Land & Water Law Review

Volume 13
Issue 1 *The Geothermal Resources Development Institute*

Article 3

1977

Geothermal Leasing Practices

Gerald J. Kitchen

University of Wyoming
College of Law
LAND AND WATER
LAW REVIEW
VOLUME XIII 1977 NUMBER 1

The geothermal landman faces problems which are both similar and dissimilar to those faced by his counterpart in the petroleum industry in securing leases. After presenting an overview of geothermal resources and discussing some of the legal and practical problems faced in developing this resource which the landman should be aware of, Mr. Kitchen, describes a hypothetical land situation and offers suggestions for the leasing of the geothermal resources on the described premises.

GEOTHERMAL LEASING PRACTICES†

*Gerald J. Kitchen**

I. INTRODUCTION

In the past few years, although it has largely escaped public notice, the United States has become the world's largest producer of electrical power from geothermal resources.[1] Present production at The Geysers geothermal field in northern California is 502 megawatts of power,[2] or approximately the amount required to supply a city with 500,000 residents. Its sustainable yield has been estimated to be 2000 megawatts or more.[3]

Although present geothermal production amounts to only one percent of current nuclear capacity,[4] the United States Geological Survey has estimated that our domestic hydrothermal geothermal reserves might be sufficient to

†This article was originally published in the Rocky Mountain Mineral Law Foundation's Geothermal Resources Development Institute. Reprinted with permission.

*Vice President and General Counsel, AMAX Exploration, Inc., Denver, Colorado; B.S., 1962, University of Wyoming; M.S., 1963, Ohio University; J.D., 1971, University of California, Hastings College of Law; member of the California, Arizona, and Colorado Bars.

1. Dolan, *Fuels For Electricity — The Long-Term Trends And Geothermal, Financial Aspects of Geothermal Resources Development*, Geothermal Resources Council Short Course No. 4, Denver, Colorado (April 8-9, 1976) [hereinafter cited as GRC 4], at 4.
2. Greider, *Status of Economics and Financing Geothermal Energy Power Production*, GRC 4, at 7.
3. Koenig, Anderson & Huttrer, *Exploration and Development of Geothermal Resources in the United States, 1968-1975*, GRC 4, at 3 [hereinafter cited as Koenig].
4. Dolan, *supra* note 1.

match one-third of our present electrical generation capacity,[5] and the Energy Research and Development Administration speculates that 246,000 megawatts centuries of "exploitable" energy could be derived from identified geothermal resources.[6]

Regardless of how wide of the mark the foregoing estimates might be, it seems safe to predict that in light of the recent events which have so profoundly rocked the nation's energy self-confidence and stimulated the search for all forms of domestic energy resources, geothermal resources will be on the shopping list of energy companies engaged in that search.

For the person experienced in petroleum leasing, the acquisition of geothermal resources will present much that is familiar. There also will be much that is new, however.

Two of the principal problems facing the geothermal landman, which will be discussed below, are that no one is quite sure what the resource is and hence the question of who owns it is open to doubt. There is a third problem. Few prospective lessors have any understanding of the resource in general or any knowledge of how a geothermal development might impact their land. The effective geothermal landman must be able to cope with all of these problems.

This paper is divided into three parts. First, a general overview of the resource is presented. This is well-plowed ground,[7] and will be dealt with in detail at this Institute by Dr. Austin. To the extent the subject bears on leasing practices, however, it will also be treated in this paper. Second, some legal and practical problems involved in developing the resource will be discussed. Finally, a hypothetical land situation will be described and the author will make some suggestions for leasing geothermal resources on the described premises.

---

5. *Id.*
6. WESTERN GOVERNORS' REGIONAL ENERGY POLICY OFFICE, SPECIAL REPORT: GEOTHERMAL ENERGY PROSPECTS IN THE WESTERN STATES (1976), citing ERDA 76-1 Plan for Energy R, D, & D.
7. *See, e.g.*, Olpin, *The Law of Geothermal Resources*, 14 ROCKY MTN. MIN. L. INST. 123 (1968). Schlauch & Worcester, *Geothermal Resources: A Primer for the Practitioner*, 9 LAND & WATER L. REV. 327 (1974); Brooks, *Legal Problems of the Geothermal Industry*, 6 NAT. RESOURCES J. 511 (1966); Aidlin, REPRESENTING THE GEOTHERMAL RESOURCES CLIENT, 19 ROCKY MTN. MIN. L. INST. 27 (1974).

II. THE RESOURCE

Geothermal literally means the earth's heat. The energy produced from that earth heat is what the geothermal industry is all about.[8]

The earth's temperature gradually increases as one penetrates below the surface. In the Western United States, for example, temperatures normally increase approximately thirty-five degrees Centigrade per kilometer.[9] There are four geothermal phenomena which alter this normal thermal gradient and which bring commercially viable heat sources[10] closer to the surface of the earth. Only one of these geothermal systems — hydrothermal convective — has present commercial use,[11] and this paper will focus on this type of system.

A hydrothermal convective system has three essential components — heat, a liquid or steam reservoir, and a porous or fractured environment to permit circulation.

When located close to the surface of the earth this system presents the fewest problems for the energy producer. At The Geysers, for example, dry steam collected from wells averaging 2,300 meters[12] deep is fed directly into turbine generators which, in turn, produce electricity. In other areas, such as at Cerro Prieto, Mexico, hot brines constitute the geothermal medium. The geothermal manifestations of Yellowstone National Park are another example of this type of system.

As will be discussed below, the origins of these hydrothermal fluids may be of great legal significance to the party attempting to acquire the geothermal resources.[13]

Two other geothermal systems may eventually prove to have commercial potential — hot, dry rock systems and geopressured systems.

8. *See, e.g.*, Olpin, *supra* note 7, at 131; Schlauch & Worcester, *supra* note 7, at 331; Geothermal Kinetics, Inc. v. Union Oil Co., No. 75314 (Super. Ct., Sonoma County, Cal., Filed June 1, 1976) at 14.
9. Interview with Harry J. Olson, Managing Geologist, Geothermal Exploration, AMAX Exploration, Inc., in Denver, Colorado (July 12, 1976).
10. *Id.* In general, electrical power generation requires heat of approximately 200 degrees Centigrade.
11. *Id.*
12. Koenig, GRC 4, *supra* note 3, at 3.
13. *See* note 95, *infra*, and accompanying text.

High temperature rock structures possess only the heat element needed for a geothermal system — reservoir and circulation are missing. Nevertheless, experiments are underway[14] to determine if these systems can be exploited. It is believed that fracturing of these structures is possible using hydrofracturing techniques commonly used in oil and gas exploration. The geothermal medium could be provided by injecting water into the fractured structure from the surface. The resulting steam or hot water could be captured in the same manner as in the hydrothermal convective system — through wells drilled into the "reservoir."

Geopressured systems are low-salinity, lithostatically-pressured, hot water aquifers located principally along the Texas and Louisiana gulf coasts at depths between 10,000 and 15,000 feet.[15] Dissolved methane in recoverable quantities usually is found in these systems.[16]

The fourth phenomenon is magma — the molten rock underlying the earth's surface which is expelled during episodes of volcanic activity. Despite the fact that it reaches temperatures of up to 800 degrees Centigrade at the surface, no commercial uses have been made of this heat source.[17]

Although geothermal resources may be used for several purposes,[18] in the United States today the greatest emphasis is on use of the resource for the production of electricity — a use best met by a resource of high enthalpy (heat content).[19] "High enthalphy geothermal systems are known only in regions of youthful geologic phenomena, such as volcanism, crustal rifting, and recent mountain building."[20]

To the geologist the foregoing means that geothermal reservoirs usually[21] will be found in metamorphic and igneous

14. Los Alamos Scientific Laboratory is conducting studies near The Valles Caldera in New Mexico. GEOTHERMAL ENERGY PROSPECTS IN THE WESTERN STATES, *supra* note 6, at 15. *See also*, Koenig, GRC 4, *supra* note 3, at 3.
15. Formation pressures are approximately twice the pressures normally found at that depth. Greider, GRC 4, *supra* note 2, at 10.
16. *Id.*
17. Koenig, *Worldwide Status of Geothermal Resources Development*, in GEOTHERMAL ENERGY: RESOURCE, PRODUCTION, STIMULATION, (Kruger & Otte eds. 1973) at 15 [hereinafter cited as KRUGER & OTTE].
18. *See* note 26 *et seq.* and accompanying text, *infra*.
19. Koenig, in KRUGER & OTTE, *supra* note 17, at 15.
20. *Id.*
21. The Imperial Valley of California is an exception. There oil and gas geology and

formations, in contrast to the sedimentary basins in which oil and gas deposits usually are found. The fracturing of the rocks, essential for the circulation of the hydrothermal fluids, probably will be random in nature, and the reservoir is likely to be geologically complex, geometrically irregular and not susceptible to accurate delineation or definition.[22]

The driller will encounter in geothermal reservoirs a more difficult medium than is common in oil and gas fields. The higher temperatures and the fracturing and faulting may cause drilling costs to exceed by fifty percent those for an oil well of comparable depth.[23]

The landman should note the geology and attendant drilling difficulties and resist giving away offset well obligations in leases he is negotiating. A gratuitous concession on this point could impose substantial burdens on the lessee without returning a commensurate benefit to the lessor. At most it might be appropriate to impose on the lessee an obligation to drill if, in the judgment of a prudent operator, activities on adjacent lands, which have not been pooled or unitized with lessor's lands, are depleting reservoirs on lessor's lands.

