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REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
AUGUST 1985

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GENERAL

8.1 Fifteen-year Extension of Geothermal Leases Sought by U.S. Senator: Democratic Senator Chic Hecht of Nevada is lobbying during the off-session of Congress just ending for passage of a bill he is sponsoring to extend for 15 years, if needed, geothermal leases on property having proven power resources that cannot now be developed for economic reasons. Seeking co-sponsors and planning to request Congressional hearing this fall, Hecht said that "the combination of large front-end development costs, risky power plant technology and uncertainty over future world energy prices has led to the cancellation or delay of many promising geothermal power projects."

"These problems," he said, "are now being compounded by certain inflexible provisions of the Steam Act (of 1970) which prohibit the extension of leases where diligent field development has occurred, but actual power plant construction has been delayed by market forces. Section 319 of last years continuing resolution gave geothermal lease holders a temporary respite by allowing the conditional two-year extension of original 1-year leases issued under the Steam Act." But this isn't sufficient, he contends.

Hecht's bill would establish a permanent mechanism for granting up to three successive five-year extensions. Firms seeking more time would have to prove with each five-year request that they had made substantial investments in exploration without being able to produce geothermal energy in commercial quantities. As company plans are reviewed, bill would require the Department of Interior to consider terminating leases "not reasonably necessary to the economic viability of a unit or cooperative plan."

Regarding attempts by environmentalists to establish "buffer zones" against geothermal development around Yellowstone National Park in Wyoming and about 20 other national Parks and monuments in country containing geothermal features, Hecht indicated that, although there's no intention to permit intrusion in these preserves, the de facto propaganda campaign instituted by park protection advocates has "dealt a serious blow to the entire geothermal industry because of their opposition to development in a few specific areas of the country."

If Hecht's amendment is adopted, every lease issued in accordance with geothermal Steam Act and, in effect, on or after July 27, 1984, would be eligible for extension if applied for either within 180 days after adoption of amendment or 60 days before lease's primary term expires, depending on which is later. (Geothermal Report 9-2-85)

8.2 St. Mary's Hospital Project Report is Available: "Geothermal Heating Project at St. Mary's Hospital, Pierre, South Dakota" final report, No. DOE/ET/28441-7 (DE85008336) is available from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, telephone 703/487-4600

St. Mary's Hospital, Pierre, S.D., with the assistance of the U.S. Department of Energy, drilled a 2,176' well into the Madison Aquifer to secure 108°F artesian flow water at 385 gpm (475 psig shut-in pressure). The objective was to provide heat for domestic hot water and to space heat 163,768 sq. ft. Cost savings for the first three years were significant and, with the exception of a shutdown to replace some corroded pipe, the system has operated reliably and continuously for the last four years.

8.3 East Mesa Pump Test Facility Report Issued: The "East Mesa Geothermal Pump Test Facility (EMPTF)" Final Report, No. DOE/SF/11556-T1 (DE85003521) is available from the NTIS, address noted above.

Barber-Nichols was awarded a contract in September, 1981 for design and fabrication of a Geothermal Pump Test Facility at East Mesa (EMPFT) by the U.S. Department of Energy. The test facility provides the pump industry with a tool for in-the-well testing at typical operating conditions for submersible pumps while eliminating the risk of actual downwell geothermal field testing. The aim of this project was to produce a test facility for use by pump manufacturers to encourage research and development of electric submersible geothermal pumps.

8.4 Sugar Refining Report Released: The NTIS has released "Use of Geothermal Heat For Sugar Refining in Imperial County" Pilot Plant Implementation Report, No. DOE/SF/10814-T1 (DE85003673).

A program aimed at replacing fossil fuels with geothermal energy for the processing of sugar beets was conducted under a Department of Energy (DOE) Program Opportunity Notice (PON). The program was to be carried out in three phases: this report documents activities during the second phase.

The first phase was performed by TRW Energy Systems Group with the Holly Sugar Corporation as industrial participant. That phase involved the preliminary evaluation of the design and potential benefits of a geothermal industrial process heat system at Holly's plant in Brawley, California.

The second phase of the program, to which this report is addressed is entitled "Pilot Plan Implementation". During this phase, Holly Sugar Corporation acted as lead organization with

TRW Energy Systems Group as integration contractor. The objective of the phase was to develop a successful geothermal resource and use it in conjunction with a geothermal process heat pilot plant to demonstrate the adequacy of a system which could provide technically sound, economical, and environmentally acceptable process heat.

The third phase of the program was planned to carry the pilot plant design to full scale and replace fossil fuel use in accordance with the design projections of the first phase.

During the second phase drilling of an exploratory production well was carried out. The well reached a total depth of about 10,000 feet. Static bottom hole temperatures as high as 393 degrees F were calculated. However, the well did not produce a free flow of more than 2-3 barrels of brine per hour. Attempts were made to stimulate the well by gas lift and circulation. These procedures were unsuccessful in promoting flow, and the well was shut in. At that point the DOE decided to terminate the project.

8.5 DOE and Industry Unite to Boost Geothermal: Government and industry have formed a group to help finance and develop geothermal energy technologies. The Department of Energy and 18 private organizations have founded the Geothermal Drilling Organization (GDO), a screening committee that will share development costs for promising technologies. DOE's Sandia National Laboratories of Albuquerque, N.M., is the manager of the program. Chairman of the new group is Del Pyle, manager of drilling operations for Union Oil Co. of California.

A GDO advisory committee, made up of four officers and two scientists appointed by the chairman, will review proposals for fabrication of hardware or field work. GDO members interested in funding a specific proposal will then form an ad hoc group to negotiate an agreement and to select a project contractor. DOE will contribute 50 percent of the funding and GDO members will meet the other half of the costs.

According to the guidelines of the new organization, all contracts must insure that patents resulting from the funded work be issued in the names of the contractors that commercialize the technology, according to a DOE spokesman. In addition, DOE and GDO members that fund projects will be entitled to royalty-free licenses for any patented equipment.

GDO members are: DOE; Union Geothermal; Geothermal Resources International; Republic Geothermal; Phillips Geothermal; Chevron Geothermal; California Energy Co.; MCR Geothermal; Steam Reserve Corp.; Mono Power Co.; Anadarko Production Co.; Foamair Products; Eastman Whipstock; NL Industries; Dresser Industries; Smith International; Dailey Directional Services; H&H Tool, and Pajarito Enterprises.

The group has already funded its first venture: Squire-Whitehouse Inc. of San Diego, Calif., received a 20-month, $950,000 award. According to the contract, Squire-Whitehouse, a logging tool manufacturer, will build two acoustic borehole televiewers that will operate at temperatures of up to 275 degrees Centigrade and will conduct laboratory tests to confirm their effectiveness. Flo-Log Inc. of Long Beach, Calif., will then use the tools for a year to conduct any geothermal well-logging operations that are requested by interested energy companies. Union Geothermal and Geothermal Resources International are the GDO members that are helping fund the work.

The U.S. Geological Survey predicts that 100,000 megawatts of electricity and process heat could be produced from geothermal energy. Presently, geothermal yields about 1,200 megawatts. Some 80 wells have been drilled this year.

"Although this country's geothermal drilling effort is tiny when compared with the oil and gas drilling business, the geothermal resources in the western United States with proper nurturing,

could become a significant contributor to the nation's electrical energy mix," says James Kelsey, GDO secretary and supervisor of Sandia's geothermal technology division.

GDO, he adds, is considering funding other ventures, including the development of an aqueous foam that can be used for well clean-out, development of drill string components that use high-temperature elastomers, and development of an open-hole bridge plug. (The Energy Daily, 8-27-85)

REGION IX

CALIFORNIA

INDUSTRIALIZATION ACTIVITIES

8.6 Spa in a Bar Developed: Larry Durkin of Santa Rosa, California has developed an evaporation process to recover minerals from hot springs. Spa in a Bar consists of minerals from 26 gallons of hot spring water, powdered milk and dehydrated lemon to produce a bar that when used in a bath gives the same effect as soaking in a thermal pool.

8.7 California Energy Commission (CEC) Announces Grant and Loan Program: The California Energy Commission is beginning the sixth funding cycle for the Geothermal Grant and Loan Program for Local Jurisdictions. Through this program the CEC distributes funds received by the state from federal geothermal leases to local jurisdictions for projects relating to geothermal development. The CEC has approximately $2.5 million available for: 1) planning projects for large and small scale power plants and direct use development; 2) projects to assess and develop geothermal resources; and 3) projects to monitor or mitigate impacts of existing geothermal development. Questions regarding this program should be directed to Michael Smith, California Energy commission, 1516 9th St, MS 43 Sacramento, CA 95814.

NEVADA

Industrialization Activities

8.8 One Operating, Four More Power Plants to Go on Line This Year: No less than four geothermal power plants are scheduled to go on line by the end of this year and one little project - Wabuska Hot Springs north of Yerington - has been supplying geothermally produced electricity to Sierra Pacific Power Company for more than a year.

While the plants are small compared to a Valmy coal-fired plant, they already are starting to add up. Geothermal projects planned or under construction in Nevada over the next three years total 121 megawatts - bigger than any of the units at Sierra Pacific's old oil and gas-fired power plants at Tracy or Fort Churchill.

That's enough electricity to supply a city the size of Reno. About a third of that - just under 40 megawatts - is scheduled to go on line by the end of this year at plants already under construction at Beowawe, southeast of Battle Mountain; Desert Peak and Brady's Hot Springs, between Fallon and Lovelock, and Steamboat, south of Reno.

Plants are nearing construction in Big Smoky Valley, south of Austin, Fish Lake Valley, between Tonopah and Bishop; and Dixie Valley, east of Fallon. And that's just scratching the surface, geothermal experts say.

A conservative estimate of Nevada's geothermal resources - 4,000 megawatts - is double the entire generating capacity of conventional power plants in the state today, said Dan Shockett, vice president and general manager of ORMAT Systems, a new

Reno-based company selling complete, packaged geothermal generating plants. Over the years, that could create a $4 billion energy exporting industry in Nevada, said Shockett. In fact, ORMAT moved its company headquarters from Boston to Reno last year to be closer to the action.

Beowawe has been one of the most thoroughly drilled geothermal areas in the state, which may account for the disappearance of several of its natural geysers, according to geologist Larry Garside of the Nevada Bureau of Mines and Geology. It and Brady's Hot Springs have the hottest geothermal steam wells in the state, Garside found in a 1979 survey of Nevada's geothermal resources.

Development of Beowawe finally got under way last year when Chevron Geothermal Co., a subsidiary of the big oil company, and the Crescent Valley Geothermal Co., a subsidiary of Southern California Edison Co., teamed up to start the largest geothermal power plant under construction in the state. They hope to start testing their 15.2-megawatt plant as early as mid-September and have it operating by the December 31 tax credit deadline.

Chevron will invest about $5 million to bring in several deep production wells, while the Southern California Edison subsidiary will spend $15 to $20 million for the power plant, said Mark Murray of Crecent Valley Energy. They are buying the plant from Mitsubishi Heavy Industries, so Japanese engineers are at the site, along with John McGregor, a Scottish project engineer for Associated Southern Engineering, which is installing the plant, and people from the Dravo Corp., the construction subcontractor. They are slant drilling to a depth of 8,000 feet in the main well where they encounter temperatures in excess of 400 degrees.

The Chevron-Edison partnership is negotiating to send the power to Southern California over Sierra Pacific's lines. Since those lines may only have a capacity for 10 or 11 megawatts, the rest will have to be sold to utilities north of Nevada or Sierra Pacific, Murray said.

While it isn't the biggest, Tad's Enterprises of Wabuska is the first geothermal plant in Nevada. Last July, the Wabuska facility began sending 650 kilowatts into Sierra Pacific lines, giving northern Nevada its first truly home-grown power.

Tad's Enterprises is the investment firm of two Bay area brothers, Neal and Don Townsend, who have been experimenting with their geothermal hot springs, 15 miles north of Yerrington, since the late '70s. First they put in a gasohol plant, using the hot water to distill corn, only to watch the oil shortage turn into an oil glut. Then they started an algae farm, growing the protein-rich plants in geothermal pools for health food outlets. They transferred that operation last year to a hot springs they own at Klamath Falls, Oregon. Now they have put another $1 million into buying a small power plant from ORMAT. "It's experimental to some degree," Neal Townsend said. "We intend to make money out of it, but we had a lot of adjustments we had to do."

A lot of geothermal experts were skeptical that Wabuska's 220-degree water could be used to generate electricity. That's considered a pretty low temperature for power generation. But the freon-based generator from ORMAT was just upgraded to 800,000 kilowatts and the Townsends plan to buy a second, 1.20-megawatt unit next year. If that proves successful and the PSC approves a favorable long-term contract with Sierra Pacific, they will add a 5-megawatt plant in 1987 or 88, he said.

Sierra Pacific, the Department of Energy and the University of Oregon have started extensive tests to monitor its efficiency of converting a low-temperature geothermal resource into electricity.

Geothermal Development Associates has been building its 5-megawatt plant at Steamboat "in a goldfish bowl," said company president Martin Booth. Its location at the busy intersection of U.S. Highway 395 and the Mount Rose Highway gives it something most Nevada geothermal projects don't have to contend with: people.

Some Steamboat Springs residents - notably Dorthy Towne, who has extensive geothermal holdings herself, as owner of the old Steamboat spa - has objected about the possibility of noise and odors from the new plant. But there are ways to get rid of the hydrogen sulfide odors that sometimes accompany gothermal water, Booth said, and the project's special use permit from Washoe County requires the plant to be 10 percent quieter than a typical residential neighborhood. The plant is being built as if it were surrounded by houses, said Booth, although the nearest, other than Towne's, is still pretty far up the Mount Rose Highway. "We want to be very good neighbors because this resource can be used by northern Nevada people. We are putting this together in a gold fish bowl because everyone can see us, so we go well beyond what we are required to do." And GDA wants a good reputation in case the project proves to be expandable, he added.

Other partners include power systems engineer Dave Mendive, Greenhouse Garden Center owner Bob Ruf of Carson City and Reno mining attorney Richard Harris. They have raised $10 million in private financing to build the plant on 30 acres owned by Sierra Pacific. PSC officials found that particularly attractive, since it can save money by hooking into a big electrical substation already on site.

GDA also is buying its generators from ORMAT, whose freon-based system will allow it to extract electricity from a "moderate" temperature of 300 to 350 degrees. At 500 to 2,000 feet deep, the three production wells are shallow compared to most geothermal projects, Booth said.

A mile or two to the south, Phillips Geothermal Group is hitting temperatures of 440 degrees in much deeper wells. Phillips also has plans for a 5 to 10 megawatt geothermal power plant at Steamboat. Officials of both companies insist their operations won't affect each other, especially since Phillips is going so much deeper. The oil company subsidiary is boring its third deep well at Steamboat in partnership with Yankee Petroleum Company. Each production well has cost about $1 million. Their latest drill rig is towering above Pleasant Valley. The companies have no projected date for their Steamboat plant, said Tom Turner, geothermal development director for Phillips.

Pieces of Phillips' 9-megawatt power plant began arriving at Desert Peak last week, where 70 workers will assemble it this fall. Turner said the $15 million project is ahead of schedule so it should have no problem beating the December 31 tax credit deadline. Desert Peak is the only "blind" geothermal reservoir in the country, Turner said - that is, there were no hot springs, geysers or steam vents to indicate the presence of super-hot water underground. Phillips geologists began poking and drilling the little mountain in 1973. Since then, according to the Nevada PSC, the company has spent $7 million in exploration alone . . . that's before spending a dollar on the power plant.

Phillips is using an experimental "biphase turbine" built in Trenton, N.J. by TransAmerica Corporation that will simultaneously generate electricity from steam and super hot water from two 9,000-foot wells which hit 410-degree water.

PSC officials said Phillips originally estimated Desert Peak has a potential for 300 or 400 megawatts, but the company has put future expansion on the back burner. It used so much of its capital to stave off a take-over bid by "corporate raider" T. Boone Pickens that it has little available for exploration, Turner explained. It has put its geothermal properties up for sale to recoup much-needed cash. That could slow geothermal development in Nevada; Phillips is one of the most active companies in the field with more than 50,000 acres under geothermal leases in Washoe, Churchill and Pershing Counties. Its Desert Peak leases take in 36 square miles of "checker-board" lands with sections alternating between the BLM and Southern Pacific Railroad's real estate company.

Steve Munson plans to generate 9.9 megawatts of electricity there (Brady Hot Springs) by the end of the year. Like the geothermal people at Steamboat, Munson said his wells won't hurt the food processing plant, about a mile away, and the Phillips wells at Desert Peak won't hurt his operation, seven miles distant. "Our properties are on substantially different resources than Phillips' and Brady Hot Springs" he said. Munson's wells are shallower than Phillips and, at 300 to 320 degrees, not as hot. He will use two different types of generators - one from ORMAT for about 3.9 megawatts and another from a pilot project in Idaho. It is a dual turbine that splits the geothermal fluid into a high and low-pressure streams and extract electricity simultaneously from both. He has signed a contract to sell his output to Sierra Pacific Power Co. and applied for PSC approval only two weeks ago. Munson has been testing the hot waters at Brady's for five years.

Nevada Geothermal Associates is drilling test wells along a 15-mile line running roughly between two well-known hot springs in Big Smoky Valley - McCloud and Darrough, where Locals often soak away their cares in a geothermal pool. Its planned 10-megawatt power plant was one of the three Sierra Pacific Power Company contracts approved by the PSC last year.

The group is still working on financing, said Jack Tjeersdma of Mill Valley, one of the investors. Other principals include land and leaseholders in the Nye County area, about 60 miles south of Austin. Tjeersdma said they expect to pay close to a rule of thumb that geothermal power costs about $2,000 per kilowatt to develop, counting exploration drilling, construction and financing. If so, their investment will total about $20 million.

Steam Reserve Corporation is negotiating with Southern California Edison to sell 15 megawatts it intends to generate in Fish Lake Valley, about 60 miles southwest of Tonopah. The company intends to install its first 5-megawatt generator next year and add the other 10 megawatts by 1988, said Dean Pilkington, chief geologist. It is a subsidiary of Amax Exploration Co., which is a subsidiary of AMAX, which operates the biggest molybdenum mine at Climax, Colorado. The power plant will feed into the facilities of Valley Electric Association, a small rural cooperative serving the Esmeralda County area, which will relay the electricity to Oasis, California, east of Bishop for distribution in California. To do that, Steam Reserve will have to build its own seven-mile power line through the remote valley. Exploration started in 1981 and the company has reached water up to 383 degrees in deep wells. "We'll operate the plant and pay for the power line," Pilkington said.

Although Dixie Valley is one of the most promising geothermal areas in the West - Hoops (BLM) thinks it could generate at least 500 megawatts of power - its developers are in a tough spot. They have to build their own power line - 220 miles from the remote Churchill County valley across Mineral county to Bishop. And the U.S. Navy which just abandoned its own geothermal project in Fallon, is balking at the high towers and drilling rigs that would be around its bombing and test ranges at Dixie Valley, Hoops said, even though the route is outside the military withdrawal. The BLM is due to release an environmental assessment of the 230-kilovolt line soon.

Oxbow Geothermal plans to build a 50 megawatt plant that would serve Southern California Edison, said Doug Powell, the company's Reno representative. That makes it the biggest geothermal project on the drawing boards in Nevada. About 20 people would be needed to operate it. If the power line is approved, construction could begin next year with power production as early as mid-1987, Powell said. For the power line and plant, he said Oxbow is prepared to spend about $100 million. (Excerpts from Reno Gazette-Journal Article, Pages 1F and 2F, August 18, 1985).

8.9 Development for Navy at Fallon Halted: The Helioscience General joint venture has thrown in the towel on developing up to 75 MW of geothermal energy at the Navy's Fallon, Nevada facility. The Joint venture decision between Helioscience and General Ener-Tech to terminate its contract with the Navy, without penalty, thus writes the finish to a project which began in April, 1983. The joint venture participants cited a sharp decline in the contract selling price of electricity as the cause for ending the contract, and said spending of $700,000 would be written off by Helioscience in 1985.

OREGON

INDUSTRIALIZATION ACTIVITIES

8.10 District Heating Considered for Goldmohr Terrace in Lakeview: Goldmohr Terrace, consisting of 25 to 30 homes in Lakeview, is seriously considering a residential district heating system. System and development costs are being investigated.

8.11 Greenhouses in Lakeview to Undergo Modifications: The "Greenhouse", formerly Oregon Desert Farms, is in the process of modifying its heating system for more efficient operation. Bare pipe mounted under benches and changes in the downhole heat exchanger in the well are expected to reduce flow requirements by 60%. The "Greenhouse" is operated by Andy Parker and the primary crop is flowers.

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JUNE AND JULY 1985

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6, 7.1 Regional Resource Assessment Completed for BPA: An "Evaluation and Ranking of Geothermal Resources for Electrical Generation or Electrical offset in Idaho, Montana, Oregon and Washington" has been completed for the Bonneville Power Administration by Dr. R. G. Bloomquist, G. L. Black, D. S. Parker, A. Sifford, S. J. Simpson and L. V. Street. The abstract of the Executive Summary follows:

In 1983, the Bonneville Power Administration contracted for an evaluation and ranking of all geothermal resource sites in the states of Idaho, Montana, Oregon, and Washington which have a potential for electrical generation and/or electrical offset through direct utilization of the resource.

The objective of this program was to consolidate and evaluate all geologic, environmental, legal, and institutional information in existing records and files, and to apply a uniform methodology to the evaluation and ranking of all known geothermal sites. This data base would enhance the making of credible forecasts of the supply of geothermal energy which could be available in the region over a 20-year planning horizon.

The four states, working together under a cooperative agreement, identified a total of 1,265 potential geothermal sites. The 1,265 sites were screened to eliminate those with little or no chance of providing either electrical generation and/or electrical offset. Two hundred and forty-five of the original 1,265 sites were determined to warrant further study.

The Four-State team proceeded to develop a methodology which would rank the sites based upon an estimate of development potential and cost. Development potential was estimated through the use of weighted variables selected to approximate the attributes which a geothermal firm might consider in its selection of a site for exploration and possible development. Resource, engineering, legal, institutional, and environmental factors were considered. Cost estimates for electrical generation and direct utilization sites were made using the computer programs CENTPLANT, WELLHEAD, and HEATPLAN. Finally, the sites were ranked utilizing a technique which allowed for the integration of development and cost information.

On the basis of the develop ability index, 78 high temperature sites and 120 direct utilization sites were identified as having "good" or "average" potential for development and should be studied in detail.

On the basis of cost, at least 29 of the high temperature sites appear to be technically capable of supporting a minimum total of at least 1,000 MW of electrical generation which could be competitive with the busbar cost of conventional thermal generating technologies. Sixty direct utilization sites have a minimum total energy potential of 900+ MW and can be expected to provide substantial amounts of electrical offset at or below present conventional energy prices.

The combined development and economic rankings can be used to assist in determining sites with superior characteristics of both types. Five direct utilization sites and eight high temperature sites were identified with both high development and economic potential. An additional 27 sites were shown to have superior economic characteristics, but development problems.

The procedure seems validated by the fact that two of the highest ranking direct utilization sites are ones that have already been developed -- Boise, Idaho and Klamath Falls, Oregon. Most of the higher ranking high temperature sites have received serious examination in the past as likely power production candidates.

Questions should be directed to John Geyer, BPA Energy Resource Specialist at 503/230-5327 or Routing PQP, P.O. Box 3621, Portland, OR 97208.

6, 7.2 USGS Holds Workshop on Cascade Range Resources: More that 100 earth scientists showed up for a U.S. Geological Survey workshop on the geothermal resources of the Cascade Range on May 22-23 at Menlo Park, CA. The purpose was to discuss the Survey's multidisciplinary effort since the late 1970's to study and understand the total energy resource of "this young volcanic belt".

The convened workshop of Federal and State, academic and industry participants was presided over by the Survey's chief geothermal investigator, L. J. Patrick Muffler, who explained his own Circular 790 U.S. geothermal assessment of 1978, suggesting igneous-related systems may be 100 times greater than all identified and undiscovered hydrothermal convection systems, and maybe 1000 times greater than energy in all hydrothermal convection systems identified up to now. "From this comparison it can be inferred that very large amounts of geothermal energy yet remain to be found," said Muffler.

A Muffler associate, Marianne Guffanti of USGS Reston headquarters, also surveyed the Circular 790 results for the Cascades, as a starting point for a revised regional assessment. Muffler's 1981 estimate shows that about half of the igneous-related geothermal energy for young systems in the western U.S.

exists a magma and nearly that much as solidified intrusion and hot surrounding rock, "with only a few percent expressed by hydrothermal convection systems," said Guffanti. Eleven Cascades systems totaling about 3900 x 10^{18} joules represent about 8 percent of the igneous-related energy in the U.S. (not including energy of the very large Yellowstone-Island Park system, non-exploitable as a National Park). (Geothermal Report July 1, 1985)

6, 7.3 DOE DGHT Has Organizational Changes: The return of Morris Skalka to geothermal energy is the major effect of the reorganization ordered by acting Assistant DOE Secretary, Donna R. Fitzpatrick, to consolidate and sharpen management of conservation and renewable energy programs, which have suffered reductions and budget cuts, particularly solar programs, under the Reagan administration.

The Geothermal Technology Division, strengthened by Skalka's return from the solar division, actually winds-up with the same manpower as it had before the reorganization, 13 positions, with one engineering program manager vacancy for the geopressured program. Where the division previously included hydroelectric programs, these now drop out and the hydro budget-direction (less than $1 million/yr. and a single manager) are now absorbed along with other budgetary and program activities at the next higher level, the Office of Renewable Technology headed by Ron Loose. Loose's office now has reporting to it geothermal, biomass, and municipal wastes, the latter two being combined into one division called the Biofuels and Municipal Wastes Division.

John "Ted" Mock remains the geothermal division chief, and with previous division branches now eliminated, all program managers now report directly to Mock. Elimination of branches and their chiefs also help reduce grade level of the remaining employees, another Fitzpatrick purpose. One administrative position for the geothermal loan program was also eliminated. (Geothermal Report, July 15, 1985)

6, 7.4 Final Report Available for Elko District Heating Project: "Direct Use of Geothermal Energy, Elko Nevada Districting Heating, DOE/ET/27033-6 is available from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, telephone 703/487-4600. Following is an abstract of the report's contents.

In early 1978 the U.S. Department of Energy, under its Project Opportunity Notice Program, granted financial assistance for a project to demonstrate the direct use application of geothermal energy in Elko, Nevada. The project is to provide geothermal energy to three different types of users: a commercial office building, a commercial laundry and a hotel/casino complex, all located in downtown Elko. The project included assessment of the geothermal resource potential, resource exploration drilling, production well drilling, installation of an energy distribution system, spent fluid disposal facility and connection of the end users buildings. The project was completed in November 1982 and the three end users were brought on-line in December 1982. Elko Heat Company has been providing continuous service since this time.

6, 7.5 Resource Assessment for Direct Use Applications Available: "Resource Assessment for Geothermal Direct Use Applications", C. Beer et al, DOE/ET/120799-3 can be obtained from the NTIS, same address as above. This report discusses the topic geothermal resource assessment and its importance to laymen and investors for finding geothermal resources for direct-use applications. These are applications where the heat from lower-temperature geothermal fluids, 120 to 200°F, are used rather than for generating electricity. The temperatures required for various applications are listed and the various types of geothermal resources are described. Sources of existing resource data are indicated and the types and suitability of tests to develop more data are described.

Potential development problems are indicated and guidance is given on how to decrease technical and financial risk and how to use technical consultants effectively. the objectives of this report are to provide: (1) an introduction low-temperature geothermal resource assessment; (2) experience from a series of recent direct-use projects; and (3) references to additional information.

6, 7.6 Geothermal Industry Group Solicits New Members: The Geothermal Industry Group, a Washington, D.C.-based legislative and regulatory affairs organization, is seeking new members in an effort to continue its work on behalf of the nation's geothermal developers and users. The GIG is an ad hoc group organized a number of years ago to represent the industry in matters that concern federal geothermal laws and regulations. Examples of current GIG interests are Senate Bill 1322, which amends the Geothermal Steam Act; lease acreage limitation increases; PURPA pricing; power transmission availability and rates; and lease and unit plan oversight. Persons interested in receiving membership information should contact Ben Yamagata or Megan Smith at 202/331-9400 or P.O. Box 25076, Washington, D.C. 20007. (GRC-PNS Newsletter, July - August, 1985)

6,7.7 Department of Interior Considering Acerage Increase: In response to what is widely viewed as an obstacle to geothermal development, the BLM has prepared a rule amendment that increases allowable acreage within a state for a single developer to 51,200 acres. As presently proposed, the rule would come into effect on December 24, 1985. The BLM has determined that the new rule does not constitute a major federal action, and will not require an environmental impact statement under NEPA. Donald Hodel, Secretary of the Interior, is expected to take final action prior to December. (GRC-PNS Newsletter, July - August, 1985)

6, 7.8 West Coast Chapter of NADHCI Formed: An organizing meeting was held July 16 in Monterey Park, California for a West Coast chapter of the North American District Heating & Cooling Institute. For details contact Richard Eckfield, NADHCI, Washington, D.C., 202/223-4922. (GRC-PNS Newsletter, July - August, 1985)

6, 7.9 Updating of Northwest Power Plan Continues: The revision of the April 1983 Northwest Conservation and Electric Power Plan is continuing according to a schedule that expects Power Council adoption in December 1985. At this time there appears to be few changes that would affect the Council's support for geothermal research and development as stated in the original Plan. For copies of new drafts and public involvement schedules phone the Power Council at 1-800-452-2324. (GRC-PNC Newsletter, July - August, 1985)

REGION VI

NEW MEXICO

State and DOE Activities

6, 7.10 World's Deepest And Hottest Hot Dry Rock Geothermal Energy Loop Completed: Leaders of a unique projet that brought together experts from three nations on June 6 announced the creation of the deepest and hottest geothermal energy system of its kind in the world.

The multinational team -- which includes representatives of the Federal Republic of Germany, Japan, and the United States -- successfully connected two wells drilled almost two-and-a-half miles down through solid rock. The project is under the auspices of the International Energy Agency (IEA).

The connection creates an underground loop that will heat water circulated through a huge reservoir of fractured hot dry rock to some 500 degrees Fahrenheit.

"It's a major milestone for the Hot Dry Rock Project which has been pushing the forefront of science and technology," says Dr. Robert San Martin, Deputy Assistant Secretary for Renewables in the U.S. Department of Energy (DOE).

The geothermal loop, located deep under the earth's surface in New Mexico's scenic Jemez Mountains, has attracted worldwide attention.

Although funded in large part by the DOE, it has drawn strong financial and technical support from the Japanese and West German governments, under an IEA agreement signed in 1980 and renewed in 1983. This technical support has involved Japanese and German scientists and engineers living in Los Alamos and working as part of the geothermal team.

"One of the most important results of this joint research project has been a clear indication of the power of such international research collaboration," said Jim Bresee of DOE and chairman of the project's tripartite Steering committee.

The large reservoir was created in December 1983, when six million gallons of water were pumped down one well at the site causing multiple fractures in the deep underground granitic rock.

The hot dry rock reservoir and the two previously drilled wells had remained unconnected, however, until a challenging effort to create the geothermal-energy loop was launched in mid-March.

The three-nation team successfully made the connection in about two months. Drilling started about 9300 feet down one well (which is inclined above the other), taking a trajectory that made a connection with the granitic rock reservoir about 12,100 feet underground.

Some 10 diagnostic techniques were employed to confirm the connection, including seismic monitoring and chemical analysis of tracers that were circulated and tracked through the giant loop.

"Knowing where to drill and actually following that direction was a truly remarkable achievement," said associate project manager George Tennyson of the DOE Albuquerque Operations Office.

The project required the development of a number of special instruments and tools able to survive the harsh conditions of drilling through hot impermeable granitic rock - a rock type generally avoided in gas and oil exploration. As a result, there have been a variety of technological spinoffs to industry from the project's research and design work.

Now that the circulation loop has been created, the next step will be a careful testing program to determine how effectively the heat within the fractured rock can be removed.

"Because the circulating water is a closed system, the energy can be removed with no impact on the environment," said Don Brown of Los Alamos National Laboratory and technical manager of the project. "Ultimately, we should be able to control the rate of heat removal and thus meet a wide range of energy requirements."

Meantime, the possible operation of the site for power generation by private industry will be explored. Also, laboratory experts have provided advise to several states and other countries to help them develop their hot dry rock geothermal systems.

"At this point, it looks like an extremely attractive energy alternative. Such systems can probably be located near population centers, because they're environmentally safe," says John Whetten, leader of the Lab's Earth and Space Sciences Division. "And we think they can easily be expanded in modules to meet electricity needs -- a very positive economic attribute."

Contact James H. Breen, Los Alamos National Laboratory, telephone 505/667-7000 for more information. (Los Alamos National Laboratory News Release).

6, 7.11 Numerous State Geothermal Involvements Discussed at Meeting: Representatives from Los Alamos National Laboratory, Sandia, NMSU, and State agencies met at Los Alamos on July 24 and 25 to get an overview of the state's geothermal energy programs, activities, and issues, through the coordinating efforts of LANL's Paul Franke. Chris Wentz discussed the New Mexico Energy and Minerals Department's role as facilitator, and Dr. Larry Icerman shared what New Mexico Energy, Research and Development Institute is doing. Dr. Rudy Schoenmachers talked about the Energy Institute's work. The HDR program was covered by Mort Smith of LANL, while Bob Harold discussed LANL's Central America development activities and Dr. Richard Traeger gave an overview of Sandia's programs. LANL is planning a mid-October technology transfer session on tools, packers, cameras and other items the laboratory is developing. Bert Dennison will coordinate the session. (Chris Wentz, NMEMD)

6, 7.12 Research Greenhouse is Proceeding: Funding has been obtained and design work is nearly complete for a research greenhouse facility to be located near Las Cruces. According to Dr. Rudy Schoenmachers, New Mexico Energy Institute, the construction RFP will be issued soon. Funding is being obtained to deepen a well at NMSU from 982 to 1500 ft and use it to provide heat for the greenhouse. Drilling is expected to start late this year. (Chris Wentz, NMEMD)

REGION IX

CALIFORNIA

Industrialization Activities

6, 7.13 AG Industrial Park Under Development at Lakeport: Lake County is in the process of developing an Ag Industrial Park that will consist of a 10,000 square foot educational and demonstration greenhouse. In addition, space will be available for 146,800 square feet of commercial greenhouses. The educational facility will be used by Lake Mendocino College. Presently, Lake County is negotiating with the new resource owner for the drilling of production and injection wells. The resource temperature is expected to be about 160°F.

6, 7.14 District Heating Proceeding for Lake Elsinore: The City of Lake Elsinore started laying pipe for a geothermal district heating system on July 27th. In two days, 990 feet have been installed, with 2200 being the completed length. Work is being done only on Saturdays in order to utilize city owned equipment.

6, 7.15 Test Well for Cogeneration/Aquaculture Completed at Ft. Bidwell: On the Fort Bidwell Reservation, a test well has been completed which produces 380 gpm at 205°F under artesian flow. Current plans are to deepen and complete it as a production well. In order to expand the aquaculture facility, more cold water is required. A good flow of cold water was encountered at 1000 feet and a cold water production well is planned. If completed as anticipated, the new wells could provide 260 kW of power generation and provide for raising more than 40,000 catfish.

6, 7.16 Bridgeport District Heating Injection Well is Being Drilled: At Bridgeport, an injection well is being drilled to 1800 feet to dispose of water from a 15 building geothermal district heating system. A 2000 foot geothermal primary pipe carries 185°F water to a heat exchanger and the injection well. Bridgeport officials are considering drilling the production well deeper to obtain greater than 205°F water for possible cogeneration.

State and DOE Activities

6, 7.17 Binary Geothermal Plant Prepares For Start-Up: The world's first commercial scale binary geothermal power plant is undergoing tests in preparation for start-up during the next few weeks in California's Imperial Valley.

If successful, binary technology being demonstrated at the $188 million Heber project by a group led by San Diego Gas & Electric Co. could help quadruple potential U.S. geothermal power capacity. It exploits in a low cost, environmentally benign way a moderate temperature resource that accounts for about 80% of U.S. geothermal reservoirs.

Chevron Geothermal Co. and Unocal Corp. share interests equally in the Heber unit and will provide geothermal brine production and reinjection facilities for the project, with Chevron acting as operator. Fluor Engineers Inc.'s power division handled plant engineering, design, and procurement. Dravo Constructors Inc. oversaw plant construction.

The U.S. Department of Energy is funding 50% of the Heber project construction and 2-year demonstration phase operations. Electric Power Research Institute 10%, and the balance by SDG&E, California Department of Water Resources, Fluor Engineers, Imperial Irrigation District, Pacific Gas & Electric Co., Southern California Edison Co., and the State of California.

Western U.S. operators have built other moderate temperature geothermal projects, including pilots in the Imperial Valley. But the Heber geothermal plant will be the first to use a nonsteam approach on a scale - about 50,000 kw - thought to be optimum for commerciality for moderate temperature projects.

Production also could stimulate interest in a new arena of third party, small-scale, power projects by resource producers and developers. Such projects have taken advantage of government tax and regulatory incentives to create minibooms in cogeneration and alternate power sources.

The Heber project also will be the first commercial scale project on stream to tap one of the world's largest geothermal resources, California's Imperial Valley.

The Imperial Valley geothermal resource, including speculated deeper reservoirs, has been pegged at as much as 30 million kw of electrical power capacity for 50 years. Established potential of the Heber anomaly alone could support perhaps 500,000 kw of long term power capacity. (Oil & Gas Journal, June 24, 1985).

REGION X

Idaho

Industrialization Activities

6, 7.18 Flint Greenhouses to Double Size: Flint Greenhouses of Idaho will be doubling the size of their facility. Geothermal water at 112°F from a new well will be delivered to the expanded facility that is located near Buhl. The greenhouse provides wholesale seasonal potted plants. (L. V. Street, IDWR)

6, 7.19 M&L Greenhouses Adds a New Well: M&L Greenhouses of Idaho, operated by Mike Archibald, added a new 112°F well with a 54 psi shut-in pressure to their facility, also near Buhl. A new greenhouse is under construction where bedding plants are sold wholesale. (L. V. Street, IDWR)

6, 7.20 Bliss Facility Rearing Exotic Mushrooms: Bliss Valley Farms, Inc. is producing an exotic mushroom, pleurotis, utilizing cellulose media such as wood or straw and a 151°F geothermal resource. Current production is about 125 pounds a day, and if the market develops positively, about one million pounds a year could be grown. The developers plan to double their current capabilities this fall. (L. V. Street, IDWR)

OREGON

Industrialization Activities

6, 7.21 Lakeview Grants Franchise to Pursue Geothermal Development: The City of Lakeview, under the coordinating efforts of John Cogar, has awarded a franchise to a joint venture group to proceed with the possible development of a district heating system. The franchise allows the rights to use public land in determining, within a six month period, geothermal resource capability and the potential geothermal energy loads. There is

a targeted operational date of one year. The joint venture is made up of Brown, Vents, and Associates, San Fransisco, CA; Applied Power Technology, Menlo Park, Ca; and Gertz, Juncal and Associates, Idaho Falls, ID. (Alex Sifford, ODOE)

6, 7.22 Newberry Drilling Proposed: Further exploration drilling in the vicinity of Newberry Volcano may result from a proposal being considered by the BLM and Forest Service. GEO Operator Corporation has proposed to drill three 4,000 ft. temperature gradient holes on leases in the Fort Rock Ranger District. The holes will be located on the north, south, and east sides of the volcano. The BLM recently issued a negative environmental declaration for the drilling. (GRC-PNC Newsletter, July - August, 1985)

6, 7.23 Drilling Near Crater Lake May Go Forward: The temperature gradient drilling proposed by California Energy Company on leases adjacent to Crater Lake National Park has been cleared by federal agencies, and may begin in late summer or early fall 1985. (GRC-PNC Newsletter, July - August, 1985)

State Activities:

6, 7.24 ODOE Begins Updating State Energy Plan: The Oregon Department of Energy's Planning Division has announced its upcoming revision of the State's Energy Plan, and is seeking comments from interested persons about issues to be considered and public involvement procedures to be used over the next year as the new plan for 1987-89 takes shape. In its original form for 1985-87 the State Plan did not include any long-range projections of geothermal power generation, but did contain short-term policy support for continuing resource assessment, demonstration projects, and elimination of institutional and market constraints. To get involved contact Hussein Hassoun, ODOE, 503/378-8278. (GRC-PNC Newsletter, July - August, 1985)

6, 7.25 Oregon Deregulates Geothermal District Heating: In response to investor-owned utility urging, the Oregon Public Utility Commissioner introduced, and the 1985 Oregon Legislative Assembly enacted, House Bill 2202 which completely removes geothermal district heating from PUC oversight. Under the terms of the new legislation geothermal non-electric systems are clearly not defined as "public utilities" and, therefore, excluded from PUC rules and regulations. The legislation also exempts non-electric uses of solar, wind, and biogas. (GRC-PNC Newsletter, July - August, 1985)

WASHINGTON

State Activities

6, 7.26 North Bonneville Pursues Pump Testing: The City of North Bonneville, Washington has asked the Washington State Energy Office for financial assistance to complete the next phase of its resource confirmation program. The City hopes to pump test its 2,000 foot production well that was completed in 1981. The well, which produces artesian fluids at approximately 92°F, is intended to serve a district heating and cooling system which is also the subject of a concurrent financial assistance application to Bonneville Power Administration. (GRC-PNC Newsletter, July - August, 1985)

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REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
NOVEMBER 1985

GENERAL

11.1 Stanford Geothermal Workshop Set for January 21-23: The Eleventh Annual Workshop will be conducted January 21-23 as part of Stanford's Geothermal Program. Technical Sessions will include well testing, fractures, reinjection, modeling, geosciences, field studies, logging, reservoir engineering, and special sessions. Information can be obtained from Paul Kruger, Stanford Civil Engineering Department, telephone 415-497-4123 or 4744.

