NOTICE CONCERNING COPYRIGHT RESTRICTIONS

CHAPTER 7

LEGAL, INSTITUTIONAL AND ENVIRONMENTAL ASPECTS

Work Group

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LEGAL, INSTITUTIONAL AND ENVIRONMENTAL ASPECTS

INTRODUCTION

To develop direct uses of geothermal energy, a few more factors must be considered than the presence of the resource, the ability of the resource to supply the energy needed for the intended use, financing and marketing. Early planning for compliance with federal, state and local environmental laws, regulations and ordinances, and for obtaining necessary permits is a "must."

A developer who learns the rules and is aware of the steps for obtaining the required approvals and permits at the very beginning of a project will be able to make realistic estimates for the time, money and personnel necessary to proceed. This chapter is designed to provide the potential developer or user with a general guide for negotiating and obtaining the necessary regulatory approvals associated with geothermal development--from obtaining access to the resource to exploration, development, distribution and use of the resource.

Fortunately, direct uses of geothermal energy usually have much less potential for severe negative environmental impact than electric power applications because direct-heat projects are smaller and do not need extensive transmission lines, power-generation equipment or cooling facilities. Direct uses generally require fewer wells per development, shallower depths, lower temperatures, and lead to less surface-disturbing activities.

Relationships with existing utilities are discussed, as well as sources for public assistance in negotiating the way through the appropriate regulatory framework. The basic thrust of this chapter is to help developers negotiate the regulatory maze without the expenditure of excessive time and expense.

The key to operating successfully within the institutional, environmental, and regulatory framework is to identify the required permits and potential environmental problems as early as possible.

It is assumed that the developer is convinced of the presence of a geothermal resource capable of supplying economical geothermal energy and that he has a use or market for the geothermal energy, such as space heating or cooling, or industrial process heat.

OBTAINING ACCESS TO THE RESOURCE

Determining the nature of surface ownership

Once the specific site or geographic area to be developed has been located and identified on appropriate maps, the would-be developer deals next with the problem of gaining access to the land, which requires a determination of ownership. This may not be as simple as it sounds. Although ownership of the surface and geothermal or mineral estates generally is the same, in some instances, the surface ownership is severed from the geothermal resource, which may require the developer to deal with the owners of both estates. In these situations, the owner of the mineral estate frequently has the implied right to enter the land and to use as much of the surface as may be reasonably required to develop the subsurface resource; but in each instance a close examination of title and a determination of the details of ownership will be required for each jurisdiction. For the developer who is experienced in the acquisition of petroleum and other mineral interests, there will be much in this process that is familiar. The problem has been complicated in some jurisdictions because the geothermal resource has not been adequately

defined, and as a result, its ownership may be uncertain (see National Conference of State Legislatures, July 1978).

In all instances, ownership is a title problem which should be handled with competent legal assistance by persons familiar with title company practices and local land records.

Determining the nature of subsurface ownership

The geothermal developer often must obtain rights in addition to surface entry and use. Water rights may need to be secured, and these, too, often are not part of the surface estate. Oil, gas, geothermal resources or, in more general language, "minerals" may be severed or separated from the surface rights. Under the Stock Raising Homestead Act of 1916, for instance, approximately 67 million acres (27 million hectares) of federal land was patented with coal and other minerals reserved to the federal government. Dry steam resources at The Geysers in California have been found to be part of this reservation, although the surface land is in private ownership.

The geothermal developer should identify and obtain all resource rights required for the planned direct heat application. This task is complicated by the complex nature of geothermal resources. Legally, the resource has both water and mineral aspects, and the inclusion of geothermal resources in a particular resource category or reservation often is uncertain. Definitions of geothermal resources in federal and state statutes should be examined. Any specific statutory assignments of geothermal resources should be evaluated. As examples, geothermal resources have been classified as mineral by Hawaii and as underground water by Wyoming. Colorado presumes that mineral reservations do not include geothermal resources, while Oregon places all geothermal resources in the surface estate. Confusion about the nature of geothermal resources is evident, and for security, the developer may wish to secure all resource rights that might possibly form the basis of a claim to geothermal resources (see Sacarto, State Policies for Geothermal Development, 1976, p. 43-46).

Entry and development rights

Private lands. Access to private land is usually gained by dealing directly with the owner of the surface and geothermal estates. In some instances, title to the land and resources may be obtained by outright purchase. In those instances, the usual caution should be exercised to ensure that clear legal title is obtained. However, access to the resource will more often be obtained through a geothermal lease. Sometimes an option to acquire a geothermal lease may be obtained, which will establish the terms of the lease and which will permit exploration during the option period in accordance with the option agreement. The owner of the land may permit access in advance of an option to purchase or lease. The developer may then conduct passive exploration including geological mapping, slim temperature gradient holes, or heat-flow studies if they are needed, or any other assessment activity allowed by the surface owner.

Although geothermal energy has been directly employed in the United States for space heating where hot springs and shallow hot-water wells occur, other commercial applications have not been common. Consequently, standard leases for direct geothermal applications have not been developed. From the developer's point of view, it would seem that lease forms for the typical commercial geothermal areas (such as The Geysers and the Imperial Valley) could be modified to fit the needs of the developer interested in direct uses. However, some consideration must be given to the royalty provision in these more standard lease forms, since the pricing model is likely to be different from that developed for the generation of electric power.

Whether access is obtained by purchase, lease, option, permit or any other arrangement, it is imperative that the developer accurately determine ownership to ensure that all the requisite

parties have joined in the transaction. In some instances, a developer may find that the property in which he is interested is already under lease for agricultural, grazing or other purposes. If so, the developer should also obtain the requisite consent from the lessee in possession, to avoid possible charges of trespass or other conflict. Substantially the same legal and title considerations are involved whether the developer is proceeding by way of purchase, lease, option or other agreement, and competent title assistance must therefore be obtained.

State lands. Rights to explore and develop geothermal resources on state lands are governed by statutes and regulations (see Appendix A). Geothermal exploration involving negligible surface disturbance may or may not require a permit or lease from the state. Check with the state lands office. In some cases, the developer may be allowed to proceed at will or after notifying the state lands officer. Intensive exploration and development operations will, however, require permits and leases.

The manner in which exploration permits and development leases are issued and the requirements they impose on the developer vary from state to state (Tables 1, 2 and 3). Diligent work requirements, lease-conversion provisions for exploration permits, rentals, royalties, acreage limitations, lease terms and renegotiation provisions for leases are important concerns for the geothermal developer.

