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RLO/2227/T36-2

**PERFORMANCE AND FEASIBILITY OF FORCED GEOHEAT
RECOVERY FOR LOW TEMPERATURE APPLICATIONS**

Second Technical Status Report

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July 1, 1978 - September 30, 1978

**PREPARED FOR THE U.S. DEPARTMENT OF ENERGY
UNDER CONTRACT NO. EY-76-S-06-2227, TA #36**

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Brief Restatement of Objectives

A basic evaluation of the technical performances and economic feasibility of providing low temperature heating by Forced Geoheat Recovery (FGR) from suitable geological structures including both thin sheet conductors with predominantly fracture flow and porous slab conductors with intergranular flow. Simple, heat-pump assisted and multi-source combined heating systems will be evaluated. Building and industrial heating applications with effective power requirements ranging upward from one MWt will be considered, with thermal water supply temperatures in the range of 25 C to 100+ C. Emphasis is being placed on the adaption of the FGR technology to the user system, including both short and long term variations in the user system demand.

PROGRESS REPORT FOR THE PERIOD

JULY 1 TO SEPTEMBER 30, 1978

Personnel

Gordon M. Reistad has devoted 1.15 man-months to the project during this period. Gunnar Bodvarsson was not on appointment on the project during this period. Joe Zaworski, a Research Assistant Unclassified in Mechanical Engineering has devoted one-half of his time during July and August. Reza Shariff, a Graduate Research Assistant in Mechanical Engineering has contributed one-third of his time for the two and one-half month period July 1 to September 15 and has been appointed at one-half time for the remainder of the contract period. Greg Mack, a Graduate Research Assistant in Geology, has remained at one-half time during this period.

Progress Summary

Efforts during the second quarter have been directed at the following areas:

- (1) Forced Geoheat Recovery (FGR) resource system design and econometrics.
- (2) Development of elastomechanical methods of testing fracture dimensions and inter-borehole fluid conductance.
- (3) Investigations of conditions for FGR in the Willamette and the Lower Columbia Basins in Western Oregon.
- (4) Literature review in district heating, heat pumps, etc.

- (5) Examination of residential heating systems as a function of available water temperature.
- (6) Development of layouts for potential types of geothermal heating schemes.
- (7) Selection and documentation of climatic areas to be considered in the evaluation of systems.

The main emphasis was on items (3) and (5) through (7).

Work on item (3) has continued the work described in the first quarterly report: the construction of geological section maps and correlation with available data on temperature gradients and heat flow in selected areas.

Items (5) through (7), the more engineering aspects of the project, represented the bulk of the effort during the second quarter. The residential heating systems being considered are (i) forced air, (ii) baseboard, (iii) radiant panel and (iv) heat-pump, forced-air systems. These systems are being evaluated for their feasibility as a function of available geothermal resource temperature. For the first three of these, i.e., the direct systems, the evaluation is straightforward for resource temperatures above about 140°F and is being carried out. However, below this temperature there is a lack of available data on the operating characteristics of such systems, particularly for the radiant and baseboard systems. Efforts are presently being made to estimate the performance data and identify the various qualitative factors. With regard to the heat pump systems, it has been found that most commercial water-to-air units for residential applications are primarily designed for air-conditioning and the performance in the heating mode is not nearly as good as it could be. Consequently, studies using this data have not shown geothermal water-source heat pump systems in the

proper light. Efforts are now being directed at evaluating such heat pump systems with heat-pump operating performance estimated as realistic for heat pumps specifically designed to use the geothermal resource. Several different heating system layouts have been developed conceptually and are presently being evaluated.

Five locations have been chosen for sites of evaluations of the systems. These sites were chosen to cover a range of climatic conditions while also being in a region of identified geothermal resources. The sites are: Boise, ID, Pendleton, OR, Portland, OR, Trenton, NJ, and Wilmington, DE.

Plans for the period October 1 to December 31, 1978

During the third quarter, we intend to continue the work of items (1) through (7) above. Special emphasis will be devoted to bringing the various aspects of the project together so that overall systems may be evaluated for performance and economics.