

ALASKA LEGISLATURE SPECIAL COMMITTEE / SUBJECT FILES 8672

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(for state KGRA classification the area must contain at least one commercial geothermal well). This permit gives the developer the exclusive right to explore for geothermal resources for a period of three years, with the possibility of an extension for two years. No additional permits are required to conduct geophysical and geochemical surveys. A permit may be converted into a noncompetitive lease either upon discovery of a resource or earlier.

If the land under permit subsequently is classified as being in a KGRA, the developer is entitled to a noncompetitive lease. Any state land not under permit but classified as KGRA land must be leased by competitive public bid. Bidding is on the basis of a cash bonus, net profits, or other single biddable factor. SLC plans to hold the first such auction in 1976, with the bid factor being the percentage of net profits the leaseholder will pay to the state. In any case, the leaseholder will have to pay, in addition to the bid factor, rent of \$1 per acre, a minimum royalty of \$2 per acre after discovery of commercial steam, and a 10 percent royalty once production begins.

In contrast to the position of the federal lessors (BLM and USGS), SLC feels that it can handle the burden of administering a net profits bidding scheme. Since it must assemble

accounting data to compute royalties, the additional burden of computing net profits is not great enough to outweigh the advantages of this method of bidding. Among other advantages, SLC cites the fact that the small independent developer without substantial cash reserve for the large "up front" cash bonus would be encouraged to enter into the competition for leasing of state-owned lands.

Whether the state grants a prospecting permit, signs a lease, or holds competitive bidding, it must prepare an EIR. Preparing these reports has not cost a great deal of money (\$9,000 has been the highest cost), but collecting the necessary data can take several months. Since there is usually a backlog of applications for prospecting permits, the time required for processing previous applications adds to the wait. In addition, the SLC staff has numerous functions to perform other than preparing environmental reports for prospective geothermal lessees.

Another factor slowing geothermal leasing on state lands is a pending proposal to allow SLC and the federal government to trade parcels of land to consolidate their holdings. SLC is not plunging vigorously ahead with geothermal leasing until it knows the outcome of these negotiations.

The state government provides an interesting contrast to the federal government in its treatment of leasing.

According to several lease applicants, when the federal government is the lessor, it conducts extensive discussions with the lessee before the lease is signed. These discussions are to resolve major questions about environmental impacts and their management before exploratory work begins on the leased land. The state government, on the other hand, conducts many of the negotiations after the lease is signed. Although the Division of Oil and Gas (DOG), plays a role at the state level comparable to that played at the federal level by USGS, SLC and DOG do not act as closely in concert as do BLM and USGS. The potential lessee can get his prospecting permit or even his lease and then begin negotiation as to how he will develop the land. SLC even has a separate procedure (discussed in Chapter 4 of this report) by which it gives permission for development activities once it has granted the lease or prospecting permit. Therefore, in comparing state and federal procedures, one must not be misled by the fact that the federal process seems to take so much longer. The federal government includes more steps in the process of signing a lease than does the state government. In certain cases, it may take as long or longer for the state to accomplish all that the federal government accomplishes in its leasing process.¹⁸

3.4.3 Local¹⁹

Local governments have not played much of a formal role in the leasing process although they may encourage or discourage

leasing activity by others. Local officials do play a formal role by commenting on environmental reports prepared for the leasing of state or federal land.

Conceivably, a county or a city could offer some of its own land for geothermal development. Lake County may have such land, and the holdings of the city of Los Angeles in Inyo and Mono counties may be even more significant. No local government, however, has yet offered land for lease. Furthermore, the amount of land involved is a very small part of the total and thus is unlikely to exert a major influence on the geothermal development process.

3.4.4 Private Leases

Geothermal leases can also be obtained from private organizations, groups, or individuals who own land with a resource potential. So far, private landowners have been a relatively neutral influence on the geothermal development process. They have been willing to lease their land for geothermal development but have not been insistent in pushing for rapid development of the leased land. Recently a few private landholders have included performance requirements in their lease agreements, but this has been the exception rather than the rule.²⁰ In general, private landholders have not put any pressure on lessees for rapid development.

3.5 Cooperative and Joint Development Ventures

If a developer does not obtain land directly from an owner, he may obtain land from another developer who already holds a geothermal lease. Geothermal developers who share leases in a given area have shown that they can cooperate at the stage of operating a geothermal field. The experience of Magma, Thermal, and Union Oil at The Geysers is the only fully commercial example of such cooperation, but this operation has run relatively smoothly. This evidence suggests that the lessees can work together to operate a geothermal field.²¹

At the leasing stage, cooperation between geothermal developers could take two forms: (1) small developers could lease and explore fields and then turn them over to large developers for the rest of the development process; and (2) small developers could undertake the exploratory work on fields where the large developers already hold leases. So far, however, neither possibility has been widely used, so that the feasibility of future cooperation at this stage is still uncertain.

Perhaps one of the main reasons for lack of interest in cooperative ventures is that the strongest incentives are still to go it alone. One possibility that has yet to occur, but may if the market in geothermal resources gets stronger, is that a small developer who proves up a field might sell

out to a large company that has the financial strength to hold the lease for years until the geothermal resource can be used for electric power production. Thus, the small company may have no incentive to undertake cooperative ventures since its best position might often be to sell out rather than hold the lease.

However, a more important negative feature of cooperative ventures is that the operators' fees are generally 6 to 10 percent of the total cash flow for the project. This feature provides a powerful incentive to be the operator in any joint venture. It is unlikely that any company, large or small, would enter into the secondary partner's role if it had other options.²²

An additional problem has been that large companies with geothermal leases they are not developing have shown no great willingness to cooperate with small developers. In a few cases, a large lessee has allowed a small developer to begin exploration work on the lessee's land, but the arrangement has not been particularly favorable to the small developer. In one case, the large lessee allowed the small developer to proceed on one of the lessee's pieces of land but proceeded to lease all the land near the small developer's own lease in another state.²³

An often-discussed partnership arrangement for a small geothermal company is a joint venture with a utility or private industrial corporation. Both publicly and

privately owned utilities, as well as corporations with a need for large amounts of electricity, have begun to lease land with the stated objective of generating power for their own use.²⁴ Such lessees tend to have a commitment and an ability to follow through the entire process of geothermal development that may be lacking in a geothermal developer who does not produce power, particularly one involved in other activities such as petroleum development. Among private utilities, SCE's Mono Power subsidiary and SDG&E's New Albion Resources Company are both leasing land and working with developers at the leasing stage. Among public utilities and industrial users, the city of Burbank, Dow Chemical, and AMAX have all formed partnerships with developers; these partnerships start working together at the leasing stage and continue to work together through several stages of development.²⁵

3.6 Public Involvement

In general, local residents and other private citizens interested in controlling the process of geothermal development do not become involved at the leasing stage but rather in the environmental reviews and public hearings required for exploration and subsequent steps. The environmental reporting procedures built into both the federal and the

state leasing processes certainly provide opportunities for public involvement, but the public has not used them much in the past, primarily because the overwhelming bulk of the leases to date have been private ones, which offer neither the visibility nor the legal handles for intervention. In at least one case, where the potential lessee was the state, the public has intervened to stop the leasing.²⁶

The lack of public involvement is apt to change, however. At least some of the intervenors have a commitment to land use planning that argues for intervention in the leasing stage. In addition, the California Department of Fish and Game has indicated that it will oppose geothermal development in one area, Pieta Creek near Clear Lake, as being incompatible with protection of fish and wildlife resources.²⁷ This agency, and perhaps others, may reach similar conclusions about other areas. Thus, although few oppose geothermal development per se (as they might oppose nuclear development), they do feel that protection of certain areas requires either prohibition of geothermal (and other) development or very stringent controls. Therefore, even though backlogs created by the newness of the leasing process are beginning to disappear, new delays may arise from active intervention and opposition by groups and individuals concerned with land use questions.²⁸

3.7 Nonprocedural Problems

The lack of outside intervention in specific leasing decisions does not mean that the general geothermal leasing process has been free of controversy. The process has been subject to sharp attacks from different, often contradictory directions. On the one hand, the state and federal governments have felt a general pressure to increase the rate at which government land is leased for geothermal development. Some advocates see geothermal development as a relatively clean energy source that will contribute to both energy and environmental goals. On the other hand, some opponents are worried about the environmental implications of such energy development, the exploitation of public resources for private gain, and the monopolization of a new energy source by petroleum companies and a few large corporations.

The response to these pressures has produced a federal scheme that uses competitive leasing with cash bonuses to ensure that the public gets the return it deserves. The system also uses short-term leases and small acreage limitations to ensure that no organization or group of organizations monopolizes the resource.²⁹ The state scheme differs slightly in specific techniques but has responded to these pressures in similar ways.

Perhaps not too surprisingly, both the federal and the state schemes face proposals for major changes. Some of the

most commonly occurring complaints include:³⁰

1. Public resources for public use--some people want a portion of the resources on public lands set aside for development by publicly owned utilities or public agencies. They find an analogy in the set-aside provisions governing the power from many large hydroelectric dams (e.g., Bonneville Power Administration).
2. An opening for the little guy--some people want a change in the lease and cash bonus system so that small developers can get involved. They stress either a bidding system that would allow delayed payment, such as royalty bidding or net profits bidding, or greater use of the noncompetitive method of leasing, perhaps even with a noncompetitive area set aside specifically for small developers.
3. Greater incentives for serious development--some people want the acreage limits raised and the lease terms lengthened so that large corporations can invest major amounts of resources in geothermal development. These people argue that no one will invest large sums of private money until

the developer he is backing has control of enough of the resource for long enough to make the investment relatively secure. Furthermore, many industry spokesmen point out that the major firms are the only ones with adequate financial resources to bear the risks of developing and utilizing geothermal resources.

Of course, attempts to make the geothermal leasing process serve these objectives will add to the time and money necessary to crank through the process.

3.8 Proposals Made by Various Participants in the Process

3.8.1 Federal Leasing Program

- Increase staff of USGS, BLM, and the Forest Service to process lease applications faster.
- Increase staff of USGS and BLM to enable them to hold competitive lease sales at a faster rate.
- Raise the acreage limit on lease holdings, perhaps to the level of oil and gas limits (240,000 acres).
- Remove the provision that allows renegotiation of lease terms every 10 years.

