Chena Hot Springs Low-Temperature Geothermal Power Project

Despite being an oil exporting state, Alaska is home to some of the highest electricity costs in the United States, particularly in its numerous remote villages. For example, the cost of power at Manley Hot Springs, where power is generated from diesel fuel, is currently 86¢ per kWhr. Residents in rural areas, where average income is below the national poverty level, typically spend 33 percent or more of their income on energy, much higher than the national average of 6.8 percent. For that reason any technology that proves workable and reliable in Alaska's harsh climate and that allows renewable energy to replace fossil fuels -- for both environmental and economic reasons -- constitutes a major benefit to the State's economy and the potential well being of thousands of Alaskans.

Chena Hot Springs Resort, located 60 miles northeast of Fairbanks Alaska, led by its owner **Bernie Karl**, in July 2006 became a pioneer in geothermal power by developing a new form of alternative energy for Alaska. Karl, through sheer determination, convinced United Technologies Corp. to adapt its then new PureCycle 200 Organic Rankine Cycle (ORC) power plant to operate in cold climates, and more importantly to run on moderate- to low-temperature geothermal water. Karl, operator of the small resort, risked his own capital, eventually convincing the U.S. Department of Energy and the Alaska-Federal Denali Commission to partner with him, to install two 200 kW turbines. The turbines, developed in 2004 by UTC to operate off industrial waste heat, were modified to run on 165 degree F water, the first time that such low-temperature hydrothermal vent water has been successfully used to make electricity. The success opens the possibility that up to four dozen villages in Alaska could see a nearly 10-fold drop in their electricity costs, if geothermal water sources can be proven at the prospective villages.

The specific objective of the Chena project was to demonstrate the low cost of the power generation equipment ($1350/kWhr installed) and the feasibility of producing electricity at a cost of less than 5¢/kWh from a 165°F geothermal resource with 98% availability. The geothermal application for the PureCycle platform involved some additional innovation to gain cost reductions beyond that of the original PureCycle 200 platform, including:

- Changing the working fluid used in the PureCycle ORC plant (from R245fa to R134a). This fluid is a better match for low temperature geothermal applications and enables a significant cost reduction, both directly because R134a is a low cost fluid widely used in HVAC equipment and indirectly by allowing lower cost commercially available components to be used in the power plant.
- Developing low-cost heat exchangers.
- Reducing the plant cost by incorporating more commercially available components.
- Developing control algorithms and methods for operation with tube and shell heat exchangers rather than the fin-tube technology applied in the original PureCycle plant.
- And by employing a low-tech siphon to 'pull' water out of a shallow, large diameter well located 2700 ft to the east of the power plant. The elevation difference of +33 ft between the cold water well and the power plant allows 1500 gpm to flow through each condenser at 5 psi without a pump.

The project was completed on schedule and close to the original budget of $1,899,065. The power plant has to date logged over 10,000 hours with 95% availability since installation, generating over 2,000,000 kWhrs and displacing 150,000 gallons in diesel fuel for an estimated savings of $500,000, and preventing significant amounts of carbon from being released into the atmosphere. The power plant has received international recognition, and was awarded the Project of the Year Award by Power Engineering Magazine in the renewable energy category. Chena Hot Springs Resort also received a Green Power Leadership Award from EPA and DOE, and more recently was selected for a very prestigious R&D 100 Award from the Department of Energy.

It is hoped that the Chena geothermal plant will encourage other sites to develop moderate temperature geothermal resources in Alaska, throughout the U.S., and around the world. The project has demonstrated that the cost of power production, even in semi-remote locations such as Chena, can be reduced to below 5¢ per kWhr. This makes geothermal power generation highly competitive with existing diesel generation in rural Alaska, particularly since fuel costs are virtually eliminated once the plant is installed.

I am nominating Mr. Karl for this award, since while Chena did have an economic incentive to lower its power costs since the resort was paying 30 cents per kWhr in 2006 (an average of $604,000 in 2005, and fuel costs represented 60% of its power costs), still the perseverance and ingenuity shown by Mr. Karl in installing this plant over innumerable critics who said the attempt was folly, was truly inspiring. U.S. Senator Lisa Murkowski.