In some states, a pre-lease environmental evaluation is required in which the potential effects of proposed exploration, development and production activities for the lease are examined for their environmental and socioeconomic acceptability. Where an environmental evaluation is necessary, delays will occur between filing for and issuance of a lease. The developer may be required to pay the costs of the evaluation. Therefore, it is important for the geothermal developer to file for the lease as early as possible to avoid delaying consideration of the potential environmental problems associated with geothermal exploration, development and production. Alternatively, developers should institute environmental baseline studies prior to lease filing, to minimize post-filing delays. Generally, baseline studies are financed by the developer.

TABLE 1

State geothermal exploration permits with conversion privileges
(from Sacarto, 1976, revised 1979)

State	Manner Awarded	Term	Conversion Privilege	Annual Rental
Alaska	By application	3 years Possible 2-yr extension	Yes	Variable; $1/ acre minimum
California	By application	2 years Possible 2-yr extension	Yes; 90-day period	$1/acre
Wyoming	a) Public drawing[1] b) By application	3 years Possible 2-yr extension	Yes; 90-day period	$1/acre

[1] When lands are newly offered for exploration, a period is set of at least 30 days and applications received during that period are awarded permits by public drawing.

TABLE 2
Leasing of state lands
(from Sacarto, 1976, revised 1979)

State	Non-KGRA Lands		KGRA Lands (Competitive Leasing)	
	Newly Offered	Application Overlap	Bidding Factor	Designation Criteria
Alaska	. . . . .	. . . . .	(A)	(A)
Arizona	By application	Qualifications or Cash bonus bidding	Cash bonus	Geology and/or competitive interest
California	(A)	(A)	Cash bonus or other (H)	Geology and/or competitive interest (H)
Colorado	(A)	(A)	(A)	(A)
Hawaii	. . . . .	. . . . .	(A)	All land awarded competitively (G)
Idaho	Public drawing (30-day filing)	By application		Producing well
Louisiana	(B)	(B)	(B)	(B)
Montana	Competitive	Competitive	Cash bonus	All lands awarded competitively
Nevada	(C)	(C)	(C)	(C)
New Mexico	Competitive (30-day filing)	By application	Cash bonus	Determined by Commissioner of Lands
Oregon	Public drawing (30-day filing)	By application	Cash bonus (D)	Geology and/or producing well
Texas	(B)	(B)	(B)	(B)
Utah	Cash bonus (E) (15-day filing)	By application	(E)	(E)
Washington	Competitive	Competitive	Cash bonus (F)	All lands awarded competitively
Wyoming	. . . . .	. . . . .	(A)	(A)

(A) Specified by state land commissioners.
(B) Regulations not finalized.
(C) Moratorium on leasing of state lands.
(D) If no bids received, Division of State Lands may reclassify for non-competitive leasing.
(E) Lands are offered non-competitively by order of application, except when they are newly offered. Newly offered lands are leased by cash bonus bidding.
(F) Unlike Montana, if a tract receives no bid, it is withdrawn.
(G) Board of Land and Natural Resources by a two-thirds vote may award a non-competitive lease to occupier of mineral reserve lands.
(H) Single biddable factor only, plus negotiable royalty rate up to 16-2/3%.

TABLE 3
State geothermal lease provisions
(from Sacarto, 1976, revised 1979)

State	Primary Term	Renewal	Renegotiation of Rentals and Royalties	Annual Rental	Royalties		Acreage Limits
Alaska	10 years	One 5-year term if drilling; for duration of commercial production, up to 40 years	20-year intervals beginning 35 years after commercial production; and at end of first 40-year lease period	Variable; $1/acre minimum	Primary: Byproduct: Minimum:	10-15% 2-10% $2/acre/year	Minimum lease: 640 acres Maximum lease: 2,560 acres (5,750 for submerged lands) Maximum state holdings: 25,600 ac
Arizona	10 years	2 years if drilling; for duration of commercial production	. . . . .	Not less than $1/acre	Primary: Byproduct: Shut-in:	at least 12.5% at least 12.5% 4 times annual rental per year	Maximum lease: 2,560 acres (4 sections) (confined to 6 miles square)
California	10 years	So long as geothermal resources are produced or capable of being produced in commercial quantities, up to 99 years	10-year intervals, beginning no sooner than 20 years and no later than 30 years after commercial production	$1/acre	Primary: Byproduct: Minimum:	10% between 2% & 10% $2/acre/year	Minimum lease: 640 acres Maximum lease: 2,560 acres Maximum state holdings: 25,600 ac (includes acreage under exploration permit)
Colorado	10 years	For duration of commercial production; lacking production, at discretion of state land board	Minimum royalty: 5-year intervals	$1/acre	Primary: Byproduct:	10% 5%	. . . . .
Hawaii	10 years	So long as geothermal resources or byproducts are produced in commercial quantities, up to 65 years; 5 years with diligent drilling without production, or with shut-in well without market	15-year intervals, beginning 35 years after the lease date	State: as bid or set in lease Surface occupant: as agreed or set by Board of Land and Natural Resources	Primary: Byproduct:	10-20% 5-10%	Minimum lease: 100 acres Maximum lease: 5,000 acres, or 2,560 acres if length of tract is more than 6 times the width Maximum state holdings: 80,000 undeveloped acres
Idaho	10 years	For duration of commercial production or drilling operations to at least 1000 feet, up to 40 years beyond primary term	. . . . .	First 5 years: $1/acre Second 5 years: $2/acre Thereafter: $3/acre	Primary: Byproduct:	10% 5%	Minimum lease: all state lands within a section must be leased Maximum lease: 640 acres Maximum state holdings: interest in 50 township-and-ranges
Louisiana	At most 10 years	For duration of commercial production or development operations	. . . . .	At least $1/acre or 1/2 cash bonus, whichever is greater	Primary: Byproduct:	at least 10% at least 5%	Maximum lease: 5,000 acres
Montana	10 years	For duration of commercial production or drilling	10-year intervals, beginning 20 years after lease date	At least $1/acre	Primary: Byproduct: Shut-in: Minimum:	at least 10% between 2% & 5% set in lease $2/acre/year	Maximum lease: 640 acres
Nevada	. . . .	. . . . .	. . . . .	$1/acre	Primary: Byproduct:	12.5% 5.0%	. . . . .

