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RENEWAL ISSUE

GEOTHERMAL HOT LINE

A Publication of the California Division of Oil &Gas

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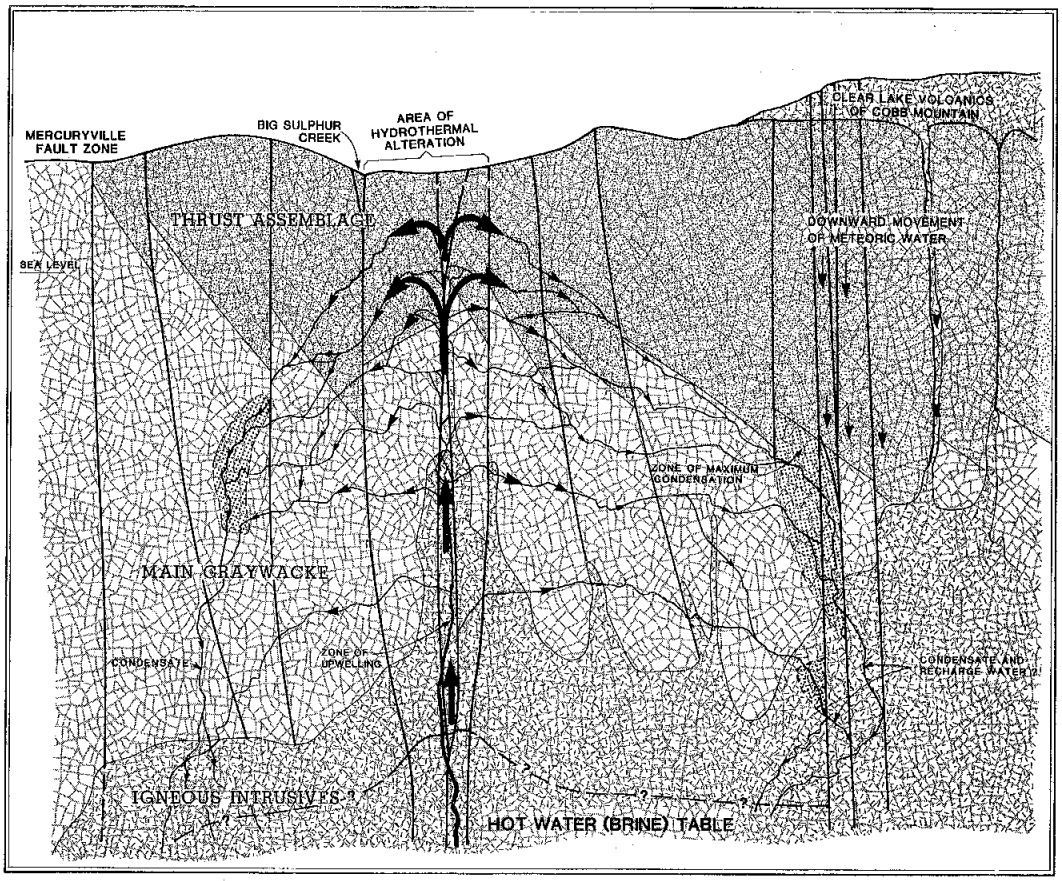
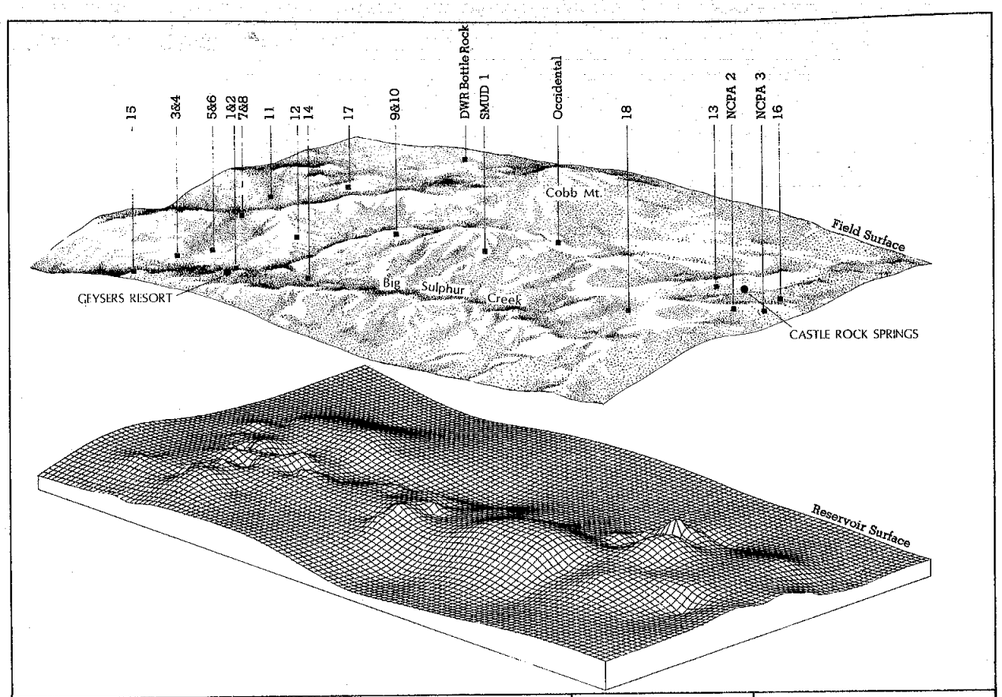


Schematicized cross section of the Big Sulphur Creek fault zone, The Geysers Geothermal field, showing the inferred relationship of geologic structure to hydrothermal fluid flow.

*Big Sulphur Creek fault zone, in The Geysers Geothermal field, may be part of a deep-seated, wrench-style fault system. Hydrothermal fluid may rise through conduits beneath the five main anomalies associated with the Big Sulphur Creek wrench trend. Upon cresting, the fluid descends through an extensive, moderately dipping, fracture network. Condensed steam at the steep reservoir flanks drains back to the hot water table. These flanks are defined roughly by marginally producing geothermal wells. Field extensions are expected to be on the southeast and northwest. From A Reservoir Assessment of The Geysers Geothermal Field, Chapter II, "Subsurface Geology", by Richard P. Thomas. Illustration by Alfred Zucca.**(See page 4.)*



Unit No.	Date on Line	Operator	Generating Capacity (MWe)	Cumulative Field Generating Capacity (MWe)
(a)PG&E 1	September '60	Magma-Thermal Power Co.(b)	12	12
PG&E 2	March '63	Magma-Thermal Power Co.(b)	14	26
PG&E 3	April '67	Union Oil Co. of CA	27	53
PG&E 4	November '68	Union Oil Co. of CA	27	80
PG&E 5 & 6	December '71	Union Oil Co. of CA	55/55	190
PG&E 7 & 8	Aug. / Nov. '72	Union Oil Co. of CA	55/55	300
PG&E 9 & 10	Aug. / Nov. '72	Union Oil Co. of CA	55/55	410
PG&E 11	May '75	Union Oil Co. of CA	110	520
PG&E 12	March '79	Union Oil Co. of CA	110	630
PG&E 15	June '79	Thermogenics, Inc.	55	685
PG&E 13	May '80	Aminoil USA, Inc.	135	820
PG&E 14	September '80	Union Oil Co. of CA	110	930
(c) NCPA 2	Proj. March '82	Shell Oil Co.	110	1040
PG&E 17	Proj. August '82	Union Oil Co. of CA	110	1150
PG&E 18	Proj. October '82	Union Oil Co. of CA	110	1260
PG&E 16	Proj. November '83	Aminoil USA, Inc.	110	1370
(d) SMUD 1	Proj. December '83	Aminoil USA, Inc.	65	1435
(e) DWR Bottle Rock	Proj. April '84	MCR Geothermal Corp.	55	1490
(f) Occidental	Proj. ? '84	Occidental	80	1570
NCPA 3	Proj. ? '85	Shell Oil Co.	55	1625

(a) Pacific Gas and Electric Company.
(b) Union Oil Co. of Calif. entered into a joint ownership with Magma-Thermal Power Company in 1967.
(c) Northern California Power Agency.
(d) Sacramento Municipal Utility District.
(e) State of California, Department of Water Resources.
(f) Occidental Petroleum Company.

Power plants, under operation and projected for completion, The Geysers Geothermal field. Field surface depicted above the reservoir surface represented by a computerized grid. Views are to the north from 20° above the horizon. Vertical separation between the surfaces is greatly exaggerated. Computer plotting courtesy of the U.S. Geological Survey. From A Reservoir Assessment of The Geysers Geothermal Field, Chapter I, "The Geysers Geothermal Field" by A. D. Stockton. *(See page 4.)*

RENEWAL ISSUE

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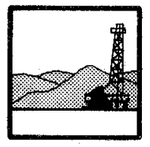
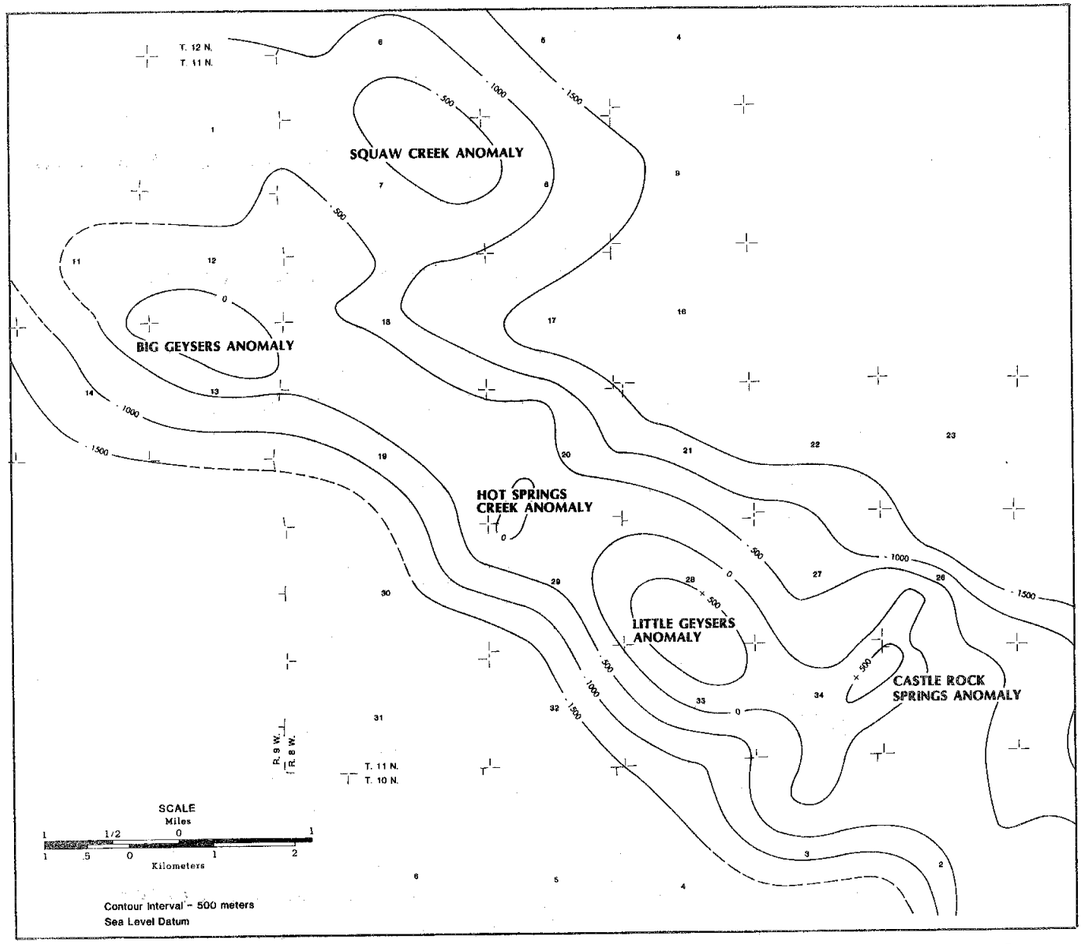


High-Temperature Development

A Reservoir Assessment of The Geysers Geothermal Field

A Reservoir Assessment of The Geysers Geothermal Field, A. D. Stockton, Principal Investigator, has been published by the California Division of Oil and Gas. The report has three major chapters: "Subsurface Geology" by Richard P. Thomas, "Geophysics" by Rodger H. Chapman, and "Reservoir Assessment" by Herman Dykstra. There are 9 plates and 27 figures. On sale for $6.50, the report is available from any division office.



Idealized map of first reported steam entries at The Geysers Geothermal field, constructed from well histories. First steam-entry major anomalies are indicated. The geographic coincidence of these anomalies with mapped structures suggest that steam flow may be structurally controlled. Contours are in meters. From A Reservoir Assessment of The Geysers Geothermal Field, Chapter II, "Subsurface Geology", by Richard P. Thomas. Illustration by Alfred Zucca.

Fire Burns Cooling Tower at The Geysers

On February 22, an estimated $8 million fire destroyed a 12-cell cooling structure at a geothermal power plant under construction at The Geysers Geothermal field.

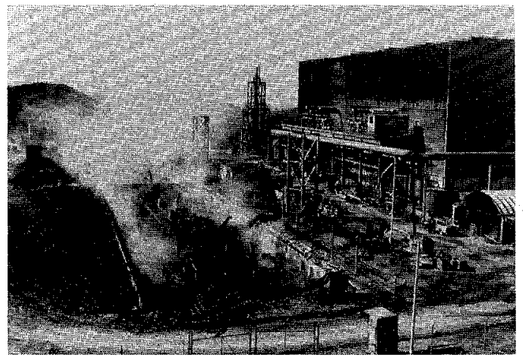
The 110 MWe power plant, NCPA 2, was 80 percent complete when its cooling structure burned down to the foundation.

The power plant, fully insured, is owned by the Northern California Power Agency (NCPA). It was to be the first power plant in the field not operated by Pacific Gas and Electric Company.

In 1980, the U.S. Department of Energy approved a $45 million loan guaranty to the NCPA for the plant's construction.

NCPA headquarters is in Citrus Heights, near Sacramento at 8421 Auburn Blvd. The agency was organized by 12 cities 14 years ago to develop independent and less expensive electrical power.

Member cities are Alameda, Biggs, Gridley, Healdsburg, Lodi, Lompoc, Palo Alto, Plumas-Sierra Rural Electrical Cooperative in Portola, Redding, Roseville, Santa Clara, and Ukiah.



After the fire. The cooling structure was burned down to the cement slab. Photo by Ken Stelling.

MSR Drills at The Geysers

MSR Public Power Agency has begun drilling well "Abril" 5B-1 at The Geysers Geothermal field in Sonoma County. The well is 1/3 mile northwest of PG&E power plant Unit 15.

The agency plans to drill two wells from this site and a third from a site about 1/3 mile to the northwest. Eventually, at least 10 wells will be drilled to supply a proposed 55 MWe power plant.

MSR is a consortium made up of the Modesto Irrigation District and the Cities of Santa Clara and Redding.

Geothermal Steam Analysis

A system for analyzing the components of geothermal steam has been developed by ANATEC Laboratories of Santa Rosa, California. The company can measure the total molecular content of steam samples as well as the gas content, including the carbon dioxide level.

Fracturing Technique Used at The Geysers

In December 1981, a formation fracturing technique was used for the first time on a well at The Geysers Geothermal field. Detonated in the well was an explosive called HITEX, designed especially for use in geothermal steam wells.

Fracturing failed to materially improve the steam output of the well, Union Oil Company of California "LF State 4597" 30. The well is 8,826 feet deep and drilled in an area of The Geysers field where steam is piped to Pacific Gas and Electric Company power plant Units 9 and 10 (see the inside front cover of this Hot Line issue).

Physics International and Rocket Research Co., San Leandro, California, made the device and worked with Union Oil Company on the project, under contract with the U.S. Department of Energy.

D. M. Mumma, engineering director for Physics International at Santa Rosa, said that while the test did not produce as much steam as hoped for, "We did prove that the technique worked."

Geothermal Development Underway at Coso

The Secretary of the Navy announced that in January 1982, a well drilled in the Coso area of the Naval Weapons Center at China Lake, California, penetrated dry steam. Jim Moore, Vice President for Exploration for the California Energy Company, a Santa Rosa-based firm that drilled the well, said (according to an article in the Bakersfield Californian) that the well, "Coso" 75-7, spews pure steam upwards of 400 feet in a windless sky, is producing 180,000 pounds of steam, and is capable of generating 9 MWe by itself. However, Moore feels the field will ultimately prove to be a hot water field.

California Energy is operating the China Lake Joint Venture on behalf of itself and an investor group headed by the Caithness Corporation of New York. The contract calls for the contractor to complete the resource evaluation, construct the power plant, and operate the plant at no capital cost to the Navy. The Navy retains title to the land, the geothermal resource, and the electricity. The contractor recoups the investment through payments for the conversion of the geothermal energy to electricity, which will be returned to the Navy. The agreement calls for the production of 75 MWe of continuous electrical power for the China Lake Naval Weapons Center and other Naval installations in Southern California.

California Energy is now operating on a 3½-square mile area of Navy fee land. Most of the Coso area was leased by the U.S. Bureau of Land Management in September 1981. Three other entities have acquired field leases: the Los Angeles Department of Water and Power (3 parcels, $6.5 million), California Energy (4 parcels, $173,774), and Grant Lyddon of Santa Monica (14 parcels, $231,113).

The Navy fee lands may yield at least 350 MWe, and another 4-square mile Navy parcel 400 MWe, according to Dr. Carl F. Austin who directs China Lake's Geothermal Utilization Center.

The Los Angeles Department of Water and Power estimates that its three leases could yield 200 MWe to 250 MWe. The department plans to drill three exploratory wells in the second half of 1982.

Naval Geothermal Development at Fallon, Nevada

Proposals for the development of potential geothermal resources at the Naval Weapons Training Complex, Naval Air Station, Fallon, Nevada have been solicited by the U.S. Navy. The proposals called for the 30-year development of the geothermal resources, including the conversion for the U.S. government of any supply of electrical energy. The initial developmental goal at Fallon is to meet the electrical requirements of the Naval Air Station. A formal invitation to bid has been issued to applicants whose technical proposals the Navy judged as satisfactory. Proposals must be submitted by April 21. For further information, call C. Flynn, Energy Engineering Branch, (415) 877-7512.

Sonoma County Looks at Geothermal Power

The Sonoma County Board of Supervisors approved a recommendation that the county look into the possibility of generating its own electricity from geothermal resources at The Geysers Geothermal field.

County Supervisor Nick Esposti of Healdsburg suggested that a 110 MWe geothermal power plant be built near the City of Geyserville, California to serve 125,000 people, about one-third of the current county residents.

Esposti will lead the project study, which should take 4-to-6 months.

Successful Well at Newberry Crater

A test hole drilled by the U.S. Geological Survey in the floor of Newberry Caldera on the east flank of the Cascade Range, 25 miles from Bend, Oregon, has penetrated a very hot hydrothermal system. According to C. G. Bufe in the February 1982 issue of Geotimes, the upper 500 meters of the well bore passes through a zone in which groundwater is cooled from downward-percolating snowmelt and cold rain water. This portion of the hole was drilled in 1979. The hole was deepened in 1981 into a 100m-thick isothermal zone and then to a caprock with a thermal gradient of nearly 600°C per kilometer that continued to within a few meters of the well bottom. Here, permeable rock was penetrated.

The bottom-hole temperature was 265°C at a depth of 932m, and the well produced steam during a 20-hour flow test. A significant energy potential may exist. The well will be retested in the spring of 1982.

Edward A. Sammel, a U.S.G.S. hydrologist, says preliminary analysis shows the steam to hold very low concentrations of dissolved solids. The temperatures are more than adequate for generating electricity.

For several years, the geothermal potential of the Cascade Range has been studied by federal scientists. Usually, the cooler temperatures near ground level have discouraged serious drilling.

According to Wendell A. Duffield, geothermal research coordinator for the U.S.G.S., commercial interests and power companies may now be interested in developing the region because of the proof that high temperature geothermal resources do exist.

