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PROPOSAL

to the

United States

DEPARTMENT OF ENERGY

GEOTHERMAL RESERVOIR ASSESSMENT CASE STUDY, NORTHERN BASIN AND RANGE PROVINCE

Submitted

by

KELLEY HOT SPRINGS, INC.

Novato, California 94947

MAY 30, 1978

KELLY HOT SPRINGS, INC.

1959 Novato Blvd.
Novato, Ca. 94947
Phone (415) 897-7833

Mr. Joseph N. Fiore
Chairman, Source Evaluation Panel
Department of Energy
Nevada Operations Office
P.O. Box 14100
Las Vegas, Nevada 89114

Re: GEOTHERMAL RESERVOIR ASSESSMENT CASE STUDY
NORTHERN BASIN AND RANGE PROVINCE, SUBMITTAL

Dear Mr. Fiore:

Kelley Hot Springs, Inc. (K.H.S.I.) is pleased to submit our Geothermal Reservoir Assessment Case Study in complete response to your Request For Proposal (RFP) No. ET-78-R-08-0003. We propose to deepen to 7-8000 feet one or both of two existing wells located on fee land under long term lease to K.H.S.I.

The Kelley Hot Springs is a large boiling hot spring (325 GPM) located within the northwestern region of the Basin and Range geological province.

Over $400,000.00 has already been spent on geothermal investigations of the Kelley Hot Springs Prospect. These investigations include surface geology, geophysical and geochemical studies and the drilling of two observation wells. Reports available include a complete geological report, a geochemical report, two passive seismic reports, electric dipole resistivity and Schlumberger soundings, twenty shallow gradient holes, magnetotelluric study and two microearthquake studies, the temperature logging of a 2,450 foot observation well and a suite of Schlumberger logs (temperature, borehole compensated sonic, induction-electrical and compensated formation density) interpreted by William Bros. Engineering Company, Tulsa, Oklahoma of a 3,400 observation well.

K.H.S.I. proposes to deepen the existing Geothermal Resources International (GRI #1) 3,206 foot well to 7-8,000 feet; and only if successful the deepening of the existing Kelley Hot Springs (KHS #1) 3,400 foot well to 7-8,000 feet.

K.H.S.I. Project Team is a group of experienced professionals in the geothermal, drilling and environmental fields.

KELLY HOT SPRINGS, INC.

1959 Novato Blvd.
Novato, Ca. 94947
Phone (415) 897-7833

The Phase 1 project (deepening and testing the GRI #1 well) is estimated to take 7 months from the signing of a contract to the submission of our report.

We estimate the total cost of the Phase 1 geothermal investigations at $760,000.00 with the D.O.E.'s share of $260,000.00 or 34% (prior share is $400,000.00).

The Phase 2 project (deepening and testing the KHS #1 well) is estimated to take 17 months from the signing of the contract to the submission of our report.

We estimate the total cost of the Phase 2 geothermal investigations at $400,000.00 with the D.O.E.'s share of $200,000.00 or 50%. (No prior share).

We respectfully ask the Source Evaluation Panel to support our efforts on Phase 1 only or on both Phase 1 and Phase 2.

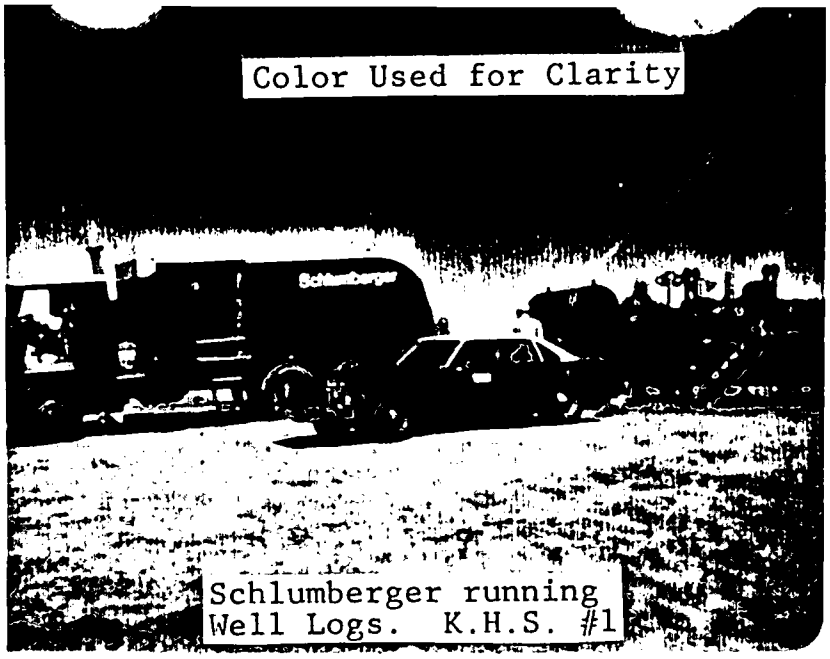
We believe that the many benefits to the geothermal industry and the country warrant your support of this project.

Thank you for your serious consideration of our proposal.

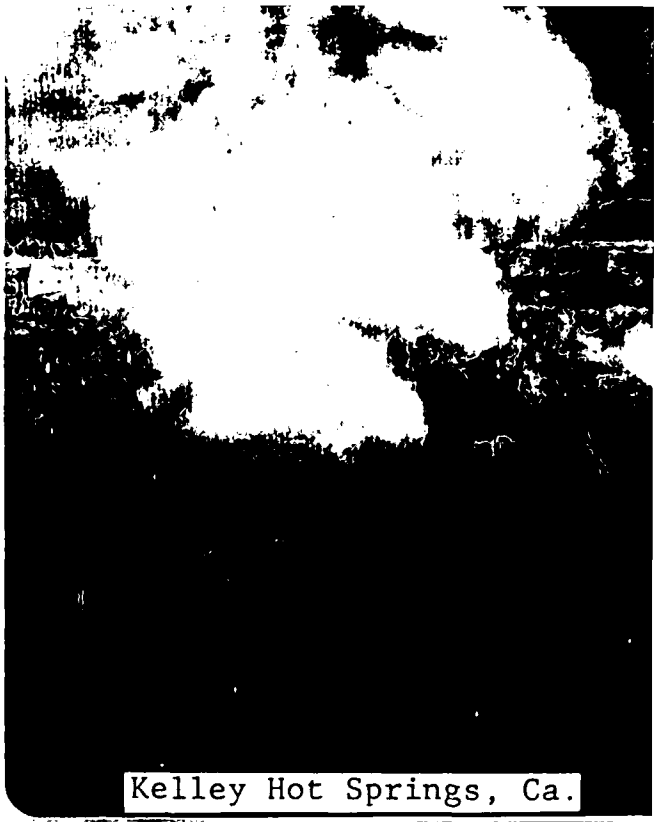
Sincerely,

Harry Beyer

Harry Beyer, Ph.D.
Principal Investigator

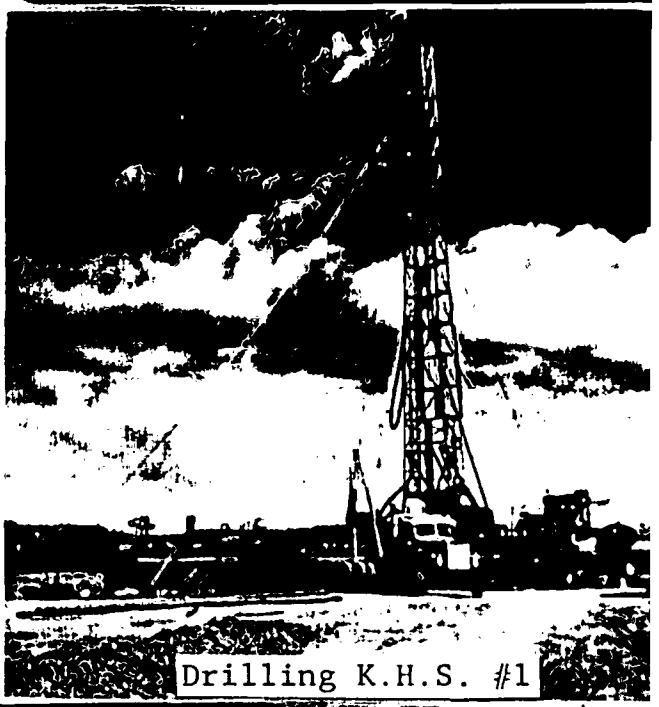


Schlumberger running Well Logs. K.H.S. #1

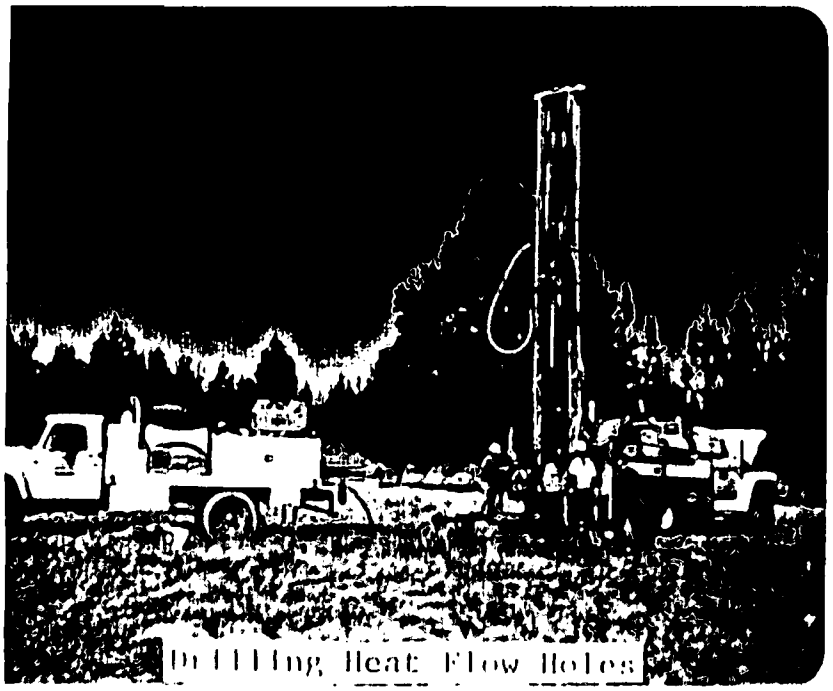


Kelley Hot Springs, Ca.

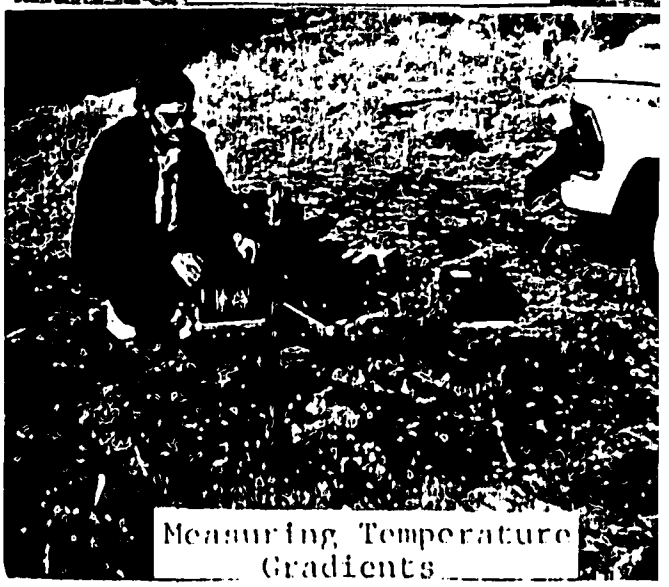
Seismic Survey



Drilling K.H.S. #1



Drilling Heat Flow Holes



Measuring Temperature Gradients

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P R O P O S A L

TO THE

U N I T E D S T A T E S

D E P A R T M E N T O F E N E R G Y

GEOTHERMAL RESERVOIR ASSESSMENT CASE STUDY
NORTHERN BASIN AND RANGE PROVINCE

SUBMITTED

BY

KELLEY HOT SPRINGS, INC.

NOVATO, CALIFORNIA, 94947

May 30, 1978

TABLE OF CONTENTS

A B S T R A C T

Kelley Hot Springs is a large boiling flowing hot springs. It lies within the Basin and Range Province as defined in the U.S. Department of Energy Request for Proposal No. ET-78-R-08-0003, Geothermal Reservoir Assessment Case Study, Northern Basin and Range Province. The hot spring is on the western margin of the Battle Mountain Heat Flow High as defined by this RFP.

Kelley Hot Springs, Inc. is a private corporation which has acquired and held geothermal leases on the hot spring itself and adjacent property since 1973. The only geothermal exploration of the prospect prior to this time was a 3206 foot deep well drilled just south of the hot springs by Geothermal Resources International (GRI #1). It is believed that the hole was drilled solely to circumvent penalty clauses in the lease provisions, as is evidenced by the fact that the hole was abandoned only 12 hours after completion. The only test made was the lowering of a maximum recording thermometer to the bottom of the hole; a temperature of 110°C was found, long before thermal equilibrium could have been reached in the hole. Since acquiring the leases in 1973, Kelley Hot Springs, Inc. has conducted extensive surveys in the area: geological; hydrogeological; geochemical; geophysical (deep resistivity, magnetotelluric, passive seismic, shallow temperature gradient, and heat flow).

In 1974, Kelley Hot Springs, Inc., drilled a deep geothermal test well to a depth of 3400 feet. The well, located about 1.6 mile east of the hot springs, was logged by Schlumberger, with interpretation of the logs made by independent consultants.

The data to date indicate, at very least, a large area of anomalously high heat flow and low electrical resistivity, cut by intersecting faults, and underlain by one or more hot water aquifers commencing at a depth of about 1500 - 1800 feet and extending to at least 3,400 feet.

Several independent consultants who have analyzed the existing data for the Kelley Hot Springs prospect have all stated that a deep test well (to 6,000 - 8,000 feet) is warranted, and necessary to prove the geothermal potential of the Kelley Hot Springs area.

Since 1973, Kelley Hot Springs, Inc., has spent about $120,000 for geological, geochemical, and geophysical work in the Kelley Hot Springs area, plus $165,000 to drill and log the deep test well. Kelley Hot Springs, Inc. has inherited the GRI #1 hole ($100,000) and reentered and temperature logged it ($15,000.00). Total cost to date equal approximately $400,000.00, not including overhead expenses.

The proposal herein presented to the Department of Energy is as follows:

1. All the data obtained to date on the Kelley Hot Springs geothermal prospect will immediately be made available to the DOE to disseminate as the DOE sees fit.

2. New data will come from deepening one of the two existing deep wells to a depth of 7,000 - 8,000 feet. Drilling costs are expected to be lower than normal for a hole of this depth because the first 3,300± feet have already been drilled. The total cost of drilling, logging, testing and analyzing the data from these wells is estimated to be $360,000.00 to $400,000.00 each. Therefore, the total cost of the complete Phase 1 Project is $400,000.00 (existing) and $375,000.00 (new) = $795,000.00. The DOE share will be $235,000.00 or 34% cost share.

3. As a second phase to this program, if testing and analysis of the first 7,000 - 8,000 foot well indicates a viable economic geothermal prospect, the second well will be deepened to 7,000 - 8,000 feet (or to the depth of productive zones encountered in the first well). The second well will be logged and tested. Reservoir engineering studies will be conducted if both deep holes are successful. We estimate the cost of Phase 2 to be $400,000.00 ($25,000.00 more than Phase 1 because of the reservoir testing and inflation). The DOE share for the second well, if drilled, would be $200,000.00 or 50% cost share.