REGION VIII

UTAH

Industrialization Activities

11.2 Greenhouse Development Expansion Planned at Newcastle: Troy Hygro currently has one acre of greenhouses producing tomatoes and cucumbers. Negotiations are underway for an additional 48 acres of land which will result in 15 acres of 128 feet by 135 feet double poly quonset type greenhouses. Forced air type heating systems are used with plate and frame heat exchangers to isolate the geothermal fluids. A geothermal well produces 246 gpm at 226°F and the developers will purchase a second well. Waste geothermal water is disposed of in a percolation pond. In 1982 the Geo-Heat Center examined the feasibility of using the local resource for greenhouse space heating and electrical power generation. (Paul Lienau, OIT 12/13/85)

REGION IX

CALIFORNIA

Industrialization Activities

11.3 Heber Plant Construction Completed: A group of developers recently finished construction of a $130-million geothermal plant in California's Imperial Valley. The Heber geothermal plant, near El Centro, will generate 52 megawatts of power. Financing construction were Chevron Geothermal Co., Unocal Geothermal Division, Dravo Corp. and Centennial Energy Inc. As operator of the geothermal resource, Chevron is responsible for the nine production wells, eight injection wells and pipelines; as operator of the plant, Dravo is responsible for the generation and delivery of electricity to Souther California Edison.

The "dual-flash" process used at the Heber plant involves delivery of hot (360°F) water to the power plant from wells drilled 4,500-10,500 feet deep. Heber's geothermal reserves were first discovered in 1947, during unsuccessful oil drilling in the area. The 7,400-acre hot brine reservoir may be large enough to provide up to 500 megawatts of electricity once it is fully developed - the equivalent of a 250-million-barrel oil field. (The Energy Daily 11/13/85)

11.4 First Direct Flash Plant Closed Down: Unocal Corp. will close an uneconomic geothermal power plant in California's Imperial Valley. "Due to the declining energy market, it is not economically feasible to continue operating this small developmental project," said Carel Otte, head of the company's geothermal division. Unocal is the world's largest geothermal energy producer.

The 10-megawatt plant has been operated for five years by Southern California Edison under a partnership with Unocal, the Los Angeles Department of Water and Power and the city-owned utilities of Burbank, Pasadena and Riverside. The project started operations in mid-1980 and has generated more than 134 million kilowatt-hours of power.

"The experience gained at the plant led to the development of new technology and materials which resist corrosion and reduce scale build-up in pipes and other equipment caused by this saline resource," Otte said. "Many of the advances were incorporated into the technology at the Salton Sea geothermal plant near Midland, where research continues." (The Energy Daily 11/07/85)

11.5 Naval Weapons Center at China Lake Considering District Heating: A Known Geothermal Resource Area, the Coso KGRA, exists on the north range of this base. Brigham Young University's Department of Mechanical Engineering is undertaking the design of a geothermal district heating system for 200 buildings on the base. (Paul Lienau, OIT 12/13/85)

11.6 District Heating Possibilities Are Being Examined at Alturas: A 903 foot constant temperature gradient hole at 7.5°F/100 feet has encouraged local officials at Alturas to consider district heating. The Geo-Heat Center is involved in a feasibility study for the space heating of schools, county courthouse complex, hospital and a commercial area which will help in a decision to determine where and how deep to drill an exploratory well. Oil and electricity are currently used for space heating in Alturas. (Paul Lienau, OIT 12/13/85)

NEVADA

State Activities

11.7 NBMG 1985 Publications List Available: The Nevada Bureau of Mines and Geology has published its 1985 list of available

publications. The catalog contains new material published by the Bureau as well as a cumulative list of all available NBMG publications on Nevada's geology and mineral resources. A separate list of out-of-print publications is also available.

The 1985 list of available publications and the out-of-print publications list are available free from the Sales Office (Room 310 in the Scrugham Engineering-Mines Building at the University of Nevada-Reno campus) or by mail (Nevada Bureau of Mines and Geology, University of Nevada-Reno, Reno, NV 89557-0088). For further information, contact Arlene Kramer: 702-784-6691. (NBMG 12/02/85)

REGION X

ALASKA

11.8 Applications Requested for Mt. Spurr Area Lease Sale: The Alaska Department of Natural Resources, Division of Oil and Gas, is requesting applications and public comment for a proposed geothermal lease sale in the Mt. Spurr area on the west side of Cook Inlet. The proposed sale area is entirely within the Kenai Peninsula Borough, northwest of Trading Bay, and approximately 40 miles west of Tyonek. On May 17, 1983, 16 tracts in this area were offered for lease in Competitive Geothermal Lease Sale 1 (Mt. Spurr). Only one tract (#9) received a bid. This tract is currently under lease.

The area of call comprises approximately 2,640 acres to the east of Chakachamna Lake between the southern flank of Mt. Spurr and the Chakachatna River.

Legislation providing for geothermal resource development was enacted by the Alaska Legislature in 1980. Leasing regulations were promulgated in July 1982 and revised in May 1983. The call

for applications does not constitute a final decision by the Commissioner to dispose of the geothermal interest in state land, but will initiate the process. (Alaska Department of Natural Resources 11/21/85)

OREGON

Industrialization Activities

11.9 Geothermal Industrial Park Being Considered for Olene Gap: Trendwest Development Company has announced the purchase of 4,000 acres near Olene, 15 miles SE of Klamath Falls, with the intent to develop an industrial park. The park could accommodate agricultural and industrial processes reliant on heat which geothermal energy could provide. The land was purchased for $425,270.

CH2M Hill, Inc. conducted a study in the area that identified wells with temperatures ranging from 131 to 224°F. High temperature gradients in other wells indicate the probability that water at 250 to 300°F could be available at deeper thermal zones. Trendwest is particularly interested in developing some type of agricultural process that would use local products. Potato processing, malting, pelletizing or cubing alfalfa and dehydrating garlic and onions (now shipped from the Tulelake area to Gilroy, California) are among the possibilities. (Paul Lienau, OIT 12/13/85)

11.10 Lakeview Geothermal District Heating Information Updated: Lakeview Thermal proposes to develop geothermal district heating for the city of Lakeview. Lakeview Thermal is a joint venture between Brown, Vence and Associates, San Francisco, and Applied Power Technology, Susanville, California. Lakeview Thermal agreed to a six month period to "put up or shut up" in bringing a geothermal well on line. The company will spend about $2 million in its first phase development. Within the next half year the company wants to determine if a well in Bullard Canyon

can provide the needed volume at necessary temperatures. If not, operations will probably shift to Hammersley Canyon north of Lakeview, which would mean higher costs because of a mile long pipeline.

The first phase heating system will serve the uptown core area, including the town's to-be built emergency services building, Elks Lodge, four schools, Lake District Hospital, motels, Fremont National Forest Supervisor's Office and the Bureau of Land Management Office. Future development includes Hunter's Lodge and the Goldmohr Terrace areas. (Paul Lienau, OIT 12/13/85)

WASHINGTON

State Activities

11.11 WSEO Enters into Joint Venture with Swedish Council: The Washington State Energy Office has signed a joint venture contract with the Swedish Council for Building Research to revise the HEATPLAN software program. HEATPLAN, previously developed by WSEO, is designed to aid in the evaluation of the feasibility of district heating systems. This venture calls for revisions of the economic and geothermal resource modules. The IBM compatible program, to be completed by the end of June 1986, will be made available in TURBO PASCAL language. Gordon Bloomquist, geothermal specialist for WSEO, is serving as the project manager for the task that will be primarily performed in Sweden. (Gordon Bloomquist 12/13/85)

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REGIONAL GEOTHERMAL PROGRESS MONITOR
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GENERAL

12.1 Geothermal Lobbying Group Separate from GRC: The Geothermal Resources Association, the planned lobbying arm of the geothermal industry has initiated their activities. The association will be independent of the Geothermal Resources Council, but will utilize them, under contract, to provide administrative services.

12.2 Acreage Limitation Increased December 26: The BLM has increased from 20,400 to 51,200 the acres that a lessee can hold on federal lands. The rule also increases the lease application fee from $50 to $75.

12.3 GRC Pacific NW Section to Meet February 19: The GRC Northwest Section will hold a 10:00 A.M. to 3:00 P.M. meeting at the Red Lion Jantzen Beach Hotel, Portland, Oregon on February 19, 1986. Topics include introduction of new officers, the OIT Varaflow Aquifer Model, water law overview, and developments in Idaho, Oregon and Washington. Contact Alex Sifford, ODOE, telephone 503/378-2778 for more information.

12.4 Introduction to Geothermal Resources Course Planned for February 5 and 6: "An Introduction to Geothermal Resources" will be offered by the Geothermal Resources Council at the Clarion Hotel, San Fransisco International Airport, Milbrae, California on February 5 and 6, 1986.

"This Course is being offered at the request of numerous companies and agencies who have new employees on their staffs with little or no overall knowledge of geothermal exploration and exploitation. The function is designed to provide a broad view of geothermal energy, which will allow an attendee to understand his or her part in its development. The background provided can immediately enhance an attendee's understanding of your present geothermal program and potentially save valuable man-hours in the future. The last time this course was offered was in 1981 and it may not be offered again until the early 1990's."

Please contact the GRC, P.O. Box 1350, Davis, California 95617, telephone 916/758-2360 for details.

12.5 GRC to Hold Small Scale Power Plant Meeting: The geothermal Resources Council is offering a topical meeting "Small Scale Power Plants and Power Plant Projects on February 12 and 13, 1986 at the El Dorado Hotel in Reno, Nevada. The meeting is designed to provide the latest information on small power plants and power plant development activities in Nevada and Northwestern California. Field trips to the Desert Peak and Brady Hot Springs plants, the Steamboat Springs site, Wendel Hot Springs, California, and the Barber-Nichols power plants. Contact the GRC, P.O. Box 1350, Davis, CA 95617, telephone 916/758-2360.

REGION IX

CALIFORNIA

Industrialization Activities

12.6 Magma 39 MW Plant Start-up: Magma Power Co. of Los Angeles last week started up a 39-megawatt geothermal power plant in southern California. Magma Power and Burlington Northern Inc. each own 50 percent of the $74-million Vulcan geothermal plant, located near Niland. Southern California Edison Co. is paying avoided cost rates for the plant's power.

More than 25 years ago, Magma chairman B. C. McCabe founded The Geysers, the large geothermal energy complex in central California. At one time, Magma owned 25 percent of The Geysers geothermal resource; Union Oil owned the rest. But two years ago, Natomas Co., before being acquired by Diamond Shamrock, bought out Magma's interest at The Geysers. Magma now owns geothermal acreage in southern California and Nevada. It operates another 12.5-megawatt geothermal venture in West Mesa, in southern California. (The Energy Daily 12/9/85)

HAWAII

State Activities

12.7 Community Geothermal Technology Program Provided: The Community Geothermal Technology Program will provide small grants, available in any amount not exceeding $10,000, for research into non-electric uses of geothermal energy in Hawaii. Non-electric uses include applications of direct heat from currently

discarded geothermal fluids or uses of by-products such as silicon and sulfur. Funding for the program is provided by a variety of public and private sources. The program is coordinated by the Hawaii Natural Energy Institute and the State of Hawaii, Department of Planning and Economic Development. The research can be performed at the PUNA Research Center, a laboratory on the grounds of the HGP-A geothermal power plant. Access to high temperature brine at about 175 psi and 368°F will be provided. Research which can more appropriately be performed at a different site will also be considered if it meets other program criteria. (Paul Lienau, OIT GeoHeat Center)

REGION X

NEVADA

Industrialization Activities

12.8 Anadarko Petroleum Announces Nevada Geothermal Discovery: On 30 October 1985 Anadarko Petroleum Corporation of Houston, Texas announced a commercial-scale discovery of geothermal energy in Churchill County, Nevada.

The well, located in the Salt Wells area approximately 60 miles east-southeast of Reno, was pumped at a maximum sustained rate of 1,300 gallons of hot water per minute during a four-day test. Water temperature ranges from 260 to 285°F. Depth of the well is 700 feet.

Robert C. Edmiston, geothermal manager for Andarko at Santa Rosa, California stated that the volume of water and temperature at the wellhead are consistent with commercial generation of

electricity using binary (heat exchanger) technology. Test results indicate that the shallow discovery zone has the potential for development into a resource capable of generating at least 30 MW per hour.

Andarko has a 100 percent interest in the discovery and in approximately 9,700 surrounding lease acres. Additional drilling will be undertaken in 1986.

A subsidiary of Panhandle Eastern Corporation of Houston, Andarko is one of the nation's largest independent oil and gas exploration and production companies and is active in the U.S., Canada and overseas. The company holds approximately 63,000 net acres of geothermal leases in Nevada, California and Oregon. (GRC Bulletin, December, 1985).

12.9 Elko County School District Going Geothermal: Three schools in the Elko County School district have started to use geothermal energy to heat their facilities. At Wells, Nevada, an 800 foot well produces 87°F water as an energy source for a heat pump to heat Wells High School. The heat pump displaced an electric boiler and is using 1/3 less kwh. The Carlin High School is also using a heat pump to heat domestic water. A 640 foot well produces 60 gpm at 87° as the energy source for the heat pump. Future plans include developing a space heating system for the high school. At Elko, a recently completed 1,970 foot well supplies 300 gpm artesian at 190°F to a new junior high school building. Piping has been installed to connect 12 additional school buildings, a convention center, the hospital, city offices and the swimming pool to the system. An injection well will be completed for disposal of the fluid that is currently being wasted to storm drains. (Paul Lienau, OIT GeoHeat Center)

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REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
SEPTEMBER 1985

GENERAL

9.1 Geothermal Programs Review Held in Washington, D.C.: Donna Fitzpatrick, Assistant DOE Secretary for Conservation And Renewable Energy, speaking to a gathering of about 70 contractors assembled for a review of DOE geothermal programs at the Sheraton Washington Hotel in the nation's capital on September 11, foresees bright future for geothermal energy both in the U.S. and worldwide. It's a "here and now" renewable resource, with a technology base that is environmentally safe, Fitzpatrick said, and U.S. is leading in advances in technology, furthering use of steam and hot water around the world.

Looking to some near future developments, Fitzpatirick praised SDG&E's Heber binary project, at 45 MW the largest such conversion plant in the world, already running at partial power in the Imperial Valley, California with the formal dedication set for December 6, 1985. She also announced that the Salton Sea Scientific Drilling Project, on the leading edge of technology to explore and map geothermal resources in the Niland, California area, will begin its drilling program in early October. Also, the DOE hot dry rock experiment, having accomplished hydraulic connections at its Fenton Hill site in New Mexico, will proceed with a surface conversion facility in the near future. The Senate Appropriations Committee, in passing the DOE FY-86 budget, already has approved $425,000 to begin a commercial HDR project in the southern Rocky Mountains area and has directed DOE to get out a RFP.

On an upbeat note, Fitzpatrick reiterated that geothermal continues to be a part of the overall energy policy of the U.S. While the budget for research is always a problem, she felt that the geothermal program manages to get a respectable share, and will certainly contribute to a long term payoff. (Geothermal Report, 10-1-85).

9.2 GRC International Convention a Success: A tremendously successful International Symposium on Geothermal Energy was held by the Geothermal Resources Council on the big island of Hawaii last month in terms of attendees variously estimated at between 600 and 700. So many paid-up registrants furnishes about 25 percent of the GRC annual $600,000 operations budget, its executive director David N. Anderson recently reported. Various courses, symposia, membership dues, etc. make up the rest.

Donna Fitzpatrick, Assistant DOE Secretary for Conservation and Renewable Energies, participated ex tempore in an opening day oratory and heard such notables as Philippines energy minister Geronimo Z. Velasco, Rep. Daniel Akaka (D-HI) and GRC president Harry J. Olson put geothermal's best foot forward.

How solar is geared up to retain its special tax credits and geothermal isn't was addressed in a special session by Ben Yamagata, who said lobbying effort would be required for coming tax overhaul legislation. The lobbyist would be Yamagata's Washington law firm, Van Ness, Feldman & Sutcliffe, which could unlimber the persuasive clout of Bill Van Ness, formerly principal aide to the late Senator Henry Jackson in his presidential bid. Anderson said the GRC had studied the possibility of a sister group to carry on lobbying, and found that an affiliated group could be set-up legally in which the affiliate might come to GRC and use its membership files, offices and support facilities. (Geothermal Report 9-16-85).

9.3 USGS Sets Mineral and Energy Forum: The USGS will hold its second annual V. E. McKelvey forum on mineral and energy resources on February 5 and 6, 1986 at the Regency Hotel in Denver, Colorado. Among the USGS activities to be discussed are evolutions of certain basins, continental U.S. basin heat history map, north American accredited terrains and thrust belts, geothermal energy sources of the Cascade Range and Salton Sea, and other subjects. For further information contact Training and Research Assistance Corporation, P.O. Box 6100, Denver, Colorado 80206, telephone 303/393-7061..

9.4 GRC-PNW Two Day Meeting a Success: The recent two-day workshop held September 24 and 25 in Portland, Oregon is considered to be very successful. About 70 persons representing regulators, developers, Federal, State and other agencies, industry and conservation groups experienced excellent dialogue on institutional and legal issues. Spearheaded by Dr. Gordon Bloomquist of the Washington State Energy Office, the Pacific Northwest Section of the GRC sponsored the meeting that covered local experiences in Washington, Oregon and California. (Gordon Bloomquist, WSEO)

9.5 Substantial Progress has Been Made on Refining Erosive-type Drilling Equipment: Improved cavitating nozzles have been developed as part of a program to increase the rate of penetration of drill bits in deep-hole oil and gas wells. The self-resonating jets produced by the new nozzles outperforms those produced by both conventional drill-bit nozzles and basic cavitating nozzles in terms of incipient cavitation number, amplitude of pressure fluctuation, rock cutting and cleaning of chips from the hole bottom.

Tests were conducted on individual nozzles at full scale and on models at small and very large scale with air, water, and drilling mud as the working fluid. Full-scale drill bits were also tested in these three fluids. Analytical models were developed for predicting the performance of Organ-Pipe Cavijet nozzles and central-vortex-generating nozzles.

Several self-resonating nozzle systems were found to produce passive oscillations that cause the jet to form discrete ring vortexes, thereby yielding incipient cavitation numbers two to six times higher than those of either conventional Cavijet nozzles or typical drill-bit nozzles. In rock-cutting trials, higher incipient cavitation numbers have been correlated with greater erosivity.

The Organ-Pipe Cavijet system proved to be adaptable to the physical form of existing bits and is the most promising concept for future bit design. The self-resonating nozzles will clean chips from a simulated hole bottom at a nozzle pressure drop of only about 25 percent that of standard nozzles. For further information, contact: J. R. Kelsey, Geothermal Well Technology Division, Sandia National Laboratories, Albuquerque, NM 87185, telephone 505/844-6968.

REGION VI

NEW MEXICO

Industrialization Activities

9.6 Baca Plant May be Sold to Mexico: Mexico's Commision Federal De Electricidad is close to signing a contract with Public Service of New Mexico to purchase the 50 MW Baca direct flash plant, or most of its main components remaining at the site, after PSNM, Unocal and DOE terminated the project in early 1982. CFE wants to build a 50 MW plant at Los Azufres, which has practically the same steam conditions, 600°F plus bottom hole temperatures and a steam inlet temperature of about 340°F, as Baca's Valles Caldera reservoir, and can use without major modification all of Baca's major components.

Jack Maddox, Baca project manager for PSNM, confirmed that negotiations are close to being consummated with CFE, which would cover about $12.4 million of plant equipment, including Bechtel's design and engineering drawings, the General Electric turbine-generator, most of the power block equipment, controls, condensers and circulating water system. Maddox said sale would not include the cooling towers, building to cover the power-plant and other miscellaneous equipment.

He expects the sales contract to be signed early this month and anticipates the first shipment of equipment in the November-December time frame, with succeeding shipments early next year. CFE wants to start construction at Los Azufres next may or June, according to Maddox. The sales contract probably would have already been signed, except for a question by CFE on performance warranty of the plant. (Geothermal Report, 10-1-85).

REGION IX

NEVADA

State Activities

9.7 Review of 1984 Mineral Industry in Nevada Available: "The Nevada Mineral Industry 1984," published by the Nevada Bureau of Mines and Geology, is now available. Special Publication MI-1984 is the sixth in a series of annual reports that describe mining, oil and gas, and geothermal activities in the State. the publication reviews metals and industrial-minerals exploration, development, and processing, oil and gas exploration and production, and geothermal exploration and development during 1984. A list showing production, reserves,

host rocks, and ages of bulk-mineable, precious metal deposits in Nevada is also included. It may be purchased for $3.00 at the Sales Office (Room 310 in the Scrugham Engineering-Mines Building on the University of Nevada-Reno, Reno, NV 89557-0088; please add 10% postage and handling). For further information contact Arlene Kramer, 702/784-6691.

9.8 Gravity Data for McDermitt 1 x 2° Sheet Available: A 1:250,000-scale gravity map of the McDermitt sheet is now available at the Nevada Bureau of Mines and Geology. This map is the latest in a series of maps published at the 1:250,000 scale to provide statewide coverage of gravity data. With the publication of this map, gravity data are now available for about 80% of Nevada.

Nevada Bureau of Mines and Geology Map 86, "Bouguer Gravity Map of Nevada--McDermitt sheet," may be purchased for $5.00 at the Sales Office or by mail as noted in the previous item.

9.9 Geology of Northern Nye County Published: The Nevada Bureau of Mines and Geology has published a new bulletin, "Geology of Northern Nye County, Nevada." Written by U.S. Geological Survey geologists Frank J. Kleinhampl and Joseph I. Ziony, Bulletin 99A describes in detail the stratigraphy, structural geology, glacial geology, and geomorphology of northern Nye County. A 1:250,000-scale geologic map accompanies the text. A separate volume describing the mineral resources of northern Nye County was published by the Nevada Bureau of Mines and Geology as Bulletin 99B. With the publication of Bulletin 99A, a series covering the geology and mineral resources of Nevada's 17 counties is now complete.

Bulletin 99A, "Geology of Northern Nye County, Nevada," may be purchased for $13.00 at the Sales Office or by mail as noted previously.

REGION X

OREGON

Industrialization Activities

9.10 Recent Lease Applications Noted for Oregon: The following are recent Federal Geothermal Lease Applications and well locations filed in the State of Oregon.

Lease Applications:

Cal Energy, Santa Rosa, CA
Jackson County, OR 37s-4e, 1920 acres

Portland General Electric, Portland, OR
Deschutes, OR 17s-9,10e, 2254 acres
Deschutes, OR 17s-10e, 6283 acres

Thermal Power Co., San Francisco, CA
Marion County, OR 6s-7,8e, 2738 acres
Marion County, OR 9s-8e, 2247 acres

Well Locations: (State Permit Pending)

GeoOperators Corp. N-1, SE Sec. 25, 22s-12e
Newberry Volcano Area
4000 ft geothermal well

GeoOperators Corp. N-3, NW Sec. 25, 20s-12e
Newberry Volcano Area
4000 ft geothermal Well

GeoOperators Corp. FV-1, NW Sec. 11, 19s-45e
Vale Area
10,000 ft geothermal well (Paul Lienau, OIT)

9.11 Drilling Near Crater Lake Postponed: Winema National Forest has announced that the drilling of four permitted wells to 4000 feet near Crater Lake has been delayed until the summer of 1986. Cal Energy Company of Santa Rosa had planned the drilling program for the summer of 1985. (Paul Lienau, OIT)

9.12 Geothermal Waste Water Heating System Proposed in Klamath Falls: The city of Klamath Falls has contracted with Balzhiser/Hubbard & Associates to design a recovery/reuse system for many wells discharging into open drainage in the Mills Addition. Nearly 100 geothermal wells discharge into open drainage in the Klamath area and it is estimated about 1000 gpm will be available for space heating homes and commercial buildings in the Mills Addition area. The siting of an injection well is planned for final disposal of the reused water. This will assist well owners in complying with the new City geothermal Resource Management Act which requires that all surface discharge be eliminated within five years. (Paul Lienau, OIT)

WASHINGTON

9.13 State and DOE Activities

The City of Olympia has been selected by DOE for funding a study to determine the feasibility of installing a district heating and cooling system.

DOE is anteing up $32,000 and the state is contributing $5,000 for a 9-month study, which involves use of the capitol city's waste water treatment plant having 15 MW capacity. The Washington State Energy Office says the resource is more than adequate to serve the needs of the 200 block area on the capitol campus, the commercial business district and a downtown low-income housing area.

Equally important, the Olympia system would save tax dollars by providing a low-cost source of energy for state buildings. In addition to study funding, a number of unspecified Scandinavian engineering and manufacturing firms have expressed interest in participating in system design and installation. Use of high-efficiency heat pumps is the key to the proposed project.

If findings are favorable, WSEO geothermal specialist Gordon Bloomquist said "We intend to follow up with a detailed engineering, financing and design study for a system which will provide low-cost reliable energy, an attractive incentive to businesses located in the capitol district." Democratic Governor Booth Gardner has endorsed the project in his economic development plan for the state. (Geothermal Report, 9-16-85).

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GENERAL

6, 7.1 Regional Resource Assessment Completed for BPA: An "Evaluation and Ranking of Geothermal Resources for Electrical Generation or Electrical offset in Idaho, Montana, Oregon and Washington" has been completed for the Bonneville Power Administration by Dr. R. G. Bloomquist, G. L. Black, D. S. Parker, A. Sifford, S. J. Simpson and L. V. Street. The abstract of the Executive Summary follows:

In 1983, the Bonneville Power Administration contracted for an evaluation and ranking of all geothermal resource sites in the states of Idaho, Montana, Oregon, and Washington which have a potential for electrical generation and/or electrical offset through direct utilization of the resource.

The objective of this program was to consolidate and evaluate all geologic, environmental, legal, and institutional information in existing records and files, and to apply a uniform methodology to the evaluation and ranking of all known geothermal sites. This data base would enhance the making of credible forecasts of the supply of geothermal energy which could be available in the region over a 20-year planning horizon.

The four states, working together under a cooperative agreement, identified a total of 1,265 potential geothermal sites. The 1,265 sites were screened to eliminate those with little or no chance of providing either electrical generation and/or electrical offset. Two hundred and forty-five of the original 1,265 sites were determined to warrant further study.

The Four-State team proceeded to develop a methodology which would rank the sites based upon an estimate of development potential and cost. Development potential was estimated through the use of weighted variables selected to approximate the attributes which a geothermal firm might consider in its selection of a site for exploration and possible development. Resource, engineering, legal, institutional, and environmental factors were considered. Cost estimates for electrical generation and direct utilization sites were made using the computer programs CENTPLANT, WELLHEAD, and HEATPLAN. Finally, the sites were ranked utilizing a technique which allowed for the integration of development and cost information.

On the basis of the develop ability index, 78 high temperature sites and 120 direct utilization sites were identified as having "good" or "average" potential for development and should be studied in detail.

On the basis of cost, at least 29 of the high temperature sites appear to be technically capable of supporting a minimum total of at least 1,000 MW of electrical generation which could be competitive with the busbar cost of conventional thermal generating technologies. Sixty direct utilization sites have a minimum total energy potential of 900+ MW and can be expected to provide substantial amounts of electrical offset at or below present conventional energy prices.

The combined development and economic rankings can be used to assist in determining sites with superior characteristics of both types. Five direct utilization sites and eight high temperature sites were identified with both high development and economic potential. An additional 27 sites were shown to have superior economic characteristics, but development problems.

The procedure seems validated by the fact that two of the highest ranking direct utilization sites are ones that have already been developed -- Boise, Idaho and Klamath Falls, Oregon. Most of the higher ranking high temperature sites have received serious examination in the past as likely power production candidates.

Questions should be directed to John Geyer, BPA Energy Resource Specialist at 503/230-5327 or Routing PQP, P.O. Box 3621, Portland, OR 97208.

6, 7.2 USGS Holds Workshop on Cascade Range Resources: More that 100 earth scientists showed up for a U.S. Geological Survey workshop on the geothermal resources of the Cascade Range on May 22-23 at Menlo Park, CA. The purpose was to discuss the Survey's multidisciplinary effort since the late 1970's to study and understand the total energy resource of "this young volcanic belt".

The convened workshop of Federal and State, academic and industry participants was presided over by the Survey's chief geothermal investigator, L. J. Patrick Muffler, who explained his own Circular 790 U.S. geothermal assessment of 1978, suggesting igneous-related systems may be 100 times greater than all identified and undiscovered hydrothermal convection systems, and maybe 1000 times greater than energy in all hydrothermal convection systems identified up to now. "From this comparison it can be inferred that very large amounts of geothermal energy yet remain to be found," said Muffler.

A Muffler associate, Marianne Guffanti of USGS Reston headquarters, also surveyed the Circular 790 results for the Cascades, as a starting point for a revised regional assessment. Muffler's 1981 estimate shows that about half of the igneous-related geothermal energy for young systems in the western U.S.

exists a magma and nearly that much as solidified intrusion and hot surrounding rock, "with only a few percent expressed by hydrothermal convection systems," said Guffanti. Eleven Cascades systems totaling about 3900 x 10^{18} joules represent about 8 percent of the igneous-related energy in the U.S. (not including energy of the very large Yellowstone-Island Park system, non-exploitable as a National Park). (Geothermal Report July 1, 1985)

6, 7.3 DOE DGHT Has Organizational Changes: The return of Morris Skalka to geothermal energy is the major effect of the reorganization ordered by acting Assistant DOE Secretary, Donna R. Fitzpatrick, to consolidate and sharpen management of conservation and renewable energy programs, which have suffered reductions and budget cuts, particularly solar programs, under the Reagan administration.

The Geothermal Technology Division, strengthened by Skalka's return from the solar division, actually winds-up with the same manpower as it had before the reorganization, 13 positions, with one engineering program manager vacancy for the geopressured program. Where the division previously included hydroelectric programs, these now drop out and the hydro budget-direction (less than $1 million/yr. and a single manager) are now absorbed along with other budgetary and program activities at the next higher level, the Office of Renewable Technology headed by Ron Loose. Loose's office now has reporting to it geothermal, biomass, and municipal wastes, the latter two being combined into one division called the Biofuels and Municipal Wastes Division.

John "Ted" Mock remains the geothermal division chief, and with previous division branches now eliminated, all program managers now report directly to Mock. Elimination of branches and their chiefs also help reduce grade level of the remaining employees, another Fitzpatrick purpose. One administrative position for the geothermal loan program was also eliminated. (Geothermal Report, July 15, 1985)

6, 7.4 Final Report Available for Elko District Heating Project: "Direct Use of Geothermal Energy, Elko Nevada Districting Heating, DOE/ET/27033-6 is available from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, telephone 703/487-4600. Following is an abstract of the report's contents.

In early 1978 the U.S. Department of Energy, under its Project Opportunity Notice Program, granted financial assistance for a project to demonstrate the direct use application of geothermal energy in Elko, Nevada. The project is to provide geothermal energy to three different types of users: a commercial office building, a commercial laundry and a hotel/casino complex, all located in downtown Elko. The project included assessment of the geothermal resource potential, resource exploration drilling, production well drilling, installation of an energy distribution system, spent fluid disposal facility and connection of the end users buildings. The project was completed in November 1982 and the three end users were brought on-line in December 1982. Elko Heat Company has been providing continuous service since this time.

6, 7.5 Resource Assessment for Direct Use Applications Available: "Resource Assessment for Geothermal Direct Use Applications", C. Beer et al, DOE/ET/120799-3 can be obtained from the NTIS, same address as above. This report discusses the topic geothermal resource assessment and its importance to laymen and investors for finding geothermal resources for direct-use applications. These are applications where the heat from lower-temperature geothermal fluids, 120 to 200°F, are used rather than for generating electricity. The temperatures required for various applications are listed and the various types of geothermal resources are described. Sources of existing resource data are indicated and the types and suitability of tests to develop more data are described.

Potential development problems are indicated and guidance is given on how to decrease technical and financial risk and how to use technical consultants effectively. the objectives of this report are to provide: (1) an introduction low-temperature geothermal resource assessment; (2) experience from a series of recent direct-use projects; and (3) references to additional information.

6, 7.6 Geothermal Industry Group Solicits New Members: The Geothermal Industry Group, a Washington, D.C.-based legislative and regulatory affairs organization, is seeking new members in an effort to continue its work on behalf of the nation's geothermal developers and users. The GIG is an ad hoc group organized a number of years ago to represent the industry in matters that concern federal geothermal laws and regulations. Examples of current GIG interests are Senate Bill 1322, which amends the Geothermal Steam Act; lease acreage limitation increases; PURPA pricing; power transmission availability and rates; and lease and unit plan oversight. Persons interested in receiving membership information should contact Ben Yamagata or Megan Smith at 202/331-9400 or P.O. Box 25076, Washington, D.C. 20007. (GRC-PNS Newsletter, July - August, 1985)

6,7.7 Department of Interior Considering Acerage Increase: In response to what is widely viewed as an obstacle to geothermal development, the BLM has prepared a rule amendment that increases allowable acreage within a state for a single developer to 51,200 acres. As presently proposed, the rule would come into effect on December 24, 1985. The BLM has determined that the new rule does not constitute a major federal action, and will not require an environmental impact statement under NEPA. Donald Hodel, Secretary of the Interior, is expected to take final action prior to December. (GRC-PNS Newsletter, July - August, 1985)

6, 7.8 West Coast Chapter of NADHCI Formed: An organizing meeting was held July 16 in Monterey Park, California for a West Coast chapter of the North American District Heating & Cooling Institute. For details contact Richard Eckfield, NADHCI, Washington, D.C., 202/223-4922. (GRC-PNS Newsletter, July - August, 1985)

6, 7.9 Updating of Northwest Power Plan Continues: The revision of the April 1983 Northwest Conservation and Electric Power Plan is continuing according to a schedule that expects Power Council adoption in December 1985. At this time there appears to be few changes that would affect the Council's support for geothermal research and development as stated in the original Plan. For copies of new drafts and public involvement schedules phone the Power Council at 1-800-452-2324. (GRC-PNC Newsletter, July - August, 1985)

REGION VI

NEW MEXICO

State and DOE Activities

6, 7.10 World's Deepest And Hottest Hot Dry Rock Geothermal Energy Loop Completed: Leaders of a unique projet that brought together experts from three nations on June 6 announced the creation of the deepest and hottest geothermal energy system of its kind in the world.

The multinational team -- which includes representatives of the Federal Republic of Germany, Japan, and the United States -- successfully connected two wells drilled almost two-and-a-half miles down through solid rock. The project is under the auspices of the International Energy Agency (IEA).

The connection creates an underground loop that will heat water circulated through a huge reservoir of fractured hot dry rock to some 500 degrees Fahrenheit.

"It's a major milestone for the Hot Dry Rock Project which has been pushing the forefront of science and technology," says Dr. Robert San Martin, Deputy Assistant Secretary for Renewables in the U.S. Department of Energy (DOE).

The geothermal loop, located deep under the earth's surface in New Mexico's scenic Jemez Mountains, has attracted worldwide attention.

Although funded in large part by the DOE, it has drawn strong financial and technical support from the Japanese and West German governments, under an IEA agreement signed in 1980 and renewed in 1983. This technical support has involved Japanese and German scientists and engineers living in Los Alamos and working as part of the geothermal team.

"One of the most important results of this joint research project has been a clear indication of the power of such international research collaboration," said Jim Bresee of DOE and chairman of the project's tripartite Steering committee.

The large reservoir was created in December 1983, when six million gallons of water were pumped down one well at the site causing multiple fractures in the deep underground granitic rock.

The hot dry rock reservoir and the two previously drilled wells had remained unconnected, however, until a challenging effort to create the geothermal-energy loop was launched in mid-March.

The three-nation team successfully made the connection in about two months. Drilling started about 9300 feet down one well (which is inclined above the other), taking a trajectory that made a connection with the granitic rock reservoir about 12,100 feet underground.

Some 10 diagnostic techniques were employed to confirm the connection, including seismic monitoring and chemical analysis of tracers that were circulated and tracked through the giant loop.

"Knowing where to drill and actually following that direction was a truly remarkable achievement," said associate project manager George Tennyson of the DOE Albuquerque Operations Office.

The project required the development of a number of special instruments and tools able to survive the harsh conditions of drilling through hot impermeable granitic rock - a rock type generally avoided in gas and oil exploration. As a result, there have been a variety of technological spinoffs to industry from the project's research and design work.

Now that the circulation loop has been created, the next step will be a careful testing program to determine how effectively the heat within the fractured rock can be removed.

"Because the circulating water is a closed system, the energy can be removed with no impact on the environment," said Don Brown of Los Alamos National Laboratory and technical manager of the project. "Ultimately, we should be able to control the rate of heat removal and thus meet a wide range of energy requirements."

Meantime, the possible operation of the site for power generation by private industry will be explored. Also, laboratory experts have provided advise to several states and other countries to help them develop their hot dry rock geothermal systems.

"At this point, it looks like an extremely attractive energy alternative. Such systems can probably be located near population centers, because they're environmentally safe," says John Whetten, leader of the Lab's Earth and Space Sciences Division. "And we think they can easily be expanded in modules to meet electricity needs -- a very positive economic attribute."

Contact James H. Breen, Los Alamos National Laboratory, telephone 505/667-7000 for more information. (Los Alamos National Laboratory News Release).

6, 7.11 Numerous State Geothermal Involvements Discussed at Meeting: Representatives from Los Alamos National Laboratory, Sandia, NMSU, and State agencies met at Los Alamos on July 24 and 25 to get an overview of the state's geothermal energy programs, activities, and issues, through the coordinating efforts of LANL's Paul Franke. Chris Wentz discussed the New Mexico Energy and Minerals Department's role as facilitator, and Dr. Larry Icerman shared what New Mexico Energy, Research and Development Institute is doing. Dr. Rudy Schoenmachers talked about the Energy Institute's work. The HDR program was covered by Mort Smith of LANL, while Bob Harold discussed LANL's Central America development activities and Dr. Richard Traeger gave an overview of Sandia's programs. LANL is planning a mid-October technology transfer session on tools, packers, cameras and other items the laboratory is developing. Bert Dennison will coordinate the session. (Chris Wentz, NMEMD)

6, 7.12 Research Greenhouse is Proceeding: Funding has been obtained and design work is nearly complete for a research greenhouse facility to be located near Las Cruces. According to Dr. Rudy Schoenmachers, New Mexico Energy Institute, the construction RFP will be issued soon. Funding is being obtained to deepen a well at NMSU from 982 to 1500 ft and use it to provide heat for the greenhouse. Drilling is expected to start late this year. (Chris Wentz, NMEMD)

REGION IX

CALIFORNIA

Industrialization Activities

6, 7.13 AG Industrial Park Under Development at Lakeport: Lake County is in the process of developing an Ag Industrial Park that will consist of a 10,000 square foot educational and demonstration greenhouse. In addition, space will be available for 146,800 square feet of commercial greenhouses. The educational facility will be used by Lake Mendocino College. Presently, Lake County is negotiating with the new resource owner for the drilling of production and injection wells. The resource temperature is expected to be about 160°F.

6, 7.14 District Heating Proceeding for Lake Elsinore: The City of Lake Elsinore started laying pipe for a geothermal district heating system on July 27th. In two days, 990 feet have been installed, with 2200 being the completed length. Work is being done only on Saturdays in order to utilize city owned equipment.

6, 7.15 Test Well for Cogeneration/Aquaculture Completed at Ft. Bidwell: On the Fort Bidwell Reservation, a test well has been completed which produces 380 gpm at 205°F under artesian flow. Current plans are to deepen and complete it as a production well. In order to expand the aquaculture facility, more cold water is required. A good flow of cold water was encountered at 1000 feet and a cold water production well is planned. If completed as anticipated, the new wells could provide 260 kW of power generation and provide for raising more than 40,000 catfish.

6, 7.16 Bridgeport District Heating Injection Well is Being Drilled: At Bridgeport, an injection well is being drilled to 1800 feet to dispose of water from a 15 building geothermal district heating system. A 2000 foot geothermal primary pipe carries 185°F water to a heat exchanger and the injection well. Bridgeport officials are considering drilling the production well deeper to obtain greater than 205°F water for possible cogeneration.

State and DOE Activities

6, 7.17 Binary Geothermal Plant Prepares For Start-Up: The world's first commercial scale binary geothermal power plant is undergoing tests in preparation for start-up during the next few weeks in California's Imperial Valley.

If successful, binary technology being demonstrated at the $188 million Heber project by a group led by San Diego Gas & Electric Co. could help quadruple potential U.S. geothermal power capacity. It exploits in a low cost, environmentally benign way a moderate temperature resource that accounts for about 80% of U.S. geothermal reservoirs.

Chevron Geothermal Co. and Unocal Corp. share interests equally in the Heber unit and will provide geothermal brine production and reinjection facilities for the project, with Chevron acting as operator. Fluor Engineers Inc.'s power division handled plant engineering, design, and procurement. Dravo Constructors Inc. oversaw plant construction.

The U.S. Department of Energy is funding 50% of the Heber project construction and 2-year demonstration phase operations. Electric Power Research Institute 10%, and the balance by SDG&E, California Department of Water Resources, Fluor Engineers, Imperial Irrigation District, Pacific Gas & Electric Co., Southern California Edison Co., and the State of California.

Western U.S. operators have built other moderate temperature geothermal projects, including pilots in the Imperial Valley. But the Heber geothermal plant will be the first to use a nonsteam approach on a scale - about 50,000 kw - thought to be optimum for commerciality for moderate temperature projects.

Production also could stimulate interest in a new arena of third party, small-scale, power projects by resource producers and developers. Such projects have taken advantage of government tax and regulatory incentives to create minibooms in cogeneration and alternate power sources.

The Heber project also will be the first commercial scale project on stream to tap one of the world's largest geothermal resources, California's Imperial Valley.

The Imperial Valley geothermal resource, including speculated deeper reservoirs, has been pegged at as much as 30 million kw of electrical power capacity for 50 years. Established potential of the Heber anomaly alone could support perhaps 500,000 kw of long term power capacity. (Oil & Gas Journal, June 24, 1985).

