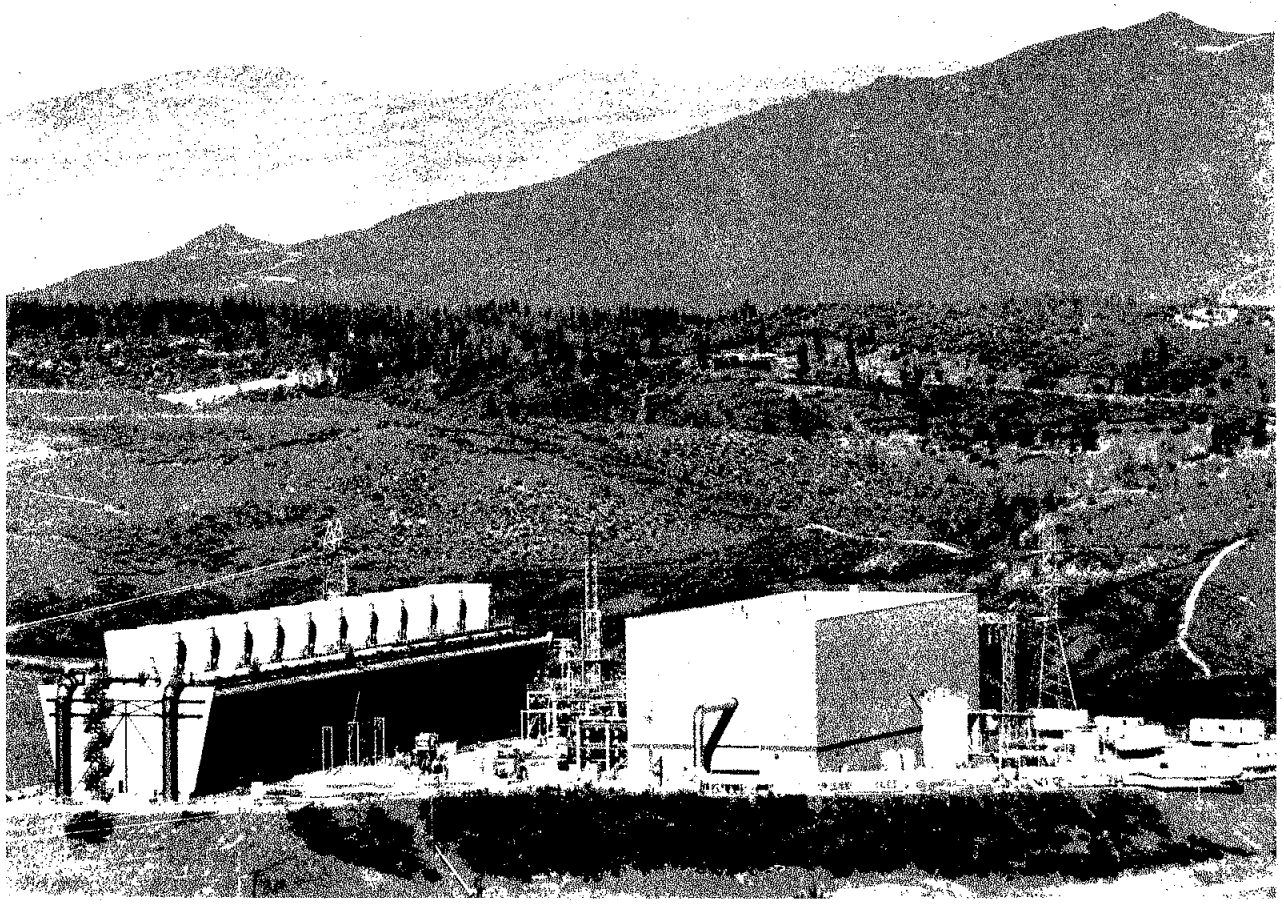
PUBLICATION NO. TR02

GEOTHERMAL HOT LINE

A Publication of the California Division of Oil &Gas

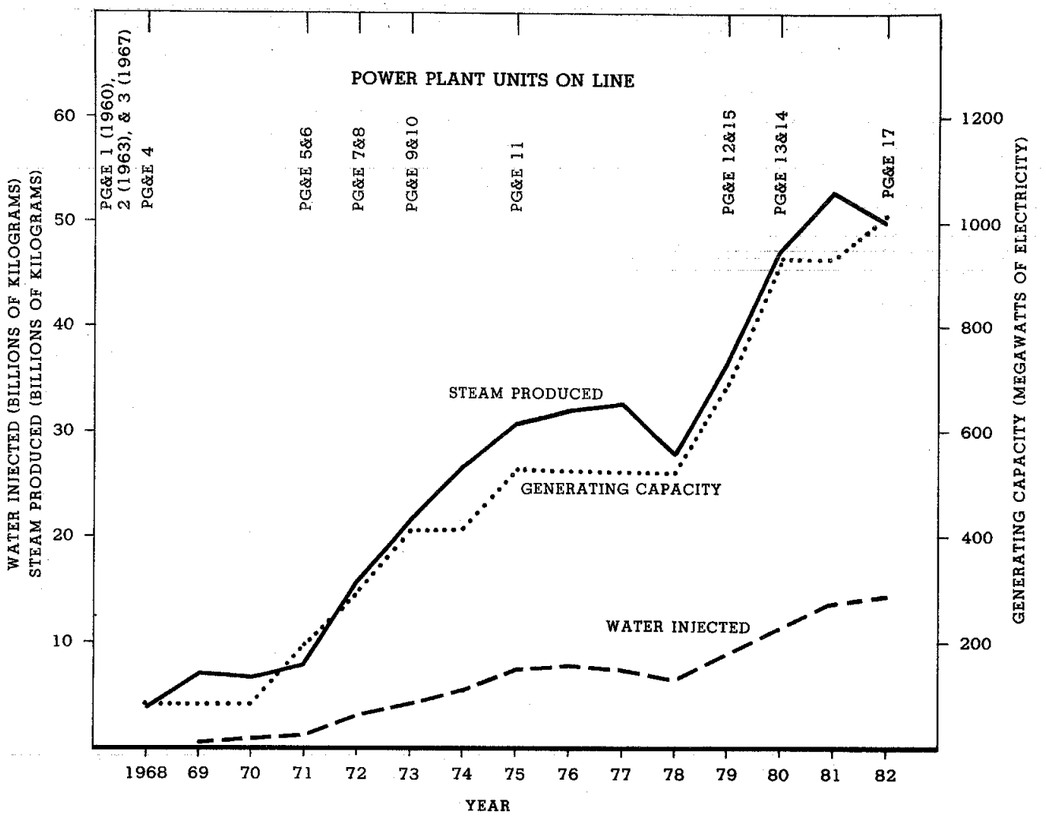
July 1983 DEPARTMENT OF CONSERVATION Vol. 13 No. 1



Power plant Unit 17, Pacific Gas and Electric Company, The Geysers Geothermal field. The Geysers, the largest geothermal electrical generating complex in the world, passed the 1,000 megawatt milestone in late 1982 when Unit 17 began operation.

The power plant has a net capacity of 110 megawatts of electricity. It includes both primary and secondary abatement systems for removing hydrogen sulfide from geothermal steam.

Geothermal power represents 9 percent of PG&E's total electrical generating capacity. The company supplies electricity to 3.5 million customers in 47 northern and central California counties. Photo courtesy of Pacific Gas and Electric Company.



History of steam production, water injection, and power plant capacity at The Geysers Geothermal field as of December 31, 1982. Compiled by the California Division of Oil and Gas. *See page 5 for further power plant information.*

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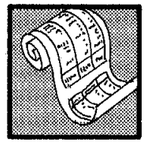
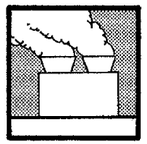
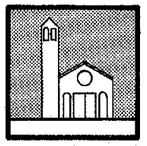
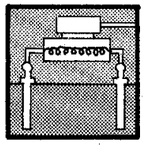








Northern California

CDOG Office Address Change

On May 16, the California Division of Oil and Gas, Geothermal District G-3 office moved from the McBride Lane address to the new state building in Santa Rosa. The new address is:

California Division of Oil and Gas
Geothermal District G-3
50 "D" Street, Room 300
Santa Rosa, California 95404

The telephone numbers remain the same and are:

(707) 576-2385
(707) 576-2386

1982 Production and Injection Statistics, The Geysers Geothermal Field

Steam production from The Geysers Geothermal field decreased 6.5 percent in 1982, according to Simon Cordova, Acting Chief of the California Division of Oil and Gas. Cordova said 49,365,069,000 kilograms of steam were produced at The Geysers in 1982 from an average of 175 wells, compared with 52,769,159,000 kilograms in 1981 from an average of 163 wells. The steam was used in 16 field power plants with a total generating capacity of about 1,040 megawatts gross of electricity.

Cordova said that the amount of water injected at the field rose slightly in 1982 from 1981 levels. About 13.8 billion kilograms were injected in 1982 and about 13.7 billion kilograms were injected in 1981.

The cumulative field reservoir-fluid deficit is about 74.7 billion kilograms.

Induced Seismicity in The Geysers Geothermal Area, California

By Donna Eberhart-Phillips and David H. Oppenheimer
U.S. Geological Survey
Menlo Park, California

The following information (presented at the 58th Annual Meeting of the AAPG-SEPM-SEG Pacific Section) is an abstract of the report, soon to be published in the Journal of Geophysical Research.

A simultaneous inversion for hypocenters, velocities, and station delays was performed from the P-arrival times of 55 microearthquakes (quakes too small to be felt) and 4 explosions distributed throughout a 90- and 100-km region centered at The Geysers Geothermal area in Northern California. The resulting one-dimensional layered model shows velocity increasing with depth from 4.4 km/s at the surface to 5.9 km/s at 8 km and deeper.

Using the new velocity model, we relocated 7,215 earthquakes that occurred between May 1975 and February 1982. These relocations show a significant spatial clustering near production wells in the steam field that was not apparent in earlier studies.

We infer from the spatial and temporal pattern of seismicity that the seismicity at The Geysers is induced by geothermal production activities. With the expansion of power production by approximately 70 percent in 1979-80, seismic activity has developed near the new production areas. Seismicity has also expanded northwestward of the present production area, although there are no active steam wells in this area.

Statistical cross-correlations between the number of earthquakes per month and both steam withdrawal and injection volume per month were calculated. For the wells studied, we find no consistent pattern of correlation between injection and seismicity. Likewise, we find little or no correlation between steam withdrawal and seismicity for steam wells in production longer than 7 years.

Our observations support the inducing mechanism proposed by Allis (1982), whereby a seismic deformation due to regional tectonic stress is converted to stick-slip (seismic) deformation due to an increase of coefficient of friction along fault surfaces, such as could occur from exsolution of dissolved silica into fractures. Accordingly, we expect seismicity to continue in The Geysers and for seismicity to appear in areas where new production occurs.

Power Plant Development in The Geysers Geothermal Field 1960 - 1991

Compiled by the California Energy Commission
Current as of March 1983

Project	CEC Certification	Estimated and On Line Date	County of Location	Gross Capacity (MW)	Net (MW)	Cumulative Net (MW)
PG&E 1	--	1960	Sonoma	12	11	11
PG&E 2	--	1963	Sonoma	14	13	24
PG&E 3	--	1967	Sonoma	28	27	51
PG&E 4	--	1968	Sonoma	28	27	78
PG&E 5	--	1971	Sonoma	55	53	131
PG&E 6	--	1971	Sonoma	55	53	184
PG&E 7	--	1972	Sonoma	55	53	237
PG&E 8	--	1972	Sonoma	55	53	290
PG&E 9	--	1973	Sonoma	55	53	343
PG&E 10	--	1973	Sonoma	55	53	396
PG&E 11	--	1975	Sonoma	110	106	502
PG&E 12	--	1979	Sonoma	110	106	608
PG&E 15	--	1979	Sonoma	62	59	667
PG&E 13	--	1980	Lake	138	133	802
PG&E 14	--	1980	Sonoma	114	109	911
NCPA 2	4/80	12/82 (tested in '82)	Sonoma	110	106	1,017
PG&E 17	9/79	12/82	Sonoma	120	110	1,127
PG&E 18	5/80	5/83	Sonoma	120	110	1,237
SMUD Geo #1	3/81	12/83	Sonoma	72	65	1,302
DWR Bottle Rock	11/80	6/84	Lake	55	52	1,354
Occidental #1	1/81	6/84	Lake	97	80	1,434
PG&E 16	9/81	6/85	Lake	120	113	1,547
NCPA 3	12/82	7/85, 10/85	Sonoma	55 & 55	106	1,653
MSR #1	---	1985	Sonoma	5	5	1,658
DWR So. Geysers	11/81	2/86	Sonoma	55	52	1,710
PG&E 20	1/83	12/85	Sonoma	120	113	1,823
PG&E 19		6/88	Sonoma	55	53	1,876
PG&E 22		6/88	Sonoma	110	106	1,982
PG&E 21		12/87	Sonoma	110	106	2,088
PG&E 23		6/89	Sonoma	110	106	2,194
CCPA #1		1/89	---	55	53	2,247
MID/Shell		1990	Sonoma	25	23	2,270
CCPA #2		1990	---	55	53	2,323
PG&E 24		6/91	Sonoma	110	106	2,429

PG&E - NCPA Electrical Transmittal Agreement

Pacific Gas and Electric Company (PG&E) has agreed to transmit power from power plant NCPA2 at The Geysers Geothermal field. The plant, owned and operated by the Northern California Power Agency (NCPA), is the first non-PG&E power plant to operate at The Geysers.

The cities comprising NCPA have pressed for this agreement with PG&E. Although they have internal electrical distribution systems, they have no way to transmit electrical power from the geothermal field to their boundaries.

Now, with the new agreement, and if the Federal Energy Regulatory Commission and the city councils approve the plan, the cities will pay PG&E for transmitting the electricity out of the field and for providing associated services to their power plant. Up to this time, electricity generated at NCPA2 has been sold to PG&E and then repurchased by the cities as needed. The cities will still purchase some electricity from PG&E, as the power plant does not supply enough electricity to meet all their needs.

NCPA cities include the Cities of Alameda, Biggs, Gridley, Healdsburg, Lodi, Lompoc, Palo Alto, Redding, Roseville, Santa Clara, Ukiah, and the Plumas-Sierra Rural Electrical Cooperative in Portola. The Cities of Santa Clara and Redding are not part of the new PG&E agreement.

Susanville Injection Well Completed
By Dick Thomas

California's first low-temperature geothermal injection well was completed in the City of Susanville in November 1982. The well is the last step in a municipal project designed to heat 14 public buildings with geothermal water. The injection well, "Richardson" 1, was drilled to a depth of 366m (1,200 ft.). Since completion, an average of 34 m^3/hr. (1200 $ft.^3$/hr.) of 57°C (135°F) water has been injected into the well. The water, at a surface pressure of 4.1 bars (60 psi), is injected into a zone of red clay and volcanics between 137m-143m (450 ft.-470 ft.), and a zone of fractured basalt between 253m-268m (830 ft.-880 ft.).

Indian Valley Hospital Wells

The Indian Valley Hospital District completed a low-temperature geothermal production well adjacent to a hospital site in Greenville, California in January 1983. Water from the well will be used to heat the community hospital.

The well, "GRN" 1, tested at a rate of 40 $ft.^3$ per minute of 47°C (117°F) water between the 128 meter to 158 meter (420 foot to 520 foot) interval. Most of the drilling funds were provided by the California Energy Commission under its Geothermal Grant Program.

A second well, "GRN" 2, will be drilled 60 meters to the northwest. The Indian Valley Hot Springs have a temperature of 41°C (106°F). They are about 24 miles southwest of Susanville.