A. PROPOSER

Kelley Hot Springs, Inc. (a successor Company to Kelley Hot)
1959 Novato Blvd. (Springs Ltd., a Limited Partnership)
Novato, Ca. 94947

B. TECHNICAL PROPOSAL:

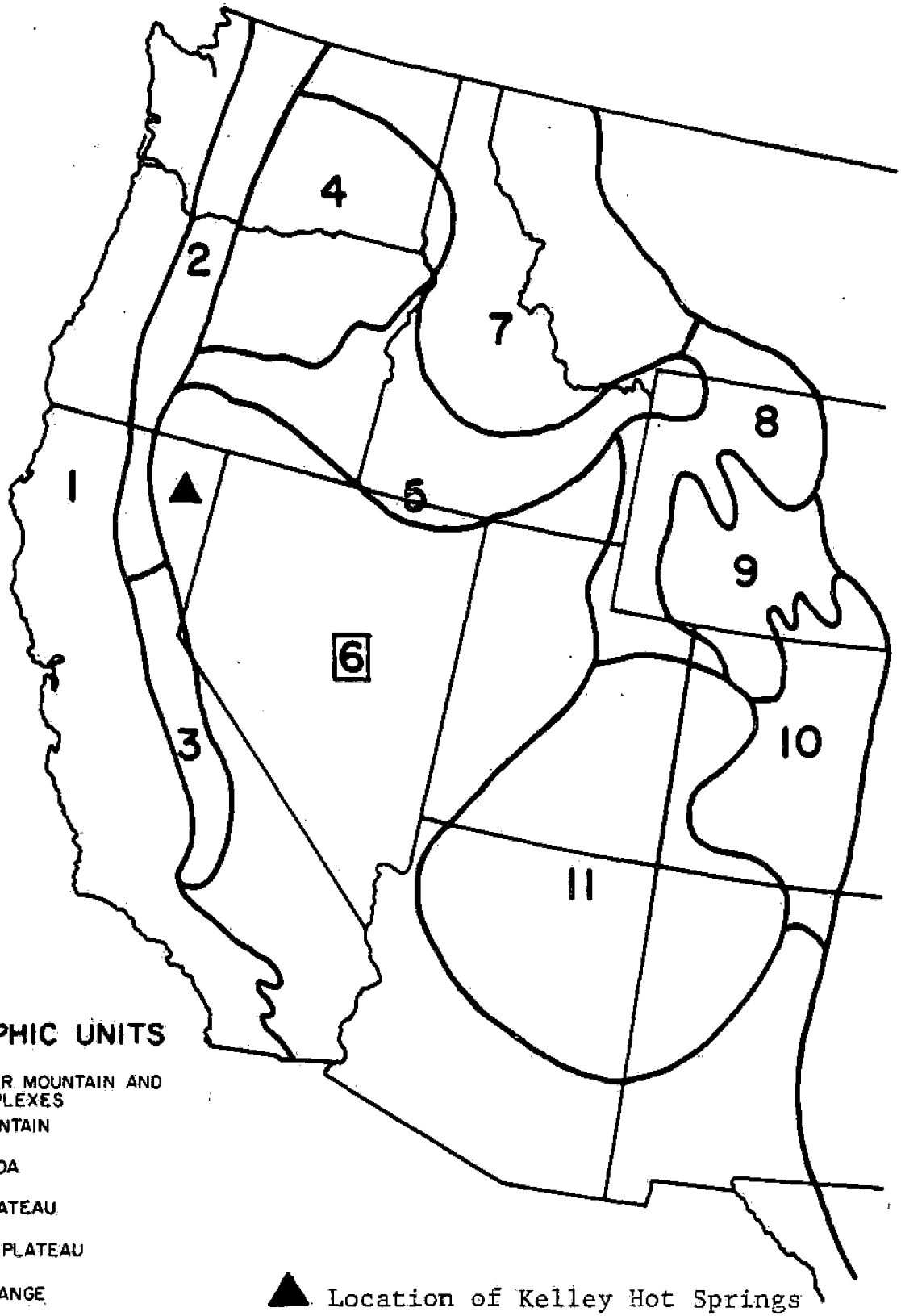
1. Investigation Site:

a) The investigation site is called Kelley Hot Springs and it is located in the northwestern portion of the Basin and Range Province (See Figure 1) and lies along the western margin of the Battle Mountain heat flow high (Figure 2) Kelley Hot Springs, Inc. has geothermal leases or assignment of leases on approximately 20,000 acres of private (fee) land. The two wells that would be deepened are located in Sec. 29 and Sec. 27, T42N, R10E, MDBM.

b) The ownership of the land is all private. The following table contains certain information concerning the geothermal lands which the Company has under lease.

Lessor	Gross Acreage	% Working Interest	% Royalties	Expiration Date	Annual Rental
Kelley Hot Springs Ranch	1200	100%	10%	1/3/86	5,000.00
Pacific Agri-Lands (Ankerbrandt Lease)	6715	100%	10%	1/11/86	9,735.00
Oakley W. Porter (Bacon Lease)	2276	100%	10%	2/2/86	2,276.00
Burnham J. Haley (Bacon Lease)	2680	100%	10%	1/1/86	2,680.00
Andrew L. Pelissa, (SX Ranch)	3842	100%	10%	3/4/86	3,842.00
Canby Ranch (Paul Golub et al)	3200	100%	10%	5/19/85	Escalati Rental 3,200.00 to 16,000.0

Both wells are readily accessible from U.S. Highway 299; a paved all year road. One well site is immediately adjacent to the highway and the other well site is only 1000 yards off the highway over a gravel road. There



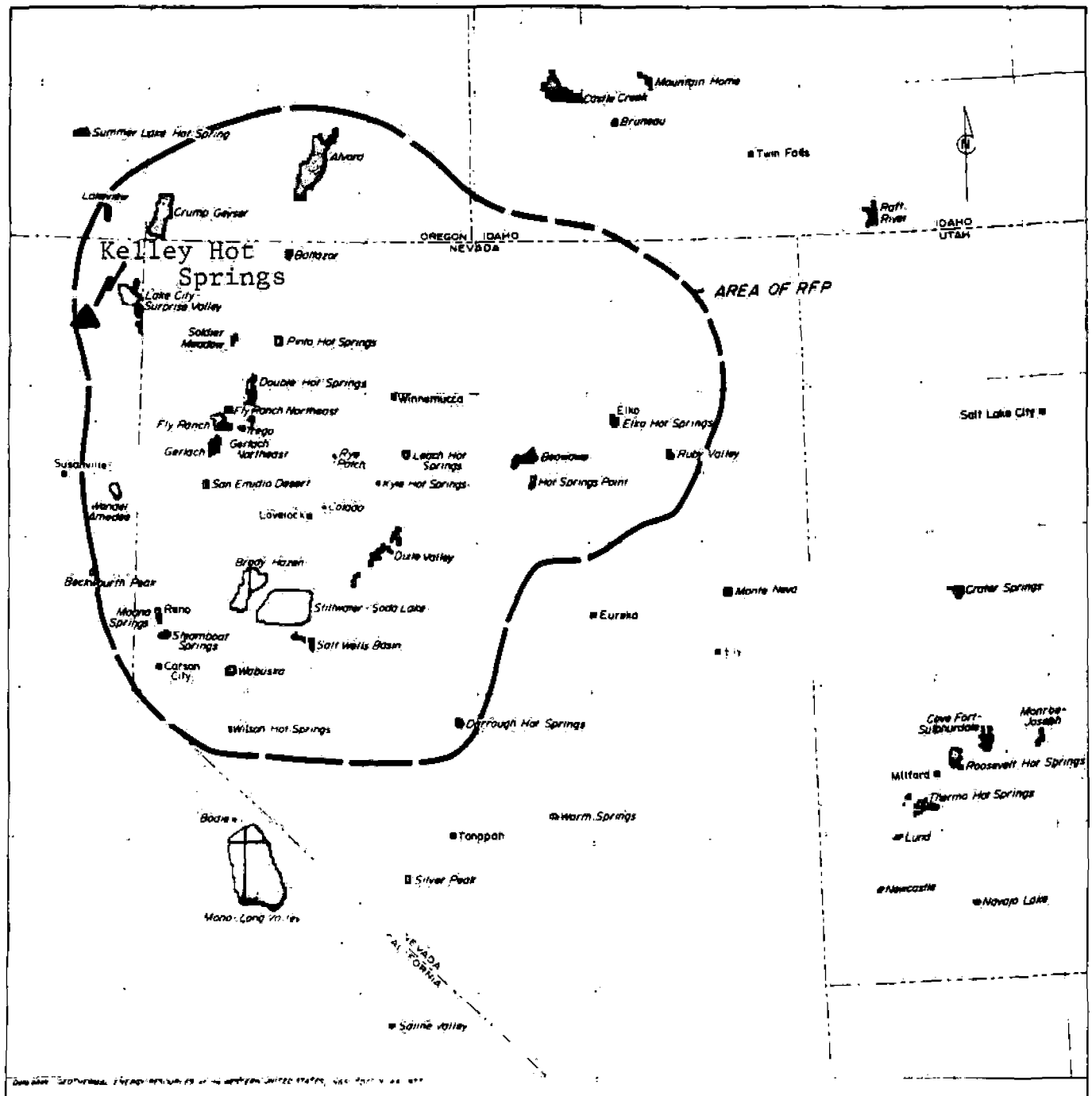
PHYSIOGRAPHIC UNITS

1 PACIFIC BORDER MOUNTAIN AND VALLEY COMPLEXES
2 CASCADE MOUNTAIN
3 SIERRA NEVADA
4 COLUMBIA PLATEAU
5 SNAKE RIVER PLATEAU
6 BASIN AND RANGE
7 NORTHERN ROCKY MOUNTAIN
8 MIDDLE ROCKY MOUNTAIN
9 WYOMING BASIN
10 SOUTHERN ROCKY MOUNTAIN
11 COLORADO PLATEAU

▲ Location of Kelley Hot Springs

(base map taken from RFP No. ET-78-R-08-0003)

FIGURE 1



AREA OF RFP

BATTLE MOUNTAIN HEAT FLOW HIGH
NORTHERN BASIN & RANGE PROVINCE

DEPARTMENT OF ENERGY
DIVISION OF GEOTHERMAL ENERGY

● CITIES ▮ KGRA

(base map taken from RFP No. ET-78-R-08-0003)

FIGURE 2

are no unitization arrangements at present but most of the KHSI leases have unitization clauses and the property would be unitized for the most efficient development of the 20,000 acres (if appropriate).

c) Geologic description

Kelley Hot Springs is located in the northwestern portion of the Basin and Range province, as shown in Figure 1, and lies along the western margin of the Battle Mountain heat flow high as outlined in Figure 2.

Natural thermal phenomena are common in the vicinity of Kelley Hot Springs, which is 56 kilometers west of the Surprise Valley area, currently the site of intensive geothermal exploration.

The Kelley Hot Springs region is "capped by vast late Tertiary and Quaternary basalt plains and numerous volcanic shield cones that largely overlap basin-range structures. These structures are typified by fault-block mountains of Tertiary volcanic rock, with intervening basin-like grabens that commonly contain sedimentary rocks deposited in large Pliocene and Quaternary lakes that had resulted from interruption of the drainage by faulting on volcanism. The faults of the Modoc region trend in a northwesterly to northerly direction. The Likely Fault (Figure 3) is believed to have had appreciable right-lateral movement, but most of the faults are normal, with primarily vertical displacement. The normal faulting reached a maximum near the end of the Miocene, but has continued into the recent time. Occasional earthquakes suggest that some of the faults, such as that along the Hat Creek Valley, are still active" (MacDonald and Gay, 1966, p.46)

In the Kelley Hot Springs area there are two groups of normal faults which stand out. "One group parallels the Likely Fault (which lies 3.7 kilometers southwest of Kelley Hot Springs) and trends northwest. The other groups parallels the northsouth trending basin and range features. These faults have little strikeslip. As Figure 3 shows these two groups of faults intersect in the Kelley Hot Springs area" (Summers, 1973). Hot springs associated with Basin and Range hydrothermal systems frequently occur at the juncture of intersecting fault systems.

Figure 4 shows the anticipated geological formations that will be encountered at depth.

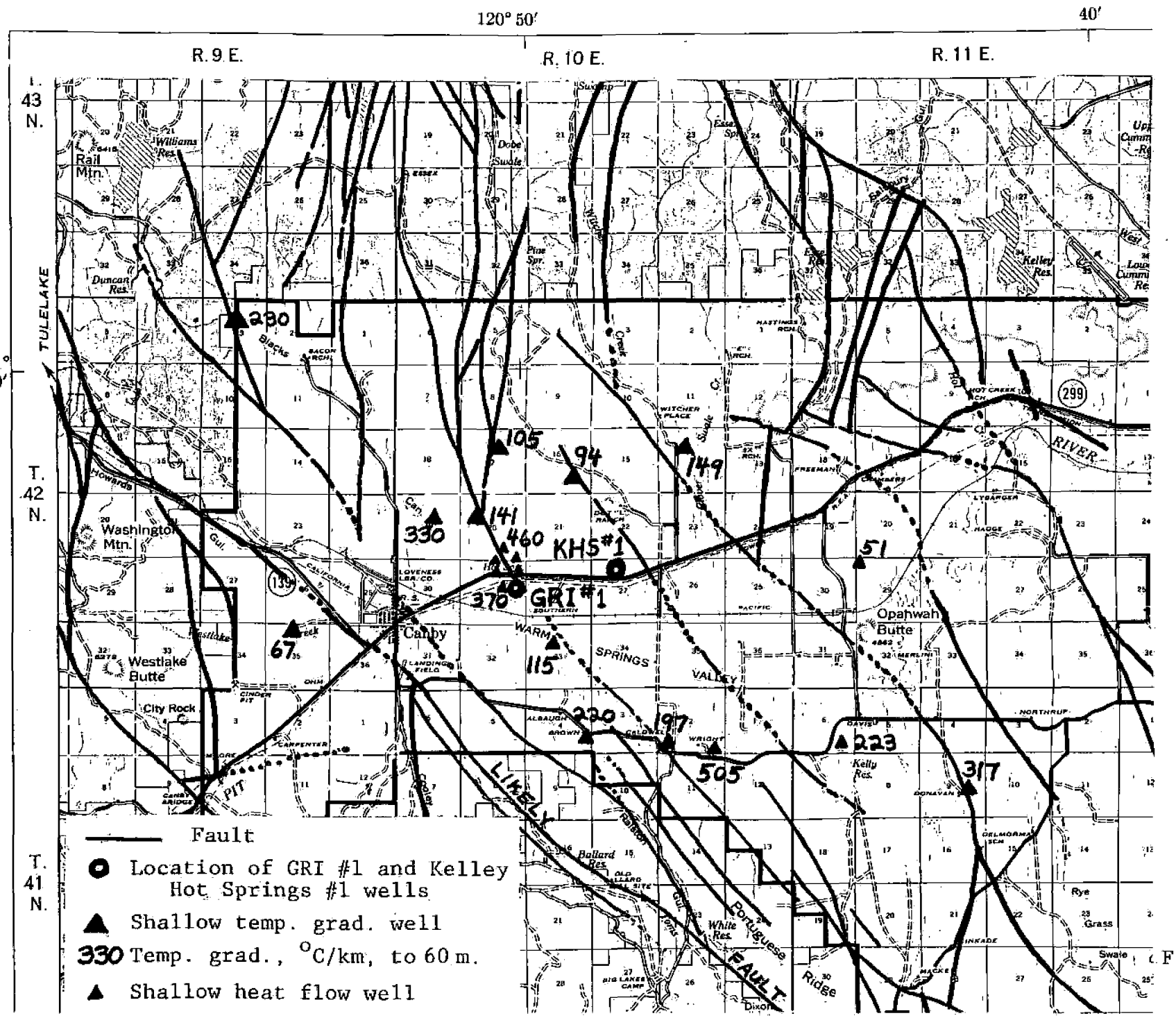
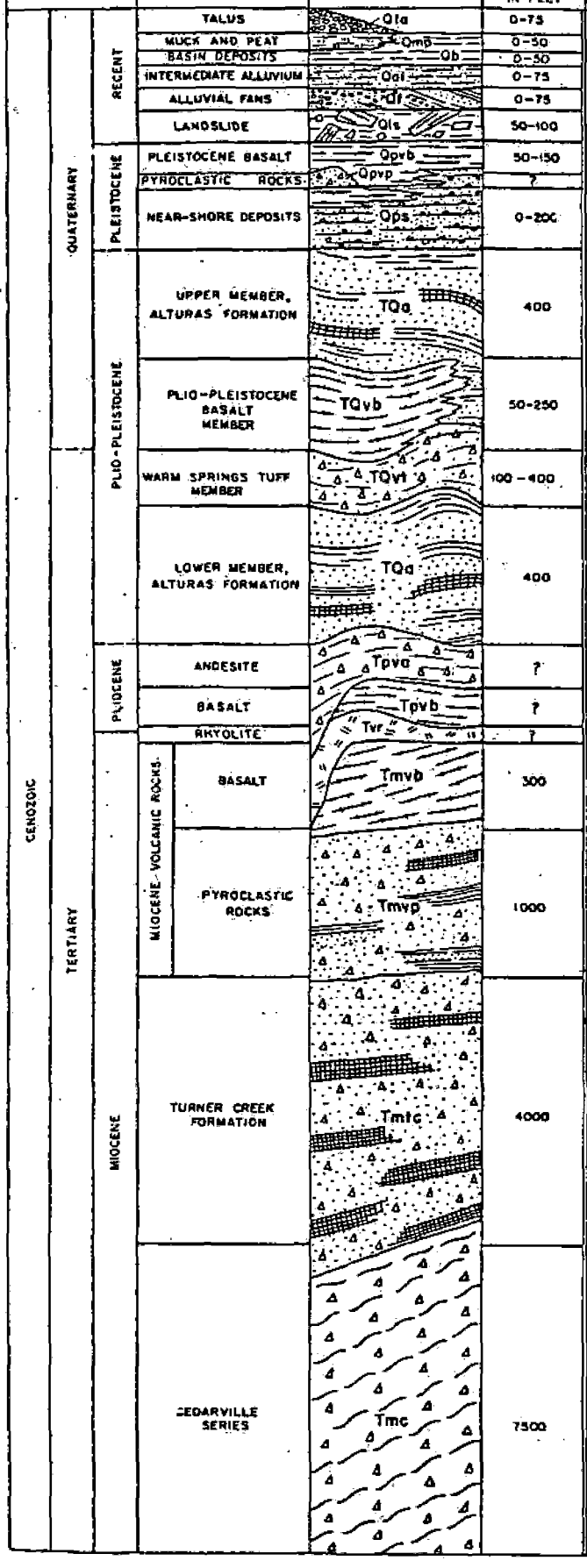

