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FEDERAL ASSISTANCE PROGRAM

QUARTERLY PROJECT PROGRESS REPORT

GEOHERMAL DIRECT-HEAT UTILIZATION ASSISTANCE

GRANT NO. DE-FG07-90ID 13040

REPORTING PERIOD: JULY - SEPTEMBER 1995

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GEO-HEAT CENTER
OREGON INSTITUTE OF TECHNOLOGY
KLAMATH FALLS, OR 97601

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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 fourth quarter of FY-95. It describes 80 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 and resources. Research activities are summarized on low-temperature resource assessment, geothermal energy cost evaluation and marketing strategy for geothermal district heating. 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: July 1 - September 30, 1995

- 1.1 Technical Assistance. GHC staff provided assistance to 80 requests during the reporting period from 22 states, France, New Zealand, Mexico, England, China and Japan. A breakdown of the number of requests relative to applications are: geothermal heat pumps (19), space heating (16), greenhouses (4), aquaculture (5), industrial (4), equipment (10), resources/wells and other (22).
- 1.2 R & D Activities. Progress is reported on: (1) Low-Temperature Resource Assessment, (2) Geothermal Direct Heat Cost Analysis and (3) Geothermal District Heating Marketing Strategy.
- 1.3 Technology Transfer. GHC Quarterly Bulletin, Vol. 16, No. 4, was published and sent to 2144 subscribers. Two seminars, one presentation and three tours were provided. A total of 390 publications were distributed on geothermal direct use. Geothermal progress monitor (GPM) reports include: (1) Northern California Power Agency Approves Project to Convert Waste Water to Geothermal Energy, (2) Two-Year Anniversary in Hawaii, (3) New Hydrogen Sulfide Study in Hawaii, (4) Calpine Enters International Power Market, (5) Nevada School Bets on Geothermal to Win, (6) Two Phase Geothermal Standard Developed and (4) Geothermal Teleconferences to be Broadcast.
- 1.4 GHC staff that worked on the project included: P. Lienau (80%), K. Rafferty (84%), J. Lund (26%), T. Boyd (68%), and D. Gibson (95%). Included time on both DOE/INEL and DOE grants.

2.0 Technical Assistance

The Geo-Heat Center provides technical assistance on geothermal direct heat applications to developers, consultants and the public which could include: data and information on low-temperature ($< 150^{\circ}\text{C}$) 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 third quarter of the program:

	<u>Name</u>	<u>Nature</u>
2.1	Tom Hauck 3435 Countryside Lane Camp Hill, PA 17011	GSHP. GSHP installed in home and church. Explained utility rates and system types. Discussed grouting of vertical boreholes (7-5-95).
2.2	Brian Brown Consulting Engineer Ft. Klamath, OR	District Heating. Discussed the risks and costs Klamath County would incur as a result of disconnecting buildings currently connected to the geothermal district heating system. Several conversations were had about a district heating and cooling project in Oklahoma City (7-5-95).
2.3	Neil Oldemeyer City Engineer Boise, ID	District Heating. Discussed the possibility of a meeting in Seattle or Kansas City with an engineering firm involved with the retrofit of the West Coast Hotel to be connected to the Boise geothermal district heating system. Told him if we could get the drawings, it would probably solve the problem (7-6-95).

- 2.4 Prof. Murmin Filiz
Ege University Tarimsal
Yapilar ve Sulama Bolumu
Bornova - Izmir
Turkey
Greenhouses. Sent information on using geothermal energy to heat greenhouses along with lecture notes (7-6-95).
- 2.5 Tak Yoshida
Shikosha, Inc.
1526 S.E. Powell
Portland, OR 97202
Equipment. Requested cost estimates to deliver geothermal fluid (50 and 200 gpm) from a production well to a new resort/spa near Home Valley, WA. The distance is 3000 ft with an elevation increase of 350 ft. The head required is 236 psi and 300 psi (well lift, elevation, pipe friction, and residual). Pump cost for lineshaft type are \$15,000 and \$30,000, operating costs are \$1,190 and \$5,590/year and piping cost is \$46.25/LF. Comments included no need for a storage tank, terrain an important factor in the cost of the pipeline, pressure may be too high for FRP pipe and submersible could be used for the 50 gpm flow rate (7-7-95).
- 2.6 Jim Thompson
Hot Lake, OR
503-963-5253
Aquaculture. Requested technical assistance for design of delivery system to aquaculture ponds, swimming pool, 5 mineral baths, space heating, and laundry water heating. Resource temperature is 170°F with an approximate flow of 1000 gpm (7-7-95).
- 2.7 Photinie Papapanagiotou
15, Boulevard Savari
8600 Poitiers
France
General. Requested info on graduate program in reservoir engineering. Referred her to the Geothermal Institute, University of Auckland, New Zealand (7-7-95).
- 2.8 Dennis Trexler
Desert Research Inst.
Univ. of Nevada
Reno, NV
701-784-6151
Space Heating. Meeting with NDEP/DOM, driller and state engineer on space and swimming pool heating for Salem Plaza. Discussion of system design and utilization of existing fiberglass piping (7-10-95).
- 2.9 Bo Shie
World Bank
Washington, DC
202-458-5207
Electric Power. Discussed feasibility of renewables in China. The "mission" is to request technical assistance to figure out how large a power plant could be installed on a particular resource given temperature, flow and ambient conditions. Suggested he call the GRC to get referred to a U.S. manufacturer of equipment. Told him we could probably send him an answer, but are primarily direct use, better to talk to power people (7-12-95).
- 2.10 OIT
Physical Plant
Klamath Falls, OR
Well. Measured drawdown during a well test of OIT #5. Drawdown was 11.85 ft with a flow of 350 gpm at 1695 rpm and 87 amp. Purpose was to test for pump problems which resulted in bearing vibration and a pump replacement (7-11-95).
- 2.11 Leslie Youngs
Div. of Mines & Geology
801 K Street
Sacramento, CA 95814
Resource. Requested digitized map of California collocated resource and city sites. Sent diskette and database (7-17-95).
- 2.12 David Collentine
SHN Engineers
812 W. Wahash
Eureka, CA 95501
Resource. Discussed using silica waste for construction materials and the R&D being done by the GHC. Sent preliminary paper on the research (7-19-95).
- 2.13 Jack Muzetti
Alamosa, CO
Space Heating. Installing a geothermal heating system using radiant floor slab for a motel. Temperature of nearby well is 100°F. Will use zone-line units as primary heat. Discussed pipe in slab: 10" - 12" centers, PE or PB, no PVC or CPVC. Will call back as he gets further along (7-20-95).