Uses of Geothermal Resources

a. Uses Other Than Power Production.

Generation of electricity is not the only use of geothermal resources in the United States. The resource is used for space heating as well.

In Klamath Falls, Oregon, over 400 shallow wells serve an estimated 10,000 persons by providing low temperature water for heating residential and commercial structures.[24] The entire campus of the Oregon Institute of Technology in Klamath Falls is heated by one geothermal well,[25] a use that

drilling experiences are readily applicable to geothermal exploration. Interview with William M. Dolan, Manager, Geothermal Exploration, AMAX Exploration, Inc., in Denver, Colorado (May 20, 1976).

22. *Id.*
23. Total well costs at The Geysers range from $600,000 to $750,000. Cromling, *Geothermal Drilling Procedures And Costs*, GRC 4, *supra* note 1, at 3.
24. GEOTHERMAL ENERGY PROSPECTS IN THE WESTERN STATES, note 6, *supra*, at 7.
25. An additional well is on standby. A third is available for use on days the tempera-

saves the Institute an estimated $225,000 a year on its heating bills.[26]

Geothermal resources also are used for space heating and greenhouse heating in Boise, Idaho, Reno-Steamboat Springs, Nevada, and Susanville, California and the use of geothermal resources is being investigated for thermal fish farming in Paso Robles, California, and greenhousing in Lakeview, Oregon, and Calistoga, California.[27] Soil warming to extend growing seasons, evaporation in sugar refining, water desalination, absorption refrigeration, mushroom growing and process drying of various materials are other uses that have been suggested.[28]

Iceland has used geothermal hot water for municipal heating since the 1930's, and nine out of ten homes in the capital city of Reykjavik are so heated.[29] Geothermal waters reportedly have been transported twenty kilometers for this purpose.[30] The Icelanders also have in excess of 3,000 acres of greenhouse space heated geothermally.[31] Iceland's geothermal water generally are potable, and consequently are used for domestic purposes as well.

Potential alternative uses of geothermal distinguish this resource from others. The well that falls short of producing enough energy for generating electricity may produce enough energy for some other commercially viable use. These uses must be feasible in place, however, for heat loss makes it impractical to transmit the resource great distances. As noted above, it might be transported up from two to twenty kilometers or more for various uses. Thus a geothermal reservoir might have great commercial value for space heating if it is

ture drops below zero. Telephone interview with John W. Lund, Assistant Director, Geothermal Heat Utilization Center, Oregon Institute of Technology, Klamath Falls, Oregon (July 19, 1976).

26. *Id.* The wells heat 500,000 square feet of space at a per annum cost of five cents per sq. foot, or $25,000. It is estimated that heating by conventional fuels would cost $250,000 annually.
27. Koenig, GRC 4, *supra* note 3, at 4.
28. Lindal, *Industrial and Other Applications of Geothermal Energy*, UNESCO Conference on Geothermal Energy — Review of Research and Development, Paris, France (1973). *See also*, Long, Economic Utilization of Low-Temperature Geothermal Energy With Emphasis on Greenhouse Heating, Colo. School of Mines (Dec. 3, 1975) (unpublished thesis).
29. Koenig, in KRUGER & OTTE, *supra* note 17, at 35.
30. *Id* at 17.
31. GEOTHERMAL ENERGY PROSPECTS IN THE WESTERN STATES, *supra* note 6, at 7.

located near a populated area. A similar reservoir may have no value in a remote location.

The landman and the lawyer will serve their clients well by remembering that there might be an alternative to capping and sealing a $700,000 well that does not produce enough energy to generate electricity.

b. Power Production.

Geothermal resources are not valuable for power production unless they are available in sufficient quantities to provide the sole "fuel supply" for a power generating plant. The geothermal producer most likely will sell his production to a utility company, which will in turn construct the power plant and transmission systems. At The Geysers the smallest plant Pacific Gas and Electric Company presently will consider constructing is a fifty-five megawatts plant. Individual wells at The Geysers average production of 150,000 pounds per hour of dry steam, or seven and a half megawatts.[32] Assuming a twenty percent standby requirement, ten wells with demonstrated reservoir capacity sufficient to allow amortization of the plant (thirty years) will be needed before a utility company might be interested in constructing a plant.

The power generating capacity of the reservoir would have to be greater than that described above if the site is remote from the utility's area of service. An additional two megawatts of reservoir capacity (for a twenty to thirty year period) generally will be necessary to support the construction of each mile of transmission line required.[33]

Thus, after the initial successful well the geothermal producer is in much the same position as the hardrock miner who encounters one high grade hole. He has an exploration success, but not necessarily a commercial one. Five years or more may pass between discovery of a commercially valuable geothermal reservoir and power production.[34] During

32. Long, *Economics of Heat and Electricity From Medium Temperature Geothermal Reservoirs*, GRC 4, *supra*, at 1.
33. Hinrichs, *Utility Company Views of Geothermal Development*, GRC 4, *supra* note 17, at 2.
34. Greider, *supra* note 2, at 3. Regulatory or environmental delay could easily extend lead time to seven to ten years.

that time additional wells will be drilled, reservoir feasibility studies will be conducted and the utility will seek certification for plant construction. The producer must have the right to shut-in wells during this period of time, and he must be assured the lease cannot be terminated if production is delayed by environmental or utility certification problems.

The Environmental Impact of Geothermal Power Production

A detailed review of the captioned subject is beyond the scope of this paper. However, it is a subject of immense interest to lessors, so a brief discussion of the topic is appropriate.

a. Land Use and Subsidence.

The reader is aware from the foregoing discussion that geothermal resources must be used, if at all, where they are found. If those resources are to be used for power generation purposes, the plant should be less than one mile from the wellhead. Heat loss prevents transporting the resource greater distances.

At The Geysers plants of 110 megawatts capacity are sited approximately one mile apart.[35] Steam gathering lines ten to thirty-six inches in diameter connect the wells to the power plant. The lines are similar to those used in the petroleum industry except for certain modifications to accommodate the high temperatures and to lessen visibility of the lines, such as U-shaped expansion loops, insulation and camouflaging.

Use of lands for geothermal power production may require modification of existing terrain for access roads, well and plant sites. However, these uses need not preclude uses of the land for other purposes. At Larderello, Italy, farms, vineyards and orchards coexist with wells, gathering lines and power plants. Cattle graze at The Geysers.[36] The major impact occurs during construction of pipelines and power-

35. Bowen, Environmental Effects of Geothermal Energy Development, Circum-Pacific Energy and Minerals Conference, Honolulu, Hawaii (August 26-30, 1974) at 3.
36. *Id.* at 200. *See also* Bowen, *Environmental Impact of Geothermal Development*, KRUGER & OTTE, *supra* note 17, at 200.

plants and while wells are being drilled. Thereafter, aside from the narrow ribbons of land set aside for gathering lines and roads, the lands can revert to their historic uses.

Ground subsidence was cited by the Department of Interior in its Environmental Impact Statement for the geothermal leasing program as a potential problem. However, ground movement for a geothermal field has been reported only at Wairakei,[37] which is a hot water field, and this problem might be solved by injection to maintain reservoir pressure.[38]

Dry steam fields appear to be of constant pressure, regardless of depth, and the very existence of a dry-steam field may depend upon the presence of competent host rock, thus precluding subsidence in this type of system.[39]

b. Potential Impact on Water Resources.