120° 50′
40′
R. 9 E.
R. 10 E.
R. 11 E.
T. 43 N.
T. 42 N.
T. 41 N.
41° 30′
TULELAKE
Rail Mtn.
Williams Res.
Duncan Res.
Washington Mtn.
Westlake Butte
City Rock
Canby
Opahwah Butte
Kelley Res.
Ballard Res.
White Res.
Rye
Grass Swale
Dixon
Ridge
Portuguese
FAULT
LIKELY
PIT
WARM SPRINGS VALLEY
HOT CREEK RANGE
HOT CREEK VALLEY
RIVER
KHS #1
GRI #1
280
105
94
149
141
460
330
370
51
67
115
230
197
223
505
317
Fault
Location of GRI #1 and Kelley Hot Springs #1 wells
Shallow temp. grad. well
330 Temp. grad., °C/km, to 60 m.
Shallow heat flow well

FIGURE 3

GEOLOGIC FORMATIONS IN ALTURAS BASIN



PHYSICAL CHARACTERISTICS	WATER-BEARING CHARACTERISTICS
Qta: Unconsolidated blocks of rock. Of small areal extent.	Highly permeable, but usually above zone of saturation. Yields water to springs.
Qmp: Unconsolidated deposits of organic muck and fibrous peat. Found only in Jess Valley.	Very low permeability. Unimportant as source of ground water.
Qb: Unconsolidated, interstratified clay, silt, and fine sand.	Permeability moderate to slight. May yield small supplies of water to wells.
Qal: Unconsolidated, poorly sorted silt and sand with some lenses of gravel.	Moderately permeable. Yields moderate quantities of water to shallow wells.
Qf: Unconsolidated to poorly consolidated, rudely stratified sand, silt, and gravel, with lenses of clay.	High permeability. May yield large quantities of water to wells; may contain confined water.
Qls: Semiconsolidated mixture of blocks of basalt in matrix of clay and sand.	Of low permeability and of little importance to ground water.
Qpvb: Highly jointed, flat-lying olivine basalt flows with interbedded scoriaceous zones.	Unit as a whole moderately permeable. Acts as forebay for recharge to adjacent sediments.
Qpvp: Semiconsolidated red and black cinders.	Moderately permeable but contains little water due to being above saturated zone.
Qps: Slightly consolidated and cemented, poorly to well stratified pebble and cobble gravel with lenses of sand and silt.	Of moderate permeability. May yield fair to moderate quantities of water to wells.
TQa: Lake deposited tuff, ashy sandstone, gravel, and diatomite. Indistinguishable from lower member.	Moderate to high permeability. Yields large quantities of water to wells. Contains confined water.
TQvb: Jointed, nearly flat-lying flows of basalt with zones of scoria.	Unit as a whole is moderately permeable. Yields water to numerous springs. Acts as forebay for recharge to adjacent sediments. May yield moderate amounts of water to wells.
TQvt: Massive pumice lapilli tuff, jointed beds of welded tuff, minor beds of ashy sandstone.	Transmits small quantities of water along joints and fractures. Sandstone beds may yield moderate quantities of water.
TQa: Indistinguishable from upper member. May be Miocene in part.	Same as upper member.
Tpva: Plugs of massive and platy andesite.	Essentially impermeable.
Tpvb: Jointed, dipping flows of basalt.	Fair to poor overall permeability. Locally yields small amounts of water to springs.
Tvr: Massive, light-colored plugs of rhyolite.	Essentially impermeable.
Tmvb: Flows of jointed vesicular basalt.	Transmits only minor quantities of water along joints.
Tmvp: Bedded mudflows, tuffs, ashy sandstone, and diatomite. May be correlative to Turner Creek formation. Upper portion may grade into lower member of Alturas formation.	Of low overall permeability. A few permeable beds may yield limited quantities of ground water to wells.
Tmtc: Massive mudflows and tuffs with beds of ashy sandstone and diatomite. Upper portion may be correlative to lower member of Alturas formation.	Of low overall permeability. A few permeable beds may yield limited quantities of ground water to wells.
Tmc: Massive tuff breccia, basalt, and andesite.	Nearly impermeable. May yield small amounts of water from fractures and joints.

FIGURE 4

d) Technical reasons for site selection

Kelley Hot Springs was described by the California Legislative Senate Factfinding Committee on Natural Resources as a "potentially significant" geothermal area. It is a boiling hot springs (95°C at 1325 meters elevation). It flows at 1230 liters per minute (Waring, 1965) which equals 73,800 kilograms, (162,500 lbs.) per hour of boiling water. This alone is evidence of a significant amount of subsurface heat. Approximately 3% of the hot springs in the United States are boiling, and Kelley Hot Springs is the second largest boiling hot springs in the country (excluding Yellowstone Park).

Two geothermal test wells have been drilled in the area. One, located about 300 meters to the south of the hot springs was drilled to a depth of 976 meters in 1969 by a company unaffiliated with Kelley Hot Springs, Inc. It appears that the hole was drilled solely to avoid a penalty clause in the lease provisions. After major lost circulation zones were encountered below 473 meters, drilling continued using cold water instead of mud, with partial or no returns to total depth. Only twelve hours after drilling ceased a maximum recording thermometer was lowered to the bottom of the hole; it showed a temperature of 110°C. No other testing or monitoring of the hole was performed before it was abandoned and the leases Quitclaimed. Kelley Hot Springs, Inc. inherited this hole and recently reentered the well to a depth of 750 meters; temperature logging revealed a maximum temperature of 112°C. at this depth.

A second well, located about 2.6 kilometers east of the Hot Springs, was drilled by Kelley Hot Springs, to a depth of 1037 meters. Temperature logging showed a maximum temperature of 116°C. at the bottom of the hole. Lost circulation zones were encountered below about 550 meters. This similarity with the first well, two miles distant suggests that there may be an extensive hot water aquifer.

Kelley Hot Springs, Inc. has conducted extensive work in the Kelley Hot Springs area, commencing with a detailed geologic and hydrogeologic study by W.K. Summers in 1973. His report concludes that "the intersecting faults provide plumbing system for geothermal fluids. The geohydrologic characteristics of the Upper Pit River Basin suggest that the area north and east of Kelley Hot Springs contains a significant subsurface source of geothermal fluids... The surficial geothermal features of the Kelley Hot Springs area compare favorably with those of Surprise Valley. Surprise Valley occurs in a classic graben-horst-structure. The rocks, however, are essentially the same as those in the Kelley Hot Springs area or are older.

Within Surprise Valley there exists a geochemical anomaly similar to that of the Kelley Hot Springs area."

Geophysical data obtained by Kelley Hot Springs, Inc. includes deep electrical resistivity, microearthquake, and shallow heat flow measurements. A dipole mapping survey revealed several square miles in the vicinity of Kelley Hot Springs No. 1 for which the apparent resistivity is less than 3 ohm-meters, and a Schlumberger sounding in this anomaly showed apparent resistivities of 1.5 ohm-meters or less from 17 meters to a depth of at least 900 meters (Furgerson, 1973 and 1974).

Microearthquake investigations (Micro Geophysics, 1975, and Senturion Sciences, 1976) have shown no microearthquake activity in the Kelley Hot Springs area. While it is generally regarded that high microearthquake activity is associated with hydrothermal systems, it must be noted that the Roosevelt Hot Springs KGRA in Utah displays no significant microearthquake activity.

Shallow drilling (80 to 160 meter depths) of six holes between Kelley Hot Springs and one kilometer north of the Hot Springs has yielded temperature gradients of 115 to 850°C./km. Thermal conductivity measurements performed on the rock chips by John Sass of the U.S. Geological Survey in Menlo Park enabled him to calculate heat flow, which, with one exception, ranged from 7.0 to 28.0 HFU. These data are presented in Table 1. Another seven holes, one to a depth of 43 meters and the others to 92 meters or more, have been drilled within a nine-kilometer radius of Kelley Hot Springs. These wells yield temperature gradients of 67 to 330°C./km. Temperature gradients measured in seven existing wells in the area ranging from 51 to 505°C./km. at various depths up to 195 meters. These temperature gradient data are presented in Figure 3. The well spacing and gradient values are somewhat erratic and therefore do not lend themselves to contouring, however, the evidence of an extensive thermal anomaly is unmistabable.

Silica content of the Kelley Hot Springs water has shown a minimum temperature of 144°C. (White and Williams, 1975). This temperature is indicative of the last equilibrium established between the water and the rock, and the actual temperature could be higher but is unlikely to be lower. A geochemical analysis of about 20 water samples from the Kelley Hot Springs area has been made by Geochemex Inc. (Franco Tonani, 1978). The most significant finding is that a water sample from Kelley Hot Springs #1 well has different chemical composition than the Kelley Hot Spring water. If this analysis is correct, it indicates that at the depth of the observed aquifer (up to 1 km.),

TABLE 1

Conductive heat flows from shallow wells

near Kelly Hot Springs, Canby, California

Well #	Depth Range m	Gradient °C/km	N[1]	Conductivity[2] mcal/cm sec °C		Heat flow[3] (hfu)
				K_s	K (30%)	
B-2	15-65	480				
	65-115	330	2	3.5	2.7	8.9
	115-160	235	2	4.2	3.0	7.0
H-7	15-60	460	3	5.3	3.6	16.6
	60-90	850	2	4.8	3.3	28.0
C-3	15-50	390	2	4.0	2.9	11.3
	75-155	270	3	4.3	3.1	8.4
D-4	35-120	500	6	3.7	2.8	14.0
	125-155	115				3.2
E-5	12-40	600				18.0
	65-90	340	2	4.2	3.0	10.2
F-6	12-80	370	3	4.2	3	11.1

[1]Number of conductivity measurements.

[2]K_s is conductivity of solid component (from chips); K (30%) was calculated (assuming a porosity of 30%) by K (30%) = $K_s^{0.7} \times K_{water}^{0.3}$.

[3]Calculated using K (30%).

boiling water exists even though it may come from more than one source. This suggests that hot water is not simply flowing a great lateral distance into the Kelley Hot Springs area, and that a heat source probably exists at depth, supplying heat to the base of the aquifer by conduction.

This possibility is obviously conjectural. However, contractors who have analyzed Kelley Hot Springs data have agreed upon one point: that deeper drilling is warranted, and necessary to assess the geothermal potential. R.M. Brimhall of Williams Brothers Engineering Co. (1974) interpreted the Schlumberger well logs from Kelley Hot Springs #1 well. He concluded:

> The predicted temperature to which the wellbore will recover after a long period of nondisturbance will be 228°F (109°C.) at a depth of near 3395 feet (1034 meters). (The temperature has actually recovered to 116°C.) The well was not drilled to a depth sufficient to penetrate a commercial source of energy. The temperature at a depth of about 5500 feet (1678 meters) is anticipated to be 350°F. (177°C). *

In assessing the same data W.K. Summers (1974) stated: "the well should be deepened to at least 6,000 feet." *

After reviewing the Kelley Hot Springs data Dr. J.B. Koenig (1974) concluded:

> a test to 6,000 to 6,500 feet (1830 - 1983 meters) seems warranted. Otherwise, the geothermal potential of this area will never be known. The 2-mile known extent of the thermal aquifer at 3,000 feet is encouraging: there may be a very large quantity of fluid in storage, and this reservoir may be fed from a deeper source at higher temperature. *

In light of more recent data Koenig (1977) reiterated this concept: It is assumed that drilling beyond 8,000 feet is not attractive on economic considerations. Therefore, a targeted depth of a future hole would be 7,500 feet, with a zone for testing between 7,000 and 7,500 feet. Chemical data from Kelley Hot Springs are typical of mildly chlorided water (perhaps 2,000 mg/l total dissolved solids at depth, based on assumed mixing). Temperatures of just over 200°C would be anticipated in this concept. This represents a gradient much lower than the overall 90°C per km calculated for the 3,300-foot-deep hole drilled by KHSI. (Kelley Hot Springs #1).

* See appendix for excerpts from these reports.

2. Program Data Offered:

The following are existing reports or data which are offered as part of this proposal.

a) Subsurface

Kelley Hot Springs, Inc., 1978, Kelley Hot Springs temperature gradient well program. This report contains temperature gradients measured in 13 wells drilled by Kelley Hot Springs, Inc. (all but one of these holes are from 80 to 160 meters deep), and temperature gradients measured in 7 existing wells (from 31 to 195 meters deep). Heat flow calculated for six of the holes by John Sass and drill cutting samples from the wells are included.

Kelley Hot Springs, Inc., 1978, Temperature gradient data in GRI No. 1 well to a depth of 750 meters. This well is located 300 meters south of Kelley Hot Springs. The lithology log is available.

Schlumberger, 1974, Suite of logs run on Kelley Hot Springs No. 1 well to a depth of 1036 meters: compensated formation density (gamma-gamma), temperature, induction electrical, borehole compensated sonic. This well is located 2.6 kilometers east of Kelley Hot Springs.

Williams Brothers Engineering Co., 1974, Interpretation of electrical logs and temperature surveys: Kelley Hot Springs #1, Modoc County, California. An analysis of the logs, run by Schlumberger 1974, to a depth of 1037 meters, in the Kelley Hot Springs #1 well.

Summers, W.K., 1974, Kelley Hot Springs #1 - a program completion report. A report by the supervisory geologist on the logging of this well.

b) Surface

Furgerson, R.B., 1973, Electrical geophysical survey in the vicinity of Kelley Hot Springs, Modoc County, California. This report contains the results of a dipole mapping resistivity survey covering about 30 square kilometers, and a Schlumberger sounding up to an AB/2 separation of 3000 feet.

Furgerson, R.B., 1974, Schlumberger and equatorial-dipole soundings S2 to S5, Kelley Hot Springs, California. A report of the data and modeling of four deep resistivity soundings (AB/a equals 4000 feet or greater).

GeoChemex Inc. (Franco Tonani), 1978, Preliminary geochemical study of the Kelley Hot Springs area, Alturas, California. Report on the chemical analysis of 20 water samples from springs (hot and cold) and wells.

Gresham Corp. 1973, Passive Seismic report. Results of a study showing high ground noise in a region extending NW from Kelley Hot Springs.