- 2.14 Louie Templeton
Public Works Division
Susanville, CA
Space Heating. Discussed performing an energy audit on a home connecting to the geothermal system. Explained heat loss calculations, U/R values, infiltration, etc. In addition, high school may have to be modeled to come up with annual heating requirements. May request technical assistance for the modeling (7-20-95).
- 2.15 Bruce Carlin
Wendover, NV
Space Heating. Discussion about cooling a large hotel/casino at Wendover, NV. Included absorption single stage/2 stage, solar boost, cooling tower sizing, district heating and cooling, temperature requirements, etc. (7-20-95).
- 2.16 George
Global Energy
Minneapolis, MN
GSHP. Discussed training that is available for GSHP installations. Told him about Univ. of Alabama and IGSHA programs (7-24-95).
- 2.17 George Crane
Southern CA Edison
Irwindale, CA 91702
818-812-7330
GSHP. Discussed assessment of GSHP development project potential in his service area (7-25-95).
- 2.18 Allen Crosby
Kingston & Morrison
Auckland
New Zealand
Resort/Spa. Discussed resort/spa development in the U.S. and direct use in general. Sent articles on developments and referred to Geothermal Institute (7-27-95).
- 2.19 Dick Nichols
DEQ
Salem, OR
503-388-6146
Wells. Discussed injection well permits for OIT, MWMC and Klamath Co. Jail. Both NPDS, surface disposal and WPCE injection permits were discussed. DEQ is transferring the permitting process for injection wells to the Oregon Water Resources Department (7-28-95).
- 2.20 Helen E. Hafner
Rt. 1, Box 1460
Bandon, OR 97411
General. Explained info services available from the GHC including Bulletins, publications and library. Provided references on off-shore vents in Oregon and Pacific Northwest volcanic and earthquake potential (7-31-95).
- 2.21 John Philpot
349 Don Allen Road
Liberty, MD 64068
816-781-7700
GSHP. Installing ground-coupled horizontal GSHP system and wanted comparative costs. Provided GSHP cost survey by NRECA and Univ. of Alabama, and a list of manufacturers (8-2-95).
- 2.22 Ron Schroeder
BGI
245 Gravatt Drive
Berkeley, CA 94705
GSHP. Provided data on electrical requirements for GSHP and air source equipment. For a site which is characterized by air temperatures of 100° to 105°F, and undisturbed soil temperatures in the range of 65°F and assuming the ground source system is designed for the customary 20° to 25°F above soil temperature suggests the heat pump entering water temperature would be 85° to 90°F. Using values from Addison air-to-air and water-to-air heat pumps, this suggests a difference of 4561 - 3950 or 611 watts (8-2-95).
- 2.23 Marshall Reed
DOE
Washington, DC
District Heating. Requested that info on geothermal district heating be sent to Floyd Collins. Sent materials and equipment selection report on 13 systems, San Bernardino, Klamath Falls and OIT systems descriptions (8-2-95).
- 2.24 Randy Romang
Salt Lake City, UT
801-532-5856
Aquaculture. Discussed aquaculture project in Utah, Poland geothermal, and thermal vents in the Great Salt Lake (8-3-95).
- 2.25 Nathan Hoffman
2750 Geraldine Drive
Cincinnati, OH 45239
General. Writing a report on geothermal energy. Explained, depending on temperature, the three categories of use: GSHP, direct-heat application and electric power. GSHPs would be applicable in Ohio. Sent packet of info (8-7-95).