Low-Temperature Development

Growing Gerberas with Geothermal Energy

When I talked with Bill Burtis, he described the benefits of managing a geothermal greenhouse. "There's ample heat," he said, comparing such greenhouses with more conventional structures. "I can heat what I have to, when I have to do it. The energy is free."

Bill is Grower Manager for the first geothermally heated greenhouse in Modoc County, California. The company, called Geothermal Floral, is owned by Sal Pantano.

Bill raises gerberas, large, brilliantly colored daisy-like flowers, in a 4,300 square foot quonset-type greenhouse covered with a double layer of plastic. The greenhouse is heated with water pumped, not from a well, but from nearby Kelly Hot Springs (Pantano Hot Springs). Spring water is about 210°F, and the inlet temperature for the greenhouse is about 195°F. The water leaving the greenhouse is about 135°F, and passes into an existing drainage system. No special disposal procedures are needed because, though cooler, the water quality is never altered.

In the greenhouse, pots of gerberas rest on pipes, partially buried, through which the hot spring water passes. The plants respond well to the warmed soil in which they grow. Bill may soon use the hot water to sterilize soil.

The gerberas raised by Geothermal Floral are varieties developed by Florida growers. Dr. Tom Byrne works for the University of California, Davis, in the Department of Environmental Horticulture, where new varieties of gerberas are developed. He told me that gerberas are a relatively low-labor greenhouse crop.

One problem, he said, with gerberas or any crop, is re-creating at the greenhouse site, optimum growing conditions for the plant. These conditions are affected by changes in elevation, climate, and sunlight. Many plants are developed in low, coastal areas and adjustments must be made to grow them at higher elevations, such as in the Modoc County greenhouse at an altitude of 4,300 feet.

At Geothermal Floral, the gerberas were started in late summer 1981 and have

Gerberas--brilliantly colored, daisy-like flowers. The variety on the left was bred at the University of California, Davis, and the variety on the right, Elsberry, Florida, was bred in Florida and is grown commercially by Geothermal Floral in Modoc County. Drawing by Jim Spriggs.

just passed through their first winter growing season in what proved to be an exceptionally dark year. Flower production declined with light loss, and did not pick up until lighting was installed in the greenhouse. Dr. Byrne says he expects that the summer light may be so intense at the high-elevation greenhouse that shades may have to be developed to protect the gerberas. On the other hand, he said many circumstances at the greenhouse are advantageous for the gerberas. The air is dry, which is good for cooling, and there is a high level of CO_2 in the atmosphere.

Dr. Byrne has given Burtis a selection of gerberas to raise in Modoc County that have been developed at Davis for yield, aesthetic quality, and vase life. Burtis will raise these along with his commercial, Florida varieties, and eventually choose from them the gerberas that perform the best under the Modoc County growing conditions.

Dr. Byrne advises anyone interested in growing a greenhouse crop to call nearby university agricultural departments and talk with crop specialists.

An educational display of gerberas and the work at UC-Davis with this flower will be open to the public in the fall of 1982 at the Golden Gate Park Conservatory in San Francisco.

For more information about Geothermal Floral, Mr. Burtis may be reached at Star Route, Canby, California 96015.

Successful Well Drilled Near Wendel

by Dick Thomas

According to Russell Juneal, consulting geologist for the GeoProducts Corporation, a geothermal well near Wendel in Lassen County has been drilled to a total depth of 5,838 feet. The well, "Wen" 1, which bottoms in Sierran Granitic rock, is the first successful deep well in the Wendel-Amedee K.G.R.A.

Final flow testing, using both flow line and down-hole pressure, temperature, and discharge rate instrumentation, is in progress, scheduled for completion April 1, 1982. Preliminary test results indicate a very high capacity well with temperatures already above the initial projection of 250°F and rising. This well is the first production well to be used in the GeoProducts Corporation hybrid geothermal-wood residue power plant. (See Hot Line, January, 1980.)

Susanville Reorganizes Geothermal Management

A resolution was passed on February 5 by the Susanville City Council to transfer authority for geothermal development from direct management by the city to a nonprofit corporation, called the Susanville Municipal Energy Corporation (SMEC).

A board of directors and committee to make the transfer have been chosen. The transfer will occur in two stages.

During the first stage, beginning March 1, the SMEC will manage and direct the daily operations of the geothermal project. The board will formulate a 5-year plan and an operations system for the project.

On May 15, if the City Council has approved the 5-year plan, the assets and overall operation of the program will be placed under the authority of the board of directors. The city will remain the final owner and operator of the program and program assets.

Fort Bidwell Indians Begin Low-Temperature Development

A successful, low-temperature geothermal well has been drilled at Fort Bidwell, California, on the Northern Paiute Indian reservation. The 500 foot well flows 116°F water at a rate of more than 400 gallons a minute without pumping.

According to Richard Bellon, business manager at the Fort Bidwell reservation, the well will provide enough water to space-heat the reservation's community buildings, houses, and planned greenhouses and aqua operations.

"We already have commitments from people who will take everything we produce here, from prawns to flowers," said Bellon. He added that the tribe has applied to the U.S. Dept. of Housing and Urban Development for grant funds to drill additional wells and to construct the greenhouses and aquaculture ponds.

The high-quality well water can be used directly for space-heating. Savings to the community are expected to reach $28,000 a year, based on the current price of propane.

Funds for drilling the $35,000 well were provided by the California Energy Commission. The well was drilled by Tom Waldrop of Susanville, under the supervision of Robert Pratt of Hydrothermal Energy Corporation.

Test Wells in San Bernardino

The City of San Bernardino is drilling four 1,500 foot geothermal test wells. City water commissioners awarded the drilling contract to McCalla Brothers of Chino at an estimated cost of $30,800. The cost was lowered from prior bids when the city said it would assume the risk in case of damage to drilling equipment in some cases, and also be responsible for cementing the wells.

The wells will be drilled in southwestern San Bernardino to pinpoint the extent of the geothermal reservoir along the Loma Linda fault.

The drilling is financed under a $396,000 grant from the Calif. Geothermal Resources and Development Account. The city plans to use geothermal energy in two ways: to warm sludge entering digester tanks at a sewage treatment plant, and to space-heat five public facilities.

El Centro Direct-Use Project
by Dave Curtis

After a number of delays, drilling was started on the City of El Centro's geothermal wells on December 16, 1981. Heat from the wells will be used to space-heat the city community center. Excess hot water will be sold to other businesses. Eventually, the water will be injected into another well. The project, funded under the U.S. Dept. of Energy (DOE)-Direct Heat Program, was first proposed in 1979. Delays were incurred due to problems finding casing and obtaining final DOE approval. Funding now includes $1.3 million for the wells and $1.5 million for the rest of the project.

The drilling proceeded smoothly. The injection well was drilled to 4,038 feet and completed on December 30, 1981. The production well was completed on February 2, to a depth of 8,511 feet. A bottom-hole thermometer in the production well recorded temperatures between 282° and 290°F. While temperature logs have not yet been run, temperatures seem to be 20° or 30° above those predicted.

The two wells are located on land owned by the Imperial Irrigation District, about 1½ miles northeast of the El Centro courthouse, and about one-half mile north of the city's community center. A closed heat-exchanging system to be located at the well site will supply both hot and cold water to the community center. The chilled water for air conditioning will be produced by a process much like that used in gas refrigerators. The city plans to sell any excess energy to nearby businesses or industries. The system is scheduled to be operating by November or December of 1982.

Hopefully, by seeing how El Centro's geothermal resources can be used, new industry will be attracted to the city. The wells will be monitored with pressure, temperature, and flow recorders, and all the project data will be available to other prospective users of low-temperature geothermal energy.

For further information, contact Dave Curtis, California Division of Oil and Gas, 485 Broadway, Suite B, El Centro, California 92243.

Unique System Planned for Ephrata

A district-heating system using energy from Ephrata, Washington's geothermally heated domestic water supply is being designed by Brown and Caldwell, Seattle, and Marquess Engineering Company. The system will be the first district-heating project in the U.S. to combine heat pumps and municipal water mains.

The U.S. Department of Housing and Urban Development has authorized a $488,000 block grant for the project's design and construction.

Project manager Allen de Steiguer says the project is unusual because an existing water distribution system is used as a source of energy.

Ephrata's water supply comes from a low-temperature geothermal reservoir in the Columbia Basin basalt formations. Water temperatures range from 80°F to 90°F at depths of 1,800 feet. The city tapped the aquifer for domestic water, and, until now, had no use for the heat.

In the first phase of the project, a large, central heat exchanger will extract heat from the domestic water in the water main, boosting the temperature of the water for the heating system to 140°F. The heated water will circulate through a separate system to provide space-heating for the Grant County Courthouse. Drinking water will return to the main at a lower, more acceptable temperature.

Once the system's effectiveness is demonstrated, local businesses will be encouraged to use it.

English Direct Heat Project

Geothermal energy will be commercially exploited for the first time in Great Britain, in the southern City of Southampton. Officials of Southampton have approved a plan to drill a well to tap an underground water source with a temperature of 158°F. The water will be used to heat a large shopping center, an office building, the civic center, a swimming pool, and a factory. Project cost is estimated at $5.4 million.

Drilling will begin in late 1981 and the project should be operating by 1984.

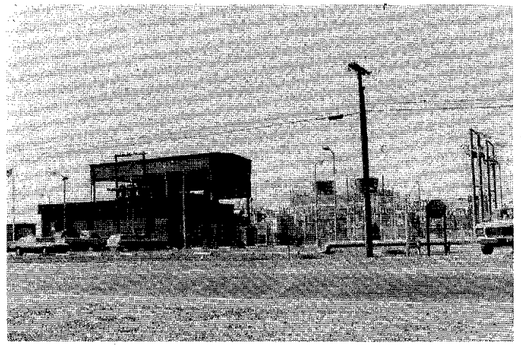
The British Department of Energy will provide $2 million of risk capital for the project. The water was discovered in 1979.

Test Well Available

Well "Old Maid Flat" 7A, a 6,000 foot deep geothermal test well on Mt. Hood, Oregon, is available for any down-hole testing, logging, or other scientific procedures an individual or company may wish to carry out. For further information contact Marshall Reed, U.S. Geological Survey, (415) 323-8111, Extension 4164.

NOTE: Two publications listed in this issue's publication section contain data on other Mt. Hood geothermal wells.

Imperial Valley



Brawley Geothermal Electric Project. Photo by Dave Curtis.

Scaling Problems Overcome at Brawley Plant

A light is shining at the end of the tunnel for Union Oil Company as it enters the second year of operations at the Brawley 10 Megawatt, direct flash geothermal power plant, according to Philip Messer, a Union geothermal reservoir engineer.

Speaking at a geothermal seminar at Stanford University, Messer said that many forseen and unforseen problems have occurred. Most problems involved scaling deposited by the geothermal brines with impurities measured above 100,000 mg./l. Scale deposited by brines entering the steam-gathering facilities is typically dark and heavy and contains metals such as iron and lead. Scale from brines that have passed through the plant is primarily silicic and much lighter in weight and color.

Messer said that many things learned at the Brawley plant have been incorporated in the Union-Southern California Edison Company direct flash plant at the Salton Sea field south of Niland. The plant is scheduled to go on stream in late April 1982.

The Brawley Geothermal Electric Project, the first commercial Imperial Valley geothermal power plant, was dedicated on October 15, 1980. Southern California Edison Company, the plant owner, operates the plant with geothermal energy extracted from the Brawley reservoir through wells owned by Union Oil Company of California.

Niland Geothermal Plant

Republic Geothermal, Inc. and Southern California Edison Company have signed a letter of intent for Edison to purchase electricity that Republic will produce from a geothermal electrical generating station to be built in the Imperial Valley near Niland, California. Initial plant capacity in January 1985, when the plant is slated to go on line, will be 25 MWe, increasing to 49 MWe within 3 years.

Heber Geothermal Plant

Chevron USA, Inc. and Southern California Edison Company have renegotiated and signed a 30-year contract for a proposed 47 MWe pilot project in the Imperial Valley south of El Centro, near Heber.

Drilling in the 8,000-acre area will begin in April 1982 from a 14-well, 3½-acre site next to the proposed power plant.

The plant is slated to go on line in January 1984. The project must be approved by the Public Utilities Commission (PUC). The commission rejected Southern California Edison's first application for the plant, submitted in May 1981. The PUC contended power from the plant would cost more than power from other sources.

The plant will be the largest, flashed hot-water plant in the United States.

Salton Sea Area Drilling

The State Lands Commission has issued geothermal prospecting permits to two firms for exploration in the Truckhaven area on the west side of the Salton Sea in Imperial County.

On December 17, 1981, the commission authorized issuance to Phillips Petroleum Company four, 2-year prospecting permits covering about 5,720 acres of fee and reserve mineral lands surrounding Phillips' private and federal lease holds in the Truckhaven prospect.

On February 25, 1982, the commission authorized issuance of two permits to Holly Energy Company, Inc. for about 1,755 acres located north and east of Phillips' Truckhaven prospect.

The permits provide a preferential right to a lease upon discovery of geothermal resources in commercial quanities. Any such lease will require a royalty of 12½ percent of gross revenue from the sale of geothermal steam and an annual rent of $1.00 per acre.

The commission may extend the permits 2 years beyond the initial period.

It is anticipated that Phillips will begin drilling its first deep exploratory well on private land in the area in March or April 1982.

Subsidence South of Salton Sea Discussed

An environmental impact report (EIR) prepared by Systems, Science and Software of La Jolla said that projected geothermal development around the southern end of the Salton Sea could drop ground levels in the area by as much as 35 feet over a 100-year period.

The report was prepared in conjunction with an Imperial County plan to zone an 111,500 acre area at the southern end of the Salton Sea for geothermal development.

The company's statement on subsidence prompted further clarification on the topic from industry and government representatives.

Dick Corbaley, district geothermal engineer with the California Division of Oil and Gas, said that what was said was valid based on the assumptions in the report, but some of these assumptions were in error.

First, said Corbaley, the EIR figures were based on the "worst conceivable case," not the "worst actual case." The worst conceivable case is an extremely unlikely occurrence.

Secondly, Corbaley said the report assumptions are formulated for a reservoir in porous sandstone, a rock more likely to subside than the fractured shale actually comprising the reservoir in the Salton Sea area.

Corbaley noted that natural subsidence around the Salton Sea, without geothermal development, is about 16 feet over the 100-year anticipated life of the reservoir.

Whatever the actual subsidence may be from geothermal activity, it can be kept in check with monitoring and ameliorating programs such as those now undertaken by the California Division of Oil and Gas and the county, Corbaley said.

Arizona-San Diego Electrical Transmission Line

San Diego Gas and Electric Company (SDG&E) received permission from the California Public Utilities Commission and the federal government for a planned $300 million electrical transmission line between Phoenix, Arizona and San Diego, California.

Called the Eastern Interconnection Project, the line will be used to bring cheaper coal-fired and geothermally-produced electricity to SDG&E customers.

California-Mexico Border Mapping Project

Identifying and assessing seismic hazards along the California-Mexico border are the dual goals of the California-Mexico Border Mapping Project. This bi-national program is one of the earthquake hazard reduction activities of the California Department of Conservation, Division of Mines and Geology. A principal program objective is to establish an exchange of earthquake research information between the United States and Mexico.

Budget for the California portion of the project is $200,000 for F.Y. '81-'82.

Current work on the project is being carried out by contract with the Scripps Institute of Oceanography, San Diego.

As part of the project, major faults in the border areas (including the Imperial Valley) will be mapped, and the slip rates and the probabilities of a maximum magnitude seismic event occurring will be assessed. Cities along the border will be notified of project findings.

A central library of papers on the mapping project is open to the public at the Scripps Institute of Oceanography, Institute of Physics and Planetary Physics, La Jolla, California 92093. For further information, contact Richard Simons, (714) 452-2031.

1981 Overview

1981 Geothermal Development: Read All About It

Two interesting overviews of 1981 geothermal development are available. One, an article in the February 1982 issue of Geotimes by Charles Bufe, U.S.G.S., states that "Worldwide use of geothermal resources for heat reached 8,000 Megawatts (thermal) in 1981, and installed geothermal electrical capacity rose to 2,400 Megawatts."

Emphasizing trends and significant publications, the article touches on the Baca project; hot dry rock; wellhead electrical power generating systems installed (Island of Hawaii

and Roosevelt Hot Springs--see Hot Line articles--Chingshui, Taiwan (3MWe), and the Dieng field, Indonesia (2MWe); the 1MW helical screw expander (tested successfully on wells in the U.S. and Mexico and to be operated in Italy); the Raft River plant; use of nitrogen drilling fluids at Valles Caldera (yields an order of magnitude reduction in drillpipe corrosion); improvement in drilling rates in granite (stemming from the use of a flame-jet drilling technique in New Hampshire's Conway granite); geothermal meetings; and the U.S.G.S. assessment activities in the U.S. Cascades.

Bufe ends by saying that 1981 was the last year for extensive federal support for geothermal commercialization activities, and that funds for geothermal research at the U.S.G.S. and the U.S. Dept. of Energy have been cut back, as well.

The second overview appears in the February 5 issue of Petroleum Information's National Geothermal Service. The article focuses more on California projects, as well as those in other western states. Together, the two summaries offer an interesting picture of geothermal activity in 1981.

Resource Evaluation

Geothermal Resources Evaluated from Oil and Gas Well Data

"Analysis of Bottom-Hole Temperature Data from Oil and Gas Wells of the Tennessee Valley Region," is a paper published in Transactions, Volume 5, by the Geothermal Resources Council. The paper discusses how oil and gas well bottom-hole temperature data were used to evaluate geothermal energy resources in the Tennessee Valley region and adjacent states.

The geothermal gradient for each of the 13 geologic subregions was established by linear regression of all the BHT data within the subregion.

A routine statistical procedure was used to identify all unusually warm wells in each subregion and the wells were plotted. "Hot spots" within each subregion were identified by noting clusters of such wells in numbers exceeding statistical expectations based on the intensity of drilling activity.

The Transactions, Volume 5, are available for $30.00 from the GRC, P.O. Box 98, Davis, California 95617.

Wyoming Hot Oilfield Brines

An inventory of Wyoming geothermal waters produced in 50 state oil and gas fields has been undertaken by the Wyoming Geothermal Resources Assessment Group within the University of Wyoming Geology Department. The group asked oilfield operators to submit water temperatures, flows, chemistry, and disposal practice data.

If the hot water could be purchased and used for direct heat projects, all parties involved would benefit.

A study on California's hot, oilfield waters in the Los Angeles Basin appeared in the July 1981 issue of the Hot Line.

Aquifer Heat Storage

Can Heat Be Stored in Freshwater Aquifers?

A Department of Energy grant funds a study at the University Minnesota to test the feasibility of storing heat in freshwater aquifers on a seasonal basis. Previous studies have shown this to be possible in a confined aquifer for a short-term operation. As much as 80 percent of the heat was retrieved at a later date in these studies.

If the study is successful at the University's St Paul Campus, the university would be able to store excess heat in the spring, summer, and fall, and remove it in the winter, eliminating need for additional wintertime boiler capacity.

To test the plan, two wells have been drilled. Groundwater at 54°F will be withdrawn from one well at a rate of 300 gpm, heated to 300°F, and injected in the second well 800 feet away.

The Department of Energy grant was awarded to Battelle Pacific Northwest Laboratories to manage the STES (Seasonal Thermal Energy Storage) program. The University of Minnesota physical plant, as prime contractor to Battelle, commissioned Orr-Schelen-Mayeron and Associates, Inc. of Minneapolis, a consulting firm, to do well engineering on the project.

Further information is available in the 1981 Fourth Quarter issue of The Johnson Drillers Journal, Johnson Division, UOP Inc., P.O. Box 43118, St. Paul, Minnesota 55164.

New Mexico

Geothermal Development at Las Cruces

New Mexico State University, at Las Cruces, will soon use 140°F hot water from two on-campus wells to satisfy 80 percent of the university's hot water needs and heat two major buildings.

The wells were drilled with U.S. Dept. of Energy (DOE) funds after the university drilled successful test wells in the area in 1978 and 1979. The $1.5 million from the DOE was also used to install pipelines, holding tanks, and heat exchangers.