- Relax the criteria that determine which land is a KGRA and thus requires a competitive lease sale.
- Process overlapping lease applications by lottery, not by declaring the overlap a KGRA.
- Give the Forest Service some continuing control over geothermal operations on Forest Service land.
- Require BLM to accept the highest bid at a competitive lease sale.
- Remove the unilateral federal authority to close down operations on federal land.
- Create tax incentives and award discovery bonuses.

3.8.2 State

- Set a required timetable for development on state lands.
- Abolish escalating rents and royalties for delayed development.
- Require developers to make public any data on areas they decide not to develop.
- Create tax incentives and award discovery bonuses.

3.8.3 Private

- Obtain an authoritative court declaration to determine ownership of geothermal resources in lands subject to a minerals reservation (it may take a separate declaration for each type of minerals reservation).
- Consider the holding of a geothermal lease without geothermal development beyond an established period of time as prima facie evidence of an intent to monopolize under the antitrust statutes.

3.8.4 Other

- Require that some portion of public lands with geothermal resources (both federal and state) be set aside for public use, either by publicly owned utilities or by federal and state government agencies.

Chapter 3

FOOTNOTES

1. Letter from USGS.
2. Ibid.
3. Ibid.
4. Letter from SLC.
5. Discussions with the Attorney General's Office.
6. Ibid.
7. See Chapter 8 for a discussion of these points.
8. Christopher D. Stone, Geothermal Energy and the Law I: The Federal Lands Management Program, Draft Report University of Southern California Law Center. September 30, 1975.
9. Discussions with USGS and BLM.
10. CEQA, Public Resources Code 21000 et seq., NEPA 42 USC 4231 et seq.
11. See 43 CFR 3300 et seq. and 43 CFR 3200 et seq. for the regulations surrounding the federal leasing program.
12. Ibid. and discussions with BLM and USGS.
13. 84 Stat. 1566 et seq. See Sections 4.4.1 and 9.3 below.
14. Stone, op. cit. Discussions with BLM and USGS.
15. See footnote 14. Discussion with Forest Service.
16. Ibid.
17. Much of the material for this section came from a review of Public Resources Code Sections 3700 et seq., and 6902 et seq., Administrative Code Sections 2250 et seq., as well as discussions with, and letters from, SLC.
18. Discussion with BLM, USGS, SLC, DOG, and various developers.

19. Information for this section came from discussions with officials of the local governments mentioned and others.
20. Discussions with officials in Sonoma, Lake, and Imperial counties. Also reviewed were several studies from the University of California at Riverside (listed in the Bibliography).
21. Discussions with Union, Magma, Thermal, PG&E, and county officials in The Geysers area.
22. Discussion with the Geothermal Energy Institute.
23. Discussion with several smaller developers.
24. Discussions with, and letters from, SCE, SDG&E, Burbank, Republic Geothermal, Magma Energy, and Imperial Magma.
25. Ibid.
26. Discussion with Lake County officials.
27. Discussion with, and letter from, the Department of Fish and Game.
28. Discussion with Sierra Club Leaders.
29. See footnotes 8 and 11, above.
30. See footnotes 8 and 11, above. Also discussions with, and letters from, BLM, USGS, NCPA, and others.

CHAPTER 4

EXPLORATION

4.1 Overview

Exploration of leaseholds for geothermal resources involves conducting a series of geotechnical survey procedures, including the drilling of temperature test holes and ultimately the drilling of two or three full-size wells. Developers normally can perform survey work short of drilling without permits or related environmental reports. However, in order to drill a full-size well on nonfederal lands, California counties require that the developer obtain a conditional-use permit from the county.¹ For the sake of maintaining good relations with local governments, developers may find it necessary to obtain use permits for drilling on federal lands as well; this is especially important for those developers who are interested in nonfederal lands in the same jurisdiction. All use permits must be based upon adequate EIRs. The problems involved in obtaining these and other permits have been the target of a good deal of criticism and the source of a number of delays in the development process.

Many of the delays at the county level, both in environmental reporting and in the issuing of permits, could be

corrected through institutional learning on the part of the private developers and the public officials involved. These problems, therefore, will probably not require any major overhauls in the system. Such learning has already occurred in the counties where geothermal development has proceeded on a large scale.²

It may be possible to accelerate this institutional learning process in counties where little geothermal development activity has taken place. The experiences of county officials in Lake, Sonoma, and Imperial counties could be particularly valuable for their counterparts in other areas of California that will have to face the same permitting and evaluation work in the coming years. Similarly, the environmental reports produced by consulting firms that have become adept at generating these documents should serve as models for consulting firms that may be producing such reports in other parts of the state.

The source of delay that will be more difficult to reduce is that caused by public hearings. Because the permits required for the exploration phase of development provide the first major chance for counties, their local residents, and private intervenors to exert influence over geothermal development, any strong local opposition to development that is going to appear will probably do so first at this stage.

The time involved in obtaining permits for drilling has varied tremendously across the state. The maximum time has been about two years in one case on private land in Lake County, while the minimum time has been eight weeks on land in Imperial County.³ However, the permitting process is becoming routinized, and processing time currently can be as low as three months in some areas.⁴

4.2 Objectives

The objectives of the developers at this stage of the process are to minimize the time and money involved in demonstrating an exploitable resource on their leaseholds. Time is required for processing permits, gathering environmental data, preparing a site for drilling, actually drilling a hole, and letting the resultant wells flow. Cost factors include the expense of the environmental report, bonds and fees required for governmental permits, mitigation technologies that the governments impose as a condition for obtaining those permits, the amount of restoration developers must undertake, and the cost of the drilling and associated activity.

Although governmental regulators are generally not opposed to development, they have several objectives in regulating the process: (1) they want to protect the environment of their area; (2) they may want to utilize the permit-granting process for ends such as the collection of

baseline environmental data and the analysis of many options, including nongeothermal ones, that might be open to the area; (3) they may want to give local residents and others a chance to be heard in the permit-granting process; (4) they may want to control the pace of development in their jurisdiction; and (5) they want to achieve a politically acceptable resolution between pro- and antidevelopment forces.

Private intervenors in the process differ in their feelings toward geothermal development, but all seem to want its environmental impacts minimized. Some may oppose any development, including geothermal development, in a given area; for these, the permit-granting process often provides the first opportunity to voice that opposition.

4.3 Significant Problems

There are several problems that must be confronted by both the developer and the county officials in obtaining drilling permits. A general one is that the process usually begins before the developer or anyone else has a good idea of what will be found or where. Developers find that predicting the location of more than one or two exploratory wells is very difficult. As a result of this uncertainty, it is difficult to project the environmental impacts of development of the lease. Of course, an EIR can analyze the impacts of the first two wells and associated exploration activities, but intervenors and government officials involved

in the process often demand analysis of the total impact of field development (including the impacts of developing a production field). This demand for projections of the impact of a fully developed field is seen by the developer as an addition to his costs and risks, and one that is unjustified because of the uncertainty of the actual shape of the development at that time.

4.3.1 Environmental Effects

At The Geysers, the drilling of geothermal wells has encountered local opposition because of a number of environmental effects related to both technical and social problems. First, the Geysers area is in the Mayacamas Mountains, which are characterized by sharp ridges and steep valleys. Because these mountains are tectonically active, drilling is technically challenging. Drillers have encountered a number of erosion problems, and geological conditions have contributed to well blowouts. Second, because of the sharp ridges and steep valleys, parts of the area have considerable natural beauty and have attracted people seeking to use the region for recreation or to reside in several small communities nearby. Although the area is not densely populated, its combination of small recreation- and retirement-oriented communities and proximity to the San Francisco Bay area has led to a conflict between these different uses for the region. Given the more than 15-year history of active development at The Geysers and the existence of something on

the order of 150 producing wells, it is not surprising that geothermal development has acquired its set of critics.

Because the characteristics of both the terrain and the particular geothermal resource being developed affect the environmental impact of geothermal development, the situation at The Geysers cannot be casually extrapolated to other areas. Nevertheless, some generalizations do appear to be valid. The following discussion of specific environmental effects encountered at The Geysers suggests those impacts that might be experienced generally.⁵

Noise. While the drilling rig itself is a fairly noisy piece of equipment, the major concern is the noise of steam being ejected from the well after a producing zone has been penetrated. Formerly, the steam was freely vented through a "blooie line," bleeding steam off at the wellhead. Fifty feet away, the noise could reach 120 dB(A). Now cyclonic mufflers, which reduce the noise to 80-90 dB(A) at 50 feet, are used. Still, this level is sufficiently annoying to local residents so that county use permits commonly stipulate that wells be shut in as soon as possible after completion.

Odor. The steam at The Geysers averages about 200 ppm hydrogen sulfide.⁶ The "rotten egg" smell of this gas can be detected by the human nose in exceptionally small concentrations, and the gas itself is toxic. During drilling, standby venting, and well clean-out, hydrogen sulfide is

unavoidably emitted. Approximately 20,000 pounds of hydrogen sulfide are vented to the atmosphere from the time the steam zone is penetrated until the well is connected to a power plant steam supply system. Although geothermal development has contributed to these emissions, there have always been natural hydrogen sulfide emissions in the area. In addition to the constant nuisance of the odor, the hydrogen sulfide oxidized in the atmosphere creates other problems, such as the presence of sulfate particulates in the air and sulfur dioxide damage to plants. Generally, the terrain creates turbulent air flows that encourage mixing of any hydrogen sulfide emissions with a large volume of air, an action that disperses the pollutant. Unfortunately, on calm days the sulfide tends to stay confined in ground-hugging air masses in the narrow valleys. If the circulation pattern is unfavorable, these air masses may concentrate in populated areas, giving rise to local complaints.

Erosion and landslides. Both roads and well pads must be graded in the steep terrain of The Geysers. Because of prior practices not requiring good compaction, adequate ditching for runoff, or careful placement, there have been instances of serious erosion and even landslides as a result of drilling-related activities. The finer material made its way into local water courses, potentially affecting spawning beds and creating siltation problems.

Such practices are no longer permitted. Engineering geologists are currently required to prepare detailed site plans to prevent such occurrences.