- 2.26 Rob Carter
Oregon WRD
Salem, OR
503-396-3121
GSHP. Discussed filing with Attorney General, etc., approval to regulate as "other" holes those drilled for ground-source heat pump system. Limited construction standards license will be required and no fees. This permitting procedure will be temporary until legislation can be passed to deal with ground source systems (8-7-95).
- 2.27 Gary Olson
985 E. 3000 N., No. 20
Layton, UT 84040
Aquaculture. Discussed design for a potential aquaculture project raising Tilapia near Bonners Ferry, Idaho. Provide data on geothermal sites in northern Idaho, a list of aquaculture extension agents in western states and information on projects at OIT (8-7-95).
- 2.28 Miguel Chavez
Eduardo Velasco
CFE
Morelia, Mich 58290
Mexico
District Heating. Discussed geothermal district heating for CFE buildings at Los Azufres. Toured OIT and city of Klamath Falls systems (8-9-95).
- 2.29 Tom Greenwood
1050 Leigh Street
Eugene, OR 97401
503-345-3930
Space Heating. Investigate Belknap Hot Springs Lodge heating system to make recommendations for geothermal heating system improvements. Two swimming pools are currently heated with 190°F at about 35 gpm from the springs. Also wanted us to determine if there was enough thermal water available to heat a greenhouse (8-9-95).
- 2.30 Vern Cook
Fairmont Hot Springs
Anaconda, MT
406-797-3241
Equipment. Discussed pumping 180 gpm of 165°F water. Replacing pump and called for manufacturers. Provided phone numbers for Centrilit, REDA and American Turbine submersibles (8-10-95).
- 2.31 David Hicks
NREL
1617 Cole Boulevard
Golden, CO 80401
General. Reviewed text for brochure on direct uses and three fact sheets that will be included with the brochure. Provided slides of direct use applications (8-11-95).
- 2.32 Shelley Smith
P.O. Box 23
Walterville, OR 97489
Greenhouses. Mrs. Smith owns the rights to the hot springs at Belknap. She plans to build a 144' x 30' greenhouse and requested technical assistance with the designs of the geothermal heating system (8-11-95).
- 2.33 Mike Monroe
Klamath County
Klamath Falls, OR
Space Heating. Reviewed Klamath County Library geothermal heating system with Mike Monroe. He is redoing mechanical drawing of the system for the County (8-14-95).
- 2.34 L. Wider
99-1041 Maueko Street
Aiea, HI 96701
Industrial. Discussed using geothermal energy for ethanol plant on the Big Island. Production land available for growing sugar cane (8-15-95).
- 2.35 Jim Liscance
Klamath Falls, OR
Resource. Reviewed maps of geothermal resource areas in Klamath County (8-16-95).
- 2.36 Traci Hanegan
P.O. Box 3954
Moscow, ID 83843
GSHP. Provided bibliograph on ground-source heat pumps (8-16-95).
- 2.37 Dennis Trexler
Desert Research Inst.
Univ. of Nevada
Reno, NV
Space Heating. Provided summary of potential savings using geothermal energy at Salem Plaza and flow requirements. Discussed irrigation with geothermal waters (8-18-95).
- 2.38 Carla Inman
7107 Mountain View Dr.
Sisters, OR 97759
Snow Melt. The Oregon Business Magazine wants to do an article on the Klamath Falls downtown geothermal snow melt system. Sent an article on the system (8-17-95).

- 2.39 Tak Yoshida
Portland, OR
Resort/Spa. Will spud new well to 3,000 ft for resort/spa development on September 10, 1995. Sent recommendations of an engineer who could evaluate the installation of pipe on a steep slope. Provided info on eel raising (8-24-95).
- 2.40 Sal Pantano
Kelley Hot Springs
Canby, CA
Equipment. Requested technical assistance with controls for mixing geothermal and cold water for fish ponds. Calculated mixing ratios (8-28-95).
- 2.41 Bob Staton
Cedar Valley High School
Cedar Valley, CA
Equipment. Problem with heat exchanger plugging up. Advised him it was probably a one-time problem--stuff built up in pipe (1/2 mile long) over the years and came out in one slug. Advised him to check strainer mesh size and screen condition (8-30-95).
- 2.42 Kerry Burris
City of Clearlake, CA
505-662-4254
Industry. Wanted to identify a type of industry for the area. Discussed existing geothermal direct use industry projects. Suggested greenhouses would be most appropriate to the Clearlake area (8-30-95).
- 2.43 Lt. Craig Hill
Energy Manager
Maxwell AFB, AL 36112
GSHP. Discussed vertical vs. horizontal ground-coupled heat pumps for townhouses of 1500 ft². Told him about the Ft. Polk project. Referred him to S. Kavanaugh, Univ. of Alabama, and G. Phetteplace, Cold Regions Lab. Explained heating vs. cooling savings and sent national survey on the cost of purchasing and installing ground-source heat pumps (8-30-95).
- 2.44 Scott Olson
Global Energy
Madison, WI
608-244-6436
GSHP. Looking for GSHP training programs around the country. Suggested he contact EPRI or EEI. Told him all large utilities have contractor certification programs for air-to-air. He is working under contract to GHPC (8-31-95).
- 2.45 Bill Williamson
P.O. Box 1045
Roseburg, OR 97470
Pool and DHW Heating. A feasibility study was completed for pool and domestic hot water heating of the Salem Plaza in Reno, Nevada. The analysis consisted of calculating the energy consumption and cost, then costing the components for retrofitting to geothermal energy. Geothermal flow of 90 gpm at 160°F would be produced from an existing geothermal production well with a submersible pump (7.5 hp) set at 100 ft. Geothermal fluids would be disposed of in an existing injection well. Capital costs amount to \$70,000 (DHW retrofit, pool retrofit, well pump and controls, piping and contingency). The savings in natural gas costs amount to \$17,000/year. Deducting operating cost for the geothermal system of \$3,350/yr, results in a net savings of \$13,650/yr and a simple-payback of approximately 5.1 years. The project is feasible (8-31-95).
- 2.46 Zbigniew Krawczyk
267 Stark Avenue
East Meadow, NY 11554
GSHP. Provided info on GSHP manufacturers, cost of purchasing and installing systems, listing of dealers and contractors in the New York area (9-1-95).
- 2.47 Marcello Lippmann
LBL
Berkeley, CA
Industrial. Discussed how solid waste (SiO₂) from brines could be used for construction materials such as building blocks. Utilization of this technology is being considered in Ecuador (9-5-95).
- 2.48 Tom Goss
1987 Esplanade
Klamath Falls, OR
Well. Performed a temperature profile on well at Esplanade and Pacific Terrace. Advised owner to bale well then the GHC will run another temperature profile. If the temperature (140°F) has not increased, then drill 100 - 150 ft deeper into a higher temperature zone (9-5-95).
- 2.49 James Lewis
2601 Old Spanish Trail
Box 1
Slidell, LA 70461
504-257-0432
Aquaculture. Discussed various sites for a combined aquaculture and greenhouse development. Waste and water from 24'-diam. Tilapia tanks is filtered through pea gravel beds which serve as growing beds for plants. The system is closed so very little make-up water is required. Provided info and data on sites at Liskeys, Kelley Hot Springs, and Lakeview, Oregon (9-5-95).

