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GEOHERMAL TECHNOLOGY TRANSFER FOR
DIRECT HEAT APPLICATIONS

Final Report

1983-1988

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MASTER

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ABSTRACT

This report describes a geothermal technology transfer program, performed by Oregon Institute of Technology's Geo-Heat Center, used to aid in the development of geothermal energy for direct heat applications. It provides a summary of 88 technical assistance projects performed in 10 states for space heating, district heating, green-houses, aquaculture, industrial processing, small scale binary electric power generation and heat pump applications. It describes an inventory compiled for over 100 direct heat projects that contains information on project site, resource and engineering data. An overview of information services is provided to users of the program which includes; advisory, referrals, literature distribution, geothermal technology library, quarterly Bulletin, training programs, presentations and tours, and reporting of activities for the USDOE Geothermal Progress Monitor.

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GEOHERMAL TECHNOLOGY TRANSFER

DIRECT HEAT APPLICATIONS

Summary

The Geothermal Technology Transfer program for direct heat applications has made significant contributions towards the development of geothermal energy. This was accomplished by providing potential users, the engineering consulting community and the public with Application Analysis on site-specific projects and an Information Service on low to moderate temperature geothermal resources and their suitable applications.

The program provided a strong service to state energy offices. Many users learned of the program through state energy offices, USDOE, from previous users or discovered it during an inquiry for technical information.

The purpose of the Applications Analysis portion of the program was to aid individuals and organizations in implementing direct heat projects involving; (1) space heating, (2) district heating, (3) greenhouses, (4) aquaculture, (5) pool heating, (6) industrial processing, (7) small-scale electrical generation and (8) heat pump applications. Of the 96 projects that received significant assistance during the 52 month period, 78 percent are either operating or at various stages of development. This represents a capacity of over 510 million Btu/hr and an annual savings of approximately 360,000 bbl of oil. Twenty two percent

of the projects were either uneconomical or not feasible from an engineering perspective and were terminated before large amounts of time and money were invested.

Most users of the program were public entities (54%) or individuals and small businesses (46%). They were usually not sure how best to utilize a viable geothermal resource or did not have the technical expertise to determine the feasibility of a proposed application. The users initially expressed an extremely favorable view of the program and USDOE because of the quick response to inquiries, the high level of interest shown, direct contact and site visits. However many users during the last two years have expressed concern over the reduction of time allowable per project (from 100 man hours in 1978 to 8 man hours in 87/88) mandated by USDOE. This has essentially eliminated site visits and most direct contact with users.

An inventory containing information and data on over 100 direct heat geothermal projects was compiled and loaded on computer files. The files are available as either diskettes or hard copy from the Geo-Heat Center.

The Geo-Heat Center acted as a clearing house for providing general and technical information on geothermal energy. Information services included; (1) advising, (2) referrals, (3) literature distribution, (4) a geothermal technology library, (5) publication of a quarterly Bulletin, (6) training programs, (7) presentations and tours, and (8) reporting activities for the

USDOE Geothermal Progress Monitor.

Nearly 2800 requests for information were handled and there were over 1526 U.S. and 230 foreign subscribers to the quarterly Bulletin which reported on the progress and development of geothermal resources for direct use. Requests for information were nearly evenly divided (8-10%) among resource/wells, space heating, district heating, greenhouses, aquaculture and equipment. The Center staff provided 78 informational talks to lay and technical audiences, over 450 persons toured geothermal use sites in the Klamath Falls area.

During the project period the number of inquiries averaged 50 requests per month, which is about the current level of inquiries. The vast majority of these inquiries were answered by telephone or letter after only a minimum effort or literature search. Many replies were made by simply forwarding copies of technical reports. The inquiries were responded to efficiently because of a complete geothermal technology reference library at hand--including copies of many technical reports related to specific applications of geothermal technology.

Introduction

The transfer of technical information to potential users, industry groups, consulting engineers, developers and the general public is an important element in the development of geothermal

energy. By far the largest number (96%) and most geographically widespread geothermal resources are in the low to moderate temperature range ($<150^{\circ}\text{C}$), suitable for space and process heating. Providing assistance and information services to the public and developers of these low to moderate geothermal systems was the primary objective of this work.

The Geo-Heat Center's contacts with the public are typically on an individual basis with a potential developer or consulting engineer. The information provided is generally of a highly project specific nature. As a result, the actual information provided usually does not make its way beyond the individual. Rather, it is the awareness of the availability of the Geo-Heat Center as a valuable information source which the individual passes on and this sequence has proven to be self perpetuating.

Geothermal application analysis to end users was designed to introduce the potential user and the engineering consulting community to geothermal direct heat. This program initially (64 man hours, now 8 man hours per project) acted as a catalyst for initiating over 80 direct heat projects. Users who derived the most benefit from this program were those having limited experience in evaluating either the resource or its applications. By generating interest and initiating geothermal projects, this activity created a demand for consulting services in the private sector where previously there was none.

Background of the Geo-Heat Center

The Geo-Heat Center is located on the Oregon Insitute of Technology campus in Klamath Falls, Oregon. The Center, as the geothermal research and information department of OIT, is a part of the Institute and of the Oregon State System of Higher Education.

The OIT campus of nearly 600,000 square feet is heated and air conditioned utilizing low temperature geothermal energy. Within the city are schools, a large hospital, businesses, apartment complexes and industrial plants utilizing geothermal energy. There are over 600 homes using downhole heat exchangers and a 6.2 megawatt thermal geothermal district heating system for the city. These facilities are available for inspection by prospective developers unfamiliar with geothermal applications and provided an excellent vehicle to acquaint them with methods, equipment and reliability of geothermal systems.

The Center was established in 1974 primarily as a result of the International Conference on Direct Use of Geothermal Energy held on the campus. Initial funding was from the Pacific Northwest Regional Commission (PNRC). The purpose was to encourage national and international exchange of ideas and applications for direct heat uses of geothermal. Since that time, the Center has performed work under USDOE, the states of Oregon, Washington and California, Bonneville Power Administration and

other public and private contracts and grants. The scope of work has included all types of geothermal associated activities including the original planning and site data base acquisition work for USDOE, marketing studies for BPA and others, aquaculture and agriculture work for PNRC and USDOE, preparation of handbooks and brochures for USDOE, technical assistance for prospective and current users of low and moderate temperature resources throughout the U.S, and special technical assistance in the state of California under contract to the California Energy Commission.

Staff members have published many papers, served on international, national, state and local advisory groups and commissions, and have provided lectures, given tours, conducted educational seminars and workshops, and published a quarterly Bulletin. As a result of this work the Center has achieved international recognition in the field of low and moderate temperature geothermal applications. The current staff consists of Paul J. Lienau, Director; Gene Culver, Associate Director; Kevin Rafferty, full time Research Associate; John Lund, part time Research Associate; two full time classified staff and a part time student librarian. John H. Smith, Dean of Administration, acts as coordinator between the Center, OIT and the Oregon State System of Higher Education and has responsibility for approval of all contracts and grants.

