Process of Geothermal Energy Development in Japan

Fumio Yamaguchi Seiki Kawazoe

Japan Geothermal Energy Association

Key words: government, regulation, subsidy, development, renewable energy

Abstract

This paper reports on the laws and regulations relating to geothermal energy generation and the promotion scheme for the development of geothermal resources taken by the governmemt of Japan.

No national law has been enacted specifically for the development of geothermal energy or generation in particular. The government has subsidized the New Energy and Industrial Technology Development Organization (NEDO), developers, utilities and local governments for geothermal energy development. The government has also introduced a subsidy system for geothermal well drilling, long term low–interest loans and a tax credit system.

Reseach and development activities and conducted under the leadership of governmental institutes such as the Geological Survey of Japan (GSJ) and the National Institute for Resources and the Environment (NIRE) which belong to the Agency of Industrial Science and Technology (AIST).

1. Introduction

There are an abundance of volcanoes, geothermal fields and hot springs in Japan, Geothermal energy has had a significant impact on Japanese culture, Since ancient times, people have visited hot springs for the purpose of recreation and medical care. "Hot spring businesses" have enabled many towns to establish lodging and amusement centers. Volcanoes, fumaroles and geysers are sightseeing attractions and are included within national parks. After world war Ⅱ, an extreme shortage in the supply of electric power existed and the development of geothermal energy for electricity was encouraged, In late 60's and early 70's, Matsukawa, Otake, Onuma and Onikobe geothermal power plants began commercial operations. In late 70's, Hatchobaru, Kakkonda and Mori put 50MW power plants on line.

As Japan imports most of its energy, the government made great efforts to develop domestic energy sources suchas geothermal, hydro and solar energy after the oil crisis in 1973. The development of nuclear energy proceeded as a semi–domestic form of energy. After the second oil crisis in 1978, the government has been actively engaged in the developmen tof renewalable energy.

This paper introduces laws and regulations related to geothermal energy development. environmental issues governmental promotion of geothermal energy development and agreements between utilities and developers.

2. Laws and Regulations Related to Geothermal Energy Development

No geothermal law has been enacted which prescribes specific procedures for the development of geothermal energy. In case of such a development project, permission needs to be obtained and legislation satisfied for the operation of each step involved in the project.

There are several steps involved in geothermal energy development and include exploration, feasibility studies construction of the power plant and operation. Such a law could make reference to land management, well drilling, water management, construction work, safety and environment.

For the step of exploration and feasibility study, well drilling is the most difficult operation to get a permit. Hot springs are considered the object of ownership provided in the Civil Law. As Geothermal resources are similar to hot springs in terms of getting steam and hot water from underground, permission is required under the provisions of the Hot Spring Law in order to drill geothermal wells, either exploration or production wells. The competent authority for the Hot Spring Law is the Environment Agency. The governor of the local government can grant permission to drill geothermal wells after accepting the opinion of the Natural Environment Conservation Conucil in the local government. The important points for obtaining permission, are the right of land use, location of hot springs near the drilling site and other regulations. In order to aquire the right of land use, field developers have to purchase the site or to lease the site. The local government takes care of any influence of the new well on other hot springs. Other regulations very in accordance with the use of the land. In the case of national forests, the use of these lands is restricted by National Forest Law, Forest Law and State –owned Propety Law. In the case of agricultural land, land use is covered by the Agricultural Land Law, Multiple Purpose Development of Land Act, as well as the improvement of Agricultural Promotion Area Law.

