DOE/ID/12014--T2

MONTANA GEOTHERMAL COMMERCIALIZATION PLANNING

FINAL REPORT

DOE/ID/12014--T2

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INTRODUCTION AND HISTORY

The U.S. Department of Energy and the State of Montana entered into Cooperative Agreement #DE-FC07-79ID12014 on January 1st, 1979. The purpose of the agreement was to investigate all aspects of the potential of geothermal energy to offset fossil fuel energy requirements in the state. Montana shared the cost of this contract, providing 12% matching funds to DOE's 88% support throughout the duration of the grant.

The total value of the contract over the grant period 1979-1983 was $232,229. The grant was amended several times, increasing the value of the contract as noted below:

Modification	Date	Amount
Basic Agreement	1/Jan/79	$57,963.00
A001	2/Aug/79	19,318.00
M002	1/Jan/80	-0-
M003	1/March/80	-0-
A004	10/April/80	72,112.00
A005	FY 80	82,836.00
TOTAL		$232,229.00

At the time the contract was signed there was no organized body of information on geothermal energy usage in Montana in existence. The originally stated purposes of the program established the direction it took over the following five year period, specifically:

1. Identification of geothermal resources in the state;

2. Construction of overall area development plans (ADP);
3. Construction of site-specific development plans (SSDP);
4. Construction of time-phased project plans (TPPP);
5. Aggregation of area and site-specific geothermal information to provide estiamtes of the total geothermal resources;
6. Compilation of legal requirements and other institutional concerns bearing on the devlopment of geothermal energy; and,
7. Development of a public outreach program.

A Resource Assessment Team was established at the Montana College of Mineral Science and Technology in Butte, MT, under separate contrct with DOE, to coordinate the first objective. A Geothermal Planning Team was established at the Montana Department of Natural Resources and Conservation in Helena, MT, to integrate the resource assessment with state energy plan and accomplish the remaining six objectives. The two teams maintained a close contact and cooperative working relationship throughout the course of the project, including a coordinated sharing of state and federal money for research, exploratory drilling, project construction, and information dissemination.

Over the course of the project, the geothermal team catalogued resources, met and developed a working relationship with resource owners, offered technical assistance on a wide variety of project plans, coordinated with the New Mexico Energy Institute in producing economic projections, and made numerous public presentations. As part of the Renewable Energy Bureau of the Department of Natural Resources and Conservation, the geothermal team reviewed proposals for geothermal projects, approved several grants, managed resulting contracts, and conducted followup studies of the projects when built. These activities have provided the

geothermal team with a unique, statewide perspective on geothermal and other forms of energy in the state of Montana, which forms the basis of the analysis and evaluation contained in this final report.

COMMENTS ON SPECIFIC DELIVERABLES

TASK 1. PROVIDE THREE TO SIX AREA DEVELOPMENT PLANS (ADP)

The geothermal team initially divided the state into ten multi-county areas for purposes of conducting Area Development Plans, with boundaries determined according to estimates of geothermal potential and population centers that might be able to use the resources. The first three areas were analyzed in order in the first progress report (reference #2) and the fourth was analyzed in the second progress report (reference #3). The general methodology consisted of assessing the resources available, the population characteristics and growth patterns, the industrial or commercial end-users, current energy use patterns, geothermal residential heating potentials, current developments, and possible future activities at area resources.

Area 1 geothermal resources receiving later attention in SSDPs or technical assistance were Boulder Hot Springs about thirty miles south of Helena; Broadwater Hot Springs immediately west of Helena; and Alhambra Hot Springs fifteen miles south of Helena. The Marysville KGRA, which received a good deal of attention early in the geothermal assessment, including the drilling of an exploratory well, was dropped from active consideration due to flow problems, piping distance, and environmental concerns.

Area 2 geothermal resources receiving later attention in SSDPs or technical assistance were Ennis Hot Springs about one mile north of Ennis, and Silver Star Hot Springs located about ten miles south of Whitehall. Both of these resources are in Madison County.

Area 3 geothermal resources consisted of numerous petroleum exploration holes of the type found scattered throughout the entire eastern half of the state. The ADP for Area 3 consisted of a listing of commercial, industrial, and residential end uses for low temperature geothermal water and an analysis of the factors involved in rehabilitating old oil wells for such uses. An SSDP was done for the town of Baker in Fallon County and an abandoned well was eventually acquired by the town of Baker in an attempt to make use of this potentially large resource. The particulars of that study are included in reference #6.

TASK 2. PROVIDE SIX TO TEN SITE SPECIFIC DEVELOPMENT PLANS (SSDP)

The research that went into the ADPs was useful in collecting information on the springs and in becoming acquainted with the state economic base. But attempting to match geothermal resources to load, or a generic industry with a hot spring, was too broad a treatment really to be useful. The geothermal team therefore decided to concentrate on the specific sites to a greater degree, taking the general approach of providing resource owners with technical assistance, information, and economioc analyses. Contact with the national effort, with the Geothermal Resources Council, and series of local presentations gave the geothermal team a broad perspective on the problems faced by owners and would-be users, and it was possible to avoid many problems and to solve others.