Applications Analysis

The applications analysis program began in 1978 when it was called the technical assistance program. Under that program up to 100 man hours per project of engineering and economic analysis, in the form of preliminary feasibility studies was available, at no cost, to public, private and corporate entities. In 1984 this effort was reduced to 64 man hours per project. In late 1986 this effort was further reduced to 8 man hours per project unless special permission for a greater amount of time was granted. Although permission for increased time was requested and granted for several projects, the effort was kept to the bare minimum of engineering assistance with no economic analysis and no formal preliminary feasibility reports have been produced since September 1986. Under the USDOE application analysis program the Center provided 88 technical studies between April 1984 and December 1986. Nearly seventy of these studies have resulted in projects that either have been completed or are in some stage of development, corresponding to a capacity of over 510 million Btu/hr. The status of these projects, corresponding to developments in 10 states, as of 1 December 1987 is: 38 percent operating, 3 percent under construction, 37 percent proposed and 27 percent have been terminated. Perhaps equally as important, many studies found the proposed project either uneconomical or not feasible from an engineering perspective and the projects were

dropped before large amounts of time and money were invested. Table 1 lists the projects for which assistance was provided in terms of a feasibility study (f), letter report (l), review of a consultants' design (c). Additionally some 2800 telephone inquiries concerning specific applications or equipment have been answered.

A feasibility study usually involved a site visit to gather information and data, resource evaluation based on published information and/or well profiling and water testing, application of engineering principles to determine development options and costs, prepare economic analysis, conceptual design, flow diagrams, and an explanation of the proposed system.

Letter reports usually addressed only a specific portion of a project. For example, a client may have questions on one or more items which could include resource, wells, well pump, heat exchangers, terminal equipment, economics evaluation and referrals or consultation to equipment vendors and consulting engineers.

A third category of request would fall under review of a consultant's design for a given project. Recently a growing number of these types of requests have been received by the Center.

Table 1.

GEOTHERMAL DIRECT HEAT PROJECTS
TECHNICAL ASSISTANCE

OIT Geo-Heat Center
1984-88

Key to Symbols:

Technology Type: S: Space Heating and Domestic Hot Water, F: Fish Farming, E: Electric
D: District Heating, P: Pools, H: Heat Pumps
G: Greenhouses, I: Industrial Processing,

Assistance Type: f. = feasibility study, l. = letter report, c. = review consultant design e. = economics, r. = resource
w. = well, wp. = well pump, h. = heat exchangers, te. = terminal equipment

Status: O. = operational, U.C. = under construction, P. = proposed, T. = terminated

No.	State	Project Name and Address	Date Initiated	Technology Type	Assistance Type	Project Capacity x million Btu/hr	Resource Temp F	Project Cost \$10 ³	Project Status
1.	AR	Hot Springs Rehab. Center Hot Springs,	Jul 85	S	l, w, wp, h, te	2.5	143	NA	P
2.	CA	Coleman Fish Hatchery Anderson	Apr 84	F	l, r	42.5	?	NA	T
3.	CA	City of Calistoga Calistoga	May 84	D	f, r	6.6	220	560.7	P
4.	CA	Siskiyou County Jail Yreka	Jul 84	S, H	c	3.0	56	921.0	O
5.	CA	Mendocino Comm. College Ukiah	Jul 84	S	f	4.4	150	145.0	T
6.	CA	Tsuji Nursery, Inc. Susanville	Jul 84	G	l	4.8	139	5.0	O
7.	CA	Great American Engineering Lake Elsinore	Jul 84	S	l	19.6	130	NA	T
8.	CA	Energy Tech. Consultants, Inc. Susanville	Jul 84	E	c	NA		NA	T
9.	CA	County of Mono Mammoth Lakes	Oct 84	D	c	51.6	320	4,200.0	P
10.	CA	Sonoma Mission Inn Sonoma	Oct 84	S, P	l	3.0	150	NA	P
11.	CA	Plant Genetics, Inc. Susanville	Feb 85	G	l	3.9	105	NA	T
12.	CA	City of Lake Elsinore Lake Elsinore	Mar 85	D	f	2.0	123	28.0	O
13.	CA	Cedarville Hospital Cedarville	Apr 85	S	f	0.6	108	52.6	UC
14.	CA	Pilot Butte Ranch Pilot Butte	Apr 85	F	l	0.2	174	NA	T
15.	CA	Yassen Co. Hospital Susanville	May 85	S	f	3.9	170	95.0	P
16.	CA	Dorris High School Dorris	Jun 85	S, H	f	1.6	75	191.9	T

17.	CA	Ft. Bidwell Aquaculture Ft. Bidwell	Jun 85	F, E	f	260 kW + 22.5 thermal	200	809.0	T & O
18.	CA	Elem. School and Maint. Shops Susanville	Sep 85	S	f	1.2	170	49.0	P & O
19.	CA	Modoc Co. Bldgs. and Schools Alturas	Nov 85	D	f	5.5	130	877.0	UC
20.	CA	Ramco Geothermal Farms Auburn	Feb 86	G	l, te	13.5	176	NA	O
21.	CA	Apartment Complex Desert Hot Springs	Aug 86	S, P	l	1.5	120	NA	O
22.	CA	Ag Park Kelseyville	Dec 86	G	w	NA	166	NA	UC
23.	CA	Lake County Ag Park Kelseyville	Aug 86	G	w,wp,n,e,c	.30	160	NA	UC
24.	CA	Ft. Bidwell Ind. Res. Ft. Bidwell	Mar 87	D	l,e	1.0	200	NA	UC
25.	CA	LDS Church Susanville	Apr 87	S	l,w,r	NA	160	NA	O
26.	CA	Rick Chitwood Mt. Shasta	Jan 87	S	l,w,r	NA	140	NA	O
27.	CA	Susanville D.H. Susanville	Aug 87	D	l,wp,te	NA	170	NA	O
28.	CA	Calistoga Hi School Calistoga	Nov 87	S	l,w,wp,r	NA	190	NA	P
29.	CA	Sutter Yuba Mosq. Abat. Dist. Sierraville	Dec 87	P	l	NA	125	NA	P
30.	CO	City of Ouray Ouray	Aug 84	P, S	f, te	0.13	140	3.0	O
31.	CO	Haystack Resources Boulder	Jan 86	G	l, r	3.8	134	166.7	P
32.	CO	City of Ouray Ouray	Jan 86	D	c	NA	156	NA	UC
33.	CO	Salida Comm. Center Salida	Jan 86	S	l	NA	150	NA	P
34.	ID	College of Idaho Caldwell	Apr 84	D	f	14.8	160	1,325.0	P
35.	ID	G. Graham Residence Weiser	Apr 84	S	l, te	0.05	150	NA	P
36.	ID	Nampa State Hospital Nampa	May 84	D	f	17.4	160	1,489.0	P
37.	ID	Kimberland Meadows Project New Meadows	Aug 84	S	l	18.8	166	1,500.0	P
38.	ID	AgriResources, Inc. Bruneau	Dec 84	G	l, te	3.6	110	NA	O
39.	ID	Hagerman National Fish Hatchery Hagerman	Jan 85	F, S	f	2.5	125	160.0	T
40.	ID	Resort Givens Hot Springs	Oct 86	S, P	l, te	0.45	136	4.1	O
41.	ID	Caldwell Pool Caldwell	Mar 87	P	l,w,r	2.5	95	NA	P
42.	ID	Osborne Residence Buhl	Aug 87	S	l,te	.04	90	NA	P
43.	MT	Symes Hotel Hot Springs	Jun 84	S	l,te	NA	125	NA	O