The fortunate occurrence of a major geothermal field in the immediate area of Las Cruces has focused a great deal of attention on the town.

Roy Cunniff, chief of the university's geothermal project, said that 64 firms have inquired about the possibility of building factories in the area and that a major exploration company, in cooperation with the state, is sinking two deep exploration wells in the field.

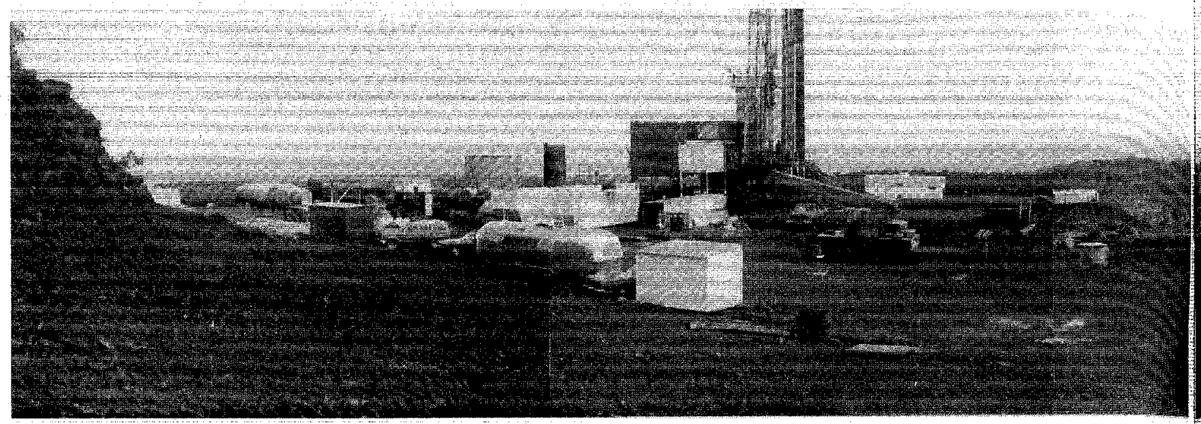
Baca Project Terminated

The New Mexico Baca project has been terminated through mutual agreement of all participants: the U.S. Department of Energy, the Public Service Company of New Mexico, and Union Geothermal Company of California.

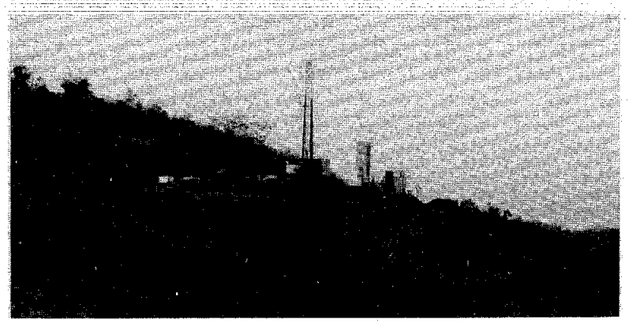
The project was to include 15 to 17 hot water wells that would supply geothermal energy to a 50 MWe demonstration, single-flash, generating unit. However, the necessary supply of hot water needed to power the unit was unavailable at a reasonable cost and on a reasonable schedule, in the opinion of the Department of Energy.

The cost of the entire project was estimated at $140 million. The project was terminated after 4 year's work and an expenditure of $65 million.

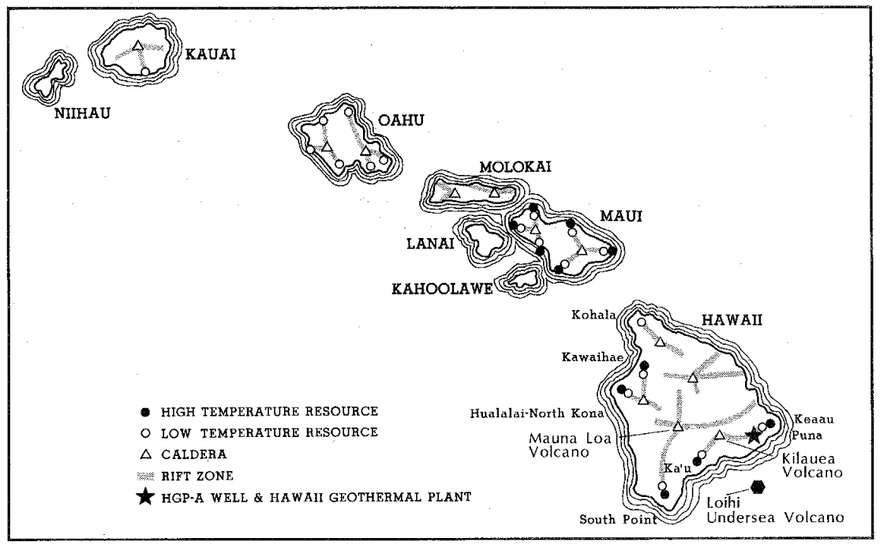
Hawaii – The Road to Hawaiian Geothermal Development



Panorama of Hawaiian geothermal development, Island of Hawaii. At left, well "Kapoho" 2 being drilled north of the Hawaii Geothermal Plant, photo right. Panorama and two close-up photos by Roscoe Martin.



Close-up of well "Kapoho" 2, the second exploratory well drilled in this area by Puna Geothermal Ventures, a company whose partners are Dillingham Corporation, Thermal Power of Hawaii, and AMFAC.



Close-up of the Hawaii Geothermal Plant. Notice the electrical transmission lines strung from the 3.5 MWe power plant.

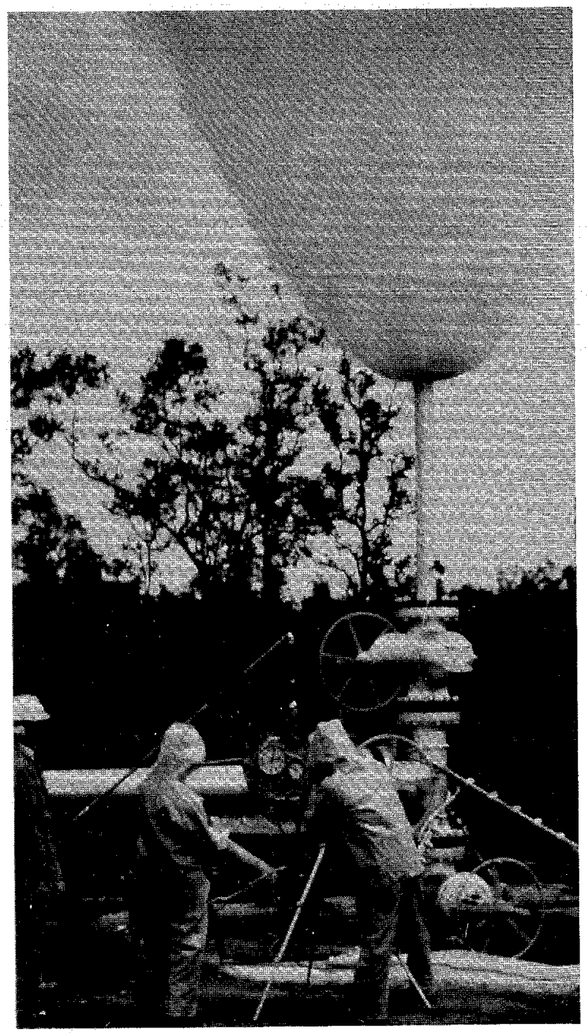
Potential geothermal resource areas in Hawaii. All areas identified as promising are in rift zones. Although heat exists in these areas, the question is whether or not the heat is in conjunction with sufficient subsurface water. Besides hydrothermal, liquid-dominated systems, Hawaii has another geothermal resource: molten magma.

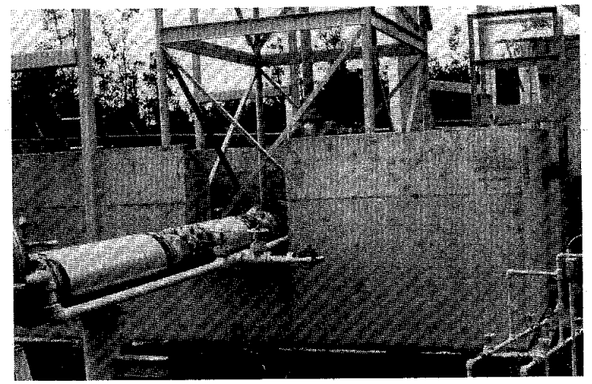
A new undersea volcano, Loihi, is erupting 20 miles south of the Island of Hawaii. Loihi's summit is presently more than one-half mile beneath the water.

A single, huge magma chamber may lie at great depth and supply lava erupted from Loihi, Kilauea, and Mauna Loa volcanoes.

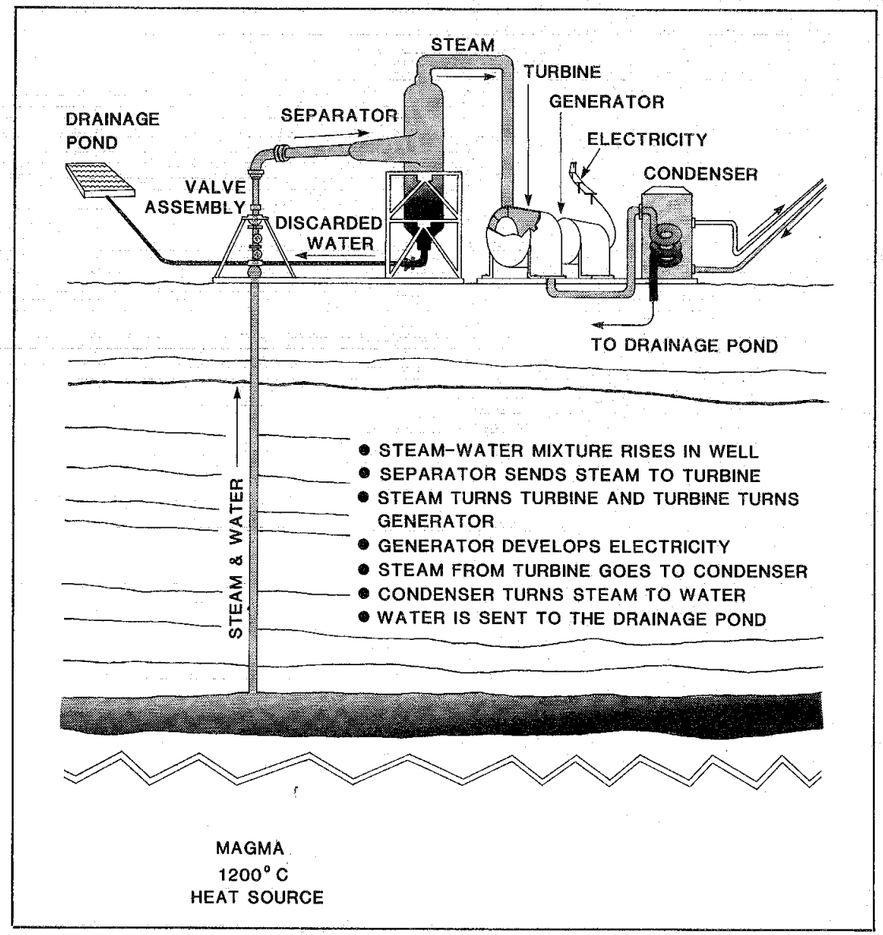
July 1976: Testing well HGP-A, the first successful geothermal well in Hawaii. The well is 6,450 feet deep with a bottom hole temperature of 358°C, and is one of the hottest geothermal wells in the world. Well fluid is 40 percent water and 60 percent steam. Since 1976, three more wells have been drilled, two thought to be successful, and one a dry hole.

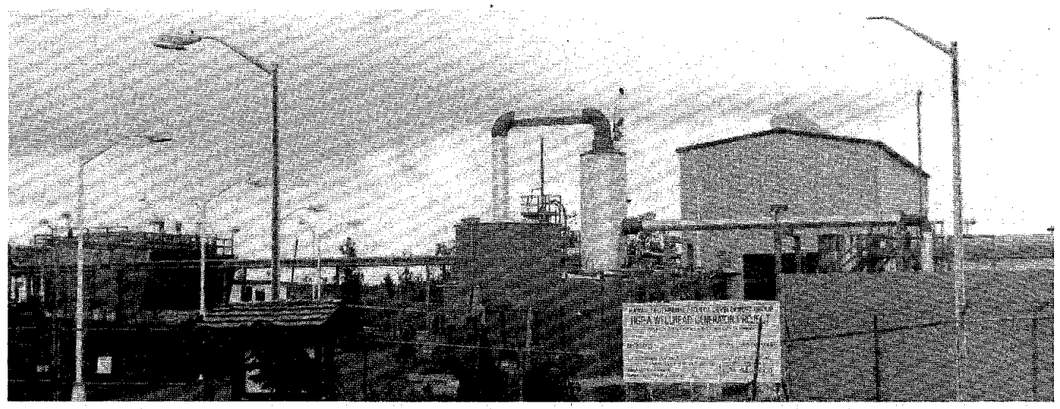
The well is drilled on the south-eastern slopes of Mauna Loa volcano, in the Kiluea East Rift Zone, Island of Hawaii.



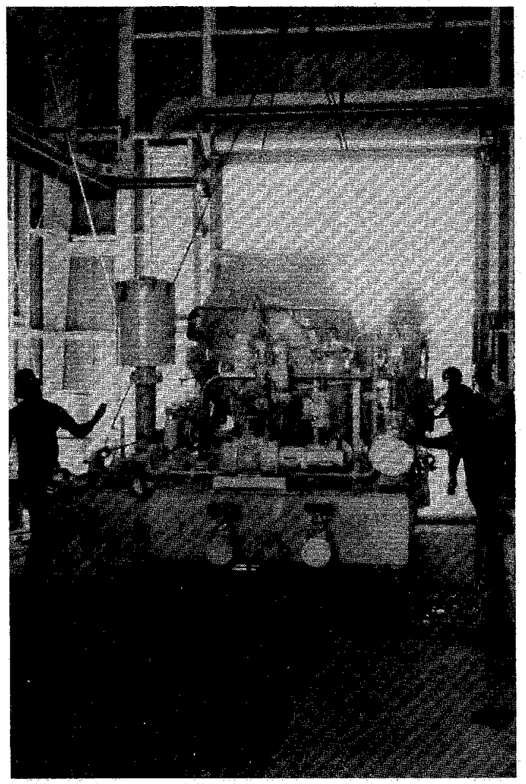


A concrete box is built around the wellhead to protect it from lava flows. Steam from the well comes from a mixture of sea water and rainwater that seeps into the hot rocks.



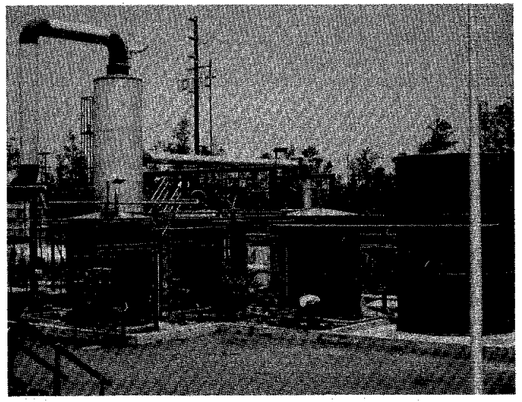


***Schematic of well HGP-A** and schematic and photograph of the Hawaii Geothermal Power Plant. This 3.5 MWe plant is constructed at the well site.*

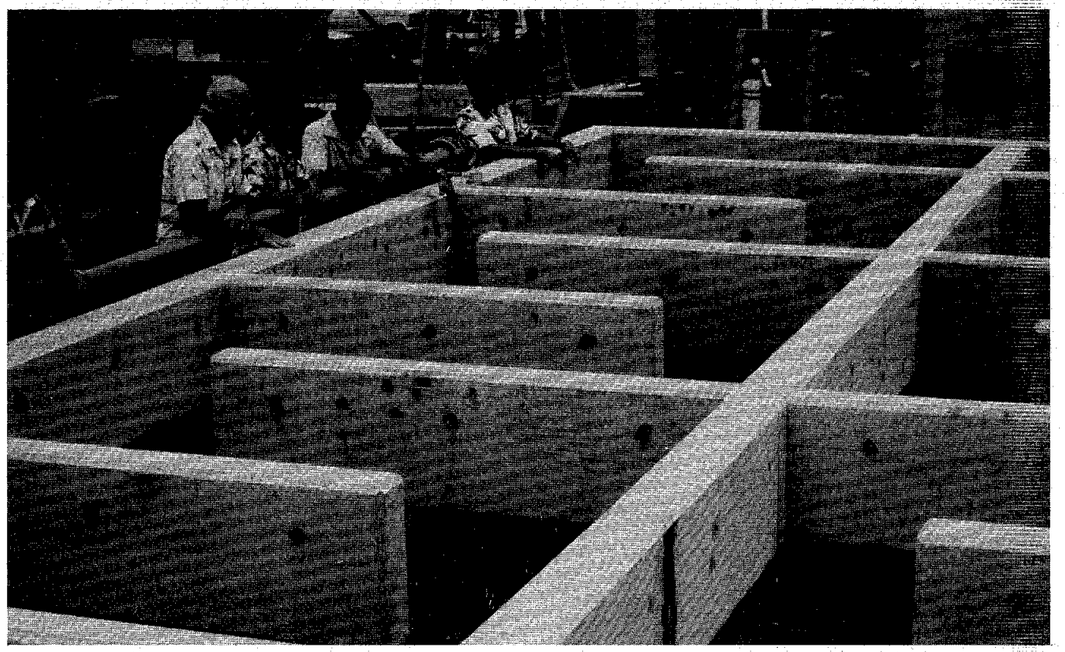


Cooling towers of the Hawaii Geothermal Plant, dedicated in ceremonies held on July 17, 1981. The plant, a joint effort of the U.S. Department of Energy and the State of Hawaii, made Hawaii the second state in the nation producing on line electricity generated from geothermal energy. (California was the first, and Utah, in the fall of 1981, became the third, when a geothermal power plant went on line at Roosevelt Hot Springs.)

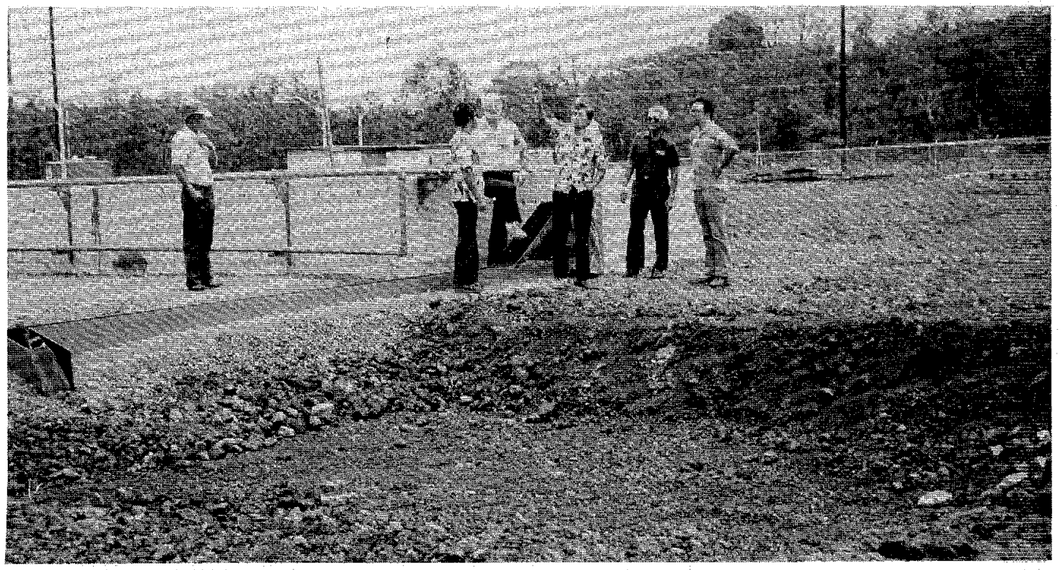
Whenever volcanic eruptions threaten, the power plant generator and other main parts can be lifted, put on a trailer, and hauled away. Time for the procedure comes from the fact that Hawaii's volcanic eruptions are nonexplosive, and warnings prior to many eruptions are detected routinely.



