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# Geothermal Sales Contracts

## INTRODUCTION

This paper discusses fundamental concepts to be considered in negotiating contracts for the sale and purchase of high temperature geothermal steam utilized for the generation of electric power. Although similar in some respects to natural gas sales contracts, contracts for the sale of geothermal energy are unique in many ways. In particular, the staged development of distinct power generating units near supplying wells requires contractual mechanisms to permit buyer and seller to determine collectively how and when field expansion should occur. The possibility of premature reservoir depletion and technological difficulties necessitates carefully drawn escape provisions. Responsibility for high cost gathering systems and reinjection facilities must be determined. Complex pricing formulas may reflect distributions of risks between buyer and seller. In the face of such difficult drafting problems, little precedent is available to assist the negotiator or the draftsman.

### A. *History*

The first geothermal sales contracts were probably those negotiated in 1967 by Magma Power Company and Thermal Power Company with Pacific Gas and Electric Company and the geysers field in northern California. Union Oil Company of California subsequently joined these pioneers and negotiated a similar contract with PG&E in 1970. Union later negotiated a contract with the National Power Corporation in the Philippines. As geothermal exploration has become more widespread, other companies have since negotiated "third generation" contracts in the Imperial Valley of California, the Roosevelt Hot Springs area of Utah, and the Valle Grande area of New Mexico. There may be others unknown to the writers.

### B. *The Resource*

High temperature geothermal resources may be found in steam-dominated reservoirs (i.e., the geysers) or in hot-water-dominated reservoirs (i.e., Im-

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perial Valley, Roosevelt Hot Springs, the Philippines), with hot-water-dominated reservoirs being the more common of the two. To be potentially commercial for electric power generation, a reservoir must have sufficient producibility (i.e., permeability and porosity), size, and ambient temperature for the use intended. Temperature in excess of 350°F generally is considered suitable for electric power generation.

In a hot water system the resource may be flashed to steam for use in a conventional steam turbine, or it may be maintained in a liquid state for use in a heat exchange system. The kinetic energy of both water and steam emerging from the well can have value.

The fluids separated from the steam will include condensate, which may be used for cooling tower and other purposes, and geothermal brines, which must ultimately be disposed of, usually by reinjection. The fluid also might contain sufficient metallic and nonmetallic substances for commercial extraction. Residual heat and liquids can be utilized for secondary or even tertiary purposes.

With present technology a geothermal resource can be moved approximately one and one-half miles from a producing well without sustaining unacceptable heat loss.

### C. *Contractual Setting*

Geothermal sales contracts are most often negotiated after exploratory drilling has confirmed that steam or hot water is present in a reservoir at sufficient temperature and sufficient volume to generate electricity on a commercial basis. Flow tests will have shown, preliminarily at least, that the resource can be extracted, used, and disposed of at a sustained rate. Fluid quality will have been shown to be amenable to power plant requirements.

The degree of confidence generated by previous testing will dictate to what extent buyer and seller can commit to a contract. If the long-range capacity of the reservoir to sustain production is not established, or if other technological factors have not been fully tested, then the initial generating plant will probably be small, in the range of 5 to 10 megawatts. If there is more certainty as to such factors, a larger initial plant of 50 to 100 megawatts might be contemplated. In either case additional units are usually dependent on the results of operation of the first or other preceding units and the demonstration of additional reservoir capacity.

## I. DEDICATION OF THE RESOURCE

### A. *General*

The geothermal reservoir will probably have been only partially defined at the time the seller and buyer enter into a sales contract. Ideally, the seller would like to have the option to sell to more than one buyer as this would

give the seller both flexibility of supply and competition for his product thereby enhancing both selling price and delivery rates. If there were multiple purchasers, the resource could be more speedily developed, since a single purchaser must consider the size, cost, and technical complexity of a plant, future system capacity requirements, and other factors in determining the timing and volume of the geothermal resource it will purchase. Such an ideal is often not possible because of the absence of transmission lines to entities that would otherwise be potential purchasers. In addition, if a reservoir is small with above average communication from well to well, it might not be feasible to sell to more than one buyer because of the risk of well interference or reservoir damage that might arise from independent production operations.

A purchaser will undoubtedly desire to contract for the seller's entire supply in a reservoir without being tied too strongly to construct additional generating facilities. This gives the buyer a stronger hand in negotiating in the future and permits development of the resource on a schedule more closely tailored to the purchaser's requirements for future generating capacity.

Bearing these considerations in mind, dedication of the resource can nevertheless be accomplished in any number of ways, some of which are summarized as follows:

1. The parties can dedicate a specific geographic area in which the seller holds or may acquire geothermal leasehold rights.
2. The parties can contract only for sufficient quantities to supply generating facilities as constructed.
3. The parties can contract for a finite volume of geothermal resources to be developed under the contract. The supplier is then free to sell volumes in excess of the contract amount to a third party.
4. The parties can contract for the delivery of specified volumes within contract periods, with the buyer also having a preferential right to contract for excess amounts offered by the seller during such period. If the buyer does not take, the seller can sell these excess volumes to third parties.
5. The buyer can simply be given a right of first refusal to purchase specified increments as they become available.

The contract may provide for the purchase of dry steam meeting certain quality standards, or it may provide for purchase of the entire geothermal resource, including both the steam and the separated fluids. The buyer may be permitted to utilize only the steam for electrical generating purposes, but buyer also can be given the right to utilize the residual heat and liquids for secondary or tertiary purposes. Buyer can also be given the right to extract metal or nonmetal substances contained in the geothermal solutions.