- 2.50 Mike Tomsmeire
Idanha Hotel
Boise, ID
Space Heating. Discussed possible retrofit of the Idanha Hotel to geothermal energy. The boiler line was cut and they wanted to know if it is possible to retrofit the building and what volume of geothermal district heating water would be needed (9-6-95).
- 2.51 John Murphy
BBC
P.O. Box 76, Strand
London, WC2B 4PH
0171-240 3456
General. Sent material on geothermal energy utilization (9-7-95).
- 2.52 Ray Gibson
OIT Physical Plant
Klamath Falls, OR
Equipment. Reviewed bid from Unit Process for wellhead flow meter. Advised installation of 10 diam. upstream and 5 diam. downstream as minimum from any fittings (9-7-95).
- 2.53 Scott Crocker
Hailey, ID
208-788-1058
Greenhouses. Discussed using geothermal energy for greenhouse heating system, residences and snow melting (9-8-95).
- 2.54 Dr. Stanislaw Ostafezuk
Univ. of Silesia
41-200 Sosnowiec
Poland
GSHP. Sent info on cost and economics of GSHPs. Provided names and addresses for graduate programs at Univ. of Auckland, Stanford Univ., and LBL (9-11-95).
- 2.55 Mike Monroe
Klamath County
Klamath Falls, OR
Space Heating. Explained 2-way and 3-way valve control, heat exchangers, etc., for Klamath County Library geothermal heating system (9-12-95).
- 2.56 Gordon Bloomquist
WSEO
Olympia, WA
GSHP. Discussed energy savings for Yakima Jail GSHP system (9-12-95).
- 2.57 Gene Beeland
Gainesville, VA
703-754-2926
Resource. Provided collocated map of California and data tables. Also sent article on city of Klamath Falls snow melt system and OIT wheelchair ramp snow melt (9-13-95).
- 2.58 Tom Langnacher
Klamath Falls, OR
Wells. Provided a list of 8 Klamath County licensed and bonded well drillers (9-13-95).
- 2.59 Ken Meyers
Walter's Climate
2730 Nevada N. Avenue
Minneapolis, MN 53427
Equipment. Discussed geothermal heating project for greenhouse--corrosion problems, well casing, storage tank and oil-lubed lineshaft pump (9-14-95).
- 2.60 Brad Carlson
Boise, ID
208-286-7924
GSHP. Building home in rural area and has artesian well (55° - 58°F) for groundwater heat pump. Pulling sand at 4-lb. pressure for irrigation and domestic water. Suggested he shut-in the artesian overflow and see if reduced well flow solves sand problem. Also explained sand separators and discussed the use of a settling tank (9-14-95).
- 2.61 Dave Henzel
County Commissioner
Klamath County
Klamath Falls, OR
Space Heating. Discussed potential for heating proposed 40,000 ft² juvenile home. Options included piping geothermal fluid from the Klamath County jail about 1 mile west of site and drilling to a depth of about 1500 ft. Provided location, depth and temperature of nearest geothermal wells (9-14-95).
- 2.62 Brian Brown
Consulting Engineer
Ft. Klamath, OR
Equipment. Discussed variable speed drive for central plant pumping of city geothermal district heating system. Suggested that any money spent by the city has to be at the customers end use--to assure that they achieve an adequate ΔT . System is approaching full capacity and excess flow at customer could become a problem (9-15-95).

- 2.63 Maurice Wildin
Univ. of New Mexico
Albuquerque, NM 87131
505-277-6288
GSHP. Discussed monitoring the GHC has done on GSHP systems and antifreeze research. Suggested he call Karen Den Braven, Univ. of Idaho and Bill Brown at Waterfurnace. Also discussed potassium acetate problems (9-15-95).
- 2.64 Chuck Edson
528 Pacific Terrace
Klamath Falls, OR
Space Heating. Temperature of domestic water heating well dropped 20°F. Has two wells, one for space heating and second for DHW. Suggested a possible leak in domestic well. Temperature of domestic water was brought back up by closing valve to DHW and opening valve for DHW in conjunction with space heating well (9-18-95).
- 2.65 Darin Dehle
Saderstran Arch.
1200 N.W. Front Avenue
Portland, OR 97209
503-228-5617
Space Heating. The architectural firm is developing a master plan for OIT. They wanted to know the current capacity of the three OIT geothermal wells, flow required for each building and short-fall if new buildings were added. Provided present capacity with existing pumps (9-18-95).
- 2.66 Alex Sifford
Energy Consultant
Salem, OR
District Heating. Discussed GHC analysis of piping geo-fluid from Hot Lake to La Grande for district heating. Sent copies of correspondence and report (9-20-95).
- 2.67 Jack Tippetts
Hildago, #17B
San Martinez HGO
Jalisco 46770
Mexico
GSHP. Discussed and sent packet on GSHPs. Also referred to G. Hiriart Le Bert for info on wells in Los Azufres area (9-21-95).
- 2.68 Bob McCandlish
2195 Clearlake Road NE
Salem, OR 97303
Aquaculture. Wants to develop an aquaculture project 13 miles east of Weiser, Idaho. Provided resource data for Washington County near Weiser, reports on aquaculture and info on GHC technical assistance program (9-25-95).
- 2.69 Elliott Estes
OIT Physical Plant
Klamath Falls, OR
Equipment. OIT well pump #5 failed due to bearings being out of alignment. Discussed bearing material--recommended not to use EDPM rubber bearings instead use material that has been successful in the past, B1 brz., ASTM B58497C 83600 leaded red brass SAE 40. Also, suggested that a 4 1/4 in. lateral for differential expansion be included in the new pump (9-25-95).
- 2.70 Mary Tippetts
734 South 550 East
Springville, UT 84663
801-489-8653
General. Sent general info on the utilization of geothermal energy for son's science project (9-25-95).
- 2.71 Scott Crocker
Hailey, ID
208-788-1064
Frost Protection. Discussed using geothermal for frost protection in a orchard. He wanted to put canals in the orchard and flow water through to create heat output. Suggested he just heat exchange with irrigation water and use sprinkler system to distribute warm irrigation water. Sprinkling is standard practice for frost protection anyway. Canals would impede regular orchard maintenance (9-26-95).
- 2.72 Colin Williams
USGS
345 Middlefield Road,
MS-923
Menlo Park, CA 94025
Industrial. Sent 17 brick samples for thermal conductivity analysis. Bricks contain various amounts of silica (9-26-95).