Sump failures. A sump is constructed adjacent to the rig itself to contain drilling mud and brines from the well. In the past, problems sometimes occurred with sumps built on steep hillsides; when these sumps failed, their contents poured into creeks and streams or percolated into groundwater. However, because of more stringent specifications in county use permits and permits from the Regional Water Quality Control Board (RWQCB), there has not been a sump failure for some time.

It should also be noted that the Geysers area is the site of a number of abandoned mercury mines. Sump failures or water contamination incidents from these operations have been erroneously attributed in the past to well operations at The Geysers.

Blowouts. On rare occasions, due to ground movement, surface instability, or a complex of factors, wells have blown out at The Geysers. In April 1975, Union's well GDC 65-28 near the Little Geysers was being vented and discharged a light blue-green serpentine material which killed vegetation in a 0.14 square kilometer area around the well.

Since there has been little experience with drilling activities in other geothermal resource areas, it is difficult to predict the sort of environmental problems that could constrain well operations. Just as there are some

impacts which are characteristic of The Geysers, other resource areas will likely have unique problems associated with drilling. These may become the focus of major debates before the agencies whose permission is needed to begin well drilling, as has happened at The Geysers. Some of the major impacts that could occur are summarized in the paragraphs below.

Brine disposal. In the more common, hot brine resource areas in California, a considerable volume of fluids may be produced during the testing and drilling of wells. Unless disposed of properly, these wastes could cause significant problems if they ended up in groundwater or surface streams, because some of the brines contain toxic materials (fluoride and arsenic). In the Imperial Valley, brines have been ejected to ponds, normally for temporary storage. Although the ponds must have impervious linings, this raises the question of groundwater contamination. More recently, fluids have been ejected to removable tanks and trucked to Class I or II disposal sites for permanent disposition. Transporting waste fluids out may involve considerable expense, thus increasing the incentive to reinject the waste.⁷

Air quality. Many geothermal resource areas are in regions of relatively pristine air. Any degradation of air quality may be resented by the public; furthermore, it may be prohibited by law. Pollutants could come from the

vehicles serving the drilling operation, the diesel engines on the rig, and the well itself. Even in hot water resources, some steam may escape during drilling; since hydrogen sulfide is a common constituent, it, along with other contaminants, could create problems.

Subsidence. There is speculation that, as geothermal fluids are withdrawn, the surface may settle. In most areas this phenomenon presents few problems. However, in the Imperial Valley there is an extensive gravity-fed irrigation and waste water collection system serving the large agricultural industry of the valley. This system could be disrupted by even minor changes in relative elevation.

Wildlife habitat destruction. Certain geothermal areas, especially in remote locations, are within or adjacent to important grazing, nesting, or migration areas for wildlife. The magnitude of disruptions at existing sites has been minor, but potential destruction of even a small fraction of these wildlife habitats may result in strenuous opposition.⁸

Noise. Even in a hot water resource, some noise from ejection of flashed steam will be created. In most cases few people will be disturbed.

Conflicts with other uses. Often geothermal resources are found in areas already committed to other uses. In some cases geothermal operations are compatible with the original uses; in other cases, they are not. Some concern has been

expressed over the loss of agricultural production and wildlife habitats due to the use of Imperial Valley land for wells and support facilities, but there appears to be no strong belief that geothermal development is completely incompatible with continued agriculture in the valley. In contrast, officials in Napa County are reluctant to approve any drilling for fear of an adverse impact of hydrogen sulfide emissions on vineyards. Also, the effects of geothermal development within national forests have been the subject of concern.

For most of the impacts mentioned, some sort of mitigation technique to eliminate the objections raised either exists now or could be developed. If significant resistance to drilling due to adverse environmental impact can be foreseen, the benefits of timely efforts to devise acceptable mitigation strategies are accordingly increased.

4.3.2 Data Collection and Analysis

Another problem of the permit-granting process is the time required for collecting and analyzing data about the factors discussed above. In some areas, previous applications for geothermal drilling permits were apparently the first activities to require formal environmental reporting under CEQA. These first reports necessarily required substantial data gathering. Similar situations could arise in cases where geothermal exploration is the first important development activity, creating a need for generation of new

environmental data. Consequently, the government granting the permit will often lack much of the required background data on environmental conditions, such as the quality and flow pattern of ambient air, the presence and quantity of vegetation and wildlife, and the basic geology of the area. Collecting these data takes a significant amount of time. Once they have been collected, however, both the environmental consultants and the permit-granting authority can use them for a variety of purposes.⁹ The unfortunate problem for geothermal development has been that a few geothermal developers have had to pay the time and money costs of gathering background data that the county will then be able to use in analyzing all development, both geothermal and nongeothermal. In a sense, therefore, the costs of early geothermal EIRs have subsidized some subsequent EIRs or made them less costly.

The fact that geothermal wells were the first activities in the area to have to undergo the environmental reporting process has also meant that developers, regulators, and intervenors were all very new to the CEQA process. This is particularly true for specific environmental effects related to geothermal development. Therefore, each had to spend a significant amount of time learning what was required and how to respond to the requirements. Many developers prepared EIRs that regulatory actors later found unacceptable. When this occurred, a new, expanded EIR had to be

prepared. Although this trial-and-error process was time-consuming, it was the way in which environmental consultants, developers, and regulatory agencies learned what was acceptable.

4.4 Interactions with Governments

4.4.1 Federal

The federal government gets involved in the permit-granting process when the developer wishes to drill on federal land. USGS must approve the developer's general plan, and BLM and USGS must supervise the actual drilling and associated activities.

BLM has a dual role. As issuer of leases it is concerned with all federal land and rights subject to the Geothermal Act. As land manager it is concerned only with the so-called National Resource lands. The Forest Service has a parallel management role on the National Forest System lands, i.e., determining whether to lease and, if so, under what conditions. After leasing, the Forest Service continues its managerial responsibility in review and approval of operating plans in cooperation with USGS and acts as the primary observer to assure compliance with this agency. USGS has the ultimate authority for enforcement.

Once a lease is issued, and prior to the commencement of operations on the lease, a plan of operation must be submitted to USGS for approval. This plan is evaluated for environmental impact by means of an Environmental

Analysis (EA) prepared by USGS. It is site-specific and addresses in detail the proposed operations. The time involved in preparation of an EA is one to three months. From this analysis a decision is made as to whether or not the proposed operations would be a major action affecting the environment. If the decision is positive, an EIS must be prepared; if negative, the plan of operation is approved if the land management agency concurs.

Special lease stipulations can be added to leases prior to issuance as a result of an EAR, and special conditions governing operations can be added to the approval of a plan of operations as a result of an EA.¹⁰

In some states, USGS and BLM will approve such activities on the basis of a rather short, informal environmental report called an Environmental Assessment. In California, the state government has asked that the federal government use a full EIS and BLM has agreed. Although federal lessees have been advised that local conditional-use permits are not required for drilling on federal lands, most drillers also apply for and obtain local conditional-use permits. However, Burmah Oil in Lake County has refused to do so, and Magma Company in Imperial County has done so only under protest. USGS maintains that in general it applies the same standards as would the state DOG and the local government, but some of the local governments dispute this. These local governments argue that developers are required to undertake fewer mitigation and restoration activities when drilling on federal land.

4.4.2 State

The state gets involved in the permit-granting process in a number of ways. If the state owns the land on which exploration activities are to take place, SLC must give its permission for those activities to take place. The prospecting permit or lease both give permission for initial activity, but full-scale well drilling requires a separate approval on a well-by-well basis, as is the case with the federal government. Any driller on nonfederal land must get a permit for his drilling activities from DOG. Since the process of drilling and testing the wells involves discharges into the atmosphere and other discharges that may enter the water system, the developer must get permits both to construct and to operate from the local APCD and a discharge permit from BWQCB. The state is also involved in the environmental reporting process, because the environmental report prepared for any lead agency must be sent to the State Clearinghouse for circulation to all state agencies that may have an interest in that activity.

4.4.3 Local

The lead agency for the permit-granting process is usually the local planning commission. In some cases,

activities will go by appeal from the planning commission to the County board of supervisors. In Sonoma County, the planning commission had granted a blanket conditional-use permit to Union Oil, so the lead agency for Union Oil's permits became the local APCD.

The local planning commission gets involved because no area in California is currently zoned to allow geothermal drilling. Therefore such activity requires a variance in the form of a conditional-use permit. To drill anywhere in the state, the developer needs a permit that specifies the conditions he must meet in order to drill in a given zone. In contrast, petroleum drilling is often an allowable use in certain areas of the state; as an allowable use, it receives a categorical exemption from the environmental reporting requirements of CEQA. In areas where it is not an allowable use, petroleum drilling may still receive a negative declaration. That is, procedures for petroleum drilling are so well known and are felt to exert such minor impacts when operated properly that the lead agency is willing to declare that the environmental impacts are not significant enough to warrant a full-scale environmental impact study.¹¹ So far, only Lake County has been willing to make the same kind of declaration about geothermal drilling, and that only recently. Several other counties are considering such a process.

4.5 Interactions with Nongovernmental Participants

This chapter has already pointed out that the permit-granting process provides the first opportunity for local residents and other private intervenors to become involved in the geothermal development process. They are often outside the leasing process but are almost always able to participate in the procedures for granting use permits. These intervenors are divided into two groups: those who are against any geothermal development in a given area; and those who want mitigation of, or financial compensation for, the impacts of such development.

In responding to the pressures exerted by these groups, local regulators are often led to broad interpretation of the CEQA requirement for the use of mitigation measures. In fact, many local regulators feel that developers have a chance to reduce their political problems if they develop better procedures for mitigating noise, odor, and surface impacts. The same regulators often believe that developers do not share these interests. Accordingly, regulators look to the environmental documents, hearings, and their own investigations to learn about mitigation technologies. They then insist that the developers either adopt such technologies or justify not doing so.

