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DEMONSTRATION OF AN ADVANCED BINARY GEOTHERMAL PLANT USING THE KALINA CYCLE SYSTEM 11

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KEY WORDS

advanced binary geothermal plant, binary geothermal plant, cooperative agreement, demonstration, Kalina cycle, energy conversion

PROJECT BACKGROUND AND STATUS

A solicitation was issued by DOE entitled "Demonstration of Economic Benefits of Improved Electrical Power Generating Systems for Geothermal Applications." Exergy, Inc. submitted an application to demonstrate an advanced binary geothermal power plant utilizing the Kalina cycle (see Figure 1). After a competitive process, Exergy was selected for an award.

The Kalina cycle uses an ammonia-water mixture as the working fluid and takes advantage of regenerative heating. The ammonia-water mixture has a low boiling point, therefore, the excess heat coming from the turbine's exhaust can be used to vaporize a substantial portion of the working fluid. This plant is estimated to be up to 40% more efficient than existing geothermal binary power plants.

Exergy is currently in negotiations with the Sacramento Municipal Utility District (SMUD) for a power purchase agreement. Initially, Exergy who has teamed with Far West Capitol had planned to enter into a power purchase agreement with Sierra Pacific, the local utility. However, due to circumstances beyond their control, Sierra Pacific was unable to enter into a long term agreement. Therefore, Exergy and Far West Capitol have been active in looking for other options. If the negotiations with SMUD are successful, this may be one of the first applications of wheeling power from a geothermal power plant to a utility across another utility's (PG&E's) transmission line.

An Environmental Assessment (EA) is being prepared by DOE. The EA will cover the land area that the power plant will be sited and the immediate vicinity in Steamboat Springs, Nevada, which is approximately 10 miles south of Reno. Studies have been done to investigate the potential environmental effects to the following environmental categories:

- Socioeconomic
- Land Use
- Geology
- Hydrology
- Biological Resources

- Cultural Resources
- Potential Accidents.

Environmental impacts to all of the above environmental categories were analyzed and determined to be insignificant. Any potential environmental impacts have been reduced by incorporating mitigation measures or project design features. Some concerns were raised regarding cultural resources, federally listed endangered plant life (Steamboat Buckwheat) and the geothermal resource itself. Based on studies targeting each of these concerns and an evaluation of construction and operational activities, no adverse impacts are anticipated for these resources.

As of January 1996, the EA is ready to be reviewed by the State of Nevada. After their comments are incorporated and/or resolved the DOE expects to publish the EA and issue a Finding of No Significant Interest (FONSI). Once the FONSI has been issued and the Power Purchase Agreement has been obtained, the detailed plant design work and construction will begin.

PROJECT OBJECTIVES

The objective of the solicitation through which this project was selected was to support geothermal projects that would demonstrate economic benefits of improved electrical power generating systems. Within that context, the objective of this project is to demonstrate the affordability of a geothermal power plant utilizing the KCS11 version of the Kalina cycle.

Technical Objectives

- Generate 12.5 MWe using the Kalina cycle that will be supplied 330°F brine flowing at 3600 gpm from two production wells.

Expected Outcomes

- Efficiency improvement over organic Rankine cycle geothermal power plants. The use of a mixture of ammonia-water allows the excess heat exiting the turbine to be used to vaporize a substantial portion of the working fluid. A conventional geothermal binary power plant utilizes the organic Rankine cycle and does not use any regenerative heating. That is, the heat exiting the turbine is transferred to the environment through the condensers. The Kalina cycle would therefore transfer substantially less heat to the environment.

Expected Outcomes (continued)

An efficiency improvement would also mean that more electricity is being produced per pound of brine. Compared to a conventional binary power plant, the Kalina cycle can produce the same amount of electricity with less brine. That translates into fewer wells needing to be drilled and maintained.

- Demonstrate the economic benefits of the Kalina cycle power plant. This power plant will be a commercial operation. Therefore, the developers interest in operating this power plant is to convert the geothermal heat to electricity cheaper than by any other means available.

