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ACCELERATING THE DEVELOPMENT OF GEOTHERMAL ELECTRIC GENERATING FACILITIES IN CHINA

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The first geothermal power plant in China was built sometime during the 1970's. Since that time, eleven demonstration geothermal power stations have been constructed, including: FengShun in GuangDong, Huailai Hebei, WenTang JiangXi, ZhaoYuan ShanDong, ReShuiCun XiangZhou Guangxi, HuiTang HuNan, XiongYue LiaoNing, Langjiu Tibet, YanBaJing Tibet, NaQu Tibet and QingShui Taiwan. The Yangajing in Tibet is the largest geothermal power plant and it provides an economic benefit as well as a positive social impact. All of these plants use low temperature geothermal resources with fluid temperatures less than 200°C. This paper provides a brief history of the progression of geothermal utilization in China and presents some practical recommendations that, if implemented, will accelerate geothermal development.

1. Tibet Geothermal Power

In order to increase the technological and economic development of geothermal power from levels achieved during the 1980's, China redoubled efforts to explore for high temperature geothermal resources and successfully drilled high temperature wells in both the Yangbajing Geothermal field and the Yangyi Geothermal field in Tibet.

1.1 YangBaJing Geothermal field

By the end of 1993, "the Tibet geothermal prospecting team" had finished drilling the first deep well ZK4002 to a depth of 2006 meters. According to initial measurements, a maximum temperature of 329°C was recorded in this well, but for various reasons, it never achieved continuous flow. For this reason, "the Tibet Geothermal Development Corporation" observed the master design requests in the invested Project. The parties studied the well logs and analyzed the data from ZK4002 and ZK352. Then, according to Tibet supporting project report of the United Nations, they made further analysis and research in the fields of deep geologic structure of the geothermal field, the temperature gradient characteristics of the northern geothermal area, and the hydrothermal alteration of the rocks. Based on the input from a wide range of foreign experts, they proposed a new well ZK4001, as the place to drill. On September 17, 1995, drilling began at the ZK4001 site and it was completed on October 15, 1996. The well was drilled to a depth of 1459 meters, with a maximum recorded temperature of 251°C.

Both temperature and lip pressure were measured at the well head. The lip pressure remained stable after 29 minutes of flow, indicating that the fluid supply from this well was sufficient. On the other hand, after 15 days of observation, the water level of ZK4002 decreased by 12 meters from the initial measurement. During the first few days, drawdown was measured at 1 meter lower per day, later it was 0.3 meters per day. From these data it was concluded that there is a hydrologic connection between the two deep wells. It is worth noting that after the15 day flow test, there was no obvious scaling in the well, which should result in a much simpler design for the geothermal power plant.

1.2 Yangyi geothermal field

The Yangyi geothermal field, located 45 km southwest of the Yangbajing geothermal field, is another high temperature reservoir that has the potential for development of 30 MW from wells that range in depth from 300 to 600 m. Temperatures in some wells exceed 200°C, and the water is so low in dissolved solids that even after a month flow test, no scaling was detected. Since the geothermal resource reserves of Yangyi geothermal field have been approved by the National Reserve Committee, the Tibet Power Department intends to develop 12 MW of capacity, with a potential for an additional 12 MW held in reserve.

2. YunNan Province Geothermal Power

Another very hopeful high temperature geothermal field is in Tengkchong County, Yunnan Province. Two large, high heat flow areas have been identified: Huangguaqing-Liuhuangtang and LangPu Reshuitang.. In 1976, a well was drilled in this area and, at a depth of 13 meters, the measured temperature was 145°C. The highest measured temperature was 276°C. Based on the geophysical data, temperatures measured in the geothermal field, an analysis of soil mercury, and an electrical resistivity survey, the size of the geothermal area is estimated to be 14.5 km^2, for a total capacity of 330 MW for 30 years.