B. *Multiple Lessees*

The reservoir may be totally within the confines of leases owned or controlled by one party, but more often multiple leases with different owners will be involved. If in a multiple ownership situation one lessee proceeds with development independent of others, there may be a pressure decline in the production area that could cause migration of geothermal resources from the adjoining leases. Since adjoining landowners may suffer irreparable losses from drainage and disruption of efficient field operations, wasteful offset drilling and debilitating litigation may occur.

Sufficient land over the reservoir must be controlled by the seller to satisfy both buyer and seller that production over a long term in required amounts can be sustained without adverse interference by other operations involving the same reservoir. If such assurances cannot be given, then it may be imprudent for both buyer and seller to make contractual commitments until such time as a unit agreement or other cooperative plan of development is established.

Even if a unit agreement exists, complications still can arise. Each party to the unit will likely have the right to contract independently for its share of the geothermal resource produced from the unitized area. This means that there can be different prices for the steam and even different delivery obligations, and conceivably two different purchasers. Ordinarily the buyer will desire that sales contracts be achieved with all unit participants on an individual or collective basis. If buyer is unsuccessful in making an agreement with other unit participants who elect to take their shares of production in kind, seller can be given the obligation to perform additional drilling to make up the deficiency in production capacity.

A contract with only one unit participant can be extremely complex because it must deal with so many contingencies related to whether or not other unit participants enter into contracts with buyer.

## II. TERM

The extended time periods required to explore for, define, and develop the resource and to construct production facilities and the electrical generating facility, together with the considerable costs involved, necessitate long term contracts. The contract may be for a finite term, such as thirty-five or fifty years. Many state utility commissions will require an operating life of thirty years for the facility.

A finite term works well for the construction of a single generating plant. It does not work well where development and dedication of successive blocks of resource to a series of generating plants is contemplated. Where multiple plants are contemplated, the more practical term will be a finite term of years after commencement of generation at the final generating facility constructed pursuant to the contract.

If a contract commits a defined amount of reservoir capacity, the term could endure for a prescribed number of years after all such capacity is either dedicated to a plant to be constructed or released for failure to be used by the purchaser.

## III. DEVELOPMENT

### A. *Conditions Precedent*

Each generating unit will usually have the same set of conditions precedent to the obligations of the parties to perform. These are:

1. That a geothermal resource of sufficient quantity and quality be shown to exist.
2. That the buyer, assuming it is a utility, receive final approval from the applicable public utility commission.
3. That all permits and approvals be received from federal, state, and local resource regulatory and other agencies such as drilling and operating permits, building permits, zoning permits, and permits concerned with the construction and operation of the facilities and restoration of the surface.
4. That all state, federal, and local environmental protection permits have been obtained.

Time periods within which the conditions precedent are to be satisfied should be established. Failure to meet the conditions usually will result in termination of the agreement, with or without penalty. Because failure to obtain permits and approvals can result from dilatory conduct on the part of the applicant, diligent pursuit of the permits and approvals should be required. Failure to satisfy the condition precedent requirements can, therefore, result in a possible claim for damages, cancellation of the contract, exercise of force majeure rights, or, depending on whether a party is willing to take the risk, an obligation on the part of the buyer to make payment to seller for steam that cannot be taken, or on the part of the seller to pay for losses suffered by the buyer as a result of inability to recover investment. Such payments generally are tied to the total investment of buyer or seller, as the case may be.

If a time period is established, sufficient time must be allowed in the contract before construction must commence. The amount of time obviously depends on location of the plant, the nature of the project, and the number and types of permits required. The contract can also provide for a permit period with extensions of time, if required, or more practically, will require the parties to diligently secure permits, with construction to commence when all necessary permits have been secured.

Buyer should have access to all technical data obtained by seller and to obtain such additional data as buyer may require to perform buyer's evalua-

tion of reservoir and well performance. In addition, buyer may be given the right to conduct, or require that seller conduct, certain tests at buyer's risk and expense. All such data will be subject to confidentiality restrictions.

B. *Initial Construction*

The contract will establish the obligation of buyer and seller with regard to drilling additional wells, constructing and operating a gathering system, constructing an initial plant, utilizing secondary heat, and disposing of excess fluids.

1. INITIAL PLANT

Assuming that both buyer and seller are satisfied that there is a resource available that is capable of supplying a commercial plant or plants with an agreed generating capacity, the size of the initial plant (which may be a small commercial pilot plant of less than 10 megawatts or a full sized facility of up to a maximum practical size of 100 megawatts) must be established. The size of the plant obviously is controlled by the resource available within delivery distance limitations, the confidence of buyer and seller as to reservoir potential, and the buyer's requirements for additional increments of generating capacity.

A time period in which the initial plant must be completed can be set, with remedies, such as delay payments, established in case of delays.

2. FIELD DEVELOPMENT

The initial plant might or might not require additional field development work. If additional work is required, the contract can specify in some detail the drilling and testing that has to be performed, and the times within which they must be completed.