TABLE 3 (continued)
State geothermal lease provisions
(from Sacarto, 1976, revised 1979)

State	Primary Term	Renewal	Renegotiation of Rentals and Royalties	Annual Rental	Royalties	Acreage Limits
New Mexico	5 years	So long as geothermal resources are produced or capable of being produced in commercial quantities if production is maintained. Secondary 5-year lease available if production is not maintained, if production is lost, Commission may extend lease in one-year increments up to three years	10-year intervals, beginning 20 years after lease date	$1/acre $5/acre for leases extended for second 5-year term without production	Primary: 10-15% (KGRA lands) Byproduct: between 2% & 10% Recreation or Therapeutic: between 2% & 10% Powerplant: 8% (net revenue) Minimum: $2/acre/year	Minimum lease: 640 acres Maximum lease: 2,560 acres Maximum state holdings: 51,200 acres
Oregon	10 years	10 years, if royalties in any year of preceding term equalled or exceeded annual rental due under lease; 5 years, if no production but discovery has been made or is deemed imminent; maximum of 50 years from lease date	. . . . .	Years 1-3: $1/acre Year 4: $3/acre Years 5-10: $5/acre Years renewed: $5/acre	Primary: 10% Byproduct: 1% demineralized water 5% other (rentals paid each year deducted from royalties due)	Minimum lease: 40 acres
Texas	(No lease terms established)			(No lease terms established)		
Utah	10 years	For duration of commercial production; or one-year terms, in absence of production, upon payment of $5/acre advance royalty	3-year intervals	$1/acre	Primary: 10% Byproduct: 10% (net proceeds)	Minimum lease: 40 acres Maximum lease: 640 to 2,560 acres, at discretion of director of state lands
Washington	5 years	So long as drilling with diligence; or upon commercial discovery, up to 20 years	. . . . .	At least $1/acre At least $5/acre upon commercial production	Primary: 10% Byproduct: at least 4% (net proceeds) Minimum: $5/acre/year	Minimum lease: 40 acres Maximum lease: 640 acres
Wyoming	10 years	So long as geothermal resources produced or capable of being produced in commercial quantities	10-year intervals	$2/acre	Primary: 10% Byproduct: 5%	Minimum lease: 640 acres Maximum lease: 2,560 acres

Federal lands. Surface access and the right to explore, develop and use geothermal resources on federal lands are joined and are controlled by the U.S. Bureau of Land Management (BLM) under the provision of the Geothermal Steam Act of 1970, except for Department of Defense and Indian Lands. In areas designated as Known Geothermal Resources Areas (KGRA's), all leases are by competitive bidding according to schedules developed by the Bureau of Land Management. Outside a designated KGRA, potential developers may submit applications to the surface-land manager on a non-competitive basis. Information about procedures and forms may be obtained from the nearest BLM or U.S. Forest Service (USFS) office.

Procedures for exploration and development of geothermal resources on federal lands provide for phased operations beginning with activities that do not disturb the surface, such as geologic mapping, geophysical measurement or shallow-temperature gradient holes (<1000 ft or <300 m) and ending with full field development and utilization.

Limited operations designed to provide a preliminary evaluation of resource potential may be carried out before leasing, under the supervision of the surface management agency (BLM, USFS, etc.). These are done under the provisions of a Notice of Intent or other appropriate form (sample form shown in Appendix B). Generally, the environmental impacts of such a preliminary resource assessment are minimal and can be covered by a negative declaration prepared by the issuing agency.

Water laws

State water laws generally will govern the production and use of geothermal fluids for process heat, space heating and cooling, but it is important to check with the state, to confirm that this is the case. State water-use regulations, existing water uses and the characteristics of the groundwater-geothermal interface are critical factors in geothermal development. They determine the availability of groundwater for geothermal development, the reliability of those geothermal groundwater supplies and the developer's legal authority to transfer geothermal fluids to a particular place of use. Geothermal fluids may grade into standard groundwater, so it is important to carry out geothermal operations so as not to damage or degrade the area's groundwater resources (Sacarto, 1976, p. 46).

Water rights for development on state and private lands generally will be governed by one of two regulatory systems. Groundwater may be considered a public resource or trust, in which case a right to appropriate water must be obtained from the state. In other states, groundwater is considered appurtenant to the surface, and the developer's right to produce water will be secured along with surface development rights. The developer may encounter some constraints on fluid production depending on the standards set for "reasonable use."

Appropriative rights for water are quantified and have priority dates. Under that system, the geothermal developer's first concern is the availability of a water right of sufficient quantity. If a groundwater basin is fully appropriated, the geothermal developer may be unable to produce the requisite geothermal fluids. This concern is moderated somewhat by the developer's ability to obtain water rights by purchasing them or by providing existing users with replacement water supplies. Also, if the geothermal fluids are determined to be separate from existing groundwater sources, the developer, by discovering and producing this new supply, may in some states have rights to the fluid as a "developed" water.

Reliability also may be a concern under an appropriative system, since earlier water rights take precedence over later appropriations.

Diversion of water to a selected place of use generally is provided for under appropriative rights systems. This is not the case in "reasonable-use" or riparian systems, in which the

water right is attached to the surface. Development requiring transportation of geothermal fluids away from the producing property to some distant load center will be constrained where the "reasonable-use" system exists.

For federal and Indian lands, development leases probably will encompass fluid production. The developer of such lands has two concerns. In states where water is deemed a public resource, the state may challenge the inclusion of water rights in federal or Indian leases. The developer should be sensitive to these conflicting jurisdictional claims and should conform with state requirements, if possible, to avoid litigation. Reliability of the water right also should be examined. Under a federal geothermal lease, for instance, the developer is allowed to produce geothermal fluids, but is not guaranteed a reliable supply since the "rule of capture" applies. A competing producer may drain the same geothermal system.

DEVELOPMENT REGULATIONS

Exploration and field development

Once land access and development rights to the geothermal resource have been secured through purchase or lease, the preparation for exploration/development activities may begin. The initiation of an exploration/development project usually requires permits from various regulatory bodies (local, state, federal) with jurisdiction over the project. Acquisition of required permits is usually preceded by different levels of review depending on the scope of the activities proposed. A project of limited scope or one that does not require surface occupancy can be reviewed in a relatively short period of time. A project that calls for the drilling of many wells or one that includes siting of an end-use facility may require several months to a year to obtain the necessary permits. Processing times also may vary among regulatory bodies due to complexities of procedure and responsibility and/or staff workload. In some cases, it may be necessary to obtain sequential permits for large-scale projects, to assess the phases of development individually.