Environmental consultants are another group involved at this stage. Since the geothermal development process has required environmental reports, several consulting firms

have specialized in the preparation of environmental reports for geothermal development. Originally, many of these firms were hired by developers to prepare the necessary reports. Because local regulators were dissatisfied with the results and are responsible for EIR certification under CEQA, they started choosing the consulting firms themselves, although the developers continued to pay the bills. Local regulators found the consultants they chose were much more satisfactory for their purposes. The group of consultants these local regulators use is small enough, and has been used often enough, so that they are beginning to develop a background of data and knowledge in this area. Thus, the time required to collect and analyze environmental data surrounding geothermal drilling activities should eventually decrease.

The whole permit-granting process has become embroiled in the general politics of the counties and the formal or informal agreements that local regulators must work out between prodevelopment and antidevelopment forces.¹²

4.6 Proposals Made by Various Participants in the Process*

4.6.1 New Procedures

- Reduce bonding requirements for wells.

*See also other relevant proposals in the comparable sections of Chapters 9 and 10.

- Increase the state and local staff that supervise operations.

4.6.2 Responses to Existing Procedures

- Start application process earlier.
- Stockpile permits.
- Obtain one permit for several wells.

4.6.3 New Technologies

- Use slant drilling.
- Use new noise abatement devices.
- Use new exploration technologies.

4.6.4 Supplies

- Increase supply of drilling crews and drilling rigs.
- Increase supply of exploration experts.

Chapter 4

FOOTNOTES

1. A county could establish a zone where geothermal development might proceed without a separate permit, but no county has yet done so.
2. Several observers reject this optimistic view of the process; the report discusses the issue in more detail in Chapter 9.
3. Discussion with staff from several Lake County agencies.
4. Compiled for permit data from various counties. See the chart of permit times in Chapter 9.
5. All of the material for the following sections comes from environmental reports filed with Sonoma County.
6. Other pollutants beside hydrogen sulfide are present in the steam, including arsenic, lead, mercury, radon, and boron, but they do not present significant hazards at this time.
7. According to the Geothermal Energy Institute, Union, Phillips, and Chevron have demonstrated reinjection technology in the Imperial Valley.
8. Some people feel that geothermal development will have little effect on wildlife and may actually be beneficial.
9. Of course, much of this information may be too site-specific or cover the wrong parameters for some uses.
10. Letter from Area Geothermal Supervisor, USGS.
11. This situation may change in the future to one in which more formal environmental procedures are required.
12. For a discussion of how the political economies of the counties and the resulting political agreements affect the process of geothermal development, see Chapter 12.

CHAPTER 5

SELLING AND UTILIZING THE RESOURCE

5.1 Overview

Geothermal development can be divided into two phases: the first includes leasing, exploring, and proving up the existence of resources; the second involves developing the production field, the power plant, and the transmission lines. In part the reason for dividing development into these two phases is that the relative magnitude of the leasing and exploration work, involving capital outlays on the order of \$1.5 million to \$5.0 million for a successful field, is less costly than building a power plant, production wells, steam pipes and related facilities (on the order of \$30 million), although the difference in cost is reduced when unsuccessful exploration is accounted for.¹ Another reason for the division is that normally a new party--the electricity producer--enters the process formally, once the resource is proven and is the one who will make much of the additional investment. Finally, the major decisions about the use of a geothermal resource are made between these two phases. To date, these decisions have been largely encompassed in the sales contracts.

Generalization about sales agreements is necessarily difficult, since the only ones that have been negotiated at this point are those at The Geysers. In some cases, the

seller and buyer are different parties; in others, as noted in Chapter 2 a single organization (e.g., city of Burbank) may be the leaseholder, driller, developer, and power generator. However, even in the latter case a resource use decision must be made; such decisions closely parallel those involved in negotiating a sales contract.

In order to justify commitments to geothermal development and other resource commitments, two classes of conditions must be met.

First, a utility or other operator must justify commitments of resources to geothermal development in terms of the other available investment options. The very limited potential for expanding hydroelectric power, high price and questionable supply of oil and gas, safety concerns and potential price increases for nuclear plants, and similar problems with coal, tend, on balance, to favor geothermal development. This is so in part because of the relative costs of energy from various sources. Also, power suppliers are presently having great difficulty in predicting the costs of building future generating capacity, both the costs and availability of fuels and even electricity demand. In such circumstances, geothermal energy can be very attractive because the scale for efficient geothermal plants (100-200 MWe) allows much smaller and less expensive additions to capacity with somewhat more predictable operating costs.²

The other set of conditions deals with the characteristics of a particular geothermal resource. For example, production

fields will not be drilled unless the leaseholder is sure that he will be able to sell or use the geothermal product. Likewise, a utility company or other user will not invest in a power plant unless it is convinced that the plant technology is reliable, that it will provide electricity at reasonable costs, and that the reservoir is both sufficient and reliable. Although the technology for power production at the Geysers steam field has been generally accepted, technologies for power production from other geothermal resources have not been accepted by American producers.³ Until such technologies have been demonstrated to the satisfaction of utilities and other users, it appears that, while leasing and exploration activities may proceed, utilization will continue to lag. With respect to such technologies, the government can influence the pace of development in several ways: (1) its agencies can buy geothermal resources; (2) it can support activities to demonstrate the viability of various generating technologies; and (3) it can help support privately sponsored demonstration projects.

5.2 Considerations in Developing Sales/Purchase Agreements

5.2.1 The Seller

By the time a geothermal field is sufficiently proven to allow sales negotiations to begin, the seller has invested, given present experience, a minimum of \$1.5 million to \$2 million.⁴ Consequently, he would like to negotiate a sales agreement that would include an acceptable price and a

guarantee of minimum purchase. However, he faces several problems in trying to achieve this goal. The first is his need to start a stream of revenue as soon as possible.

While the agreement that eventually emerges as to sales price can be expected to reflect the costs of the time between development investment and power plant operation, the seller will feel strong pressure to get things under way as soon as possible. This pressure is apt to be most intense for smaller sellers, since their costs of financing investments generally run higher and since they are less likely to be able to cope with delays.

A second problem facing the seller is the relative shortage of buyers, especially in comparison with those for other energy sources. The Geysers, with PG&E's monopsony powers under agreement with Union, Magma, and Thermal and ownership of the transmission lines out of the area is an extreme example; nonetheless, the limited number of users at a given site is apt to be a general condition.⁵ Geothermal steam or hot water cannot be transported very far economically without major temperature drops. Thus, users are likely to be those who can site their end-use facilities (e.g., chemical companies) at the electricity generation site or those with established transmission lines between the generation site and their market area. In any event, there will be only a limited number of possible users for any given geothermal field.

Finally, the monopsonistic nature of the market implies a relatively weak bargaining position for the seller, both at

the time of the sale and over the life of the contract. The initial contract has to be on the order of 30 years, the normal life-span of a power plant, and offers little possibility for modification or replacement. The nature of the problem for the seller is not so much the specific issues that might arise over a long-term contract, but rather the difficulties inherent in negotiating such agreements when there are few routes for escape before the end of the agreement.

The present contracts at The Geysers involve several features which the sellers feel are unfavorable. The basic contract was negotiated at a time when the developer (Magma) was eager to obtain revenue from its investment and the buyer (PG&E) was skeptical of the feasibility of producing electricity from geothermal resources. The arrangements, which were optimal under those conditions, now are the cause of some dissatisfaction among steam suppliers. For example, the steam suppliers are paid solely on the amount of electricity generated, with no requirements for any minimum amount of production. The contract also gives PG&E first refusal rights to any steam produced on the contracting developer's lease within a designated area. However, as a result of operating experience, PG&E has felt safe in reducing the size of the contractually dedicated holdings in recent steam purchase contracts. Nonetheless, this set of arrangements may be discouraging other potential buyers from approaching

the steam developers. Currently, PG&E has been the only buyer at The Geysers, although NCPA has entered into a steam development and purchase agreement with RFL, as noted above, and several other organizations are now beginning to negotiate with steam developers for purchase arrangements.

5.2.2 The Buyer

The buyer faces a set of problems of his own in negotiating the purchase of geothermal energy. His basic interest lies in obtaining a reliable source of energy at a predictable price for at least the life span of his power plant (25 to 35 years). Thus, one set of problems concerns the various kinds of uncertainties associated with geothermal energy, such as the life of a geothermal field, the reliability of the technology needed to convert the energy into electricity, and the (increasingly remote) possibility that cheaper alternatives may become available.

A second set of problems arises over the viability of the power plant itself: geothermal generating plants appear to have neither alternative uses nor alternative sources of energy, whereas there is at least some ability to fire conventional thermal power plants with coal, fuel oil, or natural gas and to change the fuel source over the life of the plant.

The size and location of geothermal plants present some other problems, as well. Users, particularly very large ones, appear to be strongly interested in developing large facilities and may, therefore, find making geothermal

investment decisions relatively difficult. Remote locations raise the need for transmission facilities; these are relatively more expensive for small power sources than for large ones. The transmission issue has been raised as a problem at The Geysers for buyers other than PG&E, although PG&E has discussed wheeling with NCPA and is committed to consider wheeling arrangements on a case by case basis. It is apt to be an important issue in the Imperial Valley for plants designed to serve San Diego or Los Angeles. Such plants would, by and large, have to depend upon their output's being carried over existing transmission lines or over those planned for nongeothermal sources, since the geothermal output would not be likely to justify new transmission facilities in the near future. A major problem is likely to arise if the planned nuclear plant at Sundesert is not constructed and if its transmission lines are canceled.

Finally, the geothermal buyer suffers, at least to some extent, from a paucity of sellers. This problem, however, is not so severe as that faced by the seller, since the buyer has the option of making investments in nongeothermal plants.

5.3 Government Involvement

5.3.1 Federal

To date, the government's role at this stage is indirect. This is in contrast to its role in the drilling stage discussed

above or in the power plant construction stage considered below, where the federal government may take a very active role. There are no permits needed for the sale of geothermal resources, unless the buyer is purchasing power for resale or unless the buyer or seller happens to be a public agency bound to produce some form of environmental impact analysis in connection with its contract decision.⁶

The federal government's impact is essentially connected with research and development activities and with underwriting or reducing investment risks. For example, the government has provided demonstration grants and participated in joint ventures to demonstrate technologies for using low-temperature (150-300°F) or briny water; in addition, it has sponsored research projects for resource assessment, desalinization of water, and testing new generating technologies. Such programs will help reduce the risk for generating technologies to be used outside The Geysers. Federal research and development aimed at improving knowledge of geothermal fields can also help, by increasing the certainty of the extent and duration of the resource in a given field. The federal loan program can also play a facilitating role here by making it less risky to build power plants.