Koenig, J.B. (GeothermEx, Inc.), 1974, Letter to Mr. Richard Kent, Pacific Power and Light Co., assessing Kelley Hot Springs geothermal prospect.

Koenig, J.B. (GeothermEx, Inc.), 1977, Evaluation of Kelley Hot Springs geothermal prospect.

Micro Geophysics Corp., 1975, Reconnaissance seismicity report on the Canby prospect in Modoc County, California.

Senturion Sciences, Inc., 1976, Report on TELMO survey conducted to assess the geothermal potential of Canby, California area. A reconnaissance magnetotelluric, groundmotion, and microearthquake investigation covering approximately 400 square kilometers.

Senturion Sciences, Inc., 1977, Canby magnetotelluric reinterpretation. The data from 24 magnetotelluric stations were reinterpreted (layered inversion) showing nine faults and three anomalous areas of high conductivity.

Summers, W.K., 1973, Geothermal potential: Kelley Hot Springs area, Modoc County, California. This is a comprehensive geological and hydrogeological report analyzing the prospect.

c) There are no <u>existing</u> reservoir engineering studies.

The following <u>new</u> data are offered as part of this proposal. This data is to be obtained from the deepening of Kelley Hot Springs #1 and/or GRI #1 wells to a depth of 2135 - 2440 meters (7,000 - 8,000 feet). One well will be deepened and the following data assessed; only if the data indicate that temperature, formation permeability, and fluid recovery rate are sufficient for economic power production will the second well be deepened.

a) <u>New</u> subsurface data

(1) Drilling history, including bit records, circulating mud temperatures (in and out), hole angle

surveys, and maximum thermometer readings, drilling fluid experience, H_2S and CH_4 records, and "as drilled and abandoned" well drawings.

(2) Mud Logging reports and lithology charts.

(3) Formation evaluation logs, including temperature, compensated formation density (gamma-gamma), induction electrical, and borehole compensated sonic.

(4) Auxiliary logs, if taken.

(5) Formation fluid analyses.

(6) Temperature logs taken after the well has stabilized

(7) Drill cuttings, every 5 feet (washed, dried, and identified).

(8) Core, if taken (portion to be determined upon core recovery with DOE representative).

(9) Formations fluid samples, if recovered (container to be furnished by DOE).

(10) Well Summary Report (interpretation and analysis).

(11) Flow Testing, (James method of measuring Lip pressure).

3. Program Description

a) Subsurface

The data from thirteen shallow temperature gradient holes are existing data. These wells, within a nine kilometer radius of Kelley Hot Springs (see Figure 3), were drilled by Western Geophysical Company in 1974 and 1977 for Kelley Hot Springs, Inc. The depths are 43, 80, 90(2), 92(4), 101, 110, 155(2), and 160 meters. The wells were drilled with mud using a 4½ in. diameter bit, and were completed by inserting 1 inch diameter iron or PVC pipe to total depth. Thermal conductivity measurements made on rock chips from six of these wells enabled John Sass of the USGS in Menlo Park to calculate heat flow (see Table 1). There is also existing temperature gradient data from seven local water wells (see Figure 3) with depths of 31, 67, 104, 110, 116, 171 and 195 meters. All the above temperature gradient measurements were made by employees or consultants of Kelley Hot Springs, Inc. Drill cutting samples are available for all 13 holes.

Deep temperature gradient well - GRI #1.

The following data exist for this well.

It is located about 300 meters south of Kelley Hot Springs and was drilled to a depth of 976 meters in 1969 by Geothermal Resources International, a company unaffiliated with Kelley Hot Springs, Inc. It appears that the hole was drilled solely to avoid a penalty clause in the lease provisions. After major lost circulation zones were encountered below 473 meters, drilling continued using cold water instead of mud, with partial or no returns to total depth. Only twelve hours after drilling ceased a maximum recording thermometer was lowered to the bottom of the hole; it showed a temperature of 110°C. No other testing or monitoring of the hole was performed before it was abandoned by Geothermal Resources International.

Drilling and completion procedures were:

(a) Total depth: 976 meters (3200 feet)

(b) Hole sizes and depths: 13-3/4 inches to 318 feet; 9 inches to 1060 feet; 7-7/8 inches to 3206 feet, TD.

(c) Drilling fluids: Bentonite mud, water.

(d) Casing: 10-3/4 in. steel casing to 314 feet: uncased from there to TD.

(e) Cementing: The casing is cemented from 314 feet to the surface.

(f) A maximum recording thermometer lowered to the bottom of the hole 12 hours after drilling had ceased showed a temperature of 110°C.

(g) A cement plug was inserted from a depth of 380 feet to the surface and the well was abandoned.

In 1978 this hole was reentered by Kelley Hot Springs, Inc., and a 1-1/4 inch capped iron pipe was hung in the hole to a depth of 750 meters. The pipe was filled with water; four weeks later Kelley Hot Springs, Inc., personnel measured the temperature at 15 meter intervals in the well, and obtained a maximum temperature of 112°C at 750 meters.

Deep Temperature gradient well - Kelley Hot Springs #1

The following data exist for this well. It is located 2.6 kilometers east of Kelley Hot Springs, and was drilled in 1974 by Barnes Drilling Company for Kelley Hot Springs, Inc. The well has not been abandoned.

Drilling and completion procedures were:

(a) Total depth: 1037 meters (3400 feet).

(b) Hole sizes and depths: 13-3/4 inches to 544 feet; 9-7/8 inches to 3400 feet, TD.

(c) Drilling fluid: bentonite mud and water.

(d) Casing: 10-3/4 in. steel casing to 544 feet; open ended 2-7/8 in. iron pipe hung in the hole from surface to 3396 feet (1036 meters).

(e) Cementing: The 10-3/4 in. casing is cemented over its full length from 544 feet to the surface.

(f) The well has been completed with a locked valve on the 2-7/8 in. at the surface.

Mud Logging: In and out mud temperatures were recorded by a geolograph recorder.

Logging: Lithologic logging was performed by W.K. Summers (1974). Geophysical logs, run by Schlumberger (1974) include compensated formation density, temperature, induction electrical, and borehole compensated sonic. These logs have been interpreted by Williams Brothers Engineering Co. (1974) and by W.K. Summers (1974).

Fluid Chemistry: Chemical analysis was performed by F. Tonani (GeoChemex, Inc. 1978) on water samples extracted from the open ended 2-7/8 casing at depths of 610 and 915 meters.

The new program and data offered are given below. The program is the same regardless of which hole is deepened (Kelley Hot Springs #1 or GRI #1). Immediately upon award of contract by the DOE, Kelley Hot Springs, Inc. will commence drilling (having previously acquired proper permitting and contract with a licensed driller to commence drilling). Drilling will comply with the State of California requirements necessary to obtain the drilling permit, and will include the following procedures.

In the case of the GRI #1 well the existing 1¼ inch pipe from the surface to total depth will be removed. In the case of the KHSI #1 well the existing 2-7/8 inch pipe from surface to 750 meters will be removed. Procedures for the two holes are then virtually identical.

(a) Total depth: 2135 - 2440 meters (7,000 - 8,000 feet).

(b) Hole sizes, depth and casing: redrill existing hole with 9-7/8 inch bit to the total depth of the existing hole (976 meters for GRI #1; 1037 meters for KHS #1). 7 inch casing to be inserted to the existing depth and cemented in the anulus from bottom of casing to the surface. The purpose of this casing is to seal off lost circulation zones which are known to exist below 473 meters in GRI #1, and below 550 meters in KHS #1. Drilling will then continue to total depth with a 6-1/4 inch bit.

(c) Drilling fluids: bentonite mud mixed with fresh water.

(d) Casing: In addition to the 7 inch casing mentioned in (b), 2-3/8 inch pipe will be inserted from the surface to total depth.

(e) Cementing: the 7 inch casing mentioned in (b) will be cemented over its total length in the anulus.

(f) The well will be completed with a locked valve at the surface for later reentry of the hole.

The following new subsurface data is to be supplied from deepening of either or both of the existing wells.

(1) Drilling history, including bit records, circulating mud temperatures (in and out), hole angle surveys, and maximum thermometer readings, drilling fluid experience, H_2S and CH_4 records, and "as drilled and abandoned" well drawings.

(2) Mud logging reports and lithology charts.

(3) Formation evaluation logs, including temperature, compensated formation density (gamma-gamma), induction electrical, and borehole compensated sonic.

(4) Auxiliary logs, if taken.

(5) Formation fluid analyses.

(6) Temperature logs taken after the well has stabilized.

(7) Drill cuttings, every 5 feet (washed, dried, and identified).

(8) Core, if taken (portion to be determined upon core recovery with DOE representative).

(9) Formations fluid samples, if recovered (container to be furnished by DOE).

(10) Well Summary Report (interpretation and analysis).

(11) Flow testing (James method of measuring Lip pressure).

b) Surface Investigations

This is existing data and is fully described in 2.b of this proposal.

c) Reservoir Engineering Studies

Dr. Sabir Sanyal will report on the deep drilling logs and give his opinion of reservoir capabilities. If either well flows naturally, the flow rate will be recorded using the James method of measuring Lip pressure. If both wells are completed successfully simultaneous flow testing and pressure measurements will be made to obtain maximum reservoir information.

4. Schedule

a) Existing data:

Existing data would be made available immediately after the successful negotiations of a contract with the DOE.

b) New data:

Prior to contract negotiations, KHSI plans to obtain permits to deepen the GRI #1 and/or the KHS #1 wells. During negotiations a drill rig and piping would be tentatively committed so that in the event of successful negotiations, drilling could be begun almost immediately. This is necessary because of the severe winter weather conditions that can be experienced at the site location. It is believed that if drilling can be begun in October, the final new data on phase 1 would be submitted by the end of April 1979.

If phase 1 is successful, phase 2 would begin in April 1979 and be completed in February 1980. A Work Plan Schedule is shown in Figure 5.

KELLEY HOT SPRINGS, INC.

WORK PLAN SCHEDULE

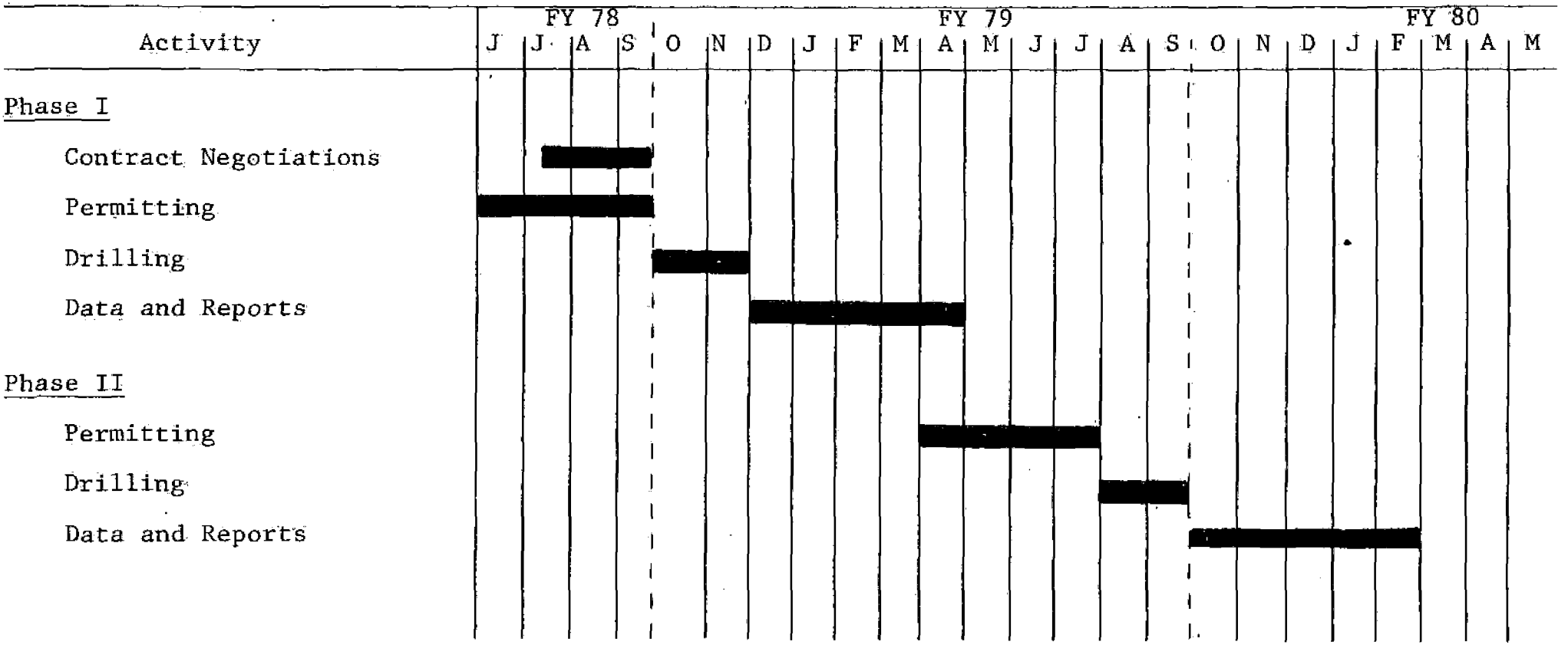


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FIGURE 5

5. Environmental Evaluation

The base document for environmental background is the Final Environmental Analysis Record (EAR) for the Upper Pit River Proposed Geothermal Leasing-1977, USBLM. The document pertains to Federal lands adjacent to the project area but enumerates the environmental concerns for the area as a whole.

Environmental reporting will necessarily fall into three categories: 1) Environmental report for project submitted according to DOE "Guidelines for Environmental Reports for Geothermal Projects." ERHD-0001 February 1977, 2) Environmental report for Modoc County use permit, and 3) Environmental monitoring and surveillance program during operation.

Of the several standard concerns of environmental impact review and mitigation, particular emphasis needs to be placed on 1) the impact of wildlife in the area (antelope kidding grounds, deer emigration and wintering, and sage grouse strutting areas); 2) the potential for water pollution or eutrophication through seepage, spills, overloads, etc. of organic wastes or geothermal effluent into underground waters and the Upper Pitt River. Attention needs to be placed on aesthetics (odoral, visual, and audial).

Ecoview will develop prognostic scenarios of waste disposal problems and estimate the potential for pollution level, nutrient or toxic substance transfer levels and rates of possible water pollution, using techniques developed by them for similar prognosis in other geothermal areas.

a) The lands affected are rural. Some of the land is under cultivation, the main crop being hay for cattle feeding. The area is sparsely populated. However, a main highway and railroad bisects the area of concern. The Kelley Hot Springs Ranch itself has an abandoned farm house and the ruins of a swimming pool and spa on it. Cows graze nearby and have been observed drinking the cooled overflow water from the hot springs.

b) It is believed that the deepening of one or both of the existing wells will have no significant impact on the existing environment.

c) The proposed drilling program has no potential for conflict with the existing land use patterns and programs. It is believed a majority of the local residents desire a successful geothermal test. They believe that this would have a favorable economic impact on the area. The cattle industry is economically depressed at the present time and a stimulous to the local economy is badly needed. Even the development of a major power plant would not displace significant ranch land as much of the land is not in use or is under-used.

The Board of Supervisors and Planning Commission of the County of Modoc have adopted a Resolution concerning geothermal development. (See Terms, Conditions, Standards and Application Procedures for Initial Geothermal Development, Modoc County, prepared by Modoc County Department of Public Works, dated 9/15/75). The following information is taken from the above described "Guide". (To obtain a use permit for an "Exploratory Geothermal Well" an operator must submit an application to the Department of Public Works. Environmental data as required by the Modoc County Guidelines for Environmental Review on private lands will be required. Requirements for waste discharge operations must be issued by the Regional Water Quality Control Board. The well program must be approved by the State Division of Oil & Gas.) Kelley Hot Springs, Inc. will address all environmental areas of concern and potential impact mitigation activities will be developed.