Southern California

Chevron, Dravo, May Be Partners in Heber Dual Flash Project

"We've cut back exploration activity because the market is not aggressive. However, Chevron remains very much in the business of developing geothermal energy," said Al Cooper, Vice President of Chevron Geothermal Company of California.

At the Imperial County Geothermal Development Annual Meeting, Cooper announced that Chevron has found a way to continue its 49 megawatt net, dual flash power plant project at Heber.

The project is the one for which Southern California Edison (SCE) had requested approval from the California Public Utilities Commission (PUC) to build and to sell the electricity generated there to SCE customers. The plant was to have been operated with geothermal water purchased from Chevron.

On October 20, 1982, the PUC both denied and approved the SCE application. The PUC decision stated that SCE could build the plant; however, the rates the SCE charged for electricity generated at the plant could not reflect plant building and operating costs. The SCE could recover through its rates only the costs it avoided by not using fossil or nuclear fuel.

As a result of this decision, Emil Hutchins of SCE told the Imperial County Board of Supervisors on November 2 that, under the restrictions imposed by the PUC, it would be impossible for SCE to operate the Heber plant as it is presently conceived.

At that time, Chevron suspended drilling activities at the project site and began looking for parties to take SCE's place.

Cooper announced at the meeting that the search was successful. Chevron has signed a Memorandum of Understanding with Dravo Corporation who will build and operate the power plant. Tentatively, the electricity is scheduled to be sold to SCE, although no agreement has been made. The final contracts with Dravo are scheduled to be signed in July 1983.

The Heber plant will be the first geothermal power plant constructed by Dravo, who owns and operates fossil fuel plants.

"Geothermal energy is not cheap," said Cooper. "However, as more plants are constructed, what we learn from them makes subsequent plants more cost effective. If we don't do something in geothermal today, we won't be able to meet the market in the 1990's."

Chevron estimates the Heber anomally will support generation of 500 megawatts of electricity for 30 years.

An article by Cooper in which he discusses geothermal development in

the Imperial Valley is in the Spring 1983 issue of Valley Grower. The issue is available for $2.50 from Valley Grower, P.O. Box 358, El Centro, California 92244-0358.

Heber Binary Plant Contracts Awarded

On May 24, 1983, San Diego Gas and Electric Company (SDG&E) awarded a $3.7 million contract to R. G. Fisher Constructors, Fresno, for the first phase of construction work on the Heber geothermal project in the Imperial Valley. Construction is scheduled to start in June.

To date, SDG&E has awarded 36 contracts totaling some $30.6 million, for equipment and construction of the 45 megawatt geothermal binary power plant project.

"Most of these contracts are for a wide range of equipment to be used at Heber in producing electricity from underground fluids of about 182°C or 360°F," said Bob Lacy, Heber project manager.

The largest contract, for $7.2 million, went to the Engineers and Fabricators Company, Houston, Texas. The firm will build the brine/hydrocarbon heat exchangers.

Another contract for $4.7 million was awarded to the Southwestern Engineering Company, Los Angeles, for construction of the hydrocarbon condensers -- equipment that is used to condense the hydrocarbon vapor exhausted from the turbine.

Two other contracts, totaling $662,000, have been awarded to the McGraw-Edison Company, Cannonsburg, Pennsylvania, for transformers.

The turbine generating equipment for the Heber plant will be built by the Elliott Company, Jeanette, Pennsylvania, under a $6 million agreement.

"These contract awards are part of the overall effort of getting the plant built on time and put into operation by early 1985," said Lacy. He added that the project signifies SDG&E's commitment to develop a broad range of domestic energy resources to provide customers with energy in the future.

The Heber project is co-funded by the U.S. Department of Energy, SDG&E, the Electric Power Research Institute, the Imperial Irrigation District, the State of California, the Department of Water Resources, and Southern California Edison.

PUC Rules on Heber Binary Plant

A ceiling of $89.5 million will be placed on costs San Diego Gas and Electric (SDG&E) customers will bear for the binary-cycle geothermal demonstration project at Heber over the next 4 years, according to a ruling by the California Public Utilities Commission (PUC) on May 18, 1983.

The limit will not be raised unless SDG&E makes a "compelling showing", the PUC ruling added. The PUC feels the ceiling should create an incentive to SDG&E to operate the plant cost-effectively, yet not be restrictive enough to terminate the project.

If the plant produces at predicted levels, SDG&E customers may realize $22 million in energy savings during the demonstration period.

Cost of the geothermal project to a typical residential customer using 400 kilowatt hours of electricity a month will be about 56¢ per month in 1983, tapering to about 37¢ a month in 1987, and ending in 1988, when the plant is expected to become commercial.

The 44.4 megawatt plant will be the nation's first project of this size to use binary-cycle geothermal technology.

Capital cost of the project, which will be completely paid off during the demonstration period, will be about $108 million. The cost of geothermal brine, purchased from Chevron U.S.A. Inc., will add another $67.8 million during the demonstration period.

Because of the importance of the project, $61 million is being provided by the U.S. Department of Energy. Lesser amounts are being provided by the Electric Power Research Institute, Southern California Edison, the State of California, the Imperial Irrigation District, and the California Department of Water Resources.

Although its share of the total cost will be only about 50 percent, SDG&E will own 83.2 percent of the facility, with the Imperial Irrigation District owning 9.7 percent, the State of California 3.9 percent, and the Department of Water Resources 3.2 percent.

The PUC approved the Heber binary project in January 1980, saying that it would benefit SDG&E ratepayers and demonstrate the viability of the technology as an alternate source of power.

Mesquite Field Development

(Adapted from a presentation by Dan Hoyer at the Imperial County Geothermal Development Annual Meeting.)

High temperature geothermal energy in the Imperial Valley Mesquite Geothermal field (once called the South Brawley Prospect) is being developed by CU I Venture, a California Partnership between MCR Holdings and Geothermal Kinetics Inc., and the California Department of Water Resources. MCR Geothermal Corporation is agent and manager for the CU I Venture.

In May 1980, the CU I Venture received a $49.4 million U.S. Department of Energy Loan Guarantee to help finance the project.

Four production wells have been drilled on the 11,000 acres leased by CU I Venture. Successful well tests have provided information on reservoir size, resource properties, well productivity, and brine chemistry. In addition, injectivity was demonstrated for produced brines with continuous on-line handling and treatment.

Final commercialization plans for the initial 640 acre development block are being made, based upon recent test data. Development plans include the construction and operation of power plant facilities that will generate 45 megawatts of electricity. Permit applications filed with Imperial County include an option to develop the initial block in stages. Initial block development could start in 1984. The first stage power plant could be on line in 1986 or 1987.

East Mesa Will Receive Raft River Geothermal Plant

A small-scale binary cycle geothermal research plant will be sent from the U.S. Department of Energy (DOE) Raft River, Idaho site to the DOE Geothermal Test Facility at East Mesa in the Imperial Valley.

In Idaho, the plant was operated by employees of the Energy Programs Division of EG&G, a prime operating contractor for the Department of Energy at the Idaho National Engineering Laboratory.

The power plant was operated at Raft River from 1978 to 1982. It was a prototype for a larger 5 megawatt pilot plant built and operated at Raft River.

At East Mesa, the plant will be used to test advanced geothermal power cycle operations with a variety of hotter geothermal fluids. Heat cycles will be studied under supercritical heating conditions. The research program is scheduled to last through fiscal year 1984.

Minerals from Geothermal Brines -- Additional Sources

The July 1982 issue of the Geothermal Hot Line included an article on mineral recovery from geothermal brines. The following information is also available on this topic.

1) Strategic materials shortages: institutional and technical issues. UCRL-53203. By A. Maimoni and I. Y. Borg. 1981. $6.00; microfiche $3.50. Published by and available from the National Technical Information Service, U.S. Dept. of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

   The paper summarizes the institutional and technical issues involved in the acquisition of strategic minerals. As market forces alone may not protect national interests, government policies such as incentives to develop lower-grade resources and government-sponsored research for techniques of mineral extraction, materials fabrication, substitution, and conservation may be needed.

2) Minerals recovery from Salton Sea geothermal brines: a literature review and proposed cementation process. 1982. By A. Maimoni. Published in Geothermics, vol. 11, no. 4, p. 239-258, 1982.

3) Chemical analyses of geothermal waters and strategic petroleum reserve brines for strategic and precious metals. UCRL-88575 Preprint. By Jackson E. Harrar and Ellen Raber. Available from Dr. Harrar, L310 Lawrence Livermore Laboratory, University of California, Livermore, California 94550. Phone (415) 422-6367.

   Trace chemical analyses techniques were used to survey waters from 7 hydrothermal-geothermal wells, 1 geopressured-geothermal well, and 6 strategic petroleum reserve wells. The elements sought were Cr, Co, Mn, Ta, Sn, V, Nb, Li, Sr, Pt, Au, and Ag. Platinum was found in a concentration of ~50 ppb in a brine from a Salton Sea geothermal resource. Brine from this region has been previously noted as rich in Li, Sr, and Mn.

   Higher concentrations (~900 ppm) of Sr occur in the high-salinity, geopressured brines.

The City of San Bernardino

The City of San Bernardino wastewater treatment plant was retrofitted to use geothermal heat instead of natural gas in its digesters. The new system was inaugurated in April 1983. The plant processes about 21.5 million gallons of domestic and industrial waste every day. Work was done under a $390,000 contract with the California Energy Commission (CEC), and with $43,400 supplied by the San Bernardino Municipal Water Department.

Work is underway in the City of San Bernardino on a second geothermal project--a demonstration geothermal district heating system. A report prepared for the CEC states that the heating system is technically and economically feasible. Geothermal water for the project measured 130°F-134°F and is available with well flow rates of up to 4,500 gallons a minute with less than 300 milligrams per liter of dissolved minerals.

To order two publications describing the district heating project, see the Publications section of this issue.

Nevada

Reno Church Heated Geothermally

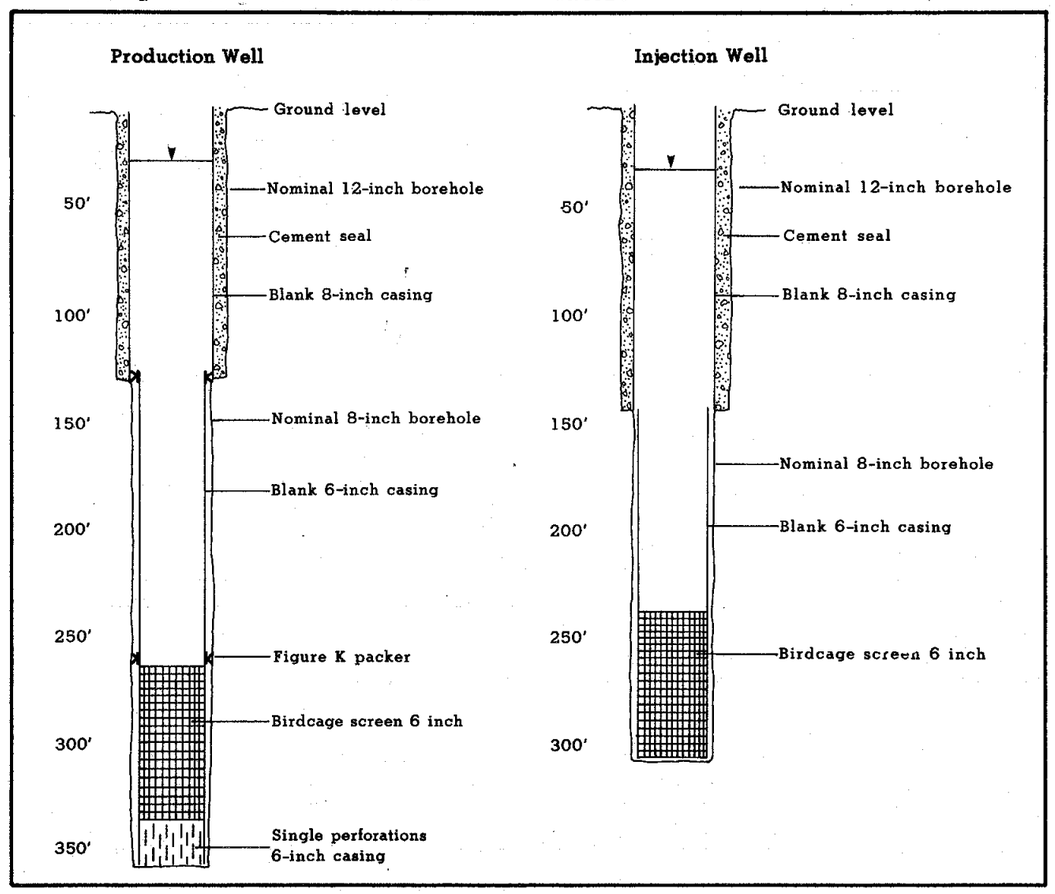
By David Carlson
William E. Nork, Inc.

In October 1982, a 107 meter (350 foot) test geothermal production well was constructed for the First Church of Religious Science, Reno, Nevada. Geothermal water from 79-to 107-meters (260-to 350-feet) will be pumped through a heat extraction system in the 16,000 square-foot church building and disposed of as heat-spent fluid in an injection well.

After the production well was completed, an existing well on church property was reworked to serve as an injection well. The well was cleaned and drilled to a total depth of 93 meters (304 feet).

A 24-hour, constant-discharge/injection test at a pumping rate of 30 gpm was conducted on October 15 and 16, 1982. Test results indicate that the production well is capable of yielding about 60 gpm for an extended period of time.

Strata penetrated by the injection well were found capable of receiving only 30 gpm of spent geothermal water.



Production well and injection well, First Church of Religious Science, Reno, Nevada.

Although a temperature survey of the well indicated a bottom-hole temperature of 75°C (167°F), the maximum recorded temperature of water pumped from the production well during testing was 63°C (145°F).

Static water level before testing was 12 meters (20 feet) below the top of the casing in the production well, and 8.5 meters (27.9 feet) below the top of the casing in the injection well. After pumping for 24 hours, the production well water level was 29 meters (92.38 feet), drawdown was 22 meters (72.05 feet), and specific capacity was calculated at 0.42 gpm/ft. The production well water level recovered 100 percent after 27 hours. At the end of 24 hours, stabilized water level in the injection well was 2 meters (5.66 feet) below the top of the casing.

Idaho

Boise Space-Heating System

In February 1983, a geothermal space-heating project began operating in Boise, Idaho. Initially, about 50 buildings will be connected to the system that could heat up to 145 homes and offices in downtown Boise and in the city's northern end.

The system was built by Boise Geothermal, a government partnership. The U.S. Department of Energy provided $3.6 million for the project.

Proposals are being discussed to link the system with a smaller geothermal space-heating system that began operating last October in the capitol and state office buildings. This merger would allow discharge from the latest system (which includes 3 Boise Geothermal wells that can produce about 4,000 gallons a minute) to be injected into wells drilled for the first system.

Hawaii

Hawaiian Deep Water Cable Project Funded

A $16.6 million contract to fund research and development of the Hawaii Deep Water Cable project has been signed by the U.S. Department of Energy and the Hawaiian Electric Company. Initial project funding is $5.6 million. Additional funding will come as the project progresses.

The underwater electrical transmission cable will connect the islands of Hawaii and Oahu. The project includes final cable and cableship designs, and placement of 20,000 feet of a prototype cable.

The cable will allow Oahu, where 80 percent of Hawaii's population lives, to receive electrical energy generated on Hawaii, where most of the state's renewable energy resources are. Hawaii's geothermal electrical production capability is estimated at 500 megawatts, almost one half of Oahu's present need.

The underwater cable will be the deepest and, possibly, the longest underwater electrical power cable ever installed. The cable will have to withstand water pressures at a depth of 7,000 feet and may have to extend for over 150 miles between the two islands.

Technology

Water Source Heat Pumps

(Reprinted from the Washington State Energy Office Newsletter.)

