# GEOTHERMAL PIPELINE

**Progress and Development Update**
**Geothermal Progress Monitor**

**WASHINGTON**

**GOP Unveils Plan to Boost Alternative Energy Sources, Cut Oil Imports**

Senate Republicans unveiled an energy policy bill that aims to offset foreign oil imports by as much as 50% by maximizing electricity production from alternative energy sources and boosting domestic oil production.

The legislative proposal also contains tax incentives for electricity produced from renewable energy sources, such as wind, solar and "biomass." It also promotes power produced by hydro-electric, nuclear and coal-fired plants.

Senate Majority Leader Trent Lott (R., Miss.) and Senate Energy Committee Chairman Frank Murkowski (R., Alaska) support the bill, which Lott said, "isn't just about increasing oil production, but about boosting energy production from coal, solar, wind and other sources.

Under the bill, a $2,000 residential solar energy tax credit would be created and the tax credit for electricity co-generated with steel and coke production would be extended.

Another tax provision in the bill excludes from electric utilities' gross income any contributions to capital fees paid by customers for connecting electric, natural gas or steam lines.

The Republican proposal would authorize $25 million for the Energy Department to establish an energy-efficiency research grants program, and would call for improving an existing U.S. home-weatherization program.

The measure would require U.S. agencies to inventory U.S.-owned hydropower facilities and develop a report on what upgrade would be necessary to increase power production.

It also calls for the Federal Energy Regulatory Commission to report within six months on measures it needs to expedite the licensing process for privately-owned hydropower plants. The Nuclear Regulatory Commission would be required to report within six months on steps that can be taken to boost output from nuclear-power plants. The bill also calls for the NRC to assess its relicensing procedures and make recommendations for improving and expediting the process.

Furthermore, the bill would create an Office of Spent Nuclear Fuel Research within the Energy Department to administer a grant program for research of "treatment, recycling and disposal" of spent fuel generated by nuclear power plants.

It calls for legislators to assess whether spent fuel destined for long-term storage in a proposed repository at Yucca Mountain, Nevada, should be subject to permanent burial or "considered an energy source that is needed to meet future energy requirements."

The bill notes that future nuclear-power uses may require construction of a second repository unless "improved spent-fuel strategies" are developed to increase the repository's capacity.

The Energy Department would be required to report within six months on the potential for increasing the output of U.S. coal-fired power plants "and any impediments to achieving such (an) increase."

The bill contains language promoting commercial application of clean-coal technologies, and in particular, calls for the Energy Department to provide grants to refine and demonstrate new technologies for the conversion of coal into liquid fuels.

Energy Committee Chairman Murkowski said he would hold hearings on the proposal within the next two weeks. The measure also will require action by the Senate Finance Committee, Murkowski noted. (Source: Dow Jones & Company, May 16, 2000).

**ICELAND**

**Geothermal Powers Húsavík**

The first geothermal power applications of the Kalina Cycle is on schedule for a June 2000 startup. The project is a 2-megawatt (net) binary geothermal power plant being built by the electric division of Húsavík, Iceland.

Once completed, this program will result in what will be one of the most geothermal energy efficient and diverse towns in the world. The 2-MW plant will provide up to 80 percent of the town's electric power demand. The heat source for the plant will come from geothermal wells located 20 km south of Húsavík.

The efficiency and overall economic advantage of the Kalina Cycle over other existing technologies was a prime consideration in the decision to install the Kalina Cycle. The distinguishing trait of the Kalina Cycle is its working fluid of ammonia-water. The efficiency gain is achieved by the ability of this working fluid to closely parallel the temperature of the heat source (in this case–hot geothermal brine) and the heat sink (cooling water). Cost effective energy recuperation within the cycle is also possible due to the unique characteristics of the ammonia-water mixture.

The efficient utilization of the geothermal energy doesn't stop at the power station. In parallel with the power plant, the hot water will be used by local industries for shrimp processing, drying of wool, process heat and drying of hardwood. (The hardwood comes from oak trees cut in Maine, USA, and after drying in Húsavík, is shipped to mainland Europe.) This geothermal energy is even being considered for pasteurizing, sterilizing and evaporating milk for the town's flourishing dairy industry.

The geothermal brine that exits the power station will also be used. After the generation of electric power, the geothermal brine will leave the power station at a cooled temperature of 80°C (176°F). This is just the right temperature for space heating and hot water use in all the homes and business in Húsavík. Other uses of this water include greenhouse heating, snow melting and heating of the town's swimming pool.