44.	MT	Camas Resort Hot Springs	Jun 84	S	l	NA	125	NA	T
45.	MT	Lost Trail Resort Sula	Jun 84	S, P, H	l, te	NA	108	NA	T
46.	MT	Lolo Hot Springs Lolo	Jun 84	S	l, te	NA	122	NA	O
47.	MT	Elkhorn Springs Resort Jackson	Jun 84	S	l	0.17	120	1.5	O
48.	MT	Warm Springs Hospital Warm Springs	Jun 84	S	l, P	3.2	168	34.6	O
49.	MT	Chico Hot Springs Pray	Jun 84	S, P	l	0.6	112	91.0	T
50.	MT	Murphy Oil Poplar	Jun 84	D, E	l	NA	200+	NA	T
51.	MT	H. Thexton Ennis	Aug 84	P	l, te	0.80	180	25.5	O
52.	MT	Montana State Prison Deer Lodge	Aug 84	G	l	NA	80	NA	T
53.	MT	Madison Lumber Co. Ennis	Oct 84	S	l	0.22	95	NA	O
54.	MT	Boulder Hot Springs Boulder	Dec 84	G, S	l	NA	160	NA	T
55.	MT	Native American Trading Co. Helena	May 85	G	l, te, wp	5.6	157	NA	O
56.	MT	Resort Granite Hot Springs	Aug 85	S, P	l, te	0.31	108	12.0	O
57.	MT	Volunteer Fire Department Jackson	Feb 86	S	l	0.08	136	NA	T
58.	MT	Bozlee Greenhouses Anaconda	Mar 87	G	l	3.0	160	NA	P
59.	MT	Barth Residence White Sulphur Springs	Sep 87	S	l	.04	130	NA	P
60.	NM	Beall Greenhouses Animas	Sep 87	G	l, wp	NA	193	NA	O
61.	NM	Las Alamos Nat. Lab. Las Alamos	Oct 87	P	l, c, e	NA	Var.	NA	P
62.	NV	Caliente District Heating Caliente	Apr 84	D	f	27.5	180	3,140.0	P
63.	NV	Kelley Hot Springs Alturas	Jun 84	E	f	1.5 MW	220	5,400.0	T
64.	NV	Golden Road Motor Inn Reno	Feb 85	S	l, w, e	7.2	115	407.0	P
65.	NV	Binary Generator Test Wabuska	Mar 85	E	report	750 kW	221	NA	O
66.	NV	Geothermal Systems, Inc. Elko	Jun 85	D	f	10.4	180	623.0	T
67.	NV	Geothermal Systems, Inc. Wendover	Jun 85	S	l	NA	120	NA	T
68.	NV	Elko Schools Elko	Oct 86	E	l, r, te	90 kW	190+	NA	O
69.	OR	Klamath C. C. Klamath Falls	Apr 84	S	w, te	0.26	170	NA	O
70.	OR	Lake Co. Hospital Lakeview	Apr 84	S	f	4.5	140	184.0	P

71.	OR	Specialized Service Co. Klamath Falls	Apr 84	S	l	2.5	115	NA	O
72.	OR	Kilpatrick Residence John Day	Jul 84	S	l	0.013	105	0.5	O
73.	OR	Brietenbush Community Detroit	Oct 84	S	l, h, te	NA	190	NA	O
74.	OR	El Dorado Motel Klamath Falls	Jan 85	S, H	l	1.2	80	104.0	T
75.	OR	Oregon Department of Forestry Klamath Falls	Jan 85	S, H	f	0.23	75	10.9	P
76.	OR	J. Sitz Drewsey	Feb 85	F	l	7.6	130	NA	T
77.	OR	Huckleberry Inn Government Camp	May 85	S, H	F	0.58	73	99.0	T
78.	OR	Hot Lakes R.V. Park Hot Lakes	May 85	S, P	l	0.92	190	41.5	O
79.	OR	The Greenhouse Lakeview	May 85	G	wp, te	2.9	180	NA	O
80.	OR	Hunter's Hot Springs Hotel Lakeview	May 85	S	l, h, te	0.07	196	0.5	O
81.	OR	Favel - Utley Corp. Lakeview	May 85	D	l, h, te	5.0	216	130.0	P
82.	OR	College Industrial Park Klamath Falls	Jun 86	D	r, w, te	8.8	130	405.0	P
83.	OR	Apartments Klamath Falls	Nov 86	S	l, w	NA	166	NA	O
84.	OR	Hillsboro Ind. Park Hillsboro	Mar 87	HP	l	?	70	NA	P
85.	OR	Mitchel Residence Klamath Falls	Aug 87	HP	c	NA	75	NA	O
86.	OR	D-7 Ranch Paisley	Mar 87	P	l, w, wp, h, te	NA	180	NA	P
87.	OR	Hargrove Residence Klamath Falls	Oct 87	S	w(DHE)	NA	190	NA	O
88.	OR	Bogatay Apartments Klamath Falls	Oct 87	S	w	NA	NA	NA	O
89.	OR	County Jail Klamath Falls	Nov 87	S	w, wp	NA	NA	NA	UC
90.	OR	MWMC Klamath Falls	Dec 87	S	w	NA	NA	NA	O
91.	SD	Indian Reservation Pine Ridge	May 84	G	f, r	1.9	120	139.6	P
92.	SD	City of Philip Philip	Mar 85	D	f	18.0	154	3,508.0	O
93.	SD	Community Center Timber Lake	Feb 86	S, H	l, te	0.27	61	23.0	P
94.	SD	Bureau of Indian Affairs Eagle Butte	Mar 86	D	l	NA	150	NA	P
95.	UT	Childerns Museum Salt Lake City	Apr 84	S	f, r	2.2	108	122.9	P
96.	UT	Utah State University Logan	Apr 85	I	l	11.8	185	455.0	P
97.	UT	Montgomery Engr. Near Williams AFB	Apr 87	E	l, w, r	NA	200	NA	P

98.	UT	Monroe Hot Springs Monroe	Aug 87	S	c.l	21	180	NA	P
99.	WA	Harrah Elem. School Harrah	May 84	S, H	l	1.4	90	228.0	T
100.	WA	Cheney High School Cheney	Jul 84	S, H	l	1.2	87	NA	T
101.	WA	County Jail Yakima	Jul 84	S	l, h	6.3	72	NA	O
102.	WA	City Buildings Moses Lake	Oct 84	S, H	f	1.4	68	468.0	T
103.	WA	Prosser Schools Prosser	Oct 84	S	f	NA	63	NA	T

Many of the original studies were the first to suggest particular equipment or techniques. Examples are the suggestion to use plate type heat exchangers, the first to come "on line" using heat pumps for district heating utilizing heat obtained from domestic water systems, new designs for downhole heat exchangers, application of downhole heat exchangers for air conditioning applications and the use of temperatures once considered to be too low for space and greenhouse heating.