REGION X

Idaho

Industrialization Activities

6, 7.18 Flint Greenhouses to Double Size: Flint Greenhouses of Idaho will be doubling the size of their facility. Geothermal water at 112°F from a new well will be delivered to the expanded facility that is located near Buhl. The greenhouse provides wholesale seasonal potted plants. (L. V. Street, IDWR)

6, 7.19 M&L Greenhouses Adds a New Well: M&L Greenhouses of Idaho, operated by Mike Archibald, added a new 112°F well with a 54 psi shut-in pressure to their facility, also near Buhl. A new greenhouse is under construction where bedding plants are sold wholesale. (L. V. Street, IDWR)

6, 7.20 Bliss Facility Rearing Exotic Mushrooms: Bliss Valley Farms, Inc. is producing an exotic mushroom, pleurotis, utilizing cellulose media such as wood or straw and a 151°F geothermal resource. Current production is about 125 pounds a day, and if the market develops positively, about one million pounds a year could be grown. The developers plan to double their current capabilities this fall. (L. V. Street, IDWR)

OREGON

Industrialization Activities

6, 7.21 Lakeview Grants Franchise to Pursue Geothermal Development: The City of Lakeview, under the coordinating efforts of John Cogar, has awarded a franchise to a joint venture group to proceed with the possible development of a district heating system. The franchise allows the rights to use public land in determining, within a six month period, geothermal resource capability and the potential geothermal energy loads. There is

a targeted operational date of one year. The joint venture is made up of Brown, Vents, and Associates, San Fransisco, CA; Applied Power Technology, Menlo Park, Ca; and Gertz, Juncal and Associates, Idaho Falls, ID. (Alex Sifford, ODOE)

6, 7.22 Newberry Drilling Proposed: Further exploration drilling in the vicinity of Newberry Volcano may result from a proposal being considered by the BLM and Forest Service. GEO Operator Corporation has proposed to drill three 4,000 ft. temperature gradient holes on leases in the Fort Rock Ranger District. The holes will be located on the north, south, and east sides of the volcano. The BLM recently issued a negative environmental declaration for the drilling. (GRC-PNC Newsletter, July - August, 1985)

6, 7.23 Drilling Near Crater Lake May Go Forward: The temperature gradient drilling proposed by California Energy Company on leases adjacent to Crater Lake National Park has been cleared by federal agencies, and may begin in late summer or early fall 1985. (GRC-PNC Newsletter, July - August, 1985)

State Activities:

6, 7.24 ODOE Begins Updating State Energy Plan: The Oregon Department of Energy's Planning Division has announced its upcoming revision of the State's Energy Plan, and is seeking comments from interested persons about issues to be considered and public involvement procedures to be used over the next year as the new plan for 1987-89 takes shape. In its original form for 1985-87 the State Plan did not include any long-range projections of geothermal power generation, but did contain short-term policy support for continuing resource assessment, demonstration projects, and elimination of institutional and market constraints. To get involved contact Hussein Hassoun, ODOE, 503/378-8278. (GRC-PNC Newsletter, July - August, 1985)

6, 7.25 Oregon Deregulates Geothermal District Heating: In response to investor-owned utility urging, the Oregon Public Utility Commissioner introduced, and the 1985 Oregon Legislative Assembly enacted, House Bill 2202 which completely removes geothermal district heating from PUC oversight. Under the terms of the new legislation geothermal non-electric systems are clearly not defined as "public utilities" and, therefore, excluded from PUC rules and regulations. The legislation also exempts non-electric uses of solar, wind, and biogas. (GRC-PNC Newsletter, July - August, 1985)

WASHINGTON

State Activities

6, 7.26 North Bonneville Pursues Pump Testing: The City of North Bonneville, Washington has asked the Washington State Energy Office for financial assistance to complete the next phase of its resource confirmation program. The City hopes to pump test its 2,000 foot production well that was completed in 1981. The well, which produces artesian fluids at approximately 92°F, is intended to serve a district heating and cooling system which is also the subject of a concurrent financial assistance application to Bonneville Power Administration. (GRC-PNC Newsletter, July - August, 1985)

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GENERAL

9.1 Geothermal Programs Review Held in Washington, D.C.: Donna Fitzpatrick, Assistant DOE Secretary for Conservation And Renewable Energy, speaking to a gathering of about 70 contractors assembled for a review of DOE geothermal programs at the Sheraton Washington Hotel in the nation's capital on September 11, foresees bright future for geothermal energy both in the U.S. and worldwide. It's a "here and now" renewable resource, with a technology base that is environmentally safe, Fitzpatrick said, and U.S. is leading in advances in technology, furthering use of steam and hot water around the world.

Looking to some near future developments, Fitzpatirick praised SDG&E's Heber binary project, at 45 MW the largest such conversion plant in the world, already running at partial power in the Imperial Valley, California with the formal dedication set for December 6, 1985. She also announced that the Salton Sea Scientific Drilling Project, on the leading edge of technology to explore and map geothermal resources in the Niland, California area, will begin its drilling program in early October. Also, the DOE hot dry rock experiment, having accomplished hydraulic connections at its Fenton Hill site in New Mexico, will proceed with a surface conversion facility in the near future. The Senate Appropriations Committee, in passing the DOE FY-86 budget, already has approved $425,000 to begin a commercial HDR project in the southern Rocky Mountains area and has directed DOE to get out a RFP.

On an upbeat note, Fitzpatrick reiterated that geothermal continues to be a part of the overall energy policy of the U.S. While the budget for research is always a problem, she felt that the geothermal program manages to get a respectable share, and will certainly contribute to a long term payoff. (Geothermal Report, 10-1-85).

9.2 GRC International Convention a Success: A tremendously successful International Symposium on Geothermal Energy was held by the Geothermal Resources Council on the big island of Hawaii last month in terms of attendees variously estimated at between 600 and 700. So many paid-up registrants furnishes about 25 percent of the GRC annual $600,000 operations budget, its executive director David N. Anderson recently reported. Various courses, symposia, membership dues, etc. make up the rest.

Donna Fitzpatrick, Assistant DOE Secretary for Conservation and Renewable Energies, participated ex tempore in an opening day oratory and heard such notables as Philippines energy minister Geronimo Z. Velasco, Rep. Daniel Akaka (D-HI) and GRC president Harry J. Olson put geothermal's best foot forward.

How solar is geared up to retain its special tax credits and geothermal isn't was addressed in a special session by Ben Yamagata, who said lobbying effort would be required for coming tax overhaul legislation. The lobbyist would be Yamagata's Washington law firm, Van Ness, Feldman & Sutcliffe, which could unlimber the persuasive clout of Bill Van Ness, formerly principal aide to the late Senator Henry Jackson in his presidential bid. Anderson said the GRC had studied the possibility of a sister group to carry on lobbying, and found that an affiliated group could be set-up legally in which the affiliate might come to GRC and use its membership files, offices and support facilities. (Geothermal Report 9-16-85).

9.3 USGS Sets Mineral and Energy Forum: The USGS will hold its second annual V. E. McKelvey forum on mineral and energy resources on February 5 and 6, 1986 at the Regency Hotel in Denver, Colorado. Among the USGS activities to be discussed are evolutions of certain basins, continental U.S. basin heat history map, north American accredited terrains and thrust belts, geothermal energy sources of the Cascade Range and Salton Sea, and other subjects. For further information contact Training and Research Assistance Corporation, P.O. Box 6100, Denver, Colorado 80206, telephone 303/393-7061.

9.4 GRC-PNW Two Day Meeting a Success: The recent two-day workshop held September 24 and 25 in Portland, Oregon is considered to be very successful. About 70 persons representing regulators, developers, Federal, State and other agencies, industry and conservation groups experienced excellent dialogue on institutional and legal issues. Spearheaded by Dr. Gordon Bloomquist of the Washington State Energy Office, the Pacific Northwest Section of the GRC sponsored the meeting that covered local experiences in Washington, Oregon and California. (Gordon Bloomquist, WSEO)

9.5 Substantial Progress has Been Made on Refining Erosive-type Drilling Equipment: Improved cavitating nozzles have been developed as part of a program to increase the rate of penetration of drill bits in deep-hole oil and gas wells. The self-resonating jets produced by the new nozzles outperforms those produced by both conventional drill-bit nozzles and basic cavitating nozzles in terms of incipient cavitation number, amplitude of pressure fluctuation, rock cutting and cleaning of chips from the hole bottom.

Tests were conducted on individual nozzles at full scale and on models at small and very large scale with air, water, and drilling mud as the working fluid. Full-scale drill bits were also tested in these three fluids. Analytical models were developed for predicting the performance of Organ-Pipe Cavijet nozzles and central-vortex-generating nozzles.

Several self-resonating nozzle systems were found to produce passive oscillations that cause the jet to form discrete ring vortexes, thereby yielding incipient cavitation numbers two to six times higher than those of either conventional Cavijet nozzles or typical drill-bit nozzles. In rock-cutting trials, higher incipient cavitation numbers have been correlated with greater erosivity.

The Organ-Pipe Cavijet system proved to be adaptable to the physical form of existing bits and is the most promising concept for future bit design. The self-resonating nozzles will clean chips from a simulated hole bottom at a nozzle pressure drop of only about 25 percent that of standard nozzles. For further information, contact: J. R. Kelsey, Geothermal Well Technology Division, Sandia National Laboratories, Albuquerque, NM 87185, telephone 505/844-6968.

REGION VI

NEW MEXICO

Industrialization Activities

9.6 Baca Plant May be Sold to Mexico: Mexico's Commision Federal D Electricidad is close to signing a contract with Public Servi of New Mexico to purchase the 50 MW Baca direct flash plant, most of its main components remaining at the site, after PS Unocal and DOE terminated the project in early 1982. CFE to build a 50 MW plant at Los Azufres, which has practi same steam conditions, 600°F plus bottom hole temperat a steam inlet temperature of about 340°F, as Baca's Caldera reservoir, and can use without major modif Baca's major components.

Jack Maddox, Baca project manager for PSNM, confirmed that negotiations are close to being consummated with CFE, which would cover about $12.4 million of plant equipment, including Bechtel's design and engineering drawings, the General Electric turbine-generator, most of the power block equipment, controls, condensers and circulating water system. Maddox said sale would not include the cooling towers, building to cover the power-plant and other miscellaneous equipment.

He expects the sales contract to be signed early this month and anticipates the first shipment of equipment in the November-December time frame, with succeeding shipments early next year. CFE wants to start construction at Los Azufres next may or June, according to Maddox. The sales contract probably would have already been signed, except for a question by CFE on performance warranty of the plant. (Geothermal Report, 10-1-85).

REGION IX

NEVADA

State Activities

9.7 Review of 1984 Mineral Industry in Nevada Available: "The Nevada Mineral Industry 1984," published by the Nevada Bureau of Mines and Geology, is now available. Special Publication MI-1984 is the sixth in a series of annual reports that describe mining, oil and gas, and geothermal activities in the State. the publication reviews metals and industrial-minerals exploration, development, and processing, oil and gas exploration and production, and geothermal exploration and development during 1984. A list showing production, reserves,

host rocks, and ages of bulk-mineable, precious metal deposits in Nevada is also included. It may be purchased for $3.00 at the Sales Office (Room 310 in the Scrugham Engineering-Mines Building on the University of Nevada-Reno, Reno, NV 89557-0088; please add 10% postage and handling). For further information contact Arlene Kramer, 702/784-6691.

9.8 Gravity Data for McDermitt 1 x 2° Sheet Available: A 1:250,000-scale gravity map of the McDermitt sheet is now available at the Nevada Bureau of Mines and Geology. This map is the latest in a series of maps published at the 1:250,000 scale to provide statewide coverage of gravity data. With the publication of this map, gravity data are now available for about 80% of Nevada.

Nevada Bureau of Mines and Geology Map 86, "Bouguer Gravity Map of Nevada--McDermitt sheet," may be purchased for $5.00 at the Sales Office or by mail as noted in the previous item.

9.9 Geology of Northern Nye County Published: The Nevada Bureau of Mines and Geology has published a new bulletin, "Geology of Northern Nye County, Nevada." Written by U.S. Geological Survey geologists Frank J. Kleinhampl and Joseph I. Ziony, Bulletin 99A describes in detail the stratigraphy, structural geology, glacial geology, and geomorphology of northern Nye County. A 1:250,000-scale geologic map accompanies the text. A separate volume describing the mineral resources of northern Nye County was published by the Nevada Bureau of Mines and Geology as Bulletin 99B. With the publication of Bulletin 99A, a series covering the geology and mineral resources of Nevada's 17 counties is now complete.

Bulletin 99A, "Geology of Northern Nye County, Nevada," may be purchased for $13.00 at the Sales Office or by mail as noted previously.

REGION X

OREGON

Industrialization Activities

9.10 Recent Lease Applications Noted for Oregon: The following are recent Federal Geothermal Lease Applications and well locations filed in the State of Oregon.

Lease Applications:

Cal Energy, Santa Rosa, CA
Jackson County, OR 37s-4e, 1920 acres

Portland General Electric, Portland, OR
Deschutes, OR 17s-9,10e, 2254 acres
Deschutes, OR 17s-10e, 6283 acres

Thermal Power Co., San Francisco, CA
Marion County, OR 6s-7,8e, 2738 acres
Marion County, OR 9s-8e, 2247 acres

Well Locations: (State Permit Pending)

GeoOperators Corp. N-1, SE Sec. 25, 22s-12e
Newberry Volcano Area
4000 ft geothermal well

GeoOperators Corp. N-3, NW Sec. 25, 20s-12e
Newberry Volcano Area
4000 ft geothermal Well

GeoOperators Corp. FV-1, NW Sec. 11, 19s-45e
Vale Area
10,000 ft geothermal well (Paul Lienau, OIT)

9.11 Drilling Near Crater Lake Postponed: Winema National Forest has announced that the drilling of four permitted wells to 4000 feet near Crater Lake has been delayed until the summer of 1986. Cal Energy Company of Santa Rosa had planned the drilling program for the summer of 1985. (Paul Lienau, OIT)

9.12 Geothermal Waste Water Heating System Proposed in Klamath Falls: The city of Klamath Falls has contracted with Balzhiser/Hubbard & Associates to design a recovery/reuse system for many wells discharging into open drainage in the Mills Addition. Nearly 100 geothermal wells discharge into open drainage in the Klamath area and it is estimated about 1000 gpm will be available for space heating homes and commercial buildings in the Mills Addition area. The siting of an injection well is planned for final disposal of the reused water. This will assist well owners in complying with the new City geothermal Resource Management Act which requires that all surface discharge be eliminated within five years. (Paul Lienau, OIT)

WASHINGTON

9.13 State and DOE Activities

The City of Olympia has been selected by DOE for funding a study to determine the feasibility of installing a district heating and cooling system.

DOE is anteing up $32,000 and the state is contributing $5,000 for a 9-month study, which involves use of the capitol city's waste water treatment plant having 15 MW capacity. The Washington State Energy Office says the resource is more than adequate to serve the needs of the 200 block area on the capitol campus, the commercial business district and a downtown low-income housing area.

Equally important, the Olympia system would save tax dollars by providing a low-cost source of energy for state buildings. In addition to study funding, a number of unspecified Scandinavian engineering and manufacturing firms have expressed interest in participating in system design and installation. Use of high-efficiency heat pumps is the key to the proposed project.

If findings are favorable, WSEO geothermal specialist Gordon Bloomquist said "We intend to follow up with a detailed engineering, financing and design study for a system which will provide low-cost reliable energy, an attractive incentive to businesses located in the capitol district." Democratic Governor Booth Gardner has endorsed the project in his economic development plan for the state. (Geothermal Report, 9-16-85).

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GENERAL

10.1 Renewable Energy Lobby Demands its Fair Share: Federal subsidies to energy producers totalled $44 billion in 1984, or $523 for every household in the nation, according to a report this week by the Center for Renewable Resources. The study is intended to influence the House Ways and Means Committee, now working on a tax reform package. The Reagan Administration's tax proposal would keep many tax subsidies for the heavy energy industries but scrap tax breaks for solar and renewable energy and energy conservation. The Center for Renewable Resources is an arm of the Solar Lobby.

"More than $41 billion of the total $44 billion 1984 subsidy was provided to mature energy technologies which long ago reached commercialization," the study claims. Electric utilities had the lion's share of the subsidies, largely through such tax breaks as the investment tax credit and accelerated depreciation. Nuclear power had a $15-billion subsidy in 1984; the oil industry, $8.5 billion; natural gas, $4.6 billion; coal, $3.4 billion; hydro, $2.5 billion; and fossil electric plants, $5.6 billion.

In contrast, non-hydro renewable energy had $1.7 billion in federal largesse last year, while energy efficiency measures had $864 million, says the report, The Hidden Costs of Energy. "By disrupting competition and favoring high-cost energy supplies," the report concludes, "the subsidies rob consumers of the opportunity to choose the most efficient energy options . . . The subsidies also perpetuate the pattern of inefficiency.

The present structure of subsidies is tied to an unspoken energy policy of replacing dwindling oil supplies with electrification of the economy and a 'second coming' of nuclear power in the 1990s."

The Solar Lobby says it favors gradual elimination of all energy subsidies. If that fails, however, the trade group wants its share of the public purse. Rep. Cecil Heftel (D-Hawaii) is leading the fight in the House Ways and Means Committee to save renewable energy tax credits, due to expire this year. Just in case tax reform goes nowhere, Heftel has introduced separate legislation in the House to extend the tax credits. Senator Mark Hatfield (R-Ore.) has done the same in the Senate. (The Energy Daily 10/18/85)

10.2 GRC Hires Washington Law Firm to Set Up Lobbying Organization: At its October 22 board meeting in California, Davis-based Geothermal Resources Council decided to proceed with plans to expand its operations to include lobbying for the geothermal industry. The first step is hiring the Washington, D.C. law firm of Van Ness, Feldman, Sutcliffe & Curtis to implement their decision. Attorney Ben Yamagata of the firm, which represents major companies and industries on Capitol Hill, including coal and geothermal, has been assigned responsibility for guiding the birth of what will be called Geothermal Resources Association.

The decision to establish the group was facilitated in part by funding from such major GRC members as California energy, Chevron, Union Oil and Thermal Power. Contributions may also be forthcoming from such companies as Magma and PG&E. As a result, papers required for the move probably will be filed within weeks. (Geothermal Report 11/1/85)

10.3 Federal Lease Acreage Exceeds 2.5 Million Acres: As of January 23, 1985 there were 2,547,952 acres in eight western states covered by Federal Geothermal Leases. There were 218 non-competitive leases covering 365,790 acres and 143 competitive leases covering 254,814 acres in California.

State	Non-Competitive (acres)	Competitive (acres)
Nevada:	615,688	79,244
Oregon:	611,701	66,402
Utah:	118,070	52,623
New Mexico:	71,743	59,598
Washington:	43,949	-
Idaho:	23,583	5,901

Several million acres are under lease from private owners or states themselves. (Donald F. X. Finn, Geothermal Energy Institute, NATCHEZ, MS)

REGON VIII

UTAH

Industrial Activities

10.4 Power Plant Dedicated at Cove Fort: On 19 September 1985, Mother Earth Industries, Inc. (MEI) officially dedicated its new power plant located at Sulphurdale near cove Fort, Utah. The dedication was attended by more than 200 persons, most of whom had some part in the construction of the plant and were local residents.

Speakers included the Honorable Norman H. Bougerter, Governor of Utah; Fred Finlinson, State Senator; James Ferguson, Mayor of

the City of Provo; Wayne Portanona, President, Mother Earth Industries and benedictions by the Reverend Richard Van Wely and LDS Church Bishop Noel Robinson. Opening remarks were made by Lucian Bernicki of ORMAT Systems, Inc.

The power plant consists of four ORMAT modular, binary units with a capacity of 0.8 MW each or 3.2 MW total. They are housed in a single building which also contains the computerized unit controls.

The ORMAT units operate on dry steam from two production wells. the combined production from both wells is in excess of 100 tons or 2,000,000 lbs. per hour. This production could sustain from 7 to 10 MW, depending on the type of generation system selected.

The City of Provo has a power purchase contract with MEI. This agreement includes the right to take the first 200 MW developed by MEI at Sulphurdale. Power is being wheeled to Provo via the Utah Power and Light power grid.

This area in Beaver and Millard Counties, near the old Cove Fort and the Sulphurdale mine, has been the focus of extensive geothermal exploration since the middle 1970s. The major portion of the land is federal managed by the Bureau of Land Management and the Forest Service.

From 1977-1979, Union Oil Company of California drilled four deep exploratory wells on some 11,000 acres that Union has leased. After completing and testing the wells, Union Oil Co. was able to confirm an unpressurized hot water resource of 330-350°F. Union decided that the property was not of adequate potential to be retained for future development, and transferred the leases to Forminco, Inc., the adjacent mining company at Sulphurdale.

In August, 1980, Mother Earth Industries, Inc. acquired the lease rights from Forminco. In the fall of 1982, MEI conducted a series of well-tests on Union's well 42-7, including the opening up of a suspected production zone sealed off by Union between 2100-2800 feet. This production zone proved to be substantially hotter in temperature than recorded by Union, and displayed excellent production capabilities. Encouraged by the well test results, MEI proceeded to evaluate the economics of drilling additional wells that would tap into the intermediate depth zone of 350-360 degrees hot water identified by MEI's well-testing program.

In October of 1983, MEI drilled its first production well and encountered a highly-pressurized dry-steam reservoir at less than 1200 feet depth. A major uncontrolled well blow-out occurred. The well blew continuously until abandoned twenty four days later by a team of blow-out specialists. In January and May, 1984, MEI completed two dry steam production wells and conducted a total of 60 days of well tests. ORMAT Turbines, the maker of MEI's turbo generator units has rated the output of the 2 wells at 8.4 MW gross output. This dry steam discovery marks the fifth such discovery in the world, and the second geothermal resource in Bever County, Utah.

MEI's reservoir engineers, ThermaSource, Inc., have prepared an economic evaluation which details the proven field as 25 MW, with the possibility of 125 MW of potential. The lifetime expectation for the field is 20 years minimum. The United States Geological Survey estimates the Cove Fort field as having a 330 MW potential.

MEI through its close associations and partnerships with Provo and other municipal governments will continue to develop the resource in incremental stages that are technologically feasible and economically justifiable. The field was developed without any federal money. (GRC Council Bulletin, November 1985)

REGION IX

CALIFORNIA

Industrialization Activities

10.5 PG&E Celebrates The Geysers' 25th Anniversary: Twenty-five years ago, the start-up of Unit 1 at The Geysers marked the entry of Pacific Gas and Electric Company and the nation into the production of electricity from geothermal steam.

Governor George Deukmejian, PG&E and Unocal Corporation celebrated the 25th anniversary of commercial power operation at The Geysers, the world's largest geothermal facility, located 90 miles north of San Francisco in Somona and Lake Counties.

The ceremony was hosted by Frederick W. Mielke, Jr., PG&E chairman and chief executive officer. Mielke, the Governor and Fred L. Hartley, chairman and president of Unocal, delivered addresses at the ceremony. The Governor, Mielke and Hartley also unveiled a special plaque to mark the event.

Mielke said that 25 years ago PG&E's "dedication of a small, 11,000 kilowatt geothermal plant might have seemed of small significance in terms of size. But we know that it was an epoch-marking event, because that plant demonstrated what could be done here. It was the forerunner of a series of 19 geothermal plants built by PG&E, a geothermal generating complex that is the largest in the world. The latest two plants, Units 16 and 20, came into commercial operation on October 18 - six weeks ahead of schedule and each 30 million dollars under budget."

The Geysers complex has grown steadily since 1960, when PG&E's 11,000 kilowatt Unit 1 started commercial operation. The amount of steam supplied by Unocal is more than 20 times what it was in 1967, when Unocal became field operator at the Geysers.

In 1973, The Geysers surpassed the Larderello project in Italy as the world's largest geothermal power plant complex.

With the addition of units 16 and 20, PG&E operates 19 units at The Geysers, capable of generating about 1.4 million kilowatts of electricity. By 1988, PG&E and Unocal expect to be generating 1.5 million kilowatts of electricicy at The Geysers, enough to meet the needs of about 1.5 million people.

10.6 Salton Sea Geothermal Test Spudded: Bechtel Corporation has spudded a well that is expected to reach one of the hottest geothermal reservoirs in the U.S.

Under a $6.13 million contract with the U.S. Department of Energy, Bechtel is drilling toward 11,000 feet near the Salton Sea in California's Imperial Valley. More than 2,000 feet of the hole will be cored.

The well will probe a region where geological conditions allow magma to approach the surface, heating reservoirs of highly saline, mineral rich brine to more than 700°F. The well will be the first U.S. drilling project to encounter the combination of such extreme temperatures and salinities at that depth, Bechtel says.

Salton Sea field is potentially one of the world's most extensive reservoirs of geothermal energy. If its heat were converted to electricity, it could provide for a city of 5 million people for 100 years, scientists estimate.

Drilling will continue through March 1986. A 6-month standby period will follow to allow scientists to monitor temperature and pressure changes in the well and take additional samples.

Thirty-seven groups of scientists from the U.S., Japan, Canada, Great Britain, Australia, and Belgium will study data collected during drilling and testing.

They will investigate geochemistry, petrology, geophysics, and activity of microorganisms in hot, saline environments.

They also plan to study mechanisms of ore formation from geothermal brine to gain information for future studies of the potential for commercial mineral recovery.

Kennecott Corp., lessee, has the option to pursue commercial testing after the scientific project is completed.

Salton Sea Scientific Drilling Program is the first major enterprise of the Continental Scientific Drilling Program, a joint research effort by DOE, National Science foundation, and the U.S. Geological Survey (Oil & Gas Journal 10/28/85)

10.7 Two New PG&E Plants to Start Operating: The two Newest PG&E Plants at The Geysers began commercial operation on October 18, about 6 weeks ahead of schedule, lifting the utility's total capacity there in Sonoma and Lake Counties to 1,363,000 KW net.

George A. Maneatis, PG&E executive vice president for facilities and electric resources development, gave the good news that the pair of plants were completed at $62 million under budget. For Unit 16 located in Lake County, the expected total cost is $132 million, or $30 million less than the pre-construction estimate of $162 million. For Unit 20 in Sonoma County, final cost is expected to be $117 million, $32 million less than $149 million estimate. Unit 16 per installed KW cost is $1,168 and Unit 20 is $1,035. (Geothermal Report 11-1-85).

10.8 Cal Pines Project Dedicated: Dedication ceremonies for a geothermal project at the California Pines Lodge near Alturas were held November 1, 1985. Glenn Matthiew, Cal Pines Community Services District board president, said that the project has been under research and construction the past 12 months. The district received a $22,050 grant from the California Energy Commission to reactivate the hot water well to supply preheated water to the Cal Pines Lodge, motels and pools.

10.9 PG&E Receives Go-Ahead for Largest Geothermal Unit at The Geysers: Pacific Gas and Electric Company received permission from the California Energy Commission (CEC) to build what will be the largest electric generating unit at The Geysers, PG&E's complex of geothermal power plants in Sonoma and Lake Counties.

The Application for Certification (AFC) approved by the CEC allows PG&E to build and operate a 140,000 kilowatt electric generating unit in Lake County, about two miles west of Pine Grove, on the northwest slopes of Cobb Mountain. The plant will be known as Unit 21 and will be the 20th unit of the complex.

Scheduled to begin commercial operation in April 1988, Unit 21 will cost an estimated $210 million. Construction is expected to begin in July 1985. (PG&E)

State Activities:

10.10 New Law Requires Productive Resource for Power Development: The California Energy commission (CEC) is required in the future to make assurances in writing that sufficient steam is available before authorizing construction of geothermal electric generation plants, under a bill that quietly passed through Legislature late in session that closed in mid-September. Bill has been signed by Governor Deukmejian.

NEVADA

State Activities

10.11 Two Geologists Join NBMG Staff: Keryl Fleming and James G. Rigby recently joined the staff of the Nevada Bureau of Mines and Geology.

Fleming, who is a Mackay School of Mines graduate, received her M.S. in mineral economics from the University of Arizona in 1983. She worked as a geologist for Bear Creek Mining Co. in Spokane, Wash., and for Anaconda Minerals in Reno before coming to NBMG. Fleming is responsible for designing geologic data bases for the Bureau as well as accessing many of the computerized data bases of the U.S. Geological Survey, the U.S. Bureau of Mines, and other organizations.

Rigby, an engineering geologist, will be involved in geologic mapping as well as conducting studies on earthquakes and other geologic hazards in Nevada. Prior to joining the NBMG staff, Rigby was a petroleum geologist for Arco Oil and Gas Co. in Texas. He also worked for the Washington Division of Geology and Earth Resources where he participated in several geology studies and mapping projects, including the area destroyed by the 1980 eruption of Mount St. Helens. Rigby received his B.S. in geology in 1969 from the University of Akron and his M.S. in geology from the University of Idaho in 1982. He also served as captain in the Air Force after graduation from the University of Akron. (NBMG 10/28/85)

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11.1 Stanford Geothermal Workshop Set for January 21-23: The Eleventh Annual Workshop will be conducted January 21-23 as part of Stanford's Geothermal Program. Technical Sessions will include well testing, fractures, reinjection, modeling, geosciences, field studies, logging, reservoir engineering, and special sessions. Information can be obtained from Paul Kruger, Stanford Civil Engineering Department, telephone 415-497-4123 or 4744.

REGION VIII

UTAH

Industrialization Activities

11.2 Greenhouse Development Expansion Planned at Newcastle: Troy Hygro currently has one acre of greenhouses producing tomatoes and cucumbers. Negotiations are underway for an additional 48 acres of land which will result in 15 acres of 128 feet by 135 feet double poly quonset type greenhouses. Forced air type heating systems are used with plate and frame heat exchangers to isolate the geothermal fluids. A geothermal well produces 246 gpm at 226°F and the developers will purchase a second well. Waste geothermal water is disposed of in a percolation pond. In 1982 the Geo-Heat Center examined the feasibility of using the local resource for greenhouse space heating and electrical power generation. (Paul Lienau, OIT 12/13/85)

REGION IX

CALIFORNIA

Industrialization Activities

11.3 Heber Plant Construction Completed: A group of developers recently finished construction of a $130-million geothermal plant in California's Imperial Valley. The Heber geothermal plant, near El Centro, will generate 52 megawatts of power. Financing construction were Chevron Geothermal Co., Unocal Geothermal Division, Dravo Corp. and Centennial Energy Inc. As operator of the geothermal resource, Chevron is responsible for the nine production wells, eight injection wells and pipelines; as operator of the plant, Dravo is responsible for the generation and delivery of electricity to Souther California Edison.

The "dual-flash" process used at the Heber plant involves delivery of hot (360°F) water to the power plant from wells drilled 4,500-10,500 feet deep. Heber's geothermal reserves were first discovered in 1947, during unsuccessful oil drilling in the area. The 7,400-acre hot brine reservoir may be large enough to provide up to 500 megawatts of electricity once it is fully developed - the equivalent of a 250-million-barrel oil field. (The Energy Daily 11/13/85)

11.4 First Direct Flash Plant Closed Down: Unocal Corp. will close an uneconomic geothermal power plant in California's Imperial Valley. "Due to the declining energy market, it is not economically feasible to continue operating this small developmental project," said Carel Otte, head of the company's geothermal division. Unocal is the world's largest geothermal energy producer.

The 10-megawatt plant has been operated for five years by Southern California Edison under a partnership with Unocal, the Los Angeles Department of Water and Power and the city-owned utilities of Burbank, Pasadena and Riverside. The project started operations in mid-1980 and has generated more than 134 million kilowatt-hours of power.

"The experience gained at the plant led to the development of new technology and materials which resist corrosion and reduce scale build-up in pipes and other equipment caused by this saline resource," Otte said. "Many of the advances were incorporated into the technology at the Salton Sea geothermal plant near Midland, where research continues." (The Energy Daily 11/07/85)

11.5 Naval Weapons Center at China Lake Considering District Heating: A Known Geothermal Resource Area, the Coso KGRA, exists on the north range of this base. Brigham Young University's Department of Mechanical Engineering is undertaking the design of a geothermal district heating system for 200 buildings on the base. (Paul Lienau, OIT 12/13/85)

11.6 District Heating Possibilities Are Being Examined at Alturas: A 903 foot constant temperature gradient hole at 7.5°F/100 feet has encouraged local officials at Alturas to consider district heating. The Geo-Heat Center is involved in a feasibility study for the space heating of schools, county courthouse complex, hospital and a commercial area which will help in a decision to determine where and how deep to drill an exploratory well. Oil and electricity are currently used for space heating in Alturas. (Paul Lienau, OIT 12/13/85)

NEVADA

State Activities

11.7 NBMG 1985 Publications List Available: The Nevada Bureau of Mines and Geology has published its 1985 list of available

publications. The catalog contains new material published by the Bureau as well as a cumulative list of all available NBMG publications on Nevada's geology and mineral resources. A separate list of out-of-print publications is also available.

The 1985 list of available publications and the out-of-print publications list are available free from the Sales Office (Room 310 in the Scrugham Engineering-Mines Building at the University of Nevada-Reno campus) or by mail (Nevada Bureau of Mines and Geology, University of Nevada-Reno, Reno, NV 89557-0088). For further information, contact Arlene Kramer: 702-784-6691. (NBMG 12/02/85)

REGION X

ALASKA

11.8 Applications Requested for Mt. Spurr Area Lease Sale: The Alaska Department of Natural Resources, Division of Oil and Gas, is requesting applications and public comment for a proposed geothermal lease sale in the Mt. Spurr area on the west side of Cook Inlet. The proposed sale area is entirely within the Kenai Peninsula Borough, northwest of Trading Bay, and approximately 40 miles west of Tyonek. On May 17, 1983, 16 tracts in this area were offered for lease in Competitive Geothermal Lease Sale 1 (Mt. Spurr). Only one tract (#9) received a bid. This tract is currently under lease.

The area of call comprises approximately 2,640 acres to the east of Chakachamna Lake between the southern flank of Mt. Spurr and the Chakachatna River.

Legislation providing for geothermal resource development was enacted by the Alaska Legislature in 1980. Leasing regulations were promulgated in July 1982 and revised in May 1983. The call

for applications does not constitute a final decision by the Commissioner to dispose of the geothermal interest in state land, but will initiate the process. (Alaska Department of Natural Resources 11/21/85)

OREGON

Industrialization Activities

11.9 Geothermal Industrial Park Being Considered for Olene Gap: Trendwest Development Company has announced the purchase of 4,000 acres near Olene, 15 miles SE of Klamath Falls, with the intent to develop an industrial park. The park could accommodate agricultural and industrial processes reliant on heat which geothermal energy could provide. The land was purchased for $425,270.

CH2M Hill, Inc. conducted a study in the area that identified wells with temperatures ranging from 131 to 224°F. High temperature gradients in other wells indicate the probability that water at 250 to 300°F could be available at deeper thermal zones. Trendwest is particularly interested in developing some type of agricultural process that would use local products. Potato processing, malting, pelletizing or cubing alfalfa and dehydrating garlic and onions (now shipped from the Tulelake area to Gilroy, California) are among the possibilities. (Paul Lienau, OIT 12/13/85)

11.10 Lakeview Geothermal District Heating Information Updated: Lakeview Thermal proposes to develop geothermal district heating for the city of Lakeview. Lakeview Thermal is a joint venture between Brown, Vence and Associates, San Francisco, and Applied Power Technology, Susanville, California. Lakeview Thermal agreed to a six month period to "put up or shut up" in bringing a geothermal well on line. The company will spend about $2 million in its first phase development. Within the next half year the company wants to determine if a well in Bullard Canyon

can provide the needed volume at necessary temperatures. If not, operations will probably shift to Hammersley Canyon north of Lakeview, which would mean higher costs because of a mile long pipeline.

The first phase heating system will serve the uptown core area, including the town's to-be built emergency services building, Elks Lodge, four schools, Lake District Hospital, motels, Fremont National Forest Supervisor's Office and the Bureau of Land Management Office. Future development includes Hunter's Lodge and the Goldmohr Terrace areas. (Paul Lienau, OIT 12/13/85)

WASHINGTON

State Activities

11.11 WSEO Enters into Joint Venture with Swedish Council: The Washington State Energy Office has signed a joint venture contract with the Swedish Council for Building Research to revise the HEATPLAN software program. HEATPLAN, previously developed by WSEO, is designed to aid in the evaluation of the feasibility of district heating systems. This venture calls for revisions of the economic and geothermal resource modules. The IBM compatible program, to be completed by the end of June 1986, will be made available in TURBO PASCAL language. Gordon Bloomquist, geothermal specialist for WSEO, is serving as the project manager for the task that will be primarily performed in Sweden. (Gordon Bloomquist 12/13/85)

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REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
DECEMBER 1985

GENERAL

12.1 Geothermal Lobbying Group Separate from GRC: The Geothermal Resources Association, the planned lobbying arm of the geothermal industry has initiated their activities. The association will be independent of the Geothermal Resources Council, but will utilize them, under contract, to provide administrative services.

12.2 Acreage Limitation Increased December 26: The BLM has increased from 20,400 to 51,200 the acres that a lessee can hold on federal lands. The rule also increases the lease application fee from $50 to $75.

12.3 GRC Pacific NW Section to Meet February 19: The GRC Northwest Section will hold a 10:00 A.M. to 3:00 P.M. meeting at the Red Lion Jantzen Beach Hotel, Portland, Oregon on February 19, 1986. Topics include introduction of new officers, the OIT Varaflow Aquifer Model, water law overview, and developments in Idaho, Oregon and Washington. Contact Alex Sifford, ODOE, telephone 503/378-2778 for more information.

12.4 Introduction to Geothermal Resources Course Planned for February 5 and 6: "An Introduction to Geothermal Resources" will be offered by the Geothermal Resources Council at the Clarion Hotel, San Fransisco International Airport, Milbrae, California on February 5 and 6, 1986.

"This Course is being offered at the request of numerous companies and agencies who have new employees on their staffs with little or no overall knowledge of geothermal exploration and exploitation. The function is designed to provide a broad view of geothermal energy, which will allow an attendee to understand his or her part in its development. The background provided can immediately enhance an attendee's understanding of your present geothermal program and potentially save valuable man-hours in the future. The last time this course was offered was in 1981 and it may not be offered again until the early 1990's."

Please contact the GRC, P.O. Box 1350, Davis, California 95617, telephone 916/758-2360 for details.

12.5 GRC to Hold Small Scale Power Plant Meeting: The geothermal Resources Council is offering a topical meeting "Small Scale Power Plants and Power Plant Projects on February 12 and 13, 1986 at the El Dorado Hotel in Reno, Nevada. The meeting is designed to provide the latest information on small power plants and power plant development activities in Nevada and Northwestern California. Field trips to the Desert Peak and Brady Hot Springs plants, the Steamboat Springs site, Wendel Hot Springs, California, and the Barber-Nichols power plants. Contact the GRC, P.O. Box 1350, Davis, CA 95617, telephone 916/758-2360.

REGION IX

CALIFORNIA

Industrialization Activities

12.6 Magma 39 MW Plant Start-up: Magma Power Co. of Los Angeles last week started up a 39-megawatt geothermal power plant in southern California. Magma Power and Burlington Northern Inc. each own 50 percent of the $74-million Vulcan geothermal plant, located near Niland. Southern California Edison Co. is paying avoided cost rates for the plant's power.

More than 25 years ago, Magma chairman B. C. McCabe founded The Geysers, the large geothermal energy complex in central California. At one time, Magma owned 25 percent of The Geysers geothermal resource; Union Oil owned the rest. But two years ago, Natomas Co., before being acquired by Diamond Shamrock, bought out Magma's interest at The Geysers. Magma now owns geothermal acreage in southern California and Nevada. It operates another 12.5-megawatt geothermal venture in West Mesa, in southern California. (The Energy Daily 12/9/85)

HAWAII

State Activities

12.7 Community Geothermal Technology Program Provided: The Community Geothermal Technology Program will provide small grants, available in any amount not exceeding $10,000, for research into non-electric uses of geothermal energy in Hawaii. Non-electric uses include applications of direct heat from currently

discarded geothermal fluids or uses of by-products such as silicon and sulfur. Funding for the program is provided by a variety of public and private sources. The program is coordinated by the Hawaii Natural Energy Institute and the State of Hawaii, Department of Planning and Economic Development. The research can be performed at the PUNA Research Center, a laboratory on the grounds of the HGP-A geothermal power plant. Access to high temperature brine at about 175 psi and 368°F will be provided. Research which can more appropriately be performed at a different site will also be considered if it meets other program criteria. (Paul Lienau, OIT GeoHeat Center)

REGION X

NEVADA

Industrialization Activities

12.8 Anadarko Petroleum Announces Nevada Geothermal Discovery: On 30 October 1985 Anadarko Petroleum Corporation of Houston, Texas announced a commercial-scale discovery of geothermal energy in Churchill County, Nevada.

The well, located in the Salt Wells area approximately 60 miles east-southeast of Reno, was pumped at a maximum sustained rate of 1,300 gallons of hot water per minute during a four-day test. Water temperature ranges from 260 to 285°F. Depth of the well is 700 feet.

Robert C. Edmiston, geothermal manager for Andarko at Santa Rosa, California stated that the volume of water and temperature at the wellhead are consistent with commercial generation of

electricity using binary (heat exchanger) technology. Test results indicate that the shallow discovery zone has the potential for development into a resource capable of generating at least 30 MW per hour.

Andarko has a 100 percent interest in the discovery and in approximately 9,700 surrounding lease acres. Additional drilling will be undertaken in 1986.

A subsidiary of Panhandle Eastern Corporation of Houston, Andarko is one of the nation's largest independent oil and gas exploration and production companies and is active in the U.S., Canada and overseas. The company holds approximately 63,000 net acres of geothermal leases in Nevada, California and Oregon. (GRC Bulletin, December, 1985).

12.9 Elko County School District Going Geothermal: Three schools in the Elko County School district have started to use geothermal energy to heat their facilities. At Wells, Nevada, an 800 foot well produces 87°F water as an energy source for a heat pump to heat Wells High School. The heat pump displaced an electric boiler and is using 1/3 less kwh. The Carlin High School is also using a heat pump to heat domestic water. A 640 foot well produces 60 gpm at 87° as the energy source for the heat pump. Future plans include developing a space heating system for the high school. At Elko, a recently completed 1,970 foot well supplies 300 gpm artesian at 190°F to a new junior high school building. Piping has been installed to connect 12 additional school buildings, a convention center, the hospital, city offices and the swimming pool to the system. An injection well will be completed for disposal of the fluid that is currently being wasted to storm drains. (Paul Lienau, OIT GeoHeat Center)

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REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
JANUARY 1986

GENERAL

1.1 Reservoir Engineering Workshop Held at Stanford: Approximately 125 specialists in the field met last month to report on progress and to exchange ideas regarding geothermal reservoir engineering. The forum was Stanford University's Eleventh Annual Workshop on the same. Some remained a fourth day for a special workshop on the chemical aspects of injection.

