DOE/ID/13040--T31

# FEDERAL ASSISTANCE PROGRAM

# QUARTERLY PROJECT PROGRESS REPORT

## GEOTHERMAL DIRECT-HEAT UTILIZATION ASSISTANCE

GRANT NO. DE-FG07-90ID 13040

REPORTING PERIOD: JANUARY - MARCH 1996

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KLAMATH FALLS, OR 97601

**ABSTRACT**

The report summarizes geothermal technical assistance, R&D and technology transfer activities of the Geo-Heat Center at Oregon Institute of Technology for the second quarter of FY-96. It describes 95 contacts with parties during this period related to technical assistance with geothermal direct heat projects. Areas dealt with include geothermal heat pumps, space heating, greenhouses, aquaculture, equipment, economics and resources. Research activities are summarized on geothermal district heating system cost evaluation and silica waste utilization project. Outreach activities include the publication of a geothermal direct use Bulletin, dissemination of information, geothermal library, technical papers and seminars, and progress monitor reports on geothermal resources and utilization.

## 1.0 Project Summary: January 1 - March 31, 1996

1.1 Technical Assistance. GHC staff provided assistance to 95 requests during the reporting period from 25 states, 1 from France, 1 from Iceland, and 1 from Canada. A breakdown of requests relative to applications are: geothermal heat pumps (20), space heating (6), district heating (5), greenhouses (8), aquaculture (3), industrial (2), economics (3), equipment (7), resources/wells (22), and other (19).

1.2 R & D Activities. Progress is reported on: (1) Geothermal District Heating Cost Evaluation , and (2) Silica Waste Utilization Project, Phase II.

1.3 Technology Transfer. GHC Quarterly Bulletin, Vol. 17, No. 2, is in preparation. Two Technical papers, three presentations and three tours were provided. A total of 378 publications were distributed on direct use. Geothermal Progress Monitor (GPM) reports include: (1) Glass Mountain Geothermal Project to Move Forward, (2) Alvord Geothermal Power Project Put On Hold, and (3) Klamath Falls Geothermal District Heating System to Be Evaluated.

1.4 GHC staff that worked on the project included: P. Lienau (91%), K. Rafferty (100%), T. Boyd (84%), John Lund (60 hours), and D. Gibson (87%).

## 2.0 Technical Assistance

The Geo-Heat Center provides technical assistance on geothermal direct heat applications to developers, consultants and the public on data and information on low-temperature ( < 150°C) resources, space and district heating, geothermal heat pumps, greenhouses, aquaculture, industrial processes and other technologies. This assistance could include preliminary engineering feasibility studies, review of direct-use project plans, assistance in project material and equipment selection, analysis and solutions of project operating problems, and information on resources and utilization. The following are brief descriptions of technical assistance provided during the second quarter of the program:

| | Name | Nature |
|---|---|---|
| 2.1 | Burkhard Bohm<br>Portola, CA 96122<br>916-836-2208<br>1/3/96 | Resource. Discussed disposal of geothermal fluids from city school geothermal heating system. Two questions were answered: (1) Any damage to city of Klamath Falls storm drains carrying geothermal fluids? Degradation occurred due to $H_2S$ on AC and concrete pipe, (2) Any case histories using a leach field? None in geothermal direct use. Litchfield correctional facility used a surface sprinkle system. |
| 2.2 | Bruce Partridge<br>15024 River Loop Dr.<br>Bend, OR 97707<br>541-593-5204<br>1/3/96 | GSHP. Discussed various types of ground-source heat pump systems. Recommended groundwater system using existing well. Sent GSHP packet. |
| 2.3 | OIT Physical Plant<br>K. Falls, OR 97601<br>541-885-1690<br>1/3/96 | Equipment. Wrote general form for specifying a lineshaft geothermal well production pump. Specifications form included general information--flow range, speed, temperature, pumping levels, setting and efficiency. Column pipe, shaft and tube specifications and materials were also included. |

2.4 Doug Yates
OIT
K. Falls, OR 97601
1/3/96

Space Heating. Inspected well and geothermal heating system of a home being considered for purchase by OIT. Expressed concern about underground pipe and crooked well.

2.5 Shelley Swisher
Belknap H.S., OR
360-256-0745
1/3/96

Greenhouse. Discussed agreement with owners of lodge on sharing flow from Belknap Hot Springs. Wants to tour geothermal greenhouses, told her we have contacts.

2.6 Don Michaels
P.O. Box 8652
Missoula, MT 59207
406-728-2576
1/4/96

Greenhouse. Discussed greenhouse project near Yellowstone using a 2000 gpm resource at 96°F. Asked about using brazed-plate heat exchangers--advised that the temperature was too low and would have to use the water directly with the understanding that the equipment will fail early. If they are going to extend the growing season, why no put tubes in the soil or floor, and peak with propane. Recommended tubing of 3/4" - 1" PE not PVC.

2.7 Sal Pantano
24596 Hwy 299
Canby, CA 96015
916-233-5765
1/4/96

Resource. Calculated output of Kelley Hot Springs at $31.125 \times 10^6$ Btu/hr or 9.1 MWt.