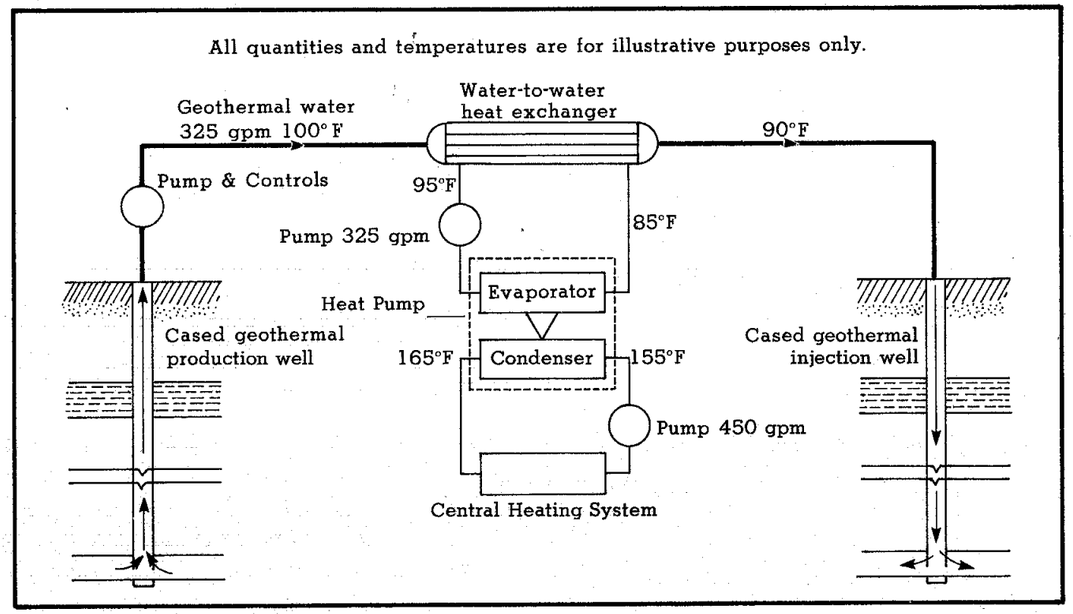
The development of water-source heat pumps is one of the most promising prospects for expanding the uses of low-temperature geothermal resources. At present, heat pumps can be utilized with water temperatures as low as 10°C (55°F); and units are commercially available with output temperatures up to 110°C (230°F). A heat pump operates on what is called the refrigeration cycle, where a refrigerant, most commonly freon, passing between its gaseous and liquid phases, absorbs or releases heat.

Heat energy is transferred from low-temperature geothermally heated groundwater to the heat pump with a heat exchanger.

The heat energy is boosted in an evaporator, and finally transferred in the condenser to a secondary fluid such as water or air to meet industrial, space, or agricultural heating needs.

In the reverse mode, the water-source heat pump will provide air conditioning by extracting heat from the air, transferring that heat to the geothermal water, which is then pumped into the ground.

Energy to drive the heat pump can be in the form of electricity, natural gas, propane, or diesel. Energy savings from heat pump utilization range from 40 to 85 percent, and are dependent upon the temperature of the geothermally heated groundwater, as well as the form of energy used to drive the heat pump.



Heat pump system for district heating.

Geothermal Water System in Use

The nation's first domestic water system designed to provide both heat and domestic water was dedicated in Ephrata, Washington by Governor John Spellman and Mayor Leslie Parr.

The Ephrata project has two parts. One, the primary system, is used to extract heat energy from the city's 84°F municipal water system. A central heat pump increases the water temperature to 120°F-150°F. Then, the water is circulated through the Grant County Courthouse and Courthouse Annex. The water will also pass through the County Law and Justice Center when the system is completed.

Preliminary data indicate the system will save Grant County almost $12,000 per year, a reduction in the county courthouse fuel bill of about 85 percent.

A smaller, second system is being used to test the use of individual heat pumps for heating single-family residences.

The Washington State Energy Office has identified over 80 cities in the state with low-temperature geothermal water accessible for use in geothermal district heating systems similar to that in Ephrata.

Governor Spellman and members of the state's congressional delegation support federal legislation that would make energy tax credits available to developers of low-temperature geothermal resources.

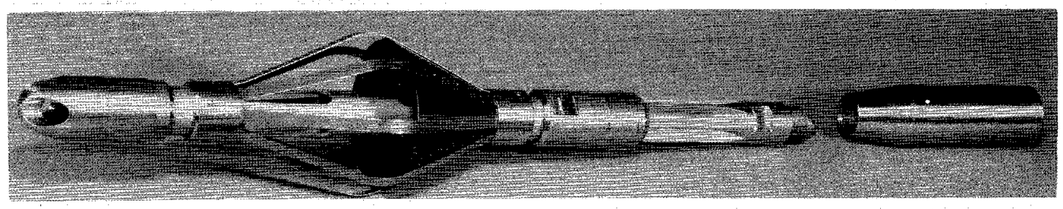
New Flowmeter Tested Successfully

A flowmeter that can measure downhole fluid flow rate with new accuracy and reliability has been developed by two researchers at Lawrence Berkeley Laboratory.

During well tests in the Imperial Valley, the instrument operated at temperatures of over 520°F at depths of about 2½ miles. Constructed of stainless steel and titanium, the flowmeter was not affected by immersion in brine with a salt content 10 times that of sea water--a highly corrosive concentration in which both aluminum and ordinary steel would deteriorate.

The flowmeter is mechanically and electrically attached to a high-temperature armored logging cable. It can penetrate wellbores as small as 3 inches in diameter. Well fluid passing through the flowmeter rotates an impeller, measuring the rate and amount of flow and producing a signal that is monitored at the surface.

"The development of a reliable, high-temperature, downhole flowmeter opens a new door in geothermal reservoir engineering research," said Sally Benson, a flowmeter developer. "Not only can the flowmeter be used for conventional applications such as delineating productive rock strata, but it can be used to determine flash depth, or boiling point, in the wellbore and to detect variations in wellbore diameter caused by scale buildup, casing changes, and caving."



The new flowmeter developed at Lawrence Berkeley Laboratory.

Northwest Power Plan

Geothermal Element in Northwest Power Plan

The first Northwest Conservation and Electric Power Plan has been adopted by the Northwest Power Planning Council. The plan includes a two-year action plan delineating how the region's future electrical needs will be met.

A section called "Renewable Resources, Geothermal," states that better information about the region's geothermal resources is needed. To gain this, the Bonneville Power Administration (BPA) is directed to select a site estimated capable of producing 100 megawatts of electricity over 30 years. The BPA must guarantee purchase of the first 10 megawatts produced, with the price tied to the cost of power from a new coal plant.

The Northwest Power Planning Council includes representatives from the States of Montana, Idaho, Washington, and Oregon.

Copies of the power plan, in two volumes, will be sent free of charge. (Volume I is the plan, itself, and Volume II, the technical appendices.)

To order, write to Northwest Power Planning Council, 700 SW Taylor, Suite 200, Portland, Oregon 97205, Attn: Beata Teberg.

M.M.S. – B.L.M.

M.M.S.-B.L.M. Reorganization

The following letter was written by Ed Hastey, Bureau of Land Management State Director, California. The letter explains the recent transfer of many Minerals Management Service activities to the Bureau of Land Management.

The Bureau of Land Management (BLM), by Secretarial Order of December 3, 1982, assumed all onshore minerals management functions including oil and gas, geothermal, and solid leasable minerals not related to Royalty Management, on Federal and Indian lands. These functions, which were formerly assigned to the Minerals Management Service (MMS), include supervision of operations and resource evaluation. The placement of all onshore mineral functions in BLM will eliminate duplication, provide one location approval for mineral actions, and reduce the time required for mineral approvals. All functions related to royalty and minerals revenue management will continue to be the responsibility of the Minerals Management Service.

Western Region states have now reached the stage of this transition when the BLM organization can accommodate all mineral industry correspondence, requests, submittals, plan approvals, inspection and enforcement actions. Therefore, effective June 13, 1983, please submit all onshore minerals correspondence formerly addressed to Western Region MMS offices to the appropriate BLM offices. This does not include royalty and mineral revenue correspondence which will continue to be submitted directly to the Minerals Management Service, Royalty Management Office, Denver, Colorado. Onshore Minerals Management activities in each state will be approved and regulated by the appropriate BLM State office. Enclosed for your use is a list of BLM offices within the former MMS Western Region states that you are to contact. Maps showing areas of responsibility are also enclosed to assist you in identifying the appropriate BLM office. Please submit all minerals correspondence in the States of Arizona, California, and Idaho to the appropriate BLM District Office. All correspondence for the

States of Nevada and Oregon should be submitted to the appropriate BLM State Office.

Your cooperation in complying with this change is greatly appreciated. We believe that these changes will provide you with the most efficient service possible. Each BLM State Office has established a position of Deputy State Director, Minerals Resources, to address mineral issues. These positions will be in-place by June 1, 1983. We anticipate that there will be questions concerning the appropriate office for your submittals, and to address those questions, you are encouraged to call the appropriate Deputy State Director, Minerals Resources, at the following numbers:

Arizona, Ray A. Brady, (602)261-3873
California, James W. Sutherland, (916)484-4515
Idaho, Bill LaVelle, (208)334-1401
Nevada, Tom Leshendok, (702)784-5451
Oregon/Washington, Pat Geehan, (503)231-6251

A partial list of BLM offices follows.

California:

Bakersfield District Office
800 Truxtun Avenue, Room 311
Bakersfield, CA 93301
(805) 861-4191

Susanville District Office
P.O. Box 1090, 705 Hall Street
Susanville, CA 96130
(916) 257-5381

Ukiah District Office
555 Leslie Street
Ukiah, CA 95482
(707) 462-3873

California Desert District Office
1695 Spruce Street
Riverside, CA 92507
(714) 351-6383

Idaho:

Bureau of Land Management
3380 Americana Terrace
Boise, Idaho 83706

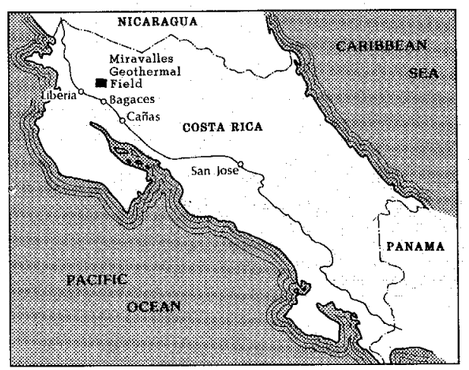
Nevada:

Bureau of Land Management
Nevada State Office
300 Booth Street
P. O. Box 12000
Reno, Nevada 89520

Oregon:

Bureau of Land Management
825 NE Multnomah Street
P. O. Box 2965
Portland, Oregon 97208

Costa Rica



Miravalles Geothermal Field
by Susan F. Hodgson

"When Costa Rica's first geothermal plant goes on line in 1987, 15 percent of the country's installed electricity will be generated from geothermal energy," Dr. Alfredo Mainieri had told me. "Still," he'd added, "I suppose a great many Costa Ricans have not heard of geothermal energy."

I thought about this as I drove north through Guanacaste, in northwestern

Costa Rica, to Miravalles Geothermal field. The day was hot and the ground as dry as it had looked 3 days earlier from the air. With me, in a land rover owned by the Instituto Costarricense de Electricidad (ICE), owner and operator of the field, were Eddie Fernandez, an ICE geologist, and Rodrigo, the driver. Dr. Mainieri also works for ICE, in the Departamento de Programas de Generacion Proyecto Geotermico.

The flat Guanacaste plains are interrupted by solitary, large trees, their long branches stretching sideways into graceful shapes. Some trees have no foilage, only hundreds of orange flowers, the color of flame. Herds of white cattle nose for green stalks in brown fields of grass.

Now, on our right, we pass a row of palm trees bordering a field. The dark green fronds flap towards the northwest. Behind them, I watch the colors on a faint, bluish conical outline gradually intensify--Miravalles volcano.

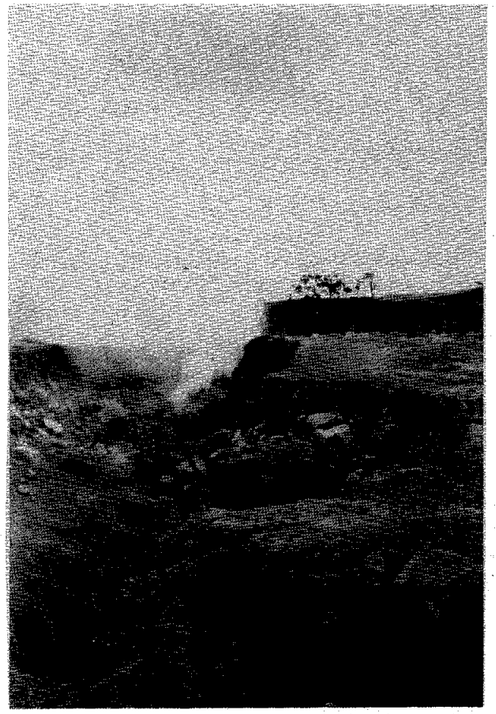
The volcanic peak is hidden by thick white clouds, and is, in fact, the site of a beautiful Costa Rican cloud forest. Miravalles volcano formed inside the collapsed caldera of an earlier, much larger volcano, the edges of which can be seen from the Miravalles Geothermal field on the lower slopes of the volcano.

Miravalles volcano, the peak covered by clouds, Guanacaste, Costa Rica. Photos by Susan F. Hodgson.

The volcano itself is 2021 meters high, and the geothermal field from 600 to 700 meters in elevation.

No eruptions have been recorded at Miravalles. Few fumeroles dot its slopes. The largest fumerole is within the geothermal field boundaries. Ash erupted from the volcano just north of Miravalles, Rincon de la Vieja, in 1966. ICE plans to develop geothermal energy there, some day, as well.

The air is dry. Dust blows into the land rover almost constantly. As we cross a small bridge spanning the Rio Estanque, we see smoke from fields being cleared. We take the Bagaces turnoff, moving from the Pan American Highway east towards the geothermal field and the nearby permanent ICE field camp.