3. GATHERING SYSTEM

The gathering system for transmitting steam and fluids from wells to plants or to disposal facilities will comprise a steam separator, insulated lines to the plant for steam, lines to convey fluids to disposal facilities, and connections to the plant. Either the buyer or the seller can be responsible for construction and operation of the gathering system in whole or in part. As a practical matter, the seller is the more likely candidate for constructing, maintaining, and operating the system because the seller, by doing so, can more efficiently control deliveries between wells, design for each well's integration into the system, and provide for alternative emergency delivery. If the buyer is responsible for the gathering system, the seller may nevertheless have the obligation to construct and operate steam separators near the wellhead. Since construction of the gathering system requires such substantial capital expenditures, the selling price will reflect an adjustment up or down depending on who undertakes the responsibility.

4. SECONDARY USES

In a wet system provision should be made for possible utilization of hot water for secondary purposes. This is a negotiated item which can be reflected in the pricing structure. The party making secondary use of the heat must be bound not to take any action that will adversely affect the delivery and utilization of steam for power generation purposes. When neither party anticipates a use for secondary heat, the contract can provide an option mechanism whereby either party can elect to use the secondary heat if the other has not already elected to do so.

5. CONTAINED MINERALS

If the geothermal fluids contain marketable precipitates or other substances, provision must be made for one party to use them. Usually this is the seller since the precipitates are part of the commodity that he has to sell and their sale or use may be subject to payment of royalties. If extraction of such substances can best be made at buyer's facility, buyer may have the right to purchase these from seller at a negotiated price.

6. REINJECTION

That portion of the hot water found in a reservoir in a wet system that does not flash into steam, and condensate from a plant, must be disposed of. Because of the large volume of water and the fact that it often contains contaminants making it unusable for agriculture purposes, reservoir fluids usually will be disposed of by underground injection. Condensates also can be disposed of in this manner.

If the seller takes this responsibility, the seller will either retain possession and transport the fluids to reinjection wells, or if the buyer builds the gathering system, the seller will take delivery from the buyer at a point near the injection wells. The costs of injection are reflected in the price, or in the pricing formula as discussed later in this paper.

Waste fluids will usually be reinjected into the producing horizon from whence they came. This not only disposes of the waste fluids, but also provides a certain amount of reservoir stimulation. It also can provide protection in some areas against potential subsidence.

The buyer may wish to add substances to the geothermal fluid to inhibit corrosion or control air emissions. These additives may plug the injection formation or otherwise shorten the life of the injection wells. To prevent this the seller should insist on quality control of the returned fluid with the buyer paying for the removal of these impurities. In addition to establishing quality requirements for the returned fluid, the contract can require the buyer to assume financial responsibility for damage to the injection wells. If the reinjection fluids are of such poor quality that they cause significant reservoir damage or plug the receiving formation, the seller should be permitted to refuse to take them.

If the buyer assumes responsibility for disposal of waste fluids, then there will only be buyer's own self-imposed restraints on fluid quality. This approach may be convenient to the seller, but impractical. The seller has expertise in drilling and injection and a greater interest in maintaining the quality of the geothermal reservoir. The seller will be more concerned that all waste disposal not only complies with the law, as well as with the terms of its geothermal leases.

If reinjection requires pumping, seller will wish to receive power from buyer's plant free of cost. Buyer could be constrained from agreeing to such a provision, however, because of public utility commission requirements. Alternatively, the parties can agree to a sale at the lowest permissible rate.

### 7. ROAD USE

Depending on who is responsible for the gathering system, seller and buyer will to some degree find themselves using the same roads. Costs for constructing and maintaining both new and existing roads should be shared on an equitable basis.

### 8. POLLUTION CONTROL

In certain areas the geothermal fluids may contain hydrogen sulphide or other gases. Geothermal waters will usually contain unacceptable levels of chlorides or other substances. Noise must be controlled.

The burden of controlling air and water emissions can be assumed by the operator of the affected facility with the seller being responsible for wells and production facilities and the buyer being responsible for the generating plant. Since the necessity for environmental controls can affect both parties, it is not unusual to find provisions for cooperative environmental research efforts to deal with such matters on a cost-sharing basis.

## IV. SUBSEQUENT GENERATING FACILITIES

A unique aspect of most geothermal sales contracts is the inclusion of provisions relating to construction of subsequent generating units. If sufficient reserves are dedicated to the contract and if the initial generating unit and subsequent field testing demonstrate the availability of additional capacity, most contracts will provide for the subsequent sequential commitment and construction of additional generating capacity.

Because of reservoir engineering advancements, commitments to construct a new unit can be made in advance of completion of development drilling. Thus the seller will drill one or two wells to confirm the availability of the resource and will time the drilling of the balance of the supply wells to coincide with completion of the plant.

The buyer will want the seller obligated to perform the necessary drilling and testing to establish the availability of additional geothermal

resources, but the buyer also will want to retain the flexibility not to construct a plant in the face of financial limitations, limited needs for additional generating capacity, or possible limitations imposed by the public utilities regulatory agency. Generally the seller will want to benefit from the additional sales resulting from the operations of subsequent plants but will not want to be burdened with unavoidable obligations to expand production if drilling and field development costs are too high or if there is any doubt about the buyer's ability and commitment to build a new plant.

There are several methods of accomplishing diligent subsequent development. In general, the seller should be required to diligently explore for and define geothermal resources and the buyer to develop these resources when found. A goal of a specified amount of additional production per year (e.g., 100 megawatts) with steam reserve requirements, may be set in advance.

Development also can be required within a certain time sequence provided the supply is available. For example, each time the seller discovers certain minimum quantities (e.g., 50 megawatts), the buyer will be obligated to complete construction of a 50 Mw plant within a specified number of years. This will assure rapid development of the resource, but it has inherent disadvantages. Proper reservoir development may be impeded; the generating facilities may not be of optimum size; or the buyer may be forced to construct unneeded generating capacity prematurely.

