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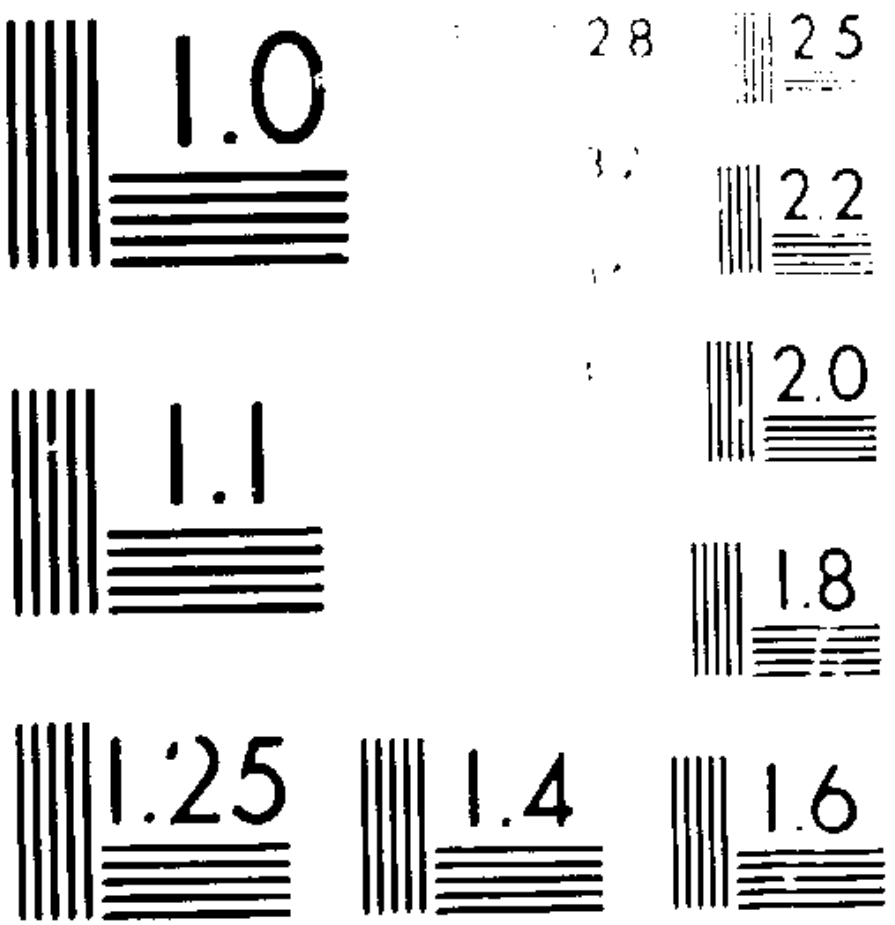
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AN INTRODUCTION TO THE DEVELOPMENT OF SMALL HYDRO-POWER GENERATION IN CHINA*

by

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I. General aspects

At present, energy shortage has become a worldwide problem. Its existence is of a long-termed character.

Measures to be taken by different countries to solve it depend on their situations of available resources.

In places where hydro-power resources are available, small hydro-power stations can be established to help the realization of rural electrification.

From the very outset since liberation in 1949, the Chinese Government has attached great importance to the exploitation of the hydro-power resources. The development is characterized by its large-scale exploitation of the widely distributed smaller hydro-power resources.

As a result of the development of the machine tool industry, difficulties to manufacture the equipments for hydro-power generation have been overcome. Special research institutes equipped with test facilities were set up after 1958 to design medium and small hydro-power equipments, such as water turbines, generators, speed governors and the auxiliary devices. The developing tempo testified the correctness of the way we have taken for rural electrification.

The long-term development of China's hydro-power resources

is one of the effective measures in the course of China's modernization.

China has a rich water power resources with a total deposit which may generate about 580,000 MW, of which approximately 150,000 MW are to be generated by medium and small rivers.