There are two aspects of geothermal development which may impact on water use for non-geothermal purposes: decrease in supply or quantity of surface and ground water and deterioration of quality of surface and ground water.

At The Geysers there is no evidence that geothermal development has interfered with quantities of surface or ground water.[40] The court in *Geothermal Kinetics Inc.*,[41] noting that the chemical composition of the geothermal condensate makes the fluid so toxic it must be injected,[42] concluded that "the resource is separate and distinct from the . . . water systems which lie above it."[43] The court added that "the small amount of meteoric water which might enter the [geothermal] system from time to time would not materially deplete the general supply of sub-surface water which is available for use in the land."[44]

37. Axtmann, *Environmental Impact of a Geothermal Power Plant*, 187 SCIENCE 800 (1975).
38. Bowen, *supra* note 36, at 204.
39. *Id.*
40. UNITED STATES DEPARTMENT OF INTERIOR, 2 FINAL ENVIRONMENTAL STATEMENT FOR THE GEOTHERMAL LEASING PROGRAM, V-54 (1973) [hereinafter cited as ENVIRONMENTAL STATEMENT]. *See also*, Bowen, *supra* note 35, at 6.
41. *Geothermal Kenetics*, *supra* note 8, at 5.
42. *Id.* at 17.
43. *Id.* at 16.
44. *Id.* at 18.

In hot water fields withdrawal of geothermal fluids may deplete shallow aquifers. The demise of the Great Geyser and some thermal springs in the vicinity of the Wairaki plant in New Zealand has been noted since geothermal production began.[45] However, the hydrologic environment will determine in each case whether geothermal withdrawal will affect ground water supplies.[46]

The question of whether geothermal fluids will pollute waters used for other purposes also must be determined on a case-by-case basis. Discharge of untreated geothermal effluents into surface or shallow groundwater systems may have a substantial detrimental effect. However, injection of the waste water should eliminate most of the important adverse environmental impacts on water quality. This is the practice at The Geysers. In other instances, however, geothermal fluids will be potable. They are used for stock watering in Klamath Falls, Oregon, and for domestic hot water in Boise, Idaho, and in Reykjavik, Iceland.[47] In the latter cases discharge may have no adverse effect on water quality.

c. Potential Atmospheric Impact.

As geothermal steam exhausts from the turbine generator it is condensed for injection into the geothermal reservoir. During this condensation process as much as seventy-five percent[48] of the resource is released to the atmosphere. It is this release of steam which creates potential air quality problems through emission of non-condensable gases.

At The Geysers non-condensable gases constitute an average of less than one percent of the steam by weight.[49] Most of the non-condensable gas emissions do not present the threat of serious environmental impact.[50] Possible exceptions are hydrogen sulphide and ammonia, present in Geysers

45. Bowen, *supra* note 35, at 5.
46. *Id.*
47. Bowen, *Environmental Impact of Geothermal Development*, in KRUGER & OTTE, *supra* note 17, at 212.
48. *Id.* at 198.
49. Finney, *Design and Operation of The Geysers Power Plant*, in KRUGER & OTTE, *supra* note 17, at 148.
50. The primary constituent of these noncondensable gases (approximately 80 percent) is carbon dioxide. Lesser amounts of hydrogen sulphide, methane, ammonia, nitrogen, hydrogen and ethane also have been detected. A detailed chart is set forth in Finney's article. *Id.* note 49, at 148.

steam at 500 to 700 parts per million respectively.[51] Studies are presently underway to learn more about these constituents, their day-to-day variance, and their long range effects.[52] In addition, power plant scrubber technology is developing more effective means of removing these gases from steam emissions.

Evidence to date indicates that radon in geothermal areas does not exist in excess of natural background levels.[53]

d. Noise.

Noise can be a particularly acute environmental problem for limited periods of time during the development of a geothermal steam field. Air drilling, well testing and bleeding produce the greatest amount of noise.[54]

After wells have been allowed to blow unmuffled for a period of time to clean out accumulated rocks and other debris, they can be diverted through mufflers to lessen the noise. A muffled test well would produce noise of a level of 65 dB(A) at 1500 feet. By contrast, noise on a street corner in a large city would be at a level of 75 dB(A),[55] or approximately twice as loud. Mufflers are routinely being used on wells and plants at present, and work is continuing on improving their effectiveness.[56]

A final note on environmental matters. In general it is not necessary to address in detail environmental issues in leases. Environmental protection is increasingly becoming a matter of statute or regulation. A simple covenant that the lessee is bound by applicable environmental laws and regulations is all a lessor normally will require for his protection.

51. Letter from R.T.H. Collis, Director, Atmospheric Sciences Laboratory, Stanford Research Institute, to E. Dale Trower, AMAX Inc. (January 19, 1976).
52. For example, Dr. C. Ray Thompson, of the Statewide Air Pollution Research Center at the University of California, Riverside, is directing a National Science Foundation Study entitled Behavior of Hydrogen Sulphide in the Atmosphere and its Effects on Vegetation. Mr. Collis, *supra* note 51, is conducting an eight site hydrogen sulphide monitoring program for Pacific Gas & Electric Company at The Geysers.
53. Collis, *supra* note 51, at 6; Axtmann, 189 SCIENCE at 330; letter citing Stoker and Kruger, Radon in Geothermal Reservoirs, paper VI-42, presented at the Second United Nations Symposium on the Development and Use of Geothermal Resources, San Francisco, California (May 1975).
54. 2 ENVIRONMENTAL STATEMENT, *supra* note 40, at V-55. Table G-8 at V-56 is a comparison of noise levels between The Geysers area and other sources.
55. *Id.*
56. Bowen, *supra* note 35, at 6.

Geothermal Compared To Mining and Petroleum

Geothermal is a hybrid resource. It resembles oil and gas in certain respects and hard rock mining in others. The same is true of geothermal exploration and development practices and requirements. The following chart inventories and illustrates some of those similarities and differences.[57]

CATEGORY	INDUSTRY	
	Mining	Petroleum
Geologic Occurrence	0	
Hydrothermal Characteristics	0	
Alteration	0	
Geochemistry	0	
Geophysics	0	
Frequency of Viable Occurrences	0	
Prospect Size		0
Property Acquisition		0
Overall Exploration Costs		0
Exploration & Production Drilling		0
Production Engineering		0
Capital Requirements	0	
Expenditure Timing	0	
Development & Production Timing	0	
Productive Life	0	
Marketing	0	
Environmental Impact		0

The geothermal property acquisition scheme resembles that which might be encountered in a petroleum exploration project. Large exploration prospects are the rule. Property blocks of several thousands of contiguous acres are common. Exploration and production drilling are similar to petroleum practices too, although as pointed out above[58] drilling tends to be more difficult, and hence more costly, in a geothermal project.

Geothermal becomes readily distinguishable from petroleum practice[59] upon discovery, however. For, as in mining,

57. Olson and Dolan, Geothermal Energy — An Industry Appraisal, American Mining Congress Annual Meeting, San Francisco, Calif. (Sept. 30, 1975).
58. *See* note 23, *supra* and accompanying text.
59. Experience in the Arctic and offshore excepted.

the geothermal producer must have the demonstrable reserves to justify capital outlays necessary to construct power production and transmission facilities. Failure to locate adequate reserves leaves the geothermal prospector with an exploration success — but an economic failure.

Following discovery, and definition of an adequate reserve, the geothermal producer faces major capital expenditures for several years before he can expect to derive revenue from the project. Once he begins production, however, experience to date indicates the geothermal producer may expect the productive life of the resource to extend for decades.

III. LEGAL AND PRACTICAL PROBLEMS

There are threshold legal problems associated with geothermal leasing which are unique in the mineral resources industry. They illustrate both the scope and the complexity of the problems facing the geothermal landman. The first problem is one of definition.

The Search For A Definition

> The subject at hand involves a resource which is basically a gas. Or a liquid. Or a solid. In any case, it either is, or is not, a mineral.[60]

Remarkably, despite the fact that mankind has been producing electricity from the resource since 1904,[61] there is still widespread disagreement on the threshold issue of whether geothermal resources are minerals[62] or water.