2.8 Ken McVay
Cedarville, CA
916-362-0929
1/4/96

Resource. Discussed how to place a value on the geothermal well supplying the school. Suggested that the energy savings (at the school) be calculated over the life of the system brought back to the present value. He will be sending a letter requesting our help in the calculation. The value of the well should be what costs it allows the school to avoid--fuel costs and installation of a new boiler and maintenance.

2.9 C. Van Sickle &
B. Pennington
3590 Roundbottom Rd.
Cincinnati, OH 45244
803-380-8278
1/5/96

Resource. Discussed possible geothermal resource sites in Arizona and California for a health resort. Sent database on Yuma and Imperial counties, state maps, and collocated data >50°C.

2.10 Ray Friesenhan
NASA Tech Transfer
Texas A&M
Houston, TX
512-305-0140
1/5/96

Aquaculture. Checked to see if client--Scott Duncan of Penbur Farms--had contacted the GHC about geothermal resources. Told him Mr. Duncan had not contacted the GHC. Sent packet of information on aquaculture to Ray to pass on to Mr. Duncan.

2.11 Kathryn Respond
Consulting Specifying Engineer
1350 E. Touhy Avenue
Des Plaines, IL 60018
708-390-2625
1/5/96

GSHP. Discussed writing an article on using GSHPs for commercial buildings. Article to contain 2400 words, figures and side-bar case study of GCHP and GWHP.

2.12 Pat Hughes
ORNL
Oak Ridge, TN
615-574-9337
1/8/96

GSHP. Discussed update on GSHP design guide for ASHRAE.

2.13 Stan McIntyre
Trane
Portland, OR
503-620-8031
1/9/96

Equipment. Discussed a unit of refrigeration--"frigorie." 1.0 frigorie = 4.1885 x $10^3$J = 3.97 Btu.

2.14 Marissa Gordon
16255 NW Blueridge Dr.
Beaverton, OR 97006
503-645-0854
1/10/96

Resource. Requested information on HDR in Oregon and cost of power generation. Sent report on HDR on the cost, USGS book and GHC Bulletin.

2.15 Ken Neely
IDWR
1301 N. Orchard
Boise, ID 83706
208-327-5455
1/10/96

Resource. Discussed article for GHC Bulletin on production history for the Capitol Mall geothermal project. IDWR has completed inventory of 60 geothermal wells in 1/4 section of Garden Valley using copper downhole heat exchangers. Also inventory of thermal wells and springs, and map for 10,000-acre Banbury area.

2.16 Ken McBay
Prof. Appraisal
10324 Placer Lane
Sacramento, CA 95827
916-362-0929
1/11/96

Resource. Developed spreadsheet to estimate value of geothermal well at Cedarville school.

2.17 Barry Phelps
BLM
Prineville, OR
1/11/96

GSHP. Building a home and wants to use GSHP. Groundwater temperature of 70°F expected. Explained the different GSHP systems and suggested that a groundwater heat pump is the best to use if he can get rid of the water.

2.18 Angie Negus
P.O. Box 56
Summer Lake, OR 97640
1/11/96

Resource. Requested information on geothermal wells in the Summer Lake area. Sent listing of thermal wells and springs from the Oregon database.

2.19 W. Evans
Statesville, NC
1/12/96

GSHP. Discussed the possibility of using a river as a heat source/sink for a GSHP. Soil may provide a more efficient system depending on the range of river water temperature. The use of river water directly is possible, but would require more maintenance than a closed loop system.

2.20 Donald Finn
121 North Field Rd.
Millington, NJ 07946
1/16/96

Industrial. Requested papers on the research the GHC is doing with silica utilization and the country update for Mexico.

2.21 David Anderson
GRC
Davis, CA
1/17/96

General. Wants 2,000 of NREL direct use brochures. Sent key word list for GHC library.

2.22 Micaela Porta
Whiting Lib. of Design
Watson Grystill Publ.
1515 Broadway
New York, NY 10036
212-536-5105
1/17/96

District Heating. Wanted diagram of a geothermal district heating system for a book titled "Ecology of Architecture." Sent diagram of Klamath Falls system.

2.23 Phil McDougal
Belknap H.S., OR
1/18/96

Pool. Designed a preliminary geothermal heating system for a swimming pool. Also calculated heat loss to demonstrate the effect of a pool cover.

2.24 Gary Meyers
Minot, ND
701-873-2858
1/18/96

Resource. Discussed geothermal resources in Texas, Arizona and New Mexico to do research on water treatment and fish culture.

2.25 James & James Science Publishers, Ltd.
Waterside House
47 Kentish Town Road
London, NW1 8NZ
44-71-284-3833
1/22/96

General. Developing a World Directory of Renewable Energy Suppliers & Services. Wanted GHC to submit an organization questionnaire, which was done.

2.26 Steve Kavanuagh
Univ. of Alabama
Tuscaloosa, AL
1/22/96

GSHP. Sent draft of section for commercial GSHP handbook. Draft included introduction, terminology, building heat pump loop, and ground-coupled systems.

2.27 Nicolas Duprat
4 allee Claude Monet
78160 Marly-Le-Roi
Paris, France
33-1-3958-3848
1/22/96

Resource. Requested name of expert on HDR for terminology translation--suggested David Duchane, LANL.