The information is available in an attractively-packaged six volume set of past workshop proceedings (1975-1980). The collection contains more than 250 papers covering reservoir physics, well testing and formation evaluation, modeling, field development, and production engineering. The cost is $100 for the proceedings and $10 postage and handling (the latter on foreign orders only). The proceedings can be ordered through Ms. Terry Ramey or Mrs. Jean Cook, Stanford Geothermal Program, Department of Petroleum Engineering, Stanford University, Stanford, CA 94305. (Geothermal Report 2/1/86)

1.2 NWPPC Reports Geothermal Potential: Armed with projections from its own staff and aided by significant input from the Bonneville Power Administration (BPA), the Northwest Power Planning Council (NPPC), which represents Idaho, Montana, Oregon, and Washington, concluded in a report released January 23 that there are 3,000-4,000 MW of geothermal power available for commercial development. Covering supply and demand in the region through 2005, the study stated that approximately 1,000 MW(e) could be generated competitively with power plants using other fuels at a cost ranging from 5.2 to 12 cents per kWh at current rates.

Groundwork for conclusions was provided by a two-year study sponsored by BPA and carried out by a team of energy experts. Efforts were coordinated by Dr. R. Gordon Bloomquist, geothermal specialist for the Washington State Energy Office (WSEO). Completed last summer after evaluating the potential at 1,265 possible sites in the four-state area, their report specified eight high-temperature locations they considered worth developing. It also pinpointed five direct utilization prospects, two already under development at Boise, ID, and Klamath Falls, OR. The NPPC will launch a study to evaluate district heating potential at these and other candidate sites within months.

In the interim, its next step is to form R&D teams to conduct detailed surveys of highly regarded high-temperature resources. This phase of the program will require about a year to complete, after which demonstration projects will be proposed. How rapidly they will be approved will depend on projected area power need, which could be lessened if one or both of the mothballed Washington Public Power Supply System (WPPSS) nuclear stations are completed, a possibility looming large lately in planning sessions at BPA and WPPSS. (Geothermal Report 2/1/86)

1.3 EPRI Geothermal Power Systems Program Update Provided: As part of its comprehensive geothermal power systems program, the Electric Power Research Institute is carrying out a number of investigations. Two of note at this time are scale control studies and monitoring at the Heber Demonstration Facility.

Research objectives of the scale-control work are to understand the behavior of geothermal fluids and to learn how to predict and control that behavior. Among the projects underway are:

- An investigation of the feasibility of bulk scale removal by selective crystallization upstream of a power plant boundary. (A flash-crystallizer unit designed by The Ben Holt Co. is being used.)

- o A study of mechanical scale-removal technologies currently available. Technologies being looked at include both on-line (sponge ball systems, brush-and-cage systems, abrasive cleaning, ultrasonic cleaning) and off-line (air- or-water driven brushes, power-driven scrapers, cutters and vibrators, water lances).

- o An examination of trace elements in geothermal systems.

A comprehensive overview of EPRI's work to date is presented by project manager Mary E. McLearn in the December 1985 EPRI Journal. Dr. McLearn can be contacted directly at EPRI's headquarters in Palo Alto, California. (Telephone: 415/855-2487).

At the Heber plant in Southern California, EPRI resumed its extensive monitoring program as soon as the December 8, 1985, dedication was completed. The program has been running continuously since then, and Vasel Roberts, McLearn's boss and program manager of the entire EPRI Geothermal Power Systems Program, says that he is "very excited about the results."

1.4 Washington State and Swedish Governments Sign Marketing Agreement: The Washington State Energy Office (WSEO) and the Swedish Council for Building Research, a government agency, contracted early last month to form a joint venture to offer worldwide geothermal district heating feasibility and planning services. Among the marketing target areas is the Peoples Republic of China, which is in the Pacific Rim area being courted economically by Washington governor Booth Gardner and his business development staff.

Key selling point of service, which will feature the use of heat pumps to increase resource temperatures, will be a sophisticated IBM computer system employing PASCAL language. The intent is to generate interest -- and business -- in installing DH systems at

locations where municipalities are interested but borderline temperatures are questionable. Startup of operation has been funded at $40,000 and is now scheduled to be offered initially in the spring. (Geothermal Report 1/15/86)

1.5 ASHRAE Holds Meeting on Geothermal Energy: Gene Culver of the Geo-Heat Center has been appointed chairman of an ASHRAE technical committee (TC6.8) on geothermal energy. The committee considered revisions to the geothermal energy chapter of the handbook, two research proposals, a tentative district heating seminar planned for Portland next June and committee program plans for the next three meetings. The two research proposals submitted to ASHRAE, which were reviewed by the committee, involve teflon tube heat exchangers and the verification of operational characteristics for earth coupled heat pump studies in several areas of the country. (Paul Lineau, OIT, 2/86)

1.6 District Heating Software Undergoing Improvement: The Washington State Energy Office has announced a joint project with the Swedish Council for Building Research to upgrade the geothermal district heating microcomputer program named Heatplan. Originally developed for WSEO in 1982 by Eliot Allen and Associates, Heatplan has been used by several Washington cities for district heating planning. The improved version of the program, which is being prepared by VBB Allen of Salem, Oregon and Stockholm, Sweden, will give greater attention to the retrofitting of inventoried heating loads; flexibility and accuracy in distribution network design; and mixing and optimization of multiple heat sources. With support from the Swedish Council for Building Research and the new version will also include experiences gained from over 40 years of extensive district heating development throughout Sweden. (PNS Geothermal Newsletter 1/86)

1.7 Ideas Needed For Equipment Conference: The OIT Geo-Heat Center is preparing to sponsor a conference on equipment commonly used in direct applications, including piping, heat exchangers, and

meters. Tentatively scheduled for May 1986 in Klamath Falls, Oregon, the conference is intended to draw together system operators, manufacturer representatives, designers, and others interested in hands-on equipment experience. Topic and speaker recommendations are welcome, and should be directed to Paul Lienau, Geo-Heat center at 503/882-6321. (PNS Geothermal Newsletter 1/86)

1.8 PNS Elects New Officers: The Pacific Northwest Section of the GRC has elected its slate of officers for 1986. The new president is Alex Sifford, Oregon Department of Energy, replacing Gordon Bloomquist. Phil Esner of California Energy Company will serve as Vice President and the secretary/treasurer post will be filled by Marshall Garnett, Oregon Resources Water Department. Eliot Allen of VBB Allen is the Director-at-large. Installation will occur at the February 19 section meeting to be held in Portland.

REGION VIII

COLORADO

Industrialization Activities

1.9 Investigative Panel/Workshop Was Held For Potential Developments at Poncha Springs, Colorado: An investigative panel/workshop was held January 27-29, 1986 at the Monarch Lodge to develop guidelines for redevelopment of the Poncha Hot Springs. The ultimate goal of the Town of Poncha Springs is to stimulate the local and regional economy and create job opportunities as a result of a large scale project based on geothermal resources. KLH Engineering Consultants, Inc. from Colorado Springs was retained by Poncha Springs to assist in selecting the best use of the resource through four committees. These committees consist of resources and their evaluation, requisites for potential development, requirements for geothermal applications, responsive

programs and community input. Thirty-two persons participated, EPRI and the Geo-Heat Center were asked to serve on the requirements for Geothermal Applications Committee. The result was a recommendation to formalize a local geothermal committee to finalize level one uses - greenhouses, senior center, motel and Salida city pools and ultimately develop a major destination resort for the area involving additional development of the resource. (Paul Lienau, OIT, 2/86)

REGION IX

CALIFORNIA

Industrialization Activities

1.10 Salton Sea Research Well Has First Flow Test: First flow test of a California deep research well tapping one of the world's hottest geothermal resources has demonstrated the resource's commercial potential, says Bechtel Engineers and Constructors, contractor for the Department of Energy project. The well is targeting pay as deep as 10,000 ft in the Salton Sea resource area as the first effort of the Continental Scientific Drilling.

The well flowed on 36 hour test 25% saline brine yielding steam and water at a rate of about 500,000 lb/hr from a zone at 6,120 ft. Temperatures were as high as 600°F. (OGJ Newsletter 1/20/86)

1.11 Brawley R&D Plant To Be Dismantled: Southern California Edison will dismantle, sell the components, and return the North Brawley KGRA site of its 10 Mw R&D power plant to its original farm land condition by June 1, 1986, according to Darrell Neal, acting material sales representative. In the almost five years of operation, the plant produced 134 million kilowatt hours of electricity.

Principal items to be sold are the generator, steam turbine, and transformers. A catalog with the details is available from Southern California Edison, Material Sales Department, P.O. Box 429, Alhambra, CA 91802. (Telephone: 818/308-6144)

Neal said that SCE will concentrate on its geothermal plant being readied at the Salton Sea KGRA, ten miles north of the North Brawley field. (Geothermal Report 2/1/86)

1.12 Cedarville School Heating System Operational: The geothermal heating system for the Surprise Valley School District in Cedarville, CA became fully operational on January 23, 1986 at the High School complex. Fluid is conveyed in an insulated buried pipeline about 2500 ft to unit and cabinet heaters in four separate buildings and discharged via an irrigation ditch. Fluid temperature at the well is 130°F, having risen 10° during a 30-day system checkout and shakedown period. TDS is about 200 mg/l. Three industrial shops at the top end of the system also use the well for total facility heating.

At the elementary school complex, similar fluid is conveyed about 2500 ft from another well to floor systems and cabinet heaters in three buildings. System effluent is then conveyed back to the well owner for livestock and irrigation uses or surface disposal at his option. At both school complexes, the geothermal system provides total space heating and hot water requirements, saving the school district about $16,000 annually in fuel costs. The well testing, engineering design, and system construction was provided by Gertsch, Juncal & Associates, Ltd., of Idaho Falls and Milford, California. (W. D. Gertsch 2/86)

1.13 GeoProducts WEN No. 3 Drilling Completed: GeoProducts Corporation of Oakland, California completed their WEN #3 in the Wendel Amedee KGRA on January 9, 1986. The well was drilled to a depth of 6,450 feet and completed in a fractured granite formation similar to their WEN #1 drilled in 1981. When lifted, the well flowed at

about 300 gpm and indicates the same 240 - 250°F range as WEN #1 and WEN #2. Extensive reservoir test will begin near the end of February. All indications suggest the availability of fluid required for the company's 28 MW geothermal-wood waste power plant. Dow Engineering is providing design services for the power plant and all permitting work for the project is now in progress. (W. D. Gertsch 2/86)

NEVADA

Industrialization Activities

1.14 Geothermal Well to be Drilled For Hotel/Casino Complex in Reno: Based on a feasibility study completed by the Geo-Heat Center, the developers of a hotel/casino in Reno, Nevada have decided to proceed with drilling a 500 foot well to produce an estimated 500 gpm at 115°F. A geothermal system for the planned 300 room hotel/casino would provide for space heating of guest rooms, preheating of domestic hot water and ventilation air and pool heating. Total incremental capital cost for the system, using water to air heat pumps in each room, was estimated to be $407,000. Savings in natural gas and electrical purchases would amount to $76,753 annually, based on current utility rates. Annual operating costs for the geothermal system total $13,000. (Paul Lienau, OIT 2/86)

REGION X

IDAHO

INDUSTRIALIZATION ACTIVITIES

1.15 Water Resources Investigation of the Idaho Batholith Made Available: Water-Resources Investigations Report 85-4172, "Geochemistry and Hydrology of Thermal Springs in the Idaho Batholith and Adjacent Areas, Central Idaho," by H. W. Young has been issued.

This report describes hydrology and geochemistry of one of the largest prospectively valuable areas for steam and associated geothermal resources in the Western United States. Chemical and isotopic data collected prior to and during 1982 are summarized.

Copies may be purchased for $13.75 (paper) or $5.50 (microfiche) from U.S. Geological Survey, Open-File Services Section, Western Distribution Branch, Box 25425, Federal center, Denver, CO 80225. (Jerry L. Hughes, USGS)

OREGON

Industrialization Activities

1.16 Drilling Planned at Breitenbush and Newberry:

Thermal Power Company of Santa Rosa, California is scheduled to drill a 5,000 foot temperature gradient hole (CTGH-1) in the summer of 1986 approximately 10 miles northeast of Breitenbush, on the Clackamas Ranger District of the Mt. Hood National Forest.

GEO Operator Corporation of Santa Rosa, California is scheduled to drill a 4,000 foot temperature gradient hole on the north flank of Newberry volcano during the summer of 1986.

GEO Operator Corporation completed its first Newberry temperature gradient hole on the volcano's southern flank last season, reaching a total depth of 4,650 feet. Public drilling records for that hole indicated a temperature of 72°C (161°F) at the 4,000 foot level.

In a related development the Deschutes National Forest will release its draft Forest Plan in January 1986, including proposed management policies for Newberry and other areas of geothermal potential. (PNS Geothermal Newsletter 1/86)

1.17 New Year Brings Geothermal Tax Changes: As called for in earlier legislation, January 1, 1986 was the effective date of several changes in geothermal tax incentives at both the state and federal levels. In Oregon the residential tax credit for geothermal systems is still allowable at 25% of the system's cost, but the previous maximum credit of $1,000 has now become $500. Also, Oregon's industrial tax credit of 35% of the value of a geothermal system has now been eliminated for geothermal electric projects with installed capacity of 1 MW or more.

At the federal level all geothermal tax credits have been eliminated, although there is still talk of Congress re-enacting some form of reduced credit. The geothermal intangible drilling cost deductions and depletion allowance remain unchanged. (PNS Geothermal Newsletter 1/86)

1.18 Klamath Falls System Expanding: The City of Klamath Falls, Oregon is completing the design for its expanded geothermal heating district. Balzhiser-Hubbard Associates of Eugene have designed a heat recovery system for some of the City's storm drains that collects geothermal waste water from building heating systems at temperatures which are still usable in secondary applications. The collected fluids will enable expansion of the City's heating service to businesses along Main Street east of the downtown area. In a related development the City recently announced its intention to expand its downtown heating service to privately-owned buildings during the 1986-87 heating season. The system's expansion, together with issues of resource development, education, and research, are part of plans for the coming year that were reviewed by the City and its Geothermal Advisory Committee on January 8. (PNS Geothermal Newsletter 1/86)

1.19 Piping Failure Shuts Down Klamath Falls District Heating System: The Klamath Falls geothermal district heating system operated without problems during the 1984-85 heating season, providing service to ten government buildings. In mid-November of 1985 it

was observed that the main closed loop was accepting 30 to 40 gpm of make-up water. The main loop carries 200 to 300 gpm of domestic water circulated at 50 to 60 psi and heated to 180°F from the central plate heat exchangers which are supplied with about 125 to 150 gpm of 209°F geothermal water. This main loop consists of about 7400 feet of fiberglass pipe and 2000 feet of steel pipe in the supply and return lines. The failure is in the fiberglass section of piping, apparently with the adhesive used to attach the mechanical key-type couplings. These key-type couplings consist of male and female halves designed for joining and locking together by means of a key strip, made of delrin, inserted in coupling groves and sealed with an O-ring. The two male halves were attached to each fitting or 20 foot section of pipe with epoxy adhesives at the factory. Apparently the epoxy adhesive contained either too much or too little hardener or was not cured properly. In addition, the derin key strips became brittle, possibly due to temperature. Samples removed from five locations in the system have been sent to a laboratory for analysis. The system was shut down in early February and may not start up until the fiberglass portion of the system is replaced. (Paul Lineau, OIT 2/86)

WASHINGTON

Industrialization Activities

1.20 Yakima County Jail Back On Geothermal: In early 1984 the 120,000 square foot new Yakima County Jail went on line with a geothermal heat pump system for space heating and cooling. The system operated from an 815 foot production well and 600 foot injection well, and the doublet was capable of pumping and disposing of 700 gpm of 76°F water. In the original design ground water was introduced directly into the heating and cooling circuits to regulate temperature. At the same time an equal flow was discharged to the injection well from the circuit to maintain system volume. As a result of the systems configuration serious

corrosion problems developed, primarily due to oxygen entering the system from the cooling tower, the storage tank and the production pump column. The geothermal system was shut down in the spring of 1984 and an electric boiler was used until December 1985. In November of 1985 the heating bill from the electric utility was $17,000. The Geo-Heat Center was asked to look into the problem in July 6, 1984 and recommended an isolation heat exchanger be installed between the wells and heating system. This was completed in December 1985. In order that long term reliability be achieved, it is recommended that system designs avoid approaches which induce exposures to air such as settling and storage tanks, take advantage of a complete water analysis prior to materials selection and more importantly, use heat exchangers to isolate groundwater from the building mechanical system. (Paul Lineau, OIT 2/86)

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REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
FEBRUARY 1986

GENERAL

2.1 Phillips Petroleum Sells Resources in Three States: Chevron Resources Co. agreed to pay about $27 million for Phillips Petroleum Company's geothermal resources in Nevada, Utah, and Oregon. Properties include Phillips' interest in a geothermal resource feeding a 20,000 kW power generating plant at Roosevelt, Utah, and a geothermal field and 9,000 kW power generating plant at Desert Peak, Nevada.

2.2 Mono Power To Liquidate Geothermal Interests: Morrison-Knudsen Engineers, Inc., Boise, Idaho, on February 3 said Mono Power Company, wholly-owned subsidiary of Southern California Edison company (SCE), had engaged MK as the exclusive engineering advisor in the sale of its geothermal interests.

Ray Juels, Manager, Mono Power, explained that under a December 1984 order of the California Public Utilities Commission, SCE is required to shed its geothermal mineral properties acquired through Mono. These are 42,000 acres of lease holds at Salton Sea, Randsburg, Coso, Long Valley, and Tecopa in California and at Beowawe, Nevada. In some instances, Mono's interests are combined with others, but these fractional ownerships also will be disposed of, and it is anticipated that the majority of Mono's assets will be liquidated over a period of three years.

Bob Crouch of SCE said that the utility company would continue to construct, operate, and own the Powerplants that are underway at these KGRAs and that they are not owned through Mono. The sale by SCE of the powerplant components at North Brawley that was announced recently is not to be interpreted as setting a precedent

for these other facilities, Crouch said, and SCE is not jettisoning geothermal but is following the PUC's direction to divest itself of its subsidiarily-owned mineral resources. (Geothermal Report 2-15-86)

2.3 Bloomquist Elected to Head ASTM Geothermal Committee: Dr. Gordon Bloomquist, Washington State energy Office, was elected on February 11, 1986 at the Committees' semi-annual meeting in Reno, Nevada to serve as the Chairman of ASTM Committee E-45 on Geothermal Resources and Energy. He replaces David N. Anderson, Executive Director of the Geothermal Resources Council, who has served well in that post, and will continue as the Secretary. The new First Vice-Chairman is Rick Wells, WKM Division of Joy Manufacturing Company, and Del Pyle of Union Oil Company will be the Second Vice-Chairman. Rusty Brian, Otis Engineering Corporation is responsible for membership. Participation in the Committees' activities is urged, and interested persons should contact Gordon Bloomquist, telephone 206/586-5074 or Dave Anderson at 916/758-2360.

REGION IX

CALIFORNIA

Industrialization Activities

2.4 DOW Chemical Increases Interest in Magma Power: Dow Chemical Company will increase to 25.5% its interest in Magma Power company, Los Angeles. Dow will take in equity its accrued engineering fees of about $8.6 million for the Vulcan geothermal generating plant at Niland, California. The plant is producing at its rated capacity of 34,000 kW for Southern California Edison. (Oil & Gas Journal 2-17-86)

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Donald W. Klick, USGS Deputy for Geothermal and Volcanic Hazards, who chairs the Scientific Coordinating Committee for the SSSDP, told GR that as of the first week in February, in 28 individual coring attempts, approximately 800 feet of core had been recovered out of a hole that had reached almost 9000 feet in depth. A second flow test is imminent. (Geothermal Report 3-1-86)

NEVADA

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The power plant is comprised of seven modular geothermal binary cycle power units, with a total gross generating capacity of 7.4 MW. Under design conditions the power plant will utilize geothermal fluid at 325°+F to generate an average of 43,800,000 kW hours per year for sale. The electrical energy will be purchased by Sierra Pacific Power Company under a ten year contract approved by the Public service Commission of Nevada.

The power plant construction which commenced on 14 October 1985, is being completed on a fast track schedule made possible by the cooperation of Sierra Pacific Company, which owns the land on which the plant is constructed, and the other firms which are participating in the project. In addition, the use of the factory integrated modular Ormat Units has resulted in the ability of the project to generate commercial power within days of completion of the basic equipment installation. Full capacity operation of the project is anticipated by mid 1986.

GDA is producing from only one well and injecting in another. In full production, the project will have at least three producing and injection wells. The producing well is approximately 700 ft. deep.

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Other projects which utilize Ormat Power Modules include a .85 MW geothermal power plant in Wabuska, Nevada which has been operating since mid September 1984, as well as several thousand power units operating all over the world in various waste heat recovery solar pond power plants, geothermal power plants and remote on-site power station applications. (GRC Bulletin 2-86)

2.8 Desert Peak Power Plant on Line: The Phillips Petroleum Company (Bartlesville, Oklahoma) and Sierra Power Company (Reno, Nevada) jointly announced the start-up 20 December 1986 of the 9 MW (nominal) power plant at Desert Peak, Nevada. The plant is one of three geothermal pilot plants that were authorized in 1981 under separate agreements between sierra Pacific and three separate operators.

The plant, which is located 65 miles northeast of Reno, and about 5 miles east of Brady Hot Springs was designed and constructed by Phillips with the power train supplied by Trans-America Delaval Biphase Systems (see BULLETIN, vol. 14, no. 2, p.7). The power system contains both a rotary separator turbine and a dual flash turbine. A wet, induced draft cooling system is used and is designed to adjust to the air temperature. This feature allows the maximum amount of power to be generated within the range of 8 to 11 MW.

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REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
FEBRUARY 1986

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GENERAL

2.1 Phillips Petroleum Sells Resources in Three States: Chevron Resources Co. agreed to pay about $27 million for Phillips Petroleum Company's geothermal resources in Nevada, Utah, and Oregon. Properties include Phillips' interest in a geothermal resource feeding a 20,000 kW power generating plant at Roosevelt, Utah, and a geothermal field and 9,000 kW power generating plant at Desert Peak, Nevada.

2.2 Mono Power To Liquidate Geothermal Interests: Morrison-Knudsen Engineers, Inc., Boise, Idaho, on February 3 said Mono Power Company, wholly-owned subsidiary of Southern California Edison company (SCE), had engaged MK as the exclusive engineering advisor in the sale of its geothermal interests.

Ray Juels, Manager, Mono Power, explained that under a December 1984 order of the California Public Utilities Commission, SCE is required to shed its geothermal mineral properties acquired through Mono. These are 42,000 acres of lease holds at Salton Sea, Randsburg, Coso, Long Valley, and Tecopa in California and at Beowawe, Nevada. In some instances, Mono's interests are combined with others, but these fractional ownerships also will be disposed of, and it is anticipated that the majority of Mono's assets will be liquidated over a period of three years.

Bob Crouch of SCE said that the utility company would continue to construct, operate, and own the Powerplants that are underway at these KGRAs and that they are not owned through Mono. The sale by SCE of the powerplant components at North Brawley that was announced recently is not to be interpreted as setting a precedent

for these other facilities, Crouch said, and SCE is not jettisoning geothermal but is following the PUC's direction to divest itself of its subsidiarily-owned mineral resources. (Geothermal Report 2-15-86)

2.3 Bloomquist Elected to Head ASTM Geothermal Committee: Dr. Gordon Bloomquist, Washington State energy Office, was elected on February 11, 1986 at the Committees' semi-annual meeting in Reno, Nevada to serve as the Chairman of ASTM Committee E-45 on Geothermal Resources and Energy. He replaces David N. Anderson, Executive Director of the Geothermal Resources Council, who has served well in that post, and will continue as the Secretary. The new First Vice-Chairman is Rick Wells, WKM Division of Joy Manufacturing Company, and Del Pyle of Union Oil Company will be the Second Vice-Chairman. Rusty Brian, Otis Engineering Corporation is responsible for membership. Participation in the Committees' activities is urged, and interested persons should contact Gordon Bloomquist, telephone 206/586-5074 or Dave Anderson at 916/758-2360.

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ACTIVITIES REPORT
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GENERAL

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For an EPRI Geothermal Conference/Workshop brochure and registration information, contact Conference Coordinator Brooke Eldredge, Electric Power Research Institute, 3412 Hillview Avenue, P.O. Box 10412, Palo Alto, CA 94303, (415)855-7919 or for technical information about the conference, contact Project Manager Mary McLearn, at the same address, (415)855-2487. (GRC Bulletin, March 1986)

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For further information, contact the IMGG, c/o Valiya M. Hamza, Instituto de Pesquisas Technologicas do Estado de Sao Paulo S.A., IPT CP71-41, 0010 Sao Paulo, Brazil. (GRC Bulletin, March 1986)

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REGION IX

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Industrialization Activities

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The turbine-generator, which was constructed by Mitsubishi Heavy Industries, Ltd., is supplied by two production wells: a 9,500 ft. and a 7,000 ft. well. The wells produce a combined flow of about 1,250,000 lbs. per hour of geothermal water. the reservoir temperature is in excess of 400°F. Waste water will be disposed of in an injection well located approximately one and one half miles from the power plant. Power is being purchased by SCE and is being wheeled through Sierra Pacific Power Company lines. A short seven tenths of a mile power line had to be constructed to tie into the Sierra Pacific power net. The plant will be operated by Chevron through the Beowawe Geothermal Power Company. (GRC Bulletin, March 1986)

3.10 Trans-Pacific Aquires Leases: Trans-Pacific Geothermal Corporation, Oakland, California is undertaking its initial power development with the acquisition of leases totaling about 5500 acres from Union Oil Company in the Stillwater, NV, KGRA about 15 miles northwest of Fallon. Tsvi Meidav, President of TGC, did not reveal what it cost to obtain the roughly 95% of the proven area of Stillwater.

The announcement said, however, that six deep exploratory wells had been drilled, with fluid temperatures of from 325-335°F encountered at depths as shallow as 900 feet. These wells will be used to supply the initial generator, which will be in the range of 1-2 MW capacity and may be operating in a year. An additional drilling program has been laid out to supply the second power plant of 8-9 MW capacity, which TGC hopes to have in production by the end of 1987. Both plants will use the binary system of heat extraction to drive the turbines.

Negotiations are proceeding with Sierra Pacific Power Company, and TGC and SPPC are cooperating in a study of transmission routes from the KGRA to the Utility's sub-station at Fallon. TGC also is pursuing its interests in other potential developments, but its spokesman said that nothing additional is mature at this time. (Geothermal Report 4-1-86)

OREGON

State Activities

3.11 State of Oregon Deregulates Geothermal District Heating: In response to investor-owned utility urging, the Oregon Public Utility Commissioner introduced, and the 1985 Oregon Legislative Assembly enacted, House Bill 2202 which completely removes geothermal district heating from PUC oversight. Under the terms of the new legislation geothermal non-electric systems are clearly not defined as "public utilities" and therefore, excluded from PUC rules and regulations. (Geothermal Energy Magazine, March 1986)

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3.10 Trans-Pacific Aquires Leases: Trans-Pacific Geothermal Corporation, Oakland, California is undertaking its initial power development with the acquisition of leases totaling about 5500 acres from Union Oil Company in the Stillwater, NV, KGRA about 15 miles northwest of Fallon. Tsvi Meidav, President of TGC, did not reveal what it cost to obtain the roughly 95% of the proven area of Stillwater.

The announcement said, however, that six deep exploratory wells had been drilled, with fluid temperatures of from 325-335°F encountered at depths as shallow as 900 feet. These wells will be used to supply the initial generator, which will be in the range of 1-2 MW capacity and may be operating in a year. An additional drilling program has been laid out to supply the second power plant of 8-9 MW capacity, which TGC hopes to have in production by the end of 1987. Both plants will use the binary system of heat extraction to drive the turbines.

Negotiations are proceeding with Sierra Pacific Power Company, and TGC and SPPC are cooperating in a study of transmission routes from the KGRA to the Utility's sub-station at Fallon. TGC also is pursuing its interests in other potential developments, but its spokesman said that nothing additional is mature at this time. (Geothermal Report 4-1-86)

OREGON

State Activities

3.11 State of Oregon Deregulates Geothermal District Heating: In response to investor-owned utility urging, the Oregon Public Utility Commissioner introduced, and the 1985 Oregon Legislative Assembly enacted, House Bill 2202 which completely removes geothermal district heating from PUC oversight. Under the terms of the new legislation geothermal non-electric systems are clearly not defined as "public utilities" and therefore, excluded from PUC rules and regulations. (Geothermal Energy Magazine, March 1986)

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REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
MAY 1986

GENERAL

Direct use Workshop Draws International Interest: A workshop covering the various aspects of geothermal direct-use projects was successfully conducted by the OIT GeoHeat Center and the Geothermal Resources Council. Considerable interest was shown by about 80 attendees from 12 states, New Zealand, Canada, Iceland, England, Italy, and Mexico. Organizations and individuals at the 3-day session held on the OIT campus included consultants, manufacturers, geologists, drillers, researchers, greenhousers, district heating operators, mineral services representatives, and aquaculture developers. Persons representing state and federal agencies were also in attendance.

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GENERAL

12.1 Portable Generator Passes Test for Sounding Earth's Crust: An engineering test of a new compact, portable, electromagnetic generator that will be useful in "exploring" the earth's crust to depths of 10 to 20 kilometers has been conducted near Cajon Pass in Southern California.

The device, a magnetohydrodynamic (MHD) generator that produces very strong current pulses, and the technique by which it is employed, were developed and tested by a collaboration of scientists from Lawrence Berkeley Laboratory and STD Research Corporation of Monrovia, California.

It is described as a small solid-fuel hybrid rocket motor that can be pulsed rapidly, producing short bursts of ionized (electrically charged) gas that expands at supersonic velocities through a magnetic field. The ionized plasma generates a current in the wall of the duct through which the plasma passes. While current pulses of up to 100,000 amperes are possible, three-second pulses of 10,000 amperes were generated in the Cajon Pass experiment.

The current is fed to a loop of wire lead out on the ground, creating a strong magnetic field. When the current to the loop is interrupted, currents are induced in the conductive earth beneath the loop and these currents decay quickly to zero. The rate and shape of the transient magnetic field associated with the current decay are detected by very sensitive magnetometers and provide information on the conductivity distribution beneath the loop. If enough such measurements are made, the conductivities can be translated by computers into "pictures" of rock structures to depths of 10 to 20 kilometers.

The technique could become an important complement to present seismic reflection geophysics and exploratory drilling to map the structure of the earth's crust and assist in the search for energy resources. (Lawrence Berkeley Lab. Public Information Department)

12.2 The Senate has New Committee Members: Senator Bennett Johnston (D-LA) takes over as Chairman of the Senate Energy Committee from Senator James A. McClure (R-ID), and, though Johnston stands up first for oil and gas interests of his own constituents and less for nuclear than McClure, he has steadfastly advocated an across-the-board broad spectrum of national energy sources, including nuclear, coal, conservation, oil and gas, plus alternate energy resources (geothermal, solar, biomass, and cogeneration). Close aides say Johnston will likely bring these broad-based interests to the committee's agenda in the new session. Staff sources also say the character of the committee is equally likely to be spelled out in the leadership of subcommittees, where Senators Howard Metzenbaum (D-OH), John Melcher (D-MT), and Dale Bumpers (D-AK) will be chairmen.

McClure also steps down as Chairman of the Interior Appropriations Subcommittee, and Senator Robert Byrd (D-VA), previously ranking minority member, will assume the chairman's job. Johnston becomes Chairman of the Appropriations Subcommittee responsible for energy programs. Last year in that subcommittee, mention was made of winding up the hot dry rock program, and there also maybe less enthusiasm for long-duration flow testing of geopressured wells. (Geothermal Report 1/187)

12.3 BPA Issues Geothermal Activity Plan: The 1983 Power Plan recommended Bonneville develop a "geothermal demonstration program" of 10 megawatts of capacity to encourage confirmation of the region's geothermal resource. In its 1986 Power Plan, the Council stepped back from advocating a single, site-specific power plant demonstration project and focused on the preliminary problem of confirming the resource. Bonneville's objectives to implement the 1986 Power Plan are threefold:

a. Design a confirmation program which, when implemented by Bonneville, would result in confirmation of a single-site, environmentally acceptable geothermal resource, within the region, capable of supporting 100 MWe for 30 years.

b. Provide assurance that the electrical power generated from the resource will be made available to the region in the future when it is needed, at competitive prices.

c. Complete the design of the confirmation program by the end of FY-1988. By all estimates, there is a vast geothermal resource potential in the region which may be both cost-effective and environmentally acceptable. Confirmation, through exploration, drilling, and reservoir development, is the only way to ascertain the nature and extent of this resource. (Paul Lineau, OIT)

12.4 Renewable Energy Growth Prompts Utility Changes: Growth in the renewable energy industry is prompting major changes in the electric utility industry, including the process of vertical disintegration of utilities and their growing investment in renewable energy technologies, according to a study by a research organization serving major institutional investors.

After an 18-month study of non-utility renewable energy producers, the Washington-based Investor Responsibility Research Center (IRRC) concluded that the current rapid growth in their power production is likely to continue and that the power will represent an important new form of competition for electric utilities. That competition is "likely to add to the growing pressure for deregulation of all electric power generation," says Scott Fenn, author of the study and director of IRRC's energy program.

Electric utilities will need to "properly adjust their business strategies" to meet the new conditions, Fenn argues. Among the strategies he recommends: utilities should specialize in either generating, transmitting or distributing electricity, but not try to do all three; and utilities should spend a greater percentage of their revenues on R&D in renewable energy technologies.

Fenn's study aggregates capacity data from 104 non-utility companies producing electricity from biomass, geothermal, wind, hydro, photovoltaic and solar thermal sources. The 104 companies had installed 2,236 megawatts of renewable generating capacity as of year-end 1984 and had firm plans for construction of an additional 5,056 megawatts of capacity by the end of 1987. Two-thirds of the companies projected an additional aggregate of 14,543 megawatts of new generating capacity by 1990 - a sevenfold increase over the amount installed through 1984. This capacity growth "is rather extraordinary in the context of the stagnant market" for new generating capacity, Fenn notes.

Increased generation by renewable energy companies "could galvanize electric utilities into greater R&D spending," Fenn believes. For example, if developers of photovoltaic cells are successful, "it could have a dramatic impact on electric utilities. Anyone could install photovoltaic cells on his house and say goodbye to his local utility."

A few utilities are making significant R&D efforts in renewable energy technologies, notably the largest California utilities and Alabama Power Company, which has a joint venture agreement with Chronar Corporation to develop photovoltaic cells, Fenn said. But the industry as a whole "has been content to let other companies serve as a testing ground" for the new technologies, he charged. "Utilities spend about 1 percent of their revenues on R&D, and that's a hell of a lot less than any other major industry in this country."

Dovetailing with the disintegration of the industry into "boutique," or specialist, utilities, Fenn foresees a fiercer battle ahead over access by non-utility producers to the power grid. "The next battleground will be on the transmission side," he said. If the grid is not accessible, independent power producers will have to move to the ultimate consumer, building smaller projects sized to meet the power needs of a specific end-use facility. If the grid is opened up more, you will see the development of larger facilities where power is wheeled to wherever it is needed."

The IRRC study forecasts a shakeout within renewable energy itself, with a consolidation from the present 250-odd companies to about one-fourth that number by the year 2000. Whether a company in the renewable energy business survives or fails depends more on the technology it has chosen than on whether it is a large multinational or a small, entrepreneurial firm, according to Fenn. "Certain technologies, such as solar thermal, are likely to get shaken out," he predicted. The large players in solar thermal--including Boeing and McDonnell-Douglas--have been hurt as badly as small companies, Fenn added.

In the rapidly-growing biomass (waste-to energy) field, on the other hand, "both big and small players seem to be prospering. There are opportunities for companies all the way up and down the size scale."

The markets for photovoltaic cells and wind-harnessing technologies are in the middle, Fenn observed. There is still enough of a market to support both large and small players. Geothermal technologies are tied to the fortunes of the oil industry, because the power purchase buy-back rates for geothermal energy are influenced by oil prices, and because oil companies are the principal investors in geothermal exploration and development. Geothermal technologies will benefit when oil prices rise, Fenn predicted. (The Energy Daily 12/4/86)

12.5 Renewable Energy; Hard Road Ahead: The U.S. must overcome several important barriers before it can claim to have an internationally competitive renewable energy industry, according to Donna Fitzpatrick, the Energy Department's assistant secretary for conservation and renewable resources.

Among the biggest hurdles faced by the U.S. alternative energy industry: the current energy glut, the country's short track record with the new technologies, stiff international competition and DOE's focus on basic research rather than applied technologies that might attract joint venture partners from private industry, Fitzpatrick told a seminar on Monday sponsored by Americans for Energy Independence.

"The R&D program at DOE concentrates on the theoretical and on basic technology," she said. "At the same time, we like to cost-share our R&D and transfer patent rights to private business."

The U.S. is expected to increase its reliance on non-depletable energy sources such as solar, wind, nuclear, waste and photovoltaic cells between now and the end of the century, Fitzpatrick said. "Renewables (including hydropower) account for 9 percent of our domestic production and are projected to account for 13 percent by the year 2000".

But several significant changes must be made before the country can rely heavily on nonconventional renewable energy sources, Fitzpatrick observed. For example, people must be convinced to switch from their current energy source to an alternate source that requires capital investment and has unproven reliability. "New infrastructure and technologies take a long time to be accepted," she noted.

Furthermore, the current market condition of energy oversupply discourages investment in alternate sources. "it is difficult to find a market for big new energy systems" under conditions of energy glut, Fitzpatrick said. Although the price of energy based on non-depletable resources will decrease over time, in the short term it is costly relative to energy from conventional sources, she explained.

Adding to the problems of the budding U.S. industry is "competition from every direction" in the international marketplace, Fitzpatrick said. The energy business is global, and "every technology we are working on has a very strong competitor in another country." (The Energy Daily 12/26/86)

12.6 Elko, NV Planning Major Event for October: The Elko Convention and Visitors Authority is coordinating a major event for October 8-10 to publicize the geothermal industry and bring the industry and others together for a meeting. Additional information may be obtained from the Authority at 700 Festival way, Elko, NV 89801, Telephone 702/738-4091.

REGION IX

OREGON

INDUSTRIALIZATION ACTIVITIES

12.7 Drilling Modifications Requested for Wells Near Crater Lake: California Energy Company, Inc. (CECI), was given permission by the Bureau of Land Management and the U.S. Forest Service on December 12, 1984 to drill up to four temperature gradient holes for geothermal exploration within the Winema National Forest. CECI has partially drilled two holes and, as a result of their drilling, have requested the BLM to modify two stipulations in their drilling permits for the two wells.

CECI has requested that they be allowed to drill to a depth of 5500 feet, an increase of 1500 over what was originally permitted. CECI also requested that they be allowed to core drill without maintaining circulation of the clay and water drilling fluids. Because of the fractured nature of the volcanic rocks, drilling fluid has been seeping into the down-hole formations, a common occurrence in Cascade geothermal temperature gradient hole drilling.

This request is in response to a U.S. Department of Energy programs that CECI has joined, that supports research to understand the deep hydrothermal resource of the Cascades volcanic region and to provide this information.

Impacts that could result from the action requested by CECI and alternatives to that request will be analyzed in a supplemental to the original environmental assessment and will apply to all drilling within both Mazama I and Mazama II units. Both BLM and the USFS are inviting comments/concerns regarding this proposed modification of the drilling permits for discussion in the supplemental environmental analysis. (Paul Lienau, OIT)

NEVADA

INDUSTRIALIZATION ACTIVITIES

12.8 Lobster Production Planned Near Carson City: Lobster West, Redwood City, CA is planning to develop a lobster production facility approximately four miles south of Carson City. The resource site consists of 280 acres with 120°F water available and a gentle 5% slope which is ideal for gravity flows and ponding. The ponds will be maintained at 70°F with a 30% salinity for raising 360,000 three-quarter lobsters (Homarus Americana) per year. The discharge temperature will be 80°F, which may be used to raise fresh water prawns. (Paul Lienau, OIT)

12.9 BLM Approves Dixie Valley Power Plant: The Bureau of Land Management, in mid July 1986, approved plans submitted by Oxbow Geothermal Corporation to construct and test a 62.5 MW gross, 50 MW net double flash power plant in Dixie Valley. Approval for commercial operation will be granted once the operational and environmental testing of the plant is complete. This is the third major geothermal project for Nevada. The others are Desert Peak and Beowawe.

Oxbow will utilize eight geothermal production wells in their Dixie Valley Unit. The unit consists of 66,000 acres in Churchill and Pershing Counties. Except for a 320 acre parcel, all of the unit is on public land.

Electricl power will be transmitted from Dixie Valley to Bishop, CA on a 220 mile transmission line now being constructed by Oxbow. Once at Bishop, the power will be sold to the Southern California Edison Co. Plant Construction will begin in 1987. (GRC Bulletin 1/86)

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REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
July-September 1987

UNIVERSITY OF UTAH
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EARTH SCIENCE LAB.

GENERAL

1. Geothermal Developers Describe Importance of Hecht Amendment:

At recent hearings on Senator Chic Hecht's bill to extend federal geothermal leases beyond their 10-year primary lease term, industry representatives dramatized the loss of leases which may occur if the Hecht amendment to the Geothermal Steam Act is not passed.

Domenic J. Falcone, senior Vice President of Finance, Geothermal Resources International, said GRI has lost upwards of $1 million through either expiration or dropped acreage due to lack of market of 58,500 acres of potential geothermal lands. GRI terminated 3,712 acres at Mono-Long Valley after spending $350,000; dropped 5,760 acres at Dixie Valley, NV, because no market was available in the last half of the lease term ; and lost leases on 1,160 acres in Steamboat Springs, NV, after investing $422,000 due to lack of market availability. These losses don't include $5 million invested at Valles Caldera, NM, which Falcone said GRI "Will probably lose due to expiration this year and next".