Private and state lands. Permit issuance authority over geothermal exploration/development projects is usually vested in several regulatory bodies with separate or overlapping jurisdictions:

1. Conditional land-use permits may be required from local regulatory bodies such as city councils, county planning departments, or county boards with local zoning guidelines, and other applicable laws and regulations;

2. Drilling permits that may specify drilling and casing requirements, spacing, bonding requirements, sump construction standards and blowout prevention equipment will be required from the state agency that administers drilling of geothermal wells;

3. Solid-waste discharge permits may be required from local or state agencies. Solid-waste discharges include used drilling mud as well as any additives which must be disposed of;

4. Permits setting limits on air emissions and water discharges may need to be obtained from state or regional air- and water-regulatory agencies in order to assure compliance with state, federal and local environmental protection laws (Clean Air Act, Safe Drinking Water Act, etc.). Disposal of geothermal fluids may be a particularly difficult problem because surface and subsurface water resources must be protected and the resource conserved. In the absence of regional or state agencies to administer the processing of such permits, the U.S. Environmental Protection Agency may do so.

Some states require an environmental analysis of the proposed project and the preparation of an

environmental document such as required by the California Environmental Quality Act (CEQA) or similar environmental legislation. The intent of such analyses and documents is to provide regulatory bodies with a detailed description of the project, full disclosure of all potentially positive as well as negative impacts and a list of recommended mitigation strategies before a decision is made on the issuance of the permit. The time required to perform such analyses and to prepare and review environmental documents (usually with public participation) varies with the scope of the project, environmental baseline collection requirements, and any legal challenges to the scope and adequacy of the environmental review. If an environmental impact report is required, several months to a year or more might be needed to complete its preparation and review.

Federal lands. Exploration (except for non-disturbing preliminary assessments), development and utilization of geothermal resources on most federal lands are carried out under lease according to the provisions of the Geothermal Steam Act of 1970 and resulting regulations.[2] Issuing leases and licensing plants are the responsibility of the Bureau of Land Management and in some cases (small research or pilot plants), the U.S. Geological Survey (USGS) . Operations on federal leased lands are supervised by the USGS Conservation Division Area Geothermal Supervisor, within the framework of Geothermal Resources Operational Orders.[3]

In general, once a lease is issued, all necessary permits are issued by the USGS Area Geothermal Supervisor. Exceptions are the permits required for emissions to the atmosphere, which are usually issued by the local air-pollution control district, and liquid emissions, which are issued by the state water resources agency or the Environmental Protection Agency, if a state has no regulatory body for water resources. The standards required on federal lands are usually the same as those imposed by the relevant state and local agencies, but enforcement of these standards on federal lands is entirely by federal agencies. In practice, federal lessees may wish to comply with local or county permitting requirements, particularly if operations are extensive or affect lands other than federal lands.

All activities on leased federal lands are carried out under a Plan of Operation submitted to the office of the Area Geothermal Supervisor. To provide for the typical phases of activity, separate Plans of Operation for exploration (one or more wells), development, utilization (plant construction), injection of spent fluid and production may be submitted sequentially or in combination, as the developer's data and commitments require.

On federal lands, most of the environmental documents to fulfill the requirements of the National Environmental Policy Act (NEPA) and state or local environmental laws during the exploration and development phases will be prepared by the federal government. An exception may be archaeological clearances for roads, drill sites or other areas to be disturbed. These are generally done by an approved professional archaeologist at the developer's expense. The developer may be asked to provide other environmental data and may need to revise and add detail to Plans of Operation in consultation with the USGS.

Most small-scale projects involving on-site uses (as is typical of direct heat applications) can be handled by a negative declaration (an analysis showing that net environmental impacts are adequately offset by the mitigating measures proposed). Public hearings and public comment are usually only necessary for more complicated projects. Formal Environmental Impact Statement (EIS) procedures may be necessary for large-scale operations, particularly those involving off-site facilities or transportation of geothermal fluids off federal lands.

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[2] Public Law 91-581, 91st Congress, S.368, Dec. 24, 1970.

[3] U.S. Dept. of Interior, Geological Survey, Conservation Div., Geothermal Resources Operational Orders, Issued under the Steam Act of 1970 (Menlo Park, CA, Jan. 1976), 30 p.

If extensive facilities are to be constructed (centralized heat exchangers, distribution lines, etc.), environmental analyses will be required. These usually are prepared by the federal permitting agency (BLM and/or USGS) at little or no expense to the permittee. They may, however, depend heavily on information provided by the lessee, so time for preparation, discussion and review of the documents should be allocated by the developer.

Production of the resource is carried out under a Plan of Production approved by the USGS and BLM or USFS. Before the plan of production can be approved, federal regulations (30 CFR 273.34 (k)) require the applicant to acquire environmental baseline data describing existing environmental parameters (air, water, noise, etc.), covering a period of one year. However, the Area Geothermal Supervisor may waive the baseline data requirement for direct-use applications and issue a negative declaration if the project will have minimal environmental impact. This waiver is done on a case-by-case basis, so the applicant/developer should consult with the USGS Area Geothermal Supervisor at the earliest possible time to determine whether a year of environmental baseline data collection will be required. Collection of environmental baseline information requires careful planning and timing, and is done at the applicant's expense. The intensity of the observations required is scaled to the scope and nature of the operations; but to avoid unnecessary delays and frustrations, plans to fulfill this requirement should be developed in consultation with the USGS Area Geothermal Supervisor as soon as possible.[4]

A permit to construct small-scale direct use facilities (one producing well and its attachments) can be issued by the USGS Area Geothermal Supervisor. Larger facilities will be licensed by the BLM, with technical advice from USGS. Many direct users of geothermal energy will not require centralized facilities, but those who do should plan sufficient lead time to obtain the necessary permits and complete environmental documents. On federal lands, only one basic permit is required for facility siting, but any off-lease facilities involve separate land-acquisition and permitting processes.

Distribution and use of the resource

The previous section examined the geothermal exploration and development processes. One of the final steps in the geothermal energy development process is to provide for utilization of the resource, either at the well site or off-site.

Private lands. To transport the geothermal fluid produced, the developer may face additional permitting requirements and problems associated with zoning compliance and right-of-way acquisition. Two scenarios are presented here, with suggestions for resolving potential problems. Scenario 1: A landowner owns property overlying a geothermal resource capable of providing his house on that property with space heating/cooling and/or hot-water heating. Scenario 2: A municipality or private investor wishes to utilize a nearby geothermal resource for a city-wide district heating and cooling and hot-water heating system.

In the first scenario, if the transportation system between the well and the house is to be located on the same parcel of property, legal problems will arise primarily in the context of zoning compliance and conditional-use permitting. Regulations and ordinances of local governments, typically cities or counties, will mandate permissible land uses and conditions under which an exception to accepted uses will be allowed. In this way, the local entity carries out its responsibility of protecting the public from potential "nuisances" created by individual citizens.