Finally, even the cold, clean mountain water used in the Kalina Cycle's condenser finds a secondary use. The cold water, initially at a temperature of 5°C (41°F), exits the condenser at 25°C (80°F). This warm water will be piped to a trout (fish) farm, where the higher temperature promotes optimal growth rate and health conditions for the fish.

The township of Húsavík expects to profit from this program in two ways. The efficient use of geothermal energy will maintain the high environmental standards of the area; while, the availability of inexpensive thermal and electrical energy will promote economic growth. The geothermal capacity potential for the town has been assessed at 75 to 100 megawatts of sustained power generation.

The Kalina Cycle technology was developed by Exergy, Inc., Hayward, California. The design and equipment procurement for this Húsavík plant was executed out of Exergy's Houston, Texas office. (Source: *GEA Washington Update*, May 2000)

## JAPAN

### Power Generation with Thermal Energy Conversion System Using Hot Springs

Introduction

Hot springs have been a part of Japanese culture since ancient times, and are important areas for tourism, therapy and general relaxation. On the other hand, with environmental and energy issues becoming even more prominent as we head into the new millennium, generating power using hot spring water is attracting considerable attention.

From an environmental and energy perspective: 1) hot spring water is a totally indeginerous energy in Japan, 2) it is a clean energy that does not discharge any $CO_2$, 3) it has a higher energy density than other forms of natural energy, 4) it has yet to be fully exploited as a source of energy, and 5) it is almost an unlimited source of energy.

The reason that it has not been fully exploited, is a combination of technological difficulties and low-economical efficiency.

Saga University has been involved in the development of OTEC (Ocean Thermal Energy Conversion), and have been pursuing research into its practical application. From this research, we invented a new cycle, which is called Uehara Cycle, and its application in various power generation systems has attracted substantial interest. Introducing this new cycle and other new technologies is expected to resolve a number of issues that have contributed to the under-exploitation of power generation using hot spring water, or other heat sources such as waste heat from factories/power plants, and heat from waste incineration.

In their research, they have established a 50-kW plant to conduct a verification test of hot spring water power generation using this new cycle, and in this article they explain the principles and current state of this test, and the future prospects for its practical application.

Principle of Hot Spring Water Power Generation

The basic principles of power generation using hot spring water, uses waste hot water and unused discharged hot water. It can be applied to binary cycle generation that uses geothermal energy directly from production wells, power generation using waste heat from factories and power plants, and heat from waste incineration.

While in principle this system is basically the same as thermal power generation, it can generate power without burning fossil fuel, using nothing more than the energy of hot spring water. In most cases, hot spring water hotter than 50°C is cooled using groundwater. In this system, hot spring water of 50-90°C is cooled after generation, so it is more readily usable. This has a potential to solve a serious problem of securing the supply of cooling water, such as groundwater.

Introducing New Technologies to Hot Spring Water Power Generation

To date, Freon gases have been used as the functioning medium when generating power from thermal energy of around 100°C, such as hot spring water or waste heat. But, the use of specified Freon gases, which were the main medium, is now restricted because of the damage they cause to the ozone layer. At present, there is no suitable medium. However, natural mediums as a Freon substitute are attracting interest. Ammonia shows some promise, especially in refrigerators and air-conditioners. Ammonia has also been used in power generation with OTEC. With ammonia, though, pressure inside the pipes reaches roughly 50 atmospheres; so, equipment costs will be very high. At the same time, a new cycle using a mixture of ammonia and water has come to the forefront. Using this cycle in hot spring water power generation has the potential to generate electricity with much greater heat efficiency than the Rankin Cycle using a pure ammonia medium. Moreover, adjusting the water-ammonia mixture allows the pressure inside the pipes to be reduced to 20 atmospheres or lower.

Space does not allow them to go into any great detail, but the introduction of new technologies such as the new cycle, turbines, and heat exchangers is expected to result in a dramatic rise in both heat efficiency and economic efficiency.

Outlook of Hot Spring Water Power Generation

Their studies reveal that there are about 300 hot springs in Japan, where this system can be used. If they add to this power generation from waste heat at factories and power plants where a similar system can be used, the range and scale of use of this system is indeed immense.

Conclusion

Power generation using a low heat source of around 100°C, such as hot spring water, was regarded as difficult technology in terms of heat efficiency and choice of the functioning medium. But this view is set to change with the invention of a new cycle using aqueous ammonia. There is still many technical issues that need to be addressed, but the practical use of power generated from hot spring water is expected to make a significant contribution to resolving today's energy and environmental problems. (Source: Haruo Uehara & Ysuguki Ikegami, Faculty of Science and Engineering, Saga University, Japan. *New Energy Plaza*, Vol. 15, No. 3 [2000] Tokyo)