C. COST

1. Phase 1

The cost of deepening GRI #1 well to 7,000 - 8,000 feet, plus all pertinent tests, both existing and new is estimated at $775,000.00

Existing

a)	geological, geochemical and geophysical	120,000.00
b)	drilling and logging of KHS #1	165,000.00
c)	drilling of GRI #1	100,000.00
d)	Reentering and logging of GRI #1	15,000.00
	Sub Total	$400,000.00

New

a)	deepening and testing of GRI #1 (see Hathaway Engineering estimate - Appendix)	$360,000.00
b)	Supervision, etc.	15,000.00
		$375.000.00
	Phase 1 Total	$775,000.00

Phase 2

(Based on success of Phase 1.)
The cost of deepening KHS #1 well to 7,000 - 8,000 feet, plus all pertinent tests is estimated at $400,000.

New

a)	deepening and testing of KHS #1 (see Hathaway Engineering estimate - Appendix)	$360,000.00
b)	Supervision, etc.	15,000.00
c)	Reservoir tests, inflation, etc.	25,000.00
		$400,000.00

2. Proposed cost to the Government.

The proposed cost to the DOE. Optional Form 60 - See Appendix

Phase 1	=	$260,000.00 (34% DOE share)
Phase 2 (Based upon the success of Phase 1)	=	$200,000.00 (50% DOE share)

D. BUSINESS AND MANAGEMENT

1. Kelley Hot Springs, Inc. a California Corporation is the successor entity to Kelley Hot Springs Ltd., a limited partnership formed in 1973 to explore for geothermal resources in the northwestern Basin and Range geologic province in and around the Kelley Hot Springs, California. Sixty Six percent of the stock of Kelley Hot Springs, Inc. is owned by Geothermal Power Corporation, a Delaware Corporation. The remaining thirty four percent of the stock is held by private individuals, all shareholders of Geothermal Power Corporation (G.P.C.).

   G.P.C. has had extensive experience in geothermal exploration in the Kelley Hot Springs area and elsewhere. Currently G.P.C. is conducting a drilling program at Roosevelt Hot Springs, Utah under the Geothermal Reservoir Assessment Case Study, Roosevelt Hot Springs, Contract No. EG-77-C-08-1524.

   All the surface and subsurface tests including the drilling of the 3,400 foot KHS #1, (and as outlined in this RFP) were conducted by G.P.C. as the General Partner of Kelley Hot Springs Ltd., (now Kelley Hot Springs, Inc.)

Organizations and individuals having cognizance with K.H.S.I. and G.P.C. activities are as follows:

1. Harry Beyer, Principal Investigator
   701 Hancock Way
   El Cerrito, Ca. 94530

   415-525-8157
   415-897-8359

2. Frank G. Metcalfe, Program Manager
   1721 Novato Blvd.
   Novato, Ca. 94947

   415-897-7833
   415-892-5324

3. Lafayette Investment Research
985 Moraga Road
Lafayette, Ca. 94549

415-284-2717

Attn: Mr. John Papini, Registered Investment Advisor

4. Mr. W. Kelly Summers, Registered Geologist
P.O. Box 684
Socorro, New Mexico, 87801

505-835-2095

5. Wikel Accountancy Corp.
275 Magnolia Avenue
Larkspur, Ca. 94939

415-924-1300

Attn: Mr. Dave Perotti

6. GeothermEx
901 Mendocino Avenue
Berkeley, Ca. 94707

415-525-9242

Attn: Mr. Jim Koenig

7. Hathaway Engineering,
6840 Grant Avenue
Carmichael, Ca. 95608

916-944-3884

Attn: Mr. William Hathaway, Registered Petroleum Engineer

8. Dr. Subir K. Sanyal
3761 Barrington Drive
Concord, Ca. 94518

415-798-4496
415-497-0691

9. Ecoview
2540 Trower Avenue
Napa, Ca. 94558

707-224-0750
707-255-1830

Attn: Dr. Jim Neilson

10. Deloitte, Haskins & Sells, C.P.A.
44 Montgomery Street
San Francisco, Ca. 94104

415-393-4300

Attn: Mr. Chuck Schwyn

11. Orrick, Herrington, Rowley & Sutcliffe
Attorneys at Law
600 Montgomery Street
San Francisco, Ca. 94111

415-392-1122

Attn: Mr. Tom Unterman

12. Western Geophysical
P.O. Box 1531
Bakersfield, Ca. 93302

805-324-0340

Attn: Mr. John Adams

13. GeoChemex
19H Orinda Way
Orinda, Ca. 94563

415-254-7682

Attn: Mr. Franco Tonani

14. Argonaut Enterprises
1001 So. Miller Way
Lakewood, Colorado 80226

303-237-0418

Attn. Mr. Robert Furgerson

15. Wells Fargo Bank
1525 Grant Avenue
Novato, Ca. 94947

415-892-1552

Attn: Mr. John C. Fee

16. Home Savings & Loan Assn.
1450 Grant Avenue
Novato, Ca. 94947

415-892-4731

Attn: Mr. N. Lawrence

2. Principal Program Personnel

(1) Harry Beyer, Ph.D., Principal Investigator Kelley Hot Springs, Inc.

Education: B.S. in physics from Lafayette College
M.A. in geophysics from Washington University
Ph.D. in engineering geophysics from the University of California at Berkeley.

Dr. Beyer has had eight years of experience as a geophysicist, the last four of which have been in geothermal exploration. Most recently he has been involved in the assessment of the Kelley Hot Springs geothermal prospect for Kelley Hot Springs, Inc.

Prior to becoming an independant consultant, Dr. Beyer was employed by Lawrence Berkeley Laboratory where he participated in planning the LBL geothermal exploration program for investigating four hydrothermal systems in the Basin and Range province of Nevada. In addition, he developed and tested geophysical exploration systems, supervised field operations, and interpreted geophysical data. Concurrently, he was a doctoral candidate at U.C. Berkeley conducting research on the interpretation of resistivity and telluric data. He published several papers on this work.

Dr. Beyer's previous professional experience includes research/exploration geophysicist positions with Western Geophysical Company, Houston, Texas; Chevron Research, La Habra, California; and Gulf Research, Harmarville, Pennsylvania.

Dr. Beyer's recent clients include GeothermEx, Inc.; Harding-Lawson Associates; Terraphysics, Inc.; and the Lawrence Berkeley Laboratory.

He is a member of the Geothermal Resources Council and the Society of Exploration Geophysicists.

(2) Frank G. Metcalfe, President - Geothermal Power Corporation
Director - Kelley Hot Springs, Inc.

Education: University of Manitoba, Canada
Mechanical Engineering Degree

Mr. Metcalfe is a Registered Professional Engineer. For the past eighteen years, Mr. Metcalfe has held a variety of management, engineering and marketing positions in the energy industry. Prior to founding Geothermal Power Corporation in 1971, he was Vice President of National

Energy Systems Corporation, a privately held power and generation concern. National Energy finances, owns, operates, and maintains stationary power plant systems. During this period he was also Vice President of American Mobile Power Corporation. American Mobile Power rents heavy mobile power generation equipment to utilities, construction, oil, and mining companies. From 1965 to 1969, Mr. Metcalfe was employed by Southern California Edison Company, the nation's sixth largest utility. He was Supervisor of Marketing Engineering and an Applications Engineer in which capacity he was responsible for in-depth studies on applications and economics of all types of energy systems, including geothermal. Prior to 1965, Mr. Metcalfe was employed for several years as a Staff Engineer for the Southern California Gas Company. He is a member of the Geothermal Resources Council.

(3) John Papini, President - Lafayette Investment Research
Director - Kelley Hot Springs, Inc.

Education: University of California, Berkeley
B.S. Engineering
Stanford University, M.B.A. Business

Mr. Papini is a founder and managing partner of Lafayette Investment Research, an investment management firm. Mr. Papini has had 15 years of business and financial experience and is a Registered Investment Advisor.

(4) W. Kelly Summers, Registered Geologist, State of California
No. 859

Education: Wayne State University, B.S., Geology
University of Indiana, M.S. Geology

Mr. Summers specializes in groundwater and geothermal resources. Prior to becoming a consultant, he was a groundwater geologist with the New Mexico Institute of Mining and Technology. Mr. Summers' research and professional publications have included: "Geothermics - New Mexico's Untapped Resource; A preliminary Report on New Mexico's Geothermal Energy Resources; and Chemical Characteristics of New Mexico's Thermal Waters - A Critique. Mr. Summers has made an intensive geological investigation of the Kelley Hot Springs area and has prepared two reports for KHSI, 1) Geothermal Potential, Kelley Hot Springs Area; 2) Kelley Hot Springs #1, A program completion report.

(5) Dave Perotti, CPA - Treasurer & Comptroller - Geothermal Power Corporation, Director - Kelley Hot Springs, Inc.

Education: University of San Francisco, B.S., Business

Mr. Perotti was formerly Vice President, Finance and Administration for an international chemical company. In addition, he spent nine years with Deloitte, Haskins & Sells accounting firm. He is currently a partner in Wikel Accountancy Corp. and serves on the Board of Directors of several closely held companies, including Kelley Hot Springs, Inc.

(6) James B. Koenig, Ph.D. President - GeothermEx, Inc.

Education: Brooklyn College, B.S., Geology
Indiana University, M.A., Geology
University of Nevada, Ph.D., Geology

Dr. Koenig has seventeen years of experience as a geologist, twelve of which have been spent in geothermal exploration. Previous work has been with the State of California and the U.S. Geological Survey. Dr. Koenig specializes in reconnaissance evaluation of geothermal prospects; geology of geothermal and volcanic regions, and the interpretation of geothermal exploration data. He has provided supervisory and evaluation services to numerous clients worldwide, including both private concerns and government agencies. Dr. Koenig has also authored a variety of published material.

(7) William N. Hathaway, Drilling Engineering Consultant

Education: Univeristy of Southern California,
Petroleum Engineering Degree

Mr. Hathaway is a Registered Professional Engineer, State of California, Petroleum No. 1129. For the past twenty six years he has been involved in the petroleum exploration and development field. From 1968 to the present he has been a Consulting Engineer, supervising and designing drilling and completion programs for oil, natural gas and geothermal wells; supervising producing operations, performing appraisals for sales, purchase and inheritance; negotiating sales contracts; analysing and originating drilling prospects. Prior to becoming an independent consultant, he was a Division Engineer and District Manager for California operations of E.L. Doheny, an independent oil and gas producer (4 years) and District engineer in charge of California's largest gas field for Amerada Petroleum Corporation, Rio Vista, California (7 years). A partial list of Mr. Hathaway's clients include United States Government, Beale Air Force Base; Natomas Exploration, Inc.; Hilliard Oil & Gas, Inc.; Dow Chemical Company; Thermal Power Company; Tri-Valley

Oil & Gas Company; Cordova Chemical Company (Division of Aerojet General); E.I. duPont de Nemours & Company; Seaboard Oil & Gas Company; Montara Petroleum Corporation; Hale Brothers and Associates.

He is a member of the American Petroleum Institute, Society of Petroleum Engineers of A.I.M.E., Past President, Sacramento Petroleum Association.

(8) Subir K. Sanyal, Ph.D. - Stanford University Petroleum Research Institute; Independent Consultant

Education: Masters degrees in applied geology from Indian Institute of Technology, and in petroleum production engineering from Birmingham University (England). Ph.D. in petroleum engineering (reservoir engineering) from Stanford University.

Dr. Sanyal has worked as a Senior Vice President of Geonomics, Inc. in charge of reservoir engineering and integrated assessment of geothermal resources worldwide. He worked as a senior staff specialist with the U.S. Geological Survey (Gulf Coast OCS), as a consulting engineer with Scientific Software Corporation (Colorado) and as a senior petroleum engineer with Texaco, Inc. (Louisiana and Texas), and has over ten years of experience in reservoir engineering and formation evaluation.

Dr. Sanyal has managed numerous technical projects in geothermal and petroleum industries for both private clients, such as the Electric Power Research Institute (EPRI), and government agencies such as U.S. Federal Energy Administration, U.S. Geological Survey, U.S. Environmental Protection Agency (EPA).

As a part of his professional activities, Dr. Sanyal has produced an array of computer software, twenty publications, a number of major published reports, and a large number of proprietary reports for private clients.

(9) James A. Neilson, Ph.D., President - Ecoview

Education: University of California, B.S., 1944
University of California, M.A., 1961
University of California, Ph.D., 1963

Dr. Neilson is a plant ecology and environmental consultant. In addition to his position with Ecoview, he is currently an Assistant Research Ecologist, Institute of Ecology, University of California, Davis. Dr. Neilson's previous work experience includes:

Self-employed agricultural production and marketing management 1947-61.

Associate Professor of Biology, Wilberforce University Ohio 1964-65.

Chemistry Department of Biology and Dean of College of Liberal Arts, Wilberforce University, 1965.

Associate Director of Co-operative Education for Biology and Physical Science, Antioch College, Ohio 1966-67.

Project Botanist, Icefield Ranges Research Project, Yukon Territory 1967.

Self-employed as educational consultant and management 1968-69.

Dr. Neilson's research and professional activities have included: Ecological research of the preservation, maintenance and restoration of native vegetation in the Lake Tahoe Basin; Environmental Impact Studies and Techniques throughout Central California; Environmental Inventory and analysis of the Walnut Creek Watershed, Contra Costs County; Impact of Urbanization on Vegetation in the Tahoe Basin; Investigations of plant communities and soil-water-plant relationships on glaciated soils in the Sierra Nevada and St. Elias Ranges of the Western United States; and, Ecology of root systems of plants of California.

3. Management Plan

The Project will be coordinated by Mr. Harry Beyer (Principal Investigator) using a Project Work Plan. The principal program personnel (key persons) shown in the Functional Organization, Figure 6, will contribute to the Project Work Plan. The key persons will be responsible for scope, schedule and funding for their areas of effort. Their effort will be negotiated with, and finally committed to the Principal Investigator and approved by the Project Manager. Task-to-task and discipline-to-discipline communication will be implemented by these key persons. All key persons have worked together on the Kelley Hot Springs project and/or the Roosevelt Hot Springs project in the past. Most of the key persons are located within close proximity to each other. Experience has shown the importance of short lines of communication.

Conflicts between tasks in the Project Work Plan will be resolved by the Project Manager in consultation with the Principal Investigator. Impacts upon the major milesones, overall scheduling, contracted scope or project funding will be resolved by the Program Manager.

FUNCTIONAL ORGANIZATION CHART

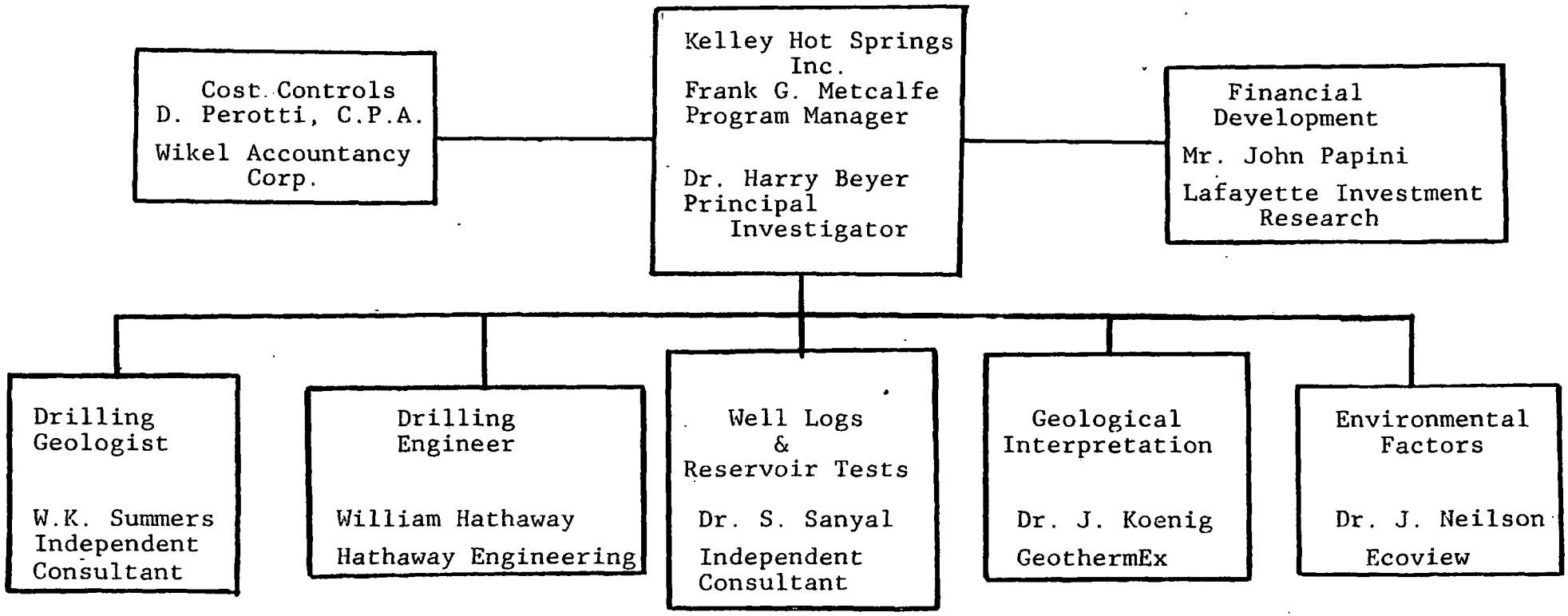

FIGURE - 6

Mr. Perotti will perform cost allocation and accounting and reporting. Mr. Metcalfe will monitor the effectiveness of the Project Work Plan by comparison of actual performance to that schedule. Deviations which are identified early can normally be readily corrected so that project objectives, budgets and schedules are met. The use of a Project Work Plan, coordinated existing professional relationships, short lines of communications and accepted cost controls are well established means of Project Control, and will assure a maximum degree of success.