Once the geothermal system is enlarged to supply city-wide needs (Scenario 2), it becomes necessary to provide an extensive pipeline-distribution system which will cross over or run along

[4]See U.S. Dept. of Interior, The Geothermal Environmental Advisory Panel, Guidelines for Acquiring Environmental Baseline Data on Federal Geothermal Leases (Menlo Park, CA, Jan. 1977), 26 p.

many parcels of property, some of which may not be owned by the municipality. Therefore, before constructing the pipeline distribution system, the user must select an appropriate right-of-way. Selection of the right-of-way will depend upon the ability of the user to secure the right to enter and use properties which he does not own. If the property is privately owned, the developer may make an outright purchase of each strip of land the pipeline will cross. However, purchasing a portion of each needed parcel is normally too costly for private or public investors. Nevertheless, for the public user (e.g., a municipality), purchase may be possible through the power of eminent domain. This statutorily authorized power permits the public entity/user to take private property for a public purpose or use (in Scenario 2, the municipal distribution system). Just compensation, typically the market value of the land fairly determined, is paid to the private property owner whose land is taken under eminent-domain authority.

Often a more feasible alternative for both private and public users is to obtain an easement, the limited right to use each parcel crossed, from the owner of the surface estate. Different terms may be used to express this right, e.g., right-of-way permit, encroachment permit or right-of-way easement. If a user wishes to use an already-established right-of-way, such as one along the side of a public road, he must generally obtain a permit from the appropriate governmental agency. This permit will not allow the user to interfere with those existing uses properly being exercised by others. Should the user decide that his pipeline must occupy a specific area already being utilized by another, it may be possible to relocate the other party's system within the same right-of-way. In these instances, the user will typically bear the cost of relocation. Finally, where the established right-of-way is owned by private interest (a good example being property owned by a railroad for its rail network), the user should obtain its express permission.

Federal lands. Rights to transmit power, fluids or other materials from a federal lease across other federal lands are permitted or licensed by the BLM under provisions of its "Organic Act" (Federal Land Policy and Management Act 1976). On BLM lands, no additional federal approvals are required once the BLM environmental documents are completed. On USFS lands, permits are issued by the USFS after completion of its regional planning and site-specific environmental documents. On Department of Defense (DOD) lands, permits for transmission of geothermal fluids are issued by the USGS Area Geothermal Supervisor, with DOD concurrence.

Disposal of fluids

Requirements for disposal of fluids vary widely depending on prior history of the area, fluid temperature and chemical composition. For example, in cases where effluent from an existing spring is merely diverted and the spring effluent is of high quality, return to the riparian system may be required by water laws. In other cases where geothermal fluids are of poorer quality, subsurface injection may be necessary to avoid contamination of surface water.

Relationship with existing utility systems

For most direct geothermal applications, the need of the user for both electrical and natural-gas service is reduced but not completely eliminated. Residential/commercial heating or cooling applications typically reduce electrical consumption, while industrial-process applications of geothermal energy reduce natural gas or fuel-oil demand. Therefore, some backup system or standby service is needed.

The user of geothermal energy should familiarize himself with the statutes and regulations governing a particular type of utility service. Statutes dealing with electric utilities typically require them to provide service, including standby service, to those customers within the utility's service area. However, the costs and conditions for such service may differ among various classes of customers. Outside the utility's service area, standby service for a particular user

may not always be available, e.g., where such service would require the utility to enlarge its generating facilities.

A different situation potentially exists with respect to natural gas service. Shortages of this conventional fuel supply in recent years have frequently caused existing gas supplies to be allocated among users according to a set of priorities established by the government. For example, residential and commercial uses are accorded high-priority status. Supplies in these end-use categories are curtailed only after those uses having lower priority rights to supplies are curtailed.

In examining the available options for standby service, the user should determine the cost of such service. For electrical or natural gas standby service, the cost or rate charged to the customer will vary, depending upon the regulatory framework within which the utility operates. The following example may be useful: one natural gas company divides its rates or charges to customers into two components--a demand charge and a commodity charge. The commodity in the user's bill primarily reflects the actual amount of gas consumed. The demand charge represents the annual cost of pipeline and related facilities, including the storage requirements for natural gas held in reserve for standby needs. While the proposed use of the geothermal system should reduce natural-gas consumption and, therefore, the commodity charge, it may not greatly affect the fixed demand charge. The utility would likely wish to continue recovering these fixed costs through higher rates charged to standby users.

In summary, the user should recognize that he will likely require some standby service where geothermal energy is used directly. In the early stages of planning for direct utilization, the user should secure assurances of new or continued standby service and learn of any differences in costs for this service. Where the user desires natural gas or electrical backup service, the appropriate local utility should be able to provide him with information on the above and to answer any other questions raised by the need for supplemental energy.

ENVIRONMENTAL ISSUES

The development of direct-heat applications of geothermal energy share many of the same potential environmental problems as electricity applications, although they are likely to be far less serious. Careful planning to avoid environmental problems, coupled with appropriate mitigation measures for the problems which cannot be avoided, can bring impacts to acceptable levels, at costs well below those required for electricity applications. Environmental issues to be considered in project planning and implementation include:

1. Land use. Any geothermal project, by virtue of the fact that the land use is changed, may be in conflict with previous uses of the land for recreation, agriculture, housing, etc. However, the conflicts are usually far less serious for direct-heat applications than for electricity production and may be minimized by careful siting in non-conflict areas.

2. Fish, wildlife, and natural vegetation; endangered species of plants and animals. Whenever natural areas are disturbed or changed to accommodate another use, natural habitats for wildlife and plants are either destroyed or altered. This kind of impact cannot be prevented, but with careful project planning, direct-heat facilities (wells, distribution systems, access roads and end-use facilities) may be sited to avoid unusual or unique habitats and critical habitats for endangered species. Negative impacts to fish and other aquatic organisms can be avoided by simply preventing geothermal discharges to aquatic bodies or by maintaining those discharges below harmful levels.

   To obtain information and planning assistance regarding potential problems with fish, wildlife and natural vegetation, contact the appropriate state or federal agency in the project

area, e.g., local U.S. Fish and Wildlife Service office or equivalent state office.

3. Air quality. Natural geothermal fluids typically contain various noncondensable gases (e.g., hydrogen sulfide) and other components (e.g., mercury, arsenic, boron) that have presented rather serious environmental problems for geothermal electricity production; however, these problems can be virtually eliminated for direct-heat applications by simply using closed-loop systems that prevent gaseous emissions. Of course, certain emissions are inevitable during well drilling and flow testing, but such activities are of short duration and usually do not result in serious long-term environmental degradation.