2.28 Thurman Blake
54015 Ave. Juarez
La Quinta, CA 92253
619-564-0418
1/22/96

Industrial. Discussed resource sites in the Clearlake area for sterilization of green waste processed at 150 tons/day. Resource temperature of 180°F is required.

2.29 Judy Bales
88604 Oak Hill Country Road
Eugene, OR 97402
1/23/96

Resource. Discussed geothermal resources and applications in the Klamath Falls area.

2.30 Brian Brown
Consulting Engineer
Fort Klamath, OR
1/23/96

Snow Melt. Calculated numbers on sidewalk snow melt at half the heat flow, but larger temperature drop. Smaller output has to be a calculation error or much higher thermal conductivity of the sand or concrete.

2.31 I. B. Kilkis
Geoenergy Int'l Consortium
3131 W. Chestnut Expressway
Springfield, MO 65802
1/24/96

General. Requested a brief article on the GHC for a newsletter.

2.32 Ray Fortuna
DOE
1000 Independence Avenue SW
Washington, DC 20585
202-586-1711
1/26/96

District Heating. Requested information on U.S. geothermal district heating systems for presentation to a Japanese delegation. Provided overview on U.S. systems, map, visuals on open- and closed-distribution systems, advantages, disadvantages, etc.

2.33 Dirk Rush
Queen Pump Co.
Portland, OR
503-287-7781
1/26/96

Equipment. Discussed corporate combining of Perma Pipe and Rickwil, newest developments and leak detection.

2.34 Bob McGinnis
Box 360
Moss Landing, CA 95039
408-633-0681
1/29/96

Equipment. Discussed Esalen Institute report on the conversion to 140°F geothermal heating for both house showers. Provided contacts for three plastic pipe suppliers and three heat pump manufacturers.

2.35 Greg Morris
802 Valley Avenue
Summer, WA 98390
1/31/96

GSHP. Discussed for new home slinky, vertical, horizontal and groundwater heat pump systems. Suggested that installer be IGSHPA certified.

2.36 David Anderson
GRC
Davis, CA
1/31/96

General. Identified target audience for geothermal materials from Education and Outreach Committee--County Economic Development Agencies, engineering and consulting firms, and heat pump dealers/contractors.

2.37 Jeff Schwan
645 Fawnbrook
Twin Falls, ID 83301
2/2/96

Resources. Requested a listing of thermal wells located in San Bernardino, Imperial and Riverside Counties. Provided databases, state map and contact.

2.38 Steven Brown
3263 Sefton Street
Port Coquitlam
BC, Canada V3B 7S7
2/5/96

General. Requested GHC Bulletin, publications list and information on binary power generation.

2.39 Judi Bales
Energy Management
88604 Oak Hill Cemetery Road
Eugene, OR 97401
2/5/96

Resource. Requested listing of thermal wells for Deschutes and Lane Counties, Oregon.

2.40 Dave Tiffany
21316 58th Avenue W
Mountlake Terrace, WA
98043
2/6/96

Greenhouse. Planning to build a greenhouse/aquaculture facility. Provided info on geothermal greenhouses and aquaculture ponds.

2.41 Roger Peake
CEC
Sacramento, CA
916-654-4609
2/6/96

GSHP. Wanted mathmatical relationship between EER and SEER for energy technology status report. Explained there was not a direct math relation since EER is a power and SEER is an energy term.

2.42 John Dochnahl
Box 764
Ennis, MT 59729
406-682-4463
2/8/96

Pool. Planning a new community swimming pool to be heated by using either the greenhouse well (400 gpm @ 195°F) or the Thexton well (80 gpm @ 195°F). Provided data on the thermal wells in Madison County, two feasibility studies on swimming pools and a brochure describing the GHC technical assistance program.

2.43 Craig E. Schepp
Project Manager
Energy Center of WI
595 Science Drive
Madison, WI 53711
2/13/96

GSHP. As a result of a presentation at the GHPC meeting on cost comparison of commercial GSHP systems, this is one of 13 requests for the final report.

2.44 Gary Erwin
Crater Lake Realty
Klamath Falls, OR
2/13/96

Space Heating. Discussed Klamath Creamery building heating system--unit heaters vs. radiant floor, billing rates, etc.

2.45 Nancy Slusser
132 N. Laguna
Klamath Falls, OR
883-7638
2/13/96

Resource. Temperature of well has dropped, no increase in water bill due to leaks in DHE. Suggested air vents in new installation, looks like cave in bottom of well. Told them we would probe well when DHE is out.

2.46 Mike Morstad
1728 Hillside
Klamath Falls, OR
882-2715
2/13/96

Space Heating. Two homes, hot tub and swimming pool are on a well using a DHE which is not providing enough heat. Since lines were replaced with copper, heating problems developed. Temperature at the wellhead is 160°F. Inspection discovered circulating pumps in opposition, also checked air-relief valves.

2.47 Perle Dorr
GEA
122 C Street NW
Washington, DC 20001
2/13/96

General. The Geothermal Outreach Working Group requested info on new or updated materials for direct use. The following were submitted: low-temperature resource assessment, direct use brochure, web page, geothermal heat pump case studies, GHC Bulletin, guidebook and reference book on direct use.