Most users learned of the technical assistance program from federal energy offices, state energy offices, by word of mouth or discovered it accidentally during an inquiry for technical information. A brochure was published describing the program and distributed primarily by means of state energy offices.

Technical assistance program users were typically public entities, small businessmen, or individuals with little or no knowledge of the technical aspects of geothermal direct use. The program provides a service that many of them could not or would not have obtained on their own. The users, almost without exception, have expressed an extremely favorable view of the program and USDOE.

As perceived by the users, the program's major strengths are:

- . The quick response to inquiries
- . The high level of interest and enthusiasm shown
- . The direct contact and site visits.

Most of the users feel that the technical assistance program

is a government program which works by helping "real people" accomplish personal energy conservation goals and make the small investor comfortable and confident in his project. Appendix A contains samples of letters from users of the program.

Although a few major corporations have made use of the program, most users are municipal governments and school districts (54%) or individuals and small businesses (46%). A typical applicant for technical assistance has, or thinks he has, a viable geothermal resource but is not sure how best to utilize it or does not have the technical expertise to determine the feasibility of his proposed application. Many, if left to their own resources, would install a system that would not operate satisfactorily or have a short useful life. This leads to disillusionment and negative attitudes towards geothermal and/or other alternative energy resources.

Some applicants have installed systems which have failed, or are not operating as planned, and requested assistance in rectifying the problems. In most cases these were installed by local heating and plumbing contractors not aware of potential problem areas and solutions. In addition to providing help to the applicants, the informational services are intended to inform contractors and consultants about design techniques applicable to direct use geothermal applications.

Technical Assistance Inventory. An inventory containing data on over one hundred technical assistance projects, completed

primarily by the Geo-Heat Center since 1978, have been loaded on to computer files. These computer files consist of data sheets, with the possibility of 23 data fields for each project, under categories of (I) Project Site, (II.) Resource and (III.) Engineering. Figure 2 shows a sample file from the collection. A listing of current projects on file are given in Table 2, which are continuously being updated and new files are being added to the listing.

REF. NO(STATE-PROJ): AZ-01

FILED: 12/24/85

UPDATED: 10/18/88

GEOHERMAL TA PROJECTS
NATIONAL INVENTORY

I. PROJECT SITE

LOCATION: STATE AZ COUNTY _____ CITY SAFFORD

APPLICATION(S): AQUACULTURE ☐ DISTRICT HEATING ☐
GREENHOUSE(S) ☐ PROCESS HEAT ☐
SPACE CONDITION X OTHER ___ HEAT PUMP ___

PROJECT STATUS: OPERATING ☐ UNDER CONSTRUCTION ☐
PROPOSED ☐ TERMINATED X
PROJECT TERMIN: NOT FEASIBLE X INSTITUTIONAL ☐

FIRST YEAR OF OPERATION: _____ EXPANSION PLANNED: _____

PROJECT NAME: __SAFFORD FEDERAL PRISON

CONTACT PERSON: Eddie Trujillo

ADDRESS: Federal Prison Camp _____
Safford, AZ ZIP 85546

TELEPHONE (602) 428-6600

II. RESOURCE

NUMBER OF WELLS: PROD 1 INJECTION 1

DRILLING DEPTH: (FT) (1) 2200 ' (2) _____ ' (3) _____

PUMPING DEPTH: _____ FT

WELLHEAD TEMPERATURE: 140 deg F

MAX POSSIBLE FLOW RATE: 142 GPM

III. ENGINEERING

TEMPERATURE AT ENTRANCE TO USE: 130 deg F

TEMPERATURE AT EXIT FROM USE: 70 deg F

DESIGN TEMPERATURE: _____ deg F

FLOW RATE (GPM): AVG _____ PEAK _____ GPM

HEATING DEGREE DAYS: 2319 DD

PEAK HEATING RATE: 1,338,000 BTU/HR

ANNUAL ENERGY USAGE: 2.483e9 BTU/YR

LOAD FACTOR: .21

FUEL SAVED: TYPE(1) NAT. GAS QUANTITY 2.867e9 CU. FT.

TYPE(2) _____, QUANTITY _____ (Specify Units)

PROJECT COST: TOTAL: \$363,440

PUBLIC FUNDING: NONE

DOE FUNDING (if any): NONE

SIMPLE PAYBACK: 19.56

DOE or STATE TA(Y or N): DOE

Table 2

Inventory of TA
Direct Heat Projects

Key to Symbols:

Project Status: O = Operating, UC = Under Construction
P = Proposed, T = Terminated

Availability: Files are available from the Geo-Heat Center on disk
or as hard copy.

File	Project Name	Status
AZ-01.AZ	Safford Federal Prison	T
AZ-02.AZ	Decker Land Development	T
CA-01.CA	Geothermal Agricultural Park	UC
CA-02.CA	Butte Valley H.S.	P
CA-03.CA	Lake Elsinore/GAE	UC
CA-04.CA	Calistoga District Heating	P
CA-05.CA	Lake Elsinore District Heating	UC
CA-06.CA	Cascading Binary Power Use	P
CA-07.CA	Mammoth Lakes DH	P
CA-08.CA	Plant Genetics	T
CA-09.CA	Pilot Butte Ranch	P
CA-10.CA	Lassen Community Hospital	T
CA-11.CA	Warm Creek Apartments	UC
CA-12.CA	DHE/Three Calistoga Bldg.	P
CA-13.CA	Greenville Schools	P
CA-14.CA	Damson Oil	P
CA-15.CA	Roosevelt Pool	P
CA-16.CA	Ramada Inn	O
CA-17.CA	Seacliff IV	T
CA-18.CA	Dumont Vineyard	T
CA-19.CA	Hot Creek Fish Hatchery	O
CA-20.CA	Green Meadow HUD Project	T
CA-21.CA	Indian Springs School	T
CA-22.CA	Wine Valley Inn	T
CA-23.CA	Sharpstein Museum	P