In accordance with the prospect for the development of China's hydro-power resources, hydro-turbine sets rated 6000 KW and under are defined as small-sized units, and hydro-power stations with an installed capacity up to 12,000 KW as small ones. Units below 500 KW capacity are regarded as generating sets " for agricultural purposes ", and those with capacities from several kw up to 200 kw are considered as micro units (or micro sets). They are small-sized and easy to transport.

Since 1958, China has constructed more than 80,000 small and micro hydro-power stations with a total capacity of 5,800 MW. Most of them are built by the people's communes at the county level and they are used by the commune members. Hydro-power generating units with capacities below 500 kw account for more than 60 % of the above-mentioned numbers. They supply the electric power for the local industries and small workshops, for the application of grain drying, wood-cutting, oil extraction, lighting and film-showing, etc. A number of people's communes have set up small hydro-electric power stations with capacities up to 1,000 kw or more. Such people's communes have developed their own local industries, commune-run small factories or workshops and other side-occupation industries. This is one of the ways to reinforce commune's economic strength. Most of the small hydro-power stations run by counties or people's communes have already shaped up their own network for power supply. Thus, wherever dispersed water power resources are available for power generation, the investment for the network could be spared.

Approximately 50% of the counties in China, i.e. about 1,100 in number, are reported to have the hydro-power resources with the potential capacity of 10,000 kw power supply or even higher. In these counties, efforts are being made to have the station with 10,000 kw installed capacity. With about 10,000 kw of electricity available in a county, the initial requirement of power supply for its industrial and agricultural requirement is met.

The development of small and micro-hydro power stations has not only solved the power supply for the people's communes but also has the advantage for multi-purpose requirements, for example, the simultaneous development of its forestry, agriculture, livestock farming, fishery and other commune-run industries.

Now, a great number of people's communes in the rural areas prefer to develop small hydro-power generation stations instead of diesel generating sets because of its fuel expense, difficult handling and complicated maintenance. For example, the fuel consumption for a 120 HP diesel engine, operating 10 hours per day, is 240 kg diesel oil, the total cost for fuel consumption exceeds 2,000 Yuan (the unit of Chinese currency) per month. The cost of electricity is approx. 6-7 cents/kwh, which is a great burden to the commune members. In addition to the low cost of 1-3 cents/kwh, the small hydro-power generating sets have the advantage of no fuel is needed, and it is reliable in performance, simple in maintenance, free from contamination and high efficiency over the wide range of load variations experienced in electricity supply. Therefore, the peasants in the rural areas prefer to develop it. The return of investment for a small hydro-power ststion is between 3-4 years. At present, any county or people's communes, where the hydro-power resources are available, will exert every effort to build small hydro-power stations.

Without electricity, it is impossible for a county or a people's commune to make any long-term planning and development. That's the reason why the small hydro-electric power is developed at an exceedingly fast tempo.

The annual manufacturing capacity of the small hydro-power generating equipment is more them 1,000 MW, and China has a staff specialized in its production and design work, as well as in research and development. They have well accumulated nearly thirty years experiences in manufacture, Further improvements are expected in this respect.

II. China's present status for the develoment of small hydro-power equipment

Before liberation, there wasfew capacity in the manufacture for small hydro-power generating sets in China. Almost all the equipment were imported. In 1952, the first 800 kw water turbine generator sets were produced, and in 1954, we began to manufacture the 10,000 kw hydro-electric sets with a head of over 30 M high.

Due to the abundant hydro-power resources, and big differences in its hydrographical diversity, appropriate measures must be taken in order to meet various requirements, otherwise the result will be a great variety of different models and types which makes the mass production very difficult. Beginning from 1972, standardization of the hydro-power generating equipment was made. Since then, unified design work was practiced on a national scale and strict quality requirement for the products has been defined. The head range for the various types of water turbine generating sets is limited between 2.5–400 meters, and

the outputs of which are between 12 - 12,000 kw.