Power plant separator (tall cylinder) and storage tanks for sodium hydroxide, used for H_2S abatement at the power plant.



Settling ponds into which liquids from HGP-A flow. Several hundred pounds a day of dissolved silica (with some calcium carbonate) precipitate. Uses for the silica are being sought.



Once the SiO_2 has precipitated from power plant effluent, the water is disposed of through percolation ponds such as this. With a larger power plant, injection will be necessary.

Today, approximately 1,000 homes in the Puna District receive electricity generated at the geothermal field.

Thriving papaya grove growing in basalt. Holes were blasted in the basalt and fertilizer, water, and plants added. Plans are underway to test irrigation of such groves with geothermal water. The geothermal water quality equals that of 85 percent fresh water and 15 percent sea water.

The Puna Sugar Company has studied the feasibility of transporting hot fluids from a well drilled in the same area as HGP-A. The fluids would be taken 16 miles to a sugar factory where they would be used as processing steam and to dry bagasse. Bagasse is sugar cane residue that is dried, pellitized, and used as boiler fluid to generate electricity.

Other direct heat uses of Hawaii's geothermal resources may include food processing, ethanol production, aquaculture, space heating and cooling, spas, and mineral recovery activities.

Although the Island of Hawaii can use only about 25 MWe of electricity (Hawaii Electric Company has issued a Request for Proposal to develop a 25 MWe geothermal power plant to go on line by October 1988 on this island), the potential exists for generating a great deal more electricity on the island from additional geothermal wells and power plants. A method of transporting such additional electricity to other markets, such as the Island of Oahu, is being planned. (Oahu uses over 80 percent of the state's energy, and no high temperature geothermal resources have been found on it.)

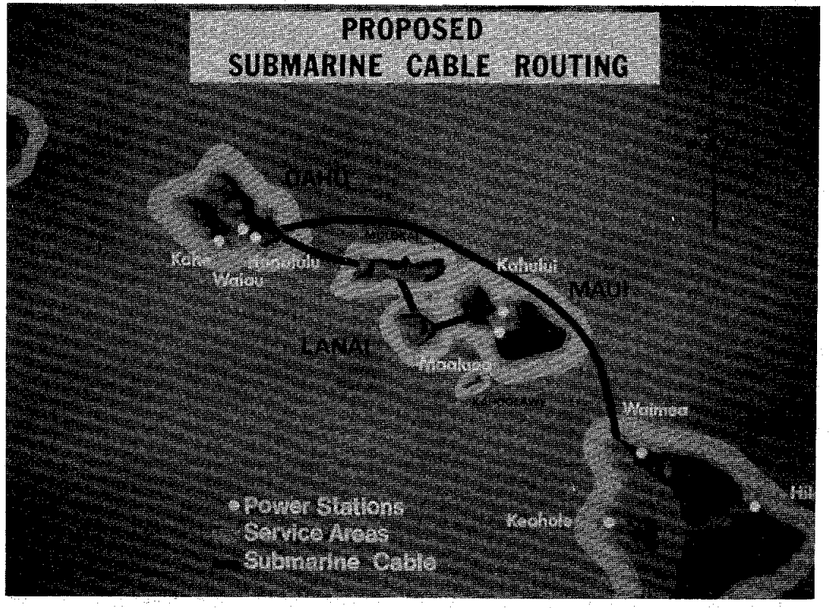
The Island of Hawaii's surplus electricity probably will be developed by many, including the three companies currently involved in geothermal projects on the island: 1) GED/CO Barnwell, which has drilled two wells near well HGP-A on the Puna rift zone. The company has received permits to drill up to 21 wells, depending on the well success; 2) Dillingham/Thermal Power/AMFAC, which has received permission to drill 2 wells; and 3) Mid-Pacific Geothermal Ventures/ Campbell Estate.

Preparations are underway to initiate a $12 million project to demonstrate the feasibility of linking the major Hawaiian islands by a deep-water electrical cable.

The cable will be laid across the nearly 7,000-foot deep Alenuihaha Channel between Hawaii and Maui, and then to the Island of Oahu, 150 miles away. To date, the longest and deepest cable of this type extends 78 miles from Norway to Denmark across water reaching a maximum depth of 1,800 feet.

The cable will be fed by several power sources, including geothermal energy generation stations.

Parsons Hawaii, a unit of the Ralph M. Parsons Company, Pasadena, California, is serving as Program Systems Integration Manager for Hawaiian Electric Company, the prime contractor for the project.



James Woodruff, Department of Planning and Economic Development, supplied the photos not otherwise credited, and technical background information. Limited copies of the Hawaii State Energy Plan are available from Mr. Woodruff at P.O. Box 2359, Honolulu, Hawaii 96804.

Drilling for Magma in Volcanic Zones

In the summer of 1981, researchers from New Mexico's Sandia Laboratories drilled through a body of magma on the Island of Hawaii. The magma body, up to 300 feet deep in spots, was formed during a 1959 eruption of the Kilauea volcano.

The magma is covered with a hard crust sturdy enough to support heavy drilling equipment. The study goal was to show that drilling equipment, placed on such a crust, could enter magma and, through continuous cooling with circulating water, cause a layer of rock to solidify around the drill pipe.

The drill pipe successfully penetrated the 130 feet of magma before entering solid, underlying rock. Hole stability was maintained for several weeks with a continuous stream of water. Many tests were made.

Sandia Engineer John Culp said, "We were fortunate that we had a large-scale model of a hydrothermal magma resource, at just the right temperature, right there at the surface where we could get at it."

In the future, researchers hope many such wells will be drilled into magmatic bodies. The water circulated through the wells would convert to steam, which would drive the turbine generators, thereby producing electricity. In California, relatively shallow magma chambers may be beneath The Geysers Geothermal field, the Long Valley-Mono Basin, and perhaps beneath Mt. Shasta and Mt. Lassen.

These regions, with the addition of the Coso Mountain area near the town of Indian Wells in Southern Inyo County and the elimination of the area around The Geysers Geothermal field, comprise what are considered as California's five most hazardous volcanic regions.

The regions were discussed in a December workshop on the Status of Volcanic Prediction and Emergency Response Capabilities in California's Volcanic Hazard Zones, co-sponsored by the California Department of Conservation Division of Mines and Geology and the Office of Emergency Services.

Dr. Robert L. Christiansen of the U.S. Geological Survey said that the Shasta and Lassen regions may pose the most hazardous prospects for future catastropic eruptions. How soon the eruptions may occur - in a few years or in thousands of years - is not known.

Utah

Search for Geothermal Energy Near Delta

A 100-square-mile area west of Delta, Utah is the site of a geothermal prospect area. Eighty-two shallow wells drilled in the area have defined a kidney-shaped prospect area about 14 miles wide and 20 miles long. Deep drilling will begin in the spring if analyses are positive.

The area, on federal and state lands, is under lease to Phillips Petroleum Company.

Electrical Generation at Roosevelt Hot Springs

A 1.6 MWe geothermal turbine generator wellhead unit, installed next to a well at Roosevelt Hot Springs Geothermal field in SW Utah, provides Utah Power and Light Company (UP&L) with its first geothermally produced electricity.

The electricity, first produced in October 1981, is generated from both the hot water and steam portions of the resource.

The generating unit includes a Biphase rotary separator turbine that produces 20 percent more kilowatts per pound of geothermal fluid as compared with a geothermal system operating on steam alone.

"In commercial practice, the rotary separator turbine can be used either

Rotary separator turbine, installed at Roosevelt Hot Springs Geothermal field in SW Utah, near Milford. At the plant, 1.6 MWe is generated.

as a satellite wellhead separator to supply steam to a central plant and supplement the total electrical output, or as a wellhead generator in combination with a small steam turbine," noted Vasel Roberts, manager of the Electric Power Research Unit's Geothermal Power Systems Program.

"As a wellhead unit," he added, "it can be used in the early stages of geothermal field development to provide information on the production characteristics of geothermal reservoirs. The information can also be used to compare the economics of the wellhead approach with that of alternative, centralized plants."

Such a study will be undertaken by UP&L after its conventional 20 MWe, $32 million, geothermal power plant goes on stream in the field in 1984. At this plant, steam alone will drive the turbines to produce electricity.

Once the 20 MWe plant is installed, the utility will evaluate the economic and technical feasibilities of both approaches and decide whether to build 5 MWe to 10 MWe wellhead units or large, centrally located 50 MWe power plants at the field.

The mobile wellhead unit was developed by Biphase Energy Systems, a joint venture of Research-Cottrell and Transamerica Delaval. Additional development and fabrication funding was from the Electric Power Research Institute.

Steam for the project is provided by Phillips Petroleum Company, unit operator for itself and AMAX Exploration Inc., Thermal Power Company, and O'Brien Resources.

Phillips discovered the Roosevelt Hot Springs geothermal resource area in 1975 after extensive exploration begun in 1972. Phillips and the unit partner have drilled 11 wells and spent over $7 million in reservoir testing and engineering design.

Officials believe Roosevelt Hot Springs Geothermal field has a generating potential of 200 MWe to 400 MWe.

An article on the Biphase turbine is in the January 1982 issue of Popular Science magazine.

Italy

A Day in Larderello, Italy

By Gerald Katz, U.S. Department of Energy

September 23, 1981 began as two weary travelers slowly walked to their rented Fiat Ritmo parked at the Pisa train station. Tony Adduci and I had recently been appointed Project Leaders under the U.S. Department of Energy (DOE) - Italy Ente Nationale per l'Energia Eletrica (ENEL) International Agreement for Geothermal Research and Development. Tony is responsible for Brine Utilization Projects. I am responsible for Environmental Impact and Control Projects.

Our trip had started weeks before when we left the San Francisco Bay Area for business on the east coast. We arrived in Rome, Italy, September 20, visited the Cesano liquid-dominated geothermal field September 21, and met with ENEL representatives in their Pisa offices

La Perla Hotel, September 1981.

on September 22. We looked forward to visiting Larderello.

People were shouting at us, "Rotondo Piatto!" Our tire was flat. We changed the tire and were off to Larderello in 30 minutes.

The 2-hour drive from Pisa to Volterra (an old Etruscan village known for alabaster) was uneventful. We had made one wrong turn, but were back on track in no time. Then we climbed the mountains, and the terrain became very rough. Most of the area was covered with a dark, reddish-brown, porous rock. Volcanic activity had left its mark. The road twisted and turned as it wound around the mountains. By noon, we had entered the Larderello geothermal field. Nuclear-style, natural draft cooling towers greeted us, along with the familiar smell of hydrogen sulfide.

Ing. Allegrini runs the Larderello power plant facilities for ENEL. His office overlooks a large boric acid facility operated by private industry. Tony and I were discussing geothermal research and development with him and Dr. Rino Bertrami who is the ENEL Environmental Impact and Control Project leader. ENEL is generating 400 Megawatts from vapor dominated resources in Italy.

The Larderello field has been producing steam for electric generation since 1904. Steam production has been declining for years, and ENEL has an ongoing reinjection program to restore the resource. A deep drilling program to explore for new resources is also underway. When discussions had ended, Dr. Bertrami took us to La Perla, our hotel.

After lunch, Dr. Bertrami gave us a tour of the Larderello area. While similarities to The Geysers field in California are quite striking, I discovered a significant difference. At Larderello, people live in concert with geothermal development. There, (where no abatement is used) hydrogen sulfide ambient concentrations were at least as high as at The Geysers, yet communities are found in close proximity to development (in some cases adjacent).

We were told that there were few odor complaints and that people living in the area felt geothermal development was good. White grapes almost the size of golf balls could be found just downwind of cooling towers. For a moment, I wondered if hydrogen sulfide was really a problem. It did not appear to be a problem here.

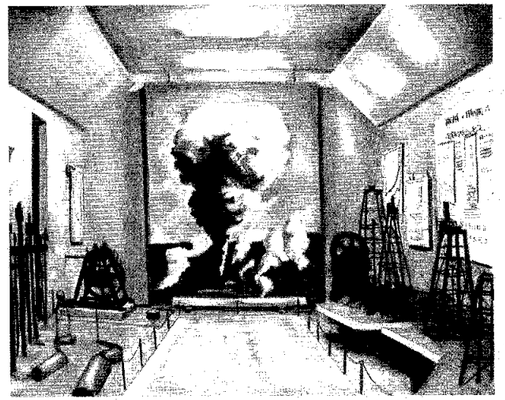
Dr. Bertrami's tour continued as we stopped by fumaroles spewing steam from chemically altered rock. Fumaroles were once very prevalent in the Larderello area. Today, only a few remain. The area we visited was, however, active and the ground felt warm.

Then, we drove to another part of the Larderello area to see the Santo Pompeii well deep-drilling project. Seismic surveys indicate a deep reflecting horizon between 3500 and 7000 meters that is felt to indicate a second reservoir below the presently producing zone. The purpose of the deep-drilling project is to reach these depths and confirm the reservoir.

There have been many problems. The granitic rocks encountered during drilling are extremely hard and require frequent drill bit replacements. Very corrosive fluids plus 400°C+ temperatures have prevented drilling beyond 4000 meters. We were shown a piece of drill pipe fished out of the hole. The treads were almost smooth, and the pipe walls were paper thin.

We then toured a 30 year old, 15 Megawatt power plant. We were told the unit operates reliably, with little maintenance required. On our way back, we stopped at a 3 Megawatt power plant with a noncondensing atmospheric discharge. The plant is one of the original ENEL units. Construction at the site was ongoing to replace the old unit with a 15 Megawatt condensing system.

At ENEL's main office in Larderello, Dr. Bertrami obtained the key to Larderello Museum to give us a private tour. The Museum is a must for all devoted geothermal advocates. The large door creaked as it opened. We entered the ancient stone building and Dr. Bertrami went for the lights. The Museum is filled with relics of Larderello's industrial past. Diagrams and photographs of the original boric acid facilities, constructed in the mid-1800's, were found on the walls. Core samples from many drilling operations were displayed. Hand augers once used for "drilling" were hanging from the ceiling. A large photograph recorded Prince Piero Ginori Centi and his reciprocating engine that gave



Larderello Museum with displays of early drilling technology.

birth to geothermal electrical development in 1904. The photographs, equipment, and mineral samples were proudly displayed. ENEL is proud of Larderello's past.

Tony and I returned to La Perla at dinner time. La Perla is the only hotel in the Larderello area. It offers simple rooms, good Italian food, and a small bar. We cleaned up, had pasta and vino, and retired to the bar to catch up on our expense accounting and post card writing. The proprietor's son and the waiter, both under 20 years old, joined us later in the evening for international discussions. We

ENEL 15 Megawatt power plant at Larderello. Natural draft cooling tower and steam gathering lines visible. Town of Castelnuovo. Drawings by Jim Spriggs from photos by Gerald Katz.

could not speak Italian and they could not speak English, yet communication developed. Using sign language and hieroglyphics, we compared both of our nations' economies. When we got to comparing food prices, Tony asked the proprietor's son, "How much are hot dogs?" The boy cried in horror "Cane Caldi, No Cane Caldi," which of course meant "Don't Cook Dogs!" We completed our discussions, being careful with colloquialisms, and went to bed.

The next morning, we woke up to presciutto, eggs, and cappuccino. After packing and checking out, we drove to Castelnuovo where Dr. Bertrami has his office. We spent the morning discussing the Environmental Impact and Control Project, and decided on a basic program outline. We will exchange information and possibly perform joint tasks in injection (including monitoring seismicity and subsidence), Air Quality (including hydrogen sulfide abatement and modeling), Water Quality, Solid Waste, and Ecosystem Impact research areas. At noon, we concluded our meeting and head back to Pisa in a torrential rain storm.

We had spent exactly one day in Larderello.

Iceland

Overview: Energy in Iceland

Iceland's geothermal and hydroelectric energy production should greatly increase in the near future, according to the Althing, Iceland's parliamentary body. The increase is needed to keep pace with growing industrialization and an expanding population. Fishing, currently the main industry, has been exploited to the limit, and Iceland needs the jobs energy-intensive industries can supply.

Geothermal and hydroelectric power sources currently provide 68 percent of Iceland's energy needs, with hydro power producing 97 percent of the country's electricity and geothermal energy 72 percent of the space-heating needs.

The Financial Times Energy Profile on Iceland, published in the fall of 1981, reported that 1 to 2 percent of Iceland's commercial geothermal sources have been tapped and only about 11 percent of the country's hydroelectric potential has been used.

Icelandic High-Temperature Geothermal Development

by J. S. Gudmundsson, S. Thorhallsson, and K. Ragnars

(This article has been excerpted from "Status of Geothermal Electric Power in Iceland 1980," a chapter from the Electrical Power Research Institute Report AP-2098, Proceedings of the Fifth Annual Geothermal Conference and Workshop.)

Most of Iceland's high-temperature geothermal areas (19 known and 9 potential hot water fields) are in the active volcanic rift zone crossing the country from the southwest to the northeast. Water temperatures in the areas range between 200°C to 350°C. About 3,500 Megawatts of electricity can be produced for about 50 years from these areas, about 3,000 of which would be from the 19 known areas.

Icelandic high-temperature geothermal development began in 1944 when a steam-driven engine with a generator was first installed in the Hengill area near Hveragerdi. By 1946, a steam turbine system capable of generating 35 kilowatts of electricity had been installed in the field. In 1947, this unit was replaced with a much larger diesel generator.

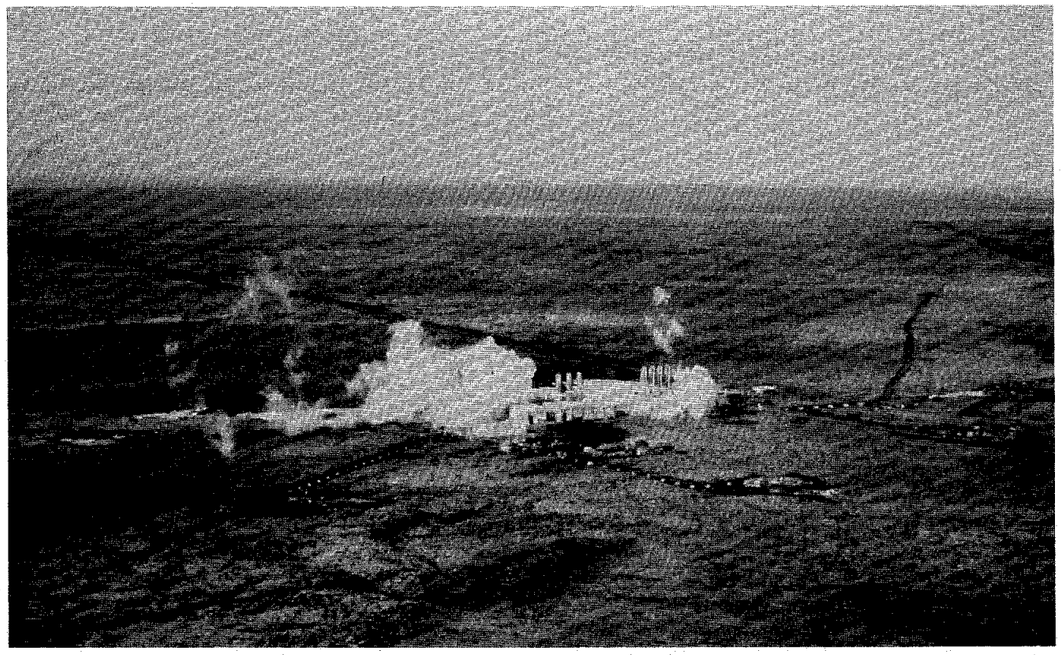
Today, there are three geothermal electric power plants in Iceland, at Namafjall and Krafla in the northeast and at Svartsengi in the southwest.

Drilling in the Namafjall area began in 1963. In 1966, the first production well was drilled that supplied steam to a 3 MWe electrical power plant and to a diatomite processing and drying plant (commissioned in late 1967).