Describing Chevron's plight, Les A. Darling, government affairs coordinator for Chevron Resources, said the company has 80 federal leases covering more than 90,000 acres in California, Oregon, Nevada, and Utah in various stages of development, most of them not likely to be producing during their primary term, scheduled to expire at the end of 1988. He said that Chevron is facing termination of 11 federal geothermal leases in the next two years under terms of the existing law. Darling noted that his firm has "spent over $1 million in evaluating these leases.

In addition, we have 42 leases which will expire in the early 1990's. Our investment in these lease areas is over $3.5 million." It would be extremely unfortunate, he said, "not only for us as lessees but also for the federal resource itself, if these leases were cancelled because the rather arbitrarily set clock runs out. Lost leases mean a lost resource base and loss of all the information that has been developed.

Oxbox geothermal's 50 MW geothermal facility in Dixie Valley, NV, and an associated 200 mile transmission line for delivery of electricity to Bishop, CA, at a projected cost of $150 million, was described by Bernard H. Cherry, Oxbow president. The project sits on 60,000 acres of Oxbow's federal leases in five western states, totalling 150,000 acres. To date, Oxbow has invested about $15 million in exploration-development in Dixie Valley. But, Cherry said, "our ability to continue to hold a significant fraction of the geothermal leases in Dixie Valley is going to be determined by the availability of additional opportunities to enter into power sales agreements for electricity produced. currently, such additional power sales agreements are not available." Oxbow stands to lose its valuable leases, he said, unless the Hecht bill is passed. (Geothermal Report 9-1-87)

2. Operation of The Hybrid Cycle Experiment at Pleasant Bayou Scheduled to Begin Spring 1988:

The Ben Holt Company has refurbished and procured equipment under contract to EPRI to be used to demonstrate the hybrid cycle for electricity production from a geopressured well. The Ben Holt Company has a separate contract with DOE to build and operate the electric conversion system at Pleasant Bayou for the purpose of field testing the hybrid cycle concept.

The system is designed to operate on 10,000 BBL/day (50% of the well output) of geopressured brine containing 22 SCF of gas/BBL. This gas is approximately 87% methane with the balance being mostly carbon dioxide. The estimated power generation from the system is 650 kW by burning methane in a gas engine (a gas turbine could be used), and 540 kW, using a binary cycle, from the hot geothermal brine and high temperature engine exhaust gas. The parasitic power is 210 kW, resulting in net power of 980 kW.

Much of the equipment for the binary cycle was donated by DOE from the Direct Contact Heat Exchange (DCHX) test facility at East Mesa, California.

Operation is scheduled to begin Spring 1988. The first three months of operation will be a start up, shakedown and testing period followed by long term continuous operation. The intent of a nine-month long term continuous operation is to demonstrate system reliability and obtain data over an extended period. Of particular interest during this test will be heat exchanger fouling and binary cycle turbine performance. (Paul Lienau, OIT)

REGION VIII

MONTANA

INDUSTRIALIZATION ACTIVITIES

3. Yellowstone Park Officials Express Concern About a Geothermal Well:

One of the most uneasy neighbors of the Church Universal and Triumphant (CUT) is also its biggest: Yellowstone National Park. Park officials believe the religious cult, which is expanding its southern Montana base in the Paradise Valley, offers "one of the most significant threats to Yellowstone National Park in the Park's history."

Critics fear church developments on the Park's border could damage wildlife, pollute its rivers and groundwater, and disrupt or even destroy the geysers and hot springs which are Yellowstone's trademarks.

The most immediate concern is a geothermal well which CUT drilled on its property in 1986. Church officials hoped to use the well, located near a formation called La Duke Hot Springs, to heat buildings.

Park officials fear that tapping the geothermal aquifer could affect spectacular formations - such as Mammoth Hot Springs - which are among Yellowstone's unique treasures. Mammoth Hot Springs is within 10 miles of the CUT well.

"We don't know whether there is an interconnection between La Duke Hot Springs and the geothermal features in the park", according to Irving Friedman, a research geochemist with the US geological Survey who is pushing for a study of the area.

Friedman said "my fear as a private citizen is that I just don't want to take a chance with Yellowstone...Even if there is only a one-in-100,000 chance. I can't see playing Russian Roulette with the park."

If the system is interconnected, drilling a well at one point could relieve underground pressures and decrease geothermal flow at other points.

A USGS Study was requested in July by U.S. Senator John Melcher, D-Mont., after heated testimony about the church's plans. "We cannot allow geothermal development around the park to damage the world's most significant geysers," Melcher said.

CUT officials have capped the well for now. A Helena engineering firm hired by the church said the well would not affect geothermal formations in the park. CUT officials say even if there is an underground link, pumping less than 500 gpm - as they intend - couldn't possibly affect Mammoth Hot Springs. (The Spokesman - Review)

REGION IX

CALIFORNIA

INDUSTRIALIZATION ACTIVITIES

4. Debt Placement Closed for Two East Mesa Plants:

Geothermal Resources International Inc., San Mateo, Calif., closed a private placement of $10 million of long term debt. The money will help pay for a geothermal project calling for two 25,000 kw power plants in the East Mesa area of Southern California's Imperial Valley. (Oil & Gas Journal 7/20/87)

5. GRI Compietes 15th Well at the Geysers:

Geothermal Resources Inc. has installed its 15th geothermal well in steam fields in The geysers area of Northern California. The company is now developing the area to supply steam to the 130-megawatt Coldwater Creek power plant, which is scheduled to begin operating late this year or in early 1988. "With the completion of these wells, Geothermal Resources has completed the principal part of its work on the project," said Ronald Baldwin, the company's chief executive officer. "One or two additional wells will be drilled later this year." San Mateo California-based Geothermal Resources will have invested roughly $105 million in the coldwater plant by the time it is completed, Baldwin noted. When operating, the facility is expected to generate revenues for the company of roughly $30 million a year. (The Energy Daily 7-1-87)

6. Santa Rosa Energy Completes Financing for China Lake Plant:

Santa Rosa Energy Company, Santa Rosa, California, completed arrangements for $66 million in financing from Credit Suisse for the first 30,000 kW turbine generator unit at its China Lake. California, geothermal power project. The company has begun power deliveries to Southern California Edison under contracts calling for supply of as much as 240,000 kW. (Oil & Gas Journal 7/27/87)

7. Coso Plant Goes On-Line July 15, 1987:

Coso Plant No. 1, Unit No. 1, on Naval Weapons Center lands at China Lake went on line at 3:21 p.m., July 15, 1987, and weeks later was producing 30 MW, which was being delivered over a 28.5 mile 115 KVA transmission line to the Southern California Edison Company's substation at Inyokern, CA. "I am happy with it," Dr. Carl F. Austin, head of the Geothermal Program Office of the Center, told GR laconically.

Cosco Plant No. 1 features Mitsubishi, 25 MW nameplate-32 MW maximum capability, outdoor, impulse reaction, single shaft, condensing double flash turbine, with a rated speed of 3600 RPM, rated steam pressure at the stop valve inlet of 80 PSI, and absolute rated steam temperature of 316°F.

The plant, which is the property of China Lake Joint Venture with California Energy Co., Inc. (a member of the Joint Venture) as the field operator, was erected by Guy F. Atkinson-Mitsubishi of America Joint Venture. Investments in the operating facilities were approximately $48 million in the plant, $3 million in the power line, and $20 million in field development.

The Navy expects to realize savings of $47 million in utility costs in the first ten years of operation. Dr. Austin said again, speaking for himself and his Deputy, Lt. Com. Hahn, "We are happy about it." Not only the first operation at the Coso Hot Springs KGRA, which has had many promising advance notices, but additional prospects there make the Navy optimistic. "The Navy just signed a new contract with China Lake Joint Venture for Unit No. 2 and Unit No. 3, which together with Unit No. 1 will supply 80 MW under a PURPA contract held by California Energy Co.," Dr. Austin told GR.

California Energy Co. has PURPA contracts with Southern California Edison totaling 240 MW, it is understood, and Lauffland Drilling Co. has three rigs at work on California Energy Co. leased land parcel No. 20 and on the Naval Weapons Center lands.

Charles T. Condy, Chair of California Energy Co., Inc., said in June on completion of its tenth production well, that the company planned to drill an additional 20 wells at China Lake during the last half of 1987 and is planning eight units by mid-1989. The company estimates that geothermal reserves at China Lake are good for 30 years. (Geothermal Report 9-15-87)

8. Heber binary Plant Legal Action Underway:

With its recent announcement that it plans to sell the Heber Binary Plant, the San Diego Gas and Electric Company drew the curtain, revealing that Chevron Geothermal Co. of California, developer of the hot brine field, has sued, seeking court determination of its rights and obligations under the contract. SDG&E announced earlier this summer that it had indefinitely closed the experimental power plant. Chevron was working on the tenth of its planned 14 production wells at that time. The electric utility company subsequently filed a cross complaint alleging that Chevron in May had failed to produce the quantities of brines called for under the contract and had announced it could not do so until mid-1989. The cross complaint also names UNOCAL, which was the original holder of the production contract and is a 50% partner with Chevron in the field. (Geothermal report 9-1-87)

9. Chevron Shuts Down Heber Development Program:

Chevron Resources Company, developer of the Heber KGRA, has shut down its development program after completing Production Well #10, and Les Darling, Public Affairs Coordinator in San Francisco,said drilling of the planned four additional wells will not be rescheduled until San Diego Gas and Electric Co., or a new owner of the Heber Binary Plant comes onto the scene and clarifies intentions to restart the 62 MWe (rated) facility. (Geothermal Report 10-1-87)

10. Test Hole Drilled at Bieber:

A test hole is being drilled at Bieber with reported mud return temperatures of 146 to 164°F while drilling at 2,000 feet. The well is permitted for 2500 feet. The test hole is funded by the California Energy Commission and the developers may apply for a permit to convert it to a production well for Bieber High School. (Paul Lienau, OIT GeoHeat Center)

11. California Energy Commission Announces Geothermal Loan and Grant Program:

The California Energy Commission (CEC) is beginning the eighth funding cycle of the Geothermal Grant and Loan Program for Local Jurisdictions. Through this program, the CEC provides funding to local governments for geothermal-related projects. For this funding cycle, the CEC has approximately $2.5 million available and will accept applications for any of the following types of projects:

a. Resource Development - This may include projects to assess and explore for geothermal resources, to drill production and injection wells; and to design and construct geothermal heating, cooling and electrical generation systems.

b. Impact Mitigation - This may include projects to identify and mitigate impacts to the environment and public services caused by geothermal power plant development.

c. Planning - This may include projects to develop general plan elements, ordinances or other policies relating to the planning and development of geothermal power plants and direct-use projects.

The CEC will award either a grant, loan or a contingent award for projects funded through this program. A grant or loan will be awarded for projects that do not produce revenue or energy savings. These include planning, impact mitigation and certain resource development projects such as resource assessment and exploration activities. The decision to receive a grant or loan for this type of project is entirely up to the applicant.

A contingent award will be made for resource development projects that produce revenue or energy savings. Once the project is completed and has been sufficiently tested, the contingent award will become a loan. These loans will have a maximum term of six years, an interest rate of four percent, and a principal that cannot exceed 80 percent of the total project cost.

Application for contingent awards must include a detailed feasibility study. This study will be used to determine if the project is technically and economically feasible. Projects that are not feasible will not be funded. The feasibility study must include at least the following information:

a description of the proposed geothermal project;

a description of the resource and its availability;

a schematic drawing of the proposed project;

a table describing new equipment needs, sizes and itemized capital costs, and annual energy savings; and

a cash flow analysis of annual energy costs, proposed operating and maintenance costs, net energy savings, debt service, and net cash flow.

Assistance is available from the CEC to prepare a feasibility study or conduct preliminary resource assessment analyses.

The schedule for the eighth funding cycle is as follows:

Pre-application Deadline	October 5, 1987
Results of Pre-application Evaluation	November 4, 1987
Final Application Deadline	January 31, 1988
Energy Commission Approval	March 1988
Legislative Approval	July 1988

Questions regarding this program should be directed to:

Michael Smith
California Energy Commission
1516 9th St., MS 43
Sacramento, CA 95814
(916)324-3502

12. Test Holes to be Drilled at Mammoth Lakes for District Heating System:

Tonto Drilling Services of Salt Lake City, UT are scheduled to drill three test holes in Mammoth Lakes, CA. Each of the test holes are scheduled for a depth of 1200 feet using 4-inch core drilling. Water samples will be analyzed and temperature measurements obtained from the holes. The first hole will be drilled near the high school and hospital, the second on city property in the northwest part of town and the third near Gateway Drive on the east edge of town.

The purpose of the California Energy Commission grant for approximately $200,000 is to determine the resource potential for a district heating system.

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REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
JANUARY 1987

GENERAL

1.1 Growth in Direct-Use Projects is Occurring: Paul J. Lienau of the Geo-Heat Center, Oregon Institute of Technology, has computed a growth of 34% in the installed capacity of direct heat geothermal projects in the year extending from September, 1985 to September,1986. Excluding 66 resorts, which are estimated to count for 75 billion Btu/year of energy use, the increase brought the annual use in 213 installed plants to 2081 billion Btu, equal to 520,000 barrels of oil.

Lienau, who is the West's leading authority on direct use, said California led in new projects because the California Energy Commission stimulated activity through state funds that were made available from the half of federal geothermal lease revenues collected by the Bureau of Land Management. Lienau cited 12 new projects in California, 1 in Colorado, 3 in Oregon, 1 in South Dakota, 1 in Utah, and 2 in Washington.

In concluding his report, which appeared in the Geo-Heat Center's quarterly bulletin for Fall 1986, Lienau wrote, "With many systems now operating and methods established for evaluating reservoirs, the potential for growth of direct heat projects in the Western U.S. appears great." (Geothermal Report 2/2/87)

1.2 Two Senior Staff Members Leave DOE Geothermal Division: DOE's Geothermal Division is losing two of its senior staff, Morris Skalka and James Bresee, original plank-owners of the program when it was first established under the old AEC in 1972. Effective February 3, 1987, Skalka is retiring with 26 years of government service, and Bresee has moved to DOE's Office of Civilian Waste Management as deputy director.

John E. Mock, geothermal division chief, saluted both for long, quality service to geothermal development. "Both personally and professionally, I am very sorry to lose Jim and Morris. Their depth of knowledge and strong leadership qualities, not to mention their good fellowship over many years, will be sorely missed by all their colleagues in the Geothermal Technology Division. I commend them for a job well done and wish them the very best in their new activities." (Geothermal Report 1/15/87)

1.3 Geo-Heat Center to Provide Specialized Geothermal Training for Philippine Engineers: The United Nations Department of Technical Cooperation for Development is providing the means for four engineers from the PNOC Energy Development Corporation to study methods of using geothermal energy for crop and lumber drying, and food processing applications. Three of the U.N. fellows will participate only in the first part of the program, which includes visits to drying equipment manufacturing plants in the Philadelphia area, and five locations in California where different types of drying plants are operating. The fourth, Mr. Guillen will remain for 3.5 months taking courses at OIT and preparing a technical feasibility study for a pilot plant located in the Philippines, with assistance from GHC staff. The program begins March 1, 1987. (Paul Lienau, OIT)

1.4 Geothermal Technology Organization is Being Formed: Potential members of the Geothermal Technology Organization met during the Twelfth Workshop on Geothermal Reservoir Engineering at Stanford University to discuss proposed changes in the group's charter and agreement with the U.S. Department of Energy. Several minor changes have been made to the charter as a result of the meeting. April 15, 1987, was selected as the final date for payment of the initial fee of $500 and signing of the Organization's charter. Shortly after that date the organization will meet to elect officers and to begin the selection of initial research projects. It is anticipated that an early action of the group will be the approval of an agreement to perform cost-shared research with the U.S. Department of Energy. Anyone wishing to join the group should contact Mr. Joel Renner at the Idaho National Engineering Laboratory, (208) 526-9824, and request a copy of the charter.

The purpose of the organization is to advance the state-of-the-art of geothermal technology by providing a forum for:

Presentation of research proposals for sponsorship by members of the Organization and others,

Advising academic organization and other research oriented groups of the needs and interests of Members, and

Facilitating the industrial development of laboratory and research results related to geothermal technology. (Joel Renner, INEL)

1.5 GRC Issues Call for Papers for Annual Meeting: The Geothermal Resources Council has issued a call for papers for the Annual Meeting to be held October 11-14, 1987, in Sparks, NV. The deadline for the submission of the final format is June 1. The council can be contacted for additional information at P.O. Box 1350, Davis, CA 95617-1350, telephone (916) 758-2360.

REGION IX

CALIFORNIA

INDUSTRIALIZATION ACTIVITIES

1.6 Lake County Ag Park Well No. 3 Tested: A third well was completed in December, 1986 for the Ag Park near Kelseyville, California. The well was drilled to 488 ft, pumped for 60 hours producing 142 gpm of 152°F hot water. The pumping rate was limited by the pump size, which only caused a 6 in. drawdown in the well. It is estimated that 300 gpm could be pumped from the well with a 2 ft drawdown. In addition to hot water, the well may have produced methane and smelled like an oil well. Gases are being analyzed by the Lake County Air Quality Management District.

With two good producing wells, Ag Park Nos. 2 and 3 for production and Ag Park No. 1 for injection, 400 to 500 gpm of 150 to 155°F water will be available for the park. Lake County is planning to build a 10,000 square ft demonstration greenhouse which will also be used for training purposes for students from Mendocino College. OIT's Geo-Heat Center has received a request to provide assistance with design of pumps, distribution piping, and irrigation supply by means of a CEC contract. The County also plans to market 3 to 4 acres of land for private development and provide hot water for heating purposes. (Paul Lienau, OIT)

1.7 40 MW Planned for Casa Diablo Area: Developers for three separate binary power plants are currently involved in environmental studies near the existing 7.5 MW air cooled binary Mammoth - Pacific (MP-1) operating unit.

The first is a 10 MW hybrid air/water cooled binary plant, called the Mammoth - Chance Project, being developed by Bonneville Pacific, Inc. Formerly, this site was the Chance Ranch project by Wood and Associates. Leases are held by the Los Angeles Department of Water

and Power; they were originally held by Magma. The location is 3.5 miles southeast of MP-1. This project is at the end of the EIR phase.

A second proposed development by Pacific Lighting and Energy Systems (PLES) is a 10 MW air cooled binary plant located adjacent and south of MP-1. Geothermal leases are on Forest Service land held by Sante Fe Geothermal, Inc. PLES is the resource developer and they are beginning the EA phase of the environmental studies.

East of the existing MP-1 unit, units 2 and 3 (10 MW each) are under development by a limited partnership consisting of PLES, Magma and Ben Holt. The site is on private property and a draft EIR has been completed. (Paul Lienau, OIT)

REGION X

IDAHO

INDUSTRIALIZATION ACTIVITIES

1.8 District Heating Development being Considered at Ketchum: Tom Drougas, President of Guyer Springs Water Company, has expressed an interest in delivering geothermal water to a proposed condominium development (one million square feet), using geothermal for spa and space heating. The proposed 30 acre site is located adjacent to Guyer Hot Springs. Guyer Hot Springs has a temperature of 155°F and flows artesian at about 1,000 gpm. Recent resource assessment activities indicate that the location of hot springs in the area is extremely structurally controlled. This may limit additional geothermal development, but further investigation is needed. Hot springs have traditionally been part of the recreational atmosphere in Ketchum, situated in east-central Idaho in the Wood River Valley. Water from Guyer Hot Springs has been piped to a hot spring resort since the turn of the century. (Paul Lienau, OIT)

OREGON

Industrialization Activities

1.9 Geothermal Mushrooms Grown in Eastern Oregon: When Jim Hommand's rotary well-drilling rig opened a geothermal aquifer in Vale in 1981, he did not realize the geyser of boiling water showering over him prestaged the birth of a mushroom-growing industry. "The well blew up about 100 feet in the air and flowed for about 24 hours before it settled down", recalled Paul H. Rutten, 45, of Ontario.

Rutten said he immediately realized the potential for the 235°F artesian well water in a project he was considering, a climate-controlled, geothermally heated indoor farm for raising white button mushrooms. Rutten, a native of Holland, had learned mushroom-growing in Europe before coming to the United States in the early 1970s.

Thus Oregon Trail Mushroom Co. was born, although the $8.5 million fresh-pack operation did not go into full production until 1986. Rutten calls it the world's most technologically advanced mushroom farm, producing 5 million pounds of the edible fungi annually.

A computer controls even the carbon dioxide levels in the plant's 40 growing rooms, automatically checking and rechecking the climate every five or six minutes. Temperatures vary from 64 to 140 degrees, depending on the stage of the process. The mushrooms are grown in eight-week "batches", with the crop from five of the growing rooms harvested each week.

Hot water from the geothermal well that makes it all possible is pumped into a closed loop system of heat exchangers that heats and cools the operation. Without the geothermal water, the process would not be cost-effective, yet the water loses no more than 10 to 15 degrees of heat before it is returned to the aquifer.

The Vale plant was established in partnership with a group of New York investors. The crop is marketed in Spokane, Seattle, Salt Lake City, and the Treasure Valley area around Vale and Ontario. (Paul Lienau, OIT)

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3.1 Geothermal Direct Use Handbook to be Published by Oregon Institute of Technology: The OIT Geo-Heat center will publish a geothermal direct use handbook for the technical community and the users of low and moderate temperature resources. Paul Lienau, OIT Geo-Heat Center Director, and Ben Lunis, Idaho National Engineering Laboratory (INEL), will be coeditors. Text contributors will be the Geo-Heat Center staff and director, Sally Benson, Lawrence Berkeley Laboratory, Gordon Bloomquist, Washington State Energy Office, Ben Lunis, INEL, and Dr. Philip M. Wright, Utah University Research Institute. Completion of the 20 chapter document is scheduled for the end of the year. (Ben Lunis, INEL)

3.2 Geothermal Binary Cycle Power Generator Installed in Australia: The first successful geothermal power plant in Australia is operating from a hot artesian bore at Mulka Station on the Birdville Track in South Australia. A 20 kW, 415 V, III phase unit has been successfully operating since May 1986. A second unit has been successfully working on a solar pond at Alice Springs since February 1985. ENRECO PTY., Ltd. designers and manufacturers of organic Rankine cycle power generators is in the process of designing larger machines, including a 120 kW plant to be installed in Southwestern Queensland. (Paul Lienau, OIT)

3.3 GRC Annual Meeting Deadlines Posted: The 1987 GRC Annual meeting to be held October 11-14 in Sparks, NV requires submittal of technical and poster papers by June 1.

The 1987 Annual Meeting will also feature two pre-meeting Short Courses: An Introduction to Geothermal Energy and Geothermal Project Management. also included are: 1) two spouse tours, 2) introductory course on geothermal energy including a field trip for spouses, and 3) three field trips to various geothermal development sites.

In addition, the following organizations will meet: 1) Geothermal Resources Association (GRA), 2) Geothermal Drilling Organization (GDO), 3) Geothermal Technical Organization (GTO), and others. If you are involved in the planning of a meeting for one or more of these organizations during the GRC 1987 Annual Meeting, please call Graciela Mata, Meeting Planner, telephone 916/758-2360, P.O. Box 1350, Davis, CA 95617.

3.4 Heat Pump and District Heating Workshop Set for May 6 and 7: The GRC Pacific Northwest Section will present a workshop May 6 and 7 at the Benson Hotel, Portland, OR.

Day one of this workshop will focus on the technical aspects of water source heat pump utilization, hydrothermal resources available for use with heat pumps, special resources, and operating experience from systems in the Northwest.

Day two of the workshop will emphasize regulatory aspects related to water source heat pump utilization and district heating. Topics include groundwater regulations, public utility implications of district heating operations, contracts and franchises, financing, and marketing.

Two short field trips to operating water source heat pump installations are planned for Wednesday afternoon, May 6, and Thursday afternoon, May 7. For details, contact Marshal Gannett, ODWR, 503/378-8456 or Gordon Bloomquist, WSEO, 206/586-5074.

3.5 BPA Issues Geothermal Plan: The 1983 Power Plan, developed by the Northwest Power Council, recommended Bonneville Power Authority develop a "geothermal demonstration program" of 10 MW of capacity to encourage confirmation of the region's geothermal resource. In its 1986 Power Plan, the council stepped back from advocating a single, site-specific power plant demonstration project and focused on the preliminary problem of confirming the resource. Bonneville's objectives to implement the 1986 Power Plan are threefold:

a. Design a confirmation program which, when implemented by Bonneville, would result in confirmation of a single-site environmentally acceptable geothermal resource, within the region, capable of supporting 100 MWe for 30 years.

b. Provide assurance that the electrical power generated from the resource will be made available to the region in the future when it is needed, at competitive prices.

c. Complete the design of the confirmation program by the end of FY-1988. By all estimates, there is a vast geothermal resource potential in the region which may be both cost-effective and environmentally acceptable. Confirmation, through exploration, drilling, and reservoir development, is the only way to ascertain the nature and extent of this resource.

BPA is a Federal agency with power generating and transmission authority in Oregon, Washington, Idaho and Western Montana. (GRC Bulletin, March 1987)

REGION VI

NEW MEXICO

INDUSTRIALIZATION ACTIVITIES

3.6 Burgette Floral Geothermal Greenhouse Covers 10 Acres: Burgette Floral now has 10 acres of rose growing facilities at Animas. Four separate units are supplied from two 200 ft. deep wells that produce 250 gpm, 245°F geothermal fluid. The utilization factor is 40% using a forced air system. About 5000 roses are produced each day, being sent as far as Washington, D.C. (Paul Lienau, OIT)

REGION VIII

WYOMING

INDUSTRIALIZATION ACTIVITIES

3.7 Geothermal Greenhouses to Raise Cultures for Penicillin: Bio-Genesis, International is building 13 acres of greenhouses near Casper to raise cultures for penicillin and other pharmaceuticals, as well as flowers. A geothermal heating system, consisting of fan coil units, will use 142°F geothermal fluids from the Madison aquifer. (Paul Lienau, OIT)

REGION IX

CALIFORNIA

INDUSTRIALIZATION ACTIVITIES

3.8 Salton Sea 3 Plant Started: Unocal Corporation's Desert Power subsidiary began construction of a 47,500 kW generating plant, designated Salton Sea 3, at the south end of the Salton Sea in Southern California's Imperial Valley. Start-up is scheduled by early 1989

with geothermal power supplied by Unocal from a nearby reservoir it believes to be one of the largest hot water fields in the world. (O&G Journal, 3/23/87)

NEVADA

3.9 INDUSTRIALIZATION ACTIVITIES

New Power Plant Scheduled for Steamboat Hot Springs, Nevada: A second power generation project is underway at Steamboat Hot Springs, about 10 miles south of Reno, Nevada. The principals are the U.S. Bureau of Land Management (BLM), Chevron Resources, and Yankee/Caithness. Plans are to construct a location for two 12.4 MW (net) modular single flash type power plants, which will be constructed by Geothermal Power Corporation of Elmira, New York.

The first unit will be installed in the spring of 1987 and should go on line in the fall of the same year,(the second unit will be installed at an undetermined time in the future). The modular unit will operate on production from three existing wells, and water will be disposed in an existing injection well. Inlet temperature to the turbine is calculated to be 298°F at 65 psia. The condenser will operate at 2.5 inches of mercury absolute.

Although the project will be constructed on private land, it is located within a Federal Geothermal Unit and is, therefore, subject to BLM approval. Final approval has not, as yet, been granted. Power will be sold to Sierra Pacific Power Company.

The first power plant in the area was constructed by Geothermal Development Associates, which went into full operation in late 1986. This plant is constructed to the north of the new plant; it generates power using modular ORMAT binary units, and it receives production from a shallower reservoir. (GRC Bulletin, March 1987)

IDAHO

INDUSTRIALIZATION ACTIVITIES

3.10 Raft River Site Package for Sale: U.S. Energy Corporation is requesting proposals for 560 acres of fee land, 4181 acres of federal geothermal leases, and 13.5 acres of private geothermal leased-hold at Raft River. Included are five production wells, two injection wells, and seven monitoring wells. Improvements include office, shop, and warehouse buildings, roads, utilities, and fencing. The 280°F resource was used for the DOE 5MW Raft River demonstration plant that completed testing in 1981. Information is available from U.S. Energy Corp., 1755 East Plumb Lane, Suite 265A, Reno, NV 89502, telephone 702/323-2866.

OREGON

INDUSTRIALIZATION ACTIVITIES

3.11 Direct-Use Development Planned at La Grande: BBC Brown Boveri District Heating and Cooling, Inc. has contracted with the Hot Lake Company of La Grande to supply pipeline equipment and financial assistance for the Hot Lake, Oregon Recreation Vehicle (RV) Resort Geothermal Project.

The model system, located in the Grande Ronde Valley of Union County will pipe 185°F geothermal surface water 2,500 feet from the Hot Lake artesian well heat source to the R.V. resort's mineral baths and related buildings, then 300 feet beyond to heat proposed greenhouses.

Financial assistance provided to Hot Lake Company will take the form of a grant to defray first year costs of the equipment Brown Boveri is supplying to the project. The aim of New Jersey-based Brown Boveri District Heating and Cooling is to show how cost effectively a smaller district heating system can meet commercial/domestic heat and hot water needs with minimum temperature loss and environmental impact to benefit both community and company. (GRC Bulletin, March 1987)

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21 The Hurdles Confronting Geothermal:

Geothermal energy could make an "important contribution to U.S. energy self-sufficiency" in the future, but reduced research support and formidable technological hurdles are slowing prospects for its full exploitation, according to a new report from the National Research Council.

A stable R&D program "is needed to determine and improve the scientific, engineering and economic feasibility of using energy from all types of geothermal sources," says the report, "Geothermal Energy Technology: Issues, R&D Needs, and Cooperative Arrangements", which was requested by the Department of Energy's geothermal technology program. The program should be funded for five years and not fall below a certain minimum level, the council recommends.

DOE's support for geothermal research fell from $158 million in 1979 to just $21 million in 1987. The council recommends that funding be increased to $35 million in 1988. Late last year, however, Congress appropriated only about $23 million for the geothermal technology program.

In the future, federal spending on the geothermal program should be expanded to $38.7 million in 1989 but then reduced to $26 million by 1992, the council recommends. Industry will likely invest $3.5 million annually to develop drilling technology and high-temperature instrumentation, the report adds.

Of the four types of geothermal energy resources examined in the report, only hydrothermal--hot water and steam--has been exploited by electric utilities. But the current effort uses only a small portion of the potential supply of hydrothermal energy, the report says.

There are economic uncertainties and technological hurdles in obtaining energy from geopressured, hot dry rock and magma sources, the report points out. Getting energy out of hot dry rock systems requires the fracturing of impermeable hot rock to allow water injected into one well to circulate through the rock network and then flow back to the surface through another well. Magma resources "represent a potentially significant source to future U.S. energy supplies," the council says. But the technological obstacles in getting to magma, which is located about three kilometers beneath the earth's surface, must be overcome.

The council's report recommends that the largest share of federal research dollars go into the more traditional hydrothermal systems. New technologies should also be developed to help in exploiting other geothermal energy sources. This approach would also yield quick energy returns, the study says.

Even though paybacks from investing in hot dry rock, geopressured and magma resources are more uncertain than hydrothermal sources, a commitment to research is necessary, the council says, noting that the U.S. government should support a "viable and stable research program for these longer-term geothermal energy resources."

Moreover, the Geothermal Drilling Organization, a cooperative research effort funded by DOE and industry, needs to broaden its emphasis to commercialize the more promising technologies, the study says. The group also should be restructured and its name should be changed to the Geothermal Development Organization. Also recommended is the creation of a Geothermal Research Organization "composed of researchers interested in scientific and technological issues of long-term geothermal resources." This group would advise government agencies, develop the research agenda and allocate funds for selected studies. (The Energy Daily, January 29, 1988)

22 GRC Issues Call for Papers:

The Geothermal Resources Council has issued the Call for Papers for its 1988 Annual meeting, to be held October 9-12 at the Town & Country Hotel in San Diego, CA. (Pre Meeting Short Courses will be held October 6-8, and Post Meeting Field Trips are scheduled for the 13th and 14th.)

Papers are being solicited in a number of areas: 1) Exploration and Development Operating Case Histories, 3) Drilling Technology, 4) Production Technology, 5) Reservoirs, 6) High and Low Temperature Power Generation, 7) Direct Use, 8) Legal and Institutional Aspects, 9) Economics, Financing, and Marketing, and 10) Environmental Aspects. Topics to be emphasized are: experiences and operational history of Imperial Valley Power Plants; case studies of Imperial Valley geothermal systems; pipelines and power lines engineering and environmental problems; drilling in geothermal systems; and hydrogeology and geochemistry of geothermal systems.

To be considered for inclusion in the program of the 1988 Annual Meeting, a paper must conform to the special format outlined by the GRC in a special Author's Packet, available from the Council at Post Office Box 1350, Davis, CA 95617-1350.

The deadline for submission of papers (in special format) is June 3, 1988.

23 GRC Offers Course for Support Staff:

The Geothermal Resources Council will offer a course for support staff personnel on the basics of exploration, evaluation and exploitation of geothermal energy. The course is to be held May 12-13, 1988 at the Radisson Inn at the San Francisco Airport. Additional information can be obtained from the GRC, P.O. Box 1350, Davis, CA 95617-1350, telephone 916/758-2360.

24 DOE's Geothermal Program Review Slated:

DOE's Sixth Annual Energy Geothermal Program Review will be held April 19-21, 1988, in San Francisco, CA. Program Review VI, entitled "Beyond Goals and Objectives," will be held in conjunction with the National Geothermal Association's half-day Industry Round Table on Federal R&D (beginning at 8:30 a.m. on April 21).

During the conference's first two days, individual program review sessions (on hydrothermal, geopressured-geothermal, hot dry rock, and Magma energy research) will address R&D in the areas of resource analysis, fluid/energy production, and energy conversion. Following the Industry Roundtable, the conference will conclude with a Special Issues Session, including discussions on Quantifying the Cost-of-Power Impacts of Federal R&D and International Markets for U.S. Geothermal Equipment and Services.

Additional information on Program Review VI is available from Ms. Carole Beeman, Meridian Corporation, 4300 King Street, Suite 400, Alexandria, VA 22302. Telephone: 703/998-3600. (Geothermal Report, March 15, 1988)

25 Renewable Energy Projects Dedicated in Massachusetts:

During "Energy Awareness Week '87" several events highlighted the growing role of renewable energy resources in meeting Massachusetts' energy needs. As part of the week's activities, Secretary Pollard dedicated three projects that utilize solar, hydroelectric, and geothermal power.

The first project dedicated was developed in conjunction with the Boston School Department. Boston English High School is using their newly dedicated geothermal heat pump system to augment heating and cooling the school. The system will displace electrical energy with geothermal energy. Depending on usage patterns and electricity prices, the school could realize savings from $25,000 to $40,000 per year.

Geothermal energy is the utilization of the earth's internal heat. The geothermal heat pump system at Boston English incorporates a 35 ton heat pump, two 1,000 feet deep wells, a desuper heater, and assorted piping and controls. The geothermal system interfaces with the schools existing HVAC system. (Energy Resources, Winter 1987/88)

REGION VI

NEW MEXICO

INDUSTRIALIZATION ACTIVITIES

26 Symposium Promotes Geothermal Greenhouse Development in New Mexico:

Nearly fifty persons involved in the greenhouse industry, real estate, geothermal and horticultural research and development, and economic development attended the second symposium February 21-23, 1988 at New Mexico State University, Las Cruces, N.M. The event was coordinated by the New Mexico Solar Energy Institute at NMSU, the New Mexico Research and Development Institute, NMSU Department of Horticulture, the Western Area Power Administration and several local greenhouse businesses. The objective of the event was to promote commercialization of greenhouses in southern New Mexico.

27 Geothermal Program Pushes Economic Development:

In 1982 the New Mexico legislature provided $100,000 to the New Mexico Energy and Minerals Department (EMD) to be spent on cost-sharing for drilling geothermal wells. The money was targeted towards private New Mexico geothermal leaseholders with the intent of reducing the risk and cost associated with geothermal exploration and development. The financial arrangement established a 50 percent cost sharing between the State and the leaseholders. The New Mexico State University Energy Institute (NMSUEI) was retained to provide technical and administrative assistance to the EMD and private developers.

The results of this program are positive. Twelve exploratory geothermal temperature gradient holes and nine geothermal production wells were drilled under the auspices of the program. Confirmation of suspected resource areas was successful for eight New Mexico leaseholders and not successful for two others. One large, previously unexplored resource area was partially delineated. The developer believes that this resource area, located on the Rio Grande Rift near Hillsboro, New Mexico, may be suitable for electricity production.

Nine production wells were drilled for several commercial enterprises. Five of the production wells are to be used for heating of large structures, primarily greenhouses. Two of the wells will be utilized for low-temperature electricity generation using Rankine-cycle technology. Two additional wells were plugged and abandoned due to insufficient fluid flows.

An extensive reservoir test was carried out for one program participant. A continuous ten-day flow test showed no drop in temperature nor any adverse effects on nearby wells. Drawdown in the production well was less that ten feet at flow rates in excess of 350 gallons per minute at 168^{o}F.

A total of 6,362 feet were drilled over the four year project period. Temperature gradient holes accounted for 67 percent or 4,258 feet. Production wells totalled 2,104 feet. New Mexico leaseholders spent over $120,000 for drilling and testing and were reimbursed by the State of New Mexico for nearly $60,000. The average cost for drilling a temperature gradient well was $9.40/ft. while production well drilling costs averaged $31.63/ft. There was a greater range in well drilling costs for production wells (e.g., from $21 to $83 per drilled foot) due to different drilling rigs, drilling depths, well diameter, well casing depth, and formations that were encountered.

The success of several of the cost-shared drilling projects will lead to new economic development initiatives within the state. In Radium Springs, a large greenhouse facility will be built by Alexander R. Masson, Inc. to utilize the geothermal resource. Initial plans are for four acres of enclosed greenhouse space to be built with possible future expansion of up to twenty acres. When the four acres are finished and placed in plant production, approximately forty people will be employed.

Another project that will contribute to greater utilization of the geothermal resource base is the power generation that will be possible with the two cost-shared production wells at Gila Hot Springs. An existing 10 kW Rankine cycle generator will be supplied with 74^{o}C water at flow rates in excess of 150 gpm. The electrical power will be distributed to the small community at Gila Hot Springs.

In addition, leaseholders who drilled temperature gradient holes have entered into a wide variety of discussions with potential developers. Some leaseholders are attempting to develop their property themselves with the intent of selling hot water and/or land to an end user. Other leaseholders have been negotiating for the direct sale of their lease and/or property believing that the confirmation of the resource has enhanced the value of their holdings.

The downturn in prices for conventional fuels has tended to slow the geothermal development process. In general, those areas with shallow resource bases (e.g., Radium Springs or Gila Hot Springs) will receive more immediate interest while the deeper resource areas (e.g., Hillsboro, Las Cruces, East Mesa) will probably not be developed as rapidly. This phenomenon is principally due to the relativity high capital costs associated with developing the deeper resource areas. (Jack Whittier, NMSU)/

REGION VIII

UTAH

INDUSTRIALIZATION ACTIVITIES

28 LDS Church Investigating Use of Geothermal Energy:

Howard Ross, UURI SCP Project Manager, recently met with Orrin Miller, P.E. (Civil Engineer and Hydrologist) of the Church of Jesus Christ of Latter Day Saints. Mr. Miller has been summoned to a mission for the Church to review the potential for geothermal resource utilization throughout the western United States. Mr. Miller noted that space heating costs for a typical chapel run from $1,000 to $3,000 per month and that the Church is searching for various ways to reduce these costs. The LDS Church has more than 300 properties in Utah alone and believes that some of these are likely connected with geothermal resources. In addition, land purchase for new chapels, farms and other properties is an ongoing effort and geothermal resource potential could influence these purchases.

UURI has provided Mr. Miller with Geothermal Resource Maps for all of the western United States, the addresses of State Teams (past and present), references to selected reports and other information. Essentially all of the data base made available to the LDS Church as been generated through many years of effort by the department of Energy State Cooperative Program, and by the organizations participating in this program. Because of the large number of LDS Church properties throughout the western United States there is some possibility that eventually, supported by a favorable early experience, the Church could become one of the largest direct heat users of geothermal energy.

Mr. Miller expressed specific interest in resource areas in Alaska, Hawaii, Idaho, Nevada, and Utah. Near term plans call for collocation studies for new chapels in the Milford and Escalante areas in Utah, and in Southern Idaho. (P.M. Wright, UURI , January 28, 1988)

REGION IX

CALIFORNIA

INDUSTRIALIZATION ACTIVITIES

29 Agreement Reached for More Plants at Coso:

California Energy Company and Mission Power Engineering Company, a wholly-owned subsidiary of Southern California Edison Company, last month announced that they had reached a "definitive agreement" for the engineering and construction of additional geothermal plants for the Coso Project. Under the agreement, Mission Power will have two additional geothermal power plants (Units 2 and 3) on line by the fourth quarter of 1988. Under separate understandings, Mission Power is also designing six additional power plants, which are expected to go on line following Units 2 and 3. (The Coso Project, which placed its first geothermal 30 MWe power plant on line in July 1987, is expected to have a total of 240 MWe on line by December 1989.) (Geothermal Report, January 15, 1988).

30 GEO to Install Two Coldwater Creek Plants:

GEO stated that the company will install two 10 MW plants on the 700 acres of land owned by Joseph W. and Mary Aidlin in the Coldwater Creek area of the Northeastern extension of The Geysers. In order to do so, GEO has purchased for about $4 million the two modified Standard Offer No. 4 power sales contracts held by SAI Geothermal, Inc., under which it will provide electricity to the PG&E.