2.48 Charles Deats
Rd #2, Box 51
Middlebury Center, PA
16935
2/14/96

General. For a school science project, info on resources and applications was sent.

2.49 Harvey Sachs
GHPC
Washington, DC
2/14/96

Equipment. Discussed vapor compression or absorption equipment for a high-temperature heat recovery application. Vapor compression is a sort of steam turbine in reverse. Steam turbine or turbo-machinery manufacturers would be the place to start.

2.50 Dave Thompson
Northwest Natural Gas
1970 19th Avenue SE
Albany, OR 97321
2/14/96

General. Requested info on GRC Annual Meeting and field trips. Also sent ASHRAE paper on Junction City High School groundwater heat pump system.

2.51 Stacey Brennan
240 S. Monmouth Avenue
Monmouth, OR 97361
2/15/96

Resources. Discussed impact of the Sept. 20, 1993 earthquake on the Klamath Falls geothermal aquifer. The results were that the water levels gradually increased 1 - 2 ft. Sent paper published in Oregon Geology and USGS paper by David Sherrod.

2.52 Donna L. Schrock
Rd #4, Box 259
Meyersdale, PA 15552
2/15/96

GSHP. Discussed using ground-source heat pumps with hydronic systems. The limitation in water temperature produced by the heat pump, which is generally less than 125°F. The result is that the hydronic heating equipment has lower capacity. Baseboard radiator elements are typically designed for 180° - 200°F supply water temperature. A radiator receiving 115°F would only have 33% of its capacity at 180°F. Provided a list of four water-to-water heat pump manufacturers for hydronic applications.

2.53 Scott Slavinsky
Air Con
Sacramento, CA
916-922-2004
2/16/96

Space Heating. Discussed possibility of using geothermal heating for Westwood elementary school in Plumas City. Also discussed the developments of Alturas elementary and middle schools. Sent resource data for the area.

2.54 Roger Peake
CEC
Sacramento, CA
916-653-6010
2/16/96

GSHP. Discussed economic model for life-cycle cost of GSHP systems. Provided paper "Demand and Energy Study of High-Efficiency Heating and Cooling Equipment in Oregon" by S. Kavanaugh.

2.55 Johann Magnusson
Rafthömun Consulting Engineers
Armili 42
108 Reykjavik, ICELAND
2/20/96

District Heating. Discussed training program for simulator on district heating systems. Also discussed presentation on Icelandic district heating for the GRC Annual Meeting.

2.56 Dennis Olmstead
DOGAMI
Portland, OR
503-731-4100
2/20/96

General. Discussed developments of direct use in Oregon for annual geothermal activity report. Projects included expansion of the Klamath Falls geothermal district heating system, snow melt, OIT monitoring program and aquaculture at Liskey Farms.

2.57 Judi Leavenworth
P.O. Box 1985
Hailey, ID 83333
2/22/96

Greenhouses. Requested info on the design of geothermal heating systems for greenhouses. Explained technical assistance program to aid in the design.

2.58 Olga Kolbek
The California Geyser
1299 Tubbs Lane
Calistoga, CA 94515
707-942-6463
2/22/96

Space Heating. Discussed corrosion problems with pump, pipes and finned pipe for home geothermal heating system. A 200-ft well at a temperature of 200°F supplies heat for the home. Suggested to use a brazed-plate heat exchanger to isolate heating system. Provided sketch and manufacturer contact.

2.59 Steve Colley
959 Westcliff Lane
Reno, NV 89503
702-747-3978
2/22/96

District Heating. Discussed feasibility study to use effluent from Steamboat binary power plant at 190°F to supply an industrial park and shopping mall. Provided examples from Klamath Falls and three feasibility studies of GDH in Reno.

2.60 Norma Dart
Star, ID
208-286-9561
2/22/96

Greenhouse. Discussed funding possibilities for greenhouse development--suggested state economic development and the oil overcharge fund. Also discussed new greenhouse development south of Marsing on Hwy 78 near Castle Rock using 180°F resource.

2.61 Jeff Birkby
New Horizon Tech.
P.O. Box 5000
Butte, MT 59702
2/23/96

Pool. Discussed municipal pool project at Ennis and sent geothermal database for Montana.

2.62 Dennis R. McGrow
Penn. Power & Light
600 Larch Street
Scranton, PA 18509
2/23/96

GSHP. Reviewed drawings and background on Water Tower Square effluent heat pump project. Expressed concern over the large effluent flow (2500 gpm to a 560-ton heat pump). Provided calculations on pumping penalty, etc. Another concern was the flow control for the sump pump.

2.63 Richard J. Bem
3246 Frankstown Road
Portage, PA 15946
2/23/96

GSHP. Discussed limitations of using GSHPs with hydronic heating system (see 2.52).

2.64 John Bigelow
McKenzie Bridge, OR
541-822-3933
2/26/96

GSHP. Discussed GSHP for the Blue River School using small head hydro to run the compressor. Suggested they could save more money/energy by simply generating electricity.

2.65 Tim Holt
Reno, NV
2/26/96

Greenhouse. Discussed final design for a greenhouse geothermal heating system. Wanted an engineer for the project--suggested Petty and Associates/Kennedy-Jenks.