In any event, it is a good idea to build in flexibility. The seller's right to require subsequent development can be limited in frequency, or subsequent development can be at buyer's option based on availability of the resource or the buyer's requirements for additional capacity.

In some instances more drilling and testing may be required to confirm a preliminary determination that available additional capacity exists. If a buyer does not agree that the quantity or quality of the resource offered by the seller actually exists, the buyer can require an evaluation by an independent reservoir engineer, and if technically justified, can require delineation and development of additional reserves.

Some agreements provide that if the buyer makes a determination as to the availability of additional capacity first, he may propose to the seller that the seller undertake additional field development. The procedure as described above would then be reversed with the matter being arbitrated if the seller does not agree with the buyer's conclusions.

If the buyer is to suffer any consequences as a result of seller's development efforts, such as a possible increase in price to reflect unforeseeable investments by seller (as described in Part VIII), seller will be required to advise buyer of its plan of development in advance.

Considering that additional development might ultimately be controlled to some degree by a state's utility commission, the remedies of the seller to enforce further development may be somewhat limited. The seller,

who must sell the resource to realize return on his investment and to fulfill his lease obligations to his geothermal lessors, desires to have some remedy to force the purchaser to either develop or release the undeveloped resource. There are several alternatives to accomplish this:

1. The contract may provide for termination except as to sufficient resources to supply existing facilities. The seller can then sell his excess geothermal resources to others. If the seller is given the right to sell reserve capacity in excess of buyer's needs, provisions will be required to protect the buyer from sales to other buyers that could threaten a reduction in the resource available for buyer's generating plants. This can be covered in the pricing provision relative to undelivered steam demanded. Seller's right to make such sales to another buyer might not provide much comfort because it can sometimes be difficult to interest another buyer in investing in a production area already designed for the benefit of another utility.
2. The contract may give each party the right to purchase the other's interests in existing facilities and in sufficient geothermal resources to fulfill the contract.
3. The contract may provide for the seller to offer each "block" of geothermal resources to the buyer who will have a preferential right to use the resource within a certain time, failing which the seller will have the right to sell such "block" to another. Buyer will usually demand a right of first refusal if more favorable terms are given to a third party. Some overlap may be necessary because if buyer were to wait for all development drilling to be completed before beginning a plant, production would suffer lengthy delays. The seller will be required, however, to have completed the drilling and development work within a specified time prior to the scheduled commencement of operations at the generating plant.

## V. GENERATING PLANT SITING

### A. *The Facility*

The facility will consist of the generating plant, appurtenant facilities, and the electrical transmission lines. The plant must be located within one and one-half miles of the geothermal production wells. The agreement should at least provide that the parties will mutually agree to a convenient location of the plant within these distance constraints. The closer the plant is to the wells, the more efficient the system. There is less heat loss, the production facilities are less complicated, the supply source is owned by fewer lessors, and less land must be used. Since the generating facility will be large, it should blend with the terrain and be made as neat and inconspicuous as possible.

B. *Surface Rights*

The right of the buyer to construct the plant may have one of several origins. Hopefully, the geothermal lease will grant to the lessee (here the seller), or its assigns, the right to construct, operate, maintain, and remove the generating facility and transmission lines, together with necessary rights of ingress and egress. If this is the case, the seller will merely assign such rights to the buyer. If the geothermal lease does not grant sufficient rights for the buyer to construct a generating plant, the buyer will still want an assignment of whatever rights the seller has. The seller will want to ensure that any such assignment, and any subsequent use by the seller, be subject to limitations of the lease and require covenants by the buyer to pay all taxes attributable to its facilities.

If surface rights for a plant are not held when the contract is completed, buyer's obligations to acquire such rights within a specified period and within a specified area must be established and contingency provisions inserted to govern the respective positions of the parties if buyer is not successful.

## VI. QUALITY AND QUANTITY

The buyer is very concerned that the resource delivered will contain sufficient heat to operate the generating facility efficiently. The buyer also is concerned that the resource will not damage the plant or create unnecessary burdens in the form of corrosion or air emissions. Thus the contract will specify minimum quantity and quality criteria such as pressure, temperature, moisture content, total dissolved solids, particulate matter, non-condensable gases, and oxygen content.

Quality criteria will vary from area to area. Examples of some of the quality criteria that have been used are:

Pressure: 100 PSIG minimum
Temperature: Saturation
Moisture Content: 0.25 percent wt. maximum (up to 0.5 percent occasionally)
Total Dissolved Solids (TDS): Less than 50 ppm or less than 2 percent by wt.
Particulate Matter: Less than 2 microns
Noncondensable Gases: Less than 2 percent by wt.
$H_2S$: 100-300 ppm maximum

If delivery is at the wellhead, the controllable aspects of quality (particulate matter) will be the buyer's responsibility. If delivery is at the plant intake, total responsibility for such aspects will be the seller's.

## VII. PRODUCTION

### A. *Delivery of Product*

With present technology the plant can be no farther than one and one-half miles from the wells, or resource temperatures will drop to unacceptable levels. The closer the plant is to the wells, the more efficient the system.

Flexibility should be built into the delivery system. To protect wells during periods of plant shutdown, provision should be made for limited delivery of geothermal resource to other plants in the vicinity. Provisions also should be made for accepting delivery of limited amounts of geothermal resource from non-dedicated wells when other plants in the vicinity (which might not belong to buyer) are shut in.