3. Favorable Policies in the Ninth Five–Year Planning Period of China

Based on the high enthalpy geothermal fluids in the Yangyi geothermal field, the Yangbajing geothermal field in Tibet, and the Tengchong geothermal field in Yunnan province., it is possible for China to build a large geothermal station during the Ninth, Five-Year Planning Period. This will probably be a single machine with a capacity of more than 10 MW. In order to promote the development of renewable energy resources China has recently implemented a series of favorable policies, which are described below.

3.1 Financial Discount

A financial discount on funds loaned by banks will be given to renewable energy power project infrastructure.

3.2 Repay Capital with Interest and Proper Profit Principle

During the repayment period of a renewable energy resource power project, repayment of capital with interest, plus proper profit may be allowed in principle. Price averaging will be allocated through every part of the power net.

3.3 Encourage Oversea Investment

China will encourage oversea capital to enter into the renewable energy resource business, which will have a tremendous positive impact. For example, the ORMAT Company and the Geothermal Corp. Ltd. of Yunnan province have signed a Joint Venture contract to develop the Tengchong geothermal field. NEDO of Japan is preparing to organize some related organizations to participate in the first stages of developing the geothermal resource in Tibet. With a large inflow of capital from domestic, overseas, and local sources, it is anticipated that China will build high-temperature, world-class geothermal power stations in Tibet and Yunnan Province at the beginning of Twenty-First Century. On the basis of present economics, the installation costs for one kilowatt will range from $1,500 to $2,000, in US dollars. These costs may be further reduced if the design consideration includes stepped energy development and cascading the heat energy into space heating, greenhouses, hot spring baths and farming applications.

4. The Benefit of a Geothermal Power Station

Historically, economic benefits and positive social impact occur with the construction of a modest-sized geothermal power station. For example, the Yangbajing geothermal power station has a capacity of 25 MW, and total investment of about 300 million RMB Yuan. Since June, 1999, the total power output has been more than 12 x 10^9 kWh, and it played an important role in promoting the economic development of LHASA area. Another example is the project in Yunnan Province, where 12 MW geothermal power station which is the first phase of Tengchong geothermal power station will be built in Tengchong. This proposal has been approved by the government, with investment from overseas, the job of building the power station will proceed step by step.

5. How to Promote the Development of the High Temperature Geothermal Power Career

In order to assure the rapid development of a high temperature geothermal power industry during the Ninth Five-Year Planning period, some assignments should be developed in order to complete the following:

5.1 To increase the prospect area of the high temperature geothermal field in Tibet and Yunnan Province

According to the initial investigation report, more than 112 areas with high temperature hydrothermal areas, with temperatures over 150°C, have been identified in Tibet and more than 30 areas have been located in western Yunnan province. Both provinces have the potential to support development of power stations. While these areas are located some distance from the large power grid, they can be developed as a local, detached net with local water power. This will completely solve the problem of the lack of electric power supply on the Southwest border of China.

5.2 Assure the long term reliability, safe and stable operation of Geothermal Power Stations during the Ninth, Five-Year Period

It is important to organize the fundamental elements to solve some technological

difficulties associated with the construction of a geothermal power station. As far as the Yangyi geothermal field, the northern Yangbajing geothermal field, and the Tengchong geothermal field, the most important thing is to solve some of the technological difficulties. These include the use of high temperature drilling fluids, directional drilling, high temperature well measurement instrumentation, the thermodynamics of scale inhibition, scale cleaning, automated power stations, and environmental protection.

5.3 Aggressively develop the international cooperation in the geothermal production and equipment and instruments step by step.

During the 1970's and 1980's, China made significant achievements with demonstration geothermal power plants. With the development of high temperature geothermal areas during the 1990's, the equipment, material, and the single machine capacity should be significantly transformed. With the investment of capital and technology, we may raise the rate of the nationalism of equipment and instruments.

Above all, after implementing a preferred National and local policy for the development of high temperature geothermal resources, augmented by hard work, by the year 2010, the geothermal power industry of our country will make great progress and will achieve worldwide recognition.