- 2.73 Terry Leshner
Ag Engr. Extension
OSU
Columbus, OH
614-292-6007
GSHP. Discussed using GSHP water-to-water system for radiant floor heating of hog producing facility. Supply temperature would be 80° - 85°F to tubes in floor of 35 ft wide by 75 ft long building (9-26-95).
- 2.74 L. Wolf
OIT President
Klamath Falls, OR
General. Economic development meeting with President Wolf and other faculty (9-26-95).
- 2.75 Melody Perz
18944 Lakeside Road
New Buffalo, MI 49117
General. Sent info on geothermal utilization for school report (9-26-95).
- 2.76 Shelley Smith
Belknap Hot Springs, OR
Greenhouse. Provided heat exchanger info and control layout for geothermal heated greenhouse. Discussed heating of lodge, pool and domestic hot water (9-27-95).
- 2.77 Herman Taub
Tau Builders
P.O. Box 275
West Port, CN 06880
203-227-5007
GSHP. Installing 2 - 3 ton residential system. Requested diagram of vertical bore system which was sent. Referred to G. Hutterer on drilling practices (9-27-95).
- 2.78 Powell Woods
HMR Construction Co.
2796 Laurel Road
Boone, NC 28607
GSHP. Developing townhouses, campus buildings, etc., with required load of approximately 800 ton. Sent cost comparison of commercial GSHP systems. Ground coupled will probably work better due to buildings spread out over 1600 acres (9-27-95).
- 2.79 Tom Greenwood
1050 Leigh Street
Eugene, OR 97401
Equipment. Sent info on heat exchangers, pamphlets and publications list (9-28-95).
- 2.80 Eric Norland
1946 Fremont Street
Klamath Falls, OR
Equipment. Discussed elimination of electric DHW heater by connecting to DHE used for space heating. Suggested he could either use brazed plate heat exchanger in parallel with heating system or tempering valve and make-up water for DHE. Decided to go with heat exchanger (9-28-95).

3.0 R & D Activities.

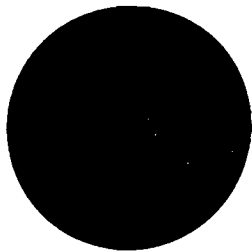
The direct use research and development program objectives are to aid industry in resource and technical development problems. To investigate and analyze methods or approaches of reducing the costs of developing, designing and operating low-temperature geothermal projects. The following are summaries of activities for the fourth quarter of Fiscal Year 1995.

3.1 Low-Temperature Resource Assessment

Reports on the compilation of data from thermal wells and springs have been completed for the 10 western states.

The final report is in preparation. It will contain an executive summary, background on previous assessments, direct heat applications, descriptive data and fluid chemistry, state resource evaluation, inventory and recommendations, collocation of resources, geothermal energy cost evaluation, and conclusions.

Letters, local resource data, and information on the technical assistance program were sent to 113 county economic development agencies. These were agencies with cities collocated with resources in their service areas. See sample letter.



GEO-HEAT CENTER

Oregon Institute of Technology • Klamath Falls, Oregon 97601 • 503/885-1750 • FAX 503/885-1754

Paul J. Lienau, Director

September 15, 1995

Richard E. Kenney
Big Bend Economical Development Council
226 W. Third Avenue
Mose Lake, WA 98837

Dear Richard:

The Geo-Heat Center, in conjunction with the University of Utah and the Idaho Water Resources Research Institute, has recently completed an assessment of western U.S. geothermal resources. This effort has resulted in the identification of 1398 thermal wells and springs above 120°F. Included in the enclosed package is information on resources in your area. The presence of these resources can be used to enhance economic development efforts.

Over the past 20 years, we have been involved in the development of geothermal projects for space heating, district heating, aquaculture, greenhouses and industrial applications throughout the western U.S. Profiles of several existing projects are included in the enclosed package.

Now, through the sponsorship of USDOE, we are able to offer, AT NO COST, limited technical assistance to potential and existing users of geothermal resources. The areas of expertise available at the Geo-Heat Center along with a description of our programs are detailed in the enclosed brochure.

In the past, we have teamed with local economic development agencies to evaluate geothermal potential for a variety of commercial and industrial clients. This has proven to be an effective strategy for expanding the use of geothermal resources and enhancing local economic development efforts.

If you have any questions about our program or a specific project which we may be of assistance, please don't hesitate to contact us. We look forward to working with you in the future.

Sincerely,

Paul J. Lienau
Director

Kevin Rafferty
Associate Director
Technical Assistance Manager

Enclosures

- 3.2 Sub-Task 2.1 Geothermal direct heat cost analysis has been completed and submitted to OSTI for publication, titled "A Spreadsheet for Geothermal Direct Use Cost Evaluation" by Kevin Rafferty.
- 3.3 Sub-Task 2.2 Geothermal district heating marketing strategy has been completed and submitted to OSTI for publication, titled "Marketing the Klamath Falls Geothermal District Heating System" by Kevin Rafferty. In addition, work continues with the city of Susanville in establishing flat-rate billing for the geothermal district heating system.