In addition to its indirect role in reducing the risk of geothermal development, the federal government--for instance, the Bureau of Reclamation--can play a more direct role as either a buyer or seller of geothermal energy.

5.3.2 State

California can play a role parallel to that of the federal government by participating in research and development activities both to improve knowledge of the extent of the resource and to demonstrate the feasibility of various generating technologies. The state's role arises from the powers of the CERCDC and from the CPUC's control over privately owned utilities.⁷ CERCDC can participate in R&D projects, although because of limited resources not on the same scale as the federal government. It can also utilize its regulatory power to encourage (or retard) geothermal development. For instance, no power company in the state will invest in geothermal technology unless it is certain that the energy commission will agree that the intended generation capacity is needed and that there will be a favorable siting decision near the field involved. CPUC also affects geothermal development via its regulatory power: firms that are not utilities are unlikely to buy geothermal energy beyond their own immediate needs, because selling excess electricity may bring them under the control of CPUC.

Finally, like the federal government, state agencies may be either buyers or sellers. The most frequently mentioned possibility is that the DWR may use geothermal energy to generate electricity for its activities in pumping water from northern to southern California.

5.3.3 Local

Local roles are apt to increase as local, publicly owned utilities become buyers and, in some cases, developers of the resource. Burbank provides an excellent case in point.

A more important local role concerns taxation; thus far, there appears to have been relatively little increase in property taxes with geothermal development prior to negotiation of a sales contract. The negotiation and contract, however, allow a value to be put on the resource involved and therefore provide a defensible basis for revaluing the property involved.⁸ This triggers major reassessments of the value of geothermal land and results in the frequently raised problem of the tax burdens rising before income, because of the delay between contract negotiation and the initiation of power plant operations.

5.4 Interactions with Nongovernmental Actors

The nongovernmental participants at this stage are almost exclusively those who are willing to consider producing electricity from a geothermal resource. Unless the participant considering power generation is a governmental agency of some sort, local residents and other private intervenors have little chance to involve themselves directly. They do have some opportunity to affect the way

CPUC controls regulated public utilities, but that power is one that involves very indirect action on this stage of the process.

Who is apt to generate power from a geothermal resource? One possibility, of course, would be the same developer-operator who discovered the commercially exploitable resource. These face three severe problems, however:

(1) they usually lack the technical expertise necessary for supervising the construction and operation of a power plant that generates electricity; (2) they often lack the stable and large financial structure that would allow them to pay the costs of building the plant and acquiring the expertise; and (3) their involvement in electricity generation may make them a regulated public utility under California law and thus subject to the jurisdiction of CPUC⁹ and perhaps of the Federal Power Commission (FPC). This third factor is one that discourages even those large geothermal developers, such as the oil companies, who have the expertise and resources necessary to construct and operate a power plant.

The second possible group of participants who might generate electricity from a geothermal resource are those corporations, such as Dow or AMAX, that need large amounts of electricity. Several of these corporations already generate much of their own electricity, so they have the requisite expertise in constructing and supervising electricity generation.

These corporations face two major difficulties. The first difficulty, as with the developer-operators alone, is the fear they have of governmental regulation and the very real possibility that producing electricity may subject them to CPUC or FPC jurisdiction. California law does allow producers that consume all of the electricity they generate to escape CPUC jurisdiction as long as no utility transmission lines are used. However, the most economic scale of geothermal plant development would imply surplus production for all but the largest users. While some companies may elect to build smaller plants, it is clear that reducing problems with selling surplus power might encourage more such development.

The second difficulty is that the power plant must be near the geothermal resources, and the corporations may have reasons for not wanting to locate their installation in that area. Consequently, what they really want to do is to produce electricity that can be traded to a utility for electricity delivered to their installation. The purpose of this elaborate arrangement would be to give the large corporation control over the cost and availability of the electricity it needs, but such an arrangement would be likely to bring it under the jurisdiction of CPUC or FPC, under current law.

A third possible group is regulated public utilities. In fact, the only geothermal electricity now being produced

comes from the power plants of such a utility, PG&E. The other two major utilities in California, SDG&E and SCE, have indicated serious interest in developing power from geothermal electricity. These utilities do not face many of the problems confronting other participants, but they do face all of the problems listed previously for other potential power generators. These include questions about the viability of the technology and the life of the resource.

5.5 Proposals Made by Various Participants in the Process

5.5.1 Helping the Seller

- Defer local property taxes until resource is sold or until revenue starts.
- Remove acres containing resources that the developer cannot sell from the amount of federal geothermal acreage he is allowed to lease.
- Insist on contracts that guarantee a minimum number of hours of plant operation.
- Sell resource by BTUs delivered.
- Sell steam or other resource at the wellhead.
- Involve the potential buyer in the early phases of development.
- Insist on inventories of spare parts for power plants and rapid repair schedules.

- Obtain loans for development from buyers.

5.5.2 Helping the Buyer

- Allow accelerated depreciation of geothermal plants for tax and rate base purposes.
- Regulate privately owned utilities to encourage investment in geothermal resources, by such methods as allowing higher rates of return for geothermal capital, listing the costs of risky technology as legitimate expenses, and so forth.
- Encourage buyers to participate in the federal loan guarantee program.
- Have ERDA actually make loans to buyers in some cases.
- Have state and federal governments build demonstration plants in areas with uncertain technologies.
- Have the buyer involved in the development process.
- Have the seller produce power himself.
- Change regulations on utilities so that developers and other potential plant operators, such as major users and government agencies, can produce electricity without becoming full-fledged public utilities.

- Have state and federal governments grant or loan money to utilities to help them build and operate demonstration plants.
- Have state and federal governments take the lead in publicizing the results of demonstration plants to potential plant builders and operators.
- Conduct antitrust activities against those who prevent potential buyers from obtaining geothermal resources.

Chapter 5

FOOTNOTES

1. Assumes roughly \$500,000 per well, \$2 million for steam pipes, and \$20 million for a 110 MWe plant itself. These cost vary widely and are offered for illustration purposes only.
2. C. H. Bloomster, "Economic Analysis of Geothermal Energy Costs," Battelle Pacific Northwest Laboratories. Sale agreement between PG&E and Union Oil Company.
3. Obviously, such technology, particularly for using hot water, has been accepted outside the United States. It is being used just over the border in Cerro Prieto, Mexico, in New Zealand, and in various other places. The sticking point is that utilities in the United States remain unconvinced that the technologies will work well enough to serve their needs.
4. This estimate of \$1.5 million to \$2 million assumes roughly \$500,000 per well for three wells, which appears consistent with past experience at The Geysers. Chevron is presently estimating such costs in The Geysers as closer to \$5 million and apparently, McCullough spent over \$1 million recently on a single well in Lake County. In contrast, however, drilling costs should be substantially lower in the Imperial Valley. In any event, the point is that proving a resource requires a substantial investment; and, once the investment is made it provides a strong incentive to realize an early return.
5. PG&E notes that its agreement with Union, Magma, and Thermal by no means gives it control of all production at The Geysers; that it has held negotiations with NCPA about wheeling power; is, indeed, legally required to at least consider such an agreement; and that CPUC has specifically found that PG&E's contracts are not anti-competitive and do not preclude access to others. However, there has been some comment that steam suppliers have been reluctant to negotiate with other buyers, for fear of damaging their chances with PG&E. Moreover, control of the lines means that PG&E will undoubtedly (very properly) fulfill its own transmission needs before wheeling for others. At any rate, PG&E has, clearly, a very strong market position at The Geysers.

6. The Federal Power Commission regulates purchases for resale. For federal agencies, such analyses would be required by NEPA. The same general point about absence of permits applies for state and local agencies, as well. Here, any required permits would be subject to the environment reporting requirements of CEQA.
7. See Chapter 10 for a full discussion of CERCDC.
8. Interviews with Sonoma County Assessor's Office. Some commentators have raised the possibility of even earlier tax increases, but there is no firm evidence of this.
9. California Public Utilities Code 218. Assembly Bill 4009 would exempt sales of geothermal electricity to utilities or single customers from CPUC jurisdiction. PFC jurisdiction would apply to sale for resale.

CHAPTER 6

POWER PLANTS AND PRODUCTION FIELDS

6.1 Overview

Bringing power plants on line is the principal influence point for increasing the rate of geothermal development. There are two essentially separate situations--one at the Geysers area, and the other in the rest of California:

1. Accelerating the licensing process for power plants in the Geysers area. (This would increase the rate at which PG&E would bring planned plant capacity on line and the rate at which other producers would develop in the area.)
2. Demonstrating the technical and economic feasibility of using hot water and other geothermal resources with characteristics different from The Geysers steam to the satisfaction of potential buyers, such as SDG&E. This would increase willingness to invest in geothermal power plants in areas other than The Geysers.

6.1.1 Accelerating the Licensing Process

At The Geysers, existing technology for both drilling and electricity generation appears adequate to develop many more power plants than now exist.¹ Also, with minor deviations in development schedules, PG&E sources have indicated that

their company would bring 200 MWe on line each year if the relevant government agencies could process the applications that fast.² Present plans call for an average of slightly over 120 MWe to be brought on line each year through 1985, bringing the total at The Geysers to 1,900 MWe.³

Each 100 MWe requires roughly 15 production wells to supply the generators. Drillers presently holding leases in the area covered by a PG&E contract could easily provide the wells needed each year if the plant builders were able to shepherd the necessary power plant applications through the review procedures.

While debate exists over the total size of the geothermal reservoir at The Geysers, PG&E sources have indicated that they feel comfortable with a total development of 2,000 to 3,000 MWe with a 30-year generating life within the area covered by their existing contract. Exploration activities outside the productive portion of this area may substantially boost the total resource available at The Geysers area.⁴

The critical factor, then, is the utilities' ability to obtain permits. All the developers in the Geysers area have indicated that they could supply steam as fast as it could be sold.⁵

6.1.2 Demonstrating the Feasibility of Hot Water Technology

Little innovation is needed at the present time to extract the hydrothermal resources. Although well drilling

and the associated permitting problems may require substantial amounts of time and money, a very large number of production wells could be drilled on existing leases with present drilling technology. However, the drilling will not lead to the generation of electricity unless someone--most likely an electric utility or a private industrial user--is willing to use the steam or hot water.