Most states, and the federal government, define the resource broadly enough to encompass almost any possibility.[63] The state statutes, with minor variations, are patterned after

60. Address by George W. Abbott, Rocky Mountain Minerals Conference, Society of Mining Engineers of AIME, Salt Lake City, September 11-13, 1963 at 6, *citing* Note, Acquisition of Geothermal Rights, 1 IDAHO L. REV. 47, 52 (1964).
61. At Larderello, Italy. Koenig, in KRUGER & OTTE, *supra* note 17, at 21.
62. This matter is discussed in detail in Section III, *infra*.
63. Except for the dissolved methane which is expected to be found in most geopressured zones. "Hydrocarbon gas" is excluded from the federal and California definitions upon which most other definitions are modeled.

the federal definition[64] or the California definition.[65] States generally adopting the former are Arizona,[66] Colorado[67] and Texas.[68] Hawaii[69] and New Mexico[70] follow the general format of the latter.

In a bit of legislative overkill Alaska[71] and Oregon[72] use both definitions. Idaho,[73] Montana[74] and Washington[75] confront the unique nature of the resource by declaring it to be *sui generis*,[76] although Montana, apparently attempting to keep all bases covered, also includes "geothermal water" in the definition of water in its statutes.[77] In the Washington statute geothermal resources includes only that heat energy "from which it is technically practical to produce electricity commercially."

Wyoming has no geothermal statute. It includes the resource as "underground water" in the Wyoming Ground Water Act.[78] Utah treads even more cautiously. Its statutes are silent on the nature of geothermal. They simply provide that the resource will be regulated by the Division of Water Rights.[79]

While legislative bodies, through artful drafting, have generally managed to include geothermal, whatever it might be,

64. "Geothermal steam and associated geothermal resources means (i) all products of geothermal processes, embracing indigenous steam, hot water and hot brines; (ii) steam and other gases, hot water and hot brines resulting from water, gas or other fluids artificially introduced into geothermal formations; (iii) heat or other associated energy found in geothermal formations; (iv) any by-product derived from them." 84 Stat. 1566, 30 U.S.C. § 1001 (1970).
65. "§ 6903. For the purposes of this chapter, 'geothermal resources' shall mean the natural heat of the earth, the energy, in whatever form, below the surface of the earth present in, resulting from, or created by, or which may be extracted from, such natural heat, and all minerals in solution or other products obtained from naturally heated fluids, brines, associated gases, and steam, in whatever form, found below the surface of the earth, but excluding oil, hydrocarbon gas or other hydrocarbon substances." CAL. PUB. RES. CODE § 6903 (West Supp. 1976).
66. ARIZ. REV. STAT. § 27-651 (Supp. 1973).
67. COLO. REV. STAT. 34-70-103(6) (Supp. 1975).
68. TEX. REV. CIV. STAT. ANN., art. 5421s (Vernon) (Supp. 1976).
69. HAW. REV. STAT. § 182-1(9) (Supp. 1975).
70. N.M. STAT. ANN. § 7-15-2A (1974).
71. ALASKA STAT. § 38.05.181(q) (6) (Supp. 1973).
72. OR. REV. STAT. ANN. § 522.005(7) (Supp. 1975).
73. IDAHO CODE § 42-4002(c) (Supp. 1975).
74. MONT. REV. CODES ANN. § 81-2602 (Supp. 1975).
75. WASH. REV. CODE ANN. § § 79.76.030 and 040 (Supp. 1975).
76. ". . . being neither a mineral resource nor a water resource, but they are closely related to and possibly affecting and affected by water resources in many instances." MONT. REV. CODES ANN. § 81-2602 (Supp. 1975).
77. MONT. REV. CODES ANN. § 89-867(1) (Supp. 1975).
78. WYO. STAT. § 41-121(b) (Supp. 1975).
79. UTAH CODE ANN. § 73-1-20 (Supp. 1975).

within the ambit of their statutes, the courts have had a more difficult time of it. In two cases the issue of the nature of the resource — and hence its ownership — has been squarely joined.[80] The score is water — one; mineral — one.[81]

As a result of confusion created by all of the foregoing, the geothermal landman faces the ownership quandary. Who should sign the lease?

The Ownership Quandary

The Congress, in enacting the Geothermal Steam Act of 1970,[82] elected to pass along to the courts the question of establishing ownership of geothermal resources. The Act[83] directs the Attorney General to institute litigation to quiet the title of the United States in the geothermal resources if the Secretary of the Interior finds development of such resources is imminent on land in which the United States has reserved the mineral estate.

Litigation was instituted against Union Oil Company pursuant to this statutory directive in 1972. The court held that the reservation to the United States in the patent of "all coal and other minerals in the land"[84] did not include a reservation of geothermal resources. The patent passed fee title, the court said, not just the surface estate. What was reserved to the United States was "all coal and other minerals" and not the entire subsurface estate.[85]

Furthermore, the court noted that geothermal resources would not have come within the definition of "minerals" in 1916. The main constituent is superheated water (or steam), the court said, and "the authorities are convincing that water was not considered a mineral when § 9 was enacted, nor is water considered a mineral today."[86] It concluded as a con-

80. United States v. Union Oil Co. of California, 369 F. Supp. 1289 (N.D. Calif. 1973), *rev'd*, 549 F.2d 1271 (9th Cir. 1977); Geothermal Kinetics, *supra* note 8.
81. Courts also have held that steam is a gas for purposes of the percentage depletion provisions of the Internal Revenue Code. Reich v. Comm'r, 454 F.2d 1157 (9th Cir. 1972).
82. *See* note 64, *supra*.
83. 30 U.S.C. § 1020 (1970).
84. The land was patented to Union Oil's predecessor in interest under the Stockraising Homestead Act, Act of Dec. 29, 1916, 39 Stat. 862, 43 U.S.C. 291 *et seq*. (1965).
85. United States v. Union Oil Co., *supra* note 80, at 1293.
86. *Id.* at 1297.

sequence that the requisite congressional intent to reserve geothermal was absent.[87]

The court found comfort in administrative interpretations of the reservation, too. The Department of Interior had on several occasions expressed the view that geothermal resources were not minerals, that they were not subject to disposal by the United States under mineral disposition acts, that they were merely water, and hence that they were the property of the patentee.[88]

The decision of the trial court in *Union Oil* was appealed to the United States Court of Appeals For The Ninth Circuit. Oral arguments were heard in December, 1975. At this writing the court has not issued its opinion.

A California Superior Court was the forum for *Geothermal Kinetics*,[89] the second case involving the question of ownership of geothermal resources where a party other than the surface owner owned "all minerals." That court noted the holding in the *Union Oil* case, commented that "[t]he approach of the District Court appears to be oversimplistic,"[90] and held that geothermal resources belong to the owner of the mineral estate.[91]

The court disregards the language of the grant and the intention of the parties at the time of the grant. It suggests that the former "is not susceptible of construction to any particular point of view," and adds that the parties were not thinking of geothermal when the conveyance took place.[92] Futhermore, resort to labels does not help, the court says. "The broad classifications of animal, vegetable or mineral do not do the job."[93]

> [W]hat this case is all about is "energy" and who owns it. Both plaintiff and defendants are basically

87. *Id.* at 1293.
88. *Id.* at 1298 *et seq.*
89. Geothermal Kinetics, Inc. v. Union Oil Co., *supra* note 8.
90. *Id.* at 18.
91. *Id.* at 19. *See also*, Bjorge, *The Development of Geothermal Resources and the 1970 Geothermal Steam Act — Law In Search of Definition*, 46 U. COLO. L. REV. 1 (1974) in which the author concludes that geothermal resources should be included within the mineral estate.
92. *Id.* at 12.
93. *Id.*

> interested in owning, capturing and eventually delivering energy to the Pacific Gas & Electric Company for profit.[94]

Water traditionally has remained appurtenant to the surface estate, the court notes, because its use is essential to the beneficial use of the land and to support life itself. Minerals, on the other hand, generally are those resources which are valuable for their own sake independent of the land.