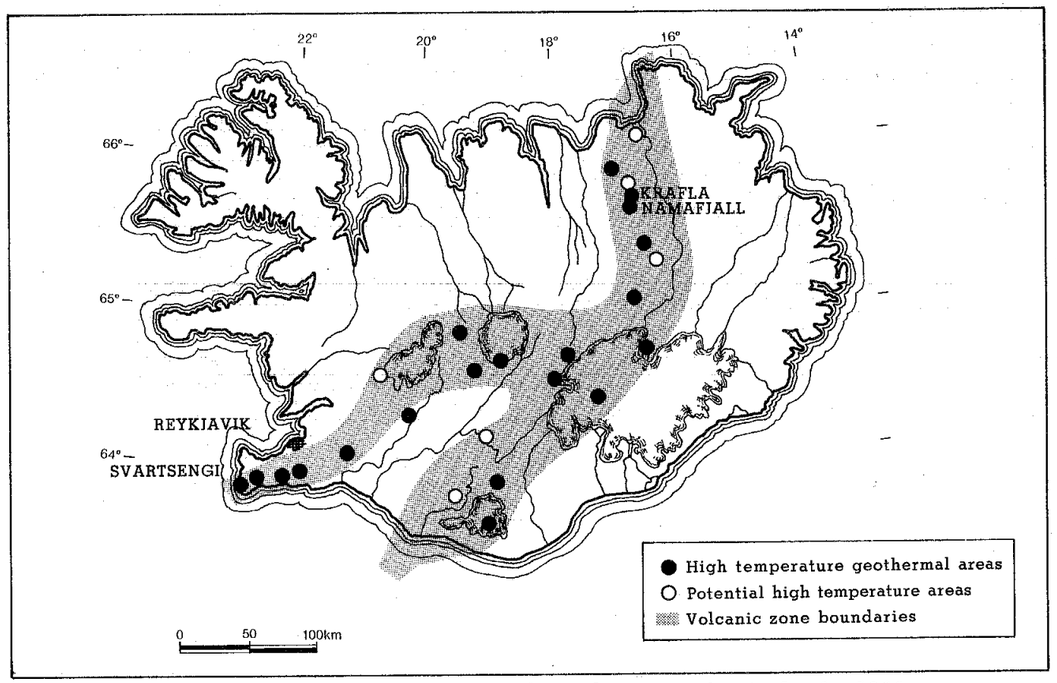
The Krafla power station is Iceland's first major geothermal electrical power project. Originally, the station was to have two 30 MWe turbine generators, but only one has been installed. The station has never operated on full load because sufficient high-pressure steam has not been available. The plant's maximum load varies between 11 and 12 MWe.

In December 1975, a volcanic eruption occurred about 2km from the Krafla station. The eruption was the beginning of a rifting episode in the fissure swarm intersecting the Krafla caldera. During the last 5 years, there have been 12 rifting episodes, 6 of which have resulted in volcanic eruptions. The magmatic activity has influenced the production characteristics of the Krafla geothermal field and is responsible for many operational difficulties at the power station. This volcanic activity continues today, and an interesting article on the topic is in the January 1982 issue of Smithsonian magazine.

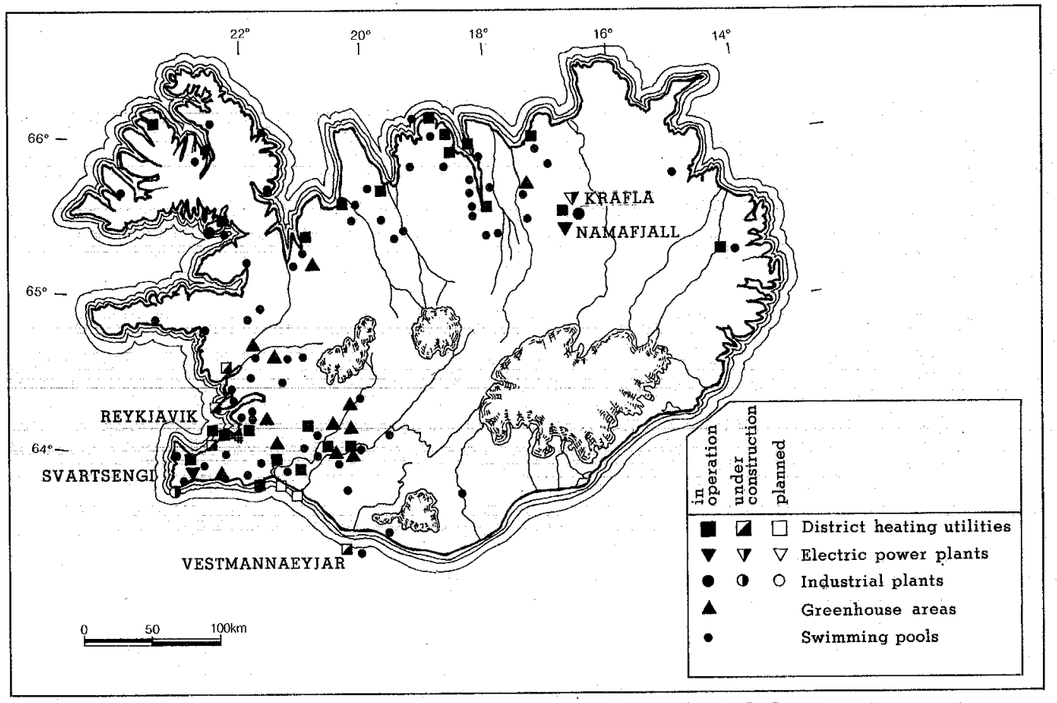
The main purpose of the co-generation power plant at Svartsengi is to produce hot water (50 MW-thermal) for district heating in the Sudurnes region on the Reykjanes peninsula. Some electricity (8 MWe) generated at the power plant is used to operate the plant itself, and some is added to the electric grid. In a novel heat exchange process, geothermal brine is used to heat fresh water to temperatures suitable for district space-heating.



Iceland's first geothermal co-generation plant, at Svartsengi. Here, high-temperature geothermal brine is used to produce 50 Megawatts-thermal of hot water used for district heating purposes and to generate 8 Megawatts of electricity. Many more co-generation facilities of this type may be built. The Atlantic Ocean is on the horizon. Pipelines and roads to wells radiate from the power plant. Photo by J. S. Gudmundsson.



Known and potential high-temperature geothermal energy in Iceland, 1980. Adapted from EPRI report AP-2098.



Utilization of geothermal energy in Iceland, 1980. Adapted from EPRI report AP-2098.

At Svartsengi, there is a disposal problem. The geothermal brine from the low-pressure separators is supersaturated with silica that polymerizes quickly into colloidal silica that gradually seals the surface lava in the disposal pond. Therefore, the size of the disposal pond increases quite rapidly. Plans are made to inject the waste brine and condensate at the field.

Information on a paper, "Corrosion in Icelandic High-Temperature Geothermal Systems," is included in the Publications section of this issue. Three other papers, "The Krafla Project: Technical Features and Operating Experience" by E. T. Eliasson et al., "A Resistivity Survey on the Plate Boundaries in the Western Reykjanes Peninsula, Iceland," and "Geophysical Reconnaissance Study of the Hengill High-Temperature Geothermal Area, SW-Iceland" by Axel Bjornsson and Gylfi P. Hersir, are available from the Geothermal Resources Council as part of Transactions, Volume 5. $30.00. Write the GRC, P.O. Box 98, Davis, California 95617.

Icelandic Low-Temperature Geothermal Development

by Jon Steinar Gudmundsson

(This article has been excerpted from "Iceland," a chapter in the World Survey of Low-Temperature Geothermal Energy Utilization by Jon Steinar Gudmundsson and Gudmundur Palmason, prepared for the Technical Panel on Geothermal Energy of the Preparation Committee for the United Nations Conference on New and Renewable Sources of Energy 1981, and printed in Reykjavik in April 1981.)

Iceland's two main low-temperature geothermal resource areas are in the southern and western portion of the country, on the edges of an active volcanic zone that crosses the country from the southwest to the northeast. However, other low-temperature areas occur, as well. Water temperatures in Iceland's low-temperature areas generally do not exceed 150°C in the uppermost 1000m.

Low-temperature geothermal energy used in district heating projects is the principal use of geothermal energy in Iceland. Such projects were begun in 1930 in Reykjavik, Iceland's capital, and have expanded, until today, about 70 percent of the Icelandic population of 226,724 (1979) people enjoy geothermal district heating. By 1986, the figure should increase to 80 percent.

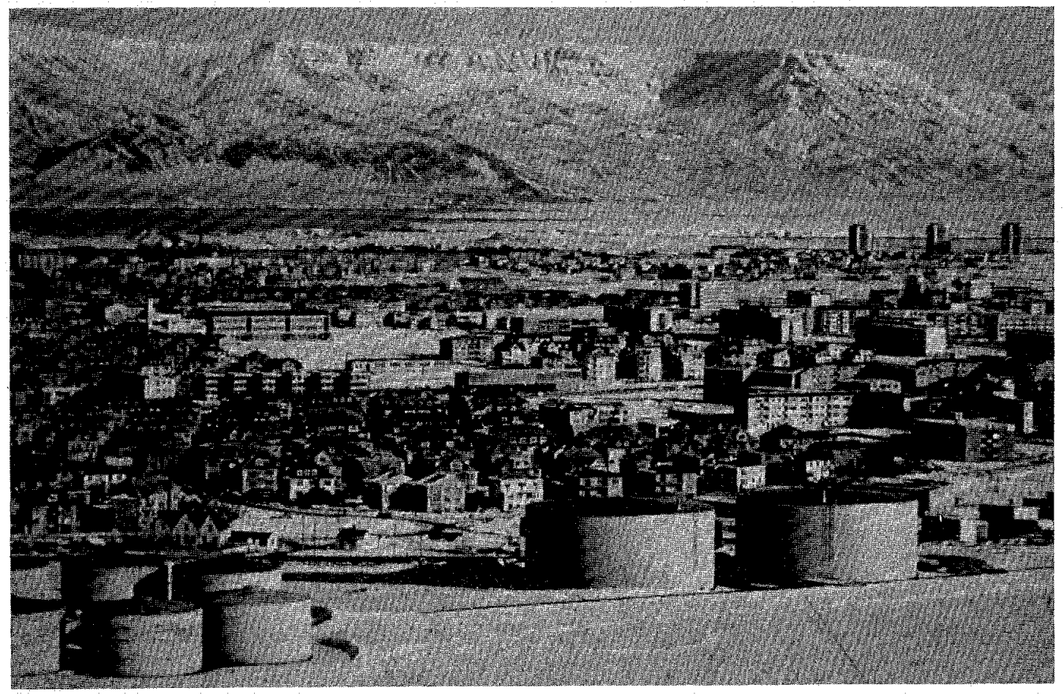
The Reykjavik District Heating Service (RDHS) is probably the world's largest district heating system to use geothermal water. Through the system, geothermal water heats homes and all commercial and industrial buildings in Reykjavik. In 1979, the total heated space was 22,388 square meters. The RDHS produces hot water from 3 geothermal fields, 2 within the City of Reykjavik and 1 in Mosfellssveit 15 to 20 kilometers away.

In 1979, 45,091,000 m^3 of hot water was pumped from underground reservoirs by the RDHS. About 91 percent of the production was sold to customers, and 8.7 percent was end-point waste used to maintain flow and temperatures. About 10 percent of the hot water delivered to customers is used as tap water.

In 1979, there were 24 publicly owned district heating services in Iceland and at least 6 privately owned services. Some of the publicly-owned services extract geothermal water from high-temperature geothermal fields such as the Sudurnes system in the Svartsengi field and the Reykjahlid system in the Bjarnarflag field of the Namafjall area. The Hveragerdi system is in the Olfusdalur field, south of the Hengill high-temperature area.

The district heating system in Vestmannaeyjar is unique in that its facilities are in a lava field formed from a volcanic eruption on the island of Heimaey in 1973.

Icelandic low-temperature geothermal resources are used for many projects



Hot water holding tanks, Reykjavik, Iceland.

besides district heating. In January 1980, 145,000 m^2 in commercial greenhouses were heated geothermally. Many home greenhouses are heated with geothermal energy, as well.

Geothermal water is used in nine fish culture stations where salmon smolt and young trout are reared. The seaweed-drying plant at Reykholar is the main use of low-temperature geothermal energy for industrial processing.

Five main rigs with a drilling capability of up to 3,600 meters are used to drill Iceland's geothermal wells. All rigs are owned by Orkustofnun, the National Energy Authority.

The estimated natural flow from Iceland's hot springs is estimated at 1825 l/s. The weighted average temperature of the hot spring water is 67°C.

The following papers on direct use of geothermal resources in Iceland are available in the publication Transactions, Volume 5, compiled by the Geothermal Resources Council: "The Cooling of the Selfoss Geothermal area, S-Iceland," "The Baer Thermal Area in Western Iceland, Exploration and Exploitation," and "Exploration and Exploitation of Low-Temperature Geothermal Fields for District Heating in Akureyri, North Iceland." Send $30.00 to the GRC, P.O. Box 98, Davis, California 95617.

Japan

Japanese Geothermal Development

Union Oil Company announced it has signed two joint-venture agreements to explore for and develop high-temperature geothermal resources on the Island of Hokkaido in Northern Japan.

A Union Oil Company subsidiary, Union Geothermal Japan, Ltd., will be the operator for the ventures undertaken with Japan Petroleum Exploration Company, Ltd., and Nissho Iwai Corporation.

Union will explore for high-temperature resources in two areas on Hokkaido.

Japanese Geothermal Energy Survey

A contract to conduct a nationwide aerial magnetic survey of Japan and surrounding oceanic areas for geothermal energy has been awarded by the Japanese government to two Japanese oil companies who have contracted with EG&G Geometrics, Sunnyvale, California to carry out the work.

The surveys, begun in May 1981, will be conducted over a 4-year period. From the survey data, subsurface temperatures can be mapped and areas identified with the highest potential for accessible geothermal resources.

The project is sponsored primarily by a newly formed Japanese governmental agency, the New Energy Development Organization, under the Japanese Ministry of International Trade and Industry.

Grants and Assistance

Geothermal Development Grant Program for Local California Governments

The California Energy Commission (CEC) received 42 pre-applications requesting $2.9 million in grant funds under its Geothermal Development Grant Program for local governments. $343 thousand will be disbursed during the first funding round. Both high-temperature and low-temperature projects are eligible for funds.

A technical advisory committee has reviewed the pre-applications, CEC staff have sent preliminary eligibility information to the applicants, and meetings are being held with local jurisdictions preparing final applications.

Final applications are due by April 15, 1982. Grants are expected to be awarded June 1982.

The second round in the grant award process is expected to begin late spring or early summer 1982. Contact Nancy Libonati, 924-2615, for further information.

A CEC publication, titled Geothermal Development Program, Direct Use Project Summaries, March 1982, is available. The publication summarizes resource assessment, technology feasibility, and demonstration studies. For a copy, write to CEC, Geothermal Energy Program, 1111 Howe Avenue, MS-66, Sacramento, California 95825.

Technical Assistance for Geothermal Direct Use and Small-Scale Electric Projects

Effective March 1982, the California Energy Commission will fund a program that offers technical assistance for geothermal direct use and small-scale electric projects under 5 MW in California. Under this program, the Geo-Heat Center at the Oregon Institute of Technology will provide in-field

technical support services to California geothermal developers and users through June 1982. The services include on-site investigations, consultations, and preliminary assessments of projects' engineering and economic feasibilities.

The assistance is free to qualified individuals and organizations involved with geothermal direct use or small-scale electric development in California. If you are interested, call or write Michael Smith, Geothermal Technical Assistance Program Manager, California Energy Commission, 1111 Howe Avenue, MS-66, Sacramento, California 95825, (916) 924-4894.

Legal

Geothermal Regulations Hearing

The California Division of Oil and Gas proposes to repeal, amend, and adopt various regulations in Subchapter 4 (Statewide Geothermal Regulations), Chapter 4, Title 14 of the California Administrative Code. These changes are designed to make the regulations consistent with the criteria set forth in Government Code Section 11349.1.

Written and oral statements relevant to the matter may be presented at a hearing on Wednesday, May 19, 1982, 1:00 p.m. to 3:00 p.m. at 1416 Ninth Street, Room 1320, Sacramento, California 95814. To be considered by the division, such statements must be received before 5:00 p.m. on that day.

A statement of the purpose of the proposed action, including any information upon which the division is relying, and a copy of the exact language of the proposed regulations may be obtained at/or before the hearing from the division.

For further information, contact Doug Stockton, (916) 323-1788.

CEQA Regulations Hearing

The California Division of Oil and Gas proposes to repeal, amend, and adopt various regulations in Division 2, (Implementation of the California Environmental Quality Act (CEQA) of 1970), Chapter 2, Title 14 of the California Administrative Code. The changes are designed to make the regulations consistent with criteria set forth in Government Code Section 11349.1.

Written and oral statements relevant to the matter may be presented at a hearing on Wednesday, May 19, 1982, 1:00 p.m. to 3:00 p.m., at 1416 Ninth Street, Room 1320, Sacramento, California 95814.

A statement of the purpose of the proposed action, including any information upon which the division is relying, and a copy of the exact language of the proposed regulations may be obtained at/or before the hearing from the division.

For further information, contact Bernd Beutenmuller, (916) 323-1788.

Summary of Pending Geothermal Legislation, California Legislature

by Trish de Levallos

Senate Bill 1373 (Presley)

The bill would allow the California Division of Oil and Gas to request a civil action in lieu of a criminal action against a person who violates or fails to comply with the laws relating to the drilling, operation, maintenance, and abandonment of oil, gas, and geothermal wells.

Assembly Bill 114 (Vasconcellos)
Chapter 998

The Budget Act of 1981 allowed for the encumberance of $2,000,000 for the Heber Binary Geothermal Demonstration Plant. A provision of the bill eliminates the appropriation from the 1981-1982 Budget.

Assembly Bill 476 (Bosco)
Chapter 19

The bill would authorize the state to cooperate with local government in mitigating impacts from geothermal development occurring near state-owned forest lands. As part of the program, the California Department of Forestry is authorized to sell 10 acres of Boggs Mountain Demonstration State Forest to the Middletown School District for a new school site.

Assembly Bill 828 (Bosco)

The bill would authorize the State Oil and Gas Supervisor to exempt from certain permitting requirements, low-temperature geothermal wells used domestically or in a noncommercial manner.

The bill would require 50 percent of revenues received by leasing indemnity lands for geothermal purposes to be deposited in the Geothermal Resources Development Account and 50 percent in the General Fund.

Assembly Bill 1616 (Rogers)
Chapter 741

Bill provisions include: eliminating provisions permitting bonds issued by the U.S. or the State of California to be filed in lieu of specified indemnity bonds; extending the period of time in which certain reports or notices must be filed; and revising the penalties imposed for nonpayment of certain charges levied and assessed by the Department of Conservation.

Change at the U.S.G.S.

The U.S. Geological Survey office of the Deputy Regional Manager for Geothermal Energy has left the U.S.G.S. to become part of the Minerals Management Agency (MMA). The MMA is a separate, bureau-level agency created within the U.S. Department of the Interior.

Natomas-Magma Merger

On February 5, 1982, over 90 percent of shareholders of Magma Power Company of Los Angeles, California voted in favor of a proposed merger with Natomas Company.

The acquisition of Magma Power by Natomas will double the company's interest to 50 percent in The Geysers Known Geothermal Resource Area. Natomas plans to spend most of its 1982 geothermal budget for increased development at The Geysers.

New Geothermal Tax in Sonoma County

Voters in Sonoma County decided to impose a 6 percent tax on publically-owned utilities generating electrical power within the county. These power plants are inside the limits of The Geysers Geothermal field.

In 1982, the tax is expected to yield $658,000 in county revenue and much more once construction of additional power plants by several public agencies is completed.

Previously, only privately-owned utilities, such as Pacific Gas and Electric Company, were taxed on geothermal plants they operated in the county.

Lake County Tax Proposed

An ordinance imposing a special tax on geothermally produced electricity will be on the June primary ballot in Lake County, California.

Voters will indicate whether or not the county should tax the gross market value of such electricity. If passed, the ordinance could raise an estimated $1.3 million annually per power plant for the county.