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 technical library and tours of geothermal facilities in the Klamath Falls area are made available.

- 4.1 Geo-Heat Center Quarterly Bulletin. Bulletin Vol. 16, No. 4 was published in October 1995 and distributed to 1822 U.S. and 322 foreign subscribers. Articles included in the issue are:

1. "20th Anniversary of the Geo-Heat Center" by P. Lienau and J. Lund
2. "Historical Impacts of Geothermal Resources on the People of North America" by J. Lund
3. "Collocated Resources" by T. Boyd
4. "Klamath Falls Snow Melt System" by B. Brown
5. "Prawn Park - Taupo, New Zealand" by J. Lund and R. Klien
6. Geothermal Pipeline - Progress and Development Update from the Geothermal Progress Monitor.

4.2 Technical Papers, Presentations, Computer Programs and Tours.

1. Seminar and Tour:

Zong-He Pang, Sabbatical to University of Oregon
Ji-Yang Wang, Laboratory of Geothermics, Academia Sinica, Institute of Geology, Beijing, China
Prof. Mark Reed, U of O Geological Sciences

July 25, 1995

Chemical composition and corrosion problems by Lienau
Geochemistry by Reed and Pang
Corrosion on DHEs by Swisher
Material selection for district heating systems by Rafferty
Tour - OIT, DHE installations, city geothermal district heating system

2. Seminar and Tour:

Kidahashi, Executive Director of NEDO
Miyamoto, Geothermal Project Leader of NEDO
Takasuigi, GERD
R. Schroeder, Berkeley Group

July 26, 1995

Comparison of commercial GSHP systems ASHRAE, ground couple sizing by Rafferty
GSHPO case studies by Boyd

DHE design by Lienau
Corrosion on DHEs by Swisher
DHE design in New Zealand by Lund
Tour - OIT, DHE installations, city district heating, and GSHP installations

3. Presentation and Tour:

Miguel Rangel Chavez and Eduardo Velasco, CFE, Morelia, Mich., Mexico, Geothermal district heating systems

August 9, 1995

4. Technical Paper:

"Geothermal Heat Pump Performance and Utility Programs in the U.S." by Paul J. Lienau, submitted for publication in Energy Sources, August 31, 1995.

4.3 Geothermal Library. During the period of July 1 to September 30, 1995, 19 new volumes were added to the library. The library now has a total of 5164 volumes cataloged.

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

<u>Topic</u>	<u>No. Publications</u>
Geothermal Heat Pumps	247
Space Heating	12
Greenhouses	7
Aquaculture	2
Industrial	4
District Heating	5
Equipment	11
Resources/Wells	8
Other	<u>94</u>
Total	390

5.0 Geothermal Progress Monitor

CALIFORNIA

Northern California Power Agency Approves Project to Convert Waste Water to Geothermal Energy

On 27 July 1995, the Northern California Power Agency (NCPA) Commission formally approved participation in the Southeast Geysers Effluent Pipeline Project (Project). The Project involves construction of a pipeline to deliver treated sewage effluent from Lake County to NCPA's Geysers geo-thermal generating facility for deep injection into the hot geothermal reservoir.

Michael McDonald, NCPA's general manager, said "the Project will provide a good source of injection water to sustain geothermal electrical generation into the next century while solving wastewater disposal problems for the city of Clear Lake and other residents of Lake County." Action by the NCPA Commission follows closely on the heels of recent approval by the Lake County Board of Supervisors of all agreements necessary to construct the pipeline, including all environmental documents. The project has been in the planning for more than 3 years and involves NCPA, Lake County, and all of the operators in the Southeast Geysers geothermal field, including Unocal Corporation (Unocal), Calpine Corporation (Calpine), and Pacific Gas & Electric CO. (PG&E). Additional injection water via the pipeline is expected to extend by at least 15 years the useful life of NCPA's existing 200 MW power generation facilities at The Geysers, located in Lake and Sonoma counties. Extending the useful life of NCPA's existing geothermal power facilities will allow the NCPA better to serve the future electrical needs of its member utilities.

Total construction costs of the main pipeline and pumping facilities are estimated at approximately \$34.1 million. Ground breaking is scheduled in late September 1995, with completion expected by December 1996. The project's innovative public/private cost-shared financing plan includes Lake County wastewater funds; federal grants from the Department of Energy, Environmental Protection Agency, Bureau of Land Management, and the Economic Development Administration; a grant from the State of California (California Energy Commission); and equity investments by all geothermal operators (NCPA, Unocal, Calpine and PG&E) totaling \$21.5 million.

NCPA estimates that the project will result in a gain of approximately 40 MW in electrical power output. Over the next 20 years, this will equate to an annual delivery of 350,000,000 kWh of clean, low-cost and renewable electrical generation. Beside the project's obvious energy benefits to NCPA and its partners, the project will provide an environmentally superior method of wastewater disposal, while providing added tax, lease and royalty revenues to local communities, the state of California, and the federal government. (Source: GRC Bulletin)

HAWAII

Two-Year Anniversary in Hawaii

The Puna Geothermal Venture's (PGV) Pohoiki power plant is 2 years old. Over this period, it has produced an average of 25 MW of power--about a fifth of the county's electrical load. The operator of the plant PGV--which is a partnership between Constellation Energy Inc., a subsidiary of Baltimore Gas & Electric Co. and OSI Power Corporation--has stated that the power plant can produce 30 MW of electrical power. PGV is now in the progress of negotiating with Helco, the local utility, to sell the extra 5 MW.