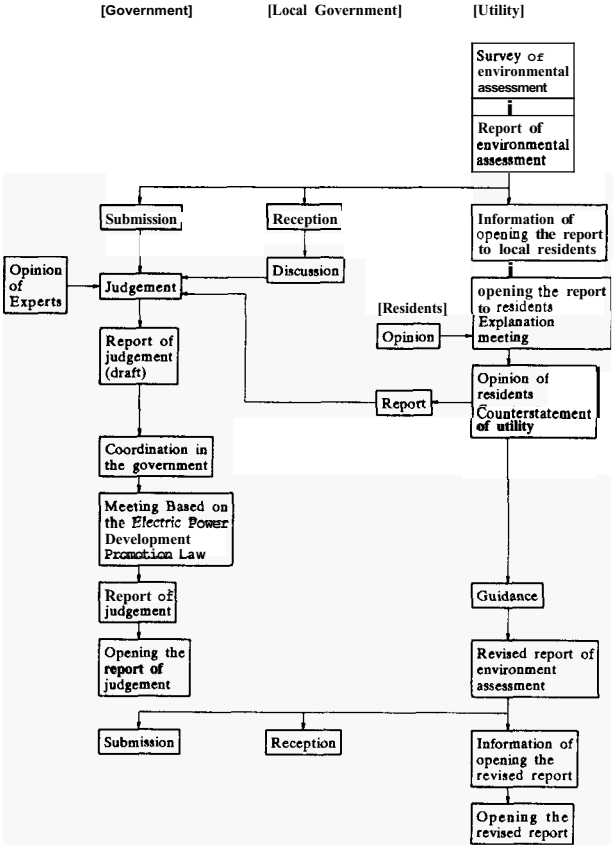
For the construction Stage of a power plant, except small ones, construction plans are required to undergo review in accordance with the Electric Power Development Promotion Law, and appropriate governmental organizations together with an assessment of environmental impact. The plans will be inserted into the National Basic Electric Power Source Plan. Fig.1 shows the procedure of environmental assessment.

For the case of constructing geothermal power plant with a capacity in excess of 10MW, the plant owner has to execute the whole procedure. The plant owner survey environmental measurements based on the guideling for geothermal power plant construction. which was instituted in 1992, and submits a report which includes measurements, a prediction of its likely influence and the counterplan, to the Ministry of International Trade and Industry (MITI).

MITI then reviews the report using the opinion of specialists, the municipal government and residents. Before a meeting based on the Electric Power Development Promotion Law, MITI cordinates the opinion of other govern-

mental organizations, After this procedure, the time for the construction work is identified.
Technical regulations in construction work of geothermal power plants depend on the Electlic Utility Law, the same as for the construction of Fossil Power Plants.
For the operation of geothermal power plants, plant operators should need not only the regulations of the Electric Utility Law but also the regulations of such environmental laws as the Air Pollution Control Act, the Water Pollution Prevention Act, the Effluvium Prevention Act, the Noise Control Act, and the Vibration Control Act.

Figure. 1 Flow chart of Environmental Assessment



3. Geothermal Energy Development Promotion by the Government

After the oil crisis in 1973, the government of Japan made the development of new energy technologies a national project, called the "Sunshine Project" which is an ambitious national technological development program. Energy sources to be treated as the object of the project are as follows: Solar Energy, Geothermal Energy, Coal Gasification and Liquefaction, Hydro Energy and Supporting Research. Surveys of geothermal resources were conducted such as the Nation-wide Geothermal Basic Survey which covered the entire country, detailed Geothermal Development Surveys at the regional level and Geothermal Development Basic Surveys of specific areas.
Furthermore, after the second oil crisis in 1978, the government announced a strategy strategy of accelerated promotion of the "Sunshine Project" and made efforts to enhance the extent and pace of the project by increasing the targets to be developed. In 1980, the New Energy and Industrial Technology Organization (NEDO) was established to act as an implementing agency of the Japanese government in fields related to technological development on the basis of the "Law Concerning the Promotion of the Development and Introduction of Oil-Alternative Energy Sources" .
Though the budget for new energy development had been from the general account only, the Law made it possible to disburse funds from the special account for power sources. The amount of the budget has continued to increase since then.
The Agency of Natural Resources and Energy (ANRE) and the Agency of Industrial Science and Technology (AIST) of the Ministry of International Trade and Industry (MITI) took the initiative for geothermal energy development in the government. ANRE is in charge of surveys and aid systems as well as AIST for research & development. AIST has research institutes for geothermal energy such as the Geological Survey of Japan (GSJ), the National Institute for Resources and the Environment (NIRE) and the Tohoku National Industrial Research Institute. NEDO performs actual surveys and R&D for the government.
In the area of surveys and explorations, the government endeavors to determine the distribution of geothermal resources for the whole country and recommends promising areas in order to decrease the risk for developers. Further, the government carries out R&D for the sake of decreasing risk and costs by improving the effectiveness of surveys. Subsidy systems and long-term low interest loans decrease the initial cost and payment of loan.
Incentives currently performed for geothermal energy development by the government are presented as follows:

