APL/JHU
QM-77-129-1
OCTOBER 1977

Geothermal Energy And The Eastern U.S.

A SCENARIO FOR GEOTHERMAL ENERGY DEVELOPMENT

THE COASTAL PLAIN IN SOUTHERN ARKANSAS

Prepared by: APPLIED PHYSICS LABORATORY
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For the: PLANNING BRANCH
DIVISION OF GEOTHERMAL ENERGY
U.S. DEPARTMENT OF ENERGY
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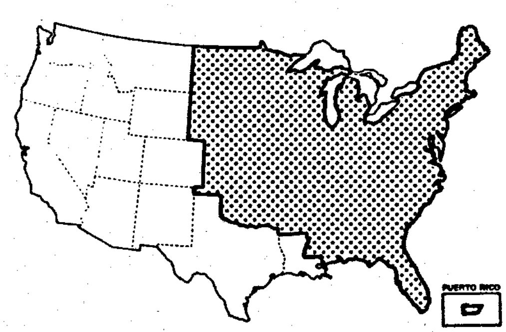
WASHINGTON, D.C. 20545



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LAUREL, MARYLAND

QM-77-129-1
25 October 1977

Geothermal Development of Arkansas

Introduction

This is a brief narrative outline of a scenario for the development of geothermal heating and cooling, (1) in the Hot Springs, Little Rock, and Pine Bluff area of central Arkansas, and (2) in the southern Arkansas area. This narrative lists basic assumptions about details of the scenario and the data included therein. The scenario is a planning document; thus all the steps that can be identified at this time necessary in its completion are listed and time phased. Separate scenarios, for specific locations, in greater detail are suggested as a necessary precursor to possible implementation planning. The thermal properties of the several geologic provinces of the State of Arkansas are not yet established, but there is ample evidence that extensive hydrothermal systems of normal and above-normal gradient are present. Systematic thermal/geological studies are needed, as will become evident below.

This narrative is to be read in conjunction with and as explanation for the chart attached.

Discussion

1. Power-on-line. The attached scenario shows thermal power as a function of time for two general areas in Arkansas for which there is evidence that moderate temperature thermal waters exist. In both cases power-on-line is thermal power used either for space heating and/or cooling and specific industrial process heat. The Air Force Military Air Transport Command Base at Little Rock is included.

The geographic use of energy was determined for each county in southern and central Arkansas. The energy usage considered only residential and commercial space heating, domestic hot water, and industrial processes which could substitute geothermal water in place of their current energy source. The total energy requirement (within the above named categories) for each county was determined from U.S. Department of Commerce data. For the scenario, 50 percent of the current energy usage was assumed to be converted to geothermal energy along with 50 percent of new development energy usage in the future. A 5 percent annual growth rate was assumed, based on the rapid population growth of 25 percent to 54 percent shown by several counties in Arkansas from 1960 to 1970 (Reference 1), and the concerted efforts of the Arkansas Industrial Development Commission to attract new industry to Arkansas. On this basis, a total of 74 mQ/yr of geothermal energy was introduced incrementally over a 10-year period, requiring some 370 wells throughout southern and central Arkansas to obtain the hot water.

2. Resource. The State of Arkansas can be divided into at least five geologic provinces. Each of these provinces has its own unique thermal characteristics, none of which to date has been defined. Accordingly, this scenario is limited to using meteoric water from aquifers located at moderate depths in the coastal plain. Temperature gradients in the coastal plain range from normal to slightly above normal (i.e., $14^{o}F/1000$ ft to $20^{o}F/1000$ ft).

For this scenario, two regions have been selected: central Arkansas in the area including Hot Springs, Pine Bluff, and Little Rock, and southern Arkansas. The temperature of the water in these two regions was taken to be equivalent to the average of bottom-hole temperature measurements from the oil-well data used in the AAPG/USGS Geothermal Gradient Project

(Reference 2). For the area in central Arkansas a temperature of 170°F at an average depth of 5000 ft is assumed, i.e., a thermal gradient of 20°F/1000 ft. In the southern region, where the sedimentary deposits are of relatively young Cretaceous age and ground water is in good supply, the resource is assumed to have a temperature of 170°F at an average depth of 7300 ft (i.e., a gradient of 14°F/1000 ft), based on data taken from wells near the towns of Hope, Magnolia, and Camden.