2.66 Tom Rutledge
10610 Upper Preston
Road SE
Issaquah, WA 98027
2/27/96

GSHP. Discussed horizontal vs. vertical GCHPs, costs, contractors, etc. Sent heat pump packet.

2.67 Dickson
Fremont Street
Klamath Falls, OR

Resource. DHE in geothermal well was not working. Pressure reducing valve was stuck.

2.68 Perle Dorr
GEA
Washington, DC
202-383-2673
3/5/96

General. Requested slides on geothermal district heating for open house and reception honoring Senator Mark Hatfield. Also provided contacts for products from Integrated Ingredients and Fish Breeders of Idaho, Inc.

2.69 John Garrick
BPA
Portland, OR
503-230-5763
3/5/96

District Heating. GSA providing funding to retrofit federal buildings to renewable energy. Discussed district heating projects in Boise, Pagosa Springs, San Bernardino and Klamath Falls.

2.70 Jim Banks
234 E. Loom
Wellsville, UT 84339
801-972-6464
3/5/96

Greenhouse. Discussed greenhouse geothermal heating system using polytubes in the floor.

2.71 Oliver Spires
1217 Pacific Terrace
Klamath Falls, OR
3/5/96

Resource. Logged well at 1217 Pacific Terrace--blocked below 105 ft. Hole full of mud--suggested it be bailed.

2.72 Scott Kimball
Boise, ID
3/5/96

Space Heating. Discussed new home slab space heating system, pool and snow melt. Getting a quote from Heatway for slab heating. GHC will work out pool heat losses. Discussed pump issues--whether to go with lineshaft or submersible. Told him submersible would be much cheaper and should be ok for 110°F.

2.73 David Bomar
Balzhiser/Hubbard Assoc.
860 McKinley Street
Eugene, OR 97402
541-686-8478
3/7/96

Equipment. Discussed insertion flow meters for OIT. Told him we settled on Data Industrial meters--cost/others experience. Also gave quick introduction to GSHPs.

2.74 Nick Staresinic
EcoMar Mariculture
Box 963
Galveston, TX 77533
3/7/96

Aquaculture. Discussed heat loss from ponds and sent software. Also discussed heat loss due to aeration.

2.75 David J. Wesolowski
Chemical & Analytical Sciences Division
ORNL
P.O. Box 2008
Oak Ridge, TN 37831
423-574-6903
3/7/96

GSHP. Discussed a GSHP system for 3000-ft$^2$, 2-story home built 125 years ago. Discussed various aspects about size of machine, length of ground coil, ducting, funding, etc.

2.76 Sarah Slingerland
120 Grant Street
Port Jefferson, NY 11777
3/8/96

General. Discussed making a model of a geothermal project for a school science project. Sent USGS, "Tapping Earth's Natural Heat," for photos of Icelandic systems. Suggested a model of restaurant on top of geothermal storage tanks.

2.77 Joan Wells
Klamath Falls, OR
3/12/96

Resource. Wanted map of earthquake hazard areas. Referred to DOGAMI.

2.78 Paul Potter
Geology
Univ. of Cinncinnati
Cincinnati, OH 45221
513-556-5037
3/13/96

Resource. Discussed large aquifer in Brazil (NY-Minn) with temperature of 75°C at 2000 m. Discussed low-temp applications and sent GHC article "Tectonic and Hydrologic Control of the Nature and Distribution of Geothermal Resources" by L. J. P. Muffler.

2.79 Doug Straub
DEQ
2148 NE 4th Street
Bend, OR 97701
541-388-6146
3/14/96

Resource. Discussed WCPF permit exemption for seven injections wells for Klamath Falls geothermal systems: OIT, MWMC, Klamath County Jail, LDS Church, city schools, and apartments at Division and Klamath Street. Provided drilling logs, consultant well test reports and monitoring plan to be used in making decisions. Critical factors are fluid returned to aquifer of similar quality and temperature.

2.80 R. E. Grossman
1217 Eldorado
Klamath Falls, OR 97601
3/14/96

Resource. Requested data on residential geothermal well and info on downhole heat exchangers.

2.81 Ken McBay
3/14/96

Resource. Discussed salvage value of submersible pump and control panel for Cedarville School well.

2.82 Judith Reich
Arthur D. Little Co.
Acorn Park
Cambridge, MA 02140
3/15/96

General. Discussed GHC research projects and funding. Provided reports on low-temp resource assessment program and reference book.

2.83 Brian Stange
P.O. Box 1375
Niland, CA 92257
619-359-3848
3/18/96

Aquaculture. Discussed geothermal sites in Oregon for possible closed aquaculture system raising lobsters. Provided contact for Liskey Farms. Sent papers on using geothermal energy for aquaculture.

2.84 Gene Beeland
P.O. Box 85
Buxton, NC 27920
919-995-4253
3/19/96

Environmental. Discussed potential environmental impacts for developing shallow ( < 5000 ft) wells for binary power plant.

2.85 Barbara Lucas
3100 Arapahoe Avenue
Boulder, CO 80303
303-449-4711
3/19/96

Economics. Represent a holding company for financing projects. Discussed economics of direct use projects. Sent economic chapter from Guidebook and reference book on direct use projects.