3.1 Nationwide Geothermal Resources Exploration Project

This program ended in FY1992. NEDO conducted this project to determine the macroscopic state of resources using remote sensing data and the selection of promising areas.

3.2 Geothermal Development Promotion Survey

This survey is a leading survey conducted by the government for encouraging developers. NEDO executes surveys of those areas that could be expected to produce geothermal energy, where adequate scientific data does not exist and/or in cases where environmental regulations are restrictive or the area in question is remotely located making development by developers difficult.
This program began in 1980. Because of the progress of surveys and technology through the introduction of geothermal resources feasibility study, the program was altered in 1992. In the past, the program was a three-year survey covering 50-70 cl . The current program consists of three types of surveys. Survey A is an area survey of 100-300 km^2 , to verify the presence of high temperature regions in the subsurface. Survey B is a district survey of 50-70 km^2 to verify the presence of geothermal reservoirs. Survey C is a preliminary feasibility study of a 5-10 km^2 area defined as geothermally promising. Production size exploratory wells are drilled in order to test Iong-term production, and the geothermal reservoir potential is estimated.
This project also includes development of new generation systems and development of geothermal reservoir estimation methods. From FY 1985 to FY 1992, preliminary surveys concerning simplified small-scale geothermal power generating facilities were conducted to utilize small-scale geothermal resouces effectively. Two types of facility were developed through this study. One is a 200kW condensing type and the other is a 300kW back pressure type. To utilize 80-150°C hot water effectively, a geothermal binary cycle power generation system has been under study since FY 1991. Under this study, 100kW and 500kW binary cycle turbine-generators will be developed and an evaluation of their economy will be made. The technical method of estimating a geothermal resevoir was developed to alleviate risks associated with development.

3.3 Subsidies for drilling costs of an exploratory well for a geothermal power plant

ANRE subsidizes SO% or less than SO% of the drilling cost of an exploratory well for the development of a geothermal power plant.

This subsidy has to be returned to the government upon completion of the power plant from the fifth year after the commencement of operation. The reason for this system is that the drilling cost is the main expenditure in exploation and that the investiment is usually a long-term debt which cannot be recovered before operation starts. If the developer gives up the development because of low grade resources, he does not have any obligation to return the loan. This means that in essence, a part of the risk is taken by the government.

3.4 Subsidies for power generation using local energy

For the purpose of inducing investment from corporate enterprises, ANRE provides funds to the New Energy Foundation (NEF) for the supplying a part of the interst to a financial firm which gives the loan for the drilling cost in an area proved to have more than 100t/h of steamto developers or local governments. The payment of the interest by the developers is one half of the long-term prime rate if it is greater than 7% and 3.5% if less than 7%.

3.5 Subsidies for the cost of the development of geothermal power generation

Developers and plant owners can be subsidized for less than 20% of the cost of geothermal power plant facilities such as wells, pipelines, and turbine-generators by ANRE. these is no obligation for this subsidy to be returned and makes geothermal genertion cost more economical.

3.6 Surveys concerning the direct use of hot water in a geothermal power plant

ANRE performs the construction of a practical facility for utilizing the hot water in a geothermal power station, which is designed to meet local characterisics and feasibility tests of the technology for direct-use. This survey produces effective utilization of geothermal energy and development of geothermal power stations by obtaining the agreement of the local society which has the merit of geothermal resources.

3.7 Financial Investiments

Government related financial organizations sueh as the Japan Development Bank and Hokkaido Tohoku Development Finance Public Cooperation invest in geothermal development with a special interest rate of category **4** and a financing ratio which is 60% of the total investment.