It has been estimated that a conventional power plant operating on oil would have burned about 800,000 barrels of oil--about eight tanker loads during the 2-year period.

PGV would like to further develop the geothermal field and construct another power plant. It was noted that the resource is available and is indigenous, so money does not have to leave the island to pay for fuel to produce electrical power. (Source: GRC Bulletin)

New Hydrogen Sulfide Study in Hawaii

The Puna Malama Pano, an organization of Puna residents who are opposing geothermal energy, has received a \$20,000 federal grant from the Environmental Protection Agency (EPA) to purchase the equipment and make a sustained test of the air around the PGV power plant. The organization believes that the monitoring equipment now being used is not properly set up to accurately monitor H₂S that is heavier than air.

The organization will monitor H₂S in the following manner:

- Set up the monitoring equipment in the low areas around the power plant.
- Shorten the length of the pick-up tubes so that they will receive air samples closer to the ground.
- Because H₂S sometimes moves like a stream of water, the monitoring stations will be at the most optimum sites to detect the gas.

The H₂S standards set by the state of Hawaii allow 25 parts per billion (ppb) from any facility. The PGV permit states that the air around the plant may not contain more than an average of 5 ppb per hour. This means that the air around the plant can register momentary surges of greater than 5 ppb, but the plant would still meet the state requirements as long as the average reading for an hour is below 5 ppb.

The standard set by the Occupational Safety and Health Administration (OSHA) is 10,000 ppb. This means that a healthy worker can be exposed to this level of H₂S for eight hours per day.

At 500,000 ppb, H₂S can cause immediate respiratory distress and paralysis, and can be fatal. (Source: GRC Bulletin)

MEXICO

Calpine Enters International Power Market; Company Initiates Program at Cerro Prieto Geothermal Resource

On 9 June 1995, the Calpine Corp. of San Jose, CA, announced that it had entered into a series of agreements with Grupo EPN S.A. de C.V. (Grupo EPN) and its affiliate, Perforadora Magma S.A. (Magma), to participate in geothermal steam production and well drilling, and repair projects at the Cerro Prieto geothermal resources in Baja California, Mexico. Representing the company's first international energy venture, the proposed projects will be under contract to Mexico's national utility, Comision Federal de Electricidad (CFE). The agreements were executed on 8 May 1995 at a ceremony held under the auspices of the U.S. Department of Energy in support of the Global Climate Change Initiative. The agreements were witnessed by Secretary of Energy Hazel O'Leary.

Grupo EPN, a Mexican resource development company, and Calpine have entered into a memorandum of understanding to produce approximately 1,600 tons per hour of geo-thermal steam at Cerro Prieto for CFE. Calpine also entered into a separate agreement with Magma for the drilling of 10 new geothermal wells to expand the capacity of the Cerro Prieto field and for the restoration of 20 of CFE's geothermal wells also at Cerro Prieto. The well drilling projects are managed in conjunction with two CFE contracts, totaling \$26 million, which were awarded to Magma in 1995. The initial 10-well program began in early July. Calpine will provide funding for the projects as well as technical, administrative and operating services.

Consistent with its long-term strategy, the Cerro Prieto projects represent Calpine's first international venture. The company anticipates strengthening its relations with CFE and Grupo EPN to further develop geothermal opportunities at Cerro Prieto.

The Cerro Prieto geothermal resource, commercially developed since 1973, is located in the Mexicali Valley on the Baja California peninsula. The resources currently produces approximately 600 MW of electricity from three geothermal power plants. This production supplies nearly 70 percent of northern Baja California's electricity demand. (Source: GRC Bulletin)

NEVADA

Nevada School Bets on Geothermal to Win

The White Pine County High School in Ely, Nevada, only opened in February, but school officials are already betting its environmental system will save \$25,500 annually in utility bills and operating costs.

The 82,000-sq-ft facility houses 550 students in a town 260 miles north of Las Vegas. Its indoor climate is controlled by a closed-loop heat exchanger made of nearly 78,000 ft of Phillips "Driscopipe" 5400 high-density polyethylene (HDPE) pipe produced by Phillips Driscopipe Inc., a subsidiary of Phillips Petroleum Co.

"One of the biggest hurdles faced by utilities and contractors promoting geothermal energy is the local community's fear of water table pollution," said Jim Lewis, acting manager, Mount Wheeler Power Co. He said the pipe was selected because of its resistance to cracking and leaking, as well as its longevity.

Desert Requirements

The town of Ely endures abrasive desert conditions, cold winter months and high altitudes. Temperatures plummet to -20°F, heating is often required for seven months each year. Conditions like that call for a strong pipe.

Glenn Messner, Phillips Driscopipe's new market development manager, said the pipe has been used in ground-source heat pump installations at Phillips 66 gas stations, where it averages \$15,000 savings in reduced utility costs.

Inter Mountain Pipe Supply, Centerville, Utah, supplied the 72,000 ft of 1-in. pipe, 5200 ft of 3-in. pipe, 440 ft of 6-in. pipe, and 240 ft of 8-in. pipe used at the school.

The system was designed by Peterson Associates, Reno, in conjunction with Earth Energy Technology and Supply, Inc., Marietta, Oklahoma. Earth Energy provides a computer model for the heat exchanger and designed the heat fields.

"The rock, rock aggregate, and other potentially abrasive materials found throughout the site necessitated a strong pipe," said Phil Schoen, Earth Energy's director of marketing.

"We've used Driscopipe 5400 on other projects at schools and homes, and know the material has a strong resistance to abrasion. The pipe also is highly conductive which facilitates the extraction of heat from the soil."

Thermal Transfer

The pipe transfers heat exchanged between the heat pump and the ground. System fluid, water or water and antifreeze, is circulated through the buried pipe system, which absorbs heat from the earth and carries it to the heat pump.