Ca-24.CA	84 Unit Condo	T
CA-25.CA	Ramada Inn	O
CA-26.CA	Sonoma State Hospital	P
CA-27.CA	Indian Valley Hospital	UC
CA-28.CA	Konocti Harbor Inn	T
Ca-29.CA	Binary Generator	T
CA-30.CA	So. County Govt Center	P
CA-31.CA	Verdant Vales School	T
CA-32.CA	Greenhouse for Retarded Citizens	P
CA-33.CA	Municipal Pool	P
CA-34.CA	Power Generation and District Heating	UC
CA-35.CA	State Office and Employment Development Buildings	O
CA-36.CA	Gerber Foods	T
CA-37.CA	San Bernadino Valley College	T
CA-38.CA	Nat'l Orange Show Fairgrounds	P
CA-39.CA	Four Municipal Bldgs.	T
Ca-40.CA	Pine Crest Mental Health	P
CA-41.CA	Frontier Inn	P
CA-42.CA	United Methodist Church	P
CA-43.CA	Del Mar Foods	T
CO-01.CO	Haystack Resources Co	P
CO-02.CO	Duray Municipal Pool	O
HI-01.HI	Geo-Waste For Ice Making	P
ID-01.ID	College of Idaho	P
ID-02.ID	Idaho State School & Hospital	P
ID-03.ID	Agri-Resources Greenhouse	O
MT-01.MT	Granite Hot Springs	O
MT-02.MT	Madison Lumber Co.	O
MT-03.MT	Bill Thexton TRL Court	O
NV-01.NV	DH for Coliente	P
NV-02.NV	Green Valley Estates	T
NV-03.NV	Salimi Plant w/Generator	P
NV-04.NV	Gerlach High School	T
NV-05.NV	DH for Hawthorne	T
NV-06.NV	Life Cycle for Hawthorne	T
NV-07.NV	El Capitan Lodge & Casino	T
NV-08.NV	MIneral Co. School System	T
NV-09.NV	Hawthorne DH	T
NV-10.NV	DHE's for Noana Area	O

NV-11.NV	Moana Municipal Pool	O
NV-12.NV	Virginia Lake Townhouses	T
NV-13.NV	MGM Grand	P
NV-14.NV	Casinos/Hotels Downtown	P
NV-15.NV	Univ. of Nevada at Reno	P
NV-16.NV	Wild Creek Racquet Club	T
NV-17.NV	Damote Ranch Housing Project	UC
NV-18.NV	Binary/Aqua./Ethanol Plant	O,O,T
NV-19.NV	Carlin High School	O
NV-20.NV	Elko County School District	O
NV-21.NV	Wells High School	O
NV-22.NV	Grover C.Dils Medical Center	O
OR-01.OR	City of Brookings	T
OR-02.OR	Aquaculture/Harney Basin	P
OR-03.OR	Basin View	T
OR-04.OR	College Industrial Park	P
OR-05.OR	Schooler Apts	T
OR-06.OR	United Church of Christ	T
OR-07.OR	Stepping Stones Rehab Center	P
OR-08.OR	75 Unit Apartments S/L	T
OR-09.OR	Co. Road Department Shops	O
OR-10.OR	Klamath Luthern Church	T
OR-11.OR	Sheild Crest Subdivision	P
OR-12,OR	MT. Laki Presbyterian	T
OR-13.OR	Modoc Lumber Co.	T
OR-14.OR	Kingswood Apartment Modif.	O
OR-15.OR	Klamath Christian Center	O
OR-16.OR	City of LaGrande	T
OR-17.OR	Pacific Wood Fuel	T
OR-18.OR	Lakeview Greenhouses	O
OR-19.OR	Malting Investment Co.	T
OR-20.OR	Fremont Lumber	T
OR-21.OR	Blue Mtn. Comm. College	P
OR-22.OR	Vale District Heating System	T
SD-01.SD	Pine Ridge Indian Res.	P
UT-10.UT	Troy Hygro Greenhouses	UC
WA-01.WA	Sal Duc Hot Springs	UC
WA-02.WA	City of Othello	T
WA-03.WA	Harah Elementary School	T
WA-04.WA	Carson & Wind River Schools	P
WA-05.WA	A.C. Davis High School	T
WA-06.WA	Easter Washington Util.W/W	T

Peak heating rate, annual energy usage and load factor are computed by a code from data entered under the engineering category for space heating projects. For other types of applications these calculations were done manually.

The files were generated using SuperCalc³ software by Sorcim and are also available as text files so they can be viewed on any IBM compatible computer using MS DOS. They are available as either hardcopy or on floppy disks from the Geo-Heat Center.

Information Services

The informational services were designed to provide the general public, potential users and the consulting engineering community with information and data on geothermal direct heat applications techniques and materials. The Geo-Heat Center acts as a clearing house for providing general and technical information on geothermal energy. This effort also acts as a catalyst for initiating direct heat projects and increases public awareness of geothermal energy.

The effort included advising, referrals, literature distribution, publication of a quarterly Bulletin, maintenance of a geothermal technology library, training programs, presentations and tours, and reporting of activities for the USDOE Geothermal

Progress Monitor.

Advising and Referrals. Answering telephone inquiries, letters and meeting with individuals or groups was a major function of the program. These inquiries usually involved questions or requests for recommendations on site-specific projects. In some cases, the inquiry was referred to someone more knowledgeable about a specific subject. Each inquiry usually required 2 to 3 hours on the average to research and respond with a telephone call or letter.

Literature Distribution. The Geo-Heat Center made available for distribution 127 publications. They are classified as summary papers (37), technical reports and publications (21), and technical assistance feasibility studies (72). A "Publications Request Form", providing a listing of the available publications, is contained in Appendix B. These publications have been written and compiled primarily by Geo-Heat Center staff on topics which include: resources, well testing, hydrology, space heating, district heating, greenhouses, aquaculture, heat pumps, piping, pumps, heat exchangers, absorption refrigeration, binary generators, corrosion, economics and pricing of geothermal energy. In addition, geothermal site data base reports are available for the states of Alaska, Idaho, Montana, Oregon, Washington and Wyoming on a loan basis. Since these reports were published in

1979, information on legal, institutional and permitting requirements is in need of updating. Formal technical assistance feasibility reports were made available for direct heat projects in nine western states.

A total of 2768 inquiries were logged during the 52 month period. The categories of the inquiries, are shown on Figure 1 which also indicates areas of most interest, including resource/wells, space heating systems, district heating systems, greenhouses, aquaculture, industrial process heating, equipment, heat pumps, low-temperature binary generators and general information.

Geothermal Technology Library. The Geo-Heat Center maintained a library dedicated to geothermal energy. Over 4,000 entries have been collected over a 15 year period. Volumes are cataloged according to title, author, subject and geographic area. A collection of resource maps and equipment supplier catalogs are also maintained. The Center also maintains a library of 35 mm slides on geothermal applications throughout the world. There are approximately 400 slides on foreign uses and over 1000 on US applications and engineering. These have been used in direct use displays, of up to 10' x 20' at energy expos, professional society meetings, and state and local fairs. The displays often include slide tape shows with literature available to the public.

In addition to the Center staff, the library was used by the public, students and engineering consultants. Volumes were also made available on a loan basis.

Geo-Heat Center Bulletin. The Center published twelve quarterly Bulletins which reported on the progress and development of geothermal resources for direct uses. This publication has 1526 subscribers in the USA and about 230 foreign subscribers.

Articles were solicited from established geothermal experts, both domestic and foreign, academic, national laboratories and the private sector.

Each Bulletin considered a central theme such as hydrologic

research, resource evaluations, binary generators, district heating, greenhouses, equipment and aquaculture. Progress monitor activities were reported in a section titled, "Geothermal Pipeline".

An effort was made to include "how to" types of articles, including determination of greenhouse heat loads, pond heat losses, pumping systems, heat exchangers, and piping systems.

Training Programs. The Center held two workshops on the campus and one long-term specialized training program for three United Nations fellows from China (not funded by USDOE).

The first, an Operating District Heating Systems Symposium and short course on corrosion was held in April 1985, with 41 persons in attendance.