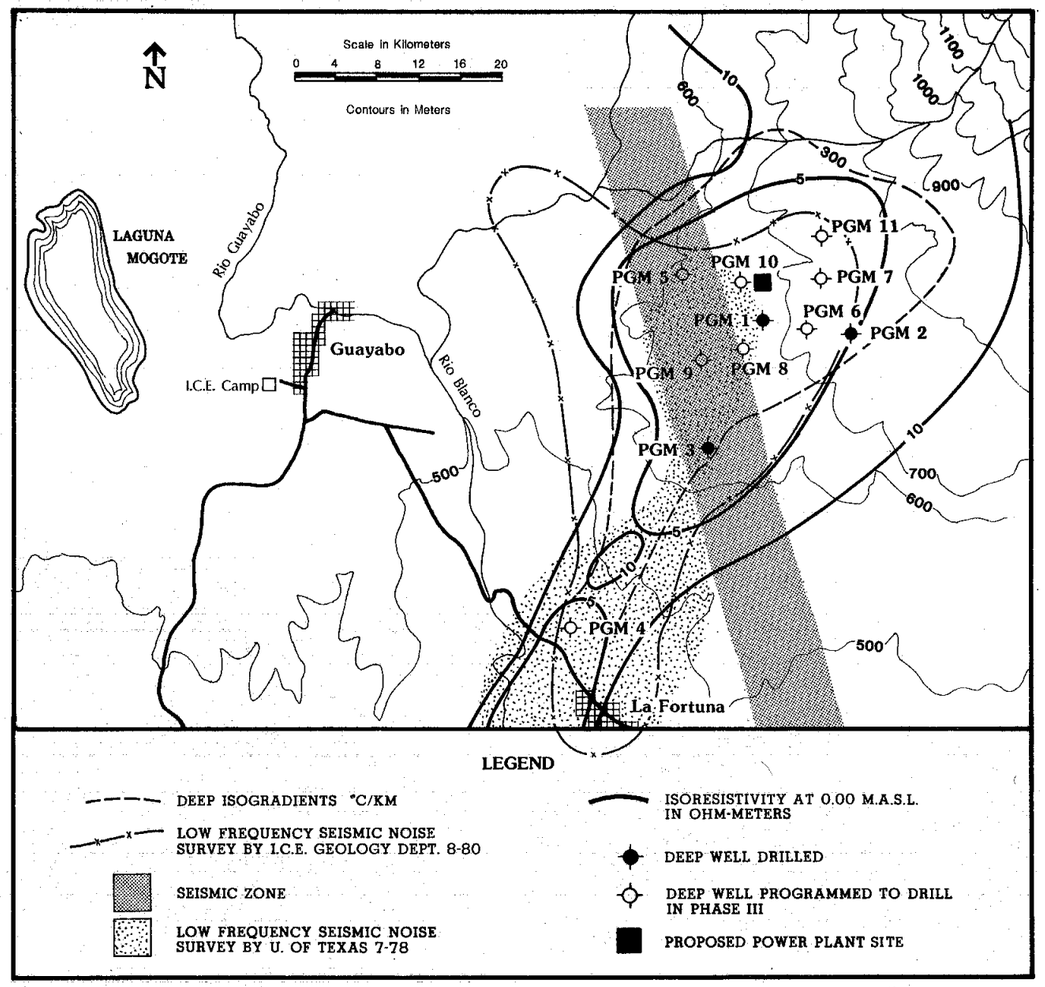


The largest fumerole at Miravalles volcano. This fumerole is within the geothermal field boundaries.

As we pass through Bagaces, it is 11:30 a.m. and school has let out. Children dressed in navy and white uniforms walk out through iron school-yard gates and head home.

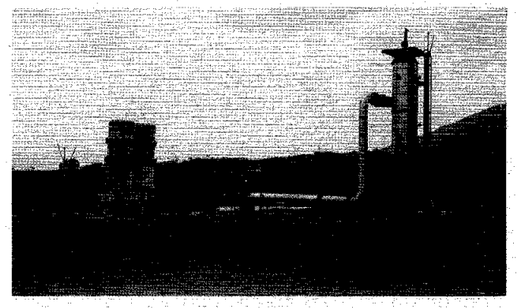
We continue the journey. Finally near the field, we drive through volcanic foothills, parched brown except for patches of green scrub brush.

Field development began at Miravalles in 1975, when 39 temperature gradient wells were drilled. Today, the field has 3 wells, PGM-1, PGM-2, and PGM-3, that will be placed on line with the first power plant. Basic well data are summarized in the table. Altogether, about 20 wells will be needed to operate the first power plant--11 production wells, 2 reserve production wells, 5-to 6-injection wells, and 2 wells eventually slated as injection wells. Geophysical studies of the area are underway. (See diagram for some well locations.) Plans are open to change, depending on results from each well as it is drilled.

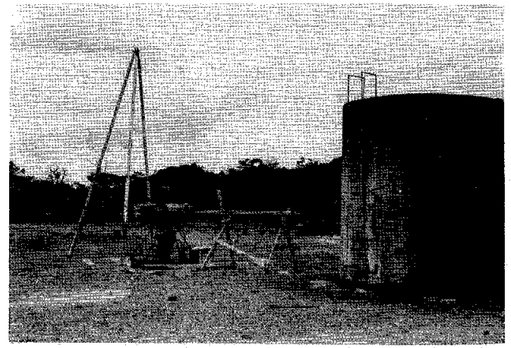


Miravalles Geothermal field anomalies, redrawn from a map by the Instituto Costarricense de Electricidad.

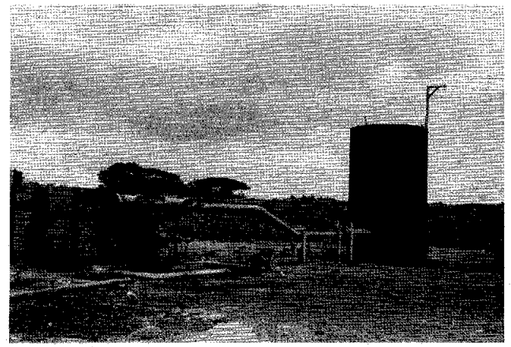
Eddie Fernandez, ICE geologist, opening a temperature gradient well drilled in Miravalles Geothermal field.



Well PGM-1. Muffler photo left, and cyclonic separator photo right. The well is tested twice a year. Flow rates are found to change very little between tests.



Well PGM-2. Below 800 meters, wells are perforated with water as the hole fluid. Drilling mud would fill reservoir fractures, destroying potential well flow.



Well PGM-3, Miravalles Geothermal field.

Well data, Miravalles Geothermal field.

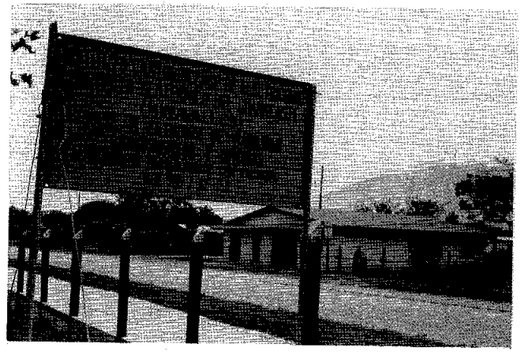
Well	Total well depth (meters)	Depth to top of reservoir (meters)	Temp. (°C)	Flow rate (kilograms per hour of total flow)
PGM-1	1300	910	244	±290,000
PGM-2	1208	760	230	±45,000
PGM-3	1162.4	595	241	±355,000

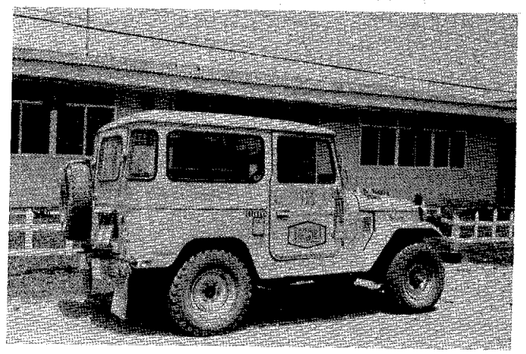
Field area on the slopes of Miravalles volcano, where future wells will be drilled.

The depth of the base of the reservoir is unknown. It is believed the reservoir is recharged by rainwater, which falls in the area at a rate of 2 meters a year. The exact reservoir recharge rate is not known.

By 1987, ICE hopes to have a 55 megawatt double flash power plant operating at Miravalles field. A second 55 megawatt plant for the field is tentatively slated for 1991. Electricity produced from the plant will enter the national electrical grid at a nearby hydroelectric dam.

In December 1981, total electrical energy generated in Costa Rica was 417 megawatts. In December 1982, the amount had risen to 438 megawatts, according to ICE representatives. In 1982, Costa Rica sold electricity to Nicaragua and continued to do so in 1983. Electrical sales to Panama are scheduled to begin in 1984.





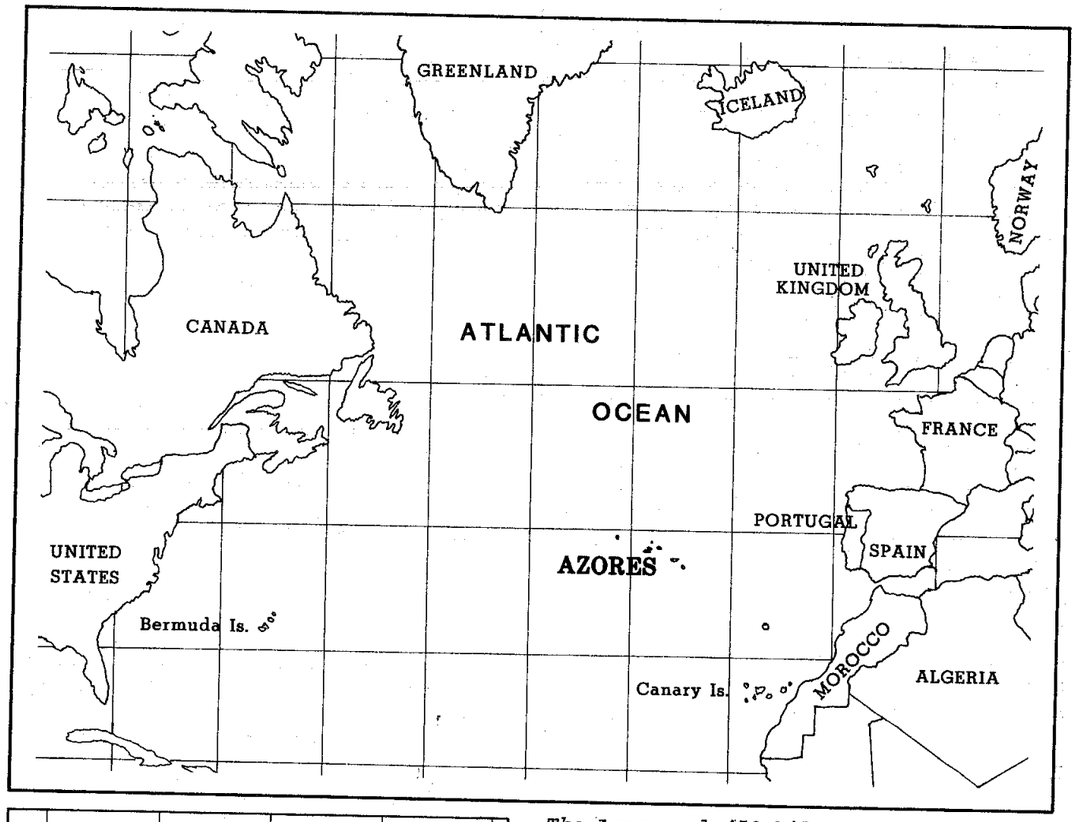
The permanent ICE field camp at Guayabo, near Miravalles Geothermal field. The camp includes a mobile chemical and geophysical laboratory, offices, and sleeping and eating facilities.

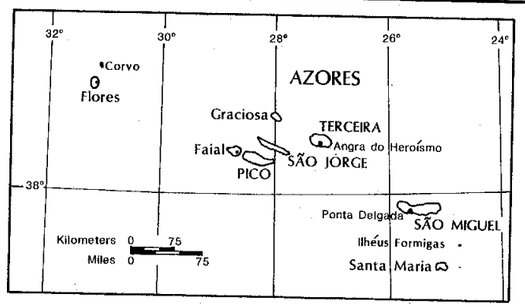
The Azores

Azores Geothermal Development

The archipelago of the Azores consists of 9 volcanic islands 1,450 kilometers west of Portugal in the Atlantic Ocean. Most of the Azores' 250,000 people live on the four largest islands: Sao Miguel, Terceira, Pico, and Faial, which together comprise about 75 percent of the total area.

Interest in developing geothermal resources in the Azores began in the 1950's. In 1976, a contract was signed with Geonomics Inc. to develop geothermal resources for electrical production on Sao Miguel. In 1977, the Laboratorio de Geociencias e Tecnologia dos Acores took responsibility for the project. Since then, five prospect wells have been drilled





The Azores, 1,450 kilometers west of Portugal.

on Sao Miguel and a 3 megawatt geothermal power plant placed on line in 1980. This power plant has been used for scientific study rather than commercial electrical generation activities. Also in 1980, the geothermal project was extended to include the other 3 largest islands.

In 1981, Aquater, an Italian company, was awarded a contract to prepare a feasibility study for Sao Miguel's first industrial geothermal power plant.

In 1979-1980, Dr. David Johnston of the U.S. Geological Survey estimated the Azores geothermal energy resources to be almost 2,000 megawatts in a 30-year period. However, some of the resources are not economically recoverable under present conditions.

By the year 2000, under current estimates, geothermal energy will account for more than 50 percent of gross electrical production in the Azores.

For further information, contact Mr. Jose Antonio Tavares Resendes, O Chefe de Divisao, Direccao Regional de Energia, Rua Dr. Caetano de Andrade, II, 9 500 Ponta Delgada, Acores.

Indonesia

Indonesian Power Plant on Stream

The Indonesian geothermal power plant at Kamojang, West Java, has begun operation. Construction began on the 30 megawatt power plant in 1978. The first well was drilled in the 5.79 square mile field in 1974.

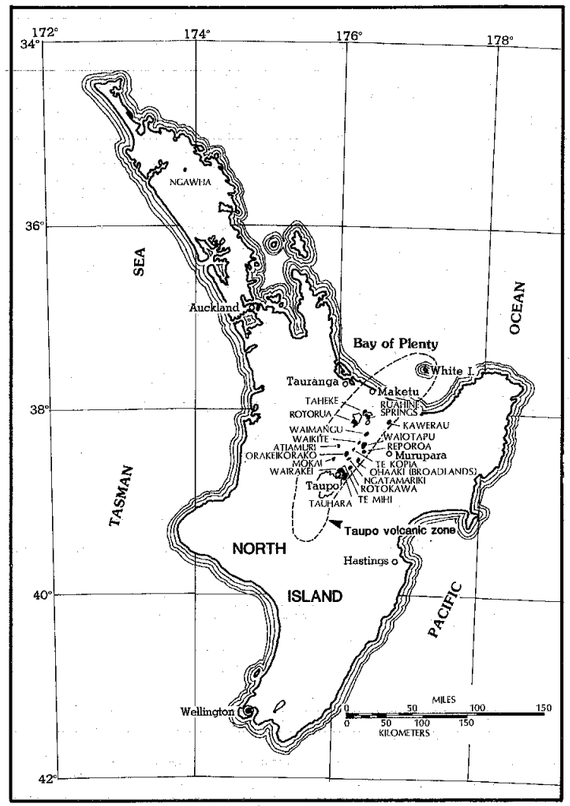
Today, six production wells are connected to the power plant.

The Indonesian geothermal project is a joint venture between the state-owned Pertamina and several Indonesian and New Zealand firms, backed by their respective governments.

New Zealand

New Zealand Development Update

In the July 1982 issue of the Geothermal Hot Line, an article appeared called "New Zealand Geothermal Development." Mr. D. R. Dawson,



North Island, New Zealand, geothermal fields.

Projects Engineer (Geothermal) of the New Zealand Ministry of Works and Development, compiled and submitted the following data to update, and/or correct statements in the article.

Kawerau Geothermal Field - There are three areas of relatively higher than average subsidence:

(a) In the area of wells 21 and 27
(b) In the area of wells 16, 17, and 19, and
(c) At the north end of the airstrip.

In these three areas, subsidence averages about 16mm per year. At the Mill site, subsidence averages about 5mm per year.

Ohaaki (Broadlands) Geothermal Field:

(a) Approval for construction of the 100 megawatt power station was granted 10/26/82. Preparation for construction commenced immediately.

(NOTE: According to the Oil and Gas Journal, the project is scheduled for completion in 1988 and will cost about $20 million.)

(b) Maximum subsidence in the field would be about 30mm per year without reinjection. As reinjection is an integral part of the project, actual subsidence will be much less.

Serious inundations are not expected.

Ngawha Geothermal Field:

(a) Maximum temperature reached to date is 260°C, in NG20, drilled in July 1982.

(b) Permeabilities have been high in wells tested since July 1982 -

> 50 d-m in NG4
15 d-m in NG8
16 d-m in NG9
1.2 d-m in NG18

Permeabilities in all other wells tested to date have been less than 1.0 d-m.

The following list of recent papers and publications is taken from Geothermal News, published by The Geothermal Coordinator, DSIR, Head Office, Private Bag, Wellington, New Zealand.