Mission Power Engineering, a subsidiary of Southern California Edison, has entered an agreement to design, engineer, and construct the power plants, which GEO said will have to be in operation by November 1989. The "Aidlin Project," as it will be called in honor of the pioneer (with B. C. McCabe) in the development of The Geysers, now the world's largest producer of energy from the Earth's heat, will cost approximately $50 million to complete, GEO estimated. (Geothermal Report, February 15, 1988)

31 Amedee Hot Springs Project Going Forward:

Trans-Pacific Geothermal, Inc. of Oakland, CA and U.S. Energy Corp. of Reno, NV are working toward the completion of Phase I at Amedee Hot Springs in Lassen Co. of northern California.

Phase 1 consists of two 6.8 MW (net) Barber Nichols modular, binary power plants. The two units will operate on brine produced from two wells that have an average depth of 1,000 ft. The reservoir temperature ranges from 220^{o} to 230^{o}F. Because waste water quality is almost the same as the water being produced by the hot spring, a temporary surface water disposal permit has been issued by the State Water Quality Control Board.

The operators are now in the process of drilling the second production well. Construction on the modular units has started and installation work in the field should start in the summer of 1988. Power will be sold to Pacific Gas and Electric Co. under a 5 MW Standard Offer 4 Contract. Power will be wheeled through a power line that passes through the property.

Phase 2 will consist of a total of 3.4 MW (net) bringing the total for the project to 5 MW (net). Amedee Hot Springs is approximately 3 miles southeast of Wendell Hot Springs or about 30 miles east of the city of Susanville, CA (GRC Bulletin, February 1988)

32 20 MW Geothermal Power Plant Built in Seven Months: Ormesa II, a 20 MW geothermal power plant, has begun supplying power to Southern California Edison, only seven months after commencement of the project. Using moderate temperature heat from ground water sources, the plant will ultimately supply the electricity needs of some 20,000 families.

Ormesa II is located in the East Mesa Known Geothermal Resources Area, Imperial Valley, California, alongside Ormesa I, its 30 MW sister plant also developed and built by Ormat. The project is the culmination of International, Inc.. Construction of the project

started in May 1987 and seven months later was substantially completed, with nine drilled and tested production and injection wells, successful preoperational tests of the power plant, and the synchronization of all the 20 Ormat Energy Converters to the grid. With the completion of the drilling, testing and hook-up of the remaining wells, the $70 million project expects to declare firm operation less than a year from the day construction started.

Ormesa II comprises 20 modular Ormat Energy Converters (OEC's), each of which is a self-contained power plant of 1.2 MW capacity. An organic fluid is heated by the hot geothermal water in a closed loop. The fluid vaporizes and passes through the turbine, turning the turbine rotor to generate electricity. The organic fluid is then cooled and reheated, and the cycle repeats itself. The modularity of the system yields advantages in that standard units can be used to build different sized plants. Furthermore, the factory assembled and tested units can be installed and made operational within a short period of time. All the operations of the facility are computer controlled, including the monitoring and control of the various flows, the determination of the electricity generation, and if necessary, the partial or complete shutting down of the system. (Ormat)

33 Sonoma County Gets Geothermal Grant: In early January 1988, the Sonoma County Board of Supervisors accepted a $238,920 grant from the California Energy Commission. The grant is to be used for studies of the geothermal potential of county land between the Sonoma Development Center and Maxwell Farms Park. The grant includes tasks to perform exploration operations pointed toward the possible production of warm water. (GRC Bulletin, March 1988)

34 Contract Signed for 37 MW East Mesa Power Plant:

Geothermal Resources International, Inc. (GEO), on 18 February 1988, announced that it has signed a contract with Mitsubishi International Corporation (MIC) for the engineering and construction of GEO's 37 megawatt geothermal East Mesa power plant with an option

for a second 37 megawatt power plant, both of which will be located approximately 30 miles east of El Centro in the Imperial Valley of southern California.

The two-plant East Mesa Project is estimated to cost a total of approximately $200 million. The contract with Mitsubishi for the engineering and construction of the two proposed geothermal power plants, which will supply electricity to Southern California Edison Company (SCE), represents over 50 percent of this total project cost.

In April 1987, GEO acquired from Magma Power Company the rights to develop and utilize the geothermal resources from Magma's leaseholds at East Mesa. Electricity from the power plants, which must be in operation by November 1989, will be sold to SCE under 30-year contracts. Since April, GEO has drilled four wells at East Mesa and anticipates commencing further drilling in the near future.

MIC will engineer the plants in conjunction with Mitsubishi Heavy Industries, Ltd. and Stone & Webster Engineering Corporation, and will employ Becon Construction (a Bechtel subsidiary) to construct the units. The East Mesa project will utilize the double-flash power cycle in which hot brine is collected from wells 4,000 to 8,000 feet deep. (GRC Bulletin, March 1988)

35 <u>Update on Mammoth Lakes Geothermal Resource Assessment:</u>

The Town of Mammoth, CA, on 31 January 1988, completed the drilling of its second geothermal temperature gradient exploratory well. The second well was drilled to a total depth of 1536 feet, with tubing hung to a depth of 1464 feet. The tubing is filled with clear water from which temperature measurements can be made. The location of this well is the town's Road Department shop area on Berner Street, near Minaret Road. The drill rig was released, and the well is presently shut in pending thermal equilibrium. Preliminary temperature indications and lithology are very encouraging, but the city will know more after a few weeks of observation.

The town's first temperature gradient exploratory well, which is on private property behind the Lutheran Church on Meridian Blvd., was completed on 11 December 1988. Several temperature logs have been recorded from this well, with a maximum temperature of 165°F observed to date. This temperature is not quite warm enough for the needs of the town. Also, there doesn't appear to be any permeability at the depths where the warmest temperatures are found.

The Mammoth Lakes Geothermal resource Assessment Project is funded through the Geothermal Grant and Loan Program of the California Energy Commission. The purpose of the project is to locate and quantify the shallow geothermal resource underlying the town of Mammoth Lakes. Mammoth Lakes is located in the southwestern section of the Long Valley Caldera. There is extensive geothermal activity in the area, and the Mammoth Pacific Binary Power Plant at Casa Diablo Hot Springs is located just a few miles outside of town. Positive results from the GRAP wells may lead to future utilization of the resource for the benefit of the town. (GRC Bulletin, March 1988).

36 Resource Discovery Made at Alturas:

On 11 March 1988, it was reported that drilling near the Alturas High School had reached a depth of 2,400 feet and temperatures in the range of 175-200°F. These temperatures were higher than expected, since a 930 foot well approximately 1.5 miles away has a bottom hole temperature of 120°F.

The city of Alturas obtained a $79,000 grant from the California Energy Commission to drill an exploratory well. The tentative plan is to complete the well as a producer to provide geothermal heating to Alturas High School and possibly county buildings. (Paul Lienau, OIT)

NEVADA

INDUSTRIALIZATION ACTIVITIES

37 Stillwater Geothermal Project Planned:

Ormat Energy Systems, Inc. of Sparks, Nevada recently announced that it has acquired the assets of the Stillwater Geothermal Project, located approximately 10 miles from Fallon, in Churchill County, Nevada. Ormat Energy Systems, Inc. will construct an 11 MW geothermal power plant utilizing their binary cycle technology which is also utilized at the nearby Soda Lake Geothermal Power Plant. The wellfield will consist of four production wells delivering geothermal fluid to the power plant. The electricity will be sold to Sierra Pacific Power Company. Ormat expects to synchronize the project to the grid by year end 1988.

The geothermal resource was originally explored by UNOCAL Geothermal (previously Union Oil of California) and was subsequently further developed by Trans-Pacific Geothermal Corporation.

The plant will join four other Ormat geothermal power plants in Nevada (seven in the western United States). (GRC Bulletin, March 1988)

38 Gerlach and Soda Lake Plants are in Service:

Ormat Energy Systems, Inc. of Sparks, Nevada announced in late January of 1988 that it has placed in service two new binary type geothermal power plants. The first power plant, (Empire Geothermal Project) which has a capacity of 4.8 MW gross, was constructed approximately 10 miles south of Gerlach, Nevada. The second plant which have gross capacity of 3.6 MW is located in the Soda Lake Geothermal Project. The plant is approximately 5 miles northwest the town of Fallon. Power from both plants will be sold to Sierra Pacific Power Company, the local utility, under two separate 30-year

power-purchase agreements. Both plants qualified for Sierra Pacific's long-term avoided cost rates. The Soda Lake plant utilizes a geothermal resource that was developed and owned by Chevron Resources. Ormat will operate both power plants. (GRC Bulletin, February 1988).

39 Steamboat Springs Plant is On-Line:

The 125 MW single-flash geothermal electric plant of the Caithness Group at Steamboat Springs, NV, has finished its 100-hour test and is on the line commercially delivering its output over a 2 1/2 -mile line to the Steamboat Springs substation of the Sierra Pacific Power Company. The power is sold under a 30-year PURPA contract approved by the Public Service Commission of Nevada. (Geothermal Report, March 1, 1988).

40 Mineral Processing Enters Second Phase:

The U.S. Bureau of Mines has allocated $600,000 for the second phase of a project to evaluate the feasibility of using geothermal heat energy to enhance gold and silver heap-leaching operations. The work will be conducted by the University of Nevada. Las Vegas Division of Earth Sciences. Results of previous studies indicate that geothermal energy could be beneficial to mining operations.

The heap-leaching process, through which pit mine operators extract gold and silver from low-grade ore, takes many months to complete, and the operation depends heavily on the weather. Active mines that use cyanide heap-leaching either shut down during the winter or use expensive oil immersion heaters to prevent freezing in the heap and the pipelines. The University's lab studies showed that geothermal heat could enable operations to continue at a profitable level on a year-round basis and that metal recovery was from 17-40 percent greater.

Since these results were published last year, two Nevada mines--Pegasus Gold Corporation Florida Canyon Mine and Echo Bay Mines Round Mountain Mine--have independently begun using geothermal heat for the cyanide solution. Right now Pegasus is applying 160°F geothermal water through a heat exchanger to heat the cyanide solution, bringing the temperature from 42 to 70°F. Researchers believe that if the temperature could get to 75°F, gold recovery could be significantly enhanced for a given period of time.

At present, spent geothermal fluids are being injected into the ground. The University envisions new field work to determine the feasibility of using the fluids directly in the cyanide circuits, reducing the amount of geothermal brines to be disposed of and eliminating the expenses involved with importing water. The big unknown is whether the chemistry of the geothermal fluids would be detrimental to ore recovery. As part of the field work, Earth Science staff will work with the Pegasus and Echo Bay mines, initially conducting large-scale column tests on the ore to determine the compatibility of the geothermal fluids with the cyanide solution. (Geothermal Report 1/88).

REGION X

IDAHO

INDUSTRIALIZATION ACTIVITIES

41 Wood River Geothermal System to be Discussed May 19

The Geological Society of America sectional meeting will be held at the Sun Valley Lodge on May 19. The one-day session, starting at 8:00 a.m., will review the Wood River geothermal system. Interested parties should contact Leah Street, Idaho Department of Water Resources, telephone 208/734-3578, or Duncan Foley, Pacific Lutheran College, telephone 206/535-7568.

OREGON

INDUSTRIALIZATION ACTIVITIES

42 Bill Protects Crater Lake From Geothermal Drillers:

On 27 January 1988, a U.S. Senate committee approved legislation that would protect Crater Lake National Park in Oregon from any ill effects of nearby geothermal drilling.

The legislation was proposed by Sen. Mark Hatfield and approved by the Committee on Energy and Natural Resources, of which the Oregon Republican is a member.

Hatfield's proposal would authorize the Secretary of the Interior to withdraw land around the park from geothermal leasing if geothermal development appears likely to damage the lake. It also would require the secretary to halt or restrict ongoing geothermal activity that appears likely to cause damage.

California Energy Co. has been drilling test holes about a quarter mile from the park boundaries since 1986. (GRC Bulletin, March 1988)

43 Geothermal Projects Progressing at Portland:

Portland's Pinnacle Geotechnical Services, Ltd. brought in a 380 foot warm water well as part of Flemming's Corporation's $8.5 million shopping center located at S. E. Powell Boulevard and 82nd Avenue. The 10 inch diameter well at the shopping center would be capable of supplying 1,000 gpm at about $60^{o}F$, although only about 10% of that capacity will be necessary for the project, according to Gerald O. Thompson, Pinnacle vice president. A shallow injection well is expected to be used for effluent disposal. The geothermal heat pump system is expected to be a big plus in getting tenants in the four building, 117,674 square foot shopping center, because it should lead to much more stable energy costs. Powell Street Station

could be the forerunner of several metropolitan Portland commercial developments using geothermal energy for heating and cooling.

For example, Lloyd Center officials have indicated plans for a $40 million plus renovation that could possibly include a geothermal heating/cooling system. (Paul Lienau, OIT)

REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
April-June 1988

GENERAL

44. Significant Increase in Geothermal Direct Use Observed by OIT:

When they made a three-month study for the DOE Idaho Operations Office, the investigators of the Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, OR, were surprised at the very large number and the spread of direct use projects in 31 states. The variety of employments of the earth's heat that were identified also impressed them. Even though, under Director Paul J. Lienau, the Geo-Heat Center has become the authority of this phase of exploitation of geothermal resources in the United States, Lienau and his two associates who did the study recorded statistics that exceeded their expectations.

"The most surprising results," Dr. Lienau told GR, "were the number of installed groundwater-source heat pumps in the eastern states, and there are probably other states with significant numbers of installations. In addition, it was discovered that there was a significant increase in the amount of geothermal energy used for aquaculture projects, especially in Arizona, compared to previous reports. A major aquaculture project raising sturgeon is proposed for north central Montana that could utilize a thermal spring of approximately 72,000 gpm at about 70 degrees F. available at the site. The installed capacity of swimming pools using geothermal fluids is also much larger than previously reported."

Operational direct use projects included 25,390 water-source heat pumps, the fastest growing segment of the market. Industrial uses (largely for enhanced oil recovery in the Williston Basin in Montana, North Dakota, and Wyoming) used the most geo-heat energy. There were 114 swimming pools counted. Pools were especially popular in the colder regions, but they had a very low heat utilization factor.

colder regions, but they had a very low heat utilization factor. Aquaculture projects were counted in the desert regions. There were 639 space heating projects, and 19 district heating sites, in which a community distribution system was employed.

Field evaluators, developers, and drillers should find the report especially interesting. The variety of applications, ranging from winter-heating of paved bridges and deicing of hilly roads to providing hot water for the laundry in a resort in the Grand Teton National Park, excite the imagination.

The report was made by Lienau, who inventoried the Northwest, and his associates, Gene Culver, southwestern states, and John W. Lund, states east of the Mississippi. Smart Data Base Manager from Innovative Software, Inc., was used in manipulating the data and, according to Lienau, "will be used to update the records as new information is obtained."

The address is: Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, OR 97601. (Geothermal Report 6/1/88)

45. BPA Official Speaks Out For Geothermal:

"Growing scientific evidence suggests that earth heat may be Oregon's leading candidate to provide large scale, low cost power in a manner which is socially and environmentally acceptable," Bonneville Power Administration's John D. Geyer recently told a seminar in San Francisco. "The public and corporate choices are whether or not to encourage and support confirmation of (the geothermal) resource ahead of the need for power. A negative decision can force power imports, loss of future income, and higher rates for residential and commercial users."

BPA is the regional power manager and coordinator of energy planning in the Pacific Northwest. The great federal power dams on the Columbia River placed the BPA in the driver's seat for half a century, but new hydro sites are few and far between, and the

"abandoned nuclear projects in Washington state and across the country effectively remove new atomic energy from future choices," as Geyer noted. Geyer warned the region, which includes California as well, since surplus hydro power is sold by the Pacific Northwest producers to utilities and public agencies to the south over the Pacific Northwest-Pacific Southwest intertie lines, against reliance on imports from Canada and Mexico for further growth of demand.

He said, "energy planners see Canada and Mexico as low cost alternatives to new plants in the U.S. Deals such as one just signed by nine Vermont utilities are justified solely on the basis of energy costs. Over the next 25 years, a population comparable to Oregon's will trade $6.5 billion for 500 MW of electricity (about half the state's supply) and freedom from perceived negative impacts of local development. This amounts to a long-term cash hemorrhage from that state."

"Several western utilities are now considering similar deals," Geyer continued. "However, a fraction of this amount invested locally in new plants would produce the same energy PLUS taxes and jobs, along with other strategic and economic values."

"As most utility power plants continue to age without replacement, the geothermal industry is moving ahead to demonstrate convincingly that:

- Modular geothermal power plants are capital intensive and site specific but provide benefits enjoyable across states and regions.

- Geothermal generation is reliable and durable over time with resistance to economic cycles.

- Development is environmentally compatible with other land uses and yields high, continuous payments to local governments.

- It has proven itself a 'good neighbor' in such diverse and sensitive settings as the intensely agricultural Imperial Valley, at recreationally oriented Mammoth Lakes, next to urban Reno, and in the heart of California's wine country." (Geothermal Report 7-15-88)

46. House Acts on Steam Act Amendments:

The House of Representatives voice-voted the Geothermal Steam Act Amendments for 1988 on June 13. Earlier in the month, the House Interior Committee had approved the geothermal leasing bill (H.R. 2794) in the same form voted by its mining and natural resources subcommittee, except for an amendment requiring the Secretary of Interior to submit a report on Crater Lake, OR, to Congress by March 1, 1989, setting out the presence or absence of thermal features.

Representative Tony Coelho (D-CA) offered the amendment after the subcommittee added Crater Lake to the list of 16 national parks having geothermal features needing protection. The amendment also asks the Interior Secretary to include in the study his recommendations as to whether Crater Lake should be retained on the parks list. It appeared to be a defeat for intense lobbying by California Energy Company, which has leases nearby and which argued no thermal features are there and, anyway, its leases are downstream from the lake and any development wouldn't flow uphill.

Coelho's view was that, even though BLM could make leases at Crater attaching protective conditions, it was unwise to leave such discretion with the Interior Department and better for the Secretary to make the study via the USGS and come back with recommendations to settle the matter once and for all. This way, if there were a recommendation to remove Crater from the parks list, Congress would have the final say.

The bill also contains a prohibition on leasing within Island Park Geothermal Area in Idaho, adjacent to Yellowstone, and further prohibits geothermal production, development, and leasing in the Corwin Springs KGRA of Yellowstone National Park until 180 days after Congress receives the report from the USGS on the impacts of such development. The report is due by December 1, 1990.

Other amendments to the Geothermal Steam Act in the bill extend lease terms to a maximum 50-year term, including a 10-year primary term and an additional 40 years in 5-year increments if the lessee qualifies via bona fide efforts to produce geothermal steam in commercial quantities. (Geothermal Report 7/1/88)

47. Senate Passes Energy-Water Appropriations Bill:

The Senate, on June 15, passed the annual Energy-Water Appropriations bill containing a $19.6 million geothermal budget as part of FY-89 Department of Energy requests. The geothermal budget was accepted at the same figure passed by the House of Representatives (GR15Mar.2) with no changes. The separate geothermal loan program, which is playing out to an end, was approved at $75,000 for administrative funds, also no change from the House action. There will be a conference on other items in the legislation, but the geothermal portion will not be subject to the deliberations.

48. Geothermal Is the Best Generating Source, Says Bullish California Firm:

Widespread hostility to nuclear power and to fossil fuel plants in California as well as its lower capital cost make geothermal power the smart way to satisfy California's voracious need for electricity, Charles Condy, Chairman of California Energy Company (CEC), told a group of stockbrokers in Washington late last week. Treated as a separate country, he opted, California is the sixth largest national consumer of electricity.

Later this year, the California Energy Commission will designate geothermal power as the "preferred fuel for the development of electrical power in the state of California," Condy predicted. "Given the ready availability and the environmentally preferable qualities of this resource, why anyone would deliberately choose another fuel is beyond me."

California Energy Company began operations in 1971 as a geothermal resource developer in Central America. The company holds geothermal development leases for 278,000 acres of land in California, Oregon and Washington. It plans to develop and operate a total of nine geothermal units at the China Lake naval weapons center. CEC will have an equity interest of between 46 and 50 percent in the plants. The company will sell the 230 megawatts of electricity produced to Southern California Edison under the terms of a profitable Standard Offer Number 4 contract. The first CEC unit came on-line in July 1978 and all nine will be on-line by July 1989, six months ahead of schedule, Condy said. (Energy Daily July 6, 1988)

49. Geothermal Has Promise in the Caribbean:

The tiny eastern Caribbean island of St. Lucia could sharply reduce its reliance on imported oil if investors could be found to develop the country's proven geothermal resources, says a study by the Los Alamos National Laboratory. The 12 megawatts of power currently consumed on the island are generated by power plants burning imported diesel fuel. A recent study and limited flow test indicated that a single geothermal well in the Sulphur Springs area could provide up to half of St. Lucia's electrical needs. St. Lucia spent roughly $15 million (about 10 percent of its gross national product) on imported fuel in 1987, according to the U.S. Agency for International Development, which provided a $6 million grant and loan package to help pay for the study. Los Alamos studied the country's geothermal resources and estimated that development of this geothermal well could save the island as much as $100 million over a 30-year period.

"It's a boomer, a very high quality geothermal resource," said Los Alamos project manager Bob Hanold, who noted that the temperature and output indicate the well's quality temperature at the bottom of the well is roughly 575 degrees F., significantly above typical well temperatures, and the initial output was in the form of steam, not a combination of steam and brine. If the steam output were to continue, it could be directed to the power plant's turbines without the intermediate step of "flashing" the brine to turn it into steam. (Energy Daily 4/19/88)

50. International Geothermal Association is Coming Closer to Reality:

The International Working Group formed last fall to review the organizational, legal, and financial aspects of "getting the whole geothermal community together" has made initial progress toward creating an international geothermal association.

At a February 1988 meeting in New Zealand, the Working Group formed a charter and bylaws and began raising seed funds. Although the formal incorporation has been accomplished, "a lot of work still needs to be done," a member of the Working Group told GR.

Most of the hard funding to date (about $11,000) has come from the United States and Italy, but a number of countries have expressed interest, including Russia and China.

The group's next meeting is expected to be in Mexicali, following the Geothermal Resources Council's Annual Meeting (October 9-12, 1988, in San Diego). The group's leadership gavel will be passed form Tony Mohon of New Zealand to Hector Alonso Espinosa, Director, geothermal Bureau, Federal Electricity Commission. (Geothermal Report, 5/2/88)

51. Geothermal Publications Available:

The Earth Science Division, Lawrence Berkeley Laboratory, has published a list of nearly 70 reports and papers on geothermal energy that are available to the public. The list includes only those documents issued by the Division since 1986. The main technical areas covered are 1) exploration and delineation of geothermal systems, 2) reservoir assessment, and 3) brine injection. A copy of "LBL Geothermal Program -- List of Publications 1986-1988," dated April 1988, can be obtained from the Earth Sciences Division, Lawrence Berkeley Laboratory, Building 50E, University of California, Berkeley, CA 94720.

REGION VI

NEW MEXICO

INDUSTRIALIZATION ACTIVITIES

52. Museum Utilizes Geothermal Heat

Visitors to the Geronimo Springs Museum in southern New Mexico are sharing an experience with the museum's namesake and ancient tribesmen.

Geothermal energy is providing space heating for the museum at Truth or Consequences.

The historic hot spring began heating the museum late last year with help from Western's Conservation and Renewable Energy (C&RE) cost-shared assistance program.

Facing rising operating costs, the museum had contemplated cutting back services to the community. The geothermal project, however, provided a way to reduce operating costs and increase comfort levels.

"This project is very beneficial to the museum and serves as a model for the rest of the community," said Museum Manager Marilyn Pittsenbarger. "We are very grateful for Western's assistance because we would never have initiated the project without it."

In addition to Western, the Sierra Soil and Water Conservation District, New Mexico Solar Energy Institute (NMSEI) at New Mexico State University, and New Mexico Energy, Minerals, and Natural Resources Department teamed with museum personnel in the project.

The project involves pumping 105-degree Fahrenheit water from an 18-foot deep well and piping it through water-to-air heat exchangers in the museum. The well is near historic Geronimo Springs just a few feet from the museum. (C&RE Bulletin, June 1988)

REGION IX

CALIFORNIA

INDUSTRIALIZATION ACTIVITIES

53. Sturgeon are Being Raised Near Susanville:

Arrowhead Fisheries, northeast of Susanville, California is using a 74 degree F geothermal resource (1350 gpm) to raise sturgeon. The project started in 1986 and currently have 12 earthen raceways (10 ft x 50 ft x 2 ft depth). The company is currently constructing another site near Likely, California that will be about 25 percent larger than the Susanville site with a flow of about 2,250 gpm. (Paul Lienau, OIT)

54. Exploration Planned Near Mammoth Lakes:

Sandia National Laboratories, a contract U.S. Department of Energy laboratory, has submitted a plan of exploration in accordance with 43 CFR 3262 and GRO #5. The site is near the Antelope Spring Road approximately 4 1/2 miles northeast of the town of Mammoth Lakes, California (NW1/4NE1/4, Section 20,T. 3 S., R. 28 E, MDB&M). Drilling, tests and experiments would be done within federal geothermal lease number 11664 held by Santa Fe Geothermal. The program is designed to: detect and study a magma body beneath the Long Valley Caldera; improve high temperature deep drilling techniques and equipment: evaluate the feasibility of producing-1 electrical energy from a magmatic heat source; provide an opportunity for the research community to perform various experiments.

The proposed project would occupy a previously permitted drill site constructed by Occidental Geothermal (now Santa Fe). No additional drill pad or access construction is proposed. The drilling program

would occur in four phases over a 4-year period. Measurements and monitoring would occur for up to 7 years after drilling is complete. (GRC Bulletin, May 1988)

55. Geothermal Greenhouse Project Begun in Lake County:

On February 18, 1988, local officials broke ground near Kelseyville at the site of a greenhouse to be heated by geothermal energy. The greenhouse will provide vocational training and research opportunities for construction crews and interested students, and will offer a site for a geothermally-heated agricultural park - the Geo-Ag Heat Center - that could attract commercial growers in the future.

The California Energy Commission (CEC) provided nearly $500,000 in grant funds for the project. The CEC's Geothermal Grant and Loan Program offers financial assistance to cities, counties, and other local governmental agencies to develop low-temperature geothermal and geothermal electrical systems. Lake County contributed $126,675 and Mendocino-Lake Community College District $73,219 to the project. (Geothermal Hot Line, June, 1988).

56. Mammoth Chance Geothermal Project Approved:

On February 9, 1988, the Mono County Board of Supervisors voted 4 to 1 to approve Bonneville Pacific Corporation's Mammoth Chance Geothermal Project. The project is an air-cooled, binary, geothermal power plant, 10 megawatts, net.

The Mono County Board of Supervisors issued a project use-permit with vigorous and stringent conditions. Specific emphasis was placed on the establishment of a monitoring program designed to detect the effects of geothermal development on the springs at the Hot Creek Fish Hatchery and Hot Creek Gorge.

The developer must guarantee that the temperatures of the fish hatchery springs do not fluctuate outside of an agreed-upon temperature range. Whenever it becomes necessary, the developer must take remedial action to ensure the protection of hatchery springs, including supplemental heating of hatchery waters and, if necessary, curtailment or cessation of all project operations. (Geothermal Hot Line, June 1988)

NEVADA

INDUSTRIALIZATION ACTIVITIES

57. Geothermal Energy to be Used in Gold Leaching System:

Round Mountain Gold Corporation, a subsidiary of Echo Bay Mines, Ltd., has embarked on an expansion program for their geothermally heated heap-leach system located at Round Mountain, NV. The mine has been on line with a geothermally heated heap leach process, designed by Geothermal Development Associates (GDA) of Reno, NV since December, 1987. The expanded geothermal system, also designed by GDA, is scheduled for start-up this summer.

Permit applications have been filed for five new production wells to increase the flow rate from 700 to 3000 gpm. Resource temperatures on the order of 180 degrees F are expected. The geothermal water will be pumped through heat exchangers and used to heat the leaching solution. The heated solution will form less ice on the leach pads during winter months, thereby allowing year round operation. The geothermal water is monitored for potential process fluid contamination before reinjection.

The Round Mountain Gold Corporation produced more than 193,000 ounces of gold in 1987, and is projected to produce more than 200,000 ounces in 1988. (GRC Bulletin, May 1988)

58. Elko District Heating Systems Experience Significant Growth:

Two district heating systems have been built at Elko, Nevada. Elko Heat Co. is a private company that has experienced considerable growth since it first began operation in 1982. The project started as a USDOE Program Opportunity Notice demonstration project consisting of three buildings; a laundry, bank, and motor hotel/casino. The system has grown to include 12 commercial buildings, two residences, and a sewage treatment plant by marketing the system. This was accomplished by offering a preliminary estimate of customer needs to retrofit, educating about the reliability of the system (down less than one day per year) and charging its customers about 50 percent the price of natural gas ($1.00 to $1.25 per 1,000 gallons of geothermal fluids). The system supplies about 36.7 billion BTU/yr from its one geothermal well that produces 650 gpm at 170 degrees F. The company has doubled the length of its delivery piping system and has reached the demand point where it will be necessary to drill a second well.

The Elko Schools district heating system, independent of the Elko Heat Company, has been servicing the High School, Jr. High School (heat pump system), gymnasium, school administrative offices, convention center, city hall and municipal pool for about two years. One of the most impressive aspects of this system is 100 degrees F temperature drop through the closed loop servicing the buildings from the two plate heat exchangers in parallel. The system supplies about 15.7 billion BTU/yr. from the 187 degree F artesian well flowing at 300 gallons per minute. A unique feature is a safe shut-down control system, designed by an employee of the school, John Belloti, to automatically call him if there is a reduction in pressure. An injection well was drilled but is not used due to concern of contamination of domestic aquifers. Disposal of geothermal fluids is to percolation ponds, storm drains, and to a golf course irrigation system. (Paul Lienau, OIT)

59. Warren Properties District Heating System Expands:

Warren Properties of Reno, Nevada has completed Phase I (Warren Estates) with 69 homes connected to a district heating system. The second phase (Manzanita Estates) has the delivery system installed and lots sold for an additional 100 homes. Two geothermal wells, Warren Well No. 1 flows 205 degrees F at 260 gpm and Warren Well No. 2 flows at 212 degrees F at 450 gpm, supply a central plate heat exchanger with a discharge temperature of 119 degrees F. An injection well is used for disposal. Energy meters are used to bill the customers at a rate 30% lower than the price of natural gas (50% less if gas furnace efficiency is considered). The only operating problem experienced has been with a water lubricated line-shaft vertical turbine pump; otherwise, the project has been very successful. (Paul Lienau, OIT)

60. Geothermal Aquaculture Research Conducted at Hobo Hot Springs:

Work in geothermal aquaculture and vertically integrated agriculture is undertaken by Washoe Aquaculture Limited, Gourmet Prawnz Inc., general managing partners. This approach to agriculture is researched at the Integrated Prototype Aquaculture Facility (IPAF) at Hobo Hot Springs, Nevada.

The principal objective at the IPAF is to use geothermal aquifers to commercially raise food, plants, and ornamental fish. At the IPAF, the feasibility of geothermal aquaculture has been demonstrated. The company has implemented many demonstration projects, including the cultivation of freshwater prawns, native baitfish, exotic tropical species, and commercially important aquatic plants.

Although Hobo Hot Springs as a geothermal aquifer is marginal in geoheat generation and in volume recharge (110 degrees F and 100 GPM, respectively), the IPAF concept, as it works, is an ideal example of vertical agriculture integration. As an example, nutrient-rich discharge waters are used to irrigate terrestial plants, such as Japanese cucumbers and commercially important aquatic plants for the aquaria market.

The company has recently demonstrated a method for intensive cultivation of freshwater prawns by individual segregation. This has increased the overall stocking density and reduces mortality associated with cannibalism. The concept is viable for commercial exploitation in areas with thermal discharge effluents, such as those with power plants, including geothermal power plants.

The IPAF uses both geothermal and passive solar (greenhousing) alternative energy sources. The efforts to implement such concepts have made a significant impact on Nevada's economic diversification. Because the business is sited on Washoe Indian lands, the Tribe has received economic benefits, as well.

Operations at the IPAF are funded by revenues generated from contract research studies through academia and industry, and by commercial sales of fish and shellfish. The company's products are marketed in California, Nevada, Idaho, and Utah.

For further information, contact Serge Birk, Washoe Aquaculture Limited, Gourmet Prawnz Inc., Route 3, Box 1, Minden, NV 89423; telephone 702/882-2670. (Geothermal Hot Line, June 1988)

REGION X

OREGON

INDUSTRIALIZATION ACTIVITIES

61. Geothermal Reduction work Achieved at OIT:

Geothermal water flow requirements have been substantially reduced to operate the heating system at Oregon Institute of Technology.

From recent improvements and system repairs, an average flow reduction of about 1000 gallons per minute has been achieved, which means that OIT will now get as much heat as before but from only three-fourths the amount of geothermal water used.

It also results in lowered pumping costs for OIT and reduced stress on the geothermal reservoir serving Klamath Falls.

To achieve the savings, workers replaced the main control valves in two OIT buildings and modified controls on a third building.

Main control valves serving the Learning Resources Center and the swimming pool were replaced in early April. The rubber seats on these valves had failed, allowing water to leak into the waste collection system.

In South Hall, modifications were made to the controls on the main heat exchanger. Originally designed to take enough heat from the geothermal water to reduce its temperature from 193 to 135 degrees F, the system at times discharged water at 180 degrees F, raising the flow rate four times higher than intended. Discharge temperatures in South Hall now are as low as 100 degrees F.

The system improvements have resulted in a flow reduction of about 27%, or an annual average reduction of 100 gallons per minute of geothermal water used. (Paul Lienau, OIT)

REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
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GENERAL

1. Hecht Bill is Stalled:

Prospects are nil for passage of Senator Chic Hecht's bill to extend federal geothermal leases beyond the 10-year primary lease term, despite broad industry support for the measure at both Senate and House hearings. House Interior Committee sources said there would be no movement on the bill this session, after sponsors were waiting for the Senate to act first. The House Committee also has a rule that bills not reported out by October 15 can't get on this year's calendar and must carry over into the next session. The Hecht bill, though mentioned, wasn't considered at the December 2 meeting of the Senate Energy Subcommittee on Mining and Natural Resources. Senate sources wouldn't say it won't come up before adjournment, but there's no scheduled meeting of the subcommittee, again pointing to action next year. (Geothermal Report 12/15/87).

2. NGA Board Members Selected

Officers elected at the National Geothermal Association Board meeting in Sparks, NV, November 11, are Lanier Lohn, Halliburton Services, President; Robert Hayes, Foster/W.L.G. System Division, Vice President; and Clement Giles, the Ben Holt Company, Secretary-Treasurer. Other members of the Board are: Donald Campbell, Mesquite Group, Inc.; James Hanson, AZ Grant Drilex; Gerald Huttrer, Geothermal Management Company; James Koenig, GeothermEX; Kenneth Nichols, Barber Nichols Engineering; Edward Pruett, Pruett Industries, Inc.; Thomas Sparks, UNOCAL; and Roy Wolke, Dresser Industries, Inc.

Donald E. White received the Geothermal Resources Council's prestigious Pioneer Award at the annual meeting in Sparks, NV, October 14, for his work in the USGS from 1939-1981 and who did some of his early work on the convection systems at Steamboat Springs, and James B. Koenig, GeothermEX, Inc., received the Joseph Aidlin award, given each year to the one who made outstanding contributions to the Council. (Geothermal Report 12/1/87)

3. GRC Will Present High-Temperature Drilling Course February 8-10

A Geothermal Resources Council course will be presented February 8-19, 1988 at the Clarion Hotel near the San Francisco International Airport. The course is designed for geothermists who are involved in the planning, drilling and completion of high-temperature geothermal wells. It not only includes discussions on hardware and drilling techniques, but also on how to set-up a system for planning accounting for expenditures and the management of drilling operations. It is assumed that attendees will already have a basic knowledge of drilling hardware and operations. Additional information can be obtained from the GRC, P.O. Box 1350, Davis, CA 95617-1350, Telephone 916/758-2360.

4. Strong Interest Continues in Exporting U.S. Technology

The growing interest in exporting U.S. geothermal expertise to developing nations was certainly evident at last month's Geothermal Resources Council Conference. In his wide-ranging keynote speech, Ronald P. Baldwin, CEO of Geothermal Resources International, pointed out that "geothermal energy is an international business for producing electrical power, and we as American companies with the technology to develop this energy have a responsibility, as well as a great business opportunity, to get involved in the international development of geothermal power."

Immediately preceding the GRC session, there was a separate Conference To Promote International Sales of Geothermal Equipment. Attendees from 23 countries from Central and South America, Europe, Asia, and Africa came to the week-long meeting to rub elbows with conference organizers and to visit major U.S. projects in California and Nevada. In addition to site visits, there was a "mini" exhibition of U.S. equipment and technology, and workshops were held on exploration, drilling, reservoir engineering and well testing, production, environment, power plants, and financial/export management.

The conference was jointly sponsored by the Committee on Renewable Energy Commerce and Trade (CORECT), the U.S. Department of Energy, the U.S. Agency for International Development, the California Energy Commission, and the Geothermal Resources Council. The World Bank also provided support.

A third, related event was the formation of an International Working Group to assess the feasibility of an international geothermal association. Chaired by Tony Mohon of New Zealand, the working group will review organizational, legal, and financial aspects of "getting the whole geothermal community together." Mohon told GR that a meeting is planned for early 1988. (Geothermal Report 11/16/87)

5. <u>R&D Funds to be Awarded by DOE-Idaho Operations Office</u>

DOE's Idaho Operation Office will be awarding approximately $1.2 million in State Geothermal Research and Development Funds. The cost-share funds -- which will not exceed $200,000 per award and which must be matched by a minimum of 10% by the state or state-designated applicant -- are available for proposed research in resource assessment, resource development, or technical assistance and related activities on hydrothermal systems.

The objective of the program is to support research that is not being undertaken by private industry but which has "the potential for results that will be applicable by industry in development of geothermal resources." The anticipated schedule for awarding of the funds has slipped from September 30, 1987, to late November or early December. (Geothermal Report 11/28/87)

6. New Mexico State University Announces 2nd Geothermal Commercial Greenhouse Symposium

The symposium will be held February 22 and 23, 1988 on the campus of New Mexico State University, Las Cruces, NM. Topics will include geothermal energy, heating and cooling systems, computer assisted environmental controls, and southwest business climate. The symposium will feature nationally recognized speakers and tours to local commercial growers and the NMSU geothermally heated greenhouse research facility. For more information, contact: Dr. Rudy Schoenmackers, P.O. Box 3 SOL, Las Cruces, NM 88003; telephone 505/646-1846. (Paul Lienau, OIT)

REGION IX

CALIFORNIA

INDUSTRIALIZATION ACTIVITIES

7. Coso Project Dedicated November 19:

In November, the U.S. Navy and California Energy Company dedicated Coso Plant No. 1, Unit No. 1, which went on line in July and weeks later was producing 30 MW being delivered over a 28 1/2 mile, 115 KV transmission line to Southern California Edison's substation at Inyokern, CA. The plant is the first operation at Coso Hot Springs KGRA, and much more is planned. California Energy Company has announced the formation of a technical/financial team for a construction program of up to ten geothermal power plants. (Geothermal Report 1/1/88)

8. California Avoided Cost Rule Stands

The U.S. Supreme Court declined on Monday to review an order by the California Public Utilities Commission forcing Pacific Gas & Electric to purchase power at two-to-three times the San Francisco based utility's published avoided cost rates. The decision, which affects at least 4,000 megawatts of contracted capacity, could cost PG&E ratepayers over $600 million a year in additional electricity costs by 1990, according to a PG&E attorney familiar with the case.

In its appeal, which the California Supreme Court had earlier refused to hear, PG&E argued that the California utilities commission violated both standard contract law and the Public Utility Regulatory Policies Act of 1978 by requiring the utility to pay premium prices for unneeded electric capacity. As it now stands, PG&E is paying

between six and nine cents per kilowatt-hour for upward of 4,000 megawatts of independent power under the terms of the PUC's ruling, the utility attorney said. By contrast, the utility's current published avoided cost rate is three cents per kilowatt-hour, he said. The differential, he said, is absorbed by the utility's ratepayers costing them hundreds of millions of dollars every year.

Even though the Supreme Court's refusal to intervene legally affirms the PUC decision, PG&E will continue to look for ways to lower the costs of this independently-produced power, the utility attorney said. For example, PG&E is closely monitoring developments at the state level as well as the PURPA review process launched by Federal Energy Regulatory Commission chairman Martha Hesse, he said. One option currently under consideration is simply that of buying out several of these independent power projects, the attorney said. In the long run, it may be significantly cheaper for the utility to buy these projects than to pay them guaranteed energy and capacity charges over 10-30 years, he said.

The PUC-PG&E dispute dates back to 1983 when the commission issued a ruling allowing small power producers to sign contracts with fixed energy charges, rather than letting them fluctuate with the market. In its written arguments, PG&E argued that the commission's action forced the utility to pay excessively high rates for power that was currently unavailable and that, when it became available, would not be needed.

PG&E has some 9,300 megawatts of independent power under contract, with some 2,000 MW currently online. None of the remaining 7,300 MW will be needed until the late 1990's, the utility attorney said, even though an estimated 3,600 will come online by the early 1990's. If the PUC ruling stands, this will further increase charges to PG&E ratepayers, he said.

For its part, the PUC argued that PG&E willingly entered into these fixed price contracts in the early to mid-1980's when it believed that energy prices would continue their upward spiral. The utility only sought contract revisions when oil prices plummeted in 1985-1986. The commission also argued that it was within its authority to design these incentive rates for small power producers. (The Energy Daily 10/6/87)

9. Heber Plant Bid Package Responded to

The San Diego Gas & Electric Co. (SDG&E) Bid Package for the purchase of the Heber binary plant was issued in mid-October, and, although officials are tight-lipped about who's offering to buy, they will say that "considerable interest has been expressed by a number of parties." Right now, bids (which fell due December 7 after the utility granted a one-week extension to its original November 30 deadline) are being evaluated, and it will probably be several weeks before final results are known, bringing an end to speculative rumors that have been flying since the sale was first announced.