### B. *Measurement and Testing*

The parties must establish responsibility for measuring the quantity and testing the quality of the geothermal resource being delivered. The agreement should specify generally the type of equipment to be used, the method of testing, the calibration of equipment, and the preservation of data. Costs of testing should be borne by the party operating the equipment.

The contract should provide for the installation, operation, and maintenance of a measuring station equipped with recording meters, and perhaps calorimeters, for the measurement of steam delivered. The buyer generally will have responsibility for the measuring station, but the seller will have access and the ability to monitor testing. The seller will want the right to install and operate check measuring equipment. Charts and records will be kept on file, usually for a period of two to four years.

A formula for determining steam delivered during periods of mechanical breakdown should be included. The formula will usually be based on averaging deliveries during preceding periods.

### C. *Base Load Units*

Delivery of geothermal steam does not equate to the delivery of fossil fuels which can be delivered on a varying or interim basis without economic penalties to the seller. The seller of geothermal resources will insist that the buyer operate all electrical generating facilities as base load units. The seller will have extremely large sums invested in geothermal wells and producing facilities. It cannot afford to deliver steam on a "swing" or supplemental basis. Steam wells cannot be completely shut in for more than brief periods of time, or both reduced productibility and well damage may occur.

### D. *Maintenance Schedule*

The contract should provide for a maintenance schedule that will allow the buyer to perform scheduled periodic maintenance required to maintain the generating facility. Any down time for maintenance in excess of the period prescribed in the contract should penalize the buyer. Geothermal resources

do not have the flexibility of delivery that fossil fuels do, and excessive shutdowns or poor operating efficiency will unfairly penalize the seller. Penalties for excessive operating inefficiencies by either seller or buyer should be covered in the pricing mechanism.

E. *Technical Committee*

Some contracts have provided for a technical committee made up of representatives of both buyer and seller. The technical committee works together in reviewing such matters as plant location, design of gathering facilities, placements of wells, reservoir testing, development of maintenance schedules, design and calibration of metering equipment, and other matters where implementation of the contract is facilitated by the cooperative effort of both parties. The technical committee also can be involved in determining whether seller has developed enough production capacity to supply the initial or subsequent generation plants of buyer.

## VIII. PRICING METHODS

Pricing in the geothermal contract should perform many functions. Initially it provides a basis whereby the buyer pays the seller for the geothermal resource purchased. Price may be based solely on the value of the resource delivered or it may be based on the cost of production and delivery of the resource, plus an agreed return on investment. Conceivably, the pricing mechanism could incorporate both of these concepts. The pricing mechanism also should anticipate value fluctuations caused by inflation or deflation, provide penalties for underperformance and rewards for overperformance by the buyer and seller, and anticipate unforeseen costs and other unanticipated problems.

Pricing can be a "block" basis with separate computations and price bases applicable to each electric generating unit. Prices for production utilized by subsequent units can remain open for negotiation until such time as each additional increment of resource is offered to buyer by seller.

A. *Unit of Payment*

The unit of payment may take several forms. An obvious unit pricing formula is payment for steam by weight, measured in pounds. Some contracts provide for payment based upon mills per kilowatt hour of electricity produced. If a closed system is used, it may be logical to sell Btus. Btu qualification could apply to both electrical power generation and space heating.

The use of a fundamental unit as a payment mechanism is relatively simple, since payment is essentially the unit price times the number of units delivered in a given period. Payment of a unit price without any other consideration could work a considerable hardship for either the buyer or seller

or both, since over a long term it is impossible to anticipate the many variables that might work inequities.

B. *Variables*

"Variables" represent an attempt by the parties to provide a mechanism that will insure an acceptable delivery to the buyer and adequate compensation for the seller over the life of the contract. The formula may be relatively simple; the unit of delivery multiplied by base price multiplied by a simple adjustment for inflation. The formula may be very complex, incorporating some or all of the variables described below.

1. INFLATION/DEFLATION

Recent history has shown that inflation has been increasing at a steady but not always ascertainable rate. The unit price should be adjusted to anticipate inflation or deflation. This can be accomplished by indexing the unit price. There are an infinite number of ways this can be accomplished. One method is to tie the price of steam to the price of other fuels, i.e., fossil, nuclear or both. There are also an infinite number of government and private indices that can be used. It is probably realistic to rely on several rather than one index to accurately reflect inflation affecting geothermal resources. For instance, many combinations of the following might be used:

a. The average hourly wage for crude petroleum and natural gas, field workers, oil and gas;
b. Alloy Index;
c. Portland Cement Index;
d. Oil Field Machinery and Tools Index;
e. Wholesale price for fuel and related products and any number of other indices;
f. IPAA Drilling and equipment costs per foot index;
g. Wandy-Whitman Electric Light & Power Plant Index;
h. Nelson Refinery Construction Cost Index.

Of course, if you have some very daring economists, it is possible to negotiate a fixed inflation increase such as "2.3 percent per quarter, compounded."

2. EXTRAORDINARY COSTS

In light of the major uncertainties that may be present relative to expenditures required to drill and produce a geothermal field, the buyer and seller might deem it desirable to provide for a price adjustment to reflect unforeseeable field development costs. The burden of such costs can be placed entirely on the buyer or can be allocated between the buyer and seller. The incentive for the buyer to assume such an obligation is to enable the seller to proceed where the magnitude of the risk might otherwise cause him to defer entering into the contract or to demand liberal escape clauses. The concept

can work both ways since expenses less than those that are defined as foreseeable can result in a price reduction.