The second was held in May 1986, in conjunction with the Geothermal Resources Council. Titled a "Topical Workshop for the Update of Geothermal Direct-Use Development and Applications", it was attended by 88 persons. The attendees came from 12 states, Canada, England, Iceland, Italy, New Zealand and Mexico.

The United Nations Department of Technical Cooperation provided three fellowships for Chinese professors from Tianjin University and an agriculture specialist to study US geothermal systems. The program included field trips, geothermal course work and project feasibility studies. The Chinese government has established Tianjin as a model city to develop its geothermal

resources (50 to 96°C) as a partial solution to air pollution from burning coal. The three Chinese specialized in the study of district heating systems, corrosion problems and greenhouse heating systems while in the US.

Presentations and Tours. The Center provided 78 informational talks for lay and technical audiences at conferences, industry organizations, professional society meetings and to community groups. The purpose of these talks was primarily to increase awareness of geothermal energy as a viable energy alternative. They included such topics as system design, economic considerations, resource distribution and evaluation, application types and examples of operating systems.

The Center had a unique opportunity to show the public and potential users examples of geothermal energy use. Tours provided the opportunity to inspect operating geothermal systems which included: a campus geothermal heating and cooling system, the city district heating system, a residential use with a downhole heat exchanger, hospital system, commercial and industrial applications including greenhouses and aquaculture. Each application is unique and use of equipment for various purposes was explained. During the period of this program, 94 groups, representing over 450 persons, utilized this service.

Progress Monitor. The Center compiled information about

geothermal development activities that occurred in Regions VII, IX and X. A total of 121 items were reported to the Geothermal Progress Monitor, compiled by EG&G Idaho, Inc. for USDOE. Selected items from this report were then published in the GHC Bulletin.

APPENDIX A

Letters from Program Users

United States Department of the Interior
BUREAU OF RECLAMATION
MID-PACIFIC REGIONAL OFFICE
2800 COTTAGE WAY
SACRAMENTO, CALIFORNIA 95825

IN REPLY
REFER TO: MP-430
105.

FEB 5 1985

Paul J. Lienau, Director
Geo-Heat Center
Oregon Institute of Technology
Klamath Falls, Oregon 97601

Dear Mr. Lienau:

The Water Users' Conference staff and I sincerely thank you for your cooperation in arranging and conducting the tour of the Geo-Heat Center. Those present on the tour found it most interesting and enjoyable.

Sincerely,

NEIL W. SCHILD
ASSISTANT REGIONAL DIRECTOR

TRM ENGINEERING LTD.
701-744 West Hastings Street
Vancouver, British Columbia
V6C 1A5 Telephone (604) 685-1111

May 23, 1985

Professor Paul J. Lienau
Director
Geo-Heat Centre
Oregon Institute of Technology
Klamath Falls, Oregon
97601

Dear Paul:

I would like to thank you on behalf of Tad and myself, for a very pleasurable and informative tour of Klamath Falls. The knowledge that we gained is invaluable, and hopefully will be put to good use.

We will contact you when we have a more definite idea of the status of the Meager Creek Geothermal Resource.

Thanks again -

Cheers,

Murray McClaren
Principal

MM:slr

HAYSTACK RESOURCES COMPANY

12600 West Colfax Avenue
Suite A-202
Lakewood, CO 80215

Geothermal Energy
& Water for Industry

Tel. (303) 234-1449

June 3, 1985

Gene Culver
Geo Heat Center
Oregon Institute of Technology
Klamath Falls, Oregon 97601

Dear Gene;

We have received the feasibility study regarding our geothermal project in Boulder, Colorado. After reviewing the report, I have found that you have done an excellent job of supplying us with valuable information for our project. We now have a better picture of our geothermal potential, the technical and financial parameters involved, operating costs, etc. which will help us determine the overall feasibility of our business project.

I greatly appreciate your time and attention to our project and remain

Sincerely Yours,

Allen Elrod

Department of Geology and Mineral Industries
ADMINISTRATIVE OFFICE

1005 STATE OFFICE BLDG., PORTLAND, OREGON 97201 PHONE (503) 229-5580

June 10, 1985

Dr. Larry J. Blake, President
Oregon Institute of Technology
Klamath Falls, Oregon 97601-8801

Dear Dr. Blake:

On May 31, 1985 the Governing Board of the Department of Geology and Mineral Industries held its regular meeting at the Union Building at OIT.

Your facilities are outstanding and the staff at the Union Building were cordial and helpful. In particular we appreciate the assistance of Paul Lienau who described the use of geothermal energy in Klamath Falls and guided a tour of the campus and downtown heating systems.

We thank you for the hospitality of OIT. It made our meeting enjoyable and productive.

Sincerely,

Donald A. Haagensen
Chairman, Governing Board

DAH:ab

HAYSTACK RESOURCES COMPANY

12600 West Colfax Avenue
Suite A-202
Lakewood, CO 80215

*Geothermal Energy
& Water for Industry*

Tel. (303) 234-1449

August 6, 1985

Dr. Ted Mock, USDOE
Forrestal Bldg., CE 324
1000 Independence Avenue SW
Washington, DC 20585

Dear Dr. Mock;

This letter is to express our support and appreciation of the geothermal technical support program at the Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, Oregon. I understand that this program is funded by your office and that a proposal for future funding is currently in review in Senator Mark Hatfield's office.

Our company has received invaluable information and assistance from this program, particularly from Gene Culver, in helping us understand the technical and economic feasibility of our own geothermal project. Our project involves the development and application of 140 degree F. geothermal water for a variety of agricultural businesses including commercial greenhouse operations and aquaculture production.

Geothermal technology is not yet widespread in this country, though there exists a strong interest for its use and there exists incredible reservoirs of useable heat, particularly in the west. Therefore, it is imperative that there exist a clearinghouse of technical information and support to assist users in the application of this renewable resource. Without the support of the Geo-Heat Center our project would be lingering in the "what-can-we-do" stage.

Instead, we are past that and now ready to develop our agricultural-geothermal park. The Geo-Heat Center has helped us determine the technical and economic feasibility of our business venture.

I strongly recommend continued funding for the Geo-Heat Center.

Very Truly Yours,

HAYSTACK RESOURCES CO.

Allen Elrod

cc. ~~Gene Culver, Geo-Heat Center~~
Sen. Gary Hart
Sen. William Armstrong
Rep. Tim Wirth
Rep. Pat Schroeder
Rep. Dan Schaefer
Rep. Kenneth Kramer

Gene Culver
Geo-Heat Center
Oregon Institute of Technology
Klamath Falls, Oregon

Dear Mr. Culver,

Thank you very much for the diagram and the reprints about downhole heat exchangers.

I am going to make one of the types that you sketched on the graph paper. Up to now I have simply used coils of copper, or plastic pipe inside the free-flowing spring that I have next to the greenhouse. This has been fairly satisfactory, but as the spring is only 115 deg F, it did get too cool in one corner of the house when the temperature dropped below negative 15 deg F. The well that we have in the same area is 110 feet deep, and has water 125 deg F. at the bottom.