The plant has been off-line since June, and transition to long-term storage was complete around November first. However, "I'm still up to my eyeballs in the project," Bob Lacy, SDG&E's main man at Heber, told GR last week. In addition to pursuing the sale and the bid evaluation, he's involved in negotiations with Chevron and Unocal, as well as in litigation matters. Also, the Electric Power Research Institute still has a man on the scene, cranking out reports and evaluating data. (Geothermal Report 12/15/87)

10. CCPA Marks Five Years of Progress

Central California Power Agency, in five years since it was organized, is more than 87% finished with the construction of its two 66 MW-unit Coldwater Creek Geothermal electric projects in The Geysers. CCPA, which is made up of Sacramento Municipal Utility

District, the Modesto (CA) Irrigation District, and the City of Santa Clara, is building the Coldwater Creek Plant, and Unit #1 should be in commercial operation by May 1, 1988, and the identical Unit #2 likewise by October 17, 1988.

"Geothermal Resources International (GRI), of the GEO group, is drilling the last production well now and has completed the reinjection wells. The steam gathering system is completed for Unit #1 and 90% completed for #2," Mr. Lee Keilman of CCPA told GR. He added that they have brought steam into the plant and checked the line and the supports. Who is responsible for that? "GRI is responsible for everything outside the fence. CCPA has contracted for 1,760,000 lbs. of steam and is guaranteed 880,000 lbs/hr/unit. CCPA will pay $1.84 per 1000 lbs. of steam," Keilman explained. (Geothermal Report 12/1/87)

11. <u>CPUC Issues Second Interim Opinion on Standard Offer No. 2</u>

California Public Utilities Commission decision 87-11-024, "Second Interim Opinion - Compliance Phase: Avoidable Megawatts, Reinstatement of Standard Offer 2" was issued. The decision, which relates to a second application of Pacific Gas & Electric Company for approval of certain standard offers pursuant to a previous CPUC ruling, is the most governing third-party generation under PURPA.

The 50-page decision covers a number of interesting points, which will be discussed in future issues of GR. However, the "bottom line," conveniently spelled out by CPUC Administrative Law Judge Kotz in the decision's opening paragraph, is that 1) "there are presently no avoidable resources for the purposes of final Standard Offer 4," and 2) "Standard Offer 2 should be reinstated for San Diego Gas & Electric Company." (Geothermal Report 12/1/8)

12. CEC to Help California Companies Export Energy Technologies

The California Energy Commission has issued a Program Opportunity Notice to identify California-based energy firms interested in receiving CEC assistance with energy export technologies. The effort is part of a program initiated last year to help small and medium sized California firms export products and services in eight energy technology areas -- including geothermal -- to international markets. Under the current program phase, the CEC, staff, and contractors will provide business assistance to evaluate the suitability of technologies to meet needs, assess legal and statutory requirements for exporting, and provide advice on financing options.

During an earlier phase of the program, the CEC issued a number of market evaluations, including Report P500-87-003 on International Geothermal Markets prepared by Meridian Corporation of Falls Church, VA. The overview report examined the current (1985) market status, reviewed market growth and trends, and forecast future market growth, summarizing the worldwide presence of companies by geothermal industry sectors and rating countries as potential markets for U.S. geothermal energy technology. Information is available from Ruben Tavares, California Energy Commission, Energy Technology Export Program, 1416 Ninth Street, MS-45, Sacramento, CA 95814. (Geothermal Report 12/1/87)

13. Major Activity Underway at East Mesa

"The electrical energy developed on the East Mesa is due to double two years from now." That's the prediction of the Holtville Tribune, perhaps the most geothermal-savvy local newspaper in the nation, what with its Imperial Valley location and its energetic reporting staff. The paper's predication is based in part on plans filed by GEO Operator Corporation with the Bureau of Land Management. The plans outline GEO's intent to build two new 37 MW plants, each with twinned 18.5 MW units using double flash turbines, for a combined capacity of 74 MW. The present schedule calls for land preparation by year's end and for major construction to be underway by February 1988, continuing through June 1989. (Geothermal Report 11/16/87)

14. Start-up Tests Begun on New Geysers Unit

Start-up tests are beginning on the Central California Power Agency's first 65 MW generating unit at Coldwater Creek in The Geysers. The 230 KVA power line that connects the station with the PG&E Geysers Collection System 1 1/4 miles away has been completed under the supervision of Richard Weitzenberg, SMUD engineer, and is backfeeding power into the plant to energize the plant itself and to power the testing program. The expectation is to have the plant in full production on line in May 1988.

Geothermal Resources International (GEO) of San Mateo announced last month that it had completed Prati 14, the final well in the bank of 17 geothermal wells, two of which will serve as reinjection wells. "The 15 production wells will deliver approximately 2.2 million pounds of steam per hour, serving both CCPA No. 1 and the second unit of equal capacity." GEO began drilling operations in January 1981. (Geothermal Report 11/16/87)

15. Additional BLM Leasing Expected to Resume Shortly

The California Bureau of Land Management office has listed the proposed Glass Mountain KGRA lease sale as its first when leasing is resumed, which could be very soon, according to Sean Hagerty, BLM geologist in Sacramento. Glass Mountain involves 40,000 acres, more or less, near Medicine Lake, west of Alturas. While Nevada got the jump on the other states as previously reported, technically the moratorium imposed by Section 115 of the FY 1987 Interior Appropriation Act was lifted on June 30, 1987, when the report by the National Park Service identifying STFs was delivered to the Congress.

Before California and states other than Nevada can proceed, the four-agency agreement on the method of operation under Section 115 must be signed by the National Park Service, Bureau of Land

Management, United States Geological survey, and the National Forest Service in Washington, D.C. The Memorandum of Understanding has been drafted and in presumed final form is being circulated for the necessary signatures.

After that hurdle has been jumped, California BLM and the Regional NPS will negotiate the final terms of the Glass Mountain call for leases. Hagerty said some compromises might be necessary, which could reduce the 40,000 acres now planned to be included in the units. However, he expected no great difficulty in clearing away any remaining obstacles. (Geothermal Report 11/16/87)

16. Test Well Completed at Mammoth Lakes

Test Well No. 1 was completed near the shopping mall to a depth of 1,610 feet and a temperature of 160°F. The well has not been perforated, therefore, no flow information is available. Drilling of a second well has started. The purpose of the drilling program is to establish an energy source for a district heating system. (Paul Lienau, OIT)

NEVADA

INDUSTRIALIZATION ACTIVITIES

17. Wabuska Development Continuing:

At Wabuska KGRA, in the Nevada desert near Yerrington, Grace Townsend, a lively, out-going, self-confident young lady, manages the State's pioneering geothermal electric generating plant for Tad's Enterprises, Inc., and right now is set to double its capacity, with a second unit all tested and primed, waiting only for the Sierra Pacific Power Company to complete the upgrading of the transmission line, promised "certainly" by November 16th.

Grace brought the first of her two Ormat Energy Converters, products of Ormat Systems, Inc., of Sparks, NV, on line in June 1984, and it has had an availability factor of 98.6% since that date. The unit has a year-round average production rate of approximately 600 kw, operating on geothermal fluids of 224^{o}F pumped by a 100 HP motor from a depth of 350 ft. The production well used by the initial unit is 420 ft. to bottom. The power is sold to Sierra Pacific under a 30-year contract at a rate that averages 6.2 cents per kwh and brings a revenue approximating $1 to $1.2 million per year. A unique feature of the operation is that Tad's uses the wastewater from a nearby geothermal fish farm for cooling purposes. (Geothermal Report 11/16/87)

18. Nevada BLM Resumes Geothermal Lease Operations:

Under an agreement reached between the regional National Park Service Office and the Bureau of Land Management's Nevada State Office, the latter has resumed its geothermal lease operations even though the national moratorium on federal geothermal leasing remains in effect.

"It's nice to get the program moving again," a spokesman at the Nevada State Office told GR. He said that, since the local moratorium was lifted, the BLM has issued three geothermal leases and should be issuing 30 or 40 more within the next few weeks. The new leases went to Round Mountain Gold Corporation for heap-leaching purposes. Preliminary work by the University of Nevada Division of Earth Sciences has developed promising data regarding the feasibility of using geothermal heat energy to enhance gold and silver heap-leaching operations.

To date, the Nevada BLM has been the only state office exempted from the moratorium, which was imposed by Section 115 of the Geothermal Rider to the FY 1987 Interior Appropriations Act (GR1 June 3). Section 115 requires identification of "significant thermal features" (STFs) at specified units of the national park system and subsequent review of lease applications for potential effects on STFs of geothermal exploration, development, and utilization. While procedural matters are being ironed out in Washington by the four agencies who must administer Section 115 provisions (National Park Service, Bureau of Land Management, U.S.G.S., and the Forest Service), the national moratorium, which could have been lifted by mid-April under the "best case" implementation of a Congressionally-impose timetable, remains in effect. (Geothermal Report 11/2/87)

REGION X

OREGON

INDUSTRIALIZATION ACTIVITIES

19. Deep Exploratory Well Proposed for Newberry Crater

GEO Operator Corp. is proposing to drill a 10,000 foot geothermal exploratory well on the west flank of Newberry Crater northeast of LaPine, Oregon. Drilling is planned for the summer of 1988. The drilling site is proposed on two acres of land on the Fort Rock Ranger District of the Forest Service. Four alternate sites have been suggested by the development company, in case environmental assessment for the selected site shows it unacceptable. A team of specialists from the Bureau of Land Management and the Forest Service would study what impact the drilling would have on the environment. The proposed well is part of a continuing exploration program for geothermal resources, since a USGS experimental well encountered 265°C temperatures inside the caldera.

20. Well Tested for Klamath County Jail:

Klamath County is building a new $8 million jail that will use 158°F geothermal fluids for space heating. The site is located about one mile east of the urban geothermal area. The well was completed to a depth of 1215 feet with a bottom hole temperature of 158°F. A tapered casing was used with 12 in. to 500 ft, and 10 in. from 500 ft to 980 ft, with open hole below 980 ft. A float shoe was used to place bentonite and approximately 30 ft of cement at the bottom of the casing. A 34 hour step pump test was conducted on December 4th-5th, 1987, that produced a maximum flow of 25 gpm. (Paul Lienau, OIT)

GENERAL

71. Electricity Surplus Appears To Be Over in the Pacific Northwest:

The Northwest Power Planning Council (NPPC) was told on 12 October 1988 that the electricity surplus in the Pacific northwest has almost disappeared during the past year due to the region's economic growth.

A year ago, it could be said with reasonable certainty that there was a 1,400 MW surplus. Now the best estimate from the NPPC staff and the Bonneville Power Administration puts the surplus at about 400 MW.

The drop prompted the council to reopen its 20-year power plan, adopted in 1986. The council ordered its staff to prepare an amendment to the plan for presentation to its November meeting. The amendment will include a new forecast of power needs.

The surplus had been as high as 2,500 MW in 1986. The region consumes about 18,000 MW. A city the size of Seattle consumes about 1,000 megawatts. The surplus has dwindled because of an economic recovery in the region from the recession of the early 1980s. Construction of new industry and homes has increased and the aluminum market has improved, increasing the consumption of electricity.

The way the surplus is dwindling, it is felt that the area could need power in the early to mid 1990s, depending on how rapidly the growth is.

The council will continue to focus on energy conservation as the cheapest method of meeting new power needs. It makes more sense to spend money on energy efficient buildings and improving heating and lighting systems, rather than build costly new power plants.

The council also decided to reexamine its decision to consider new coal-fired power plants as one way to prevent future power shortages. The council is concerned about acid rain and a possible "greenhouse effect" caused by the burning of fossil fuels.

It also is unlikely the council would consider building nuclear plants or finishing two mothballed Washington Public Power Supply System nuclear Plants. (GRC Bulletin, December 1988)

72. Geothermal Legislation Passed:

Senate Bill 1889, sponsored by Senators Melcher of Idaho and Hecht of Nevada, was signed by the president on 22 September 1988. The last official title of the bill was "A Bill to Amend the Geothermal Steam Act of 1979 to Provide for Lease Extensions and For Other Purposes". It is now officially known as Public Law No. 100-443.

The Geothermal Steam Act Amendments of 1988 amend the Geothermal Steam Act of 1970 to remove bona fide sales of geothermal steam as a requirement for geothermal lease extensions. It amends the commercial production or utilization requirement of geothermal steam leases to include wells capable of producing geothermal steam in commercial quantities only if the Secretary of the Interior (the Secretary) determines that diligent efforts are being made towards geothermal steam utilization. It permits extension of lease terms for up to two successive 5-year periods even though geothermal steam has not been produced or utilized in commercial quantities by the end of its primary or extended term, if the lessee can show bona fide production or utilization efforts and: (1) make annual payments in lieu of the production of commercial quantities; (2) demonstrate significant expenditures on an annual basis.

It requires the Secretary to review cooperative or unit plans of development on a five-year periodic basis in order to eliminate those leases that are not regarded as reasonably necessary to operations.

The amendment requires the Secretary to maintain a list of National Park System units with significant thermal features, and to maintain a monitoring program for such features. It specifies units to be listed, and directs the Secretary to determine if operations proposed by a lease applicant would likely subject significant thermal features within the National Park System to significant adverse effects. It prohibits the issuance of a lease upon such a finding, and mandates that stipulations designed to protect significant thermal features be included in leases and drilling permits.

It requires the Secretary of Agriculture to consider the effects on significant thermal features within units of the National Park System in determining whether to consent to leasing lands under his/her jurisdiction.

It prohibits the Secretary from issuing a lease for land within the Island Park Geothermal Area, and requires the Secretary to report to the Congress regarding the presence or absence of significant thermal features within Crater Lake National Park. It suspends all geothermal resource production (including leases and drilling permits) in the Corwin Springs Known Geothermal Resources Area until 180 days after the United States Geological Survey has submitted to the Congress an impact study of present and potential geothermal resources development in such areas on thermal features within Yellowstone National Park. (GRC Bulletin, December 1988)

73. Success of Small Binary Plants Noted:

In a 3-part series by Dr. Ronald DiPippo, Mechanical Engineering Department, Southern Massachusetts University, GR reviewed the progress of geothermal binary plants. The total number of units worldwide is 86, producing 126.305 MW, or 1.469 MW/unit. When these figures are adjusted to exclude the Heber plant, the numbers are 85, 81.305, and 0.957, respectively. Dr. DiPippo concluded that, if there is a success side to the binary plant story, it is found in small, modular units in the range of 600-1200 KW. These plants work, are quick to build and put on line,

and are flexible to operate. However, they can tend to be inefficient and are subject to significant variations in output. A move toward refinement and improvement seems to have brought us to a reasonable technological progression. (Geothermal report 1-1-89)

74. Geophysical Data: Questions of Access:

Geophysical data collected using Federal funds "are the property of the general public," according to a National Research Council panel. "Special efforts must be made," they declare, "to ensure...accessibility to users in all cases not in conflict with the interests of national security." However, panelists agreed that the geophysicist who collects data using Federal funds "normally has a right to exclusive access to these data for an appropriate period of time...as short as is reasonable under the given circumstances." Geophysical Data: Policy Issues is available from the Committee on Geophysical Data, 2101 Constitution Ave., NW, Washington DC 20418. The telephone number is 202/334-3368. (Energy Today, November 1988)

75. Fourteenth Annual Workshop on Geothermal Reservoir Engineering to be Held at Stanford:

The Fourteenth Workshop on Geothermal Reservoir Engineering sponsored by the Stanford Geothermal Program has been scheduled for 24-26 January 1989 at Stanford University. The aim of the workshop is to bring together researchers, engineers, and managers involved in geothermal reservoir studies and development, and to provide for prompt and open reporting of progress and the exchange of ideas. The Fourteenth Workshop continues the policy of inviting all scientists and engineers active in the field of geothermal reservoir engineering to submit a paper for presentation at the workshop, and publication in the Workshop Proceedings.

76. Geothermal Publications Available:

The Earth Sciences Division, Lawrence Berkeley Laboratory, has published a list of nearly 70 reports and papers on geothermal energy that are available to the public. The list includes only those documents issued by the Division since 1986. The main technical areas covered are: 1) exploration and delineation of geothermal systems, 2) reservoir assessment, and 3) brine injection. A copy of LBL Geothermal Program - List of Publications 1986-1988, dated April 1988, can be obtained from the Earth Sciences Division, Lawrence Berkeley Laboratory, Building 50E, University of California, Berkeley, CA 94720. (GHC Bulletin, Fall 1988)

77. Technical Reports Available From DOE:

Two reports, "Beyond Goals and Objectives", and "Geothermal Innovative Technologies" are available from the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

"Beyond Goals and Objectives" is a 200-page volume that comprises the proceedings for DOE's Geothermal Program Review VI, held April 1988 in San Francisco, CA. The report includes papers by a veritable Who's Who of geothermal researchers at laboratories and consulting firms throughout the United States. Topics cover hydrothermal, geopressured-geothermal, hot dry rock, and magma-energy research. A final "special issues" section presents examples of government-industry cooperation and discusses international market opportunities for geothermal companies.

"Geothermal Innovative Technologies Catalog" contains diagrams, drawings, and schematics that are liberally sprinkled through this 203-page document prepared for DOE by the Meridian Corporation of Alexandria, VA. The report is intended for the U.S. industry and other entities interested in the development and utilization of both domestic and international geothermal resources. The catalog identifies "significant advances in geothermal technology" that have flowed from

R&D sponsored by DOE's Geothermal Technology Division. The catalog reviews hardware, software, data bases, processes/procedures, test facilities, and handbooks for: 1) exploration, 2) drilling, well completion, and reservoir production, 3) materials and brine chemistry, and 4) direct use. There is also a discussion of economics software and an Appendix with a Directory of Contacts for both individuals and organizations.

78. GRC Pacific Northwest Section Selects Officers:

Officers were selected at the November 9, 1988 annual business meeting of the Pacific Northwest Section of the Geothermal Resources Council. Al Wiebel (Columbia Geothermal) replaces Alex Sifford (Oregon Department of Energy) as the president for 1989. John Geyer (BPA) is the new vice president, and Barbara Priest (Multnomah County) serves as the secretary-treasurer. Alex Sifford and Bob Fujimoto (U.S. Forest Service) were added to the board of directors.

REGION IX

CALIFORNIA

INDUSTRIALIZATION ACTIVITIES

79. Construction begins on 230 KV Coso Project Transmission Line:

California Energy Company, Inc. (San Francisco, CA) on behalf of Coso Energy Developers, announced on 12 August 1988 that construction has begun on a $7.6 million, 28.5 mile long 230 kV electric power transmission line from the Coso Project to Southern California Edison's substation at Inyokern, California.

Construction is expected to be completed in December of this year. Mission Power Engineering Company, an affiliate of Southern California Edison Company, is general contractor for the project.

This new transmission line will enable California Energy Company and their partners to bring incremental power, beyond the already contracted 230 M We, on line in short order. Initially this new line will service three power plants at one of the Coso project sites. (GRC Bulletin, October 1988)

80. Energy Commission Awards Grant to Augment Technology Export Program:

California's geothermal entrepreneurs should take note that the California Energy Commission (CEC) has received a two-year, $360,000 grant from the U.S. Trade and Development Program to augment its reverse trade mission work. Through reverse trade activities, and other efforts of its Energy Technologies Export Program, the CEC informs experts from other countries about and introduces them to California firms involved with energy technologies, including geothermal.

The relatively new program, which the CEC initiated in FY 1985-86, has had some measure of success. For example, in October 1987, the Commission cosponsored the Geothermal Tour/Reverse Trade Mission held in conjunction with the Geothermal resources Council's annual conference (GR 16 November '87). Representatives from 18 countries and 60 California equipment vendors took part. Follow-up by the CEC indicates that a significant amount of business was generated for California firms, including 1) $500,000 in sales (well drilling equipment and power plant control systems) and 2) $13 million currently under negotiation (for two $6 1/2 million flash-steam units). (Geothermal Report 11-1-88)

81. Sturgeon are Being Raised Near Susanville:

Arrowhead Fisheries, located approximately 20 miles northeast of Susanville, California is using a 74°F geothermal resource (1,350 gpm) to raise sturgeon. The project started in 1986 and currently 12 earthen raceways (10 ft. x 50 ft. x 2 ft. deep) are in use. The company is currently constructing another site near Likely, California that will be about 25 percent larger than the Susanville site and will have a flow of about 2,250 gpm. (OIT Geo-Heat Center)

82. Glass Mountain Bids Prove Continuing Viability of Geothermal:

Staff members of the Bureau of Land Management's Sacramento (CA) office were quite pleased by the bidding process for the Glass Mountain KGRA, calling it "better than expected, bringing a higher average bid than anticipated" and proving "continuing viability of and enthusiasm for geothermal development".

BLM received 29 bids on 20 parcels, totaling 38,283.53 acres, 12 were bid on, bringing in a total of $3,056,382.71. The big bidders were Freeport McMoRan Resource Partners and Ormat Systems. (Geothermal Report 1-16-89)

NEVADA

INDUSTRIALIZATION ACTIVITIES

83. Ormat Modular Binary Plants Effective in Five Nevada KGRA's:

Ormat Energy Systems, Inc., Sparks, NV, reviewed its Nevada projects for GR as 1988 was closing. The firm's modular binary plants have proved effective in opening five KGRAs in the deserts of the Silver State.

The table below highlights Ormat's Nevada projects. With the exception of the first project listed, which is operated by Tad's Enterprises, Ormat is the plant operator on all of the projects. The power purchaser in every case is Sierra Pacific Power Company.

The Soda Lake Geothermal partnership noted on the table is comprised of affiliates of Chevron, Ormat, and Constellation Investments, Inc. The Empire and Stillwater geothermal partnerships are comprised of affiliates of Ormat and Constellation. (Geothermal Report 12-15-88)

ORMAT'S NEVADA PROJECTS

Plant/Location	Commercial Rating Net Firm Capacity	Went Operational	Plant Operator
Tad's Enterprises Wabuska, NV	1.5 MW	9/84	Tad's
Steamboat Geothermal Steamboat Springs, NV	6.8 MW[1]	1986	Far West Hydro-electric Fund
Soda Lake Geothermal Fallon, NV	2.7 MW	12/87	Soda Lake Geo-thermal Company
Empire Geothermal Empire, NV	3.1 MW	12/87	Empire Geothermal Company
Stillwater Geothermal Stillwater, NV	11.0 MW	12/88[2]	Stillwater Geo-thermal Partnership

1 This figure includes the capacity from the Steamboat 1A Expansion, completed 11/87.

2 This project is presently under construction, but is expected to be complete by the end of December 1988.

84. Ormat Energy Systems, Inc. Receives U.S. Department of Energy 1988 Award for Energy Innovation:

Ormat Energy Systems, Inc. (Sparks, NV), on November 1, 1988, was presented with the United States Department of Energy 1988 Award for Energy Innovation for their geothermal power plant at Steamboat Springs, Nevada. In presenting the award, Assistant Secretary of Energy Donna Fitzpatrick said, "Ormat does it again!" The 7.4 MW binary power project, which has been operational since 1985, is non-polluting (zero discharge), and recently received the Governor's Energy Award from Nevada Governor Richard Bryan. A letter of commendation also was received from Senator Chic Hecht in recognition of Ormat's pioneering efforts. (GRC Bulletin, December 1988)

85. Groundbreaking at Steamboat Geothermal IA Project:

Ormat Energy Systems, Inc. (Sparks) announced on September 2, 1988 the groundbreaking of the Steamboat Geothermal IA project in Steamboat Springs, Nevada (about 10 miles south of Reno). This expansion is expected to be completed by November 1988. The addition of two Ormat Energy converters will provide an additional 2 MW (gross) by utilizing the geothermal water prior to injection.

The project, which is to be owned by Far West Capital of Midvale, Utah, will sell electricity to Sierra Pacific Power Company under a long-term power purchase contract and will be operated by Ormat Energy Systems, along with the existing Steamboat Geothermal I power plant.

An air cooling system will be utilized to assure low environmental impact. This project is the ninth project to be developed by Ormat in the states of Nevada, Utah and California. (GRC Bulletin, September/October 1988)

86. New Aquaculture Project Started Near Jackpot:

A new aquaculture project is getting underway on the Y-3-II Ranch near Jackpot, Nevada. They have 3 wells, one in use, artesian flowing 2.53 cfs (1,135 gpm) at 107^{o}F. They are in the pilot stage with 8 - 1/16 acre raceways. They obtain fingerling catfish from Leo Ray and sell the grown fish to Leo Ray. (OIT Geo-Heat Center)

IDAHO

INDUSTRIALIZATION ACTIVITIES

87. Boise, Warm Springs Reach Pact Over Geothermal Fluid:

Boise (AP)--The city of Boise and Warm Springs Water District have reached an agreement that at least temporarily heads off a lawsuit over the rights to use an underground pool of geothermal water.

As a result, 200 homes along Boise's Warm Springs Avenue will be guaranteed enough natural hot water to heat their homes this winter.

Boise Public Works director Bill Ancell said Wednesday that a $16,000 link between the two geothermal systems will be built at city expense as a backup water supply for Warm Springs.

The district has claimed that the city's system has depleted the geothermal aquifer since it began pumping in 1983 to heat Boise City Hall and several other large downtown building.

Boise previously offered to sell water to the Warm Springs district because of the pressure problem, but the district declined.

Concern about the dropping geothermal water level prompted the state Department of Water Resources to restrict further development of the aquifer and start extensive studies of the resource.

"It's positive any time you stay out of court," said Terence O'Rouark, chairman of the board of the Warm Springs district. He said the arrangement should not affect rates to the district's residential customers.

City Council President Mike Wetherell said the agreement was "at least a temporary compromise." The council approved the arrangement after a closed-door meeting Tuesday night.

O'Rouark said the temporary arrangement should provide the district with time to monitor its geothermal wells and get a better idea of where the resource stands.

Ancel said the city expects to make back some of its $16,000 investment by selling water to Warm Springs for the Idaho State Agricultural Laboratory, which now receives intermittent service from the district when adequate water is available.

Warm Springs has been pumping the naturally hot water since 1892. (Post-Register, Idaho Falls, ID 12/15/88)

OREGON

Industrialization Activities

88. Klamath County Jail Injection Well Tested:

An injection test of the well was conducted November 2-4 utilizing 492 gpm of geothermal fluid from the production well. The well accepted the 492 gpm under gravity flow conditions. A water level rise of 23 ft was noted in the old injection well about 100 ft away, but there was no temperature breakthrough. (OIT Geo-Heat Center)

89. New OIT Injection Well Drilled:

The new well is drilled to 2,005 ft and is awaiting arrival of slotted casing for installation. A pump test will be conducted after completion. At this time prospects of successful injection are questionable. Only one loss zone of about 20 ft was encountered and appears to be a non thermal zone. Lithology was primarily basalt and clay for the entire depth below the conductor casing at 200 ft. (OIT Geo-Heat Center)

90. Geothermal System Made More Efficient at OIT:

Geothermal water requirements to operate the heating system at Oregon Institute of Technology have been substantially reduced.

From recent improvements and system repairs, an average flow reduction of about 1,000 gallons per minute has been achieved, which means that OIT will now get as much heat as before, but from only three-fourths the amount of geothermal water used. It also results in lowered pumping costs for OIT and reduced stress on the geothermal reservoir serving Klamath Falls.

To achieve the savings, workers replaced the main control valves in two OIT buildings and modified controls in a third building. Main control valves serving the Learning Resources Center and the swimming pool were replaced in early April. The rubber seats on these valves had failed, allowing water to leak into the waste collection system.

In South Hall, modifications were made to the controls on the main heat exchanger. Originally designed to take enough heat from the geothermal water to reduce its temperature from 193 to 135^{o}F, the system at times discharged water at 180^{o}F, raising the flow rate four times higher than intended. Discharge temperatures in south Hall now are as low as 100^{o}F. The system improvements have resulted in a flow reduction of about 27 percent, or an annual average reduction of 100 gallons per minute of geothermal water used. (OIT Geo-Heat Center)

REGIONAL GEOTHERMAL PROGRESS MONITOR
ACTIVITIES REPORT
January-March 1989

GENERAL

89.1 Renewable Energy Gets Hill Boost:

Renewable energy efforts received a boost on Wednesday as Rep. Phil Sharp (D-Ind.), chairman of the House Energy and Commerce energy and power subcommittee, introduced the Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989. The bill, originally introduced last year, seeks to bolster the commercialization and international competitiveness of U.S. renewable energy and energy efficiency technologies, Sharp said, adding: "Renewable energy and energy efficiency have been the neglected stepchildren of our national energy policy".

The bill's cosponsors include: Reps. Marilyn Lloyd, (D-Tenn.), chair of the Science, Space and Technology subcommittee on energy research and development; Carlos Moorhead (R-Calif.) and Sid Morrison (R-Wash.), ranking Republicans on Sharp's and Lloyd's subcommittees respectively.

The proposed law established performance goals for the Department of Energy's renewable energy and conservation programs as well as authorizing three-year DOE outlays for the programs. Six joint ventures which demonstrate the commercial potential of renewable technologies are also called for in the measure. (The Energy Daily 3-2-89)

89.2 Kalina Cycle has Potential to Improve Geothermal Power Plant:

A technical seminar was convened on January 16, 1989 at the Holiday Inn Crown Plaza in Burlingame, California, dealing with recent developments in a new power technology. The Kalina Cycle, named after its inventor, Dr. Alexander I. Kalina, is a method of generating power using any thermal heat source in a manner that is substantially more efficient than the standard Rankine cycle. According to the seminar's host,

Exergy Inc. of Hayward, California, the purpose of the meeting was to acquaint the power generation community with recent developments in the Kalina Cycle.

Among several designs shown, Dr. Kalina presented a variant specifically developed for geothermal binary applications. Referred to as Kalina Cycle System 12 (KCS12), Dr. Kalina compared his design to an existing 3 MW binary plant operating at a brine inlet temperature of 367°F and an outlet of 170°F. At these conditions, the output of KCS 12 was in excess of 4.9 MW, according to Dr. Kalina. This is an improvement of 63 percent.

KCS 12 features a .83 ammonia water mixture as the cycle's working fluid, operating in a conventional subcritical evaporator. It contains two turbine stages with reheat in between. The exhaust of the second stage is used recuperatively for preheater and evaporator duty. This is made possible by selecting a mixture whose dew point is considerably higher than its initial boiling temperature.

In addition to the stated performance improvement, the use of an ammonia water mixture as the working fluid permits conventional steam turbine designs to be used. Ammonia and water have been similar molecular weights, thus similar turbine geometries. Customized hydrocarbon or chloroflourocarbon turbines are not necessary. Dr. Kalina also pointed out that ammonia water mixtures are not flammable and are not environmentally benign. Standard carbon steel heat exchangers are specified. (GRC Bulletin, February 1989)

89.3 Outgoing FY-90 Budget Proposes $15.4 Million for Geothermal:

President Reagan's outgoing FY-90 budget proposes $15.4 million for DOE's geothermal program, which is about the same level as the $16.5 million asked for last year, which was increased by Congress to $19.6 million in FY-89 appropriations, primarily by a $3.1 million hike for geopressured test operations.

DOE GEOTHERMAL BUDGET
(in millions)

	FY-89 Appropriations	FY-90 Request
Geopressured	$ 6.0	$ 2.9
Geothermal Technology Development		
Hard Rock Penetration	2.3	2.3
Reservoir Technology	2.5	2.153
Conversion Technology	1.935	1.580
Hot Dry Rock Research	3.5	3.5
Magma Energy research	1.7	1.7
Capital Equipment	.795	.450
Salaries & Program Direction	.826	.826
	$19,556	$15,409
Geothermal Loan Program	.075	.075
	(Geothermal Report 2-1-89)	

89.4 Workshop Scheduled on Sales Strategies for Central America:

Billed as "the first geothermal export financing and marketing course that addresses the critical problems facing United States exporters," a special two-day session has been scheduled later this month by the National Geothermal Association to develop a national geothermal export strategy with a workable program to export U.S. geothermal hardware and services.

Emphasis will be on Central America, one of the fastest-growing geothermal areas in the world. The program will include a status report of geothermal in that region and review how geothermal compares with other options for electricity production. Also on the agenda:

financing packages now being offered by international contractors; innovative financing strategies and techniques; a proposed U.S. geothermal export marketing strategy; development of a consortium of U.S. vendors for the export of U.S. geothermal technology; and possible legal ramifications of the proposed export strategy.

The session will be held later this month (February 27-28) at the Los Angeles Airport Hyatt Hotel, 6255 West Century Boulevard, Los Angeles. The price-tag is $350 for current 1989 NGA members and $400 for non-members. Additional information is available from the National geothermal Association, P.O. Box 1350, Davis, CA 95617. Telephone: 916/758-2360. (Geothermal Report 2-15-89).

89.5 DOE Seminar Will Emphasize Technology Transfer:

DOE's Seventh Annual Geothermal Program Review will be held March 21-23, 1989 at the Ramada Hotel, Fisherman's Wharf, San Francisco, CA.

PR VII, entitled "DOE Research and Development for the Geothermal Marketplace," will emphasize technology transfer and will seek to identify market opportunities for DOE-sponsored R&D innovations.

In Session I, John E. "Ted" Mock, Director of DOE's Geothermal Technology Division, will introduce the theme and will describe the technology transfer process. His remarks will be followed by presentations on "Disappearing Power Surplus Should Push Geothermal" (John Geyer, Bonneville Power Administration) and "Direct Use Engineering and Design Guidebook Issued for a Rapidly growing Marketplace" (Ben Lunis, Idaho National Engineering Laboratory, and Paul Lienau, Oregon Institute of Technology).

Sessions II through V will run from Tuesday afternoon through Wednesday, March 22, and will discuss R&D strategies and applications in, respectively, Hydrothermal, Geopressured, Magma Energy, and Hot Dry Rock. In conjunction with PR VII, the National Geothermal Association will present an "Industry Critique" and discussion of the DOE R&D program on the morning of the third day. (Geothermal Report 3-1-89)

89.6 NGA Schedules Companion Session to PR VII:

The National Geothermal Association has scheduled a Seminar of Successful Power Marketing for New Generation Projects in conjunction with PR VII. Slated for Monday, March 20, at the Travelodge at the Wharf in San Francisco, the seminar has been designed to aid attendees in the development of marketing skills, a marketing program, and the actual sales of geothermal power. The target audience is anyone presently involved or soon to be involved in the sales of electricity to utilities or other bulk consumers.

Registration is $200 for all participants. Additional information is available from the National Geothermal Association, P.O. Box 1350, Davis, CA 95617-1350. Telephone: 916/758-2360. (Geothermal Report 3-1-89)

89.7 Direct Use Publication Available:

The Fall 1988 Quarterly Bulletin of the Geo-Heat Center, Oregon Institute of Technology, Klamath Falls, OR 97601-8801, is devoted to "Direct Use of Geothermal Energy Home and Abroad" and covers projects in Iceland, Mexico, Hawaii, Turkey, Japan, San Bernardino, and USSR, concluding with a review of recent direct use news. John W. Lund was the Acting Editor of this fine production. The Center mails its bulletins to subscribers free of charge. The Center, sitting amidst the Klamath Falls low-temperature field and heating and cooling its campus buildings with geothermal fluids, is gaining increasing stature as the chronicler and advocate of the direct use branch of the geothermal industry, which is slowly gaining headway in the United States. (Geothermal Report 2-1-89)

89.8 New MMS Geothermal Evaluation Publication is Available:

In June of 1988, the U.S. Department of Interior published Valuation of Federal Geothermal Resources-Electrical Generation. This report supersedes a report of the same title dated October 1987 and represents the existing official policy of the Minerals Management Service (MMS)

for valuing federal geothermal resources for royalty purposes under existing regulations 30 CFR 206 350 and 351 (redesignated from 206 300 and 301 at 53 F.R. 1184, 15 January 1988).

The October 1987 report contains guidelines for valuing for royalty purposes federal geothermal resources used to generate electricity and represented MMS's official policy on geothermal resource valuation prior to 1 March 1988. However, effective 1 March 1988, MMS instituted certain changes to the netback procedure used for valuing geothermal resources not sold but utilized directly by the lessee in its own power plant for the generation and sale of electricity (the so-called "no Sales" resources). The changes affect the methods of computing the transmitting and generating deductions and include (1) use of Standard and Poor's BBB industrial bond rate as the rate of return on capital investments. (2) an option to use a return on investment method to recover capital costs, and (3) the elimination of the 10 percent limit on overhead costs.

On 5 January 1989, MMS published a notice in the Federal Register (54 F.R. 354) of a proposed rule-making regarding geothermal resource valuation regulations. Comments were solicited for a 50-day period ending 6 March 1989. The MMS will appreciate any comments that you may have regarding the proposed regulations. Comments should be sent to the address given in the Federal Register notice. Please be advised that the guidelines appearing in the 1988 report will represent MMS's official geothermal valuation policy until new final valuation regulations are adopted.

For more information, please contact Dennis C. Whitcomb, Chief, Rules and Procedures Branch at 303/231-3432. (GRC Bulletin, February, 1989)

89.9 Geothermal Power Plant Update Slated:

The Geothermal Resources Council has scheduled An Update on Geothermal Power Plants in the Western United States and Selected Direct-Use Operations. To be held at John Ascuaga's Nugget Hotel in Sparks, NV,

the session will convene on April 17 and 18 with an optional field trip on April 19 to the new flash plant and other facilities at Steamboat Springs, following a tour of two binary power plants near Honey Lake.

The first 1 1/2 days of the conference will focus on Power Plants Update and Operating Histories, and 20 different projects are slated to be discussed. The remainder of the second day will be devoted to presentations on 1) New Power Plant Cycle and Noncondensing Unit, 2) Power Plant Support Equipment, and 3) Direct-Use Applications.

More information is available from the Geothermal Resources Council, P.O. Box 1350, Davis, CA 95617-1350. Telephone: 916/758-2360.

REGION IX

CALIFORNIA

INDUSTRIALIZATION ACTIVITIES

89.10 California Energy Adds Four New Power Generating Plants:

California Energy Company, Inc. announced on 5 January 1989 the quadrupling of generating capacity at its Coso Project with the addition of 4 new power generating units at Coso Hot Springs, Inyo County, California. With the successful start up of these additional units, California Energy's capacity will grow to 140 MWe, from its present capacity of 30 MWe. The company expects that these units will produce on average, monthly revenues of $4 million. These four units are on line ahead of schedule, due to the efforts of the engineering team and those of the construction group assembled by the project's contractor, Mission Power.

The commercial sale of electricity from the company's Coso Project began in July, 1987. Its first 30 MWe plant has been operating at an average of 92 percent of capacity and has produced more than 336 million kilowatt hours of electricity and $29.1 million in gross project revenues through 1 January 1989. (GRC Bulletin, February, 1989)

89.11 California Energy Employs New Technology at Coso:

California Energy Company's Navy II (geothermal power plant) project employs new geothermal technologies which are an important advance in the continued development of this generating resource. Navy II utilizes a new noncondensable gas injection technology to control and minimize emissions. The geothermal technology pioneered by Cal Energy should result in the increased development of California geothermal resources.

The environmental control system, already in use at California Energy's Navy I project at Coso, cuts noncondensable gas emissions to about one percent of those produced by comparable coal-burning electric generation plants. For example, a 30 MW oil-fired plant would have emitted nearly 18 million pounds of CO_2 over the sixteen months that the Coso Project's initial unit has been in operation. In contrast, the Coso geothermal plant has released only fourteen thousand pounds of CO_2. At the same time, the Coso plant has displaced more than 572,000 barrels of oil. (GRC Bulletin, February, 1989)

89.12 CECo Breaks Ground to Complete Navy II:

Last month, California Energy Co., Inc. of San Francisco broke ground on the three generating units needed to complete its nine-unit, 230 MW Coso Geothermal Project at the China Lake Naval Weapons Center 175 miles northeast of Los Angeles. This new complex, called Navy II, is under contract for construction by Mission Power Engineering of Irvine, which will have a workforce of 600 and promises completion by year's end. The turbines are scheduled to arrive in April, May, and June. The Navy II element will contribute 80 MW and is estimated to cost $165 million. (Geothermal Report 4-1-88)

89.13 CEC GRDA Funding Recommendations are Down:

On April 1, the California Energy Commission is scheduled to send to the California Legislature its FY 1989-90 Funding Recommendations for the Geothermal Resources Development Account (see summary table). For this year's Round 9 funding cycle, the recommendation is $1.632 million for 8 projects -- down considerably from last year's recommendation of $4,730 million for 13 projects and the preceding year's recommendation of $3,272 million. The largest chunk of money is the $395,000 earmarked for the City of Colton to conduct a resources assessment/drilling project, in contrast to last year's top dollar award of $1.372 million for the Town of Mammoth Lakes.

During the preapplication period for Round 9 funding, 18 projects were submitted for a total of $6,429 million. By the final request period, 8 projects had dropped out, and the total amount requested was pared down to $3,086 million. Recommendations by the Technical Advisory Committee (TAC) brought the total to $1,964 million, fairly close to the $1.632 million approved by the Commission at its March 15 meeting.

Applicant/Project	Recommendation
o Kelseyville Unified School District -- Conduct a resource assessment/drilling project to develop space and water heating at the proposed Riviera Elementary School.	$149,788
o City of Clear Lake -- Initiate Phase II of a Hot Dry Rock Investigation. (Under a previous CEC grant, the City identified two potential sites that warrant further investigation.)	225,000
o Lake County -- Expand production and irrigation systems of the Geo-Ag project, gaining the ability to operate it as a commercial greenhouse facility.	234,664
o City of Colton -- Conduct a resource assessment/exploratory drilling program along the San Jacinto fault, which lies between the Cities of Colton and San Bernardino. There are several potential uses in the proposed study area.	395,000
o Mono County -- Complete the resource exploration for the Bridgeport Geothermal District Heating Project. Twelve structures, most of them county-owned, are targeted for retrofit.	295,000
o South Lake County Fire Protection District Heating Project. Twelve structures, most of them county-owned, are targeted for retrofit.	84,000
o North Sonoma County APCD -- Purchase the Pine Summit monitoring site (the first air quality monitoring station in The Geysers Road.	82,685
o Sonoma County -- Reconstruct a portion of the Cloverdale-Geysers road.	166,000*
TOTAL:	$1,632,137

* The CEC cut the TAC's $498,478 recommendation by $332,478. (Geothermal Report 4-1-89)

89.14 GPPL Project Prospects Look Dim:

The Geothermal Public Power Line Project, hotly contested between its four proposed owners and the Pacific Gas and Electric Company before the California Energy Commission (CEC) for several years, seems about to be laid away for lack of need.