The resource in this case, the court finds, is corrosive and toxic and so potentially dangerous environmentally that it must be injected into the earth. Further, the scientific evidence indicated to the court that the water was of ancient origin and that only "minimal" amounts of meteoric water entered the geothermal reservoir.[95]

> In the final analysis, a geothermal system is an energy resource. The energy which is produced is a direct product of the molten minerals and gases within the resource. The water which transports the energy to the surface is a conveyor belt, nothing more. The total resource has all of the basic characteristics of those resources which courts have classified as minerals on many occasions in many jurisdictions. The water condensed from the resource is not necessary for or beneficial to the use of the land. The surface owner wants the energy which the water carries, not the water itself.[96]

The *Geothermal Kinetics, Inc.* decision is a refreshing change from the form over substance arguments which have for some time clouded the fundamental issues. The logic of the decision is compelling. Geothermal resources are an energy resource. Treating them for ownership purposes like other energy resources strikes this writer as a conspicuously reasonable thing to do.

Additional litigation is under way in California on the issue of ownership of geothermal resources. The case of *Pariani* v. *California*[97] addresses the question of whether a reservation

94. *Id.* at 14.
95. *Id.* at 17-18.
96. *Id.* at 19.
97. Pariani v. California, No. 657-291 (Super. Ct. San Francisco County).

of "all minerals" in a California state patent reserves geothermal resources. The case went to trial on July 8, 1976.[98]

As is apparent from the foregoing discussion, the answer to the ownership quandary is still in the hands of the courts. Until it is resolved the cautious landman has little choice except to attempt to acquire geothermal rights from *all* potential owners.

Possible Applicability of Water Laws

Unique among most energy production activities, geothermal operations frequently are net *producers* of water.[99] While this relieves the producer of certain headaches regarding acquisition of water for his operations, it is a mixed blessing. For the production of water from a geothermal well brings the producer into possible headlong confrontation with federal and state water laws.

The ultimate categorization of geothermal as a mineral or water resource probably will have little bearing on the relationship of the resource to water laws. The fact is that the primary component of geothermal resources in any form is water. Consequently, a party seeking to acquire geothermal rights must determine the applicability of federal and state water laws.

The use of water in the western United States is in general controlled by the states. The Supreme Court has held that federal legislation[100] had "effected a severance of all waters upon the public domain from the land itself."[101] In 1955 the Court narrowed the scope of its earlier rulings by distinguishing "public lands" from "reservations" and holding in

98. Since this paper was written, the courts have acted to ease the Landman's burden of determining who owns geothermal resources. On January 31, 1977, the Ninth Circuit Court of Appeals reversed the *Union Oil* case discussed *supra*, holding that the mineral reservation in the Stock-Raising Homestead Act includes a reservation of geothermal resources. 549 F.2d 1271 (9th Cir. 1977). The California state in *Pariani* reached a similar conclusion. Its decision, dated June 30, 1977, holds that geothermal resources were reserved under the California statute both as "mineral water" and, independently, as "mineral deposits."

The matter has not been laid to rest, however. A petition for certiorari was filed in *Union Oil*, but the Supreme Court neither denied it nor granted it during its last term. *Geothermal Kinetics, Inc.* and *Pariani* have both been appealed.

99. *See* Laird, Water from Geothermal Resources, in KRUGER & OTTE, *supra* note 17, at 177 *et seq.*.

100. *E.g.*, The Desert Land Act of 1877, Act of March 3, 1877, 19 Stat. 377, *as amended*, 43 U.S.C. § § 321 *et seq.* (1965).

101. California Oregon Power Co. v. Beaver Portland Cement Co., 295 U.S. 142 (1935).

the so-called "*Pelton Dam*" case that the severance of waters from lands applied only to the former.[102]

The notion that a severance did not occur on federal reservations is of potential interest to geothermal developers because in 1930 President Hoover withdrew "every smallest legal subdivision of the public land surveys . . . [containing] a hot spring, or a spring the waters of which possess curative properties."[103] The Department of the Interior has suggested that this executive order was not limited to hot springs created solely by the force of nature. "[T]he development of these hot springs systems by drilling wells on the public lands would be within the purview of the executive order of July 7, 1930."[104]

If the foregoing analysis is correct, geothermal lands were reserved, the waters on those lands were not severed, and presumably use of waters on those lands would be governed by federal — not state — law.

Regrettably, from the geothermal developer's point-of-view, there has not been a groundswell of enthusiastic support for the Acting Solicitor's opinion. Indeed, as mentioned above,[105] some states now regulate geothermal under their water laws, and the author is not aware of any efforts — judicial or otherwise — being taken to resist this regulation.

Congress did not seize the moment either. Drafters of the Geothermal Steam Act wanted no part of this troublesome problem.

> Nothing in this Chapter shall constitute an express or implied claim or denial on the part of the Federal Government as to its exemption from state water laws.[106]

The geothermal developer's problem is that in many of the western states, where geothermal prospects seem bright-

102. Federal Power Comm'n v. Oregon, 349 U.S. 435 (1955).
103. Withdrawal Order 5389 of July 7, 1930.
104. M-36625, Memorandum from Edward Fisher, Acting Solicitor, Department of Interior to Director, BLM (August 28, 1961).
105. *See* notes 77 and 78, *supra*. *See also* COLO. REV. STAT. § 34-70-107 (Supp. 1975).
106. 30 U.S.C. § 1021. (1970).

est, existing water supplies have been over-appropriated.[107] Consequently, if geothermal activities are made subject to state water laws, developers of the resource may have to perfect their appropriations as "developed," or nontributary waters.[108] Otherwise they may find themselves waiting in vain at the end of long lines of persons seeking water for other, competing uses.

One commentator recommends we let the technical experts provide the solution to this water law problem.[109] If geothermal wells are interfering with conventional water resource users, he suggests, then geothermal operators must conduct their operations in harmony with the water laws and with those competing rights. If geothermal operations do not interfere with other water users, he adds, there is little reason to impose restrictions on the geothermal operator except for those restrictions necessary to prevent pollution of conventional water resources.

The State of California has attempted to ease the water law problem through issuance to geothermal operators of certificates of primary purpose. These statutory devices[110] create a rebuttable presumption that the geothermal resources operator has ownership of such resources and that those resources are not conflicting with existing ground water uses. These devices have the advantage of protecting existing water rights without unduly interfering with geothermal operations. The party whose water rights are being affected by geothermal operations protects those water rights by rebutting the presumption. The geothermal operator cannot be enjoined and forced to demonstrate that he is not interfering until the presumption is overcome.

In California, the certificate may be granted by the Geothermal Resources Board to the operator for a geothermal

107. Utah, Nevada, New Mexico, Arizona and much of Colorado. Dewsnup, *Problems Under State Water Laws: Initiation of New Rights*, 8 NAT. RESOURCES J. 347 (1975).
108. "Water which has been added to the supply of a natural stream and which never would have come into the stream had it not been for the efforts of the party producing it." City and County of Denver v. Fulton Irrigating Ditch Company, 179 Colo. 47, 506 P.2d 144, 147, (1972).
109. Olpin, *supra* note 7, at 134.
110. CAL. PUB. RES. CODE § 3742.2 (Supp. 1975); OR. REV. STAT. § 522 (Supp. 1975).

well located on private, federal or California state lands. The operator must demonstrate to the Board's satisfaction that the well is primarily for the purpose of producing geothermal resources and not for the purpose of producing water usable for domestic or irrigation purposes. Once he makes this demonstration the operator is entitled to a presumption of ownership to the geothermal resource.

The landman seeking to acquire geothermal resources in states other than California must face the water law problem without the comfort of Certificates of Primary Purpose. The prudent course of action in most cases will be to apply for water rights.[111]

The Federal Leasing System

The details of the federal geothermal leasing scheme have been described elsewhere,[112] and they will be summarized in the illustration *infra*. There is one aspect of the federal leasing program which bears directly on geothermal leasing activities on privately owned lands, however, and that feature should be noted by the landman for it may affect the timing of the lessee's operations.