2.86 Tom Amerman
Enlink Geothermal Services
8303 SW Freeway
Houston, TX 77074
713-270-6700
3/20/96

GSHP. Discussed new drilling technology that reduces time to install vertical ground coupled coils by 50%. Methods employs drilling with continuous pipe. Requested GSHP case study report.

2.87 Ted Paddock
Bill Ransom
1060 Lakeshore Drive
Klamath Falls, OR
884-4440
3/2/0/96

Greenhouse. Discussed possible resource sites in Klamath Basin for greenhouse development. Also closed system greenhouse/aquaculture technology.

2.88 Ted Mock
Washington, DC
3/21/96

Economics. Discussed spreadsheet for evaluating costs for low-temp geothermal production/injection wells. Documentation and runs on OIT system, and manufacturing facility in eastern Oregon were also provided.

2.89 Eric B. Belldina
P.O. Box 81
Masontown, WV 26542
304-864-588
3/21/96

GSHP. Discussed installation of a ground-source heat pump for a new home. However, the costs are 50% higher than a gas furnace and air conditioner, and in the Masontown area, there are no rebates. Calculated annual water heating cost of a dedicated heat pump ($10.7/kWh) at $105/yr and gas cost at $130/yr.

2.90 Jessica Schweit
Rd #2, Box 211
Wellsboro, PA 16901
3/22/96

General. A student is including geothermal energy in an energy notebook. Explained application dependence on temperature--electric power generation, direct use and heat pumps, which can be used in Pennsylvania. Sent geothermal material for the notebook.

2.91 Harry Knox
River Road, Box 16
King Hill, ID 83633
3/22/96

GSHP. Discussed heat pumps by application, explained ARI 320/325/330. One of two units in home failed (installed in 1972). Told him lots of manufacturers, but have to go with who is available through dealers in your area.

2.92 Todd Pellett
CalEnergy Co., Inc.
301 S. 36th Street
Omaha, NE 68131
402-231-1675
3/26/96

Economics. Discussed contact for economic study of geothermal district heating in northern Poland. Provided papers on Polish economics of direct use projects and district heating system for Zakopane. Provided geothermal contacts in Poland.

2.93 Mike Battis
Energy Solutions
2814 Yale Street
Irving, TX 75061
214-790-4055
3/26/96

Equipment. Discussed absorption projects in geothermal. He is working on some absorption projects for the Gas Research Institute. Explained OIT project and general economics of absorption/geothermal. Told him economics are "thin" for geothermal due to temperature requirements which could change with CFC phaseout.

2.94 Scott Bourey
AGRA Earth & Environmental
7477 SW Tech Center Dr.
Portland, OR 97223
503-639-3400
3/26/96

General. Discussed geothermal direct use--greenhouses, aquaculture and dehydration projects. Requested subscription to GHC Bulletin and publications listing.

2.95 Perle Dorr
GEA
Washington, DC
202-383-2678
3/29/96

GSHP. Faxed line drawings of ground-coupled, hybrid ground-coupled, and groundwater commercial ground-source heat pump systems.

## 3.0 R & D Activities.

The direct use research and development program objectives are to aid industry in resource and technical development problems. To investigate and analyze methods or approaches of reducing the costs of designing, developing and operating low-temperature geothermal projects. The following are summaries of activities for the second quarter of Fiscal Year 1996.

### 3.1 Geothermal District Heating System Cost Evaluation

The task of evaluating geothermal district heating system total cost for single-family residential areas is nearing completion. The final report will be distributed during the third quarter of FY 96.

Work on single-family residential geothermal district heating systems has incorporated the following factors into the analysis:

- Central plant design vs. a direct design in which geothermal fluid is delivered directly to the customer,
- Cost of three piping installation methods and materials for branch service lines to customers,
- Cost of distribution piping materials and installation,
- Pipeline corridor under unpaved areas vs. paved areas,
- Traffic control during construction,
- Combined resource development costs with distribution and central plant costs resulting in a total system installed cost,
- Comparison of conventional heating costs (for space and domestic hot water) using gas, wood and all electric to geothermal, and
- Identification of situations where it is feasible to develop geothermal district heating in existing single-family residential areas.

### 3.2 The Silica Waste Utilization Project, Phase II

We have completed 41 different mix designs utilizing two samples taken from the disposal ponds. They have been tested for flexural strength, thermal conductivity and weathering properties. The thermal conductivity being completed this quarter. The silica/cement samples show a correlation between the amount of silica added to the strength, thermal conductivity and weathering. The silica/lime samples show a correlation between the amount of silica added to the strength and weathering, but doesn't appear to affect the thermal conductivity.

Milestones to be completed include:

1. Selecting the most suitable mix designs,
2. Performing a cost evaluation for the selected mix designs,
3. Constructing a field test wall with the selected mix designs, and evaluate how they perform, and
4. Submit a final report.

## 4.0 Technology Transfer.

The Geo-Heat Center prepares and publishes information and educational materials on direct heat applications that includes: a quarterly Bulletin, technical papers, computer programs and progress monitor activities. In addition, resources of a geothermal technical library, and tours of geothermal facilities in the Klamath Falls area are made available to the public.