3.8 Tax credits

Corporate taxes can be reduced for wells, condensors, cooling towers, well head equipments, steam separators, steam tanks, pumps and pipelines for geothermal power plants having a capacity which is greater than 1,000kW. The owner can select either **a** tax reduction of 7% on the purchase ammount or ordinary depreciation plus 30% depreciation in the first year.

The municipal property tax can be reduced for geothermal power plants producing more than 750MW. The standard of assesment may be reduced by 5/6ths during the first thee years of operation.

3.9 Surety of obligation

NEDO guarantees the obligations incurred in geothermal development.

3.10 Technology development

NEDO develops techniques related to geothermal develoment.

In order to investigate geothermal resources which are believed to exist under geothermal storage layers into practical use, a "Deep-Seated Geothermal Resources Survey" was begun in FY 1992 using technologies developed named in the "Development of Drilling and Production Technology for Deep-seated Geothermal Resources" program. For the survey result, particularly looking for fracture type reservoirs,. NEDO has made efforts to improve geophysical surveys such as an array-typa Controlled Source Magnet otelluric survey, Vertical Seisemic Profiling, Seismic Tomography, and practical data processing and analysis software using micro earthquakes. In the area of drilling technology, an MWD system for geothermal wells has been developed and for production, geothermal material development and technology to increase steam productivity have been pursued. Research is also being done into binary cycle power generation and HDR power generation are also researched as new types of geothemal power generation.

4. Rules for promoting Geothermal Energy Development

There are two styles of developing geothermal resouces for generation in Japan. One is an once though style whereby one company constructs all facilities from well to generator. The other is a steam supply style, in which a steam supplier sends steam to a plant owner, usually a utility. In the case of the once through style, the decision to begin construction of a power plant is made inside the company after a feasibility study has been conducted. On the other hand, the steam supplier must explain the results of exploration to the plant owner and the two companies have to conclude a basic agreement regarding power generation. As a large amount of money is reguired for a new plant, the plant owner gives careful consideration to the decision and usually needs long time for discussion.

Therefore, rules for promoting or going ahead with geothermal energy development haue been discussed for a long time.

4.1 Standard price for geothermal steam

In 1992, the Federation of Electric Power Companeies (FEPCO) demonstrated the basic concept when utilities purchase steam from developers.

In short, it has become easier for developers to promote the development of geothermal energy sources as it is possible to sell steam at values that are higher than in the past.

4.2 General principles for coordinating the development of geothermal power plants

In the case of the steam supply style, General Principles for Coordinating the Development of Geothermal Power Plants were outlined by NEDO, FEPCO and the Japan Geothermal Developers Council in 1993 for the sake of putting forth smooth procedures without time losses during the course of total development from the "Geothermal Development Promotion Survey" to the commercial operation.

4.3 Guidelines for Geothermal Reservoir Evaluation

Hearing the opinions of both utilities and steam suppliers, NEDO prepared technical guidelines for geothermal reservoir evaluation in 1993. The guidelines consist of needed surveys, the contents of measurements and evaluation guidelines from the result of the exploratory surveys. These guidelines help in decisions regarding the output of the power plant.

5. Conclusion

From the point of view that Japan depends on most of its

energy from foreign countries, geothermal energy is recognized as an important energy source for Japan. The government promotes its development through subsidies and technology development with the results of these measures showing an increase in capacity.

6. References

Nakashima, H. (1993). Summary of the Fiscal year 1993 Draft Budget in Relation to Geothermal Development (in Japanese), Jnl. Geothermal Energy., Vol. 18(2), PP. 4–15.
AIST/NEDO (1993). Japan's Sunshine Project 1992 Annual Summary of Geothermal Energy R&D, pp. 134.
JGEA (1993). Movement of Geothermal Power Generation in Japan 1993 Version (in Japanese), pp.74.
Electric Power Generation Div., Public Utility Dept., ANRE (1992). Thermal Power Handbook (in Japanese), Denryokushinposha. 831.