The federal leasing scheme contemplates two types of geothermal lands. First, the United States Geological Survey designated those areas most likely to contain commercially viable geothermal resources. It called those areas "known geothermal resource areas," or KGRAs. These are comparable to "known geological structures" of an oil or gas field with some important differences. The most important difference is that in the case of KGRAs there was little hard geological data upon which to draw. This deficiency has been made up by blending administrative clairvoyance[113] with a flexible regulatory scheme which permits reclassification in the case of nearby discoveries,[114] competitive interest,[115] "or other indicia

111. It has been suggested this will not be necessary in Idaho if water is to be used solely for power generation. *See* Schlauch & Worcester, *supra* note 7, at 348.
112. *Id.* at 333 *et seq.*
113. Dolan, *supra* note 1, at 2.
114. Within five miles, if the geological structure is not known, or, if the structure is known, all lands within the structure regardless of the distance from the discovery. 43 C.F.R. § 3200.0-5(k) (2) (1976).
115. An overlap in two lease applications of 50 percent or more. 43 C.F.R. § 3200.0-5(k) (3) (1976). To avoid KGRA classification under this provision, landmen ap-

[which] would, in the opinion of the Secretary, engender a belief in men who are experienced in the subject matter that the prospects . . . are good enough to warrant expenditure of money for that purpose."[116] Lease of geothermal resources in KGRAs is possible only through a competitive bidding procedure.

In areas of the public domain not classified as KGRAs, the Department of the Interior accepts application for non-competitive leases, and those leases generally are issued to the applicant who is first in time.

A geothermal operator who intends to include federal acreage in his land package proceeds at his peril if he drills on private acreage before his federal leases are issued. The cause of his peril is the regulatory provision mentioned above[117] which allows reclassification to KGRA status of *unleased* federal lands in case of a nearby discovery. A reclassification requires that the lease be issued by competitive bidding. The discoverer's application for a non-competitive lease in such a case would be discarded.

The prudent geothermal explorer under these circumstances must postpone his drilling operations until he acquires security of tenure through issuance of the federal leases. He may face a lengthy wait. Department of the Interior policy at this writing is to postpone issuance of leases on lands where title may be in doubt (*i.e.*, Stockraising Homestead lands) until ownership is judicially resolved, presumably until the *Union Oil* case runs its course.

Efforts have been made by industry to encourage the Department to administratively cure the problem created by the above-mentioned regulation. It has been suggested, for example, that leases could be issued with a provision that royalties be placed in escrow pending resolution of the ownership issue. The author has been advised that BLM is pursuing this

plying for leases in areas where competitors are active are called upon to use their ingenuity to create lease blocks of irregular configuration which have as their single merit the likelihood that they will not be fifty per cent overlapped by a competitor's application.

116. 43 C.F.R. § 3200.0-5(k) (1976).

117. 43 C.F.R. § 3200.0-5(k) (2) (1976).

suggestion internally and that the Solicitor has approved of the concept.

Administrative sluggishness has been responsible for delay in issuing leases in some cases where the ownership issue is not in doubt. For example, from January, 1974, to July 31, 1977, 1763 applications were submitted for geothermal leases on lands administered by the United States Forest Service. Only nineteen leases have been issued in response to those applications.[118] Whatever the cause of this snail-like pace in issuing leases, the effect on the geothermal operator is clear. If he intends to include federal acreage in his land package, the reclassification problem requires that he puts the brakes on his exploration project — even on adjacent private lands — until the regulations are amended or the leases are issued.

It is curious that regulations implementing legislation designed to encourage development of geothermal resources would have precisely the opposite effect. Nevertheless they do. As a consequence, the landman must avoid development — or even drilling — commitments in private leases if unleased federal lands are to be included within the project area. The best approach in such cases is to affirmatively disclaim any obligation to drill until lessee in his good faith judgment determines he reasonably can do so.

IV. LEASING GEOTHERMAL RESOURCES

In sections II and III of this paper the author discussed the nature of geothermal resources and some of the legal and practical problems the operator might encounter in developing them. In this section of the paper some proposals will be made for leasing the resource.

The Land To Be Leased

Assume that the land to be leased is a 5,000 acre parcel in California owned by A. A's title derives from two sources. Half of the property (Tract 1) was patented under the Stock-raising Homestead Act.[119] Title to the other half (Tract 2)

118. Bureau of Land Management, Non-Competitive Geothermal Leasing, Summary Leasing Report (July, 1977).
119. Reserving to the United States "all coal and other minerals."

originated in a State of California patent in which "all minerals" were reserved to the state.

Title to geothermal resources in the property described above may be owned by A, the United States, or the State of California. The landman should evaluate the interests of each party and determine whether it is necessary to acquire whatever interest in the geothermal resources each party owns.

Interests of The United States

A's patent to Tract 1 contains a reservation of "coal and other minerals" to the United States. The landman should apply for a federal lease to Tract 1. This will protect the landman's client in the event the outcome of the *Union Oil* case is a determination that geothermal resources are included within this mineral reservation.

If Tract 1 has not been included within a KGRA by the United States Geological Survey, the landman can acquire priority rights to the geothermal resources in those lands by being first in time to file an application for a non-competitive geothermal lease.[120] An application for lease must cover a total land area of at least 640 acres, but not more than 2560 acres.[121] These lands must be within a six-mile square or an area of six surveyed or protracted sections in length or width.[122]

A party, whether an individual, corporation or other entity, may not own or control at any one time geothermal leases covering more than 20,480 acres in a single state.[123] There are some statutory exceptions to this acreage limitation which make it less restrictive.[124] Industry critics have objected to this limitation, however. They point out that a party exploring for oil and gas can lease more than ten times as many acres[125] as a party exploring for geothermal resources.

120. 30 U.S.C. § 1003 (1970).
121. 30 U.S.C. § 1006 (1970); 43 C.F.R. § 3203.2(a) (1976).
122. 30 U.S.C. § 1006 (1970).
123. 30 U.S.C. § 1006 (Supp. 1975); 43 C.F.R. § 3201.2 (1976).
124. 30 U.S.C. § 1017 (1970) excepts lands which are pooled or unitized in an approved cooperative development plan. It also excepts leases operated under approved operating, drilling or development contracts. The regulation implementing these statutory exceptions are 43 C.F.R. § § 3201.2(c), 3243.2 and 3243.4 (1976).
125. 30 U.S.C. § 184(d) (1) (1970); 43 C.F.R. § 3101.1-5(a) (1976) permits up to 246,080 acres to be held in a single state other than Alaska.

In view of the similarities between land acquisition requirements in the two industries[126] this is a legitimate criticism.

The application for the noncompetitive lease must be accompanied by payment of a nonrefundable service charge in the amount of fifty dollars[127] plus advance rental for the first year of the lease term of not less than one dollar per acre, or fraction thereof.[128] The lease applicant also is required to obtain lease compliance and property protections bonds. Original copies of these bonds must be filed with the BLM within thirty days after receipt of notice from BLM of the bonding requirement.[129]

The primary term in a federal lease is ten years.[130] The lease will be extended for so long thereafter as geothermal resources are produced in commercial quantities up to a maximum of forty additional years. The lessee will be entitled to a preference right for a new lease for a second period of forty years if the lands are not needed for other purposes.[131] Royalty rates in federal leases are initially set at not less than ten percent nor more than fifteen per cent of the value of the resource derived from production under the lease and sold, utilized, or reasonably susceptible to being sold or utilized by the lessee.[132] A maximum five per cent royalty is imposed on by-products.[133]

The regulations authorize rentals and royalties to be adjusted at not less than twenty-year intervals beginning thirty-five years after the date geothermal steam is produced.[134] Royalties cannot be increased by more than fifty per cent of the amount payable in the preceding period and the maximum royalty payable cannot exceed twenty-two and one-half percent.[135]

In most other respects, acquisition of and operations under a federal geothermal lease are similar to those of an oil and gas lease.

126. *See* note 53, *supra*, and accompanying text.
127. 43 C.F.R. § 3205.1(b) (1976).
128. 43 C.F.R. § 3205.3-1 (1976).
129. 43 C.F.R. § 3206.1-2 (1976).
130. 43 C.F.R. § 3203.1-2 (1976).
131. 43 C.F.R. § 3203.1-3(a) (1976).
132. 43 C.F.R. § 3205.3-5(a) (1976).
133. 43 C.F.R. § 3205.3-5(b) (1976).
134. 43 C.F.R. § 3205.3-9 (1976).
135. 43 C.F.R. § 3205.3-9 (1976).