Recently, we are developing the tubular turbine sets, which are especially suitable for very low heads with large flow rates. In comparison with the conventional vertical-shaft Kaplan sets, the tubular types have the advantage of higher efficiency in the district of large flows. The tubular turbine set is still under research and development stage, especially the medium and small-sized ones. Many technical problems are to be solved for further improvement.

A bulb-type tubular turbine set of 10,000 kw with the runner diameter of $D_1 = 5.5$ meters is just under construction. Another small bulb type and experimental tubular turbine set for a tidal power station will soon be put into operation. It has an output of 500 kw and the runner diameter is $D_1 = 2.5$ m.

We are aware that the microhydro generating sets with the rating capacity from several up to 200 kw is worthy to be developed, especially for these countries where energy resources are limited and the hydro-power resources are widely scattered.

In China, the water turbines are divided, according to their sizes, into two categories: the " large-medium " and the " medium-small ". For the latter type, the specific speed n_s between the different runners are somewhat wider then that of the large-medium type. For reactive turbines n_s are ranged from about 100 up to 760 with 8 runners types, while the impulse type has 4 runners types.

Recently, a research institute in Tianjin has turned out several new types of mini-hydro electric generator sets with capacities from 1 - 20 kw, according to the heads and flowrates

of the sites. Efforts have been devoted to develope designs for, such equipments. Thousands of these units are produced annually. they are much welcomed to those who live in the mountainous regions.

At present we are producing water turbines generators, speed covenors and auxiliary equipments. Further more, we are supplying complete sets including electrical control parts, transformers, switch gears etc., for better service for our rural electrification.

III. The prospect and long-term development of China's small hydro-power generating equipment

China is very abundant in her hydro-power resources. But up to now only 3% of the total reserve is being exploited. Therefore potentiality for its further development exists not only in the micro type, but medium and large type as well.

China's energy policy is the simultaneous development of hydro-power generation and thermal-power generation, and of large, medium and small type of units. Priority is given to those areas where medium and small hydro-power resources are available, so as to relieve considerably the burden for the national grid, and to supply the power needed to develope industry and agriculture on the county and people's commune level. If over one thousand counties in China could be equipped with hydro-power station with an installed capacity of 10,000 kw each, one can imagine how important role they are going to play in the realization of " four modernizations " of our country. Our main target now is to make our efforts for the rapid establishment of " 10,000 kw hydro-electric power in the counties ", which is also

the prospect for the development of small hydro-power resources.

For the construction of small and micro-hydro power stations by counties and people's communes, the Chinese Government's poli- be summarized as follows :

1. Wherever the water resources are promised, the government impels to install small or micro-hydro power stations which would not only step up the productions of industry and agriculture, but also raise the income and living standard of the local populations.

2. Huge amount of state loans with low interest is dedicated annually to people's communes that engage in constructing the aforesaid stations.

3. To the plants that produced hydro-electric power installations and equipments, the government would give timely and appropriate investments to increase production.

4. With the small and microhydro stations that are integrated into the national grid, the state would supply electricity with a privileged charge in order to promote rural electrification.

Production of China's hydro-electric sets is consumed mainly in the home market. But certain amounts have been exported to developing countries in recent years. In face of the unstable resources and fluctuation of petroleum prices, there are also such problems as contamination and the supply of electricity to remote regions, the comprehensive utilization of water resources and the prominent advantages of development of hydro-electricity. China has listed the increasing small and micro-hydro electric equipments as one of the leading items in development. The advantages

of small hydro-electric power would be increasingly recognized by the developing countries. China's experiences in constructing small and microhydro power stations could be of use to other countries.

Due to the varieties of our water resources, our hydro-electric stations and their equipments as well as the experiences there of are quite different too, and we will insistently make improvements and perfections. We heartily welcome hydro-electric experts of developing countries to visit our country, and render our service in cooperation and swapping experiences in technique. As one of the members of UNO as well as the IEC, China would be much obliged to take an active part in various international activities in hydro-electric project and do her best.