Such a formula would identify as foreseeable costs the number of production and reinjection wells necessary to supply each plant. If more wells are required than anticipated, or if excessive replacement or rehabilitation of wells becomes necessary, such costs will be unforeseeable costs and the price for production delivered to completed facilities will be escalated to afford seller a recovery of a portion of these unforeseeable costs over a reasonable amortization period. If fewer wells than those economically projected as foreseeable are required to provide the requisite amount of resource to power a generating unit and reinject waste fluids, then the price per unit can be reduced in a similar manner.

Buyer can also agree to bear all or a portion of such costs directly with or without a right of recovery of investment from production.

### 3. TAX AND ROYALTY ADJUSTMENTS

As is the case with natural gas contracts, geothermal sales contracts will ordinarily allow for price adjustments to reflect increases in taxes (other than income taxes) imposed on the seller and any increases in royalty payments. Such taxes would include severance taxes, production taxes, ad valorem real property taxes. Adjustment also might be made if the depletion allowance available to producers of geothermal resources is reduced.

Adjustments for such increases in taxes and royalty payments can be spread over an annual payment period through monthly price increases.

### 4. PERFORMANCE CRITERIA

In addition to inflation and other external forces that might affect the price of the geothermal resource, consideration should be given to rewards and penalties for performance. For instance, a factor can be integrated into the pricing formula that will reward or penalize the seller for over or under delivery of the geothermal resources from the existing wells and field facilities dedicated to the buyer's generating facility. Likewise, a penalty or reward factor should be included in the formula to reflect performance by the buyer that is above or below a certain norm. If the buyer operates the generating facility in excess of its rated generating capacity or uses less than the number of days of downtime allowed for maintenance, the buyer should be rewarded by a decrease in unit price. If the plant produces below its rated generating capacity, or requires more than normal maintenance during a specific period, the buyer should pay a higher unit price.

Performance criteria may be more efficiently applied by use of a split formula. One increment can be a charge predicated on seller's ability to deliver. The buyer must pay for the contract amount of deliverable resource, even if it is not taken, thus encouraging the buyer to fulfill his pur-

chase obligation. The second increment can be predicated on actual delivery of the resource. The buyer will pay only for the resource delivered, thus encouraging the seller to fulfill his delivery obligation. The weight given to each of these increments can be varied on a percentage basis, with the sum of the increments equaling the total charge for each unit of resource.

Potential long term failure of either party to meet his commitment can be covered in the contract. If the buyer fails to take delivery of the resources for long periods of time, the seller's remedy may be receipt of the demand charge portion of the unit price. If the parties deem this payment to be insufficient compensation to seller over the long term, then seller may be compensated by an agreed amount as liquidated damages. Likewise, if seller fails to deliver part or all of the contract amount of resource over a long period of time, parties may agree on an amount of liquidated damages to be paid by seller to buyer. If either party irretrievably fails to perform, the remedy can be a buyout of the other party.

5. QUALITY

A factor should be included for quality adjustment. If the quality of steam delivered exceeds established quality criteria, the seller should be rewarded. If the steam falls below the criteria but is still acceptable for the buyer's use, then the seller should be penalized by a reduction in the unit price paid for the steam. If contained total solids or noncondensible gases exceed specified levels, a material reduction in quantities delivered can be made.

6. QUANTITY

It is important to both seller and buyer that a steady supply of steam at adequate pressure is delivered and accepted. If the steam delivered by seller is less than that desired by buyer to operate a plant, or if the delivery pressure is less than that required for efficient plant operations, then the seller should be penalized by a reduction in price. Conversely, a price increase can be effected if the seller is able to deliver the full quantity of steam required for plant operation and the buyer cannot take it. Formulas and schedules to achieve such price increases or reductions can be prepared for insertion in the contract along the lines described in subparagraph 4 above.

C. *Waste Disposal*

The geothermal fluids remaining after use of the steam resource must be disposed of. This can be either the seller's or buyer's responsibility. If it is the seller's responsibility, the costs of disposal can be built into the unit price or can be included as an additional factor in the pricing formula. If the buyer is responsible for disposal, the cost can either be built into the pricing formula, or the buyer can absorb such cost or pay the seller directly for providing such services. If a separate price is charged by seller for reinjecting these fluids, it will usually be based on a set fee per pound of water handled

subject to adjustments similar to those applicable to the price for steam. Penalties for inadequate pressures and unsatisfactory quality will be provided for in addition to price variations to reflect inflation or deflation.

## IX. INDEMNIFICATION, WARRANTIES, AND DAMAGES

### A. *Warranties of Title*

Rarely will the seller own the producing lands in fee. The right of the seller to explore for and produce geothermal resources will invariably be pursuant to a lease. The seller will have either had abstracts of title and a title opinion prepared, or in California, have secured title insurance. The seller can, if he so desires, warrant title to the geothermal resources under the lands from which the contracted geothermal resources will be produced. For the seller to warrant his title to the geothermal resources in many instances will be an uncertain and probably unwise act. In addition to the usual uncertainties involved in warranting title to any mineral development, geothermal resources present additional problems.