The Imperial Valley is recognized as an area with one of the highest potentials in California for large-scale development of electric power production from high-temperature geothermal brines. But experience to date has defined significant technical barriers to its development. The high-salinity brines found in the Salton Sea and North Brawley KGRAs quickly corrode and deposit scale on well casings and surface equipment. New technology to control these problems is needed before large-scale development can proceed.

Power production in any new field will probably start with small plants (5-10 MWe) to test the technology and the reservoir. In the best of circumstances, approximately two to five years will be required for the utilities to satisfy themselves that the new field can justify a large-scale development program.⁶ The government can help keep this testing period to a minimum by funding R&D, particularly in such areas as reservoir assessment and control of scale and corrosion, and by providing insurance against major loss from insufficient or unreliable reservoirs or technologies. Such government activities also help persuade utilities to test new fields and technologies.

6.1.3 Objectives at the Construction Stage

Some of the objectives of the power producers at this stage are fairly obvious: they want to build a power plant that will reliably generate electricity from a geothermal resource. Generally, they also want to build it as quickly and cheaply as possible. Of course, motives may not be as simple as they seem. In spite of existing geothermal activities by California's major utilities and vigorous opposing arguments by utility spokesmen and others, several observers have charged that utilities have an interest in moving slowly in adding geothermal capacity so that they do not handicap their arguments for adding nuclear capacity.⁷ Others have argued that the present system of regulating utility rates creates financial incentives to prefer higher capital costs to lower ones for rate-making purposes and to prefer a combination of high capital costs and low operating costs to a more equal mixture between the two, even if the more equal mixture has a lower total bill.⁸ Since the production of geothermal electricity involves relatively low-cost power plants compared to some other alternatives, several observers charge the utilities with moving slowly in building these plants.⁹

The regulators at this stage in the process have a variety of objectives, including many that are the same as those at other stages. CPUC must certify that any proposed plant will be safe, reliable, a financially

sound investment, and serve the public convenience and necessity.¹⁰ CERCDC must certify that the plant is placed in an environmentally acceptable site and that the additional capacity it represents will not exceed CERCDC's forecast of future demand for electricity.¹¹ Others must review the proposed plant's emissions during both its construction and operation; its discharges, if any, into local water supplies; its need for appropriations from local water supplies; and its compatibility with area wildlife and existing patterns of land use.¹² At the same time, all of these regulators generally want political acceptance of the decisions they reach concerning a particular power plant application. They will, therefore, give varying weights to their estimates of political acceptability as well as to their specific mandates.

At this stage of development, the motives of local residents and other private intervenors are similar to those of such groups at the drilling stage. A few of these individuals and groups want geothermal development prohibited in given areas, many want it strictly controlled, and others want it accelerated. (As previously mentioned, almost no one is against geothermal development per se, as one might be against nuclear development.) For these concerns, the building stage provides a better forum than does the drilling stage. The process is more visible, it involves more levels of government, and the consequences of wrong decisions are more drastic. Although members of intervenor groups charge that favorable decisions at the drilling stage create almost

overwhelming pressures to go ahead at the building stage, the requirements for additional permits from different regulators also provide a forum for expressing concern about the effects of development and additional mechanisms for its control.¹³

6.2 Licensing and Procedural Problems

Once a developer has discovered a geothermal resource suitable for electricity generation and has made an arrangement for power production, the entity seeking to build a power plant must obtain at least one and perhaps two major permits. Almost all entities must obtain a certification that the site involved is acceptable and the plant's addition to capacity is consistent with CERCDC's forecast of energy needs.¹⁴ If the entity is a privately owned utility, it must obtain a second major permit--a Certificate of Public Convenience and Necessity from CPUC.¹⁵ In both cases, the agencies must hold hearings; these hearings afford many opportunities for those interested in controlling geothermal development or stopping a particular power plant to have their say.

In the Geysers area of California, obtaining appropriate permits to build power plants has been the bottleneck to producing geothermal electricity. At least two power plant projects in which the resource has been discovered and the production wells have been drilled waited years for governmental permission to begin building the generating

units. Although the permits for Geysers 12, 14, 15, and perhaps 13, will have been granted by the time this report is released, developers have waited for those permits for as long as three years, and may still wait for some of them. As a consequence of this delay, PG&E's construction schedule has slid several years into the future.¹⁶

6.2.1 Environmental Impact Controversies

The decision to allow power plant construction to go forward has consequences that are often the source of major public controversy. Power plant complexes (plants, wells, and steam lines) absorb a significant amount of land; they also exert strong influence on uses of the surrounding land, making it more attractive for some purposes, such as industrial development, and less attractive for others, such as residential or recreational development.¹⁷

Environmental impacts of power plants and their associated production wells have been the subject of major controversies, many of which are unresolved. The impacts vary enough from plant to plant to make any general resolutions extremely unlikely; the chances are much better for resolutions on a plant-by-plant or area-by-area basis. A number of the environmental objections raised have had the effect of slowing the pace of development. The concerns cluster primarily in the following areas: air pollutant emissions, water pollution, noise, visual impact, localized thermal effects, sump and brine discharges, and, for saline hot water systems, the availability of cooling water.¹⁸

The Geysers. As mentioned before, the only actual experience with electric power production from a geothermal resource in the United States has been in the dry steam fields at The Geysers. Because of a number of peculiarities of the technology used there, experience at The Geysers cannot be a universal indicator of problems that may be encountered elsewhere. The production fields at The Geysers produce dry steam at roughly 350°F.¹⁹ An open-spray, direct-contact condenser system is used on present units, but this system is not planned for future units.²⁰ In this system, condensed steam is used as cooling water, so that fresh water from an outside source is not required. Because the condensed steam is a source of very high quality water and is low in dissolved solids, it is ideal for plant needs. The condensed steam is sprayed directly into the steam ejected from the turbine; the mixture is then further cooled in a mechanical draft wet tower. There is no attempt to separate spent steam from coolant. Because of the high quality of the condensate and its use as a coolant with reinjection of the surplus, there have been no brine disposal problems at The Geysers.

There are some problems with this system, however. First, since the water in the wet tower is evaporated to provide the necessary cooling, there is a net loss of fluid to the Geysers reservoir; in fact, only approximately 25 percent of the steam entering the turbine is reinjected

to the producing zone as water. There has been some concern over this operation, but so far only slight decreases in the output from existing wells have been noticed.²¹

Second, any noncondensable gases entrained in the steam ultimately are vented to the atmosphere. The most troublesome of these gases is hydrogen sulfide. Uncontrolled, a 55 MWe plant ejects about 900 tons of the malodorous gas into the air each year. Because of the poor mixing in the narrow valleys of The Geysers, the gas is not well diluted and remains a localized problem. Even though there is a fairly high ridge (3,200 feet) between Sonoma and Lake counties (all power plants so far are in Sonoma County), the air mass near the plants seems to drift over the ridge and flow down the canyon into the populated areas. For three out of 30 days tested by PG&E, ambient air quality around The Geysers plants exceeded the 30 ppb standard set by ARB. PG&E has now begun to retrofit its old plants with a catalytic iron scrubbing system and others, and plans to build its new plants with an indirect-contact, shell-and-tube condenser; this device will isolate the noncondensable gases in order to reduce the amount of sulfide emitted to the atmosphere.²²

Hot water system.²³ Hot water systems must provide proper disposal of the brines. In the Cerro Prieto field in Mexico and the Wairakei fields in New Zealand, the brine condensate is simply dumped. Most power plant systems being researched in the United States envision brine reinjection.

Assuming that the expense of reinjection is reasonable and will be borne by the plant owner, brine disposal should be manageable in most situations.²⁴

In most proposed designs--multiple stage flash, total flow, binary fluid--the geothermal resource never contacts the atmosphere, largely as a consequence of attempts to hold down scaling and corrosion in high-salinity areas. Nonetheless, at least some noncondensable gases will probably be vented, perhaps to reduce the volume of material that must be reinjected. However, the amount vented will undoubtedly be less than in a steam field, so attaching scrubbing devices to each vent should be easier.

Cooling water, however, may present some challenges. The basic conflict, especially in the Imperial Valley, is between (1) flashing some of the brines to produce a high-quality cooling water for consumptive use in wet towers, and (2) reinjecting the equivalent volume of fluids which are produced to prevent subsidence. If subsidence or reservoir depletion is not a concern, obtaining a portion of the cooling water from flashing of the brine is reasonable. However, geothermal resources are often found in remote, arid areas, such as the Imperial Valley, where the brines themselves are often the only water source available. If subsidence becomes a problem and other sources of process water are unavailable, development could be slowed or stopped.

At present there is fresh water available for irrigation in the Imperial Valley. However, the supply of fresh water is currently at a premium, and its availability and the competing demands of alternative uses pose serious problems requiring careful attention. If geothermal development occurs on a significant scale, tens of thousands of acre-feet of water will have to be evaporated to provide power plant cooling. Since this problem is widely recognized among the developers, it is receiving a great deal of attention.

Two solutions currently under investigation are (1) the use of saline water from the Salton Sea in specially designed cooling towers, and (2) reinjection of Salton Sea water (some of which must be disposed of in any case in order to prevent its escaping and damaging agricultural land) and flashing of the geothermal brines to produce cooling water. According to the developers, dry cooling towers, which consume almost no water, are not viable in this application because they would reduce the already slim temperature difference on which the plants operate.²⁵ The loss in efficiency and increase in cost resulting from a further reduction of temperature difference would be enough to eliminate any economic advantage of geothermal, as opposed to more conventional, power production. However, a recent study shows that a hybrid wet-dry tower would be viable.²⁶ Development of alternate cooling systems would be appropriate for further government-sponsored R&D work.

6.2.2 Other Controversies

Land use considerations and regionwide development issues invariably become involved in power plant siting hearings. Clearly, construction of the power plant is important to more than the local area: the placement of a geothermal power plant can affect the later siting of coal or nuclear power plants; the placement of transmission lines; and the location of industrial, residential, agricultural, and recreational activities. Thus, debates emerge over the secondary and tertiary impacts that may be associated with a given geothermal generating plant. Most of these broad issues of regional development remain unresolved.