4. Water quality. One of the most serious water-quality concerns is that geothermal fluids released to natural aquatic bodies will degrade water quality and result in negative impacts to fish and other aquatic organisms. The disposal of toxic fluids is closely regulated in most states, with no discharges permitted. Direct-heat projects should be designed to avoid or minimize equipment failure resulting in accidental releases of fluids to aquatic bodies. In areas where the geothermal fluids are potable or of irrigation quality, it may be possible to obtain permits for surface discharge or cascaded uses of the geothermal fluid (e.g., irrigation) after some of the heat is extracted.

5. Hot springs. One of the most serious concerns associated with the withdrawal of geothermal fluid is its possible affect on hot spring activity. Geologic and hydrologic data are often insufficient to predict potential impact. As a result, the drilling of geothermal wells and the utilization of geothermal fluids in areas adjacent to hot springs is usually controversial and may be prohibited within a certain radius. The California State Legislature has already considered, but not yet passed, such a legislative proposal.

   In states where geothermal activities are regulated under water-rights laws, additional problems may be encountered with regard to obtaining rights to the geothermal resource (see elsewhere in this chapter for more discussion on water rights).

6. Geology. Normal site and soil-stability studies should be completed prior to any substantial exploration activity to avoid or minimize such geologic hazards as landslides, liquefaction and earthquakes. In particular, two geological hazards are usually mentioned in association with geothermal development--subsidence and induced seismicity.

   (a) Subsidence. Subsidence may be a problem in any area if net fluid withdrawals exceed natural recharge or injection. The actual incidence of subsidence depends on the nature of the reservoir and the surrounding geologic formations--in fracture-permeability reservoirs, subsidence should be negligible, whereas in sedimentary reservoirs, subsidence could be a substantial problem. In this latter case, subsidence may be reduced through a well-planned program of injection of the geothermal fluids. Moreover, such injection also conserves the geothermal resource and extends the reservoir's producing life.

   (b) Induced seismicity. Induced seismicity is generally associated with deep high-pressure fluid injection. Since such injection is unlikely to be associated with activities related to the direct-heat utilization of geothermal resources, induced seismicity is not an important concern.

7. Noise. Noise is usually a problem only during well-drilling/testing activities adjacent to residential areas, recreational areas and critical breeding areas for certain wildlife (1-1/2 miles or approximately 1 km). Noise problems can be minimized by siting geothermal facilities to avoid such areas and by applying well-known noise abatement strategies that can attenuate the majority of sound within short distances of the source.

8. Socioeconomics. Even with large-scale geothermal developments for electric power production, negative socioeconomic impacts have been quite small. Therefore, negative socioeconomic impacts from even large-scale direct-heat applications are likely to be small or negligible.

9. Archaeological/cultural resources. Archaeological resources may be disturbed during geothermal development activities. The simplest way to avoid such disturbances is to conduct thorough archaeological surveys of prospective development areas and to locate facilities in non-problem areas. Hot-spring areas, especially, were often favored Indian or pioneer sites of occupation--another reason to avoid areas immediately adjacent to hot springs for geothermal development.

PUBLIC ASSISTANCE AND INFORMATION

Government

State and federal government agencies responsible for alternative energy promotion, development and regulation are good sources of information regarding technical, legal and institutional aspects of geothermal utilization as well as sources of financial support. Staff are usually anxious to share information and to recommend procedures for the development of direct-heat geothermal projects. First contacts should be made with the state energy office (if one exists) and the U.S. Department of Energy. The Department of Energy administers geothermal programs from its headquarters in Washington, D.C. and through field offices such as the San Francisco, Nevada, and Idaho Operations offices, and the offices of the regional representatives. Most federal direct-heat geothermal programs are administered from either the San Francisco or Idaho Operations offices. Federal laboratories, especially Lawrence Berkeley, Jet Propulsion, Battelle and the Idaho National Engineering Laboratories, can also be of use when the developer has questions regarding legal, institutional and environmental aspects of direct-heat utilization. Universities, Energy Extension Service and Agricultural Extension Service offices may be helpful, as well as local Chambers of Commerce and local Economic Development Departments. The U.S. Economic Development Administration, Housing and Urban Development Agency, Farmers Home Administration, Community Services Administration and Geological Survey all have programs that may be useful to geothermal developers, from technical assistance, grants, loans and resource assessment to referrals for permit assistance.

Public

Two organizations are especially active in public assistance programs--Oregon Institute of Technology's Geo-Heat Utilization Center and the Geothermal Resources Council. The Geo-Heat Utilization Center is attached to the Oregon Institute of Technology in Klamath Falls, Oregon. The staff at the Geo-Heat Center have valuable "hands on" experience in direct-heat projects, from planning, permitting and construction to economics and evaluation.

The Geothermal Resources Council (GRC) is a non-profit organization dedicated to the dissemination of geothermal information and support of educational symposia, technical training courses, short courses and an annual meeting. The GRC publishes a directory, special reports and a monthly bulletin. Staff at the Council headquarters in Davis, California, are always willing to refer telephone inquiries to the appropriate entity. Refer to Appendix C for names, addresses and phone numbers of key direct-heat contacts for legal, institutional and environmental matters.

The National Conference of State Legislatures in Denver has published several informative docu-

ments including State Policies for Geothermal Development, Issues in Geothermal Legislation and State Policies for Geoheating. These reports provide excellent summaries of issues and problems and make suggestions for facilitating increased levels of direct-heat usage.

The American Bar Association's Geothermal Subcommittee (a subcommittee of the Natural Resources Committee) may also be a useful organization to contact.

Finally, private consultants can provide valuable assistance, ranging from identification of institutional processes and preparation of environmental impact reports to engineering and economic feasibility studies. Consult the GRC Registry or inquire within the "geothermal community" for consultants recommended for the particular need at hand.