In many jurisdictions it is uncertain whether geothermal resources should be classified as water, minerals, or simply *sui generis*. This raises many potentially horrendous problems. Does the landowner have the right to lease the surface or subsurface for production of geothermal resources? Where the surface and mineral estates are divided, did the conveyance or reservation of the mineral estate convey or reserve the rights to lease the geothermal resources? If the geothermal resource is hot water, is its use subject to the doctrines of prior appropriation and other laws affecting the owner's use of water? If geothermal resources are not water, will their use nevertheless impact the rights of senior appropriators? And on *ad infinitum*.

Should the seller assume all these risks? The buyer ordinarily will be a large utility with capable legal counsel. It may be more equitable to simply furnish the buyer sufficient title information and require the buyer to make its own judgment as to the validity of seller's title and seller's right to sell the geothermal resources. If each party is to share responsibility, then it is logical that the seller should have only a limited obligation to cure defects in title. The contract might provide an obligation for the seller to make this effort, failing which the seller will obtain, at its expense, geothermal resources from other lands within the contractual area of interest, if available. If seller cannot deliver, the provisions in the pricing section concerned with underdelivery shall take effect. The seller can, of course, warrant that the lease is in good standing. The seller also might be willing to give a broader warranty if its liability is limited to repaying buyer for all sums paid to seller for which buyer is held legally liable to a third party.

Because of the considerable expense of a geothermal project, it can be

safely assumed that buyer and seller will carefully examine title prior to committing large capital expenditures to the project.

## X. RELIEF FOR FAILURE TO PERFORM

### A. *Remedies*

Several possible remedies are open to each party if the other should fail to perform. In negotiating a contract, a good approach is to list all the situations that could result in nonperformance and then attempt to select an appropriate remedy for application if the event occurs. A partial list of such remedies would include the following:

1. *Cancellation.* Such a remedy is most appropriate where conditions precedent, such as approval by the state public utilities regulatory agency, cannot be met. Neither party is liable to the other.
2. *General Damages.* Liability of one party to the other is based on proof of actual damages as determined by applying fundamental legal principles. The parties will almost always insist that such damages not include consequential damages.
3. *Liquidated Damages.* Where possible, the parties would like to achieve certainty by setting up a liquidated damages formula in advance. Such a formula can be based on recovery of investment adjusted by a reasonable amortization rate. For example, one party might be required to pay the other party one percent per month of the other party's total investment with interest, until the deficiency is corrected or the entire investment recovered.
4. *Buy-out.* In some situations where one party cannot perform, such as where the operation becomes uneconomic, the other party, will, as an alternative to damages, want the option to buy the other's facilities according to a preestablished pricing formula. The pricing mechanism can be based on fair market value. This will permit a buyer, for example, to continue operating its expensive plant even though a loss is suffered on the fuel supply operations. The seller usually will want to reserve a royalty of some sort out of the resource that he must turn over to buyer. The party who buys out the other will assume all existing obligations, including unsatisfied obligations secured by liens.
5. *Suspension of Operations Until Problem is Corrected.* The obligations of both parties can be suspended without liability under certain situations until a problem is corrected. This procedure usually is followed under conditions of force majeure, which is described in Part B below.
6. *Specific Performance.* Although it is not often seen, a provision for specific performance would seem to be appropriate in situations where either buyer or seller fails to complete the construction of production or electric generating plant facilities.

7. *Price Adjustment.* If on a temporary basis seller cannot deliver enough steam for buyer to meet its needs, or if buyer is not in a position to take steam delivered by seller, there can be an increase or reduction in the price of steam delivered, as appropriate, or a reduction or increase in price for steam delivered in the future.

B. *Force Majeure*

Force majeure provisions in the geothermal contract should consider all of the usual force majeure reasons and more due to the complexity of operations and obligations required of both the seller and buyer such as the construction of the field facilities, drilling of wells, the construction of generating facilities, and construction of transmission lines. There are many unknowns that can enter into this involving not only the usual acts of God but failure to secure permits, failure to deliver materials, accident and delays in construction, strikes, action . . . and inaction of governmental bodies, and so forth.

While the provision should provide broad protection for either party for failure to perform, it should contain obligations that the party claiming force majeure will proceed diligently to correct the condition of force majeure. It probably is practical to build in a specific time in which certain episodes of force majeure will be cured, for example, twenty or thirty days. The remedy to be provided would be that after the period of correction specified had run the delinquent party would then pay the penalty specified for failure to take or deliver in the price mechanism. In other words the seller would receive a lesser price for partial delivery or possibly suffer a penalty on the price received for future deliveries. On the other hand the buyer during this period of failing to correct the incident of force majeure would make payments similar to those to be paid for failure to complete construction and commence operation of the generating facility on time.

A permanent continuation of force majeure in which either the seller was unable to deliver or the buyer unable to take should trigger termination clauses or some sort of buy-out arrangement.

C. *Failure to Deliver or Take*

1. UNECONOMIC OPERATION

Geothermal sales contracts are necessarily for long terms. It is conceivable that one of the parties through no fault of its own might be placed in a situation where continued performance under the contract according to its terms will be uneconomic and continued performance would create severe economic disadvantages for such party. The contract can attempt to deal with uneconomic operations by providing that the disadvantaged party will contact the other party and endeavor to renegotiate the terms of the contract so that the relative economic positions of the parties are restored. This can either be accomplished by an illusory agreement to agree or it might

even be made a matter of arbitration. If the parties cannot agree through this mechanism, then, as an alternative to damages, the remedy could be a buy-out by one party. Any contract provisions permitting a party to be relieved of its contract obligation for reasons of uneconomic operation must be made difficult enough so that a party will not leave a contract as a matter of convenience.