If Tract 1 has been included within a federally designated KGRA, the landman will be required to enter a competitive bid for purposes of acquiring the lease.[136] Lands within a KGRA may be nominated for lease by the Bureau of Land Management or a third party.[137] Notice of a lease sale will be published weekly for four consecutive weeks prior to the date of sale.[138] The notice will describe the lands to be sold, the terms and conditions of the sale, the time and place of the sale, and the manner in which bids may be submitted.[139] Bidders must submit with their sealed bids a certified or cashier's check, bank draft, money order or cash in the amount of one-half of the amount bid.[140] The right to reject any and all bids is reserved by regulation.[141]

The successful bidder will be sent three copies of the lease. Within thirty days thereafter, he must pay the first year's rentals, the balance of the bonus bid, and he must file the required bonds and submit a proposed plan of operations setting forth those matters detailed in the regulations.[142]

Interest of The State of California.

The court in the *Pariani* case may determine that a reservation of "all minerals" in a state patent includes geothermal resources. To anticipate this eventuality the landman in the instant case should file an application for a California State prospecting permit for Tract 2. The California Geothermal Resources Act of 1967[143] is similar in many respect to the federal system. Areas within the state may be classified as "known geothermal resource areas". These areas are leased by competitive bid[144] unless prior to designation as a known geothermal resource area a party holds a prospecting permit for that area. In the latter event, the permittee has a prefer-

136. 30 U.S.C. § 1003 (1970).
137. 43 C.F.R. § 3220.1(b) (1976).
138. 43 C.F.R. § 3220.3 (1976).
139. 43 C.F.R. § 3220.4(a) (1976).
140. 43 C.F.R. § 3220.5(a) (1976).
141. 43 C.F.R. § 3220.6(c) (1976), *But see* Stone, Geothermal Energy And The Law, Univ. of Southern California Law Center, Draft Report, (Sept. 30, 1975) at 121. "[I]t does not appear to us that Interior has the authority to reject high bids for leases, The Geothermal Steam Act [30 U.S.C. § 1003] states that KGRA lands '*shall* be leased to the highest responsible qualified bidder . . .' " (emphasis added).
142. 43 C.F.R. § 3220.6(d) (1976). The requirements for the plan of operations are set forth at 43 C.F.R. § 3210.2-1(d) (1975).
143. CAL. PUB. RES. CODE § § 6902 *et seq.* (Supp. 1976).
144. CAL. PUB. RES. CODE § 6912(a) (Supp. 1976).

ence right for the lease if he has done exploration work on the lands.[145]

If the lands are not included within a known geothermal resource area, a party may apply for a prospecting permit. This permit gives the permittee the exclusive right, for a period of three years, to conduct geothermal exploration activities upon the permitted lands.[146] The term of the permit may be extended an additional two years.[147]

The permittee is required to make available to the State Lands Division and the Geothermal Resources Board on a confidential basis, geological, geophysical, geothermal and geochemical results from his operations on the lands.[148] Upon classification by the state of the permitted area as a known geothermal resource area, the permittee is entitled to a preferential lease for those lands.[149] The lease terms under the California Act are similar to those under the federal act. Leases may be issued for not less than 640 acres, nor more than 5,760 acres. A party's state-wide geothermal lease interests may not exceed 25,600 acres, with the exceptions relating to unit development mentioned in the discussion of federal leases, *supra*.[150]

Leases issued under the California Geothermal Steam Act are for a primary term of twenty years and so long thereafter as geothermal resources are being produced or utilized or capable of being produced or utilized in commercial quantities. The maximum term under the Act is ninety-nine years.[151]

Royalties on California state geothermal leases are ten per cent of the gross revenue received from the sale of geothermal resources and a royalty of not less than two per cent nor more than ten per cent of the gross revenue received from sale of by-products.[152] After geothermal resources are discovered in commercial quantities, royalties must equal at least

145. CAL. PUB. RES. CODE § 6912(a) (Supp. 1976).
146. CAL. PUB. RES. CODE § 6910 (Supp. 1976).
147. CAL. PUB. RES. CODE § 6910 (Supp. 1976).
148. CAL. ADMIN. CODE § 2253 (Supp. 1976).
149. CAL. ADMIN. CODE § 2255 (Supp. 1976).
150. CAL. PUB. RES. CODE § 6908 (Supp. 1976). The exceptions are described in 30 U.S.C. § 1017 (1970).
151. CAL. PUB. RES. CODE § 6918 (Supp. 1976).
152. CAL. PUB. RES. CODE §§ 6913(a) and (b) (Supp. 1976).

two dollars per acre.[153] Royalties are subject to renegotiation after twenty years from the effective date of the lease and at ten-year intervals thereafter.[154]

Of special interest to the landman is a provision in the California Act which gives to the owner of the surface, A in our case, a preferential right to obtain a permit or lease to geothermal resources underlying his property.[155] Applicants for permit or lease are required to give notice to the owner of the surface of such application. The owner of the surface receiving such notice has a period of six months from the date of service of notice within which to file his own application for a permit or lease. If the surface owner meets the qualifications of the Act,[156] his application shall be granted in preference to the initial applicant's. If the owner's lands are classified as being within a known geothermal resource area, and the property subsequently is sold at competitive lease sale, the owner will be notified of the highest bid. He may within ten days after receipt of this notice submit an identical bid. In that event, the owner shall be issued the lease.[157]

Thus, in the instant case, the landman can obtain geothermal rights to Tract 2, whatever the outcome of the *Pariani* litigation. All that is required is an appropriate covenant in A's lease requiring him to exercise his statutory preferential right to a state permit or lease if a third party applies for it and an agreement by A to assign any such permit or lease to the landman's client.

A's Interests.

A owns the fee title to the property. He may own all — or none — of the geothermal resources underlying the property, however. Nevertheless, the trial court's holding in *Union Oil* is that A owns geothermal resources on Tract 1.[158] And through exercise of his statutory preferential lease right A can acquire the geothermal resources on Tract 2 even if the *Pariani* litigation[159] results in a determination adverse to him.

153. CAL. PUB. RES. CODE § 6913(d) (Supp. 1976).
154. CAL. PUB. RES. CODE § 6913(e) (Supp. 1976).
155. CAL. PUB. RES. CODE § 6922 (Supp. 1976).
156. CAL. PUB. RES. CODE § 6801 (Supp. 1976).
157. CAL. PUB. RES. CODE § 6922 (Supp. 1976).
158. *See* note 80 and accompanying text. *supra.*
159. Pariani v. California, *supra* note 97.

Clearly, A is a key player in this land acquisition program. A lease of his interests should be a matter of first priority.

The Contents of A's Lease.

Provisions in state and federal geothermal leases are matters of statute and regulation. There are matters which can be included in a lease with A, however, which will acknowledge some of the legal uncertainties surrounding ownership of geothermal and protect both parties to the lease. It is these provisions which are unique to geothermal that will be considered below. Lease provisions familiar to the oil and gas man will not be included in the following discussion.

a. The Granting Clause.

In view of the general uncertainty regarding the legal nature of geothermal resources, the landman should assure that his granting clause includes a definition broad enough to encompass all possible things the resource might be. Both the California and the federal definitions adequately cover the subject,[160] although a lessee whose target is a geopressured zone should include "hydrocarbon gas" within the language of the grant to assure his right to dissolved methane. He also might add "kinetic energy" to remove any doubt that characteristic of geopressured reservoirs is within the meaning of "associated energy."

b. Lease Term.

The landman might suggest two possibilities to A regarding the primary lease term. If the lessee can enter into the secondary term of the lease only if he is engaged in "production," a primary term of twenty years may be more appropriate than one of ten years in view of the likelihood of project delay. (The landman's client must postpone activities which might result in a discovery until the ownership of Tract 1 is determined, it must be remembered).

Alternatively, the landman might suggest a primary term of ten years with entry into a secondary term if there has been a *discovery* and if the lessee is diligently working toward additional discoveries.

160. 30 U.S.C. § 1001 (Supp. 1975); CAL. PUB. RES. CODE § 6903 (Supp. 1975).

The general requirement that a lessee be engaged in "production" before he can enter into the secondary term of a lease is one instance where oil and gas practice and geothermal realities do not coincide. It is probable that power production from geothermal wells will not be possible until a producer has sufficient resources to generate at least fifty-five megawatts. At The Geysers this requires approximately ten production wells. And time must be allowed for power plant certification.

c. Royalties.

In leases between private parties, standard royalty provisions on geothermal resources are ten per cent of gross proceeds received from the sale of the resource. The royalty on by-products, which likely will require further treatment before they will be salable, generally is five per cent of net proceeds received from sale. Royalties on federal and state[161] leases fall into this general pattern as well. A similar royalty schedule would be appropriate for A's lease.