4.1 Geo-Heat Center Quarterly Bulletin. Bulletin Vol. 17, No. 1 was distributed in February to 1840 domestic and 320 foreign subscribers. Bulletin Vol. 17, No. 2 is in preparation and will be published in May. Articles will include:

1. "Beppu Hot Springs" by S. Taguckhi, R. Itoi and Y. Yusa.
2. "3,000 kW Suginoi Hotel Geothermal Power Plant" by K. Kudo.
3. "Geothermal Greenhouse in Kyushu, Japan" by P. Lienau.
4. "The Nevada Geothermal Industry - 1996" by T. Flynn.
5. "White Sulphur Springs, West Virginia" by J. Lund.
6. "Hot Springs, Virginia" by J. Lund.
7. Geothermal Pipeline

4.2 Technical Papers, Presentations and Tours.

1. Tour. K. C. Lee, Geothermal Institute, University of Auckland toured the OIT and city of Klamath Falls geothermal district heating systems (1/30/96).
2. Presentation. An OIT faculty seminar was presented on the 20th anniversary of the Geo-Heat Center and international developments of geothermal energy by P. Lienau and J. Lund (2/6/96).
3. Presentation and Tour. Ten mechanical contractors from throughout Oregon were given a slide presentation on direct use of geothermal resources and applications, and a tour of the OIT geothermal heating system (2/9/96).
4. Presentation and Tour. Seventeen students from Lane Community College, Eugene, were given a presentation on the engineering aspects of geothermal system design and a tour of the OIT geothermal heating system (2/12/96).
5. Technical Paper. A technical paper "Groundwater Heat Pump Experiences at Two High Schools" by K. Rafferty was presented at the ASHRAE Annual Meeting in Atlanta (2/20/96).
6. Technical Papers. The New Energy Foundation (NEF) invited two member of the Geo-Heat Center staff to Tokyo to present two workshops on the direct uses of geothermal energy in the United States. All expenses were paid by NEF. The following technical papers were presented:

   2/29/96

   a. "U.S. Overview and Status of Geothermal Direct-Heat Development" by J. Lund,
   b. "The Geo-Heat Center's R&D and Technical Assistance Programs" by P. Lienau,
   c. "DOE Program Opportunity Notice and User Coupled Programs" by J. Lund,
   d. "Low-Temperature Geothermal Resource Inventory and Collocated Resources" by P. Lienau,
   e. "Details of Greenhouse and Aquaculture Design" by J. Lund,

f. "Details of Geothermal District Heating System Design in the U.S." by P. Lienau,

g. "Industrial Operation and Designs for Vegetable, Fruit Drier, Heap Leaching of Gold, and Silica Waste for Construction Materials" by J. Lund,

h. "Ground-Source Heat Pump Performance" by P. Lienau,

i. "Legal, Regulatory and Environmental Considerations" by J. Lund, and

j. "Promotional Material and World Wide Web Homepage: http://www.oit.osshe.edu/~geoheat" by P. Lienau.

Prior to the meetings, a field trip was arranged to visit geothermal installations at Beppu, Hatchobaru and Otake.

The NEF conducts various surveys and studies relating to the development and utilization of new energy and submits proposals to the government to be incorporated in their policy-making. All proposals are made with the consensus of related industries. The activities of the NEF are supported and funded by the member companies (186), including public utilities and various industries involved in the development of new energy. One of the major divisions of the NEF is the Geothermal Energy Development Center headed by Director General Hiroshi Mori and consisting of approximately 40 employees. The four main subdivisions of the Geothermal Center are: (1) Policy Proposals, (2) Information Collection and Distribution, (3) Environmental Surveys and Research, and (4) Activities for the Implementation and Dissemination of Geothermal Energy. The latter subdivision has a main function of "surveys on direct use of geothermal fluid technologies." There is also New Energy Industrial Forums which includes a Geothermal Power Committee. They are also doing research on the commercialization of small-scale binary-cycle geothermal power generation systems.

4.3 Geothermal Library. During the period of January 1 to March 29, 1996, 68 new volumes were added to the library. The library now has a total of 5245 volumes cataloged.

4.4 Information Dissemination. The GHC provided publications to individuals according to the following topics:

| Topic | No. Publications |
|---|---|
| Geothermal Heat Pumps | 278 |
| Space Heating | 6 |
| District Heating | 10 |
| Greenhouses | 11 |
| Aquaculture | 6 |
| Industrial | 4 |
| Equipment | 9 |
| Resources/Wells | 22 |
| Other | 32 |
| Total | 378 |

## 5.0 Geothermal Progress Monitor

### CALIFORNIA

### 5.1 Glass Mountain Geothermal Power Project to Move Forward

The Bonneville Power Administration has reached an agreement with two power companies to proceed with an environmental analysis of the Glass Mountain geothermal power project on the Klamath National Forest.

The Bureau of Land Management will take the lead in drafting an environmental impact statement (EIS), working in cooperation with BPA, the Forest Service and Siskiyou County. Agencies involved in the process met the week of April 25th.

The 49-megawatt project, expected to be completed in three years, is proposed by Calpine Corp., based in San Jose, California and Trans-Pacific Geothermal Corp., based in Oakland.

The project is proposed for construction along the border of the Klamath and Modoc national forests, near Medicine Lake about 50 miles south of Klamath Falls.