Mr. Beyer and Mr. Perotti will develop the Cost Plan. This plan shall be the baseline for incurring costs on the contract and used to measure progress in terms of cost. It shall be reviewed and approved by the Program Manager. Mr. Perotti will submit the monthly Cost Management Report. Mr. Beyer, the Principal Investigator, will submit the monthly Technical Progress report. Both these reports will be reviewed and approved by Mr. Metcalfe, the Program Manager. Mr. Metcalfe will submit the quarterly Program Status Report.

4. The names, addresses and telephone numbers of the proposer's primary business and technical contacts with whom the Government may discuss the proposal are to be found in Section D. 1.

5. The provisions of the draft contract are completely acceptable for contract negotiations. There are no unacceptable provisions.

6. The "Program Technical Scope" set forth in the RFP has been reviewed and all the data which will be furnished pursuant to a contract may be published.

7. The latest (April 30, 1977) audited financial statement of G.P.C., the 66% owner of Kelley Hot Springs, Inc. are included for your inspection. Recently, Graymont Ltd. of Montreal, Canada invested $160,000.00 in G.P.C. which is not reflected in the financial statement. Audited financial statements for April 30, 1978 by Deloitte, Haskins & Sells should be ready for your inspection by negotiation date. The 34% common stock owners of Kelley Hot Springs, Inc. are private investors with a combined net worth of over $4,000,000.00. The Investment Company of one of the common stock holders has agreed to provide financing for $125,000.00 of the non-DOE share. (See letter from Lafayette Investment Research - Appendix). G.P.C. will provide the financing for the remainder of the non-DOE share.

8. This proposal will remain in effect for at least 120 days from May 30, 1978.

9. Dr. Harry Beyer, Principal Investigator, the signatory of this proposal, has the authority to commit Kelley Hot Springs, Inc. to all the provisions of this proposal, pursuant to a resolution of the Board of Directors of Kelley Hot Springs, Inc. dated May 15, 1978.

10. GSA Form 19B. (See Appendix)

References

MacDonald, G.A., and Gay, T.E., 1966, Geology of the southern Cascade Range, Modoc Plateau, and Great Basin areas in northeastern California: in Mineral Resources of California, California Division of Mines and Geology, Bull. 191, p.43-48.

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A P P E N D I X

CONTRACT PRICING PROPOSAL
(RESEARCH AND DEVELOPMENT)

Office of Management and Budget Approval No. 29-RO184

This form is for use when *(i)* submission of cost or pricing data (see FPR 1-3.807-3) is required and *(ii)* substitution for the Optional Form 99 is authorized by the contracting officer.

PAGE NO. 1 | NO. OF PAGES

NAME OF OFFEROR	SUPPLIES AND/OR SERVICES TO BE FURNISHED
KELLEY HOT SPRINGS, INC.	Phase 1 Deepening of a 3,300± foot geothermal observation hole to 7-8000 feet well logging and testing
HOME OFFICE ADDRESS 1959 Novato Blvd. NOVATO, CA. 94947	
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED KELLEY HOT SPRINGS, CALIFORNIA	TOTAL AMOUNT OF PROPOSAL $ 260,000.00
	GOV'T SOLICITATION NO. RFP ET-78-R-08-0003

DETAIL DESCRIPTION OF COST ELEMENTS

			EST COST ($)	TOTAL EST COST[1]	REFERENCE[2]
1. DIRECT MATERIAL *(Itemize on Exhibit A)*					
a. PURCHASED PARTS					
b. SUBCONTRACTED ITEMS					
c. OTHER—(1) RAW MATERIAL					
(2) YOUR STANDARD COMMERCIAL ITEMS					
(3) INTERDIVISIONAL TRANSFERS *(At other than cost)*					
TOTAL DIRECT MATERIAL					
2. MATERIAL OVERHEAD[3] *(Rate % X $ base =)*					
3. DIRECT LABOR *(Specify)*	ESTIMATED HOURS	RATE/ HOUR	EST COST ($)		
TOTAL DIRECT LABOR					
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)		
TOTAL LABOR OVERHEAD					
5. SPECIAL TESTING *(Including field work at Government installations)*			EST COST ($)		
TOTAL SPECIAL TESTING					
6. SPECIAL EQUIPMENT *(If direct charge) (Itemize on Exhibit A)*					
7. TRAVEL *(If direct charge) (Give details on attached Schedule)*			EST COST ($)		
a. TRANSPORTATION					
b. PER DIEM OR SUBSISTENCE					
TOTAL TRAVEL					
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
See Hathaway Engineering Estimate following			260,000		
TOTAL CONSULTANTS				260,000	
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*				-0-	
10. TOTAL DIRECT COST AND OVERHEAD				260,000	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate % of cost element Nos.)*[3]				-0-	
12. ROYALTIES[4]				-0-	
13. TOTAL ESTIMATED COST				260,000	
14. FEE OR PROFIT				-0-	
15. TOTAL ESTIMATED COST AND FEE OR PROFIT				260,000	

OPTIONAL FORM 60
October 1971
General Services Administration
FPR 1-16.806
5060-101

CONTRACT PRICING PROPOSAL
(RESEARCH AND DEVELOPMENT)

Office of Management and Budget Approval No. 29-RO184

This form is for use when *(i)* submission of cost or pricing data (see FPR 1-3.807-3) is required and *(ii)* substitution for the Optional Form 59 is authorized by the contracting officer.

PAGE NO. 1 | NO. OF PAGES 4

NAME OF OFFEROR	SUPPLIES AND/OR SERVICES TO BE FURNISHED
KELLEY HOT SPRINGS, INC.	Phase 2 Deepening of a 3,300± foot geothermal observation hole to 7-8000 feet, well logging and testing
HOME OFFICE ADDRESS 1959 Novato Blvd. NOVATO. CA. 94947	
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED KELLEY HOT SPRINGS, CALIFORNIA	**TOTAL AMOUNT OF PROPOSAL** $ 200,000.00
GOV'T SOLICITATION NO. RFP ET-78-R-08-0003	

DETAIL DESCRIPTION OF COST ELEMENTS

			EST COST ($)	TOTAL EST COST[1]	REFERENCE[2]
1. DIRECT MATERIAL *(Itemize on Exhibit A)*					
a. PURCHASED PARTS					
b. SUBCONTRACTED ITEMS					
c. OTHER—(1) RAW MATERIAL					
(2) YOUR STANDARD COMMERCIAL ITEMS					
(3) INTERDIVISIONAL TRANSFERS *(At other than cost)*					
TOTAL DIRECT MATERIAL					
2. MATERIAL OVERHEAD[3] *(Rate %XS base=)*					
3. DIRECT LABOR *(Specify)*	ESTIMATED HOURS	RATE/ HOUR	EST COST ($)		
TOTAL DIRECT LABOR					
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE=	EST COST ($)		
TOTAL LABOR OVERHEAD					
5. SPECIAL TESTING *(Including field work at Government installations)*			EST COST ($)		
TOTAL SPECIAL TESTING					
6. SPECIAL EQUIPMENT *(If direct charge) (Itemize on Exhibit A)*					
7. TRAVEL *(If direct charge) (Give details on attached Schedule)*			EST COST ($)		
a. TRANSPORTATION					
b. PER DIEM OR SUBSISTENCE					
TOTAL TRAVEL					
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
See Hathaway Engineering Estimate following			200,000		
TOTAL CONSULTANTS				200,000	
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*				-0-	
10. TOTAL DIRECT COST AND OVERHEAD				200,000	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate % of cost element Nos.)*[4]				-0-	
12. ROYALTIES[5]				-0-	
13. TOTAL ESTIMATED COST				200,000	
14. FEE OR PROFIT				-0-	
15. TOTAL ESTIMATED COST AND FEE OR PROFIT				200,000	

OPTIONAL FORM 60
October 1971
General Services Administration
FPR 1-16.806
5060-101

This proposal is submitted for use in connection with and in response to *(Describe RFP, etc.)*

RFP ET-78-R-08-0003

and reflects our best estimates as of this date, in accordance with the Instructions to Offerors and the Footnotes which follow.

TYPED NAME AND TITLE	SIGNATURE
Harry Beyer, Principal Investigator	Harry Beyer

NAME OF FIRM	DATE OF SUBMISSION
KELLEY HOT SPRINGS, INC.	May 30, 1978

EXHIBIT A—SUPPORTING SCHEDULE *(Specify. If more space is needed, use reverse)*

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST *(5)*

I. HAS ANY EXECUTIVE AGENCY OF THE UNITED STATES GOVERNMENT PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER GOVERNMENT PRIME CONTRACT OR SUBCONTRACT WITHIN THE PAST TWELVE MONTHS?

☐ YES ☒ NO *(If yes, identify below.)*

NAME AND ADDRESS OF REVIEWING OFFICE AND INDIVIDUAL	TELEPHONE NUMBER/EXTENSION

II. WILL YOU REQUIRE THE USE OF ANY GOVERNMENT PROPERTY IN THE PERFORMANCE OF THIS PROPOSED CONTRACT?

☐ YES ☒ NO *(If yes, identify on reverse or separate page)*

III. DO YOU REQUIRE GOVERNMENT CONTRACT FINANCING TO PERFORM THIS PROPOSED CONTRACT?

☒ YES ☐ NO *(If yes, identify.):* ☐ ADVANCE PAYMENTS ☒ PROGRESS PAYMENTS OR ☐ GUARANTEED LOANS

IV. DO YOU NOW HOLD ANY CONTRACT *(Or, do you have any independently financed (IR&D) projects)* FOR THE SAME OR SIMILAR WORK CALLED FOR BY THIS PROPOSED CONTRACT?

☒ YES ☐ NO *(If yes, identify.):* EG-77-C-08-1524

V. DOES THIS COST SUMMARY CONFORM WITH THE COST PRINCIPLES SET FORTH IN AGENCY REGULATIONS?

☒ YES ☐ NO *(If no, explain on reverse or separate page)*

See Reverse for Instructions and Footnotes

OPTIONAL FORM 60 (10-71)

2

INSTRUCTIONS TO OFFERORS

1. The purpose of this form is to provide a standard format by which the offeror submits to the Government a summary of incurred and estimated costs *(and attached supporting information)* suitable for detailed review and analysis. Prior to the award of a contract resulting from this proposal the offeror shall, under the conditions stated in FPR 1-3.807-3 be required to submit a Certificate of Current Cost or Pricing Data (See FPR 1-3.807-3(h) and 1-3.807-4).

2. In addition to the specific information required by this form, the offeror is expected, in good faith, to incorporate in and submit with this form any additional data, supporting schedules, or substantiation which are reasonably required for the conduct of an appropriate review and analysis in the light of the specific facts of this procurement. For effective negotiations, it is essential that there be a clear understanding of:

a. The existing, verifiable data.
b. The judgmental factors applied in projecting from known data to the estimate, and
c. The contingencies used by the offeror in his proposed price.

In short, the offeror's estimating process itself needs to be disclosed.

3. When attachment of supporting cost or pricing data to this form is impracticable, the data will be described *(with schedules as appropriate)*, and made available to the contracting officer or his representative upon request.

4. The formats for the "Cost Elements" and the "Proposed Contract Estimate" are not intended as rigid requirements. These may be presented in different format with the prior approval of the Contracting Officer if required for more effective and efficient presentation. In all other respects this form will be completed and submitted without change.

5. By submission of this proposal the offeror grants to the Contracting Officer, or his authorized representative, the right to examine, for the purpose of verifying the cost or pricing data submitted, those books, records, documents and other supporting data which will permit adequate evaluation of such cost or pricing data, along with the computations and projections used therein. This right may be exercised in connection with any negotiations prior to contract award.

FOOTNOTES

1 Enter in this column those necessary and reasonable costs which in the judgment of the offeror will properly be incurred in the efficient performance of the contract. When any of the costs in this column have already been incurred (e.g., on a letter contract or change order), describe them on an attached supporting schedule. Identify all sales and transfers between your plants, divisions, or organizations under a common control, which are included at other than the lower of cost to the original transferror or current market price.

2 When space in addition to that available in Exhibit A is required, attach separate pages as necessary and identify in this "Reference" column the attachment in which the information supporting the specific cost element may be found. No standard format is prescribed; however, the cost or pricing data must be accurate, complete and current, and the judgment factors used in projecting from the data to the estimates must be stated in sufficient detail to enable the Contracting Officer to evaluate the proposal. For example, provide the basis used for pricing materials such as by vendor quotations, shop estimates, or invoice prices; the reason for use of overhead rates which depart significantly from experienced rates (reduced volume, a planned major re-arrangement, etc.); or justification for an increase in labor rates (anticipated wage and salary increases, etc.). Identify and explain any contingencies which are included in the proposed price, such as anticipated costs of rejects and defective work, or anticipated technical difficulties.

3 Indicate the rates used and provide an appropriate explanation. Where agreement has been reached with Government representatives on the use of forward pricing rates, describe the nature of the agreement. Provide the method of computation and application of your overhead expense, including cost breakdown and showing trends and budgetary data as necessary to provide a basis for evaluation of the reasonableness of proposed rates.

4 If the total cost entered here is in excess of $250, provide on a separate page the following information on each separate item of royalty or license fee: name and address of licensor; date of license agreement; patent numbers, patent application serial numbers, or other basis on which the royalty is payable; brief description, including any part or model numbers of each contract item or component on which the royalty is payable; percentage or dollar rate of royalty per unit; unit price of contract item; number of units; and total dollar amount of royalties. In addition, if specifically requested by the contracting officer, a copy of the current license agreement and identification of applicable claims of specific patents shall be provided.

5 Provide a list of principal items within each category indicating known or anticipated source, quantity, unit price, competition obtained, and basis of establishing source and reasonableness of cost.

CONTINUATION OF EXHIBIT A—SUPPORTING SCHEDULE AND REPLIES TO QUESTIONS II AND V.

REPRESENTATIONS AND CERTIFICATIONS

(Construction and Architect-Engineer Contract)

(For use with Standard Forms 19, 21 and 252)

REFERENCE *(Enter same No.(s) as on SF 19, 21 and 252)*

NAME AND ADDRESS OF BIDDER (*No., Street, City, State, and ZIP Code*)

KELLEY HOT SPRINGS, INC.
1959 Novato Blvd.
NOVATO, CA. 94947

DATE OF BID

May 30, 1978

In negotiated procurements, "bid" and "bidder" shall be construed to mean "offer" and "offeror."

The bidder makes the following representations and certifications as a part of the bid identified above. *(Check appropriate boxes.)*

1. SMALL BUSINESS

He ☒ is, ☐ is not, a small business concern. (A small business concern for the purpose of Government procurement is a concern, including its affiliates, which is independently owned and operated, is not dominant in the field of operations in which it is bidding on Government contracts, and can further qualify under the criteria concerning number of employees, average annual receipts, or other criteria as prescribed by the Small Business Administration. For additional information see governing regulations of the Small Business Administration (13 CFR Part 121)).