At The Geysers Pacific Gas and Electric pays steam producers a price for power delivered to the bus bar. Energy losses occuring during conversion of the resource to electricity thus become losses borne by the geothermal producer. The royalty provision in A's lease should give A a percentage of gross proceeds received by the lessee from sale of the resource. The other alternative — percentage of value of steam at wellhead — places none of the burden of energy loss on A.

In the instant case the landman should attempt to reach an agreement with A to place royalty payments in escrow from each parcel[162] in which ownership is in doubt pending a final determination of ownership of the resource. While it is unlikely production would begin prior to resolution of the ownership question, if that event did take place, the lessee might otherwise find himself paying royalties to multiple parties.

161. *See* 43 C.F.R. § 3205.3-5(a) (1976); 43 C.F.R. § 3205.3-5(b) (1976); CAL. PUB. RES. CODE § § 6913(a) and (b) (Supp. 1976) and accompanying text.

162. Production from individual wells can be metered so that calculating proportional royalties on Tract 1 and Tract 2 would not present a problem to the lessee.

Ideally, agreement can be reached on an escrow arrangement with the Department of Interior as well, in which case the landman's client can make a single payment for production from Tract 1 into an escrow account and the proceeds can be disbursed when ownership is determined.

d. Lesser Interest: After Acquired Interest.

The geothermal lease with A must contemplate the possibility that A owns no interest whatsoever in geothermal resources. At the same time, it should be made clear in the instrument that whatever the ownership of geothermal resources, the lessee will attempt to obtain them. Thus, if A does not own the resource, and the lessee is able to acquire the federal or state rights to the resource, the lease must contemplate lessee's use of A's surface estate. An equitable way of handling this situation is to provide that if A has no interest in the geothermal resources, the lessee can use A's surface estate so long as he pays A the fair market rental of the property actually used. It is generally agreed that ten per cent of the gross value of the property is a reasonable per annum rental.

In view of A's statutory preferential right to a geothermal lease on state lands underlying his surface, it would be appropriate to incorporate in A's lease a provision requiring him to exercise such preferential right if the lease applicant is someone other than the lessee in the instant case. In most states this covenant could merely be in the form of an after-acquired interest provision. In California, however, it would be advisable to specifically refer to the statutory preferential right. The lease should provide that lessee would pay the costs of acquiring said lease and that there would be no additional consideration payable to A for exercise by him of this right.

e. Disclaimer of Implied Obligations.

Because of the reclassification problem mentioned above,[163] the agreement with A should disclaim any express or implied covenants to develop or drill A's property until in lessee's good faith judgment, it is prudent to engage in those

163. *See* 43 C.F.R. § 3200.0-5(k) (2) (1976) and accompanying text, *supra* note 116.

activities. It is suggested that the lease might impose upon the lessee the standard of a reasonably prudent businessman in determining the pace at which development or drilling should take place.

f. Miscellaneous Provisions.

1. Pooling and Unitization.

Although geothermal reservoir structure may differ markedly geologically and geometrically from petroleum reservoirs, the need for conservation and efficient resource exploitation is applicable in both cases. Many state legislatures have recognized this need by codifying pooling and unitization procedures[164] or by granting regulatory bodies discretionary powers to conserve the resource.[165]

Pooling generally means the aggregation of small tracts into a larger tract sufficient in size to permit issuance of a well permit under applicable spacing rules.[166] Unitization, on the other hand, refers to "the joint operation of all or a part of a producing reservoir."[167]

A's tract is large enough so the lessee need not worry about pooling A's land to qualify for a well permit (forty acre spacing has been common at The Geysers). The landman should seek A's consent to unitize, however, in the interest of promoting orderly development of any reservoir underlying A's lands.

The landman should resist attempts by A to impose severe acreage restrictions on this right in view of the uncertain configuration of the geothermal reservoir which might underlie A's land.

In general, the considerations regarding pooling in oil and gas leases are applicable to geothermal pooling provisions.[168]

164. *See, e.g.*, ARIZ. REV. STAT. §§ 27-664 *et seq.* (Supp. 1973); CAL. PUB. RES. CODE § 6923 (Supp. 1976); COLO. REV. STAT. § 34-70-104 (Supp. 1975); and N.M. STAT. ANN. § 7-15-14 (1974).
165. NEV. REV. STAT. § 534A020(1) (1975); UTAH CODE ANN. § 73-1-20-1 (Supp. 1975).
166. WILLIAMS & MEYERS, OIL AND GAS LAW § 901 (Abridged ed. 1972).
167. *Id.*
168 *See generally, Id.* at § § 920 *et seq.*.

2. *Shut-In Royalty Clause.*

Circumstances which give rise to the need for a shut-in royalty clause in a gas lease (*e.g.*, the inability to produce until a pipeline to the well is completed) also arise in geothermal operations, of course. Indeed, the likelihood of an operator being unable to produce for want of a market no doubt is far greater in the geothermal industry. Only one public utility in this country to date has built and operated commercial plants using the resource. Other utilities, while they might be interested in following suit, may be unable to do so at present due to commitments already made for plants fired by other fuels.[169]

Plant certification delays might await those utilities able and willing to get into the business. And the composition of the resource might present some engineering problems which have to be solved before the resource can be exploited.

In any of the above instances, if the operator is making a good faith effort to remove the cause of delay, he should have the right to shut-in. The landman in the instant case should include a shut-in royalty clause in A's lease which contemplates the above circumstances.

3. *Environmental or Regulatory Delay.*

In some parts of the country the geothermal industry is having a tumultuous gestation. One California county,[170] for example, prohibited production of geothermal resources for two years while the county staff prepared a geothermal ordinance. In a nearby county litigation[171] involving the scope of an Environmental Impact Report required by the California Environmental Quality Act held up issuance of a permit for an exploration well for eighteen months. And delay is resulting from inaction on some federal lease applications.

169. Utility generation expansion plans commonly require that facility commitments be made ten years in advance of the time facilities are expected to come on line. This requirement to commit present capital to future needs may impair a utility's flexibility and make it difficult for the company to integrate geothermal plants into its plans. *See* Hinrichs, GRC 4, *supra* note 33.
170. Napa County.
171. Friends of Cobb Mountain v. County of Lake and Union Oil Co., No. 13106, Super. Ct., Lake County, Calif. (1975).

Where the lessee faces prolonged delay for administrative or environmental reasons, it generally is to the benefit of both the lessor and the lessee if the lessee focuses his attention on eliminating the causes of delay so that the lessee can get on with production. Accordingly, it may be appropriate in some circumstances for the lessor to share the lessee's burden of such delay. The lessor might agree for example, to reduce rentals on the property by fifty per cent during such periods of time as lessee is spending excessive amounts of money on activities not directly related to exploring the property. Examples of such expenditures could be things such as attorney's fees incurred in preparing draft geothermal regulations, costs of consultants hired to make presentations to administrative agencies or the cost of complying with unusually burdensome environmental requirements.

If A were being paid twenty-five dollars per acre, for example, the landman might suggest that if delay arises from one of these environmental or regulatory causes, the rental would be reduced to fifteen dollars per acre while the lessee is diligently attempting to cure the cause of delay.

4. *Use of Resource For Non-Power Generating Purposes.*

In rare instances the lessor's property may be so situated that a geothermal resource inadequate for power generation may be suitable for other commercial uses. If this circumstance arises, the landman should contemplate alternative uses in the lease.

If his own client is not likely to be interested in retaining the property for the non-power generating purposes, the landman should assure that the lease is reasonably assignable to a third party which is, for example. And alternative uses may demand a revision of the royalty structure. A ten percent gross royalty may be appropriate for power generation. It may not be appropriate if the resource has to be extensively processed prior to its use for other purposes.

V. CONCLUSION

Geothermal is an industry in its infancy. It has been compared to the oil and gas industry at the turn of the century. Consequently, even those in the industry occupy low posts on the geothermal learning curve. There is still much to be discovered about how this resource is found and used and about how it is leased.

The landman embarking on a geothermal acquisition program will encounter much that is familiar. He should avoid the temptation of being lulled into a false sense of security, however, for numerous pitfalls await the unwary. Instead, he should learn as much as possible about the nature of the resource and its uses, and he should acquire an understanding of the legal and practical problems in which his geothermal client is embroiled. If he does these things, the landman should be well equipped to lease this resource whose time has come.