APPROACH

Exergy has brought together a team with the expertise and ability to make this project a success. The team members and their respective responsibilities are as follows:

- Exergy - Technology licensor and technical consultant.
- Far West Capitol - Lessee and developer of the geothermal resource and power plant operator.
- Atkinson - Engineering, design and construction of the power plant.
- Department of Energy - Project management through Cooperative Agreement.

FUTURE PLANS

The future plans of this project will proceed as follows:

- Detailed Engineering and Design
- Plant Construction
- Testing and Start-up
- Commercial Operation

REFERENCES

Installation of an Advanced Binary Geothermal Demonstration Plant Using the Kalina Cycle; Revision 1; Proposal to U.S. Department of Energy, National Renewable Energy Laboratory; June 1993.

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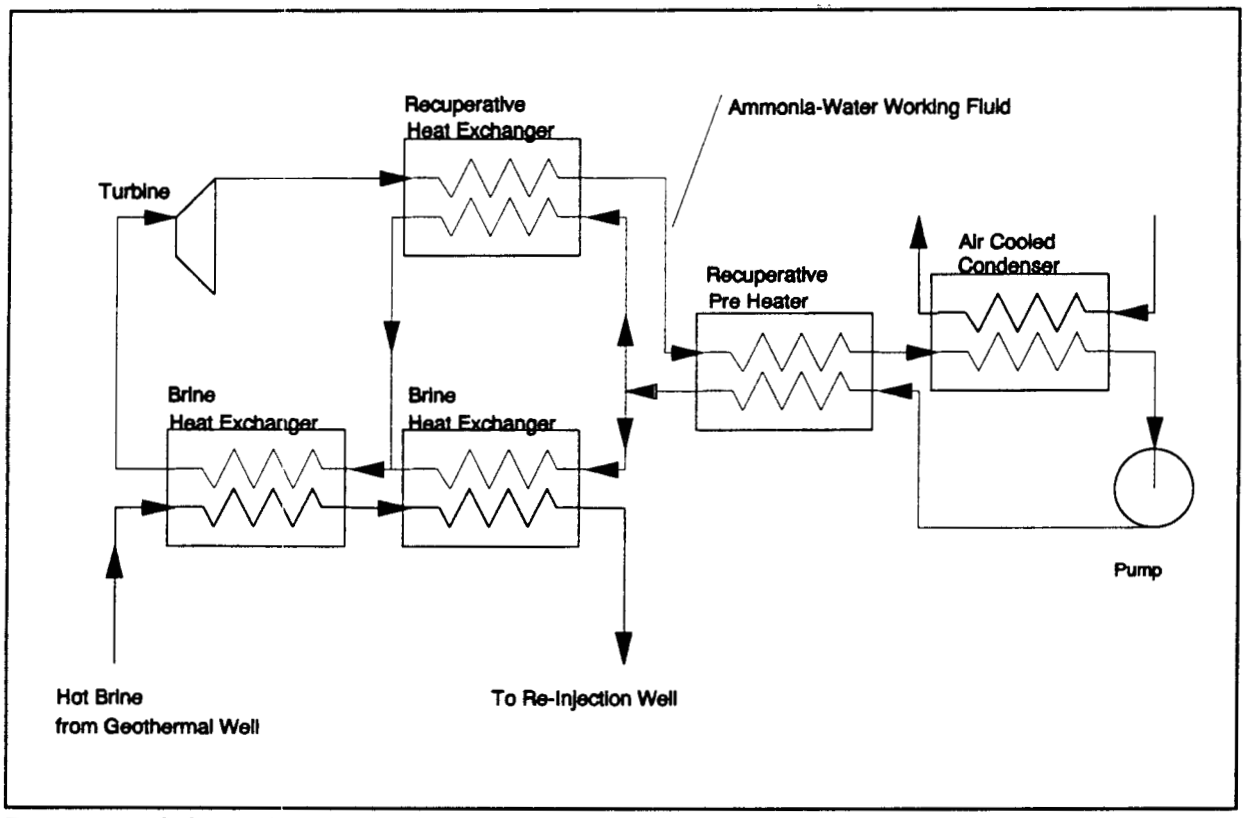

Figure 4 - Schematic of Kalina Cycle System 11 (KCS11)