The tax would not be higher than 6 percent, and would be levied against state and federally-owned power plants, not plants owned by entities presently paying property taxes, such as Pacific Gas and Electric Company.

The tax must be ratified by a two-thirds majority of the voters.

Lake County School Payments Begun

According to an article in the Lake County Record Bee, Lake County, California, schools will receive $4,500 for every student with a parent working at least half time at geothermal power plants in the county operated by the California Department of Water Resources (DWR) and Occidental Petroleum, or for children with a parent working for companies servicing the plants.

The DWR contract does not include schools in Upper Lake and Lucern, whereas the Occidental contract includes all county schools and also includes payments for children of employees working in the steam field.

Dr. William Cornelison, Superintendent of the Middletown Unified School District, said he hoped similar contracts could be made with other power plant owners, including the Northern California Power Plant Agency and Pacific Gas and Electric Company.

The school districts will use the money for buildings, buses, and capital outlays.

Leases

Lease Sale Schedule as of 3/5/82

Lease sale dates are provided by the 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	Original Sale Date
Clifton AZ	03/17/82	08/?/79
Belknap-Foley Hot Springs/McCredie Hot Springs/ Summer Lake Hot Springs OR	04/20/82	07/06/78
Indian Heaven WA	04/20/82	03/19/79
Dunes/Ford Dry Lake/Glamis/Lake City-Surprise Valley/Wendell-Amadee/Little Horse Mountain/ Love Lady Ridge CA	05/?/82	06/?/79
Cove Fort-Sulphurdale/Crater Springs/ Monroe-Joseph/Navajo Lake/Roosevelt Hot Springs UT	05/11/82	05/11/82
Bodie/Coso Hot Springs/Saline Valley CA	05/25/82	06/?/79
Alvord/Crump Geyser/Klamath Falls/Summer Lake Hot Springs/Vale Hot Springs OR	06/15/82	06/15/82
Mineral Hot Springs/Poncha/Valley View Hot Springs CO	06/24/82	06/24/82
Beckwourth Peak CA	07/?/82	06/?/79
Knoxville/Lassen Hot Springs/Sespe Hot Springs/ Witter Springs CA	07/20/82	07/20/82
Castle Creek/Conda/Crane Creek ID	08/10/82	08/10/82

Socorro Peak NM	08/17/82	08/17/82
Breitenbush Hot Springs/Carey Hot Springs/ Mount Hood OR	08/24/82	07/?/78
Vulcan Hot Springs ID	09/07/82	09/07/82
Geysers-Calistoga/Mono-Long Valley/Salton Sea CA	09/21/82	09/21/82
Kennedy Hot Springs WA	12/15/82	12/15/82

Geysers-Calistoga and Glass Mountain Lease Sale Results

On February 18, $6.6 million in bids for geothermal leases in The Geysers-Calistoga and Glass Mountain KGRA's were opened by the California State Office of the U.S. Bureau of Land Management.

High bidder was Occidental Phillips Petroleum, which offered $523.51 an acre for Parcel No. 5 in the Glass Mountain KGRA, Siskiyou County.

Other parcels numbers, winning bidders, and per-acre bonuses, were:

No. 1, California Energy Company, $17.81
No. 2, Anadarko, $195.00
No. 3, Anadarko, $207.00
No. 4, Occidental Geothermal, $30.33
No. 5, Occidental Phillips Petroleum, $523.51
No. 6, No bid
No. 7, Union Oil, $505.00
No. 8, Union Oil, $201.10
No. 9, Occidental Phillips Petroleum, $395.55
No. 10, Union Oil, $151.05
No. 11, Union Oil, $402.23
No. 12,13, No bid
No. 14, China Lake Joint Venture, $7.18
No. 15,16,17, No bid
No. 18,19, Removed
No. 20, No bid
No. 21, Reading and Bates, $5.15

Sonoma County Geothermal Resources Lease

Aminoil U.S.A., Inc. of Santa Rosa was the apparent high bidder for the lease of geothermal resources from approximately 349 acres of state-owned reserve mineral lands in Sonoma County when the State Lands Commission opened bids January 8, 1982, in Sacramento.

Terms of the competitive lease sale were a fixed royalty of 12.5 percent of gross revenue, annual rental of $1 per acre, and the biddable factor was the highest percentage of net profits.

Aminoil U.S.A., Inc. which submitted the only bid for the lease of the state's mineral interest, bid 22.76 percent of net profits.

Mono County Lease Sales

A one-time windfall of $315,000 will go to Mono County in 1982 as a result of recent geothermal leasing activity. The lease sale, on 26,000 acres of Bureau of Land Management and Forest Service land, totaled $2.1 million. Leased land is between Mammoth Lakes and Long Valley.

Another 26,000 acre block is expected to be offered for lease in June by the Forest Service. The land is between Mammoth and Mono Lake.

Utah Lease Sale Results

The State of Utah, Division of State Lands, offered seven tracts of land totaling 6,207.96 acres in four counties for geothermal steam leasing. The final filing date was February 19, 1982.

Only two of the leasing units were bid on, No. 158 with 674.52 acres and No.

159 with 640 acres, all Beaver County land. Union Oil Company was sole bidder for both units, offering $2139.75 for No. 158 and $2028.80 for No. 159. The company was awarded both leases.

The Utah State Land Office is at 3100 State Office Building, Salt Lake City, Utah 84114, (801) 533-5381.

Nevada First in Geothermal Leases

"Nevada ranks first among the western states on the number of geothermal leases held on public land," Bureau of Land Management, (BLM) Nevada Director Ed Spang announced.

The state includes 44 percent of the total acreage leased in the west for geothermal potential.

The BLM completed sales of 10-year leases for Known Geothermal Resource Areas in the Brady and Hazen Hot Springs area, Dixie Valley and Elko in the fall of 1981.

Spang said no bids were received on geothermal areas at Monte Neva, Salt Wells, and Wabuska. Since these areas were offered for bid before, the BLM will ask the Geological Survey to declassify them as KGRA's.

Colorado Lease Sale

The Colorado State Office of the Bureau of Land Management has scheduled a geothermal lease sale during fiscal year 1982. This sale will cover all lands within Colorado classified by the U.S. Geological Survey as being within a known geothermal resource area (KGRA).

Since the office has not sponsored a geothermal sale since 1977, it would like to develop a list of companies interested in receiving the sale announcement.

If your company would like to be on the mailing list for geothermal lease sales conducted in Colorado, please notify the office. If you wish to be included in the mailing for the sale scheduled for 1982, the notification should be received by April 1, 1982. Send all notifications to the Bureau of Land Management, Colorado State Office, 1037 20th Street, Denver, Colorado 80202.

Courses

(Editor's Note: The Hot Line would like to publish information on other geothermal programs and courses. If you have such data, contact Susan Hodgson, the Division of Oil and Gas.)

Stanford Geothermal Program

The Stanford Geothermal Program, founded by Professor Henry J. Ramey, Jr., Chairman of the Stanford Petroleum Engineering Department and Professor Paul Kruger of the Civil Engineering Department, is funded through a $1.35 million U.S. Department of Energy grant. The grant was extended in October 1981 for 3 years.

Stanford geothermal research concentrates on reservoir engineering. Researchers study how to assess the sizes of underground reservoirs and how to plan production strategies. Another goal of the program is to train engineers for employment in the geothermal industry.

The Stanford Geothermal Program is comprised of:

1) Research tasks - heat extraction from hydrothermal reservoirs, non-condensible gas reservoir engineering, and bench-scale experiments and well test analysis;

2) Cooperative research programs with Italy (Ente Nationale per l'Energia Electric) and Mexico (Instituto de Investigationes Electricas); and

3) Public workshops and seminars.

A course titled Geothermal Reservoir Engineering, is offered each winter quarter at Stanford by the Department of Petroleum Engineering. Three, 1 hour weekly meetings are held. Currently, the course is taught by Dr. Jon Steinar Gudmundsson and Dr. Roland N. Horne. Most course students are enrolled in degree programs, but some students, working in industry or government positions, come to Stanford only to take the course.

For a course syllabus, workshop or seminar information, or additional data on other parts of the Stanford Geothermal Program, write Dr. Jon Steinar Gudmundsson, Dept. of Petroleum Engineering, Mitchell Building, Room 360, Stanford University, Stanford, CA 94305.

Stanford Seminar Schedule

The Stanford Geothermal Program Seminar Schedule for Spring Quarter 1982 is as follows. The seminars are held on the Stanford University campus, Room 102 Terman Engineering Center, on Thursdays from 1:15 to 2:30 p.m. There is no charge.

April 8, "Geothermal Reinjection: The Department of Energy Program," Martin W. Molloy, Department of Energy.

April 15, "Reservoir Engineering Modeling of The Geysers Geothermal Field," Ronald Schroeder, BGI Consultants.

April 22, "Geology and Geothermal Systems of the Cascade Range," Charles R. Bacon and L. J. Patrick Muffler, U.S. Geological Survey.

April 29, "Characteristics of Wells in the Tongonan and Palimpinon Geothermal Fields, the Philippines," Anthony J. Menzies, KRTA Consultants.

May 6, "Geochemical Characteristics of the Reservoir Conditions at the Coso Geothermal Prospect," Robert O. Fournier, U.S. Geological Survey.

May 13, "Regulating Geothermal Resource Development: The Need for Earth Scientists," William F. Isherwood, U.S. Minerals Management Service.

May 20, "Geology and Reservoir Engineering of the Beowawe Geothermal Area, Nevada," Robert W. Butler and I. Jerry Epperson, Chevron Resources Company.

May 27, "Mini-symposium on Geothermal Activities at the Institute of Electrical Investigations in Mexico," Eduardo R. Iglesias, Sergio Mercado, and David Nieva, IIE, Mexico. TIME CHANGE: 1:15 - 4:15 p.m.

Where to Look in Government

Tapping your Government's Information Sources, Washington and Sacramento, is the title of a 1-day seminar offered through the Lifelong Learning U.C.-Berkeley Extension program.

The seminar will be taught by Matthew Lesko, M.B.A., Chairman and Founder of Washington Researchers, and Jack Leister, M.L.S., Head of Information Services, Institute of Government, U.C.-Berkeley.

The seminar will be held on May 14, 1982, 9 a.m. to 4:30 p.m., Sheraton-Palace Hotel, Market and New Montgomery Streets, San Francisco. Cost $260.00, including three publications:

Researchers Guide to Washington (600 pages; subject-indexed federal telephone and address directory covering over 20,000 major offices and a directory of over 2,500 federal data experts);

Washington Information Workbook (major data sources of federal departments and agencies; federal document rooms; 43 public and private information clearinghouses; and

State of California Telephone Directory (list of state departments, agencies, and offices).

To enroll in the seminar, write Lifelong Learning, (USPS 312-500), University Extension, University of California, Berkeley, California 94720, or call (415) 642-4111.

Geothermal Resources Council

Throughout the years, many workshops have been offered by the Geothermal Resources Council (GRC) on geothermal topics.

On May 24-26, the GRC has scheduled a "Workshop on Geothermal Drilling and Completion." The workshop will be held in Reno, Nevada, at the El Dorado Hotel and emphasize drilling, hardware, and support services. $325.00 members; $340.00 nonmembers.

On June 14-16, 1982, a conference on Small-Scale Geothermal Power Plants will be held in Long Beach on the Queen Mary. Members $325, nonmembers $340. Rooms are $50 a night.

On August 27 and 28, the GRC will sponsor a 2-day workshop, "Fractures in Geothermal Reservoirs," held in conjunction with the Circum-Pacific Energy and Mineral Resources Conference, sponsored by the American Association of Petroleum Geologists at the Hilton Hawaiian Village Hotel, Honolulu, Hawaii.

In January 1983, a 2-3 day meeting will be held on Economics and Financing of Geothermal Development.

For further information, contact the Meetings Department, Geothermal Resources Council, P.O. Box 98, Davis, California 95617, (916) 758-2360.

United Nations Sponsors Geothermal Training

The United Nations and the U.N. agencies sponsor geothermal training programs in four countries: Italy, Japan, New Zealand, and Iceland. There are three types of programs: a diploma course at the University of Auckland, New Zealand, sponsored by UNDP; comprehensive, group oriented courses at Kyushu University, Fukuoka, Japan and at the International Institute for Geothermal Research, Pisa, Italy, both sponsored by UNESCP; and practical training courses in specialities developed for individuals at the National Energy Authority of Iceland, in cooperation with the University of Iceland, Reykjavik, sponsored by the UN University. The courses are offered to citizens of developing countries.

By the end of 1981, 54 students will have graduated from the New Zealand program over a 3-year period. About 15 scientists and engineers will have participated in the Icelandic program over the same time.

In Iceland, participants receive highly specialized training for 6 months while working on projects with Icelandic specialists. The Icelandic program is funded almost equally by the Icelandic Government and the U.N. University. For further information on the Icelandic program, contact:

Dr. I. B. Fridleifsson
UNU/NEA Geothermal Training Programme
Geothermal Division
National Energy Authority
Grensasvegur 9
108 Reykjavik
Iceland

Apart from training programs, the U.N. has sponsored 20 geothermally related projects, costing $7.4 million, in many areas throughout the world. Among these are the geothermal plants at Ahuachapan in El Salvador, the Kenya project at Olkaria (see July 1981 Hot Line), and and projects in Ethopia, China, Mexico, Chile, and the Philippines.

The Ethiopian project is jointly financed by the Ethiopian government, the European Economic Community (EEC), and the United Nations Development Programme (UNDP).

The project involves exploratory drilling for geothermal energy in the southern Shoa-Sidamo regions of the Rift Valley. In a 2½-to-3-year period, 9 exploratory holes will be drilled in the lakes region and feasibility studies will be made.

Similar exploratory drilling will begin soon in the Tendaho area of the southern Welo region where surface studies are underway for selecting drill sites.

Some additional information on the U.N. geothermal program is in an article titled "U.N. Aiding Geothermal Development" in the October 1981 issue of Geotimes.

Conferences

International Conference on Geothermal Energy, Florence, Italy, May 11-14, 1982.

The meeting will provide an opportunity to discuss current geothermal technology and how it relates to future development. For information, write to Conference Organiser, Geothermal Energy Conference, BHRA Fluid Engineering, Cranfield, Belford MK43 OAJ.

Papers presented in the technical and poster sessions will be published in English in two bound volumes. A visit is being arranged to the Larderello geothermal electrical power plant on Saturday, May 15 (tickets on a first come-first served basis).

Fourth Symposium on the Cerro Prieto Geothermal Field, Guadalajara Sheraton, Guadalajara, Mexico, August 10-12, 1982.

A field trip to Los Azufres Geothermal field is scheduled for August 13 and 14.

For information, contact Ing. Alfredo Mañón, Coordinadora Ejecutiva de Cerro Prieto, C.F.E., P.O. Box 248, Calexico, California 92231; or Rubén Zelwer, University of California, Lawrence Berkeley Laboratory, Earth Sciences Division, Berkeley, California, 94729; (415) 486-5560; FTS 451-5560.

According to an article in Geotimes, "Geothermal Energy" by Charles Bufe, power is expected to be on line from Los Azufres field sometime in 1982. Surface studies continue at La Primavera, Araro, and Pathe fields, with deep drilling underway at La Primavera and Araro.

The first deep well drilled by the Comisión Federal de Electricidad in Los Humeros Caldera, east of Mexico City, resulted in a high-temperature well (252°C).

Third Circum-Pacific Energy and Mineral Resources Conference, American Association of Petroleum Geologists, Hilton Hawaiian Village, Honolulu, Hawaii, August 22-28, 1982.

For further information, contact the Conference General Chairman, J. Erick Mack, Jr., Union Geothermal Division, Union Oil Company of California, 461 S. Boylston Street, Los Angeles, California 90017. (213) 977-6336.

Geothermal Resources Council 1982 Annual Meeting, "Geothermal Energy: Turn on the Power," Sheraton Harbor Island Hotel, San Diego, California, October 11-14, 1982.

Keynote speakers will discuss geothermal exploration, field development, applications, and politico-economic climates. Optional field trips preceding and following conference. For further information, contact the Geothermal Resources Council, P.O. Box 98, Davis, California 95617, (916) 758-2360.

Pacific Geothermal Conference and 4th New Zealand Geothermal Workshop
University of Auckland, New Zealand, November 8-12, 1982

Annual workshop held as a concluding event for the 1-year course offered at the Geothermal Institute, University of Auckland under the joint sponsorship of the United Nations Development Program and the New Zealand Ministry of Foreign Affairs. For further information, write the Administrative Assistant, Geothermal

Institute, University of Auckland, Private Bag, New Zealand.

Some proceedings from former workshops are also available from this address.

A field symposium in Iceland is being planned for September 1983. The meeting will emphasize coastal and river morphology and hydraulics.

For information, write to Thorbjorn Karlsson, University of Iceland, Reykjavik, Iceland.

Computerized Data

Questions on Federal Geothermal Programs? Ask GRAD

GRAD is the Geothermal Resource Areas Database created in 1979 as part of the National Geothermal Progress Monitor System. GRAD contains data used to develop, monitor, and evaluate federal geothermal programs. Sixteen records with pre-lease, lease, and post-lease activities for each geothermal area are included in GRAD.

The GRAD system is publically available for retrieval and use. Winifred W. S. Yen and J. Dennis Lawrence of the U.C. Lawrence Berkeley Laboratory presented a paper on the GRAD system at the 1981 Geothermal Resources Council Annual Meeting.

New NEIS Data Base

The National Energy Information System (NEIS) Public Use Energy Statistical Data Base is available to government agencies and the general public.

The data base provides a quick means of locating and accessing 785 data series of EIA and non-EIA energy and energy-related data.

The data are organized in six sections: petroleum, natural gas, coal, electricity generation (utilities), energy indicators, and economic variables. The first four sections contain series that measure domestic resources, reserves, production, imports, exports, changes in stock levels, sales, and prices at various levels in the supply chain. Variables associated with end-use consumption characteristics are shown in the sections on energy indicators and economic variables. Depending on the time series, the data are available at the monthly, quarterly and/or annual frequencies.

A unique feature of the data base is the inclusion of explanatory documentation describing each time series, which includes the source of information, and the publications which contain the data.

Further plans include linking the data base to the Federal Energy Data Index (FEDEX), EIA's bibliographic data retrieval system, and enlarging the data series depending upon user needs and requirements and accessing the data base on-line in the National Energy Information Center at DOE's Forrestal Headquarters.

The Energy Data Base is available from the National Technical Information Service, Springfield, VA 22161, Order No. PB81-248510. The information contact for subscription prices is Stuart Weisman of NTIS, telephone (703) 487-4808.

Using Computers to Evaluate Mineral Resource Analysis

The tenth Geochautauqua on Computer Applications in the Earth Sciences was held October 23 and 24, 1981, in Ottawa. The meeting was sponsored by the Geological Survey of Canada, the International Association for Mathematical Geology, the International Geological Correlation Programme, and Syracuse University. The meeting theme was the use of computers for mineral-resource analysis.

Papers presented during the meeting will be published, in full, in the Journal of Mathematical Geology and the Journal of Computers and Geosciences.

Computerized Data Files

The following list of companies offering computerized data files is extracted from the third of a series of articles discussing computerized data useful to geologists. The initial article outlined the series and appeared in the October 1981 issue of the Explorer, a publication of the American Association of Petroleum Geologists (AAPG).

The second article discussed well data, scout data, and drilling history and was printed in the December 1981 issue of the Explorer.

The article from which the present data are extracted appeared in the January 1982 issue. (Firms offering Canadian files are mentioned in the article but omitted from the summary.) A statement is included by the AAPG with the material that says the mention of a company or contractor is not an endorsement by the AAPG or the AAPG Committee on Computer Applications to Geology concerning a computer system's capability or compatibility, data quality, accuracy, or content.

The fourth article in the series will list companies leasing and selling computer contouring software (programs).

Geological Correlation Data Files In The United States

Geological Computing Services (GCS)
J. William Vineyard
8204 Westglenn
Houston, Texas 77063
Phone: (713) 785-7900

The file currently has over 31,000 wells with approximately 650,000 proprietary tops. This file contains basically all wildcat wells and important field wells in the Mesozoic trend from the Rio Grande in Texas to the Panhandle of Florida.