### 2. INABILITY TO GET PERMITS OR TO MEET OTHER CONDITIONS PRECEDENT

Protection must be built in so that the party seeking the permit cannot use its inability to secure the permit as a reason for not proceeding. In other words you do not wish the party to be dilatory in seeking permits since this would be quite an easy way to delay performance. If cancellation is not appropriate, the other party should have the right after a certain period in which to buyout the party seeking the permit. Other situations, such as failure to secure a plant site, can be treated similarly.

### 3. INABILITY OF BUYER TO TAKE

#### a. Technical Problems

This supposes that the technical problems of buyer are not of a temporary nature, since temporary delays can be handled in the price mechanism or through some other system of financial penalty. If the technical problem is of a permanent nature and causes partial failure of delivery, then an adjustment can be made in the price mechanism which would protect the seller by providing for a higher unit price. If the technical problem results in a permanent total inability to take geothermal resources, then the buyer should be permitted to either cancel the contract as to that portion of the geothermal resource committed to the particular plant which is unable to take, or the seller should be permitted a total cancellation of the contract. The use of a partial cancellation whereby the seller could then deliver the geothermal resource to a third party of course will be governed in part by whether the area covered by the geothermal sales contract has the potential of having available a second purchaser of geothermal resources.

#### b. Excess Generating Capacity

If the buyer finds itself with excess generating capacity and permanently shuts in the generating facility, then the property remedy for the seller will involve cancellation of the contract as to those resources so that they may be sold to another party, and also damages, the measure of damages conceivably being the damages suffered in the transfer if the seller is able to sell to another party. If there is no other buyer available, the damages will be actual damages.

Geothermal wells cannot remain idle for long periods of time, due not only to plugging and other problems, but also to the problems of heat loss

within the casing and collapse of the well. It is for this fundamental reason, of course, that geothermal sales contracts are written as baseload contracts.

4. PREMATURE RESERVOIR DEPLETION

If premature reservoir depletion is due to poor operations by the seller, then the buyer obviously will have remedies in damages. If no fault is involved and the reservoir prematurely depletes, the buyer may have a preemptive right to purchase any other geothermal resources owned by the seller, but not contracted for, that are located within usable distances of buyer's generating plant. Another possible remedy would be for the seller to be liable for the cost incurred by buyer in purchasing additional geothermal resources from a third party. In addition to these remedies, if the reservoir is depleted and no other resource is available, the contract can terminate, possibly with the seller being charged for reclamation costs.

5. UNACCEPTABLE QUANTITY AND QUALITY

If the seller totally fails to deliver steam, or delivers so little as to make the generating facility's operations uneconomic, or in the alternative the seller is ready and willing to deliver, but the buyer doesn't take for reasons other than a temporary shutdown, there should be some remedy for each party. The remedy for failure to perform has previously been discussed as a pricing formula mechanism.

It also is possible that the quality of product is so unacceptable as to preclude its being delivered to the generating facility. In this instance one remedy would be for the buyer to purchase resources from another seller with the original contracting seller paying the difference in cost, if any, to the buyer for the alternative supply. Another remedy may be for the seller to pay a certain penalty for the delay incurred while the seller is correcting the problems that have made the resource unacceptable. This penalty might be simply a reduction in price for future deliveries until the costs to the buyer for the delay have been repaid.

The seller also might be given the obligation to drill additional wells or rehabilitate old ones in such a situation. The costs for such activities can be borne entirely by the seller or shared with the buyer.

6. INSOLVENCY

This presents a unique problem. Under ordinary circumstances one of the reasons that the buyer contracts with the seller is to secure the competency of the seller's expertise in producing and delivering geothermal resources. This being the case the buyer might have definite concerns over the replacement of the seller by a more solvent but less competent seller. The contract can provide that in event of insolvency the buyer will have a prior right to take over seller's interest under the contract on a prescribed financial basis, such as payment of fair market value for the seller's assets and geothermal

resources. If this can be accomplished, then the buyer will be able to control who the future seller might be. This concept raises not only drafting problems, but problems of proper notice of the buyer's quasi-security interest in seller's assets in the event of insolvency.

7. BUYER FOUND TO BE A PUBLIC UTILITY

The seller, often a large corporation, with diverse interests in extractive industries, will often not be able to tolerate being classified as a public utility. This would subject all of the seller's corporate accounts to possible scrutiny and interference by the public utilities regulatory authority. Because of the breadth of state statutes describing what conduct constitutes public utility services, and the lack of any clear definition in applicable statutes relative to categorization of geothermal resource supply activities, there is a risk that the seller can be classified as a public utility. Accordingly, the seller will want an escape clause allowing him to terminate the contract if such a classification should occur. If the seller cannot sell his interest to a third party, buyer generally should have the right to purchase seller's facilities, with seller retaining a significant royalty or net profits interest.

In summation, geothermal sales contracts have become more sophisticated as buyers and sellers have learned more of the problems encountered and matters to be considered in negotiating workable and equitable contracts. The provisions of these contracts have become more varied with the entry of additional parties into the industry. Whether these provisions will remain widely varied or whether the best of these provisions will be amalgamated in time into a "standard" geothermal sales contract remains to be seen. More importantly, only time and usage will tell us whether these third and fourth generation contracts are really an improvement over those early contracts by Magma, Thermal, and PG&E at the geysers.