There is much evidence that there may be thermal resources of interest in the other provinces of the state. For example, along the Quachita Mountains which run along the upper edge of the coastal plain from the western border of the state to the city of Little Rock, there is evidence of thermal activity. At the town of Crystal Springs there are old plugged fumaroles as well as many mineralized deposits. Further to the west there are thermal springs at Caddo Gap and to the east at Magnet Cove. At Hot Springs National Park, located in this same mountain range, approximately one million gallons of water flow daily at an average temperature of 143°F from 47 springs. Although extensive oil and gas exploration has taken place in the state and production has occurred in the central and southern region, little exploration has occurred near Hot Springs National Park in the Quachita Mountains. These mountains are intensely folded sedimentary and crystalline rocks of recent to Ordovician age.

Reference 3 contains a model of the Hot Springs hydrologic system and a proposal for its validation. This and similar studies have not been pursued, probably mainly because of the concern of the Department of Interior's National Park Service, which has been apprehensive lest geologic studies hazard the source of the Hot Springs at the National Park. The Reference 3 model of the hydrology and its purview is not sufficient to encompass the Caddo Gap and the Magnet systems. Further, the proposed study does not include a systematic analysis of the source of the thermal energy. Reference 3 and other data do, however, indicate that only a small portion, i.e., 5-20 percent, of the thermal water underground proximate to the town of Hot Springs comes to the surface at the Hot Springs National Park.

3. Development Strategy. The Hot Springs National Park has plans in the future to use for space space heating all of the thermal water in excess of that

which is required for balneological bathing. The scenario suggests that DGE continue to follow and encourage the Park Service's plan to fully utilize the surface thermal water; this could serve as a reference demonstration project.

Systematic geologic/hydrologic and heat flow study of the state are recommended, not only in and along the interface of the Quachita Mountains and the Gulf Coastal Plain, but in the other more northern province of the state as well. The study of the Quachita Mountains should locate the source of thermal energy evidenced by the thermal springs and map the structure and extent of the system transporting the thermal waters. If these thermal waters do not extend as far as the town of Little Rock, to the southwest corner of the state, or into the coastal plain, then separate systematic geophysical examinations of these areas are required to evaluate the availability of water and the temperatures of hydrothermal systems in these areas.

Any geologic studies <u>near</u> the Hot Springs National Park must be done with the concurrence of the Department of the Interior which must be convinced that these studies do not prejudice the continued operation of the Park. Accordingly, the first task must be the determination of the extent of the hydrothermal systems in the area, determined if possible by non-intrusive geophysical techniques.

If geologic studies confirm that there are adequate thermal waters available in any of the areas of interest in Arkansas, then an engineering model of the hydrology and thermal properties of each reservoir must be developed and validated. In the area proximate to the Hot Springs National Park it is suggested that a demonstration be carried out showing that water can be removed without undue effect on the Hot Springs National Park springs.

REFERNECES

1. U.S. Department of Commerce, "County and City Data Base," 1972.

2. USGS/AAPG, "Geothermal Survey of North America, Data Base."

3. USGS/National Park Service, "The Waters of Hot Springs National Park, Arkansas - Their Origin, Nature, and Management," Open-file Report, Little Rock, Arkansas, 1976.

CSA 10377

PROSPECT: CENTRAL AND SOUTHERN ARKANSAS

SITE CHARACTERISTICS:

- CAPACITY ESTIMATE: SUFFICIENT FOR SCENARIOS
- FLUID TYPE: WARM HOT WATER
  - TEMPERATURE: 140°–170° (EST.) F
  - SALINITY: VARIABLE
- INDUSTRIAL INVOLVEMENT: LOCAL CONTRACTORS
- ASSIGNED CONFIDENCE %:
- LAND LEASING: MUNICIPAL, PRIVATE, FEDERAL
- DRILLING STATUS: PROPOSAL FROM ARKANSAS GEOLOGICAL SURVEY

LEGEND

- ▲ EVENTS
- NUMBER ABOVE TRIANGLE INDICATES POWER-ON-LINE INCREMENT IDENTIFIER
- NUMBER BELOW TRIANGLE INDICATES QUANTITY OF POWER-ON-LINE IN mQ(10^{12} BTU) THERMAL
- ▬ START AND COMPLETION OF AN ACTIVITY
- NP HOT SPRINGS NATIONAL PARK

SCENARIO: CENTRAL ARKANSAS: INDUSTRIAL & SPACE HEATING
SOUTHERN ARKANSAS: INDUSTRIAL & SPACE HEATING

PLANT: CENTRALIZED MUNICIPAL SYSTEMS & LOCAL SYSTEMS