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APPENDIX A
(from Sacarto, 1979)

State Laws and Regulations Regarding Geothermal Resources

ALASKA

Statutes: Geothermal Resources Act (1971) AK.Stat. 38.05.181
Leasing: Div. of Lands - Regulations & Statutes Pertaining to Coal and Other Leasable Minerals (1974) - 11 A.A.C. 84.700...
Drilling: Div. of Oil & Gas - 11 A.A.C. 94.730... (1974)

ARIZONA

Statutes: Geothermal Resources (1972); amend. HB 2257 (1977) A.R.S. 27-651...
Leasing: Land Dept. - Geothermal Resources (1972) T.12C.5.A.22 (under revision)
Drilling: Oil & Gas Conservation Comm. - General Rules & Regulations Governing the Conservation of Geothermal Resources (1972) T.27C.4.A.4

CALIFORNIA

Statutes: Leasing - Geothermal Resources Act (1967) Pub. Res. Code 6902...
Production - Laws for the Conservation of Geothermal Resources (1967, as amend.) Pub. Res. Code 3700...
Siting - Energy Resources Development; Conservation Act (1974) Pub. Res. Code 25000...
Leasing: State Lands Comm. - Leases & Prospecting Permits for Geothermal Resources (1970) C.A.C. 2250...
Drilling: Div. of Oil & Gas - Statewide Geothermal Regulations (1976) C.A.C. 1900...
Siting: Energy Comm. - Provisions Applicable to Geothermal Notices & Applications (1978) DRAFT

COLORADO

Statutes: Geothermal Resources Act (1974) C.R.S. 34-70-101...
Leasing: Board of Land Commissioner - Special Rules & Regulations Relating to Geothermal Resources Leases (1972) SLB #248-1
Drilling: Oil & Gas Conservation Comm. - Rules & Regulations for the Development & Production of Geothermal Resources (1976) G101...

HAWAII

Statutes: Government Mineral Rights (1974); amend. HB 3033 (1978) H.R.S. 182.1...
Leasing: Dept. of Land & Natural Resources - Regulations on Leasing & Drilling Geothermal Resources (1978) Reg. No. 8
Drilling: Reg. No. 8

IDAHO

Statutes: Leasing - Geothermal Resources Leasing Act (1975) ID Code 47-1601...
Production - Geothermal Resources Act (1974, as amend.) ID Code 42-4001...
Leasing: Board of Land Commissioner - Rules & Regulations Governing the Issuance of Geothermal Resources leases (1974; under revision)
Drilling: Water Resource Board - Drilling for Geothermal Resources (1978)

LOUISIANA

Statutes: Geothermal Energy Resources (1976) L.R.S. 30:800...; Geothermal & Geopressure Energy Research & Development Act (1975) L.R.S. 30:681

Leasing: Mineral Board - none (oil & gas model likely)

Drilling: Office of Conservation - Statewide Order 29-P (1978)

MARYLAND

Statutes: Geothermal Resources Act (1978) A.C.M. 8-8A-01...

Leasing: Not available

Drilling: Not available

MONTANA

Statutes: Leasing - Lease of Geothermal Resources (1974) R.C.M. 81-2601...
Siting - Major Facilities Siting Act (1975, as amend) R.C.M. 70-801...
Filing bottom-hole temperatures - Act to Facilitate the Discovery of Geothermal Energy Sources (1975) R.C.M. 60-127, 144,148

Leasing: Dept. of State Lands - Geothermal Rules & Regulations (1975) M.A.C. 26-2.6(2)

Drilling: Dept. of Natural Resources & Conservation - Geothermal Investigation Reports (1975) M.A.C. 36-2.8(14)

NEVADA

Statutes: Leasing - An Act Relating to State Lands (1975) N.R.S. 322.030...
Production - An Act Relating to Geothermal Resources (1975) N.R.S. 534A.010...

Leasing: Div. of Lands - pending

Drilling: Div. of Water Resources - Regulations Pertaining to Exploration Drilling (1978)

NEW MEXICO

Statutes: Geothermal Resources Act (1967) N.M.S.A. 7-15-1...
Geothermal Resources Conservation Act (1975; Chap. 272)

Leasing: State Land Office - Rules & Regulations Relating to Geothermal Resources Leases (1971)

Drilling: Oil Conservation Div. - Rules & Regulations for Geothermal Resources (1974)

OREGON

Statutes: Geothermal Resources (1975) O.R.S. 522.005...
Geothermal Heating Districts (1975) O.R.S. 523.010...

Leasing: Div. of State Lands - Geothermal Lease Regulations (1975) 75-010...

Drilling: Dept. of Geology & Mineral Industries - Rules, Regulations & Laws Relating to Exploration & Development of Geothermal Resources (1977) 632-20-005...

TEXAS

Statutes: Geothermal Resources Act (1975) V.A.C.S. Art.5421s

Leasing: Railroad Comm./Div. of Oil & Gas - none (oil & gas model likely)

Drilling: Railroad Comm./Div. of Oil & Gas - Rules Having General Application to Oil, Gas & Geothermal Resource Operation (1976) 051.02.02.000
School Land Board - Rules & Regulations Governing Drilling & Producing on Permanent Free School Lands (1974; general)

UTAH

Statutes: Water & Irrigation Laws (1973) U.C.A. 73-1-120

Leasing: Div. of Lands - Rules & Regulations Governing Issuance of Mineral Leases (1973); Geothermal Steam Lease Agreement (1973)

Drilling: Div. of Water Rights - Rules & Regulations for Wells Used for the Discovery & Production of Geothermal Energy (1978)

WASHINGTON

Statutes: Geothermal Resources Act (1974) T.79 R.C.W.
Leasing: Dept. of Natural Resources - Geothermal Leasing Policy (1978) DRAFT
Drilling: Dept. of Natural Resources - none

WYOMING

Statutes: Underground Water (1973) WY Stat. 41-121
Leasing: Board of Land Commissioner - Rules & Regulations Governing the Issuance of Geothermal Resource Permits & Leases (1975)
Drilling: Oil & Gas Conservation Comm. - Rules & Regulations (1975; general)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Notice Number

NOTICE OF INTENT TO CONDUCT GEOTHERMAL RESOURCE EXPLORATION OPERATIONS

Applicant(s)	Address *(include zip code)*
Operator	Address *(include zip code)*
Contractor(s)	Address *(include zip code)*

hereby apply for authorization to conduct exploration operations pursuant to the provisions of 43 CFR 3209 now or hereafter in force across and upon the following-described lands *(give description of lands by township, attach map or maps showing lands to be entered or affected)*

Type of operations to be conducted *(give brief description)*

Exploration operations will be conducted during the period *(date)* from to

Attached ☐ $ Surety bond ☐ Rider to Nationwide bond ☐ Rider to Statewide bond ☐ Bond to be furnished

Upon completion of exploration operations the undersigned agrees to notify the Authorized Officer that authorized exploration operations have been completed in conformance with the general and special terms and stipulations of the notice.

The undersigned hereby agrees (1) that he will not enter upon the described land until he has been informed in writing whether there are special stipulations applicable to his Notice of Intent, as to either time or method of operation or otherwise, and, if there are such stipulations, what those stipulations are, (2) that he will comply with those special stipulations, if any; and (3) that he will not enter upon the described lands until his entry has been approved by the Authorized Officer.