Geomap/Peppard-Souders
Dave Eggleston
6001 Savoy
Houston, Texas 77036
Phone: (713) 972-1018
Fred Reed
802 Three Park Central
1515 Arapahoe Str.
Denver, Colorado 80202
Phone: (303) 893-5858

Currently the file contains approximately 43,000 wells and approximately 320,000 proprietary tops. The wells are located in the Rocky Mountains, West Texas, Texas Coast, Louisiana Coast, and Mississippi.

Tenroc Corp.
David Dominey
9015 Main, P.O. Box 467
Needville, Texas 77461
Phone: (713) 793-4115 - Rosenberg
(713) 342-8641 - Houston

This file was designed specifically to supply geological data on the Tertiary section of the Gulf of Mexico, Texas, Louisiana, and Offshore. The file contains approximately 27,000 wells with approximately 220,000 proprietary tops.

Exploration Graphics, Inc.
Jamie Thompson
1700 North Big Springs
P.O. Drawer 2478
Midland, Texas 79701
Phone: (915) 683-4771

This file was designed specifically for selective retrievals and computer mapping in the Permian and Delaware Basins of West Texas and New Mexico.

It contains approximately 24,000 wells with approximately 200,000 proprietary geological tops.

Geomasters, Inc.
Gerald C. Glaser and Andrew C. Jurasin
Northwest Atrium 11
7878 Grow Lane, Suite 22
Houston, Texas 77040
Phone: (713) 939-1166

This file was designed for the purpose of computer mapping using Tertiary micropaleo data offshore in the Gulf of Mexico--most of the data is from Louisiana wells. The file contains 1,500 wells with approximately 6,000 proprietary paleo tops; over 1,200 of these wells contain environmental data.

Lithology Data Files Containing Correlative Tops

The following major files are computerized lithology data obtained from well cuttings or sample log descriptions. Each of the files also contain correlative tops as a part of their system.

Permian Basin Sample Laboratory
R. Ken Carpenter, Business Manager
401 N. Colorado
Midland, Texas 79701
Phone: (915) 683-3363

American Stratigraphic Company
(AMSTRAT)
R. E. (Dick) Anderson, Vice President
6280 E. 39th Avenue
Denver, Colorado 80207
Phone: (303) 399-2746

Well History Files--With Scout Or Operator Tops

Petroleum Information Corp.
Paul A. Slattery, National Marketing Manager
4100 East Dry Creek Road
Littleton, Colorado 80122
P.O. Box 2612
Denver, Colorado 80201
Phone: (303) 740-7100

Of all the files discussed, this is the largest because the file contains over 1.2 million wells in the United States and is currently being increased with over 60,000 annually. The file contains an estimated 6.2 million tops.

Permian Basin Well Data System
Dick Teel, Chairman
Amoco Production Company
P. O. Box 3092
Houston, Texas 77001
Phone: (713) 652-4265

This is an historic file of all the wells drilled from 1900-1964 in the Permian and Delaware Basins of West Texas and New Mexico. It contains 165,000 wells with approximately 1 million geological tops.

Hotline Energy Reports
John L. Pate
70 West 6th Avenue, Suite 415
Denver, Colorado 80204
Phone: (303) 623-7130

Hotline, in cooperation with Munger Oil Information Service, Inc., is currently building a file of West Coast and Rocky Mountain data. The West Coast file is approximately 120,000 wells with approximately 100,000-120,000 tops. The Rocky Mountain file is currently 29,000 wells but by the end of 1982 will be approximately 160,000 wells; this file currently has about 300,000 tops.

Petroconsultants S. A.
J. Mark Lador
8-10 Rue Muzy, P.O. Box 228
1211 Geneva
Switzerland
Phone: Geneva 36-88-11

This is a computer well history file of approximately 25,000 foreign wells excluding the United States and Canada. Because of the highly confidential nature of foreign data, the system contains a limited number of geological correlations as reported by operators. 30,000 tops are reported in 4,400 of the 25,000 wells.

Maps

See Federal Documents in Sacramento

National Cartographic Information Center (NCIC) materials may now be seen in Sacramento at the new NCIC state affiliate office. The office, part of the California Resource Information System (C.R.I.S.), Department of Conservation, is at 717 K Street, Suite 224, Sacramento 95814, (916) 324-0847, and open Monday through Friday from 8 a.m.-12 p.m. and 1 p.m.-4 p.m.

(NOTE: The office may be moved to a nearby Sacramento location. After June 1982, call before visiting.)

NCIC is a focal point for learning where to obtain federal and California maps, charts, aerial photographs, catalogues, microfiche, films, digital elevation models (DEM), digital line graphs (DLG), and remotely sensed data.

Some indexes have national coverage, others cover only the Western Region (Oregon, Washington, Arizona, Idaho, Nevada, and California), and some just California.

Also the Catalogue of Environmental Resource Data, an inventory (with locations) of state-held resource data, may be accessed through the C.R.I.S. program.

Map showing mineral resource evaluation of 53 proposed wilderness areas, California. By Fraticelli and Albers. 1:2 million. Microfiche $.50; paper copy $3.50. Available from the California Division of Mines and Geology, P.O. Box 2980, Sacramento, California 95812.

Gravity map of California, Geologic Data Map No. 3. By Oliver et al. 1:750,000. Over the counter and by mail, folded, $5.00. By mail, rolled in a tube, $6.50. Bulletin 205, Interpretation of the gravity map of California and its continental margin, $6.50. Published by and available from the California Division of Mines and Geology, P.O. Box 2980, Sacramento, California 95812.

Oblique map of the Southern California Inner Continental Borderland. By Alpha. 1:340,000. Microfiche $.50, paper copy $1.75. Available from the California Division of Mines and Geology, P. O. Box 2980, Sacramento, California 95812.

40 new and revised official maps of Special Studies Zones in California delineated pursuant to the Alquist-Priolo Special Studies Zones Act are available. The maps are effective on January 1, 1982, and all newly drawn maps supersede prior editions.

For information on Official Maps of Special Studies Zones previously issued, and for provisions of the Alquist-Priolo Act, consult the 1980 Edition of California Division of Mines and Geology Special Publication 42, "Fault-Rupture Hazard Zones in California." $1.00. Published by and available from the California Division of Mines and Geology, P. O. Box 2980, Sacramento, California 95812.

Copies of the maps may be obtained or examined at offices of the affected cities or counties and at district offices of the California Division of Mines and Geology. Copies may be purchased from Blue Print Service Company, 149 Second Street, San Francisco, California 94105, (415) 495-8700.

Groundwater temperature map of Colorado. By Repplier, Relf, and Columbia. 1:1 million. $.75 a copy mailed, free over-the-counter. Published by and available from the Colorado Geological Survey, Room 715, 1313 Sherman Street, Denver, Colorado 80203.

Geologic map of the crater section of Haleakala National Park, Maui, Hawaii, by Gordon A. Macdonald. Miscellaneous investigation series 1-1088, U.S.

Geological Survey (1978). 1:24,000. 1 sheet, in color. 8-page text. $1.50. Reprint.

Published by and available from the Western Distribution Branch, U.S. Geological Survey, Box 25286, Federal Center, Denver, Colorado 80225.

Geophysical reconnaissance of prospective geothermal areas on the Island of Hawaii using electrical methods. By Kauahikaua and Mattice. Microfiche $3.50; paper copy $8.50. 66 pages. Available from the Hawaii Division of Water and Land Development, P.O. Box 373, Honolulu, Hawaii 96809.

North Dakota Geothermal Resources Map. Free. Available from the North Dakota Geological Survey, University Station, Grand Forks, North Dakota 58202.

Geothermal Resources of Washington (State). 1:500,000. Free. Available from the Washington State Energy Office, 400 East Union, Olympia, Washington 98504.

The map shows the locations of 338 wells with temperatures over 20°C (68°F); 60 thermal and mineral springs; heat flow values; KGRA's; and other data.

Distribution map of heat discharge by hot springs in Japan. By Kiyoshi Sumi. Cost unknown. Map Series 21, Geological Survey of Japan (1980), 1-3, Higashi 1-chrōme, Yatabe-machi, Tsukuba-gun, Ibaraki-ken, 305 Japan. 1:2,000,000. 1 sheet, in color. English and Japanese. Includes inset of Neogene tectonic provinces at 1:4,000,000.

World seismicity map. By A. Tarr., 1974, reprint. 1:39 million. $2.50, unfolded only. Published by and available from the U.S. Geological Survey, 169 Federal Bldg., 1961 Stout Street, Denver, Colorado 80294.

Videotapes

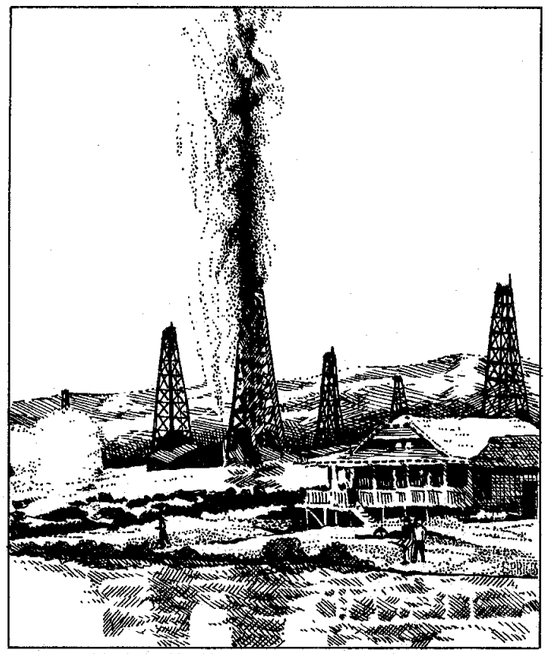
BOPE Videotape Available

Blowout Prevention Equipment Inspection Procedures of the California Division of Oil and Gas is the title of a new videotape produced by and available from the division.

Procedures used by division engineers to test most California oil, gas, and geothermal wells (excepting wells at The Geysers) are demonstrated with appropriate equipment and animated diagrams.

The videotape is based on division publication M07, Oil and Gas Well Blowout Prevention in California, which is being updated to include sections on geothermal wells and offshore oil and gas wells.

The 40-minute tape is available in 3/4-inch or 1/2-inch VHS format for $250.00. For further information, contact Susan Hodgson, (916) 323-2731.



Publications

Worldwide directory of national earth-science agencies and related international organizations. 1981. Circ. 834. By Bergquist, Tinsley, Yordy, and Miller. Free. 87p. Published by and available from Eastern Distribution Branch, Text Products Sections, U.S. Geological Survey, 604 South Pickett Street, Alexandria, Virginia 22304.

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Worldwide synthetic fuels and alternate energy directory P1162. $35.00. Published by and available from PennWell Directories, 1421 South Sheridan, Tulsa, Oklahoma 74101.

Lists over 1,500 companies involved in coal liquefaction and gasification, solar, geothermal, nuclear, oil shale, tar sands, heavy oil, and biomass. Project descriptions, personnel, and job titles are included.

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Geothermal resource base of the world: a revision of the Electric Power Research Institute's Estimate, LA-8801-MS. $8.00. Available from N.T.I.S., U.S. Dept. of Commerce, Springfield, Virginia 22161.

The report includes new estimates of the geothermal resources base for 107 countries.

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Resources for the 21st century: summary and conclusions of the International Centennial Symposium of the U.S. Geological Survey. By F. C. Whitmore, Jr. 1981. Circ. 857. Free. Published by and available from the Eastern Distribution Branch, Text Products Section, U.S. Geological Survey, 604 South Pickett Street, Alexandria, Virginia 22304.

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Satellite data users bulletin. Free. Available from the U.S. Department of Commerce, National Climate Center, Satellite Services Division, Washington D.C. 20233.

Lists contain all SEASAT SAR data (both optically and digitally correlated) that are currently on archive at the Satellite Data Services Division. Publication list and illustrations are included.

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Energy data contacts finder. Dept. of Energy, National Energy Information Center. 1981. Free. Available from U.S. Department of Energy, Energy Information Administration, National Energy Information Center, E1-20, Forrestal Building, Washington, D.C. 20585.

Names and telephone numbers of energy data contacts.

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DOE information services, 9/81. By the U.S. Dept. of Energy. Free. Published by and available from the Technical Information Center, P.O. Box 62, Oak Ridge, Tennessee 37830.

A thorough and useful resume of the many DOE Technical Information Center (TIC) information services available. A list of contacts to call for further TIC information has been included.

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EIA publications, new releases. Monthly. Free. Published by and available from National Energy Information Center, 1000 Independence Avenue, S.W., Washington D.C. 20585 (202) 252-8800.

Includes reports, periodicals, data files and data bases.

NOTE: By October 1982, the EIA computerized data base, FEDEX, will be expanded. At this time, users will not only be able to recall tables or graphs from EIA publications, but also to retrieve energy statistics from many other federal and state reports.

Most EIA publications are put on microfiche and are available to the public for $4.00 per fiche. To order, contact NTIS, U.S. Dept. of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

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American Society for Testing and Materials Publications Catalog. 1982. Free. Available from the ASTM, 1916 Race Street, Philadelphia, PA 19103. 65p.

The ASTM is a nonprofit organization that provides a management system in which producers, users, consumers, and government and academic representatives develop and publish "voluntary consensus standards."

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History of geology. 1978. 37 volumes-when purchased together, $1,151.00. Separate purchase possible. Printed by and available from Arno Press, A New York Times Company, Three Park Avenue, New York, N.Y. 10016.

Fields of study covered by volumes in this collection include seismology, mineralogy, paleontology, metallurgy, and geological theory.

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Books and bibliographies in the geosciences. Free. Published by and available from the American Geological Institute, Customer Service Dept., 211GT, 5205 Leesburg Pike, Falls Church, Virginia 22041.

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Geothermal energy employment and requirements 1977-1990. By Hannah and Mangum. DOE-1R-70004-1. $14.00 paper copy, microfiche $3.50. Available from the N.T.I.S., U.S. Department of Commerce, Springfield, Virginia 22161.

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Geothermal systems: principles and case histories. Edited by Rybach and Muffler. $61.95. Published by and available from Wiley - Interscience, 605 Third Avenue, New York, New York 10016.

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Hot dry rock geothermal energy development program for FY 1980. LA-8855-HDR. $13.00. Available from the N.T.I.S., U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161.

The report includes an analysis of geothermal resource potential for many areas in the United States.

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An article entitled "Environmental Control Technology Development for Geothermal Energy," by Gerald Katz, has been published in the October 1981 issue of the Journal, Water Pollution Control Federation.

Katz says that geothermal energy utilization provides a unique opportunity for development of environmental control technology before major environmental impacts occur. The state-of-the-art of control technology is accelerating and should offer geothermal energy a clean future.

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Every month, the Earth Sciences Division of Lawrence Berkeley Laboratory publishes reports describing the development of geothermal resources. For a free, up-to-date bibliography, write to Ms. Orah Goldman, U.C. Lawrence Berkeley Laboratory, Earth Sciences Division Reference Room, Building 90, Room 1070, Berkeley, California 94720.

One current LBL report is "Evaluation of well-to-well tracers for geothermal reservoirs, literature survey and laboratory work." Available from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161, August 1981, $11.00.

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E. G. and G. Idaho, Inc. has published 5 technology transfer reports in a series that will eventually include over 25 such reports. The reports will be distributed on a limited basis. For further information, contact E. G. and G. Idaho, Inc., P.O. Box 1625, Idaho Falls, Idaho 83415.

The 5 reports available are:

1. EGG-2137, Geothermal Source Potential and Utilization for Methane Generation and Alcohol Production.
2. EGG-2138, Geothermal Source Potential and Utilization for Alcohol Production.
3. EGG-2139, Potential Geothermal Energy Applications for Idaho Elks Rehabilitation Hospital.
4. EGG-GTH-5512, Aquaculture facility potential at Boulder Hot Springs, Boulder, Montana.
5. EGG-GTH-5599, A Preliminary Conceptual Design for Geothermal Space Heating Conversion of School District 50 Joint Facilities at Pagosa Springs, Colorado.

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Permit requirements for energy and other natural resources for:

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State	Open-file report No.	Microfiche	Paper copy
Alabama	OF81-1248	$3.50	$ 8.25
Alaska	OF81-1249	$3.50	$13.25
Arizona	OF81-1250	$3.50	$13.75
Arkansas	OF81-1251	$3.50	$10.50
California	OF81-1252	$3.50	$17.75
Colorado	OF81-1253	$3.50	$20.75
Idaho	OF81-1256	$3.50	$12.25
Illinois	OF81-1257	$3.50	$ 9.25
Kansas	OF81-1259	$3.50	$11.75
Louisiana	OF81-1261	$3.50	$10.25
Maryland	OF81-1262	$3.50	$ 8.00
Missouri	OF81-1265	$3.50	$ 8.75
Mississippi	OF81-1266	$3.50	$ 9.25
New Mexico	OF81-1269	$3.50	$ 9.00
New York	OF81-1270	$3.50	$ 9.50
Nevada	OF81-1271	$3.50	$ 8.75
North Carolina	OF81-1272	$3.50	$11.50
Ohio	OF81-1274	$3.50	$ 7.00
Oklahoma	OF81-1275	$3.50	$10.25
Oregon	OF81-1276	$3.50	$13.50
Pennsylvania	OF81-1277	$3.50	$13.50
South Carolina	OF81-1278	$3.50	$11.50

Tennessee	OF81-1280	$3.50	$ 9.00
Texas	OF81-1281	$3.50	$12.25
Utah	OF81-1282	$3.50	$12.25
Washington	OF81-1284	$3.50	$14.00
West Virginia	OF81-1285	$3.50	$ 6.00
Wyoming	OF81-1287	$3.50	$ 7.75

All reports published by and available from Open-File Services Section, Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, Colorado 80225.

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Conference summary report and list of participants for the Direct Heat Geothermal Workshop, held August 7, 1981, and sponsored by the California Department of Conservation. Free. Available from the California Department of Conservation, 1416 Ninth Street, Sacramento, California 95814.

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Commission decision on the Occidental Geothermal Inc. application for certification of the Oxy Geothermal Plant No. 1, No. P800-82-002. First copy free. Available from the California Energy Commission, Publications Unit (Address below).

Project status report No. 3, September 1981. 1 copy free. Subsequent copies $4.00. Published by and available from the California Energy Commission, Publications Unit, 1111 Howe Avenue, Sacramento, California 95825 (916) 920-6216. A list of publications also is available.

The report identifies and describes potential electrical generation projects in which California-investor-owned utilities, municipal utilities, local irrigation districts, and the State Department of Water Resources have either an ownership interest or an expectation of receiving energy.

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Water and Energy - DWR Update

Two publications by the California Department of Water Resources (DWR) evaluate water availability and energy.

One, The Availability of Water for Emergency Energy Technologies for the California Region, is a limited edition report with a lengthy chapter on "Geothermal Electrical Generation." The report may be read in the Water Resources Building, Room 252-14, in Sacramento. Contact Ralph Allison, DWR Statewide Planning Branch, Division of Planning (916) 445-2356, for details.

The second water/energy DWR publication will be available in the fall. It is a bulletin (No. 160-82) that will describe California water demands based on California Energy Commission energy data. There will be a charge for the publication, and inquiries may be sent to DWR, P.O. Box 388, Sacramento, California 95802.

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Geothermal potential of the Cascade Mountain Range: exploration and development. Special Report No. 10. Co-sponsored by the Geothermal Resources Council, Bonneville Power Administration, Washington State Energy Office, and Oregon Department of Energy. NSBN No. 0-934412-10-3. $12.00. Available from the Geothermal Resources Council, P.O. Box 98, Davis, California 95617.

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Volcanic stratigraphy and secondary mineralization of U.S.G.S. Pucci geothermal test well, Mount Hood, Oregon. By Gannett and Bargar. Open-file report OF81-1330. Microfiche $3.50, paper copy $3.50. 27 pages.

and

Data from geothermal test wells near Mt. Hood, Oregon. By Robison, Forcella, and Gannett. Open file report OF81-1002. Microfiche $3.50, paper copy $3.25. 26 pages.

Both reports published by and available from the Open-file Services Section, Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, Colorado 80225.