The construction of a power plant is also the stage at which concerns about conservation of existing energy supply versus expansion of that supply come to a head. Indeed, California law²⁷ now requires CERCDC's energy demand forecast to include explicit consideration of energy conservation as an alternative to building new generating plants. This forecast then plays a major role in deciding when and where to site new power plants.

At this stage of the geothermal development process, the participants involved are required to spend time, money, and effort wrestling with the major issues surrounding all forms of energy development. Moreover, the issues that must be examined in CPUC and CERCDC hearings and in other forums have been changing rapidly and will probably continue to do so.²⁸

6.3 Interactions with Government

6.3.1 Federal

The federal government may get involved at this stage of geothermal development in one of two ways: (1) if it owns the land on which the power plant is to be built, and (2) if a federal agency wants to build a power plant. The federal government can also get involved indirectly by giving a grant or loan to an entity that wants to construct and operate a power plant.

Few rules exist concerning the federal government's involvement. If a federal agency wants to construct and operate a power plant, it will probably abide by the same rules and procedures as would a state agency or a privately owned utility. Although some possibility does exist that the procedures might be different in some way, it is not at all clear what the differences would be. The same is true for power plants to be built on federal land: no one knows exactly what will happen. The land-managing agency will be involved, and possibly the USGS; but participation by other federal agencies is very uncertain, as is the relationship of such participants to state, local, and private parties.

One problem has already arisen. A power plant operator will almost certainly be subject to the conditions imposed on the geothermal resource lessee. In addition, the producer will probably have to apply to BLM for a Special Land Use Permit.

Neither requirement is currently acceptable to most producers. Both geothermal leases and Special Land Use Permits have terms of 10 years with uncertain renewal; economic factors generally require that a plant operate for roughly 30 years. This problem is only one of the many that need some resolution before power production is likely to take place on federal lands.²⁹

The time required for federal and other participants to work out their roles in this development stage may be another source of delay in the process. The effort to clarify some of the issues through regulations under the Geothermal Steam Act of 1970 was just beginning in July of 1976. BLM and USGS are aware of the problems and have begun meeting with each other to work out solutions, but they have yet to conduct more than informal discussions with many of the other parties that will be involved.³⁰

6.3.2 State Government Influences

At the state level, the major agency has been CPUC. That agency has had the responsibility for certifying the economic advisability, the technical feasibility, and the environmental amenability of any power plants that privately owned utilities want to construct and operate.³¹ After political negotiations, the county planning commission, which must grant a conditional use permit, functions as a colead agency with CPUC, and pays primary attention to the production

wells and piping associated with the power plant. These two agencies share the lead in having EIRs prepared and in conducting the hearings. These reports are then circulated to various state agencies through the State Clearinghouse.³²

A number of other state agencies are also involved at this stage but play smaller parts. Power plants need to obtain permits from the RWQCB if water discharges are involved; from the Department of Fish and Game if stream bed alterations are involved; from the State Water Resources Control Board Division of Water Rights if allocations of surface water are involved; and from the local APCD for emissions involved in construction and operation. DOG has to grant a permit for all the drilling activities involved. If a power plant is to be constructed on state-owned land, SLC will also be involved. In the future CERCDC will play a very major role, as Chapter 10 discusses in detail.³³

6.3.3 Local Government Influences

At the local level, the planning commission must approve a use permit for wells and piping. The County Board of Supervisors might be involved as the appeals board from the planning commission's decision. Publicly owned utilities may become involved as potential constructors and operators of power plants.

As previously mentioned, it is difficult to discuss specific problems occurring in this stage of development

100

because the procedures have been changing so rapidly. In addition, only one area of the state--Sonoma and Lake counties in the Geysers field--has reached this stage of geothermal development. Therefore, producing either a definitive statement of the problems or a list of effective proposals for change is very difficult.³⁴

6.4 Interactions with Nongovernmental Participants

Many of the relationships with nongovernmental participants at this stage of development are continuations of the interactions that took place in the previous stage of development--the sale of the resource. For instance, the developer who leased the land and discovered the exploitable field remains a significant participant in the process of obtaining a permit to construct and build a power plant. As the one who will drill the production wells and construct the pipelines to take the geothermal resource from the wells to the power plant, he is also the one who must obtain the permits for these wells and piping.

Another set of nongovernmental participants are privately and publicly owned utilities other than the one applying for the permit. Publicly owned utilities have intervened in the past to argue that CPUC should deny the privately owned utilities the permits to construct particular power plants. The only interventions so far have been by

NCPA in Geyser proceedings because it believed the steam supply contracts were anticompetitive. In every case to date the CPUC ruled against NCPA's contentions.³⁵ One can, however, imagine that privately owned utilities or heavy users of electricity may intervene in the new procedures involving CERCDG for much the same reasons.

This stage also provokes activity by a whole range of suppliers. The availability, cost, and operational experience of various plant components become an issue. These plant components include both those designed for power production, such as turbines, and those designed for environmental mitigation, such as various types of treatment machinery for air emissions. Since many turbines for electric generators are custom-made, the backlog of turbine orders at turbine construction firms could markedly affect the time needed for construction and thus also the economic and environmental impacts of the power plant.³⁶

In addition, many of those involved at the construction hearings have argued that a power plant that is taken off line for a few days may exert more serious environmental impacts than one that is operating. When plants shut down, it is often necessary to vent the steam from the production wells directly to the atmosphere to prevent the wells from becoming clogged. If the plant will be off line for no more than three days, the steam suppliers would prefer to vent the wells rather than cap them because of the clogging

potential. This vented steam is, of course, not run through the plant's pollution control devices. Thus, the ability of suppliers and the power plant operator to keep the plant running becomes an issue in whether or not the power plant should be constructed.³⁷

Section 6.2 has already mentioned the intervention of local residents and others concerned about a wide range of potential impacts of power plant construction and operation at a particular site. The visibility and immediacy of impacts stemming from construction and operation make this stage of the process the one most often chosen to force the resolution of many of the serious issues confronting all forms of decisions about energy production. In general, the intervenors at this stage are the same as those found at the drilling stage. The difference in their intervention at this stage is that the debate is more focused and the impacts are presumably more predictable. Therefore, the fight may involve more people and be far more bitter.

The potential for the involvement of large numbers of people in bitter debate highlights the importance of decisions about who can become involved in this process and in what form--in particular, who can testify at the certification hearings and what forms their testimony may take. If many participants can appear as parties to the hearings, give their own oral testimony, and cross-examine other parties to the proceedings, one can expect the cost and

delay of the proceedings to increase. However, if potential participants have to give their testimony in written form and are not allowed to cross-examine the testimony of others, the cost and delay of the proceedings may decrease. Of course, shortening the proceedings in this manner may raise further questions relating in general to hearing procedures and to the ability of the hearing process to resolve the political disputes involved in the location of power plants.

Of course, the explicit function of the hearing process is to generate additional information and analysis that might help the public agency conducting the hearing reach a better decision. Nevertheless, the hearing process does more. When it allows many groups and individuals to "say their piece," it helps create acceptability for the decision the public agency reaches. For example, if a shortened hearing brings on a viable court suit, the hearing process will not have performed this less explicit function--the total procedure will be lengthened instead of shortened. The impending entrance of CERCDG into this stage of geothermal development affects this issue as well as many others.³⁸

6.5 Proposals Made by Various Participants in the Process³⁹

6.5.1 State versus Local Control

- Set time limits for local decision making.

6.5.2 Organizational Learning

- Encourage information flow from one county to another, from experienced counties to state agencies, from one state agency to another, and so forth.
- Encourage information flow from one utility to another; in particular, from PG&E to anyone else interested in building a geothermal power plant.
- Use experienced consultants to prepare EIRs that will anticipate questions the public will ask.
- Keep all parties abreast of the costs and benefits of new mitigation technologies.
- Keep all parties abreast of new power generation technologies.

6.5.3 New Procedures

- Set a higher priority among potential builders for building geothermal power plants than for building other types of power plants.
- Set a higher priority for approving geothermal power plants among those who must approve them.
- Control who testifies at geothermal power plant hearings.

- Anticipate the issues that will arrive at those hearings and prepare responses for them.
- Use federal and state funds to encourage the experimental use of mitigation technologies in power plants.
- Have governmental agencies build power plants as part of demonstration efforts.
- Have regulators insist on adequate parts inventories and repair schedules.
- Match the federal programs for studying hard-to-exploit resources (geopressured zones, hot dry rock) with state and federal programs to test technologies associated with easier-to-exploit resources.

Chapter 6

FOOTNOTES

1. The actual limits to the power capacity of The Geysers are very uncertain. The temperature and pressure at existing wells has been decreasing, but new methods of reinjection may markedly delay any major depletion of the resource. In addition, a geothermal resource may exist below the present one and thus represent additional capacity, even though it would require new drilling and production technologies to exploit. Reich v. Commissioner, 52 TC 700 (1969) and letter from Republic Geothermal.
2. Discussion with PG&E.
3. The plan submitted to CERCDC by PG&E gave the following schedule for additions to geothermal capacity:

Year	1978	1979	1980	1981	1982	1983	1984	1985
Capacity (in MWe) to be added	106	300	220	110	220	110	110	220
4. Letter from PG&E.
5. Discussions with Union, Natomas, Magma, Pacific Energy, and others.
6. Discussions with SDG&E, SCE, Chevron, Union, Imperial Magma, and others.
7. This point has been made several times in hearings and other communications to the California Assembly, according to staff of the Committee on Land Use, Resources, and Energy.
8. For a recent example of the academic literature making these points, see Robert A. Meyer, "Capital Structure and the Behavior of the Regulated Firm Under Uncertainty," Southern Economic Journal 42 (April 1976), pp. 600-609.
9. See Chapter 5 for further discussion of the motives of potential power plant builders.
10. Public Utilities Code, Sections 1001 et seq.