The last hook on which the project hung was the lack of a long-term guarantee by the big utility that it would have transmission capacity and would wheel the power generated in The Geysers by the four public agencies that are the Joint Owners of the GPPL to their local systems. Now, it would appear, that hook is about to be removed through an exchange between the contestants of wheeling contract proposals called for by the CEC.

The Joint Owners of the GPPL are the Sacramento Municipal Utility District, the Modesto Irrigation District, the Northern California Power Agency, and the City of Santa Clara. After much preparation, the Joint Owners submitted their proposed wheeling contract to the PG&E, copy to the CEC, late last November. The PG&E stretched out the 60 days that it was expected to take in reviewing the proposal and making a counter suggestion to the beginning of March, 1989. Its eventual response was distributed to the Joint Owners and the CEC, not as a proposed wheeling contract with the GPPL, but in the form of separate proposed wheeling agreements for each of the geothermal power generating stations of the individual Joint Owners.

Jim Bemis, GPPL Project Manager, told GR that the counter proposals of PG&E had been received by the Joint Owners, which individually had the proposals made to them under study. He said the plan was for the GPPL to get the Joint Owners together before the end of March to begin an in-depth review that will lead to negotiations with the PG&E and presentations to the CEC.

The GPPL, as proposed, would be a 60-mile, 230 KVA line extending from the vicinity of Middletown in The Geysers to a point of connection with the Western Area Power Agency System west of Williams in the Sacramento Valley.

In a long series of conferences and hearings before the CEC, the PG&E contended the line would not be needed, since it had capacity on its lines to get the public power out of The Geysers. The Joint Owners responded that their forecasts refuted this claim and, furthermore, that the PG&E had been unwilling to enter long-term wheeling agreements with them, thereby proving that the utility was uncertain of its future ability to perform. Latent, also, were contentions that the PG&E's wheeling charges were out of line with costs and that it would be cheaper to build the GPPL than to rely on the utility. (Geothermal Report 4-1-89)

OREGON

COMMERCIALIZATION ACTIVITIES

81.15 California Energy Company May Resume Drilling Outside Crater Lake:

Cal Energy has leases on 76,000 acres on the Winema National Forest adjacent to the park boundary. After beginning 2 test holes just east and south of the park in September 1986 - one to a depth of 1,354 ft, the second to 485 ft, and encountered temperatures of 226°F, which encouraged further exploration. In early 1987, Cal Energy sought to change the total authorized depth of the wells from 4,000 to 5,500 ft and alter drilling procedures. The Bureau of Land Management approved the request, but the Sierra Club and other environmental groups appealed the decision in July 1987. In February 1989, the Interior Board of Land Appeals ruled that no environmental impact statement is required by Cal Energy to sink deeper test drill holes.

Crater Lake officials believe evidence of warmer water at Crater Lake's bottom "suggests the presence of hydrothermal activity" and geothermal development at the drill sites may affect the ecosystems of the lake. (Paul Lienau, OIT)

89.16 Settlement Reached on Klamath Falls Geothermal District Heating System:

The Klamath Falls City Council accepted a $685,000 settlement in litigation over the geothermal district heating system. The geothermal system has been shut down since February 1986 after failures in several factory-made joints were discovered in the fiber glass portion of the secondary loop. The suit was filed in Klamath County Circuit Court against Crooch & Harris Plumbing and Heating Co., United Pacific Insurance Co., Fiberglass Resources Corp., Perma-Pipe, Inc. and Balzhiser & Colvin Engineering, Inc.

The council also authorized the city to apply for funding from the Small Scale Energy Loan Program through the Oregon Department of Energy for geothermal replacement and expansion. (Paul Lienau, OIT)

89.17 Northwest Meeting Highlights Mineral-Related Issues:

The Bureau of Land Management, Oregon State Office, and Region 6 of the U.S. Forest Service have scheduled their Annual Northwest Mineral Industry Meeting for March 15, 1989, 8:30 a.m. - 4:30 p.m., Viscount Hotel, Portland, OR. The focus will be new mineral-related legislation, policy, and regulatory changes, including a review of the 1988 Geothermal Steam Act Amendments and an update on Activities at Newberry Crater.

The State Geologists from Oregon and Washington also are scheduled to attend, each to present a 5-year forecast of activities relating to fluid and solid minerals, including geothermal. The keynote address will be presented by Constance Brooks, former Vice President-General Council of the Mountain States Legal Foundation. Contact either Eric Hoffman or Mary Mannix at 503/231-6812. (Geothermal Report 3-1-89)

89.18 Breitenbush Area of Oregon Report Released:

A new geologic report on studies of an area that includes the Austin and Breitenbush Hot Springs, both so-called Known Geothermal Resource Areas (KGRA) in the Cascade Range, presents a geologic cross section and geothermal model in greater detail than had been possible so far.

The Oregon Department of Geology and Mineral Industries (DOGAMI) has released "Geology and Geothermal Resources of the Breitenbush-Austin Hot Springs Area, Clackamas and Marion Counties, Oregon", as DOGAMI Open-File Report 0-88-5. The report was edited by D. R. Sherrod of the U.S. Geological Survey (USGS) and contains contributions by Sherrod and five other scientists from the USGS, Washington State University, and Southern Methodist University.

The report summarizes several ongoing investigations including geologic mapping, alteration studies, and the heat flow results from cooperative and industrial drilling programs. The researchers were able to use, for the first time, previously confidential information from industry drilling.

The first five chapters present detailed treatments of geologic setting, stratigraphy, geochemistry, alteration phenomena, and of a substantial set of new data on thermal conductivity and heat flow. In the final chapter, all the contributions are combined into a geologic cross section showing topography, stratigraphy, structure, isotherms, heat flow, gravity, and hydrology.

The 91-page report is accompanied by a geologic map and cross section of the area around geothermal drill hole CTGH-I, located about 14 km (8.7 mi) northeast of Breitenbush Hot Springs and 6 km (3.7 mi) northwest of Olallie Butte. This hole was rotary-drilled cooperatively by Thermal Power Company, Chevron Geothermal, and the U.S. Department of Energy in 1986 and yielded an essentially 100 percent core recovery down to its total depth of 161 m (528 ft).

Open-File Report 0-88-5 is now available at the Oregon Department of Geology and Mineral Industries, 910 State Office Building, 1400 SW Fifth Avenue, Portland OR 97201-5528. The price is $8. Orders under $50 require prepayment. (GRC Bulletin, February 1989)

89.19 <u>New Geologic Map for Oregon Hot Spring Area Released:</u>

A new geologic map published by the Oregon Department of Geology and Mineral Industries (DOGAMI) and partially funded by the U.S. Department of Energy provides a detailed geologic description of the McKenzie Bridge 15-minute quadrangle in the Cascade Range.

Geologic Map of the McKenzie Bridge Quadrangle, Lane County Oregon was prepared by G. R. Priest, G. L. Black, and N. W. Woller of DOGAMI and E. M. Taylor of Oregon State University. It was published in DOGAMI'S Geological Map Series as Map GMS-48.

The McKenzie Bridge quadrangle is located at the transition zone between the older Western Cascades and the younger High Cascades. This zone is also the location of some of the hottest known thermal springs in the Cascade Range. A major purpose of the study that culminated in the production of this map was to define the structure of the area in greater detail.

The report consists of two map sheets and five-page text discussing the map data. The full-color geologic map at a scale of 1:62,500 (Plate 1) identifies 56 surface, volcanic, and intrusive rock units and their structural relations and is accompanied by four cross sections. The second sheet (Plate 2) contains index and sample-location maps and three tables showing chemical analyses and radiometric ages of rock samples. The text discusses the structural geology, paleogeographic history, and mineral and geothermal resources of this complex geologic boundary.

The report is now available at the Oregon Department of Geology and Mineral Industries, 910 State Office Building, 1400 SV Fifth Avenue, Portland, OR 97201-5528. The price is $8. Orders under $50 require prepayment. (GRC Bulletin, February 1989)

RESERVOIR SIMULATION ON THE CERRO PRIETO GEOTHERMAL FIELD: A CONTINUING STUDY.

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INTRODUCTION

The Cerro Prieto geothermal field is a liquid-dominated geothermal reservoir of complex geological and hydrological structure. It is located at the southern end of the Salton-Mexicali trough which includes other geothermal annomalies as Heber and East Mesa. Although in 1973, the initial power plant installed capacity was 75 MW of electrical power, this amount increased to 180 MW in 1981 as field development continued. It is expected to have a generating capacity of 620 MW by the end of 1985, when two new plants will be completely in operation. Questions about field deliverability, reservoir life and ultimate recovery related to planned installations are being presently asked. Numerical modeling studies can give very valuable answers to these questions, even at the early stages in the development of a field.

An effort to simulate the Cerro Prieto geothermal reservoir has been undergoing for almost two years. A joint project among Comision Federal de Electricidad (CFE), Instituto de Investigaciones Electricas (IIE) and Intercomp of Houston, Texas, was created to perform reservoir engineering and simulation studies on this field. The final project objective is to simulate the behaviour of the old field region when production from additional wells located in the undeveloped field zones will be used for feeding the new power plants.

Early project results from a preliminary material balance applied to the old part of this field (Cerro Prieto I region) using a simplified geological model had indicated the existance of a strong cold water recharge into this region (Castañeda et. al., 1982). This conclusion agreed with the results presented by previous authors (Westwood, 1981; Grant, 1982; Bermejo, 1979).

Now, a tridimensional coarse grid reservoir model has been extended over the entire field as additional reservoir information has been generated and become available to this project. This study presents the simulation efforts to obtain a reservoir pressure and enthalpy history match of the Cerro Prieto I region, using this coarse grid model, when production from other field regions is taken into account. The influence of some reservoir features (i.e., geologic faults) on these match as well as predictive calculations are also presented.

RESERVOIR MODEL

The extended field area used in this simulation study is presented in figure 1. This area (19.5 Km^2) encloses the practical boundaries of the field, as they were defined by CFE[11].

The tridimensional coarse grid model imposed to this area was based on the geologic model presented by Cobo, 1981. Basing his model on well cuttings, he recognized five lithologic units within this area that showed differences in origin, mineralogy, grading, color, etc. From the oldest to most recent, these lithologic units are: biotite granite, gray shale, coffe-colored shale, mudstone and unconsolidated sediments. Most all Cerro Prieto wells are completed on the gray shale and/or coffe-colored shale units although there are some wells that have reached the granitic basement (Sánchez and De la Peña, 1981).

Although this geologic model replaced the one we had been using in the preliminary material balance calculation of this project (a model based on well logs interpretation, (Abril 1978), they showed some similarities on both proposed lithologic columns. Cobo's mineralogic model was then used mainly because there was not enough reservoir information in the other model to characterize the extended field area.

Figure 2 presents a tridimensional representation of Cobo's contour map of the top of the gray shale unit. This figure clearly suggests that the field area of study can be subdivided in 5 main blocks (blocks I through V) limited by the respective faults. This figure also suggests that hotter reservoir zones are expected to be found deeper in the southeast part of the field (Cerro Prieto II area) as it has been indicated by other authors and confirmed by drilling (Domínguez, 1982, Rivera et. al., 1982).

For simulation purposes, these five irregular blocks were replaced by rectangular blocks but the same respective block area was kept. Figure 3 shows this schematic representation.

Faults were included in this representation by assigning to them a defined dimension (thickness of 50 m). For this study, Hidalgo and Patzcuaro faults were considered only.

Figure 4 shows the model vertical representation. Mainly, each block consists of 4 units: 1) a cooler aquifer (unconsolidated sediments) overlying the main geothermal reservoir, 2) a shaly layer (Cobo's mudstone layer and sometimes referred as a "cap rock" by other authors), 3) a shaly sand layer (gray shale coffe-colored shale units), considered as the zone of geothermal interest (higher temperature and higher permeability zone, and 4) the granitic basement. The thickness of each unit represents an average value for each block. Cobo's contour maps of each unit were used for such purpose.

The geologic faults were only included in the gray shale coffe-colored shale unit. Both faults were sealed at the mudstone layer and they did not continue through the unconsolidated sediments.

FORMATION PROPERTIES

For this study, the rock properties were determined by means of geophysical well log analysis and well test data (Castañeda et. al., 1982). This rather scarce data was not sufficient to define the entire area of study or to characterize all lithologic units. Some rock properties were inferred or assumed in zones where no information was available. Figure 5 presents the assigned reservoir parameters to all units.

INITIAL CONDITIONS

The initial field temperature distribution used in this work is presented in figure 6. These temperature profiles were obtained from isoterm maps elaborated from shut-in wells temperature data (Castañeda et. al., 1983). However, the temperature distribution of the eastern part of the field may have been affected by former explotation of the western area. Thus, the presented temperature profiles for the part of the field (blocks 3, 4, and 5) were only used as an approximation to the real initial temperature values.

The initial pressure distribution was computed by assuming an atmospheric pressure at the ground surface and then calculating a hydrostatic distribution of pressure with depth, subject to the initial temperature distribution. These initial conditions neglect any changes that might have occurred in the western field area before 1973. Although some wells were completed and tested in this area on the late 60's, full production started in 1973.

The initial conditions imply that the reservoir was at single phase (liquid) condition prior to production at Cerro Prieto. It has been indicated by some authors (Grant et. al. 1981) that although there was a region of boiling fluid initially in the reservoir, this region was local and very small and that most of reservoir rock contained fluid at single phase (liquid). If that condition of boiling existed in the reservoir, this was a local phenomenon and could not be represented in our coarse grid model.

BOUNDARY CONDITIONS

Presently, the fact that a strong recharge is taking place at the old part of the field (Cerro Prieto I region) is generally well accepted although there has been no agreement on the magnitude and direction of such recharge. Some authors (Bermejo, 1979; Sánchez and De la Peña, 1981) have suggested that there is a significant recharge into this region from the north and east. Others (Grant et. al., 1981; Lippman and Bodvarsson, 1982) have found that the most of the recharge comes from the west and shallower zones.

In this study, a steady-state recharge representation was selected. This required placing aquifer blocks (outer elements) to the rectangular grid model. Aquifer blocks are defined as those elements in the model that communicate directly with an aquifer that is not itself modeled as part of the calculation grid but whose effects are introduced through the specific aquifer terms. The influx into an aquifer block is calculated as:

$$\text{influx rate} = VAB \times (P_i - P_{n+1}) \text{ RB water/day}$$

where:

P_i = initial block pressure

P_{n+1} = block pressure at end of time step

VAB = aquifer influx coefficient RB/DAY/psi

The aquifer blocks in the model are: in the western side of the model, nodes I=1, J=1 to 7; in the northern side, J=1, I=1 to 4; in the eastern side, I=4, J=1 to 7 (in all three sides, layers K=1 to 18). In the southern side, no recharge was considered.

Initial temperature profiles of periphery wells were used to represent the recharge temperature. For the western side of the model, well M-6 (block I), well Q-743 (block II), well M-92 (block IV) and well M-189 (block V) were used for such purpose. Well M-94 (blocks I and III) was considered for the northern side. For the eastern side, well H-2 (block III) and well NL-1 (blocks IV and V). Figure 7 shows these profiles.

SIMULATION RUNS

Intercomp's geothermal reservoir simulator GEOTHERM) was used in this work. The finite difference formulation of this simulator is explained by Coats, 1974. This simulator does not account for the presence of inert gases or for varying concentration and precipitation of dissolved solids.

The grid model representation including main blocks, layers, faults as well as aquifer blocks gave a total of 504 elements.

Rather than simulating a single well, groups of wells were formed according to their location in the field (at a given main block) and their depths of open intervals. In the latter case, the open intervals of each well were projected onto the model vertical representation. This procedure determined the producing layers of the model. Figure 8 shows the 17 groups of wells formed in this manner and their location in the grid model. Some of these wells are not presently on production and they are not accounted for in the histoy match process. They are wells needed for the two new power plants and will become producers in the predictive calculations.

Production history was taken from the monthly production data reported by CFE. Figures 9, 10 and 11 show the production assigned to each well in the model for blocks I, II and some wells in block III, respectively, during the production period of March 1973-May 1983.

The prime objective was to match the observed Cerro Prieto I (block I in the model) reservoir pressure and enthalpy history under the steady-state recharge assumption. These histories are presented in figure 12 and 13, respectively. Both histories are representative of a 1200 m depth zone. The histories suggest that this region has remained single phase (liquid) during this production period (at least until 1979). Some authors (Grant et. al., 1981); Lippman and Bodvarsson, 1982) have shown that although local near-well boiling is a common phenomenon in Cerro Prieto, a more extensive steam zone has not been formed in this part of the field, under exploitation conditions.

HISTORY MATCH RUNS

To handle the recharge strength, aquifer influx coefficients (VAB) were assigned to the aquifer blocks. The same recharge strength (i.e., same VAB values) were given to each of the three recharge sides of the model. This combination may not be unique and it is possible that an acceptable history match could also be obtained with any other combination. However, at this point, there is not enough field information in this coarse grid model to determine such combination exactly.

Because of the single phase (liquid) characteristic of this part of the reservoir during the history match period, the relative permeability concept was not relevant in this set of runs. However, if a two-phase zone develops in other field regions within the model during these runs, the same Corey's curves presented in reference 3 are used, but with residual liquid saturation of 0.3 and residual vapor saturation of 0.05.

For simulation studies, the single most important reservoir parameter is its permeability. Although rock porosity, compressibility, heat conductivity and heat capacity data are also needed for simulation studies, the effects of these parameters are not as great as those of permeability (Lippman and Bodvarsson, 1982). Therefore, the matching procedure was to vary the reservoir permeabilities in the production zones (gray shale-coffe-colored shale units) in combination with the variation of the aquifer influx coefficients. For sake of space, only the most representative simulation runs are presented here.

Figure 12 shows the simulated pressure when the initial reservoir parameters presented in figure 5 were used, for aquifer influx coefficients of 25, 100 and 300. In this case, k_h = 50 md and k_v = 10 md, for the production zone. As it can be observed, simulated pressures were higher than the observed values. To obtain a more gradual pressure drop throughout time, this rather low k_h/k_v ratio of 5 was increased to 10 (an acceptable ratio value for sedimentary reservoirs). Keeping the same k_h value, the vertical permeability (k_v) was reduced to 5 md. Figure 12 also shows this case when a VAB value of 200 is used. The respective simulated enthalpy is presented in figure 13.

Although a perfect pressure match was obtained for three of the four observed values, it was decided that the same weight should be given to the four observed points. An additional pressure drop could be obtained if the aquifer influx coefficients were reduced (i.e., less recharge) but this procedure would tend to decrease the cooling of that region (i.e., give higher simulated enthalpies) and the enthalpy match could not be obtained. Another method to produce an additional pressure drop could be by reducing the reservoir horizontal permeability and retarding the effect of the recharge on the reservoir pressure. To avoid an excessive pressure drop, the aquifer influx coefficient values have to be increased. Figure 14 presents both pressure and enthalpy matches when k_h was reduced to 30 md and a VAB of 1500 was used (the k_h/k_v of 10 was held constant).

It is interesting to notice that the simulator predicts an increase on reservoir pressure in the Cerro Prieto I region, after the period of 84 months (i.e., after 1979). Although no Cerro Prieto I isobaric maps have been made

after that period to verify this result, the above could be explained if we observe the production history of the wells # 2 and 3 on the model. These wells are directly responsible for the pressure drop in that zone (see figure 9). Though the mass flowrate of well 3 remains almost constant during this period, the mass flowrate of well 2 increases to a maximum and then it is reduced to almost half of that value after the period of 84 months. If this part of the field was being over-exploited, this mass flowrate reduction of well 2 should result in a pressure increase on that zone due to the strong aquifer recharge that is taking place in that region.

The rise in the observed enthalpy during the first two years could not be reproduced by this model. It is believed that such rise was produced by taking into account wells that were producing from an initial small two-phase region (Grant et. al., 1981). in the calculation of the overall enthalpy of Cerro Prieto I for those years.

The cooling of the region is due to recharge fluid of lower temperature coming from the west and north sides of the model, as well as that coming from blocks II and III at the same depth. Additional cooler fluid may be coming from the upper unconsolidated layer. Although the vertical permeability of the mudstone layer was set to 5 md (a considerably lower value than the reservoir permeability), some authors have shown that this value could not be sufficiently small to exclude significant downward flow through this layer (Grant et. al., 1981). However, with this coarse grid model, it is only possible to observe an overall effect of this recharge phenomenon.

EFFECT OF FAULTS

The trend of the Cerro Prieto I observed enthalpy in Figure 13 suggests that such enthalpy could stabilize after the 84 months period. To explore such possibility, the vertical permeability of the faults was increased to allow for mixing of more hot fluid from the lower hayers with cooler recharge fluids. The desired overall effect was to decrease the decline rate of the Cerro Prieto I temperature (i.e., enthalpy) at that depth. Although the faults vertical permeability was increased to 500, 1000 and even 10,000 md, the effect was insignificant to be noticed on the corresponding enthalpy graph.

PREDICTION OF FUTURE PERFORMANCE

A single prediction of future performance of the Cerro Prieto I region (i.e., after 1983) was performed. The calculation was merely an extension of the matched performance up through May of 1983. The simulator was allowed to run for an additional 20 years. Figure 15 presents the required mass flow rate to integrate the two new power plants, the wells that will become producers and the approximated dates of the plants starting operation (POISE, 1983). The mass flow rate of the already producing wells was held constant at the value reported by CFE in May of 1983.

Figure 16 shows the predicted pressure and enthalpy performance of this region. At the end of this period, the pressure has slowly decreased to 96 bars. The reservoir enthalpy has decreased to 1030 KJ/Kg, corresponding to a liquid water temperature value of 237°C.

The enthalpy decline is not lineal during this period. The rate of enthalpy decline diminishes with time and could possibly reach a constant enthalpy value for a longer period of time. As mentioned before, this phenomenon could be already occurring with the observed Cerro Prieto I enthalpy. If this is the case, then the predicted enthalpy would be a pessimistic value. Therefore, it would be worthwhile to continue generating this kind of data to verify such field behaviour.

Figure 17 compares the predicted pressure and enthalpy values to that of the steam-water saturation curve. As it can be observed, the Cerro Prieto I region remained single phase (liquid) during the predicted period.

CONCLUSIONS

1.- An acceptable pressure and enthalpy history match of the Cerro Prieto I region was obtained considering a steady-state recharge assumption, for the production period of 1973-1979.

2.- A 30 years predictive calculations using this coarse grid model indicate that reservoir pressure in this part of the field will slowly decrease to 96 bars. However, the reservoir enthalpy will continue to decline but a lower decline rate than at the begining of the field explotation.

3.- Because of the strong recharge taking place in this part of the field, the model predicts that Cerro Prieto I will not come into two phase conditions during the predicted period, under the proposed explotation program.

4.- The Cerro Prieto I predicted enthalpy of 1030 KJ/Kg (a liquid water temperature of 237 C) could be a rather pessimistic value. Further enthalpy data is needed to validate this conclusion.

5.- This coarse grid model suggests that the eventual demise of the Cerro Prieto I region would be a thermal degradation (i.e., cooling effect) rather than a pressure decline in the classical sense.

ACKNOWLEDGEMENTS

The authors would like to thank Coordinadora Ejecutiva de Cerro Prieto and also Instituto de Investigaciones Electricas for the opportunity given to them in presenting this paper.

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The following abbreviations will avoid monotonous repetitions:

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CPII : Proceedings of the Second Symposium on the Cerro Prieto Geothermal Field, October 17-19, 1979, Mexicali, B. C., Mexico.

CPIII: Proceedings of the Third Symposium on the Cerro Prieto Geothermal Field, March 24-26, 1981, San Francisco, Ca.

CPIV : Proceedings of the Fourth Symposium on the Cerro Prieto Geothermal Field, August 10-12, 1982, Guadalajara, Jal., Mexico.

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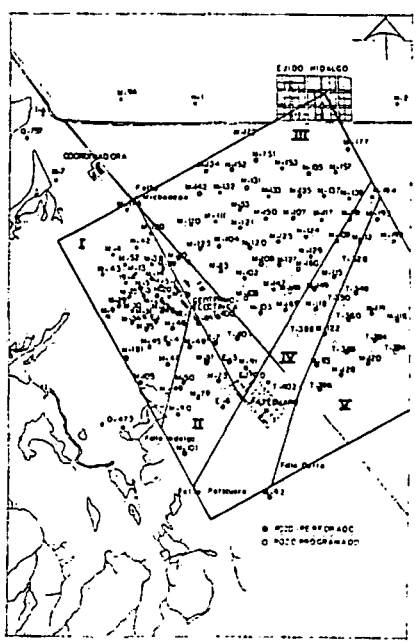

Fig. 1 Extended field area used in this work.

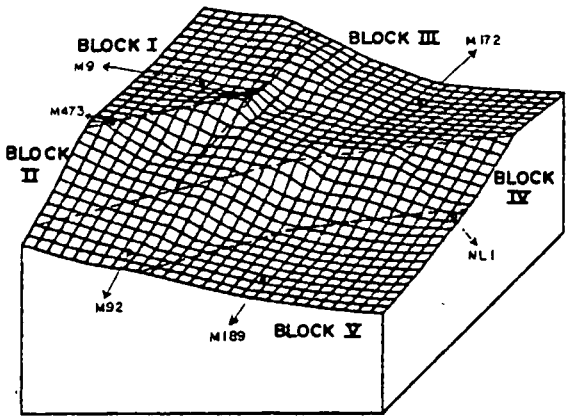

Fig. 2. Tridimensional representation of the top of the gray shale unit.

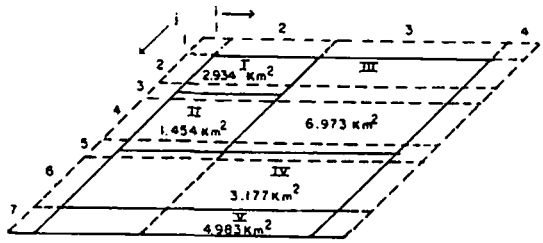

Fig. 3 . Schematic distribution of aereal grid elements.

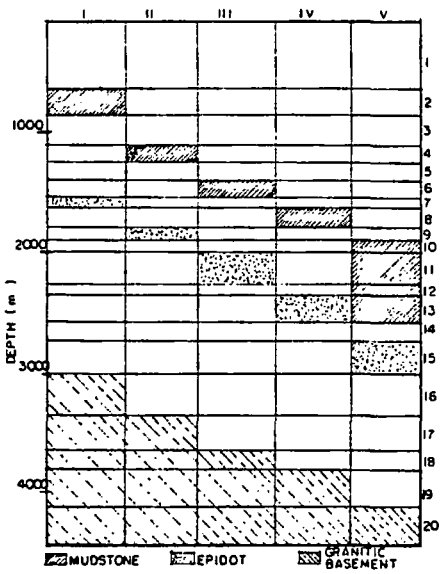

Fig. 4 . Vertical representation of the grid model.

PARAMETER \ UNIT	UNCONSOLIDATED SEDIMENTS	MUDSTONE	GRAY SHALE COFFEE-COLORED SHALE	BIOTITE GRANITE
POROSITY (fraction)	0.10	0.04	0.1	0.02
HORIZONTAL PERMEABILITY (md)	100	1	50	0.1
VERTICAL PERMEABILITY (md)	20	5	10	0.01
THERMAL CONDUCTIVITY BTU/ft°F	35.0	35.0	35.0	35.0
ROCK HEAT CAPACITY BTU/ft³·°F	39.5	39.5	39.5	39.5
ROCK COMPRESSIBILITY (psi^{-1})	4×10^{-6}	4×10^{-6}	4×10^{-6}	4×10^{-6}

Fig. 5 . Initial reservoir parameters for each model unit.

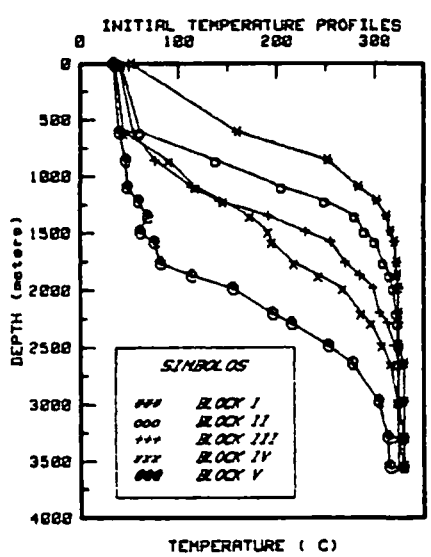

Fig. 6 . Initial temperature profile for each main block.

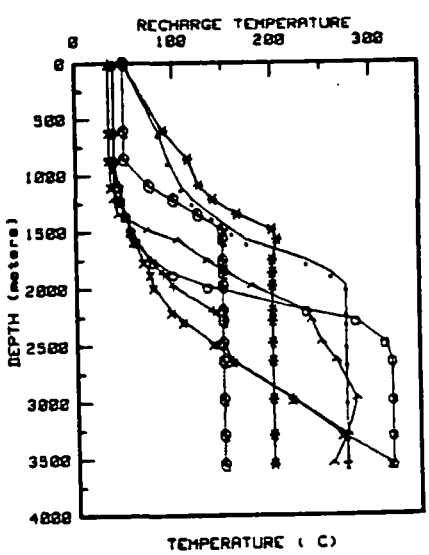

Fig. 7 . Recharge temperature profiles considered in this work.

MODEL WELL NUMBER	LOCATION I	J	K	WELL	BLOCK
1	2	2	2	M9, M 291	I
2	2	2	4-5	M2911, M11, M31, M9A, M15A, M26, M27, M14, M5, M21A, M35, M8, M 42.	I
3	2	2	5	M-20, M45, M25, M46, M39, M-30, M34, M43	I
4	2	2	7		I
5	2	4	5	M48, M50, M90	II
6	2	4	5-7	M51	II
7	2	4	10-11	M101	II
8	2	4	9	M84, M73, M79	II
9	3	2	11	M53, M91, M102, M103, M113, M117, M120, M121, M124, M125, M135, M137, M139, M150, M155, M157, M169, M177, M195, E5, E7.	III
10	3	2	9	M104, M110	III
11	2	4	13-14	E6	II
12	2	2	9	E2	I
13	3	2	12	M133, M127	III
14	3	2	13-14	M111	III
15	2	6	13	M109, M112, M115, M118, M122, M149, M191, M194, M328, M350 M388	IV
16	2	7	15	M93, M116, M119, M128, M348 M364, M366, M386, M395	V
17	3	4	11	M129, M147, T400	III

Fig. 8 . Location of the groups of wells in the coarse grid model.

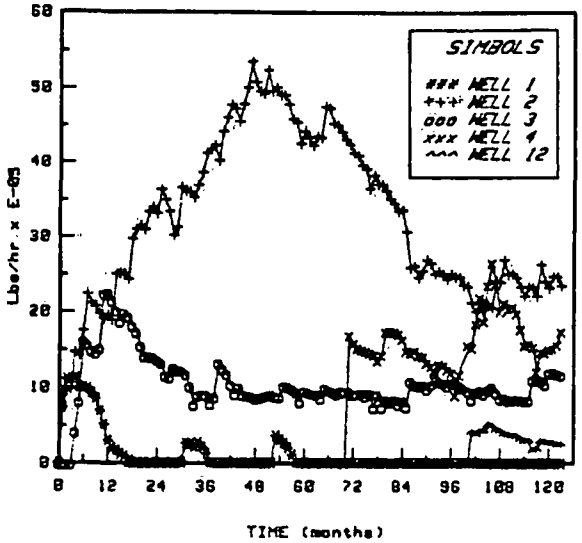

Fig. 9 . Production history for model main block I .

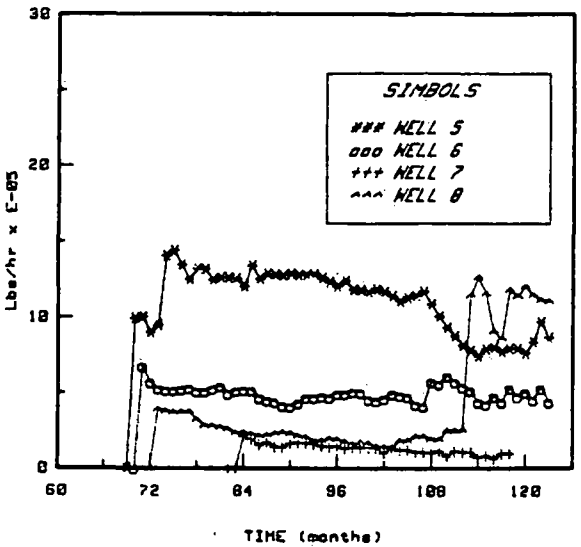

Fig. 10 . Production history for model main block II.

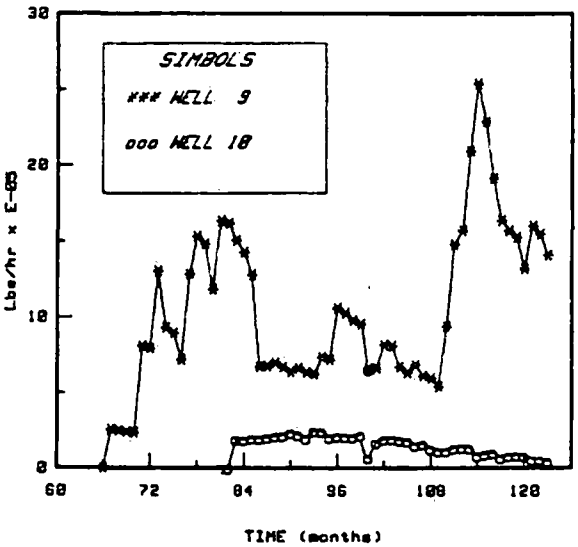

Fig. 11. Production history for model main block III.

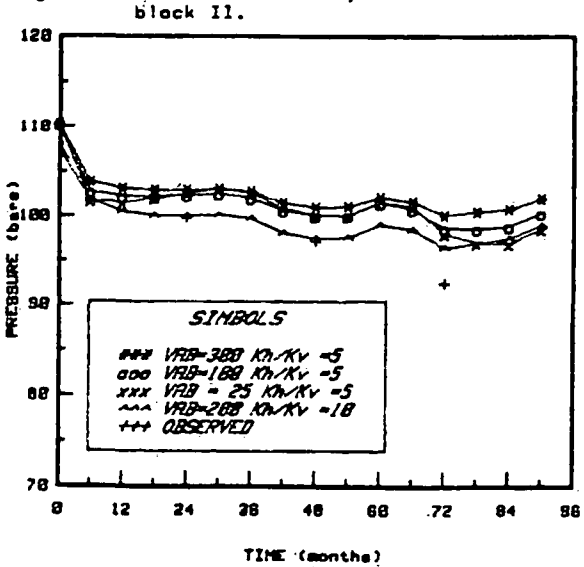

Fig. 12 . Simulated pressure for the initial reservoir parameters.

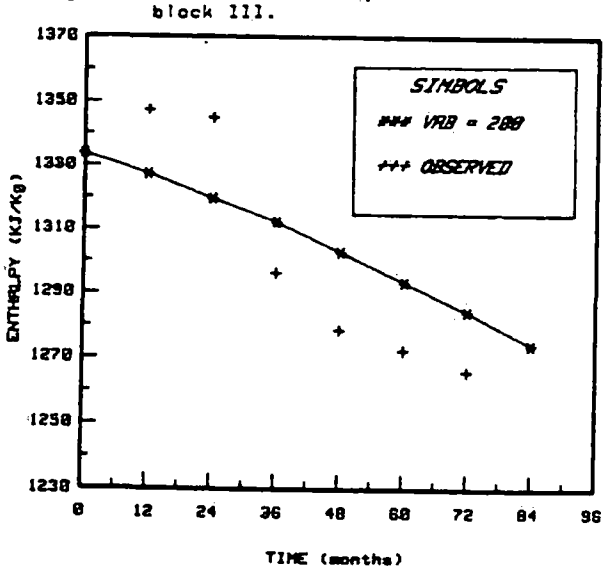

Fig. 13 . Simulated enthalpy for the case Kh/Kv = 10 , Kh = 50 md .

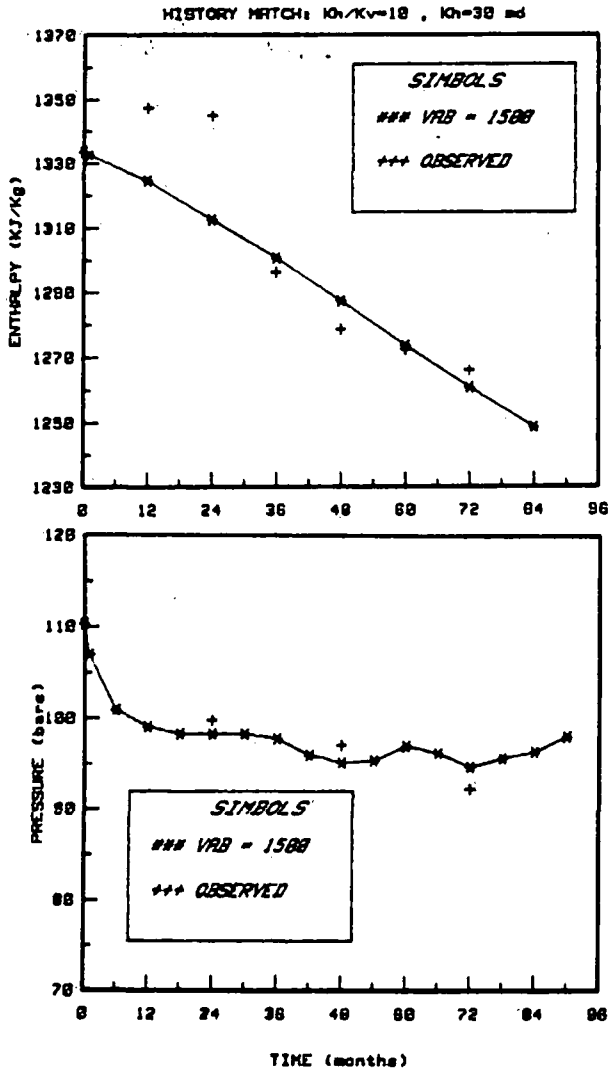

Fig. 14 . Pressure and enthalpy match for Cerro Prieto I (at depth of 1200 m)

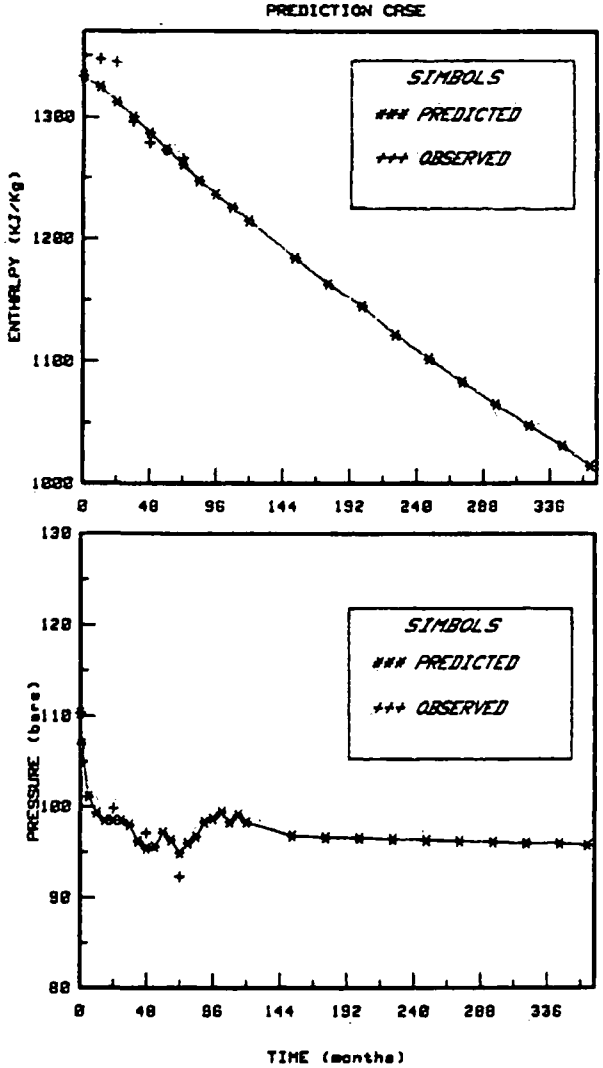

Fig. 16 . Predicted pressure and enthalpy for Cerro Prieto I region (period 1973-2083)

POWER PLANT	UNIT	DATE	WELLS	MASS RATE PER WELL (Ton/hr.)
CP II	1	DIC/1/83	M93, M116, M119, M128, M364, M366, M386, M395, M348, M122 T400.	233.1
	2	NOV/1/84	M129, M147, M27, M115, M118, M149, M328, M350, M388.	233.1
CP III	1	ENE/1/85	M150, M117, M121, M113, M124, M110, M109, M112, M125, M111.	233.1
	2	JUL/1/85	M135, M137, M139, M157, M155, M177, M195, M191, M194, M133.	233.1

Fig. 15. Required mass flow rate and approximated starting operation dates for the two new power plants.

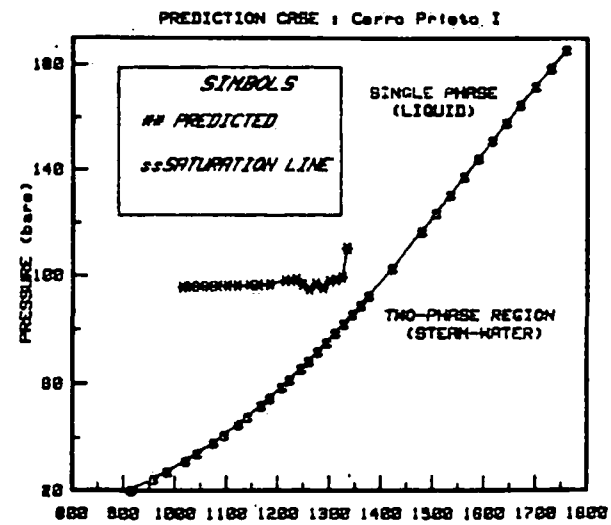

Fig. 17 . Comparison of predicted pressure and enthalpy with the steam-water saturation curve values