Blattner, P.: Oxygen Isotope Shifting Capacity of Rock-Model and Application to the Ngawha System. Isotope studies of Hydrologic Processes, NIU Press, De Kalb, 1982.

Donaldson, I.G.: Heat and Mass Circulation in Geothermal Systems. Ann. Rev. Earth Plant Sci. 10: 377-95, 1982.

Geothermal Institute, University of Auckland: Proceedings of Pacific Geothermal Conference 1982, incorporating the 4th New Zealand Geothermal Workshop. Parts 1 & 2, 1982.

Grant, M.A., Donaldson, I.G., Bixley, P.F.: Geothermal Reservoir Engineering. Academic Press, December 1982, 376 pp.

Henley, R.W., Glover, R.B.: Chemistry of Fluids Discharged from Exploration wells at Mokai: MK 1 and MK 2. Chemistry Division Technical Note 82/9, October 1982.

Mahon, W.A.J.: Geothermal Energy in New Zealand - a resumé of the last ten years. The Energy Journal 55(9), September 1982.

Owers, W.R., Shannon, W.T.: Removal of Arsenic from Hot Geothermal Waters with Dissolved Air Flotation. Part 1: Preliminary Economic Appraisal. Part 2: Results, Summary. NZ DSIR Industrial Processing Division Report IPD/RI 746. September 1982.

Scott, B.J., Cody, A.D.: The 20 June 1982 Hydrothermal Explosion at Tauhara Geothermal Field, Taupo. NZ Geological Survey Report 103, 1982.

Scott, B.J., Lloyd, E.F.: Hydrological Measurements - Frying Pan Lake - Inferno Crater Lake 1970-1981. Waimangu Hydrothermal Field. NZ Geological Survey Report G67, August 1982.

Shannon, W.T., Owers, W.R., Rothbaum, H.P.: Pilot Scale Solids/ Liquid Separation in Hot Geothermal Discharge Waters using Dissolved Air Flotation. Geothermics 11(1): 43-58.

Soylemezoglu, S., Harper, R.: Oxygen Ingress into Geothermal Steam and its Effect on Corrosion of Low Carbon Steel at Broadlands, New Zealand. Geothermics 11(1): 31-42, 1982.

Wooding, R.A.: On transient flow in stratified aquifers with high horizontal permeability, in Mathematics and Models in Engineering Science. pp 169-77. DSIR Wellington, New Zealand, 1982.

Japan

Japanese Geothermal Resources Studied

Eureka Resource Associates, a California geologic and geophysical consulting firm, is participating in a major evaluation of Japanese geothermal resources. The study is sponsored by the New Energy Development Organization (NEDO), a new Japanese government agency.

In the study, the geothermal potential of the Japanese archipelago will be evaluated with geophysical, geologic, and remote sensing data. The initial phase, now underway, covers the southernmost principal Japanese island, Kyusha.

Eureka is developing techniques for integrating geophysical and lineament data to produce structural models useful in geothermal exploration of this area.

Funding

Funding Available for Industrial Use of Alternative Energy

The California Manufacturers Association, under contract to the California Energy Commission (CEC), is offering funding assistance for feasibility studies of alternative energy projects. With the use of Energy Commission funds designated for the development of alternative energy resources, the California Manufacturers Association will enter into co-funding agreements with industrial firms interested in determining the feasibility of installing alternative energy systems at their industrial sites.

Participation in the Energy Assistance Program is open to all manufacturing, food processing, and other industrial firms in California; applicants need not be members of the California Manufacturers Association. Projects involving any of the following energy technologies are eligible:

- o geothermal direct use
- o small-scale hydroelectric power
- o cogeneration
- o solar energy
- o fuel cells
- o wind energy conversion.

Program funds available for any one project are limited to one-half of the study costs or a maximum of $20,000. The balance of funds may come from the project sponsor alone or from the sponsor in conjunction with any other interested parties. If the project is determined to be technically, economically, and environmentally feasible, the project sponsors are to repay the funds to the California Manufacturers Association, where they will be made available for subsequent studies.

Proposals will be funded on a first come basis; therefore, applications for proposed feasibility studies should be submitted as soon as possible. If you are interested in obtaining funding assistance, please call or write Linda Greule, Biomass/Cogeneration Office, California Energy Commission, 1516 Ninth Street, MS-42, Sacramento, California 95814 (916) 324-3479.

CEC Geothermal Grant Program

By Nancy Libonati
California Energy Commission

Under the Geothermal Grant Program, the California Energy Commission (CEC) awards grants to local governments through a competitive application process. The grant monies distributed are received by the State of California from geothermal leasing activities on federal lands.

Round 3 grant applications are under review. About 1.2 million dollars was requested by 21 final applicants. A funding recommendation will be made by the Technical Review Committee before the end of June 1983. The full Commission is expected to approve grant awards in mid-August 1983. Applications were received from:

- o Sonoma County
- o Mendocino College
- o Lake County
- o Northern Sonoma County Air Pollution Control District (A.P.C.D.)
- o Mendocino County A.P.C.D.
- o Susanville Department of Parks and Recreation
- o Pit River Resource Conservation District
- o City of Calipatria
- o Southern California Association of Governments
- o Mono County
- o City of Lake Elsinore
- o Indian Valley Hospital District
- o Lake County A.P.C.D.
- o Imperial Valley College District
- o Imperial County (2)
- o City of Susanville
- o Mendocino County Resource Conservation District
- o City of Calistoga
- o City of Clearlake
- o Plumas Unified School District
- o Imperial County A.P.C.D.

The CEC awarded a total of $366,800 in first round grants to 7 local jurisdictions throughout the state. Grants were awarded in June 1982 to:

- o The City of Susanville
- o The City of Huntington Beach
- o Imperial County
- o Lassen County
- o Indian Valley Hospital
- o The Inyo/Mono Association of Governmental Entities
- o The Anderson Springs Community Services District.

The second funding round was completed in December 1982. In this round, $888,835 in grants was awarded to 15 local jurisdictions. Grants were awarded to:

- o The Bridgeport Public Utilities District, Mono County, for resource assessment including a temperature gradient hole to determine the viability of building a district heating system and a small-scale (300-500 kW) electrical generation system. The CEC provided $75,000 with $2,285 local matching funds.

- o The Indian Valley Hospital, Plumas County, to design and construct a space and water heating system for the hospital. The CEC provided $161,000 with $7,416 local matching funds.

- o The Calistoga Joint Unified School District, Napa County, to drill a production well and retrofit portions of the Calistoga High School for geothermal space heating. The CEC provided $29,616 with $1,777 local matching funds.

- o The Surprise Valley Joint Unified School District, Modoc County, for resource assessment at the Fort Bidwell Indian Reservation and at Surprise Valley elementary and high schools. The CEC provided $100,000 with $39,686 local matching funds.

- o The Indian Springs School District, Shasta County, for resource assessment including drilling a production well in Big Bend, California, to use for geothermal space-and water-heating at the Indian Springs School. The CEC provided $60,000 with $7,250 local matching funds.

- o The City of Santa Clara for resource assessment on city property near the town of Loyalton in Sierra County and areas in Plumas and Lassen Counties. The CEC provided $50,500 with $16,950 local matching funds.

- o Siskiyou County for a planning

study to assess county resources, identify potential end users, and formulate county policy. The CEC provided $31,124 with $5,719 local matching funds.

- The City of Paso Robles, San Luis Obispo County, for a feasibility geothermal development study in the Paso Robles area. The CEC provided $34,900 with $11,910 local matching funds.

- Lake County for a geothermal coordinator, funded with the County's matching funds, to inventory and market the direct use of low-temperature resources, and a CEC-funded consultant to assist in the activity. The CEC provided $50,000 with $40,000 local matching funds.

- Mendocino County for a planning project to help the county formulate policies and procedures to control, direct, and facilitate its geothermal development. The CEC provided $15,732 with $4,396 local matching funds.

- Sierra County for a marketing program aimed at developing a geothermal direct use industry in Sierra Valley. The CEC provided $25,000 with $5,000 local matching funds.

- The Heber Public Utility District, Imperial County, to study the potential social, economic, and environmental impacts on the community of Heber from development of the Heber KGRA. The CEC provided $15,000 with $25,700 local matching funds.

- The Kern County Council of Governments to identify geothermal resources within Kern County, focusing on the Lake Isabella and Scovern Hot Springs areas. Development and marketing plans will be undertaken. The CEC provided $45,838 with $5,771 local matching funds.

- The Anderson Springs Community Service District, Lake County, to install 5,000 feet of 6-inch diameter water transmission pipeline from the community to a diversion point on Gunning Creek. The CEC provided $76,000 with $170,000 in local matching funds.

- Lake County for placement of asphalt concrete paving on the remaining 1.67 miles of damaged Butts Canyon Road. The CEC provided $119,025 with $9,118 local matching funds.

A reception for grant recipients, sponsored by Assemblyman Dan Hauser and Senator Jim Nielsen, was held in the Capitol on March 23, 1983. Grant recipients met with their representatives and discussed grant activities.

For further information or grant application assistance, contact Andy Coughanour, Grant Program Manager, (916) 324-3504.

Legislation

Federal Legislation

Legislation has been introduced in Congress to allow the geothermal energy tax credit to apply to equipment used to develop geothermal deposits with temperatures below 50°C (122°F). Representative Tony Hall (D-OH), author of HR 2927, and Senator Steven Symms (R-ID), author of S 1237, have introduced companion bills designed to encourage the use of groundwater heat pumps.

Other federal legislation introduced in the U.S. Congress during the current session include:

HR 21 - Energy Competition Act
HR 278 - Geothermal Energy Control Act of 1983
HR 576 - Business Energy Tax Credit Act of 1982
HR 1596 - Renewable Energy Small Business Development Act of 1983
HR 1775 - Renewable Energy Tax Credit Act of 1983
HR 1884 - Internal Revenue Code of 1954 Amendment
HR 1966 - Internal Revenue Code of 1954 Amendment
HR 2058 - Geothermal Steam Act of 1970 Amendment
S 96 - Lee Metcalf Wilderness and Management Act of 1983
S 558 - Geothermal Steam Act Amendments of 1983
S 616 - Renewable Energy Small Business Development Act
S 883 - Geothermal Steam Act Amendments of 1983

California Legislative Update
By Shirley Mitchell and R. A. Reid

Assembly Bill 886 (Kelley); Introduced 2/24/83. Amended 5/27/83. Passed by the Assembly. (Consent Calendar item.) Referred to Senate Committee on Government Organization on 6/16/83.

In cases where the state is the owner of the geothermal rights of a parcel, and the surface rights of the parcel are owned by more than one person, AB 886 would permit the State Lands Commission (SLC) to grant geological or geophysical exploration permits or leases on parcels that are less than 640 acres. The bill also reduces from 6 months to 3 months, the time in which the surface owner can submit a permit or lease application after the owner is notified by the SLC that another party has applied for a permit or lease for the same lands.

The SLC would be able to grant a permit or lease to the surface owners if they are qualified and the commission determines that the land permitting or leasing is in the best interests of the state.

Assembly Bill 988 (Baker); Introduced 2/28/83. Passed by the Assembly. (Consent Calendar item.) Passed by Senate Natural Resources Comm. on 6/28/83. (Consent Calendar item.)

The Geothermal Resources Board, within the Department of Conservation, consists of specified state officials with prescribed powers and duties, including the duty to hear appeals to orders of the State Oil and Gas Supervisor or District Deputy of the California Division of Oil and Gas.

This bill would abolish the Geothermal Resources Board and transfer authority to hear appeals to the Director of the Department of Conservation.

This legislation provides an opportunity for a geothermal operator who is subject to an order of the supervisor, to make a first-level appeal to the Director of Conservation. The appeal procedure for a geothermal operator would parallel the procedure currently used to hear appeals to orders of the Supervisor concerning oil and gas well operations.

Assembly Bill 1466 (Rogers); Introduced 3/3/83. Amended 4/13/83 and 6/6/83. Passed by the Assembly. (Consent Calendar item.) Passed by Senate Natural Resources Comm. on 6/28/83. (Recommended for Consent Calendar.)

The bill would transfer funding responsibility for the Geothermal Regulatory Program from oil and gas operators to geothermal operators by requiring the State Oil and Gas Supervisor to establish annual well fees on each producing, service, or idle geothermal well existing at

any time during the preceding calendar year. These fees will be in addition to the current drilling fees.

Low-temperature geothermal wells that are not used for commercial purposes may be exempt from well fees to encourage the development of low-temperature geothermal resources. Also, well fees shall not apply to shallow wells drilled for observation purposes or to wells for which the supervisor has approved suspension.

The bill stipulates that total monies collected from the annual well fees and drilling fees be equal to the appropriation for the supervision of geothermal resource wells as provided in the Governor's Budget. They shall include any adjustments for actual expenditures in the current and prior fiscal years.

Any budget change proposal for support of the chapter shall be submitted by the supervisor to geothermal operators for review and comment.

Assembly Bill 1780 (Hauser and Nielsen); Introduced 3/4/83. Passed in the Assembly. (Consent Calendar item.) Passed by Senate Natural Resources Comm. on 6/28/83. (Recommended for Consent Calendar.)

The State Energy Resources Conservation and Development Commission is authorized annually to expend 30 percent of the revenues deposited in the Geothermal Resources Development Account during the preceding fiscal year to provide grants to local jurisdictions to carry out specified geothermal resources development activities.

Under AB 1780, the term "local jurisdiction" would expand to include a unit of Indian government.

The bill would also permit the expenditure of revenues for grants during the fiscal year the revenues are received, thereby making an appropriation. Any ungranted revenues in the account beginning with the 1984-85 fiscal year would be made a part of the Governor's Budget.

Leasing

BLM Final Rulemaking for Geothermal Leasing Program

To eliminate "...burdensome, outdated, and unneeded..." provisions of existing geothermal leasing regulations, the Bureau of Land Management has undertaken a final rulemaking, effective May 20, 1983.

The amendments to the existing regulations resulted from public comments on the proposed rulemaking, and from an intensive review of the existing regulations by Bureau of Land Management personnel.

The final BLM response to the 20 comments it received on the proposed amendments is in the Federal Register, vol. 48, No. 77, Wednesday, April 20, 1983, "Rules and Regulations."

Most of the comments supported the proposed rulemaking. The sections that were most controversial and received adverse comments were those addressing diligent exploration, escalating rental requirements, environmental analysis, and surface management provisions.

BLM Releasing Program

On June 1, 1983, the Bureau of Land Management (BLM) began a noncompetitive releasing program for federal geothermal leases canceled, relinquished, terminated, or expired (in California, before March 1983).

Lease applications for the lands must be received by June 30, 1983 in appropriate BLM state offices. If more than one application is received for a lease, the winning applicant is selected randomly.

Tanina Scimemi of the California BLM office says the program will last indefinitely. To receive updated lists of leases available under the program, contact state BLM offices. For California, the address is BLM, E2841 Federal Office Building, 2800 Cottage Way, Sacramento, California 95825.

Lease Sale Schedule as of 6/83

Lease sale dates are provided by state directors of the U.S. Bureau of Land Management (BLM). Lease sale dates are tentative until public notice is issued 30 days prior to sale. Lease sale notices may be obtained by contacting the appropriate BLM office.

Location of KGRA	Latest Sale Date Scheduled
East Brawley/East Mesa/Mono-Long Valley/Salton Sea/ Wendel-Amedee (BLM)(CA)	To be rescheduled
Coso Hot Springs/Dunes/Glamis/Lassen Hot Springs/ Saline Valley (CA)	To be rescheduled
Socorro Peak (NEW MEX.)	To be rescheduled
Double Hot Springs/Gerlach/Leach Hot Springs/ Soldier Meadow/Trego (NV)	9/22/83
Breitenbush Hot Springs/Carey Hot Springs/McCredie Hot Springs/Summer Lake Hot Springs (USFS)(OR)	10/20/83

Courses and Conferences

GRC Courses Offered

A Workshop on Small-Scale Geothermal Power Plants: Decision Analyses from Conception to Production, R.M.S. Queen Mary, Long Beach, California, July 25-27, 1983.