The undersigned agrees to be bound by the terms and conditions of this notice to conduct exploration operations when approved by the Authorized Officer.

The undersigned agrees that the filing of this *Notice* under the regulations (43 CFR Subpart 3209) does not vest or confer any preference right to a geothermal resources lease.

The undersigned agrees further that all exploration operations shall be conducted pursuant to the following terms and conditions:

1. Exploration operations shall be conducted in compliance with all Federal, State, and local laws, ordinances, or regulations which are applicable to the area of operations including, but not limited to, those pertaining to fire, sanitation, conservation, water pollution, fish, and game. All operations hereunder shall be conducted in a prudent manner.

2. Due care shall be exercised in protecting the described lands from damage. All necessary precautions shall be taken to avoid any damage other than normal wear and tear to improvements on the land including, but not limited to, gates, bridges, roads, culverts, cattle guards, fences, dams, dikes, vegetative cover, improvements, stock watering, and other facilities.

3. All drill holes shall be capped when not in use and appropriate procedures shall be taken to protect against hazards in order to protect the lives, safety, or property of other persons or of wildlife and livestock.

4. All vehicles shall be operated at a reasonable rate of speed and, in the operation of vehicles, due care shall be taken to safeguard livestock and wildlife in the vicinity of operations. Existing roads and trails shall be used wherever possible. If new roads and trails are to be constructed, the Authorized Officer must be consulted prior to construction as to location and specifications. Reclamation and/or reseeding of new roads and trails shall be made as requested by the Authorized Officer.

5. Upon expiration, conclusion, or abandonment of operations conducted pursuant to this *Notice*, all equipment shall be removed from the land, and the land shall be restored as nearly as practicable to its original condition by such measures as the Authorized Officer may specify. All geophysical holes shall be safely plugged. The Authorized Officer shall be furnished a *Notice of Completion of Geothermal Resource Exploration Operations* (Form 3200–3) immediately upon cessation of all such operations and shall be further informed of the completion of reclamation work as soon as possible.

6. Location and depth of water sands encountered shall be disclosed to the Authorized Officer.

(Continued on reverse)

7. Operator shall contact the Authorized Officer, prior to actual entry upon the land in order to be appraised of practices which shall be followed or avoided in the conduct of exploration operations pursuant to the terms of this *Notice* and applicable regulations. Operator will conduct no operations on the land unless the attached bond is in good standing.

8. Due care shall be exercised to avoid scarring or removal of ground vegetative cover.

9. All operations shall be conducted in such a manner to avoid (a) blockage of any drainage systems; (b) changing the character, or causing the pollution or siltation of rivers, streams, lakes, ponds, waterholes, seeps, and marshes; and (c) damaging fish and wildlife resources or habitat. Cuts or fills causing any of the above-mentioned problems will be repaired immediately in accordance with specifications of the Authorized Officer.

10. Vegetation shall not be disturbed within 300 feet of waters designated by the Authorized Officer, except at approved stream crossings.

11. Surface damage which induces soil movement and/or water pollution shall be subject to corrective action as required by the Authorized Officer.

12. Trails and campsites shall be kept clean. All garbage and foreign debris shall be eliminated as required by the Authorized Officer.

13. Operator shall protect all survey monuments, witness corners, reference monuments, and bearing trees against destruction, obliteration, or damage. He shall, at his expense reestablish damaged, destroyed, or obliterated monuments and corners, using a licensed surveyor, in accordance with Federal survey procedures. A record of the reestablishment shall be submitted to the Authorized Officer.

14. Operator shall make every reasonable effort to prevent, control, or suppress any fires started by the operator, and to report, as soon as possible, to the Authorized Officer location and size of fires, and assistance needed to suppress such fires. Operator shall inform the Authorized Officer as soon as possible of all fires, regardless of location, noted, or suppressed by independent action.

15. No work shall be done within one-half mile of a developed recreation site without specific written authority from the Authorized Officer. Any travel within one-half mile of a recreation site shall be over existing roads or trails.

16. Use of explosives within one-half mile of designated waters is prohibited unless approved, in writing, by the Authorized Officer.

17. If operations conducted under the provisions of this *Notice* causes any damage to the surface of the national resource lands, such as, but not limited to, soil erosion, pollution of water, injury or destruction of livestock or wildlife, or littering, operator shall, within 48 hours, file with the Authorized Officer a map showing exact location of such damage and a written report containing operator's plans for correcting or minimizing damage, if possible.

18. Violation of, or failure to comply with any of these terms and conditions shall result in immediate shutdown of field operations until deficiency is corrected. Failure to correct deficiency within the time period allowed by the Authorized Officer shall result in forfeiture of bond.

19. The Bureau of Land Management reserves the right to close any area to operators in periods of fire danger or when irreparable damage to natural resources is imminent.

20. Contractor shall be liable for assuring compliance with all terms and conditions of this *Notice* and all actions of his designated operator, agents, and employees.

21. Where continuation of the operation will result in irreparable damage to the land and other natural resources this *Notice* will be immediately cancelled by the Authorized Officer.

22. Special Stipulations:

(Signature of Applicant)	(Date)	(Signature of Operator)	(Date)

We hereby agree to the special stipulations added and made a part of this *Notice* to conduct exploration operations.

(Signature of Holder of Notice)	(Date)	(Signature of Operator)	(Date)

I hereby approve this *Notice* to conduct exploration operations.

(Signature of Authorized Officer)	(Title)	(Date)

GPO 851-317

APPENDIX C

Key direct-heat geothermal contacts for legal, institutional and environmental matters

General Information

David N. Anderson
Executive Director
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(916) 758-2360

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12th & Pennsylvania Avenues
Washington, DC 20461
(202) 633-8760

Sharon Sellars
Office of Regional Representative, Reg. IX
U.S. Department of Energy
111 Pine Street
San Francisco, CA 94111
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Morris Skalka
U.S. Department of Energy
12th & Pennsylvania Avenues
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Hilary Sullivan
Geothermal Energy Division
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1333 Broadway
Oakland, CA 94612
(415) 273-7943

Syd Willard
California Energy Commission
1111 Howe Ave., MS-59
Sacramento, CA 95825
(916) 920-7315

General Information/ East Coast

William J. Toth
Applied Physics Laboratory
Johns Hopkins University
Laurel, MD 20810
(301) 953-7100, x-3055

General Information/Institutional Aspects

R. Gordon Bloomquist
Department of Natural Resources
Division of Geology, PL 21
Olympia, WA 98504
(206) 254-1217

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Technical Information

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