2. MINORITY BUSINESS ENTERPRISE

He ☐ is, ☒ is not a minority business enterprise. A minority business enterprise is defined as a "business, at least 50 percent of which is owned by minority group members or, in case of publicly owned businesses, at least 51 percent of the stock of which is owned by minority group members." For the purpose of this definition, minority group members are Negroes, Spanish-speaking American persons, American-Orientals, American-Indians, American-Eskimos, and American-Aleuts."

3. CONTINGENT FEE

(a) He ☐ has, ☒ has not, employed or retained any company or person (other than a full-time bona fide employee working solely for the bidder) to solicit or secure this contract, and *(b)* he ☐ has, ☒ has not, paid or agreed to pay any company or person (other than a full-time bona fide employee working solely for the bidder) any fee, commission, percentage or brokerage fee, contingent upon or resulting from the award of this contract; and agrees to furnish information relating to *(a)* and *(b)* above as requested by the Contracting Officer. *(For interpretation of the representation, including the term "bona fide employee," see Code of Federal Regulations, Title 41, Subpart 1-1.5.)*

4. TYPE OF ORGANIZATION

He operates as an ☐ individual, ☐ partnership, ☐ joint venture, ☒ corporation, incorporated in State of California

5. INDEPENDENT PRICE DETERMINATION

(a) By submission of this bid, each bidder certifies, and in the case of a joint bid each party thereto certifies as to his own organization, that in connection with this procurement:

(1) The prices in this bid have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor;

(2) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, in the case of a bid, or prior to award, in the case of a proposal, directly or indirectly to any other bidder or to any competitor; and

(3) No attempt has been made or will be made by the bidder to induce any other person or firm to submit or not to submit a bid for the purpose of restricting competition.

(b) Each person signing this bid certifies that:

(1) He is the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein and that he has not participated, and will not participate, in any action contrary to (*a*)(1) through (*a*)(3) above; or

(2) (i) He is not the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein but that he has been authorized in writing to act as agent for the persons responsible for such decision in certifying that such persons have not participated, and will not participate, in any action contrary to (*a*)(1) through (*a*)(3) above, and as their agent does hereby so certify; and (ii) he has not participated, and will not participate, in any action contrary to (*a*)(1) through (*a*)(3) above.

(c) This certification is not applicable to a foreign bidder submitting a bid for a contract which requires performance or delivery outside the United States, its possessions, and Puerto Rico.

(d) A bid will not be considered for award where (*a*)(1), (*a*)(3), or (*b*) above, has been deleted or modified. Where (*a*)(2) above, has been deleted or modified, the bid will not be considered for award unless the bidder furnishes with the bid a signed statement which sets forth in detail the circumstances of the disclosure and the head of the agency, or his designee, determines that such disclosure was not made for the purpose of restricting competition.

NOTE.—Bids must set forth full, accurate, and complete information as required by this invitation for bids (including attachments). The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

THE FOLLOWING NEED BE CHECKED ONLY IF BID EXCEEDS $10,000 IN AMOUNT.

6. EQUAL OPPORTUNITY

He ☒ has, ☐ has not, participated in a previous contract or subcontract subject to the Equal Opportunity Clause herein, the clause originally contained in Section 301 of Executive Order No. 10925, or the clause contained in Section 201 of Executive Order No. 11114; he ☒ has, ☐ has not, filed all required compliance reports; and representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained prior to subcontract awards.

(The above representations need not be submitted in connection with contracts or subcontracts which are exempt from the equal opportunity clause.)

7. PARENT COMPANY AND EMPLOYER IDENTIFICATION NUMBER

Each bidder shall furnish the following information by filling in the appropriate blocks:

(a) Is the bidder owned or controlled by a parent company as described below? ☒ Yes ☐ No. *(For the purpose of this bid, a parent company is defined as one which either owns or controls the activities and basic business policies of the bidder. To own another company means the parent company must own at least a majority (more than 50 percent) of the voting rights in that company. To control another company, such ownership is not required; if another company is able to formulate, determine, or veto basic business policy decisions of the bidder, such other company is considered the parent company of the bidder. This control may be exercised through the use of dominant minority voting rights, use of proxy voting, contractual arrangements, or otherwise.)*

(b) If the answer to *(a)* above is "Yes," bidder shall insert in the space below the name and main office address of the parent company.

NAME OF PARENT COMPANY	MAIN OFFICE ADDRESS *(No., Street, City, State, and ZIP Code)*
GEOTHERMAL POWER CORPORATION	1959 Novato Blvd. Novato, Ca. 94947

(c) Bidder shall insert in the applicable space below, if he has no parent company, his own Employer's Identification Number (E.I. No.) *(Federal Social Security Number used on Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941)*, or, if he has a parent company, the E.I. No. of his parent company.

EMPLOYER IDENTIFICATION NUMBER OF	PARENT COMPANY	BIDDER
➔	94-230-3047	Number Applied For

8. CERTIFICATION OF NONSEGREGATED FACILITIES

(Applicable to (1) contracts, (2) subcontracts, and (3) agreements with applicants who are themselves performing federally assisted construction contracts, exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause.)

By the submission of this bid, the bidder, offeror, applicant, or subcontractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. He certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The bidder, offeror, applicant, or subcontractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certificatons from proposed subcontractors prior to the award of subcontractors exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause; that he will retain such certifications in his files; and that he will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

9. CLEAN AIR AND WATER

(Applicable if the bid or offer exceeds $100,000, or the contracting officer has determined that orders under an indefinite quantity contract in any year will exceed $100,000, or a facility to be used has been the subject of a conviction under the Clean Air Act (42 U.S.C. 1857c-8(c)(1)) or the Federal Water Pollution Control Act (33 U.S.C. 1319(c)) and is listed by EPA, or is not otherwise exempt.)

The bidder or offeror certifies as follows:

(a) Any facility to be utilized in the performance of this proposed contract has ☐, has not ☒, been listed on the Environmental Protection Agency List of Violating Facilities.

(b) He will promptly notify the contracting officer, prior to award, of the receipt of any communication from the Director, Office of Federal Activities, Environmental Protection Agency, indicating that any facility which he proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities.

(c) He will include substantially this certification, including this paragraph (c), in every nonexempt subcontract.

Check the appropriate box below:

[ ] I. CERTIFICATE OF CONCURRENT SUBMISSION OF DISCLOSURE STATEMENT(S)

The offeror hereby certifies that he has submitted, as a part of his proposal under this solicitation, copies of the Disclosure Statement(s) as follows: (i) original and one copy to the cognizant Contracting Officer; and (ii) one copy to the cognizant contract auditor.

Date of Disclosure Statement(s):_____

Name(s) and Address(es) of Cognizant Contracting Officer(s) where filed:_____

The offeror further certifies that practices used in estimating costs in pricing this proposal are consistent with the cost accounting practices disclosed in the Disclosure Statement(s).

[ ] II. CERTIFICATE OF MONETARY EXEMPTION

The offeror hereby certifies that he, together with all divisions, subsidiaries, and affiliates under common control, did not receive net awards of negotiated national defense prime contracts subject to Cost Accounting Standards totaling more than $10,000,000 in either Federal Fiscal Year 1974 or 1975 or net awards of negotiated national defense prime contracts and subcontracts subject to cost accounting standards totaling more than $10,000,000 in Federal Fiscal Year 1976 or in any subsequent Federal Fiscal Year preceding the year in which this proposal was submitted.

CAUTION: Offerors who submitted or who currently are obligated to submit a Disclosure Statement under the filing requirements previously established by the Cost Accounting Standards Board are not eligible to claim this exemption unless they have received notification of final acceptance of all deliverable items on all of their prime contracts and subcontracts containing the Cost Accounting Standards clause.

[ ] III. CERTIFICATE OF INTERIM EXEMPTION

The offeror hereby certifies that (i) he first exceeded the monetary exemption for disclosure, as defined in II. above, in the Federal Fiscal Year immediately preceding the year in which this proposal was submitted, and (ii) in accordance with the regulations of the Cost Accounting Standards Board (4 CFR 351.40(f)), he is not yet required to submit a Disclosure Statement. The offeror further certifies that if an award resulting from this proposal has not been made by March 31 of the current Federal Fiscal Year, he will immediately submit a revised certificate to the Contracting Officer, in the form specified

[X] Certificate of Exemption for Contracts of $500,000 or Less.

The offeror hereby claims an exemption from the Cost Accounting Standards clause under the provisions of 4 CFR 331.30(b)(8) and certifies that he has received notification of final acceptance of all items of work on (i) any prime contract or subcontract in excess of $500,000 which contains the Cost Accounting Standards clause, and (ii) any prime contract or subcontract of $500,000 or less awarded after January 1, 1975, which contains the Cost Accounting Standards clause. The offeror further certifies he will immediately notify the Contracting Officer in writing in the event he is awarded any other contract or subcontract containing the Cost Accounting Standards clause subsequent to the date of this certificate but prior to the date of any award resulting from this proposal.

13. DISCLOSURE STATEMENT--COST ACCOUNTING PRACTICES AND CERTIFICATION

Any contract in excess of $100,000 resulting from this solicitation except (i) when the price negotiated is based on: (A) established catalog or market prices of commercial items sold in substantial quantities to the general public, or (B) prices set by law or regulation, or (ii) contracts which are otherwise exempt (see 4 CFR 331.30(b) and FPR 1-3.1203(a)(2)) shall be subject to the requirements of the Cost Accounting Standards Board. Any offeror submitting a proposal which, if accepted, will result in a contract subject to the requirements of the Cost Accounting Standards Board must, as a condition of contracting, submit a Disclosure Statement as required by regulations of the Board. The Disclosure Statement must be submitted as a part of the offeror's proposal under this solicitaion (see I. below) unless (i) the offeror, together with all divisions, subsidiaries, and affiliates under common control, did not exceed the monetary exemption for disclosure as established by the Cost Accounting Standards Board (see II. below); (ii) the offeror exceeded the monetary exemption in the Federal Fiscal Year immediately preceding the year in which this proposal was submitted but, in accordance with the regulations of the Cost Accounting Standards Board, is not yet required to submit a Disclosure Statement (see III. below); (iii) the offeror has already submitted a Disclosure Statement disclosing the practices used in connection with the pricing of this proposal (see IV. below); or (iv) postaward submission has been authorized by the Contracting Officer. See 4 CFR 351.70 for submission of copy of Disclosure Statement to the Cost Accounting Standards Board.

CAUTION: A practice disclosed in a Disclosure Statement shall not, by virtue of such disclosure, be deemed to be a proper, approved, or agreed to practice for pricing proposals or accumulating and reporting contract performance cost data.

NAME OF CONTRACTOR	DATE	FEDERAL AGENCY
(include known first-tier sub-contractors)		

c. The bidder or proposer represents that if the bidder has 50 or more employees and if this Contract is for $50,000 or more, and that for each subcontractor having 50 or more employees and a subcontract for $50,000 or more, and if he has not developed one, a written affirmative action plan will be developed for each of its establishments within 120 days from commencement of the Contract. A copy of the establishment's plan shall also be maintained at the establishment within 120 days from the date of commencement of the Contract.

The Affirmative Action Compliance Program will cover the items specifically set out in 41 CFR Part 60-2 and shall be signed by an executive of the Contractor.

d. Where the bid of the apparent low responsible bidder is in the amount of $1 million or more, the bidder and his known first-tier subcontractors which will be awarded subcontracts of $1 million or more will be subject to full, preaward equal opportunity compliance reviews before the award of the Subcontract for the purpose of determining whether the bidder and his subcontractors are able to comply with the provisions of the equal opportunity clause.

e. The bidder or proposer, if he has 100 or more employees, and all subcontractors having 100 or more employees are required to submit the Government Employer Information Report SF 100 (EEO-1), within 30 days after award, unless such report has been filed within 12 months preceding award. The EEO-1 report is due annually on or before March 31.

12. COST ACCOUNTING STANDARDS--EXEMPTION FOR CONTRACTS OF $500,000 OR LESS--CERTIFICATION

If this proposal is expected to result in the award of a contract of $500,000 or less and the offeror is otherwise eligible for an exemption, he shall indicate by checking the box below that the exemption to the Cost Accounting Standards clause (FPR 1-3.1204) under the provisions of 4 CFR 331.30(b)(8) (see FPR 1-3.1203(h)) is claimed. Where the offeror fails to check the box, he shall be given the opportunity to make an election in writing to the Contracting Officer prior to award. Failure to check the box below or make such an election shall mean that the offeror cannot claim the exemption to the Cost Accounting Standards clause or that the offeror elects to comply with such clause.

SUPPLEMENT TO REPRESENTATIONS AND CERTIFICATIONS

10. BUY AMERICAN CERTIFICATE

The bidder or offeror hereby certifies that each end product, except the end products listed below, is a domestic source end product (as defined in the clause entitled "Buy American Act"); and that components of unknown origin have been considered to have been mined, produced, or manufactured outside the United States.

Excluded end products (show country of origin for each excluded end product):

11. AFFIRMATIVE ACTION PROGRAM

The following paragraphs are added:

a. The bidder or proposer represents that he (a) [X] 1. has developed and has on file, [ ] 2. has not developed and does not have on file at each establishment an affirmative action program as required by the rules and regulations of the Secretary of Labor (41 CFR Part 60-1 and 60-2), or that he (b) [ ] has not previously had contracts subject to the written Affirmative Action Program requirement of the Secretary of Labor.

If such a program has not been developed, the bidder will complete the following:

The bidder does [ ], does not [ ] employ more than 50 employees and has [ ], has not [ ] been awarded a contract subject to Executive Order 11246 in the amount of $50,000 or more since July 1, 1968. If such a contract has been awarded since July 1, 1968, give the date of such contract, but do not list contracts awarded within the last 120 days prior to the date of this representation.

b. The bidder or proposer represents (a) that a full compliance review of the bidder's employment practices [ ] has, [X] has not been conducted by an agency of the Federal Government; that such compliance review [ ] has, [X] has not been conducted for the bidder's known first-tier subcontractors with a subcontract of $50,000 or more and having 50 or more employees and (b) that the most recent compliance reviews were conducted as follows:

under I. above or IV. below, as appropriate, to verify his submission of a completed Disclosure Statement.

CAUTION: Offerors may not claim this exemption if they are currently required to disclose because they exceeded monetary thresholds in Federal Fiscal Years prior to Fiscal Year 1976. Further, the exemption applies only in connection with proposals submitted prior to March 31 of the year immediately following the Federal Fiscal Year in which the monetary exemption was exceeded.

[ ] IV. CERTIFICATE OF PREVIOUSLY SUBMITTED DISCLOSURE STATEMENT(S)

The offeror hereby certifies that the Disclosure Statement(s) were filed as follows:

Date of Disclosure Statement(s):_____

Name(s) and Address(es) of Cognizant Contracting Officer(s) where filed:_____

The offeror further certifies that practices used in estimating costs in pricing this proposal are consistent with the cost accounting practices disclosed in the Disclosure Statement(s).

14. ADDITIONAL COST ACCOUNTING STANDARDS APPLICABLE TO EXISTING CONTRACTS--CERTIFICATION

(a) Cost accounting standards will be applicable and effective as promulgated by the Cost Accounting Standards Board to any award as provided in the Federal Procurement Regulations Subpart 1-3.12. If the offeror presently has contracts or subcontracts containing the Cost Accounting Standards clause, a new standard becomes applicable to such existing contracts prospectively when a new contract or subcontract containing such clause is awarded on or after the effective date of such new standard. Such new standard may require a change in the offeror's established cost accounting practices, whether or not disclosed. The offeror shall specify, by an appropriate entry below, the effect on his cost accounting practice.

(b) The offeror hereby certifies that an award under this solicitation [ ] would, [ ] would not, in accordance with paragraph (a)(3) of the Cost Accounting Standards clause, require a change in his established cost accounting practices affecting existing contracts and subcontracts.

NOTE: If the offeror has checked "would" above, and is awarded the contemplated contract, he will also be required to comply with the clause entitled Administration of Cost Accounting Standards.