Workshop topics will include: marketing, resource evaluation, power plant selection, regulation, economics, and financing. Tabletop display space will be available for a limited number of exhibitors for $50 to $100.

A Workshop on Low-to Moderate-Temperature Hydrothermal Reservoir Engineering, R.M.S. Queen Mary, Long Beach, California, July 28-29, 1983.

The workshop, jointly sponsored by the Idaho National Engineering Laboratory (EG&G Idaho, Inc.) and the GRC, will provide guidelines

to developers and consultants in evaluating reservoir characteristics. Areas to be covered include reservoir classification, reservoir engineering, conceptual modeling, testing during drilling, theory of aquifer monitoring, and instrumentation.

For further information, contact the Meetings Group, Geothermal Resources Council, P. O. Box 1350, Davis, California 95617. Phone (916) 758-2360.

15th International Post-Graduate Course in Geothermics, International Institute for Geothermal Research, Pisa, Italy, February 15, 1984 to December 15, 1984.

The course is designed to train geothermal experts in applied geology, geophysics, and geochemistry, particularly in geothermal exploration.

The course is presented under the auspices of the National Research Council-Rome; the Italo-Latin American Institute-Rome; the Ministry for Foreign Affairs-Rome; and UNESCO-Paris.

The course is open to geologists, geophysicists, and geochemists who have been awarded 1 of the 20 scholarships offered by the Italian Ministry of Foreign Affairs-Department for Cooperation to Development.

Prerequisites for receiving scholarship are:

a) Citizenship in a developing country that is a member of UNESCO, and

b) A university (or equivalent) degree, and

c) Minimum of professional experience and active service, preferably with a public or government organization, and

d) Candidature presented by a national or international organization.

Scholarship applications must be submitted by September 30, 1983, to the Italian Embassy in the applicant's country of origin.

The places remaining in the course from any scholarships not awarded may be assigned to citizens of UNESCO member countries who fulfill the requirements in points b, c, and d, and at their expense.

For further information, contact Dr. Mario Fanelli, the International Institute for Geothermal Research, via del Buongusto 1, 56100 Pisa, Italy.

Potential Water Supply and Demand Issues in the Kelsey Creek and Putah Creek Watersheds, Board of Supervisors' Chambers, County Courthouse, 255 N. Forbes Street, Lakeport, California, July 20, 1983, 10:00 a.m.

The conference is sponsored by the Lake County Board of Supervisors. At it, potential water and supply demand issues will be discussed that are associated with geothermal, agricultural, and community development in the Kelsey Creek and Putah Creek Watersheds.

Energy on Tap, 1983 Annual Meeting of the Geothermal Resources Council, Red Lion-Jantzen Beach Hotel, Portland, Oregon, October 24-27, 1983.

The meeting will include three days of technical sessions, a poster session, special sessions (the Cascade Range and Industrial Geothermal Water Heat Pumps), a photo contest display, and commercial and educational exhibits. Pre-and post-meeting field trips have been scheduled.

For further information, contact Geothermal Resources Council, Meetings Group, P. O. Box 1350, Davis, California 95617. Phone (916) 758-2360.

Energy in Central America, San Jose, Costa Rica, November 21 to 25, 1983.

The seminar is organized by the Permanent Committee for Science, Technology, Society, and Development Seminars in Central America.

The seminar will focus on hydropower, hydrocarbons, and nonconventional energy sources. Also covered will be economic, political, and social energy-related issues, and technology transfer.

National and international organizations, professionals, and university students are invited to participate.

Abstracts of papers offered for conference presentation should not exceed 10 pages. Submit all abstracts by September 1. Every paper should be related to a conference topic.

For further information, contact Ing. Roberto Oliva, Coordinator of the Committee for Science, Technology, Society, and Development Seminars in Central America, Apartado Postal 37, Ciudad Universitaria Rodrigo Facio, Costa Rica. The telephone number is 25-27-44.

Third International Seminar on the Results of European Communities Geothermal Energy Research, Munich, Germany, November 29-December 1, 1983.

The seminar will include oral presentations, a poster session, exhibits, films, and a workshop.

Topics to be covered include resource exploration and evaluation, reservoir assessment, geophysics and geochemistry, drilling and production technologies, down-hole instrumentation, surface processes, economics and environmental impact, hot dry rock, marketing, and technical and nontechnical problems.

For further information, contact E. Staroste, Commission of the European Communities, DG XII/E-2, Rue de la Loi, 200, 1049 Brussels, Belgium.

Publications

International directory of new and renewable energy information sources and research centres, first edition, 1982. Prepared jointly by the United Nations Educational, Scientific, and Cultural Organization and the Solar Energy Research Institute. $20.00. Available from the Solar Energy Research Institute Accounting Department, 1617 Cole Boulevard, Golden, Colorado 80401.

The valuable, unique directory was prepared to facilitate information availability and transfer by providing names and addresses of resource organizations, institutions, and publications with expertise in some area of new and renewable energy, including geothermal energy.

The 2,955 entries are listed by country, publications, subjects, and organizations. The directory is available as a computerized data base.

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Energy information directory, DOE/EIA-0205(82/4Q). 1982. $5.50 (domestic) $6.90 (foreign). Available from Superintendent of Documents, U.S. Govt. Printing Office, Washington, D.C. 20402.

Lists energy information sources by subject area, and program offices of the DOE and other governmental agencies.

Subsequent issues will be published semiannually.

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Bibliographical bank on industrial technology. 1982. Compiled by the Secretariat for Industrial Technology, an agency of the Brazilian Ministry of Industry and Commerce, as part of a Data Base of Alternative Energy Sources of Information.

Available from the Secretaria de Tecnologia Industrial, Gerencia de Informacao e Documentacao, SAS-Quadra 02-Lote 03 (Predio do INPI), Cx Postal 040442 SHS, 70300-Brasilia, Brazil.

Geothermal references are included in the data base. Written in Portugese, but most words in the geothermal entries are readily understood by English speaking people.

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Energy terminology: a multi-lingual glossary. 1982. Hardback, $100.00; paperback, $35.00. Available from Pergamon Press Inc., Fairview Park, Elmsford, New York 10523.

The glossary includes over 1,000 standard energy terms in English, French, German, and Spanish. Vocabulary is listed for conventional and unconventional energy technologies, including geothermal energy. Conservation and environmental terms are given, as well.

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The geothermal research program of the U.S. Geological Survey. Circular 862. By W. A. Duffield and Marianne Guffanti. Free. Published by and available from the U.S.G.S., Room 122, Bldg. 3 (MS 33) 345 Middlefield Road, Menlo Park, California 94025.

U.S.G.S. research of geothermal systems is described. Major accomplishments are documented.

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EPA Office of Research and Development publications announcement. Free. Published quarterly, and available from ORD Publications, P. O. Box 14249B, Cincinnati, Ohio 45214.

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Geothermal energy projects, planning and management. Edited by L. J. Goodman and R. N. Love. 1980. $35.00. Published in cooperation with the East-West Center, Hawaii. Available from Pergamon Press Inc., Fairview Park, Elmsford, New York 10523.

Overview of the world-wide development of the geothermal industry. Includes four case studies evaluated according to the integrated project planning and management cycle, developed at the East-West Center.

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The future of small energy resources, an international conference organized by the United Nations Institute for Training and Research, 1981. Edited by R. Meyer and J. Olson. $67.00. Published by and available from Coal Age Mining Information Services, McGraw-Hill, Inc., 1221 Avenue of the Americas, New York, New York 10020.

Section 6 of the publication, titled "Geothermal Power," contains 10 papers on geothermal energy presented at the 1981 UNITAR conference. Included in these papers is "A Resource Assessment of the Desert Hot Springs Geothermal Resource Area, California" by R. Corbaley, A. Nation, and R. Grannell. A summary of this paper appeared in the July 1981 issue of the Geothermal Hot Line.

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AAPG bookstore, earth science publications, Spring 1983 list. Free. Published by and available from the American Association of Petroleum Geologists, P. O. Box 979, Tulsa, Oklahoma 74101.

The AAPG offers for sale several geothermal publications and geothermal maps. Included are volumes with papers presented at the 1974 and 1975 Circum-Pacific Energy and Mineral Resources Conferences, and a portfolio of 39 computer-contoured and labeled geothermal gradient maps.

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Interciencia. Bi-monthly journal. Individuals, $30.00; Latin American libraries and institutions, $40.00 (1 year); $76.00 (2 years); other libraries and institutions, $55.00 (1 year); $104.50 (2 years). Free issue on request. Available from Pergamon Press Inc., Fairview Park, Elmsford, New York 10523.

The editors of Interciencia state as the goal of their journal the stimulation of scientific and technological research, and the humane use and study of its social context, with special emphasis on the problems facing Latin America and the Caribbean. Articles are published in English, Spanish, or Portuguese, with full, detailed summaries in all three languages.

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California energy update. 24 issues a year. $100 for 6 months or $195.00 a year (check enclosed with order) or $115 for 6 months or $215.00 a year (with later billing). Published by and available from Frank Kester Associates, 1081 Alameda, Suite 38, Belmont, California 94002.

The periodical covers new and developing energy activities of state agencies and private firms. Geothermal activities are among those included in the publication.

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Manually prepared geothermal steam production, water production, and injection reports. Free. Published by and available from the California Division of Oil and Gas, 1416 Ninth Street, Room 1310, Sacramento, California 95814.

The new manual was prepared to help operators record monthly geothermal production and injection data in a standard manner before the data are submitted to the division.

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Permit requirements for energy and other natural resources for:

State	Open-file Report No.	Microfiche	Paper Copy
Florida	OF 81-1254	$3.50	$17.25
Georgia	OF 81-1255	$3.50	$13.75
Indiana	OF 81-1258	$3.50	$10.75
Kentucky	OF 81-1260	$3.50	$12.25
Michigan	OF 81-1263	$3.50	$21.00
Minnesota	OF 81-1264	$3.50	$19.00
Nebraska	OF 81-1268	$3.50	$ 7.25
N. Dakota	OF 81-1273	$3.50	$ 9.25
S. Dakota	OF 81-1279	$3.50	$ 8.50

These U.S.G.S. open-file reports may be viewed in several repositories, including the U.S.G.S. Library, 345 Middlefield Road, Menlo Park, California 94025.

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Two Publications on The Geysers

Potential geothermal electrical development in The Geysers steam field, California. P700-82-012. Nov. 1982. By G. Lee and R. Strand. $2.90; one copy free. Separate map prepared for the publication, $2.50 (no free map copies).

Erosion and sedimentation study of a portion of The Geysers-Calistoga KGRA. Nov. 1982. By D. Schwartz and E. Craddock. $2.50.

Both publications are published by and available from the California Energy Commission, 1516 Ninth Street, Sacramento, California 95814. (A complete list of CEC publications may be ordered from this address, as well.)

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These U.S.G.S. open-file reports may be viewed in several repositories including offices of the California Division of Mines and Geology, 1416 Ninth Street, Room 1341, Sacramento, California 95814.

Integrated model of the shallow and deep hydrothermal systems in the East Mesa area, Imperial Valley, California, OF 82-0080. Microfiche $3.50, paper $15.25.

Site characterization for 6 and 7, El Centro Strong Motion Array, Imperial Valley, California, OF 82-1040. By A. T. F. Chen and M. J. Bennett. Microfiche $3.50, paper $5.00.

Hydrogen gas monitoring at Long Valley caldera, California, OF 82-0930. By K. A. McGee, T. J. Casadevall, M. Sato, A. J. Sutton, and M. D. Clark. Microfiche $3.50, paper $1.50.

Aeromagnetic measurements in the Cascade Range and Modoc Plateau of Northern California, OF 82-0932. By R. Couch and M. Gemperle. Microfiche $3.50, paper $3.25.

Aeromagnetic measurements in the Cascade Range and Modoc Plateau of Northern California, OF 82-0933. By R. Couch and M. Gemperle.

Heat flow and subsurface temperatures in the Great Valley, California, OF 82-0844. By Jiyang Wang and R. J. Munroe. Microfiche $3.50, paper copy $13.25.

The Lassen geothermal system, OF 82-0926. By L. J. P. Muffler, N. L. Nehring, A. H. Truesdell, C. J. Janik, M. A. Clynne, and J. M. Thompson. Microfiche $3.50, paper copy $1.00.

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The following publications are published by and available from the California Energy Commission, Publications Unit, 1516 Ninth Street, MS-13, Sacramento, California 95814.

Geothermal grant program for local governments, revised grant application manual, publication P500-83-009. Free.

The manual was written as an aid for local jurisdictions applying for grants under the C.E.C. Geothermal Grant Program for Local Governments. In it are described the kinds of projects eligible for geothermal grants, who may apply, and how to apply.

Bridgeport geothermal energy project, publication P500-82-055. $3.35.

The report is an analysis of a proposed geothermal energy district heating system for Bridgeport, California. The report was prepared for the CEC by Lahontan, Inc.

Report to the Legislature on the California Energy Commission's Geothermal Development Grant Program for Local Governments, publication P500-83-008. $2.50.

The report includes the history and status of the Geothermal Development Grant Program for Local Governments. The program was established by Assembly Bill 1905 (Chapter 139 Statutes of 1980).

Feasibility of geothermal direct use applications in San Bernardino, California, publication P500-83-012. May 1983. $3.15.

Feasibility of geothermal direct use applications in San Bernardino, California, Appendices, publication P500-83-013. May 1983. $3.85.

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New signs of Long Valley magma intrusion, article by Richard A. Kerr in the June 10, 1983 issue of Science, vol. 220, no. 4602. $2.50. Available from the American Association for the Advancement of Science, 1515 Mass. Ave., N.W., Washington, D.C.

Very interesting update of the Long Valley seismological activity, compiled from presentations at the 1983 annual meeting of the Seismological Society of America.

Scientists have new evidence that magma from an 8-kilometer-deep chamber is forcing itself into rock as shallow as 3 kilometers. The activity is causing earthquakes and swelling the crust. According to the article, researchers accept the expansion of the magma chamber as indisputable and view shallow magma intrusion as plausible, even probable.

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New CDMG Geothermal Publications

The following new, California Division of Mines and Geology (CDMG) publications may be ordered from the CDMG, P. O. Box 2980, Sacramento, California 95812.

The reviews are reprinted from the June 1983 issue of California Geology.

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Reconnaissance geothermal resource assessment of 40 sites in California, OFR 82-4 SAC. Part of the third year report, 1980-81, of the U.S. Department of Energy--California state-coupled program for reservoir assessment and confirmation. By Eddie Leivas, Roger C. Martin, Chris T. Higgins, and Stephen P. Bezore. $18.00.

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Reconnaissance geothermal resource assessment of 40 sites in California, OFR 83-12 SAC. Part of the fourth year report, 1981-82, of the U.S. Department of Energy--California state-coupled program for reservoir assessment and confirmation. By Eddie Leivas and C. Forrest Bacon. $15.00.

The two geothermal resource assessment reports set forth the results of a reconnaissance-level evaluation of California low- to moderate-temperature geothermal sites. The study was undertaken by the Geothermal Resource Assessment Program of the California Division of Mines and Geology to obtain and publish data on natural hot springs, thermal wells, and selected oil, gas, and water wells with potential for development as a geothermal resource. Areas suitable for more intensive area-specific studies were identified, as were hot springs and wells with strong potential for energy development.

Study sites were selected for potential of development into a significant geothermal resource. The following guidelines were used in determining potential.

1. Amount of data available for temperature, purity of steam or water, rate of flow, extent of the resource, and surface and subsurface phenomena indicating that the site may be developed into a relatively significant resource.