Site Specific Development Plans (SSDPs) comprised the major work reported in references 3 through 6. Some sites received attention more than once because of shifting or continued interest. Because Montana's resources are rather tightly circumscribed by variables of temperature, flow, location, and available uses, the level of detail devoted to a given study was quite easy to determine.

A list of major SSDPs follows, with a brief synopsis of each. In some cases a given SSDP developed in several stages, reflecting local interest, new ideas, or the infeasibility of original plans. These developments bear upon deliverables listed as MOD 4-2 and 4-3, in the DOE contract, which call for updated and expanded information on previously studied sites. They are so noted in the synopsis.

1. Baker, MT

The geothermal team was instrumental in analyzing the geothermal potential of this site, which is surrounded by oil wells tapping Madison Formation strata with bottom hole temperatures commonly in excess of 150 degrees F (reference #4). An exhaustive analysis was made in conjunction with the New Mexico Energy Institute to give some indication of what would be necessary to make a district heating project economic. The geothermal team aided in obtaining a DOE grant to conduct an engineering feasibility study similar to that of Lemmon, SD. As a result of these efforts, and those of a local oil company official, the town was deeded a well by Shell Oil. The well was opened and tested, but yielded a disappointing 60 gpm. (Reference #6; MOD 004 Update). Several individuals in Baker have since considered making use of the resource for greenhouse heating, but no further action has been taken.

2. Boulder, MT.

High flow rate, clean water, and reasonable proximity to the town of Boulder gave several people the idea of piping water from Boulder Hot Springs to an end user within the town of Boulder. The geothermal team contacted EG&G Idaho for technical assistance on the feasibility of aquaculture, beer brewing, district heating, and space heating potentials on site. In conjunction with the state renewable energy program the geothermal team arranged for money to drill a test well near the spring site. The Resource Assessment Team was active in selecting a promising location, which was not, as it turned out, on Boulder Hot Springs land. The spring owner then vigorously objected to any drilling in the area, and the plans were scrapped. the money was later put into well casing for Ennis Hot Springs near Ennis. (reference #4). Since that time the owners have put their efforts into restoring the aging resort and have considered a condominium development, but nothing has gone beyond the planning stage.

3. Avon, MT.

Technical assistance given to this rural, low temperature site consisted of designing and constructing a weir to measure flow, aiding in greenhouse design, and advising on grant writing to the state renewable energy program (reference #4). The grant received funding and the sixteen by fifty foot greenhouse using eighty degree water for heating is in its second season. During an extended period of twenty degree F. below zero the geothermal system kept interior temperatures above fifty degrees. The owners have been able to sell all of the produce from the greenhouse, and have given several presentations on the style of construction and uses of geothermal energy for greenhouse heating. An excellent slide show was produced that

has been used in several Department of Natural Resources and Conservation presenttions since. Numerous individuals and groups have visited the site (MOD 004-1 and 2). Since development was easily handled through the state grant program and technical assistance, no Time-Phased Project Plan was necessary.

4. White Sulphur Springs, MT.

The site an early successful renewable energy program grant, interest has always been high in geothermal energy in this small ranching community. The geothermal team has been active in providing technical assistance and planning for various options. Work with the New Mexico Energy Institute indicated that a district heating system for several buildings in the downtown area would be almost immediately cost effective (reference #4). While not yet constructed, the likelihood remains high that ultimately such a system will be built.

5. Camp Aqua Test Well Site

This project illustrates well the coordination of several programs with private sectio involvement. A private engineering firm in Kalispell proposed to the state renewable energy program to drill a production well to provide about half of the energy required to process grain to ethanol. Due to the uncertainty of the resource, the geothermal team recommended that a test well be drilled on site to confirm it before going ahead with grant funding. The Resource Assessment Team oversaw the drilling, which resulted in a four inch artesian geothermal well at one hundred ten degrees (reference #5). Subsequently the engineering firm received $100,000 through the state renewable grant program to drill a production well, which was successfully completed. About this time changes in the economy were calling into

question the overall profitability of ethanol production, and further financial support for the facility, while not withdrawn, suffered some setbacks. Currently the owner is still working on a finance package to make construction possible.

6. Bozeman Hot Springs

Bozeman Hot Springs was an early study project for the geothermal team, and its owner was an early recipient of grant money through the renewable energy program (1978). In 1980, using money still remaining from the state grant, the owner successfully drilled a production well that flowed at 1000 gpm and 120 degrees F. Prior to this the geothermal team had done considerably work in assessing the resource, calcualting heat flows, and offering alternatives for end use. After the new well was in place, technical assistance was performed in conjunction with the New Mexico Energy Institute to determine the overall feasibility of end uses including space heating for housing tracts in the area, aquaculture, and greenhouses (reference #5).

At the time of this final report, no further development has taken place at this Bozeman Hot Springs. Costs associated with the energy potential of the water from the spring has never been sufficiently delineated for the owner to enter into agreements for its use, and a slump in building shortly after the new well was completed has delayed the projected growth rate. Greenhouses, long expected to be a popular use for low temperature resources like this one, have failed to materialize, in large part due to the continued low cost of importing edibles from other states. Also, the unresolved question of the value of the geothermal energy discourages development. Owners do not want to give their resource away any more than users want to pay full avoided cost for it.