At the high school, the heat pump extracts heat from the pipes, compresses it to a higher temperature, and distributes it to individual heating-cooling units in each classroom. The individual units enable each teacher to determine individual classroom temperatures.

Heat may be drawn from one classroom to a cooler one. Unneeded heat is returned to the earth via the piping network.

Construction

Christiansen Drilling, Ely, drilled 144 boreholes 250 ft deep and inserted U-shaped, closed-loop, 1-in. pipe filled with water. After insertion, the pipes were hooked to a pressure pump as a quality-control check-up to 100 psi.

The boreholes were then filled to the surface with bentonite grout, to bond the pipe to the hole walls and prevent air cavities from forming. The natural clay material seals the boreholes from bottom to top, to protect the integrity of the system and of nearby aquifers. It also provides a thermal bridge between the earth and the pipe.

O'Flaherty Plumbing & Heating excavated 5 ft down the borehole to butt-fuse the 1-in. well loop to a common 3-in. prefabricated manifold. The manifold leads to the valve vault, where the piping was butt-fused to 6-in. pipe and a series of circuit setters and valve headers.

The System

The school's system has two heat loop fields, each consisting of six well clusters or zones. (A well cluster has 12 wells.) Interconnecting the wells into one cluster took the crew eight to 12 hours.

One 8-in. supply and return line coming from the school teed-off into two 6-in. ones, one for each heat loop field. The 6-in. lines fed to the valve vaults, where valve manifolds comprised of six valves and six circuit setters isolated each well cluster. (Valve vaults enable individual or group control of the clusters to monitor temperature and pressure.)

Benefits

Although the project involved a lot of work, all involved seem to think it worth the effort.

"Ground-source pumps cost more to install than conventional heating systems, but geothermal energy pays for itself in only a few years," Lewis said. "In two demonstration projects completed in Ely, electric bills were 78% less using geothermal energy."

The school's system was estimated to cost \$340,000 more initially than a \$423,000 conventional heating and cooling system. Officials estimated it would save more money in the long run. Mount Wheeler Power financed the project with a 12-year lease option.

"We offered financial assistance on this installation to prove to the community that geothermal energy works," Lewis said. "The school will save \$25,000 in reduced heating costs each year, which calculates to nearly \$800,000 savings during the projected 50-year life of the school." (Source: Engineered Systems)

PENNSYLVANIA

Two-Phase Geothermal Fluid Standard Developed

The chemical analysis of geothermal fluids is important to the maintenance and operation of geothermal wells and power plants.

And, although sampling of geothermal fluids is performed around the world, experts believe there has been no consensus standard developed, which ensures that consistent and reliable data is gathered from different sources.

According to Paul Hirtz, that will change.

Hirtz is chairman of a task group with the American Society for Testing and Materials (ASTM). His committee, Task Group E44.15.01 on Sampling and Chemical Analysis, has helped produce the society's Standard E 1675, "Practices for Sampling Two-Phase Geothermal Fluid for Purposes of Chemical Analyses."

According to ASTM, the purpose of the practice is to obtain representative samples of liquid and steam as they exist in a pipeline transporting two-phase geothermal fluids. The chemical composition data may be used for many applications important to geothermal energy exploration, development, and the long-term managed exploitation of geothermal resources, the association said.

According to ASTM, applications include resource evaluations, such as determining reservoir temperature and the origin of reservoir fluids, compatibility of produced fluids with production, power generation, and reinjection hardware exposed to the fluids, long-term reservoir monitoring during field exploitation, and environmental impact evaluations, including emissions testing.

The organization said the natural chemical produced in geothermal fluid can cause a number of problems, such as scale deposits and corrosion of the well-bore casing and production piping.

ASTM added that a significant feature of the practice is the use of a cyclone-type separator for high-efficiency phase separation, operated at flow rates high enough to prevent significant heat loss, while maintaining an internal pressure essentially the same as the pipeline pressure.

ASTM said Standard E 1675 is available from its customer service, 215-299-5585. For more information about E 1675, contact Hirtz, Thermochem Inc., 5347 Slylane Blvd., Santa Rosa, California 95403, 707-575-1310. (Source: Air-Conditioning, Heating & Refrigeration News)

VIRGINIA

Geothermal Teleconferences to be Broadcast

The sponsors of the natural geothermal heating and cooling teleconferences announced the 1995-96 continuation of the series developed in conjunction with the Geothermal Heat Pump Consortium.

In 1995 and 1996, there will be three teleconferences each year, every one focusing on a specific topic, type of building, or customer segment.

Dates and topics for 1995 are Sept. 14--"Geothermal Heat Pumps in Commercial Buildings", and Nov. 16--"Geothermal Heat Pumps for Residential Customers."

The two-hour teleconferences will provide information for audiences of commercial and residential designers, utility personnel, facility managers, users, realtors/developers, and others interested in the technology.

Downsite participants will be given the opportunity to telephone questions to GHP authorities, users, designers, and installers who will be in the teleconference studio.

For more information, contact the Conference Coordinator, Policy Research Associates, Inc., 703-742-8402, 703-742-8671 (fax).

Topics for the 1996 teleconferences will be, spring--"Multi-Family Residential Buildings", early fall--"Small Office Buildings", late fall - "Retail Buildings."

The teleconferences will be broadcast via satellite from 10:30 a.m. to 1 p.m. eastern time (10:30 to 11 a.m. is the test pattern).

Major sponsors include the U.S. Department of Energy, U.S. Environmental Protection Agency, Electric Power Research Institute, Geothermal Heat Pump Consortium, International Ground Source Heat Pump Association, National Rural Electric Cooperative Association and Edison Electric Institute. (Source: Air-Conditioning, Heating & Refrigeration News)