2. Proximity of site to a population center.

3. Proximity of site to an agricultural or industrial operation that could use the energy, or existence of commercial or other need for the energy in the area.

4. No recent or thorough studies of the site have been made that are available to the public.

5. The site is not within or near a Known Geothermal Resource Area (KGRA) unless it has not been adequately explored or shows potential only for direct heat use.

6. The occurrence is of general scientific interest and its study may improve the understanding of other geothermal occurrences.

7. Proximity to a major transportation facility that could encourage the development of an industrial or agricultural plant.

8. The site is owned by the state and may be a source of energy that could be developed for state use.

9. Local support or industrial, local, state, or federal government interest in developing the resource exists.

The following tasks were conducted for each site:

1. Literature review of site geology, hydrology, structure, hydrothermal alteration, geothermal heat, and history.

2. On-site geological evaluation.

3. Springs or wells at each site were located on maps.

4. Measurement of well and spring water temperatures.

5. To the extent feasible, geothermal gradients of existing wells were measured.

6. Samples of water from a representative well or spring at the site were collected and sent to the University of Utah Research Institute for cation analysis and to the Geochemical Laboratory of the California Division of Mines and Geology.

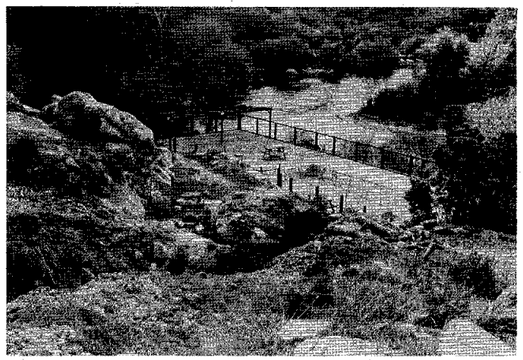
7. Preparation of a report for each site, presenting the results of the data collected in Nos. 1-6.

Recommendations

Areas recommended for further study were selected from the groups of geothermal sites presented in these reports. These are not the only areas that may be suitable for further, more intensive study; under different economic and technological conditions, other areas may become favorable for geothermal development.

Based on 1980-81 (OFR 82-4 SAC) investigations, the following areas are recommended for more detailed study. These areas are not presented in any order of priority.

1. *Elsinore*. Water temperatures range from 40°C to 56°C. Area of interest extends from Glen Ivy on the north to Murrieta Hot Springs on the south, a distance of some 40 kilometers. Many faults, including the Elsinore fault zone, provide a likely conduit for upwardly migrating thermal water.



Democrat Hot Springs, Kern County, California. The hot spring, 38 kilometers east of Bakersfield, is the westernmost of several hot springs along this portion of the Kern River. The swimming pool, photo center, is part of a resort. About 56.8 liters per minute of warm water (39°C) flow through a pipe in the trench that extends from photo lower left to photo center.

The photo and hot springs data are exerpted from a new report by the California Division of Mines and Geology, Reconnaissance Geothermal Resource Assessment of 40 Sites in California, 1980-81. Photo by Eddie Leivas.

2. *Tecopa*. Abundance of warm water, ranging from 32°C at Shoshone on the north to 48°C near Tecopa. This world famous hot spring area is being developed by a number of local entrepreneurs. The large number of tourists using the hot springs has created a demand in the area for more facilities. The geothermal resource should be studied prior to full-scale development in order to provide an assessment of the geothermal-hydrologic resource potential for planning purposes.

3. *Twentynine Palms*. Many warm water wells (48°C to 53°C as shown on Geothermal Resource Map) indicate that an extensive warm water aquifer underlies the City of Twentynine Palms and an area to the north of the city between the Marine Corps base and the city.

Based on 1981-82 (OFR 83-12 SAC) investigations, the following areas are recommended for more detailed study. These areas are not presented in any order of priority.

1. *Sierra Valley*. Resource appears to be of significant size. Several small towns in the area could benefit by use of thermal water for heating. Sites in or near Sierra Valley that are described in this report include: Marble Hot Wells, Campbell Hot Springs, and White Sulfur Springs.

2. *Long Valley*. Located in a collapsed caldera, it is within an area designated as a Known Geothermal Resource Area (KGRA) and has been explored for geothermal resources capable of electrical generation. The potential for using low- and moderate-temperature geothermal water appears to be high and should be investigated further. Sites in or near Long Valley decribed in the report include Hot Bubbling Pool and Big Alkali Lake Springs.

3. *Surprise Valley*. Many warm water wells and springs. Portions of Surprise Valley are within the boundaries of a KGRA. Several exploration wells have been drilled within and without KGRA boundaries. While the possibility of a geothermal resource capable of supporting an electrical generation facility is not clear, the existence of low- to moderate-temperature geothermal water here is beyond doubt. The potential for agricultural uses of this water should be studied. Sites in Surprise Valley described in the report include Fort Bidwell, Surprise Valley Mineral Wells, and Menlo Baths.

4. *Big Bend*. The geothermal resource at Big Bend, while not of regional significance, probably is large enough to be considered significant to this community. The thermal water could be used primarily in community facilities, including the school. Sites in the Big Bend area described in the report include Big Bend Hot Springs, Indian Valley School, and Hunt Hot Spring.

5. *Canby-Alturas-Likely*. Potential uses of low- to moderate-temperature geothermal resources in this area include regional agricultural applications and district heating in Alturas. Sites in or near the Canby-Alturas-Likely area described in the report include the SX Ranch Spring and well (east of Canby) and the Van Loan well (see OFR 82-4 SAC) north of Likely.

Conclusions of these studies are not intended to discourage consideration of geothermal sites not chosen as recommended sites. The recommended

sites do, however, share the following characteristics:

1. Potential for use by a large number of consumers.

2. Large volume of water.

3. Indications of large underlying resource area (a characteristic that increases the chance that the geothermal resource is economically significant).

Sites of more limited geographical extent may lend themselves to very favorable economic development of the geothermal resource on a smaller scale for agricultural use or for space heating.

Study results may be used by the general public as a source of technical data for each of the sites included in the report, by public and private agencies for land-use planning, and by consultants conducting detailed evaluations of the geothermal potential of the sites.

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Investigations of low-temperature geothermal resources in the Sonoma Valley Area, California, OFR 83-13 SAC. By Les G. Youngs, Rodger H. Chapman, Gordon W. Chase, Stephen P. Bezore, and Hasu H. Majmundar. 1982. $10.00.

A geoscientific investigation of the low-temperature geothermal resources in the Sonoma Valley area, California, was conducted by the California Division of Mines and Geology under a grant contract with the U.S. Department of Energy. The purpose of the study was to determine the areal extent, depth, maximum temperature, volume, water quality, and other properties that must be known about geothermal recovery before geothermal development is planned. The historical development of the geothermal resources in the Sonoma Valley area as well as the results of geological, geophysical, geochemical, geothermometric, seismological, and temperature measurement investigations are given.

A widely distributed, moderately shallow, low-temperature geothermal resource (characteristic of a liquid-dominated hydrothermal convection system) exists in the Sonoma Valley area. The dominant "east side" fault, delineated primarily from geophysical surveys, provides a conduit for upward migration of fluids warmed at depth and simultaneously forms a barrier to westward lateral movement of the thermal fluids. Warm waters enter aquifers, predominately in permeable units of the Sonoma volcanics, in an approximate 5.4 square kilometer zone east of the fault. The maximum recorded water temperature in the Sonoma Valley area is 62.7°C (147°F) at 137.2 meters (450 feet) in a well at Boyes Hot Springs, which is in this zone. The maximum temperature of the geothermal reservoir may be in the range of 52°C-77°C (126°F-171°F) based on the average values of several algorithms of the Na-K-Ca geothermometer.

Current utilization of the low-temperature geothermal resources of the Sonoma Valley area appears to be feasible for a wide variety of local direct-heat uses, and development of the resource is recommended.

This report is available for reference at the Sacramento, San Francisco, and Los Angeles offices. A copy may be purchased from the Sacramento office only.

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Resource investigation of low- and moderate-temperature geothermal areas in Paso Robles, California. Open File Report 83-11 SAC. By L. F. Campion, R. H. Chapman, G. W. Chase, and L. G. Youngs. $9.00.

The California Division of Mines and Geology (CDMG) selected the Paso Robles area for detailed geothermal resource investigation because the area was known to contain potential geothermal resource sites and a population large enough to benefit from the use of a low- or moderate-temperature geothermal energy source. Also, the City of Paso Robles had expressed serious interest in developing the area's geothermal resource. The main known thermal areas are located in the City of Paso Robles and to the southeast of town.

Ninety-eight geothermal wells and springs were identified and plotted, and a geologic map and cross sections were compiled. Detailed geophysical, geochemical, and geological surveys were conducted.

The geological and geophysical work delineated the basement highs and trough-like depressions that can exercise control on the occurrence of the thermal waters. The Rinconada fault was also evident. Cross sections drawn from oil well logs show the sediments conforming against These basement highs and filling the depressions. It is along the locations where the sediments meet the basement highs that three natural warm springs in the area occur.

Deep circulation of meteoric waters along faults may account for the presence of thermal fluids. The Santa Margarita, Pancho Rico, and Paso Robles Formations would be the first permeable zones that abut the faults through which thermal water could enter. Temperatures and interpretation of well logs indicate that the warmest aquifer is at the base of the Paso Robles Formation. Warm water may be entering higher up in the section, but mixing with water from cooler zones seems evident. Geothermometry indicates reservoir temperatures could reach 91°C (196°F).

••

Geothermal resources of the Bridgeport-Bodie Hills Region, California, open file report 83-14 SAC. By Chris T. Higgins, Rodger H. Chapman, and Gordon W. Chase. 1983. $8.00.

The proposed model of the Bridgeport-Bodie Hills Region geothermal system is that of a water-dominated, hydrothermal convection cycle. The system's age is unknown, but is probably on the order of thousands of years. Its source of heat could be a still-hot, solidified igneous body under the Bodie Hills, but is more likely hot rock unrelated to remnant magmatic heat.

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Proceedings of a workshop on Volcanic Hazards in California, status of volcanic prediction techniques and emergency response capabilities. Roger C. Martin and James F. Davis, Editors. 1983. $7.00.

The workshop focused on volcanic prediction research and research methods applicable in California's varied volcanic environments. The presentations covered volcanic hazards, volcanic activity prediction, human response to volcanic disasters, hazards planning, and emergency operations.

The publication includes papers presented, discussions, and formal panel discussions.

The workshop was held in Sacramento in December 1981.

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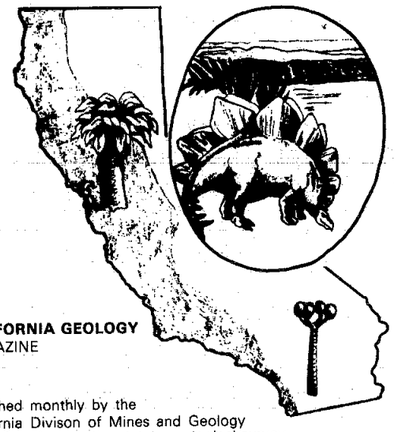

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CURRENT ARTICLE OF INTEREST IN CALIFORNIA GEOLOGY

Volcanic formations along the Klamath River near Copco Lake. By Paul E. Hammond. May 1983 issue.

In the article, informal stratigraphic units of the Western Cascade Series are discussed. The units include permeable lava flow complexes that may be favorable geothermal reservoir rocks.

●

Nevada Bureau of Mines and Geology Publications. 1983. Free. Available from the Nevada Bureau of Mines and Geology, Room 310, Scrugham Engineering-Mines Building, Univ. of Nevada, Reno, Nevada 89557-0088.

A new list of publications that includes new material published by the Nevada Bureau of Mines and Geology (NBMG) and a cumulative list of all NBMG publications.

●

Bibliography of Nevada geology and mineral resources through 1980. $6.00 ($6.60 when purchased by mail). Published by and available from the Nevada Bureau of Mines and Geology, University of Nevada Reno, Reno, Nevada 89557-0088.

The bibliography includes over 13,000 entries. Geology, mineral technology, and mining history, from the earliest years through 1980, are documented.

●

Hydrogeology of the Stillwater geothermal area, Churchill County, Nevada, OF 82-0345. By D. S. Morgan. Microfiche $5.00, paper $17.50. Available for viewing in several U.S.G.S. open-file repositories, including the U.S.G.S. Library, 345 Middlefield Road, Menlo Park, California 94025.

●

Discovery and geology of the Desert Peak Geothermal field: a case history, NBMG Bulletin 97. By W. R. Benoit, J. E. Hiner, and R. T. Forest. $12.00. Published by and available from the Nevada Bureau of Mines and Geology, Univ. of Nevada-Reno, Reno, Nevada 89557-0088.

Desert Peak Geothermal field was the first blind geothermal discovery in the Basin and Range physiographic province of the United States. The book includes a history of the exploration, development through 1980, and geology of the field area. There are sections on geochemistry, geophysics, and temperature-gradient drilling.

●

Preliminary Geochemical Data on Some BLM-Administered Land Including Wilderness Study Areas in Oregon and Washington. Free. Published by and available from the Oregon State Office, Lloyd Center Tower, 825 NE Multnomah, P.O. Box 2965, Portland, Oregon 97208.

The Bureau of Land Management is releasing additional geochemical data (collected in summer, 1982) from widely scattered public lands in connection with wilderness studies and land exchanges.

●

The following open-file material, compiled under the Baca Geothermal Demonstration Power Plant Project and the Industry-Coupled program, are available from the Earth Science Laboratory.

NM/Baca/102-115 and McCoy reports DOE/ET/27010-1 and NV/McCoy/101.

Please request a new publications list before ordering. $.50 handling fee is charged for each free publication offered. No telephone orders for priced reports and open-file material accepted without prepayment. Direct all inquiries to: Publications, Earth Science Laboratory, 420 Chipeta Way, Suite 120, Salt Lake City, Utah 84108.

●

Hot dry rock geothermal energy development program, annual report fiscal year 1981. By M. C. Smith and G. M. Ponder. LA-9287-HDR. Available from the National Technical Information Service, U.S. Dept. of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161. Microfiche $3.50, paper $10.00.

The report is divided into four parts:

1) Data collection and investigation results for U.S. regions that appear especially promising either for further energy extraction experiments or commercial development.

2) Discussion of a 9-month, continuous, closed-loop, recirculating flow test of the enlarged Phase I system at Fenton Hill.

3) Discussion of a newly drilled production well, part of the Phase II system at Fenton Hill.

4) New developments in downhole instrumentation and equipment; geochemical and geophysical studies; rock-mechanics and fluid-mechanics investigations; computer analyses and modeling; and overall system designs.

●

Deep drilling data, Raft River geothermal area, Idaho Raft River geothermal injection well no. 6, OF 79-1129. By H. R. Covington. 1 oversized sheet. Microfiche $.50, paper copy $4.75. The U.S.G.S. open-file report may be viewed at several repositories including the U.S.G.S. Library, 345 Middlefield Road, Menlo Park, California 94025.

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List of publications, Colorado Geological Survey, January 1983. Free. Published by and available from the Colorado Geological Survey, Publications Department, 1313 Sherman, Room 715, Denver, Colorado 80203.

●

Wyoming Geothermal Energy

The Thermopolis hydrothermal system with an analysis of Hot Springs State Park, Preliminary Report 20. By B. S. Hinckley, H. P. Heasler, and J. K. King. 1982. $4.00.

The Thermopolis hydrothermal system was studied under a state-wide geothermal resource assessment program. The system includes spectacular, natural hydrothermal features.

Thermal springs of Wyoming, Bulletin 60. By R. M. Breckenridge and B. S. Hinckley. 1978. $3.00.

Geothermal resources, present and future demand for power and legislation in the State of Wyoming, Public Information Circular 1. By E. R. Decker. 1976. $1.00.