When I drilled the well, I put slots in the casing near the center of the well, but unfortunately, cold water enters in at the level I chose. I've tried to seal the well, but have not succeeded as yet. That is why I've decided to just put an exchanger down in the hot bottom.

The valley that we live in is quite interesting from a geothermal point of view. On our property we have about ten acres with three or four small springs coming out along the shore of the Crystal River. We're using two of them, plus the well. Anywhere in that ten acre area (and on the 40 acres next to ours) one can get warm water at about five to six feet depth. At that depth it is about 100 deg F. At 115 ft. there is a hard layer of red stone that makes cable tool rigs unusable. I am considering drilling deeper at a later date.

I have used the spring exchanger to heat our house, as well as the greenhouse for several years. Now this next year we are opening a health facility with a hot swim spa as well as hot tubs. For this we will be pumping about 70 gal./min. thru the building and then back to the river. We will filter the water both at the source and at the pools, because of visible iron. Possibly the water will be clean enough to pump directly through the radiant heating pipes without exchanging.

Well, thank you again for the prompt sending of the material. It is greatly appreciated. I will keep in contact with you.

B.B. Johnson
14628 Hwy. 133
Carbondale, CO 81623

Sincerely,

Bernarr B Johnson
Bernarr B Johnson, M.D.

ESKATON

good health

good living

September 10, 1985

Mr. Kevin Rafferty
Research Associate
Geo Heat Center
Oregon Institute of Technology
Klamath Falls, Oregon 97601

Dear Kevin:

I want to thank you for the report you sent to us. The collection and analysis of data relative to the feasibility of using geothermal energy for the Lassen Community Hospital obviously consumed a good deal of time, and resulted in some very useful information.

The finding that geothermal energy has a very slow payback, especially in comparison to a 3-year payback for the alternate co-generation proposal, was quite a surprise. We appreciate your work in making this comparison possible.

Thanks again.

Sincerely,

Philip J. Grief

MODOC COUNTY PLANNING DEPARTMENT

202 WEST 4th STREET
Phone: (916) 293-2582 or 233-3215- 233-3939 ext. 403
ALTURAS, CALIFORNIA 96101

JERRY K. GROVE
Director of Planning

December 16, 1985

Gene Culver
Associate Director
Geo-Heat Center
Oregon Institute of Technology
Klamath Falls, OR 97601

Dear Gene:

I have received your letter of recommendation concerning the geothermal applications in Alturas. It looks like a lot of information for 64 hours of work! Did you send separate copies to the Board of Supervisors and Modoc Joint Unified School District? If you did not let me know and I will forward copies to the---otherwise I will assume you did.

Sincerely,

JERRY K. GROVE, DIRECTOR

Pamela Townsend
Assistant Planner

JKG/PT:110

Lyle D. Griffith, M.D.

April 9, 1986

Office: 710 SUNSET DRIVE
LA GRANDE, OREGON 97850
PHONE (503) 963-8481
Home: ROUTE 2, BOX 2350
LA GRANDE, OREGON 97850
PHONE (503) 963-5522

Kevin Rafferty, P.E., Research Associate
Geo-Heat Center
Oregon Institute of Technology
Klamath Falls, OR 97601

Dear Mr. Rafferty:

We received your report re: the RV park and hot springs pools and support buildings. I want to thank you for all your effort here. It is obvious you are very familiar with this kind of energy for space-heating. As to our progress, we are submitting this to the State Department of Energy and hopefully will get the local officials to help us spell out the exact specs for our upcoming project.

I will enclose a copy of Ken Nichols' report on the effectiveness of the small energy electrical plant located in Susanville. Please look this over. I would greatly appreciate it if you would get in touch with us and let us know how you could help us with this project. It appears that we could implement the electrical generating plant and use the tailwater to provide the heating we are going to need in the RV Park.

Please keep me informed as to the exact date of the Geothermal Resource Council conference to be held there in Klamath Falls so we can plan to attend. Thank you very much for all your help on this.

Very truly yours,

Lyle and Donna Griffith, Hot Lake RV Project

LDG/kj

enc: Ken Nichols' report

Parker's Various Activities

P.O. BOX 709 LAKEVIEW, OR 97630

THE KING'S CHRISTMAS TREE COMPANY
THE GREENHOUSE
PARKER RENTALS

D. ANDY & CAROL PARKER
503-947-3923

April 22, 1986

Mr. Gene Culver
Oregon Institute of Technology
Klamath Falls, Oregon 97601

Dear Gene:

Thanks for the time and advice on geothermal utilization. We are going to install a heat exchanger as mentioned as an improvement for our facility.

Before we do that, may we request some additional assistance for a design utilizing a well we have purchased adjacent to our greenhouse operation. I need to revamp and redesign so that an adjacent home and shop can be heated along with the greenhouse.

This is the old well known as the "Hart well" just west of the Highway 395. We will have to move the heat beneath the highway. Since this well geysers almost continuously it should cut a lot of pumping cost. I do need to know how much heat can be extracted by this proposed use.

I am open to meet anytime but please call so it will be set as this is a busy time for us.

Thanks.

Sincerely,

D. Andy Parker

RICHARD H. BRYAN
Governor

JEAN FORD
Director

OFFICE OF THE GOVERNOR
OFFICE OF COMMUNITY SERVICES

Capitol Complex
Carson City, Nevada 89710
(702) 885-4420

January 27, 1987

Paul J. Lienau, Director
Geo. Heat Center
Oregon Institute of Technology
Klamath Falls, Oregon 97601

Dear Mr. Lienau:

First of all, I would like to congratulate you on your wonderful publication GHC's Quarterly Bulletin. It provides, not only up-to-date information on projects within our state, but also our neighboring states.

I would, however, like to call your attention to the fact that in the Fall 1986 issue, the Elko project funding was stated to have come from the schools and hospitals program of Health and Human Services. Actually, the funding was provided by both the local entities and a grant through the Department of Energy's Institutional Conservation Program (ICP) for schools and hospitals, administered on the state level by our office.

I only wanted to bring this to your attention because I believe this project and the funding source have been mentioned before in your publication and wanted to set the record straight.

Sincerely,

A handwritten signature in cursive script, appearing to read "Harriet Schaller".

Harriet Schaller
ICP Manager

HS/1

IN REPLY
REFER TO:

United States Department of the Interior

3200 (920)

BUREAU OF LAND MANAGEMENT

OREGON STATE OFFICE
P.O. Box 2965 (825 NE Multnomah Street)
Portland, Oregon 97208

FEB 17 1987

Paul J. Lienau, Director
GEO-HEAT CENTER
Oregon Institute of Technology
Klamath Falls, Oregon 97601

Dear Paul,

Thanks for sending the recent Geo-Heat Center Quarterly Bulletin. That issue was certainly well written and impressive. The substantive articles and reference material will be very helpful. I commend you and your staff for it.