7. Sleeping Buffalo Resort, Saco

This site has an artesian well long used for heating a swimming pool and sauna. The water pressure is so high that the well head pipe has to be throttled back with an orifice plate and externally braced at a 90 degree bend to prevent reaction displacement. The owner expressed interest in installing a low head hydro turbine to produce electricity in place of the orifice plate. The geothermal team located brand names of turbines and price listings for the owner and coordinated technical assistance with EG&G. The geothermal team and an engineer from EG&G visited the site and provided analyses of potential head and methods necessary for testing the output.

To date the owner has not undertaken further testing. The cost of the hardware was a serious concern to him, especially with the low cost of electricity in the area of the Saco well. The geothermal team had thought that this well might provide a good test case for artesian pressure and electricity production, although it is higher in pressure than most other wells.

TASK 3. PERFORM INSTITUTIONAL AND ECONOMIC ASSESSMENTS

As part of this Cooperative Agreement, the geothermal team prepared the "Montana Geothermal Institutional Handbook--A User's Guide of Agencies, Regulations, Permits and Aids for Geothermal Development" (reference #8). Five hundred copies of this document was printed by DOE, and an additional 300 copies were printed by DNRC. This document summarized all the legal and institutuional red tape that a geothermal developer must understand before he can develop a geothermal resource, and proved to

be one of the most useful tools developed under this agreement. Every geothermal resource owner in Montana received a copy of the Handbook, and much staff time was saved by having the document at hand to answer regulatory questions. Particularly useful was a quick reference list of all permits required for any type of geothermal development within the state of Montana. This list provided rapid answers to developers' questions on the legal hurdles that must be cleared before a project could be started in Montana.

Other institutional and economic work was accomplished with the help of the New Mexico Energy Institute (NMEI). Under NMEI's direction, resource data on all sites in Montana were gathered, and sensitivity analyses were run on the most promising site to determine what factors are most likely to influence the cost of a given project. For example, well depth was found to be one of the most critical factors in determining the economics of a space heating project in Baker, Montana. NMEI also did economic analyses on a heat pump system at Ennis. In addition, NMEI summarized all state data into two large computerized documents, and provided Montana with a copy of this information.

TASK 4. CONDUCT AN OUTREACH PROGRAM

The outreach program and technical assistance provided to Montana's geothermal resource owners proved to be the most beneficial aspect of the entire geothermal project. Site specific development plans, economic analyses, and other paper studies were useful, but for the average private geothermal resource owner in Montana, having a staff engineer provide information on geothermal piping material or what size heat exchanger to use was much more relevant.

Over eight percent of Montana's geothermal resources were personally visited by a geothermal team member during the project. Spending an afternoon with a geothermal resource owner, listening to his problems, and then finding solutions to his individual problem proved to be the most fruitful part of this program. As the contract developed, the geothermal team began spending more and more time on providing individual technical assistance to geothermal resource owners, and less time on overall geothermal and area development plans.

Technical assistance and outreach took many forms. Answering questions on the phone took up much of our time, with many questions being answered quickly, but some requiring a large amount of research to answer. Many of the contracts and responses are listed in the semi-annual reports developed throughout this project.

Another major outreach mechanism consisted of two geothermal energy conferences, one held in 1980 and one in 1982. Both conferences were heavily attended by private geothermal resource owners in Montana, and proved to be effective forums for exchanging information about the use of geothermal energy in Montana.

TASK 5. PREPARE A STATE GEOTHERMAL PLAN

Under the original Cooperative Agreement, DNRC agreed to develop a "geothermal plan" which was to be a blueprint for geothermal developement for the state of Montana. This plan was to have provided a framework and direction for the commercialization of geothermal in Montana, and focus on legislative and other institutional problems that might be overcome by legislative action.

No overall "blueprint" was developed under this contract. As the contract progressed, it became increasingly obvious that each geothermal resource had unique development problems, and few of these problems were related to institutional barriers on the part of the state. Montana's resources are primarily privately owned, which lessened the regulatory red tape often experienced by state and federally owned geothermal resources. Instead of producing an overall geothermal plan, the Montana geothermal team ended up concentrating on providing technical assistance to individual geothermal resource owners. This proved to be the most effective mechanism for promoting the development of geothermal resources in the state.

CONCLUSIONS

Montana has received many benefits from this Cooperative Agreement. Before this project was initiated, the state of Montana had no centralized source of information on the development of geothermal energy. In fact, there was no clear understanding of the extent of the geothermal resource in Montana, or the current or potential uses of geothermal in the state. Through this contract, the awareness of the value and potential of geothermal energy in Montana has been realized. Montana developed a centralized source of information on the uses of geothermal, information on the current uses and owners of Montana's geothermal resources, and access to regional and national experts in geothermal resource development and engineering. Hundreds of contacts were made with geothermal resource owners, the press, and the general public. Several geothermal developments were completed that may never have been developed were it not for ths assistance of the geothermal program. In summary, the project succeeded in promoting and assisting geothermal development in the state of Montana.

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