcshp.org/shp