All are published by and available from the Wyoming Geological Survey, Box 3008, University Station, Univ. of Wyoming, Laramie, Wyoming 82071. (A publications list may be ordered free of charge from this address.)

●

Potential geothermal energy use at East Coast Naval facilities, NWC Technical Publication 6423. By Robb Newman, Applied Physics Laboratory, Johns Hopkins University, for (and available from the) Geothermal Utilization Division, Public Works Department, Naval Weapons Center, China Lake, California 93555.

The limited-edition report documents results of a survey of Atlantic Coast Naval facilities as potential geothermal energy users.

Geothermal source temperatures were determined by extrapolating surface temperature gradients to the basement. A list of the temperatures is included, along with a table of nonelectrical energy consumption data for each facility.

The source temperature and nonelectrical energy consumption data for each facility have been used to determine promising sites for further investigation.

●

Self-potential surveys related to probable geothermal anomalies, Hualalai Volcano, Hawaii. OF 82-0127. By D. B. Jackson and M. K. Sako. Microfiche $3.50, paper $2.25. The U.S.G.S. open-file report may be viewed at several repositories including the U.S.G.S. Library, 345 Middlefield Road, Menlo Park, California 94025.

●

Assessment of the petroleum, coal, and geothermal resources of the Economic Community of West African States region, OF 82-0714. By R. E. Mattick. Microfiche $3.50, paper copy $11.25. The U.S.G.S. open-file report may be viewed at several repositories, including the U.S.G.S. Library, 345 Middlefield Road, Menlo Park, California 94025.

●

Several new reservoir engineering and geophysical reports have been issued by the Earth Sciences Division of the Lawrence Berkeley Laboratory on studies for the Department of Energy.

Heat transfer in fractured geothermal reservoirs with boiling by K. Pruess.

Injection and energy recovery in fractured geothermal reservoirs by G.S. Bodvarsson, K. Pruess, and M.J. O'Sullivan.

Modeling studies of the natural state of the Krafla Geothermal Field, Iceland by G.S. Bodvarsson, K. Pruess, V. Stefansson, and E.T. Eliasson.

Nonisothermal effects during injection and falloff tests by S.M. Benson and G.S. Bodvarsson.

An investigation of the conductivity distribution in the vicinity of a Cascade volcano, Ph. D. thesis, by E.C. Mozley.

A limited number of these reports are available and may be requested by writing to Robin Spencer, Earth Sciences Division, Lawrence Berkeley Laboratory, 90/1106, Berkeley, CA 94720.

Maps

Two New Geothermal Fields

Two new California geothermal fields have been designated by the California Division of Oil and Gas. The fields are Mesquite Geothermal field (formerly the South Brawley area) in Imperial County and Calistoga Geothermal field in Napa County.

On June 14, 1983, the Imperial County Board of Supervisors adopted the Geothermal G Overlay Zone for the new Mesquite Geothermal field. The zone includes about 16,000 acres. Almost all of this field is leased by MCR Geothermal Corporation.

Field maps are available from the division for $3.00 each.

●

Composite magnetic anomaly map of the United States, GP-0954-A. By Isidore Zietz. Two sheets, and a 59-page text. $5.00 a set. Scale 1:2,500,000. Published by and available from the Western Distribution Branch, U.S.G.S., Box 25286, Federal Center, Denver, Colorado 80225.

●

Preliminary overview map of volcanic hazards in the 48 conterminous United States, MF-0786. By D. R. Mullineaux. 1976 (Reprint) Scale 1:7,500,000. $1.25. Published by and available from the Eastern Distribution Branch, U.S.G.S., 1200 South Eads Street, Arlington, Virginia 22202.

●

Map showing distribution, composition, and age of late Cenozoic volcanic centers in California and Nevada, I-1091-C. By R. G. Luedke and R. L. Smith. 1981 (1982). Two sheets, one scaled at 1:1,000,000, the second scaled at 1:500,000. $6.00 a set.

●

Map showing distribution, composition, and age of late Cenozoic volcanic centers in Oregon and Washington, I-1091-D, By R. G. Luedke and R. L. Smith. 1982. Scale 1:1,000,000. $3.00.

Both maps (2 in a series of 4) are designed primarily as guides for exploring and evaluating igneous-related geothermal resources. Emphasis is on the type and number of vents.

Both maps are available from the Western Distribution Branch, U.S.G.S., Box 25286, Federal Center, Denver, Colorado 80225.

●

An interpretation of the Bouguer gravity map of Nevada, Caliente Sheet, by D. B. Snyder. 1983. $2.00. Written to accompany Nevada Bureau of Mines and Geology Map 70, Bouguer Gravity Map of Nevada: Caliente Sheet. $4.00. Both items published by and available from the Nevada Bureau of Mines and Geology, University of Nevada, Reno, Reno, Nevada 89557-0088.

Twelve local gravity anomalies are described in the publication. Sections on gravity data, general geology, and regional gravity interpretation are included.

●

Map showing mineral and geothermal resource potential of the Mount Hood Wilderness, Clackamas and Hood River Counties, Oregon MF-1379-E. 1982. By T. E. C. Keith and J. D. Causey. Scale 1:62,500. $1.25. Published by and available from the Western Distribution Branch, U.S.G.S., Box 25286, Federal Center, Denver, Colorado 80225.

Bureau of Land Management Maps

Scale, 1:100,000

These Bureau of Land Management (BLM) maps are mostly planimetric (without contours). The maps are available in either surface management or surface-minerals management editions. The surface management edition shows public lands administered by BLM, other federal lands, state lands, and private lands. Restrictions on the management of federal lands established by withdrawals are also shown.

The surface-minerals management edition has the extent of federally-owned mineral rights overprinted on the surface management edition. The maps are printed on 29" x 42" sheets and cost $3.25 each. When ordering, specify either surface management or surface-minerals management edition.

Order the maps from the Western Distribution Branch, U.S.G.S., Box 25286, Federal Center, Denver, Colorado 80225.

Sheet Name	Contour Interval
Colorado	
Glenwood Springs (1982)*	50 meters
Steamboat Springs (1982)*	50 meters
Vail (1982)**	50 meters
Walden (1982)**	50 meters
Idaho	
Kooskia (1982)*	50/10 meters
Warren (1982)*	50 meters
Montana	
Polson (1982)*	50 meters
Plains (1982)*	50 meters
North Dakota	
New Rockford (1982)**	5 meters
South Dakota	
Kadoka (1982)*	20 meters
Sisseton (1982)**	5 meters

* Surface-management edition only

** Surface-minerals management edition only

California Wells

CDOG Collects Geothermal Well Data

Every month, the California Division of Oil and Gas collects geothermal production and injection data from the state's geothermal operators.

A computer-generated file of these geothermal production and injection statistics for wells with records open to public inspection is available from the division for $50.00.

Also available is an instruction booklet for operators submitting these data. The booklet is called Manually Prepared Geothermal Steam Production, Water Production, and Injection Reports.

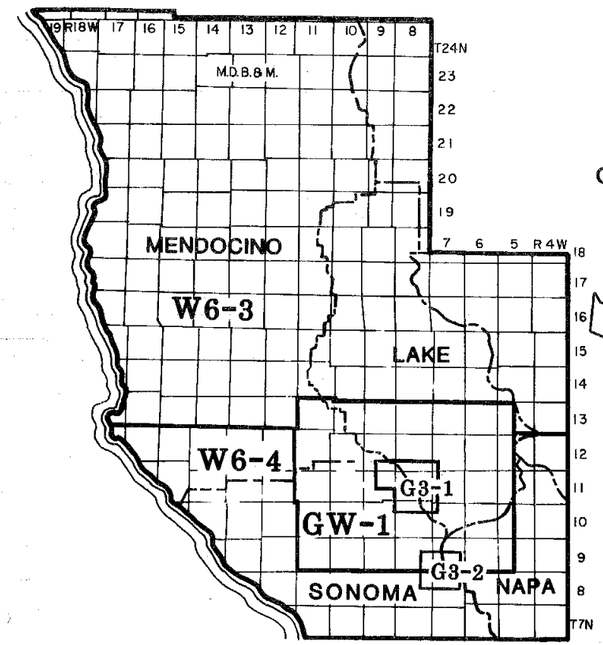
Drilling Permits for Geothermal Wells Approved October 1982 Through May 1983 by the California Division of Oil and Gas

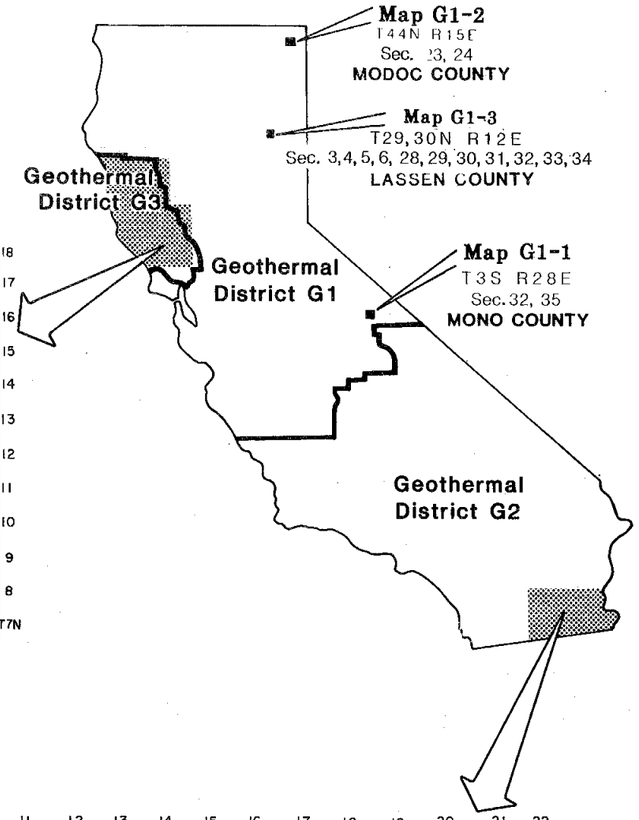
LAKE COUNTY

Date Notice Received	Operator & Well No.	API No.	Sec.	T.	R.	Location & Elevation
10/8/82	MCR Geothermal Corp. "Coleman" 3-5	033-90442	5	11N	8W	Fr. NW cor. 770m S, 309.7m E. 812.8m KB.
10/8/82	MCR Geothermal Corp. "Coleman" 4-6	033-90443	6	11N	8W	Fr. NE cor. 1155.5m S, 134.9m W. 909.5m KB.
11/3/82	Aminoil USA, Inc. "Bianchi" 3	033-90444	27	11N	8W	Fr. SE cor. 746m N, 108m W. 762m GR.
11/22/82	Republic Geothermal, Inc. "McLeskey" 1	033-90445	32	13N	8W	Fr. SE cor. 335m N, 427m W. 665m KB.
1/17/83	MCR Geothermal Corp. "Coleman" 4-5	033-90447	5	11N	8W	Fr. NW cor. 769.9m S, 292.9m E. 813m KB.
1/24/83	Union Oil Co. of Calif. "DX State 4596" 52	033-90448	8	11N	8W	Fr. SE cor. 731.5m N, 853.4m W. 1026.5m KB.
1/28/83	Sunoco Energy Dev. Co. "Sprouse" A-1	033-90449	26	11N	8W	Fr. NE cor. 256m S, 180m W. 602.4m KB.
4/22/83	MCR Geothermal Corp. "Coleman" 5-6	033-90462	6	11N	8W	Fr. NE cor. 1128.2m S, 159.2m W. 909.5m KB.
5/4/83	Natomas Company "Davies Estate" 4	033-90463	36	11N	8W	Fr. SE cor. 275.2m N, 660.6m W. 577m KB.
	MENDOCINO COUNTY					
11/12/82	Shell Oil Company "SCPI-MID-Hale" 1-26	045-90048	26	12N	10W	Fr. SE cor. 303.6m N, 395.6m W. 820m KB.
	SONOMA COUNTY					
12/21/82	Union Oil Co. of Calif. "D & V" 16	097-90560	33	11N	8W	Fr. SE cor. 315m N, 137m W. 870.4m KB.
1/26/83	Union Oil Co. of Calif. "LF State 4597" 35	097-90562	20	11N	8W	Fr. SW cor. 612.5m N, 283.9m E. 760.5m KB.
2/2/83	Union Oil Co. of Calif. "DX State 4596" 61	097-90563	7	11N	8W	Fr. NW cor. 718.4m S, 985.2m E. 860.2m RT.
2/8/83	Union Oil Co. of Calif. "GDC" 18	097-90565	20	11N	8W	Fr. SW cor. 93.4m N, 13.9m E. 620.0m KB.
2/11/83	Union Oil Co. of Calif. "LF State 4597" 36	097-90566	20	11N	8W	Fr. SW cor. 622.9m N, 295m E. 761m KB.

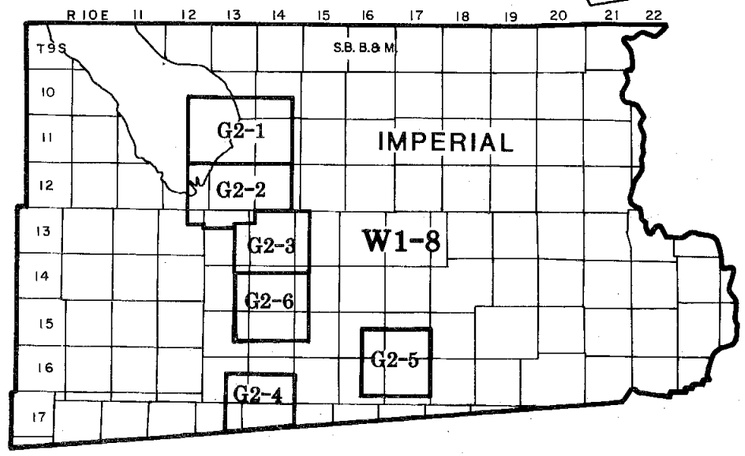
Date Notice Received	Operator & Well No.	API No.	Sec.	T.	R.	Location & Elevation
2/28/83	Union Oil Co. of Calif. "Sulphur Bank" 30	097-90579	11	11N	9W	Fr. NW cor. 274.3m S, 413.9m E. 560m KB.
3/10/83	Union Oil Co. of Calif. "Geyser Gun Club" 6	097-90580	11	11N	9W	Fr. SE cor. 583.1m due N, 423.3m due W. 690.2m GR.
		PLUMAS COUNTY				
12/11/82	Indian Valley Hospital "GRN" 1	063-90012	2	26N	9E	Fr. NE cor. 884m S, 640m W. 1068m GR.
12/11/82	Indian Valley Hospital "GRN" 2	063-90013	2	26N	9E	Fr. NE cor. 838m S, 664m W. 1068m GR.
		LASSEN COUNTY				
5/28/83	Litchfield Developers "Johnston" 2	035-90068	2	29N	13E	Fr. NE cor. 683m S, 204m W. 1250m GR.
		IMPERIAL COUNTY				
5/14/83	Charles Crocker "Crocker" 1	025-90552	22	10S	10E	Fr. NW cor. 91m S, 137m E. -67m Gr.

California Division of Oil and Gas
GEOTHERMAL MAPS





MAP NO.	FIELD OR AREA	MAP SCALE
G1-1	Casa Diablo	1:20,000
G1-2	Lake City	1:20,000
G1-3	Susanville	1:7,200
G2-1	Salton Sea (North)	1:20,000
G2-2	Salton Sea (South)	1:20,000
G2-3	Brawley	1:20,000
G2-4	Heber	1:20,000
G2-5	East Mesa	1:20,000
G2-6	Mesquite	1:20,000
G3-1	The Geysers	1:20,000
G3-2	Calistoga	1:12,500
GW-1	The Geysers Area	1:62,500
W1-8	Imperial County	1"=2mi.



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