A test well drilled last year to a depth of about 500 feet revealed the geothermal aquifer is capable of power production, said Maurice Richard, program manager for Calpine.

"We're satisfied with the results that we have, and therefore, we have confidence to proceed with the expenditure required to proceed with an EIS," Richard said.

Water temperatures of at least 450°F are required to generate power, Richard said. Additional holes are expected to be drilled over the next two years, he added.

The environmental impact statement will cover construction and operation of the plant, a 24-mile transmission line and power purchase agreements. The EIS is expected to be completed by the fall of 1997.

BPA said it is pursuing new sources of "renewable" power despite their relatively high cost, and even though there is currently a surplus of electricity in the northwest.

"BPA's approach to developing and marketing green power products reflects the (U.S. Energy) department's desire to encourage long-term investments that will benefit future generations in the region," said Charles Curtis, deputy secretary of Energy Department.

BPA officials said the Glass Mountain project is located in an area capable of producing 500 megawatts of power, and is one of the world's largest untapped geothermal resources.

Katherine Potter, spokeswoman for Calpine, said construction would create about 200 temporary jobs, and 15 - 20 permanent jobs. There is no firm estimate of construction costs, she said.

Glass Mountain is one of several renewable energy projects proposed in the northwest. The Newberry Geothermal Project has been issued a permit for construction on the Bend-based Deschutes National Forest.

Other projects include wind power facilities in Wyoming and Washington. (*Herald & News*, April 19, 1996)

**OREGON**

### 5.2 Alvord Geothermal Power Project Put On Hold

A California energy company has put the brakes on plans for a controversial geothermal power plant in the remote Alvord Desert in southeastern Oregon.

Anadarko Petroleum Corp. has asked M. H. A. Associates of Sacramento, California to suspend work on an environmental impact statement on the plant, said Cody Hansen, Burns district manager for the U.S. Bureau of Land Management.

The site is on BLM land about a mile from Borax Lake, the largest geothermal lake in Oregon. The lake is just north of the high desert settlement of Fields.

Hansen said the project has been stalled because Anadarko and Portland General Electric were unable to reach a power purchase agreement consistent with an April 1995 memo of understanding between the two.

PGE, initially had agreed to purchase 22.9 megawatts of electric power from the proposed plant.

Anadarko wants to review the project plans with BLM officials in July, said Hansen. But he said the federal agency wouldn't be able to participate in serious planning to resurrect the project until October 1996, the start of BLM's 1997 fiscal year, even if Anadarko decides to proceed with it again.

The proposal has attracted state-wide interest over the past few years because of environmental concerns about a rare, inch long fish called the Borax Lake Chub living in the 10-acre lake. Environmentalists say the lake also is important to trumpeter swans, snowy plovers, white-faced Ibises and other water-fowl species, as well as an unusual 2-foot reptile called the long/nosed leopard lizard.

In 1993, several environmental groups unsuccessfully appealed to stop Anadarko from drilling test wells near the lake. They included the Sierra Club, the Wilderness Society, the Portland Audubon Society, Oregon Trout and the Oregon Natural Desert Association.

Later that year, the Nature Conservancy purchased the lake from two local ranchers to protect the chub and wild life living around the water. The nonprofit land brokerage paid $320,000 for 320 acres, which included Borax Lake.

According to blueprints for the plant, it would use geothermal water to heat another fluid that would spin a turbine and generate electric power. Afterward, the geothermal water would be pumped back into the underground reservoir.

No steam of gases would be vented into the atmosphere, according to Anadako's project planners. The underground water exceeds 170°F at the bottom of the 100-foot deep lake, and steam produced under pressure reaches 306 degrees.

Anadarko officials have said the plant would employ 17 to 20 workers, with low-profile buildings and probably could not be seen with the naked eye from the 9,670-foot summit of nearby Steens Mountains. (*Oregonian*, April 2, 1996)

### 5.3 Klamath Falls Geothermal District Heating System to Be Evaluated

Klamath Falls has contracted with a geothermal heating specialist to evaluate the city's geothermal district heating system.

Melvin Smith, geothermal supervisor for the city public works department, told members of the Geothermal Advisory Committee, the evaluation should reveal ways to make the system more efficient.

The city has hired Brian Brown, a mechanical engineer from Fort Klamath, to conduct the evaluation at a cost not to exceed $10,000. Brown has worked with the city's downtown geothermal loop almost since it was designed, Smith said.

Brown had begun the evaluation and is expected to work 3 - 6 months on the project.

Brown will examine a telemetric system designed to control the pumps at the city's two geothermal wells located along Old Fort Road. The system is supposed to allow city workers to control the pumps' speed by remote control, pumping more water when more is needed during cold spells, and less water during warm spells.

But the telemetric system has never worked properly, and the pumps have to be operated manually, Smith said. As a result, the pumps often run at a higher speed than is needed, wasting electricity.

Brown will also examine the performance of the heating systems in several downtown buildings. Smith said some building may be receiving more geothermal fluid than needed, resulting in waste.

Smith said the city believes the downtown loop is working at 16 - 18 percent of the capacity, and could serve many more buildings. Brown has been asked to verify that assumption, Smith said.