11. Public Resources Code, Sections 25000 et seq.
12. Discussion with the relevant state and local agencies. The JPL report also contains a description of the agencies involved in geothermal development and the responsibilities of each.
13. Discussions with Sierra Club leaders and various county officials.
14. See footnote 11. One exception concerns plants of less than 50 MWe. Other possible exceptions include plants to be built on federal land or by federal actors. See Section 6.3.1 for more discussion of the federal government's role in this stage of development.
15. Public Utilities Code, Sections 1001 et seq.
16. Discussion with PG&E.
17. Agriculture and geothermal development may be quite compatible. In The Geysers, cattle graze in areas around plants and steam lines; in the Imperial Valley, wellheads and SDG&E's thermal test loop are in, or immediately adjacent to, croplands.
18. Discussions with Sierra Club leaders.
19. The data for the discussion in this paragraph and ones immediately following were compiled from various EIRs filed with Sonoma and Lake counties and CPUC.
20. Letter from PG&E.
21. The amounts were small in numbers, but high enough to convince the federal courts that a depletion allowance was justified. Reich v. Commissioner 52 TC 700 (1969).
22. Discussion with PG&E.
23. Much of the information for this discussion comes from discussions with the developers, utilities, and regulators active in the Imperial Valley as well as from reports prepared at the University of California at Riverside and elsewhere.
24. As previously mentioned, The Geothermal Energy Institute reports that reinjection has been demonstrated in the Imperial Valley.

25. Discussion with SDG&E and Imperial Magma.
26. Letter from Chevron.
27. Public Resources Code, Sections 25000 et seq.
28. See Chapters 9 and 10 for more discussion of these issues.
29. Letter from USGS.
30. Ibid. and letter from BLM.
31. Public Utilities Code, Sections 1001 et seq.
32. Discussions with Lake and Sonoma County officials, PG&E and CPUC.
33. The relevant statutory provisions are scattered throughout the California codes dealing with the agencies involved. Reviewing the legal record of a power plant application (on file at CPUC) or talking to a power plant applicant are the fastest ways to uncover this information. The study team used all three. The JPL report also has a comparable discussion.
34. Further discussions of this point appear in Chapters 9 and 10.
35. See, for instance, CPUC's Decision #85276 in Application #53465. For an argument that CPUC was wrong, see Stanford Environmental Law Society, Geothermal Energy: Legal Problems of Resource Development. May 1975.
36. Further discussion of this point appears in Chapter 5.
37. Discussions with Sonoma and Lake county officials and various steam suppliers.
38. A more complete discussion of the influence of CERCDC appears in Chapter 10.
39. See also other relevant recommendations in the proposals sections of Chapters 5, 9, and 10.

CHAPTER 7

TRANSMISSION ISSUES

7.1 Overview

For large, central-station, electricity-generating units, the transmission of power to customers does not constitute a major factor in the total costs of such a project. However, for geothermal plants, transmission of the power may involve some special problems because geothermal energy is a site-specific resource generally located far from load centers and is used in small generating plants (10-100 MWe). Transmission of power over large distances is not much of a hurdle for large power plants in remote locations: because of advantages derived from economies of scale, transmission costs are a small fraction of the total costs. However, for the small plants that, typically, are built to utilize geothermal resources, transmission costs may represent a substantial fraction of the total cost of producing and delivering power.¹

Whether these costs are prohibitive depends on a number of other physical and economic factors; high transmission costs alone may not rule out a geothermal project. However, high transmission costs may make a geothermal venture come under closer scrutiny, especially if there is a chance that the plant may not work out technically or that the reservoir

may be rapidly depleted and the transmission line become superfluous. Pilot plants in remote, new geothermal fields may therefore be unattractive to utilities and represent a significant obstacle to expanding development, unless the utilities are confident that several hundred megawatts of capacity could be produced at the site. At this level, transmission costs would be much less of a factor. If a plant is not the first in a particular field, but is the first of a new developer (i.e., a utility or other energy producer) in the area, new lines for the new participant may be necessary. Again, the total cost of the project--compared to the alternatives available to the participant--must be carefully examined before concluding that the transmission costs are prohibitive. In general, building several transmission systems in the same area is economically impractical.

7.2 Principal Problems

If new transmission lines from geothermal plants to points of interconnection with another power system must be built, the principal difficulties will be assembling the necessary right-of-way and obtaining government approvals. These problems are not unique to geothermal resource utilization. However, in the developer's efforts to avoid building long new lines, several strategies may be employed which involve other more important difficulties. These strategies include:

1. Building plants only in those geothermal resource areas that are close to existing transmission lines or local load centers.
2. Selling power into another system that is closer than the developer's own.
3. Using a preexisting transmission system, having it "wheel" the power.

These strategies have varying significance depending on the particular geothermal field and the particular power producer.

7.2.1 Geothermal Areas Close to Existing Lines and Loads

In California, several of the federal KGRAs are, fortunately, near existing high-voltage transmission networks or near service areas which can absorb the power. These KGRAs include The Geysers-Calistoga (and the nearby peripheral KGRAs), Lassen, Mono Lake-Long Valley, Randsburg, and the Imperial Valley region.

The Geysers-Calistoga. Even in 1960, when construction on plants was first underway at The Geysers, the PG&E had high-voltage lines nearby to tap into for transmitting power out of rural northern Sonoma County. As development has proceeded, PG&E has added new lines to increase the transmission capacity and is now planning to build a major new line from The Geysers to the Lakeville substation. If PG&E's plans for additional geotherma. capacity in the area

proceed on schedule, substantial new capacity will have to be added again by 1985.² However, if energy producers other than PG&E wish to ship power out of the Geysers area, alternative, publicly owned transmission systems are quite some distance away and would require more than 100 miles of new circuits to reach an existing substation for interconnection. The significance of this situation is discussed below. For PG&E, future development at The Geysers poses no major transmission problems; but it does pose such problems for other potential producers, unless PG&E is willing to lease its facilities.

Lassen. The Lassen KGRA is very near to the high-capacity 500 kv AC transmission lines of the Pacific Northwest-Southwest Intertie. However, interconnection with the intertie is impractical for amounts of power less than 100-200 MWe because of the high cost of adding a new substation.³ Therefore, it probably would be necessary to construct new lines to tie any power from geothermal plants in the Lassen area into lower-voltage systems (for which the costs of interconnection are not so high). Since the Lassen KGRA is within the PG&E service area and is near several hydroelectric dams owned by PG&E, several opportunities for convenient interconnection with 69 kv and 115 kv lines exist. However, these lines could provide capacity for no more than 50 MWe of additional power. Further expansion of capacity from geothermal plants in the Lassen area would require construction of extensive new transmission facilities.

Publicly owned transmission lines are also relatively nearby at Shasta Dam, but these too would probably be limited to 50 MWe of additional capacity. Gaining access to these lines would also involve negotiations with PG&E because of prior arrangements made between PG&E and the U.S. Bureau of Reclamation (USBR).

Mono Lake-Long Valley. SCE and LADWP both have major transmission lines in the Owens Valley area of California to bring electricity from hydroelectric dams. These lines terminate just southeast of Lake Crowley, putting most of the geothermal areas within 50 miles of 155 kv and 230 kv lines. The 750 kv DC circuit of the Pacific Intertie is also located near this region. However, it would not be available for interconnection, at least in the early stages of development, because of the high cost of the substation that would be required. To serve communities in the Owens Valley area, the lower-voltage lines, at least for SCE, not only carry power out of the region during the high water flow in the spring but also carry power in during low water flow. Arranging system conditions to handle a continuous base load flow of power from the Mono Lake-Long Valley region may be difficult, but it would not be impossible. The maximum amount of additional capacity that could be handled on these lines is 50 MWe for the SCE lines and 50 MWe for the publicly owned lines of LADWP.⁴

Randsburg. Little activity has occurred at the Randsburg KGRA, but if it does occur, lines of both public and

privately owned utilities are nearby. LADWP transmission lines bringing power from dams on the Colorado River pass close to the area. When the fossil-fuel-burning SCE plant near Coolwater, California, is completed, 220 kv transmission lines will be very near.⁵ The exact amount of additional capacity each line could accommodate is uncertain, but the amount is unlikely to be more than 50 MWe in either case.

Imperial Valley. Each of the six KGRAs in the Imperial Valley (Salton Sea, Brawley, Glamis, Dunes, East Mesa, and Heber) are in the service territory of the Imperial Irrigation District (IID). IID has listed its intention to build 200 MWe of geothermal power plants in the area, but it is likely that other utilities will also wish to develop fields in the region. No high-capacity, high-voltage transmission lines are at present conveniently located to bring power from the Imperial Valley to load centers in the urban areas of southern California. However, SCE and SDG&E have physical interconnections with IID and hope to enter into some sort of cooperative arrangement with IID in order to avoid building their own new lines into the area, at least for the initial plants.

Other KGRAs. Other KGRAs in California are not so conveniently located in relation to existing transmission lines. Several are in areas served only by small utilities that do not have the transmission network, the loads, or the financial resources to risk supporting a geothermal venture.

The Wendell-Amadee and Honey Lake KGRAs are in areas near the service territory of the California-Pacific Utilities Company and the Sierra Pacific Power Company. The Lake City-Surprise Valley KGRA is in the service territory of a small electric cooperative, but it is also near lines of the Pacific Power and Light Company (PP&L), a larger privately owned electric utility headquartered in Portland, Oregon. Other KGRAs are in fringe areas of large utilities where high-voltage lines are rare. This situation seems to hold for Glass Mountain (PP&L), Beckwourth Peak (PG&E), Coso Hot Springs (PG&E, SCE), Ford Dry Lake (SCE), and Sespe Hot Springs (PG&E, SCE). In either case, costly new transmission lines to connect to larger systems may be required even for the initial plants in these unexploited fields.

New transmission lines for other plants. Utilities in California are planning to add large new nuclear and fossil-fuel burning power plants in remote locations both inside the state and in other parts of the western United States. In some situations, it appears that the transmission lines for these facilities will pass near KGRAs that otherwise might have a transmission problem. SDG&E is planning to build its large Sundesert Nuclear Plant near the Colorado River just outside Imperial County. The transmission lines from the plant will head almost due west to San Diego and run near several KGRAs in the Imperial Valley region. The proposed nuclear plant at Vidal could also result in SCE transmission lines passing near the Imperial Valley and the