Here are the names and addresses for your mailing list that we discussed:

Dov Levitte, Head
Environmental Geology Division
Geological Survey of Israel
30 Malke Yisrael Street
Jerusalem, 95501
Israel

Michael Gill, Marketing Manager
Ormat Turbines, Ltd.
P. O. Box 68, Yavne 70650
Israel

Doug Miller, Project Development
Ormat Systems, Inc.
500 Dermody Way
Sparks, Nevada 89431

I've sent out the issues to Israel already and managed to scrounge up a copy from one of my friends. I did mention your interest in receiving articles or news items in my letters. Thanks again for your help.

Sincerely,

Jack Feuer
Geologist

LAKE DISTRICT HOSPITAL

700 SOUTH "J" STREET • LAKEVIEW, OREGON 97630 • TEL (503) 947-2115

8/3/84

Paul J. Lienau
Director
Geo-Heat Center
Oregon Institute of Technology
Klamath Falls, Oregon 97601

Dear Paul,

Thank you for the geothermal and energy review done by your staff at Lake District Hospital. Kevin Rafferty's letter of June 21 should be a big help in getting an energy audit approved by our Board. Thanks also to Gene Culver and Thor for their contributions.

The geothermal methodology best suited for our site is still undetermined. We are keeping our feelers out, and have some interesting possibilities. One is to induce outside investors to provide the capital, take all the risk, and to share in the resulting savings. Another is to enter into a joint venture with the four area schools, utilize known hot wells, plus the schools and hospitals grant program, and the outside investor scheme. That last possibility has the greatest complexity as well as the greatest potential benefit.

Your study has given us a down to earth (excuse the pun) view of our independent geothermal possibilities. Your efforts have not gone unnoticed and will almost certainly lead to a better, more efficient, less costly energy future for our facility.

Please extend my appreciation to the individuals involved.

Respectfully,

Michael J. Ponsford

Michael J. Ponsford

Chief Financial Officer

Specialized SERVICE COMPANY

1434 MAIN STREET • P. O. BOX 968
KLAMATH FALLS, OREGON 97601
503/884-5103

..... Serving the Automotive, Truck, Industrial, and Agricultural Fields Since 1932 .

August 6, 1984

Oregon Institute of Technology
Geo-Heat Center
Oretech, OR 97601

Gentlemen:

I would like to thank you for the assistance you gave us recently on analyzing our heating needs. We have used geothermal waste water in the storm sewer for many years to meet part of our heating requirements. The changes being made by the city for the downtown heating project caused us to lose much of the resource we depend on.

We first went to two different private firms to try to find the best solution to our problem. Not being satisfied with their recommendations, I asked for assistance from the Geo-Heat Center. I was most pleased with the way Kevin approached the task, analyzed our needs, and made short-term and long-term recommendations. I feel he saved us considerable expense for studies and equipment which couldn't be justified.

Thank you again for your services.

Sincerely,

Neal Eberlein

NE:dr

DEPARTMENT OF INSTITUTIONS
MONTANA STATE HOSPITAL

TED SCHWINDEN, GOVERNOR

WARM SPRINGS, MONTANA 59756

STATE OF MONTANA

(406) 693-2221

August 21, 1984

Mr. Gene Culver
Associate Director
Geo-Heat Center
Oregon Institute of Technology
Klamath Falls, OR 97601

Dear Gene:

I would like to thank you for the time and effort you spent looking at the geothermal project on our campus. I have read your report with interest and have shared it with my supervisor and with the Department of Institutions' staff. The report was well-received, and at this point in time we are putting together a proposal to present to the next legislature requesting funds to repair/replace the well pump. It's most likely that these repairs will not be completed until next summer. Your report appears to have all necessary information and has confirmed, to my satisfaction at least, that the repairs and/or replacement of this pump is economically in the best interest of the State of Montana and, in particular, Montana State Hospital. Once again, thank you for the effort, and we certainly appreciate your input!

Sincerely,

A handwritten signature in cursive script, reading "Thomas D. McCarthy".

Thomas D. McCarthy
Director Environmental Services
Montana State Hospital

TDMcC/sw

cc: Frank Childs, EGNG Idaho
Jeff Birkby, Montana Energy Office

City of Ouray

OURAY, COLORADO 81427

March 22, 1985

Mr. Gene Culver, Associate Director
Geo-Heat Center, Oregon Institute of Technology
Klamath Falls, Oregon 97601

Re: Ouray Hot Springs Pool/Bathhouse

Dear Gene:

I am writing to update you as to the status of the above referenced facility. I apologize for the delay in getting back to you, but in some ways the elapsed time is an advantage since I can now report on the actual use the pool has experienced in its first winter season of operation.

The bathhouse geothermal heating system was installed and operational during the first half of December. We selected the system you recommended which utilized the McQuay Unit Heaters. Your recommendations were also followed in the design of a system to use geothermal for heating hot water for showers. A plate type heat exchanger manufactured by APV Inc. was installed in late December. Both of these systems have been operating satisfactorily. We have already realized a reduction in the cost of operating the bathhouse.

Your assistance in the design of these systems was invaluable. Without it the project would have taken much longer and certainly been more costly. The City appreciates your efforts on its behalf.

Visits to the pool during this first winter of operation were higher than anticipated. Since the season began October 13, 1984, 6,994 people have used the facility. This has generated over \$16,000.00 in revenues. From these figures it is clear that the winter pool operation has been well worth the investment and a huge success! (See enclosed newspaper clipping).

We are aware of the important role you and the Oregon Institute of Technology have played in this endeavor. Thank you again for your assistance.

Sincerely,

David Vince,
Treasurer/Grant Administrator

DV/lz
enc.

RECORDS SET AT POOL

A new record was set this past Sunday at the Ouray hot springs outdoor swimming pool. 315 people used the pool that day — the most of any day during this first winter season for the pool. The weekend, overall, also set a winter-operation record with a total of 642 people enjoying the use of the pool from Friday through Sunday.

— Photo by
Joyce Jorgensen

APPENDIX B

Publications Request Form

PUBLICATIONS REQUEST FORM

Geo-Heat Center Oregon Institute of Technology Klamath Falls, Oregon

Due to budget restrictions, please limit your request to a maximum of five summary papers, reports and studies

Quarterly Bulletin
1975 - Present

A quarterly progress and development report on the direct utilization of geothermal resources, Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, Oregon.

Please include my name on the mailing list for the Bulletin.

SUMMARY PAPERS

Allis, Richard G. and James, Russell; A Natural-Convection Promoter for Geothermal Wells, Wairakei, New Zealand.

Culver, G. Gene and Reistad, Gordon M., December 1979, Evaluation and Design of Downhole Heat Exchangers for Direct Applications, Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, Oregon.

Culver, G. Gene and Reistad, Gordon M., Testing and Modeling of Downhole Heat Exchangers in Shallow Geothermal Systems, prepared for ERDA contract #EY-76-S-06-2429, Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, Oregon.

Geo-Heat Center, Geothermal Heat, Merle West Medical Center, Klamath County Nursing Home, Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, Oregon.

Gudmundsson, Jon; et al, Doublet Tracer Testing in Klamath Falls, Oregon, Stanford University and the Geo-Heat Center, December 1983.

Higbee, Charles V., September 1980, Pricing Direct-Use Geothermal Energy, Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, Oregon.

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