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Guides to some volcanic terranes in Washington, Idaho, Oregon, and Northern California. 1981. Circular 838. By David A. Johnston and Julie Donnelly-Nolan. Free. Published by and available from the Eastern Distribution Branch, Text Products Section, U.S. Geological Survey, 604 South Pickett Street, Alexandria, Virginia 22304.

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Publications, Nevada Bureau of Mines and Geology. 1982. Free. Available from the Nevada Bureau of Mines and Geology, Publications Office, University of Nevada-Reno, Reno, Nevada 89557-0088.

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The hydrothermal system in southern Grass Valley, Pershing County, Nevada. By Welch, Sorey, and Olmsted. Open-file report OF81-0848. Paper copy $28.50, Microfiche $4.00. 200 pages. Published by and available from the Open-file Services Section, Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, Colorado 80225.

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Colorado geothermal newsletter. Free. Available from the Colorado Geothermal Commercialization Project, Colorado Geological Survey, Room 715, 1313 Sherman Street, Denver, Colorado 80203

Information on Colorado geothermal potential and development.

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Current energy research in progress in Washington State, 1981, WADENG 81-13. The list of 428 projects may be ordered from Ginger Alexander, Librarian, Washington State Energy Office, 400 East Union, ER-11, Olympia, Washington 98504.

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The Arizona Geothermal Commercialization Team has concluded 4 years of evaluating Arizona's geothermal resources. Some of the team's activities will be continued by the University of Arizona and the Arizona Bureau of Geology and Mineral Technology.

Twenty publications by the geothermal team are available as open file reports at the Arizona Bureau of Geology and Mineral Technology, 1845 N. Park Avenue, Tucson, Arizona 85719 (602) 626-2733.

The reports must be reviewed in the office, but readers may make Xeroxed copies of the reports themselves.

In addition, Xeroxed report copies may be ordered from Alpha Graphics, Tucson, Arizona (602) 882-0410. The firm has one file copy of each report and will reproduce the reports for 4½ cents per page plus $5.00 for postage and handling.

Also available from the bureau, in March 1982, will be a bibliography titled Geothermal Resources in Arizona - A Bibliography (1867-1981). A fee, still not set, will be charged for the bibliography.

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Gravity and magnetic features and their relationship to the geothermal system in southwestern South Dakota. By Hildenbrand and Kucks. Open-file report OF81-1346. 48 pages. Microfiche $3.50, paper copy $6.00. Published by and available from O.F.S.S., Western Distribution Branch, U.S. Geological Survey, Box 25425, Federal Center, Denver, Colorado 80225.

Corrosion in Icelandic high-temperature geothermal systems. By E. T. Elisson and A. Einarsson. Paper to be presented on March 23, 1982 at CORROSION/82, the annual meeting of the National Association of Corrosion Engineers. Preprinted copies are available for $3.00 each from NACE Headquarters, P.O. Box 218340, Houston, Texas 77218.

The paper covers details of materials selection practices for Icelandic high-temperature geothermal systems. Especially emphasized is the corrosion test program recently undertaken at the Krafla geothermal power plant. (See Hot Line articles on Iceland in this issue.)

Other preprints, available from the same address for the same price, deal with many types of equipment corrosion in low-temperature and high-temperature wells.

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Address Correction: The correct address for Geothermal World is 5762 Firebird Court, Mission Oaks, Camarillo, California 93010. Available from this company are the Geothermal World Directory, a journal called Geothermal Energy, several geothermal publications, and audio visual materials. A free pamphlet titled "Resourceful Readings" describes these items.

California Wells

1981 Geothermal Well Statistics for California

(Excludes the following wells drilled on federal lands: temperature gradient wells, deep exploratory wells, and development wells at The Geysers Geothermal Field.)

Well Type	Meters Drilled
New wells	106,153
Reworks	2,130

Well Type	CDOG Notices to Drill	CDOG Notices to Rework	CDOG Notices to Abandon	Wells Drilled
Development	28	37	2	28
Service	49	6	0	1
Exploratory	18	19	6	13
Observation	25	0	181	116
TOTAL	120	62	189	158

Drilling Permits for Geothermal Wells Approved Sept.-Dec. 1981 by the California Division of Oil and Gas

Date Notice Received	Operator, Well No.	API No.	Sec.	T.	R.	Location, Elevation
Lake County						
9/25/81	Aminoil USA, Inc. "McKinley" 9	033-90423	26	11N	8W	Fr. SW cor. 663m N, 639m E. 661m GR.
12/2/81	Union Oil Co. of Calif. "Tocher" 2	033-90428	27	11N	8W	Fr. NW cor. 226m S, 280m E. 966m GR.

Date Notice Received	Operator, Well No.	API No.	Sec.	T.	R.	Location, Elevation
Sonoma County						
9/16/81	GRI Operator Corp. "Prati" 8	097-90519	35	12N	9W	Fr. SE cor. 770m N, 366m W. 663m GR.
10/13/81	Union Oil Co. of Calif. "DX State 4596" 63	097-90522	8	11N	8W	Fr. NW cor. 1051m S, 548m E. 1029m GR.
11/6/81	M-S-R Public Power Agency "Abril" 5B-1	097-90523	15	11N	9W	Fr. NW cor. 373m S, 557m E. 616m GR.
11/24/81	GRI Operator Corp. "Prati" 7	097-90524	34	12N	9W	Fr. NE cor. 397m S, 458m W. 702m GR.
12/2/81	Union Oil Co. of Calif. "DX State 4596" 64	097-90528	8	11N	8W	Fr. NW cor. 813m S, 287m E. 1029m GR.
12/2/81	Union Oil Co. of Calif. "D & V" 12	097-90529	33	11N	8W	Fr. SE cor. 318m N, 127m W. 859m GR.
12/2/81	Union Oil Co. of Calif. "D & V" 13	097-90527	33	11N	8W	Fr. SE cor. 321m N, 142m W. 859m GR.
12/10/81	Union Oil Co. of Calif. "Modini" 3	097-90532	27	11N	8W	Fr. SW cor. 67m N, 269m E. 997m GR.
12/10/81	Union Oil Co. of Calif. "Modini" 4	097-90531	27	11N	8W	Fr. SW cor. 76m N, 258m E. 997m GR.
12/31/81	Larry T. Durkan "SS" 3	097-90533	--	6N	6W	Fr. NW cor. Sec. 22 1350m S, 1030m W. 120m GR.
Lassen County						
9/24/81	Carson Development Co. "Johnston" 1	035-90065	2	29N	13E	Fr. NE cor. 640m S, 585m W. 243m GR.
Plumas County						
10/29/81	Charles W. Gadda "Sierra Valley" 1	063-90011	32	22N	15E	Fr. SW cor. 530m N, 843m E. 1487m GR.
Imperial County						
10/3/81	MCR Geothermal Corp. "Lacy" 1A-28	025-90501	28	14S	14E	Fr. NW cor. 91.4m S, 1008.9m E. -43m GR.
10/23/81	Union Oil Co. of Calif. "East Highline Unit" 2	025-90502	8	13S	16E	Fr. SW cor. 296m N, 23m E. -12m GR.
10/23/81	Union Oil Co. of Calif. "Veysey" 12	025-90503	16	13S	14E	Fr. SW cor. 109m N, 747m E. -43m GR.
10/23/81	Phillips Petroleum Co. "Truckhaven" 1	025-90504	7	11S	10E	Fr. NE cor. 63m S, 60m W. -20.9m GR.
12/5/81	MCR Geothermal Corp. "Lacy" 2-28	025-90505	28	14S	14E	Fr. NW cor. 896m S, 1020m E. -43m GR.

CDOG Well Data Available

A computer-generated file of geothermal production and injection statistics for wells with records open to public inspection is available from the California Division of Oil and Gas. All data are in metric units. The file may be purchased for $50.00 from the California Division of Oil and Gas in Sacramento.

Geothermal Well Records that May Be Copied in the Santa Rosa Geothermal Office

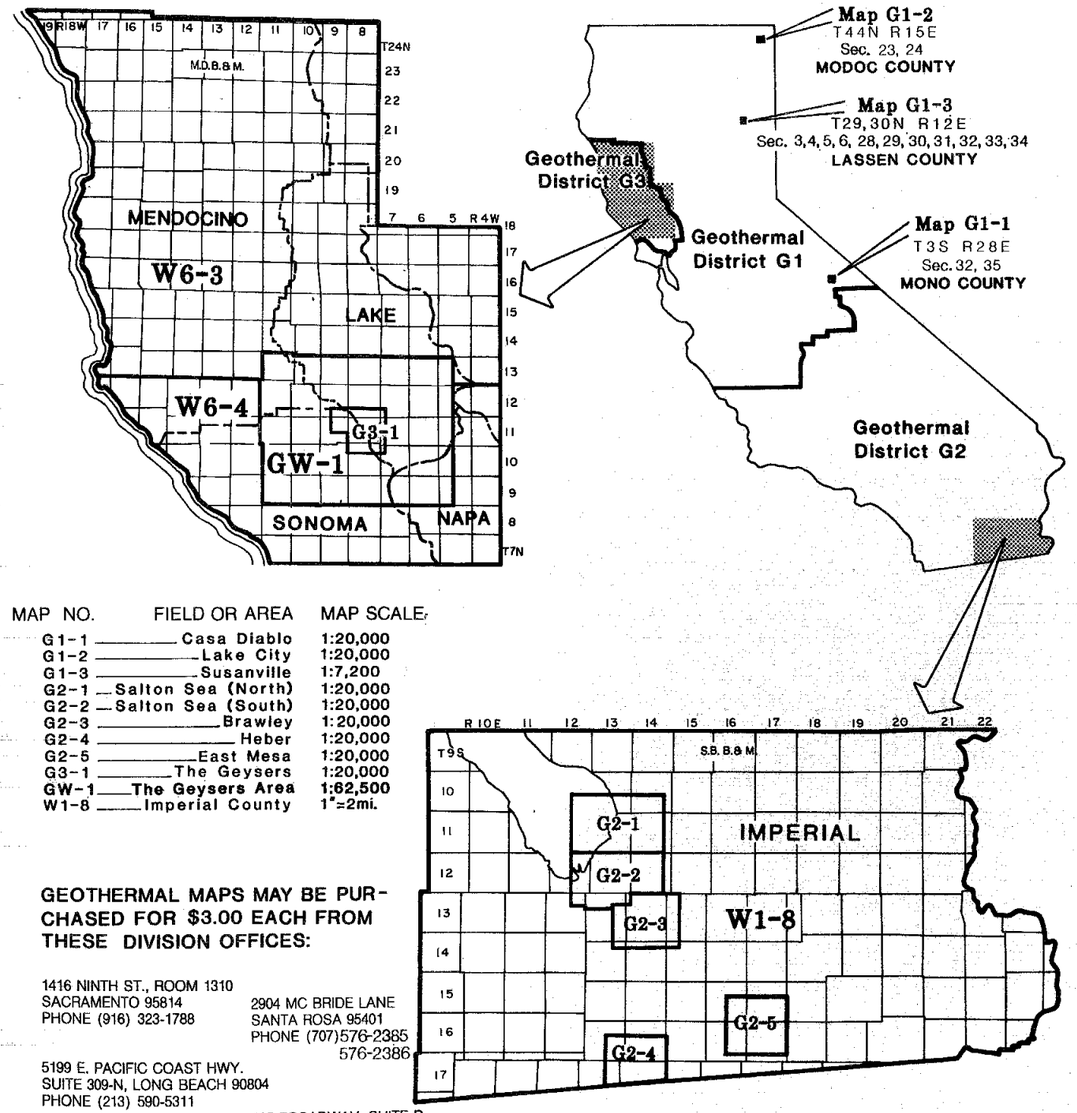
Well Designation	API Number	Sec.	T.	R.
UNION OIL COMPANY OF CALIFORNIA				
"Curry" 85-13	097-90008	13	11N	9W
"DX State 4596" 1	097-90009	18	11N	8W
"DX State 4596" 2	097-90010	18	11N	8W
"DX State 4596" 3	097-90011	18	11N	8W
"DX State 4596" 4	097-90099	7	11N	8W
"DX State 4596" 5	097-90012	7	11N	8W
"DX State 4596" 8	097-90014	18	11N	8W
"DX State 4596" 10	097-90015	7	11N	8W
"DX State 4596" 18	097-90156	6	11N	8W
"DX State 4596" 21	097-90144	18	11N	8W
"GDC" 32-13	097-90018	13	11N	9W
"GDC" 32A-13	097-90019	13	11N	9W
"GDC" 53-13	097-90020	13	11N	9W
"GDC" 66-12	097-90022	12	11N	9W
"GDC" 77-12	097-90023	12	11N	9W
"GDC" 85-12	097-90024	12	11N	9W
"GDC" 86-12	097-90025	12	11N	9W
"GDC" 88-12	097-90026	12	11N	9W
"Geyser Gun Club" 1	097-90031	11	11N	9W
"Geyser Gun Club" 2	097-90032	12	11N	9W
"Geyser Gun Club" 3	097-90128	11	11N	9W
"Geysers" I	097-90027	13	11N	9W
"Geysers" II	097-90028	13	11N	9W
"Geysers" III	097-90449	19	11N	8W
"Geysers" IV	097-90137	13	11N	9W
"Geysers" V	097-90138	18	11N	8W
"Geysers" VI	097-90029	13	11N	9W
"Geysers" VII	097-90422	13	11N	9W
"Geysers" VIII	097-90030	18	11N	8W
"Happy Jack" 1	097-90033	13	11N	9W
"Happy Jack" 2	097-90034	13	11N	9W
"Happy Jack" 3	097-90035	12	11N	9W
"Happy Jack" 4	097-90036	12	11N	9W
"Happy Jack" 5	097-90037	12	11N	9W
"Happy Jack" 6	097-90038	12	11N	9W
"Happy Jack" 7	097-90129	13	11N	9W
"Happy Jack" 7A	097-90039	13	11N	9W
"Happy Jack" 8	097-90040	12	11N	9W
"Happy Jack" 9	097-90041	12	11N	9W
"LF State 4597" 1	097-90044	20	11N	8W
"LF State 4597" 2	097-90045	20	11N	8W
"LF State 4597" 3	097-90109	17	11N	8W
"LF State 4597" 4	097-90136	20	11N	8W

Well Designation	API Number	Sec.	T.	R.
"LF State 4597" 5	097-90046	20	11N	8W
"LF State 4597" 6	097-90100	20	11N	8W
"LF State 4597" 8	097-90048	20	11N	8W
"LF State 4597" 9	097-90049	20	11N	8W
"LF State 4597" 10	097-90115	20	11N	8W
"LF State 4597" 11	097-90101	17	11N	8W
"LF State 4597" 12	097-90116	19	11N	8W
"LF State 4597" 13	097-90125	20	11N	8W
"LF State 4597" 14	097-90126	20	11N	8W
"LF State 4597" 15	097-90093	20	11N	8W
"LF State 4597" 16	097-90122	20	11N	8W
"LF State 4597" 17	097-90119	20	11N	8W
"LF State 4597" 18	097-90114	20	11N	8W
"Little Geysers" 2	097-90043	28	11N	8W
"Magma" 1	097-90050	13	11N	9W
"Ottoboni State 4596" 1	097-90051	18	11N	8W
"Ottoboni State 4596" 2	097-90052	12	11N	9W
"Ottoboni State 4596" 3	097-90127	7	11N	8W
"Ottoboni State 4596" 4	097-90053	12	11N	9W
"Ottoboni State 4596" 5	097-90054	7	11N	8W
"Ottoboni State 4596" 6	097-90055	7	11N	8W
"Ottoboni State 4596" 7	097-90056	18	11N	8W
"Ottoboni State 4596" 8	097-90057	7	11N	8W
"Ottoboni State 4596" 9	097-90091	7	11N	8W
"Ottoboni State 4596" 10	097-90089	1	11N	9W
"Ottoboni State 4596" 11	097-90113	12	11N	9W
"Sulphur Bank" 1	097-90058	11	11N	9W
"Sulphur Bank" 3	097-90060	11	11N	8W
"Sulphur Bank" 4	097-90061	11	11N	9W
"Sulphur Bank" 5	097-90062	11	11N	9W
"Sulphur Bank" 7	097-90064	12	11N	9W
"Sulphur Bank" 8	097-90065	13	11N	9W
"Sulphur Bank" 9	097-90066	13	11N	9W
"Sulphur Bank" 10	097-90085	12	11N	9W
"Sulphur Bank" 11	097-90086	12	11N	9W
"Sulphur Bank" 12	097-90087	13	11N	9W
"Sulphur Bank" 13	097-90067	13	11N	9W
"Sulphur Bank" 14	097-90068	12	11N	9W
"Sulphur Bank" 15	097-90069	12	11N	9W
"Sulphur Bank" 16	097-90070	12	11N	9W
"Sulphur Bank" 17	097-90071	12	11N	9W
"Sulphur Bank" 18	097-90072	12	11N	9W
"Sulphur Bank" 19	097-90073	12	11N	9W
"Thermal" 2	097-90075	13	11N	9W
"Thermal" 3	097-90076	18	11N	8W
"Thermal" 5	097-90077	13	11N	9W
"Thermal" 6	097-90078	13	11N	9W
"Thermal" 7	097-90079	13	11N	9W
"Thermal" 8	097-90080	13	11N	9W
"Thermal" 9	097-90081	13	11N	9W
"Thermal" 10	097-90082	13	11N	9W
"Thermal" 11	097-90083	13	11N	9W
"Thermal" 12	097-90124	13	11N	9W
"Thermal" 13	097-90103	13	11N	9W
"Thermal" 14	097-90104	13	11N	9W

Well Designation	API Number	Sec.	T.	R.
CORDERO MINING COMPANY				
"Torchio-Ferro" 1	045-90001	24	12N	10W
"Wilbur Hot Springs" 1	011-90001	29	14N	5W
E. B. TOWNE				
"Sullivan" 1	033-90012	18	12N	8W
EARTH ENERGY				
"Bradley Mining Co." 1	033-90006	5	13N	7W
"Bradley Mining Co." 2	033-90007	5	13N	7W
GETTY OIL COMPANY				
"Kettenhofen" 1	033-90013	28	13N	8W
HAWAII THERMAL POWER COMPANY				
"Clear Lake" 1	033-90008	5	13N	7W
MAGMA ENERGY				
"Magma-Watson" 1	033-90035	20	13N	8W
MAGMA POWER COMPANY				
"Wilbur Hot Springs" 1	011-90002	29	14N	5W
NORTHERN PLAINS PETROLEUM COMPANY				
"J. McGuire" 1	045-90002	3	18N	17W
"Union Lumber Co." 1	045-90003	2	18N	17W
SOUTHERN UNION PRODUCTION COMPANY				
"Davies" 1	033-90010	36	11N	8W
SULPHUR BANK GEOTHERMAL POWER COMPANY				
"Sulphur Bank" 1	033-90011	5	13N	7W
SUN OIL COMPANY				
"Macii-State" 1	045-90005	13	12N	10W
THERMOGENICS, INC.				
"Rorabaugh" 5	097-90003	14	11N	9W
"Bruno" 1	097-90142	14	11N	9W

(Geothermal well records that may be copied in the Headquarters and El Centro offices will be printed in the next Hot Line issue.

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
G3-1	The Geysers	1:20,000
GW-1	The Geysers Area	1:62,500
W1-8	Imperial County	1"=2mi.

GEOTHERMAL MAPS MAY BE PURCHASED FOR $3.00 EACH FROM THESE DIVISION OFFICES:

1416 NINTH ST., ROOM 1310
SACRAMENTO 95814
PHONE (916) 323-1788

2904 MC BRIDE LANE
SANTA ROSA 95401
PHONE (707)576-2385
576-2386

5199 E. PACIFIC COAST HWY.
SUITE 309-N, LONG BEACH 90804
PHONE (213) 590-5311

485 BROADWAY, SUITE B
EL CENTRO 92243
PHONE (714) 353-9900

TR02(4-82-DWRR-13C)

CALIFORNIA DIVISION OF OIL & GAS
1416 NINTH STREET, ROOM 1310
SACRAMENTO, CA. 95814