Firm: _____

Name: _____

Date: _____

Title: _____

WILLIAM N. HATHAWAY
PETROLEUM ENGINEER
6840 GRANT AVENUE
CARMICHAEL, CA 95608
(916) 944-3884

May 26, 1978

Frank G. Metcalfe, President
Geothermal Power Corporation
P. O. Box 1186
Novato, CA 94947

Dear Mr. Metcalfe

Enclosed is the deepening program and cost estimate you requested for well "Kelly Hot Springs Ranch" No. 1 in Section 29, T 42N, R 10E, MDB&M. I recommend this well be chosen for deepening because of the recent entry of the existing well bore with the $1\frac{1}{4}$" tubing.

I believe the same cost estimate would apply if the well "Kelly Hot Springs" No. 1 (Section 27) were chosen to be deepened.

Sincerely

William N. Hathaway
WNH/gw

Proposer's Note: To avoid confusion, "Kelley Hot Springs Ranch" No. 1 well is described in the proposal as GRI #1.

WILLIAM N. HATHAWAY
PETROLEUM ENGINEER
6840 GRANT AVENUE
CARMICHAEL, CA 95608
(916) 944-3884

GEOTHERMAL POWER CORPORATION

Kelly Hot Springs Ranch No. 1

Location: 2300' south and 750' west from the northeast corner Section 29, T 42N, R 10E, MDB&M, Modoc County, Calif.
Elevation: +4342' ground.

Present Condition of Well

TD 3206'. PD 3206'. 10" hole to 1060', 7-7/8" hole to TD.
Casing: 10-3/4", 32.75#, H-40 cemented @ 314'.
Tubing: 1¼" hung to 2450'.

Deepening Program

1. Move in drilling rig equipped with 3½" RIF drill pipe. Install flow riser on 10-3/4" casing. Pull 1¼" tubing.
2. Run 9-7/8" pilot hole opener (Pilot less than 7-7/8") and open hole to 9-7/8" to 3206'.
3. Run Schlumberger DIL-Sonic & FDC/CNL logs to 3206'.
4. Cement 7", 20#, K-55 casing @ 3206' with 1275 cubic feet slurry volume Class G cement premixed 1:1 expanded perlite, 2% gel, 40% silica flour and ½% turbulent flow additive (50% excess. Change excess if so indicated by Sonic log caliper.) Run Flexiflow guide shoe and centralizers 15', 80' & 160' above shoe. Tack weld and Bakerlok bottom 4 collars, weld shoe solid. Use plugholding head, bump top plug on shoe. Do outside cement job if cement returns not obtained.
5. Cut off 10-3/4" casing. Land 7" casing. Install dual hydraulic ram type gate and bag type preventer with thermal rubber. Test each preventer, casing, kelly cock, kill and blow down lines with 1200 psig. Notify DOG to witness.
6. Drill 6¼" hole to 8000'. Run Schlumberger DIL-Sonic, FDC/CNL and temperature logs 3206'-8000' (temperature to surface). Hang 2-3/8" EU, 4.7#, J-55 tubing @ 8000'. Bull plug bottom of tubing and run it dry. Remove BOE and install top valve.
7. Install mud logging service 314'. Record normal mud log plus hydrogen sulfide and mud temperature in and out. Take two sets ditch samples (2 paleo, 2 W&D) every 30' and on significant drilling breaks.
8. Mud program.
   Above 3206'. Run minimum weight, minimum solids, gel or inhibited mud. Be prepared for lost circulation.
   Below 3206'. Same as above. Be prepared to raise mud weight 10 pcf. if required.

May 26, 1978

WILLIAM N. HATHAWAY
PETROLEUM ENGINEER
6840 GRANT AVENUE
CARMICHAEL, CA 95608
(916) 944-9884

GEOTHERMAL POWER CORPORATION

Kelly Hot Springs Ranch No. 1

Deepening Cost Estimate

Drilling Contractor: Move rig	$ 40,000
30 days @ $5000	150,000
Drilling location	5,000
Bits and hole openers	18,000
Water	2,000
Drilling mud	20,000
Cement and cementing services	6,000
Electrical logging	15,000
Core analysis	1,000
Mud logging	11,000
3200' of 7" casing	30,000
8000' of 2-3/8" tubing	16,000
Wellhead equipment	3,000
Engineering and geological supervision	15,000
Contingencies	28,000
Total estimated cost	$ 360,000

This estimate is an estimate only and there is no guarantee, either express or implied, that actual costs will be equal to, larger, or smaller than estimated above.

May 26, 1978

HASKINS & SELLS
CERTIFIED PUBLIC ACCOUNTANTS

44 MONTGOMERY STREET
SAN FRANCISCO, CALIFORNIA 94104

AUDITORS' REPORT

Geothermal Power Corporation:

We have examined the balance sheet of Geothermal Power Corporation as of April 30, 1977 and the related statements of loss and deficit and of changes in financial position for the year then ended and cumulatively since inception (December 8, 1971) and of common stock and additional paid-in capital for the period from inception to April 30, 1977. Our examinations were made in accordance with generally accepted auditing standards and, accordingly, included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

The Company's ability to recover its direct and indirect investments in unproven geothermal properties, to attain the goals of its programs, and to meet its obligations is dependent upon obtaining continuing financing, successful exploration and development of the properties, and achieving a satisfactory level of operations. The outcome of these matters cannot be determined at this time. See notes 1 and 3 to the financial statements for additional information.

In our opinion, subject to the effects on the financial statements of the matters mentioned in the preceding paragraph, the aforementioned financial statements present fairly the financial position of the Company as of April 30, 1977 and the results of its operations and the changes in its financial position for the year then ended and cumulatively for the period from inception (December 8, 1971) to April 30, 1977, in conformity with generally accepted accounting principles consistently applied.

Haskins + Sells

August 30, 1977

GEOTHERMAL POWER CORPORATION

BALANCE SHEET, APRIL 30, 1977

ASSETS

CASH (including interest bearing accounts of $286,783).....	$295,534
INVESTMENTS:	
Kelley Hot Springs Limited (Note 3).....	10,674
Lease acquisition costs and deposits (Note 4).....	67,812
OFFICE FURNITURE AND EQUIPMENT - At cost (less accumulated depreciation of $1,243).....	1,986
TOTAL.....	$376,006

LIABILITIES AND STOCKHOLDERS' EQUITY

LIABILITIES:	
Accounts payable and accrued liabilities.....	$ 1,648
Accrued salary due officer and related payroll taxes.....	53,380
Advances from officer.....	14,177
Total liabilities.....	69,205
STOCKHOLDERS' EQUITY:	
Common stock (authorized, 2,000,000 shares of $.10 par value; issued, 618,000 shares).....	61,800
Additional capital.....	603,649
Deficit.....	(315,898)
Reacquired common stock (49,375 shares at cost).....	(42,750)
Stockholders' equity.....	306,801
TOTAL.....	$376,006

See notes to financial statements.

GEOTHERMAL POWER CORPORATION

STATEMENT OF LOSS AND DEFICIT
FOR THE YEAR ENDED APRIL 30, 1977 AND
CUMULATIVELY SINCE INCEPTION (DECEMBER 8, 1971)

	YEAR ENDED APRIL 30, 1977	CUMULATIVELY SINCE INCEPTION (DECEMBER 8, 1971)
CONSULTING FEES AND INTEREST INCOME.....	$ 7,365	$ 19,365
EXPENSES:		
Salaries and payroll taxes.....	25,211	106,298
Financial and other professional advisory services.....	8,334	71,602
Travel and promotion.....	14,503	55,997
Exploration.....	1,375	41,159
Office.....	7,260	40,233
Business taxes and fees.....	552	4,031
Interest.....		3,367
Depreciation and amortization.....	699	2,268
Miscellaneous.....	7,650	10,308
Total.....	65,584	335,263
NET LOSS (per share: year, $.11; cumulatively, $.59).....	$58,219	$315,898

See notes to financial statements.

GEOTHERMAL POWER CORPORATION

STATEMENT OF CHANGES IN FINANCIAL POSITION
FOR THE YEAR ENDED APRIL 30, 1977 AND
CUMULATIVELY SINCE INCEPTION (DECEMBER 8, 1971)

	YEAR ENDED APRIL 30, 1977	CUMULATIVELY SINCE INCEPTION (DECEMBER 8, 1971)
SOURCES OF FUNDS:		
Issuance of common stock for cash (less cost of issue, $12,471)	$387,529	$625,149
Refunds and other decreases in lease application deposits	14,688	49,061
Recovery of investment in Kelley Hot Springs Limited	16,559	(10,674)
Advances from officer	17,576	73,987
TOTAL SOURCES OF FUNDS	$436,352	$737,523
APPLICATIONS OF FUNDS:		
For operations:		
Net loss	$ 58,219	$315,898
Less items not requiring the application of funds:		
Depreciation and amortization	699	2,268
Financial services and other expenses paid by issuance of common stock		40,300
Total for operations	57,520	273,330
Increase in cash	268,926	295,534
Lease application costs	26,656	116,873
Decrease in accounts payable	14,817	(1,648)
Decrease in unpaid officer's salary and related payroll taxes	23,389	(53,380)
Advances to officer	490	59,810
Reacquired common stock	42,750	42,750
Other	1,804	4,254
TOTAL APPLICATIONS OF FUNDS	$436,352	$737,523

See notes to financial statements.

GEOTHERMAL POWER CORPORATION

STATEMENT OF COMMON STOCK AND ADDITIONAL PAID-IN CAPITAL
FOR THE PERIOD SINCE INCEPTION (DECEMBER 8, 1971) TO APRIL 30, 1977

	NUMBER OF SHARES ISSUED	AMOUNT	ADDITIONAL PAID-IN CAPITAL	..REACQUIRED STOCK.. NUMBER OF SHARES	AMOUNT
DECEMBER 1971 - Shares issued for cash ($0.125 per share)	200,000	$20,000	$ 5,000		
MARCH 1973 - Shares issued for cash ($0.50 per share)	50,000	5,000	20,000		
MARCH 1974 - Shares issued for cash ($0.50 per share, per previous agreement)	20,000	2,000	8,000		
MARCH 1974 - Shares issued for cash ($1.00 per share)	40,000	4,000	36,000		
MARCH 1974 - Shares issued as payment for services (agreed value, $1.00 per share)	25,000	2,500	22,500		
SEPTEMBER 1974 - Shares issued as payment for services (agreed value, $1.00 per share)	2,800	280	2,520		
JANUARY 1975 - Shares issued as payment for lease rights (at agreed values ranging from $0.67 to $1.00 per share)	78,000	7,800	54,820		
FEBRUARY 1975 - Shares issued for cash ($2.00 per share)	25,000	2,500	47,500		
APRIL 1975 - Shares issued as payment for services (agreed value, $2.00 per share)	5,000	500	9,500		
JUNE 1976 - Shares issued for cash ($2.23 per share)	11,200	1,120	23,880		
JUNE 1976 - Shares issued as payment for services (agreed value, $2.50 per share)	1,000	100	2,400		
BALANCES, APRIL 30, 1976	458,000	45,800	232,120		
OCTOBER AND APRIL 1977 - Shares issued for cash ($2.50 per share) less cost of $12,471 related to issue	160,000	16,000	371,529		
JANUARY 1977 - Shares reacquired from financial advisor for cash ($1.00 per share) (Note 7)				30,000	$(30,000)
APRIL 1977 - Shares reacquired for cash ($0.66 per share)				19,375	(12,750)
BALANCES, APRIL 30, 1977	618,000	$61,800	$603,649	49,375	$(42,750)

See notes to financial statements.

GEOTHERMAL POWER CORPORATION

NOTES TO FINANCIAL STATEMENTS

1. THE COMPANY

The Company is engaged in exploring and acquiring (directly and indirectly) geothermal properties for subsequent development as sources for electrical power.

The Company's ability to recover its direct and indirect investments in unproven geothermal properties, to attain the goals of its programs, and to meet its obligations is dependent upon obtaining continuing financing, successful exploration and development of its properties, and a satisfactory level of operations. The outcome of these matters cannot be determined at this time.

2. SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

The direct costs of acquiring and maintaining geothermal leases on geothermal property are capitalized; such costs include leases acquired in exchange for stock valued at approximately $63,000. Costs related to leases which are subsequently determined to have no commercial value or which are abandoned are charged to expense at that time. Costs related to leases which may be developed commercially will be amortized in a manner yet to be determined.

Exploration costs are expensed as incurred.

The investment in Kelley Hot Springs Limited is accounted for by the equity method (see Note 3).

Office furniture and equipment is depreciated on a straight-line basis over a ten-year life. Used vehicles are depreciated over three years.

Per share amounts are computed based on the weighted average number of common shares outstanding. No consideration has been given to options outstanding or to shares issuable in connection with the Kelley Hot Springs Limited venture since their inclusion would be antidilutive.

3. INVESTMENT IN KELLEY HOT SPRINGS LIMITED

Kelley Hot Springs Limited (KHS) is a limited partnership organized to develop sources of geothermal energy on leased property in northern California. The Company and its president are general partners of KHS. The limited partner of KHS is a stockholder of the Company.

The Company contributed leases (at a cost of $16,100) for a 66% interest in KHS. The limited partner contributed cash ($150,000) in return for his 33% interest in the partnership. The limited partner has agreed to provide 33% of future working capital requirements to continue the partnership's exploration, subject to a maximum of $20,000. At April 30, 1977, the aforementioned leases and a deep well constitute substantially all of the net assets of KHS.

It is anticipated that substantial losses will be incurred before KHS will achieve a profitable level of operations. In this connection, KHS's partnership agreement provides for the following with respect to allocation of losses and profits:

	Initial $150,000 of Losses and Profits	Profits and Losses in Excess of $150,000
Company	1%	66%
President	1	1
Stockholder	98	33

Should dissolution occur prior to the attainment of operations sufficiently profitable to recover the limited partner's initial investment ($150,000), the limited partner is entitled to net assets of KHS to the extent of any deficiency. At April 30, 1977 the limited partner's deficiency is in excess of the net assets of KHS.

On May 22, 1975, KHS entered into an agreement with Natomas Company for further exploration and development of properties under geothermal leases. Under this agreement Natomas reimbursed KHS for lease costs incurred through July 1, 1977, at which time Natomas elected not to continue further expenditures and the joint venture was terminated.

4. LEASE APPLICATION DEPOSITS

The Company has applications for geothermal leases on certain properties in California, New Mexico, and Utah and has deposited approximately $34,000 with the leasing authorities. Should the applications be rejected, substantially all amounts deposited are expected to be refunded.

5. SALARY AND ADVANCES DUE OFFICER

The president's salary, which has been ratified by the Board of Directors, has not been fully paid. The president has informally agreed to postpone partial payment of the unpaid amount until the Company has sufficient working capital to permit repayment without impairing the Company's ability to meet current operating expenses.

Advances to and from the president accrue interest at 8-1/2% per annum computed on a monthly basis.

6. STOCK ISSUED AND ISSUABLE FOR SERVICES AND STOCK OPTIONS

Common stock has been issued for services as follows:

Description of Service	Date	Number of Shares	Amount
Financial advisory services....	March 1974	25,000	$25,000
Consulting services.....	September 1974	2,800	2,800
Consulting services*.....	April 1975	4,000	8,000
Financial advisory services*...	April 1975	1,000	2,000
Financial advisory services....	April 1976	1,000	2,500

*Transactions involving pre-existing stockholders.

The amounts recorded as consideration for the stock issued represent the fair value of the services provided, determined by the Company and the parties. Transactions between the Company and pre-existing stockholders have been approved by the Board of Directors.

The Company has an agreement to issue to certain consultants 3,000 shares if the Kelley Hot Springs well is successfully completed as a commercial producer.

The Company plans to adopt a stock option plan for key management personnel. Pursuant to the proposed plan, the Board of Directors will be authorized to grant options to purchase an aggregate of 50,000 shares of the Company's common stock to employees who are officers of the Company or who are in managerial, professional, or other key positions.

7. FINANCING

During the year ended April 30, 1977, the Company issued 160,000 shares of common stock at $2.50 per share as part of a private stock offering. Net proceeds to the Company were $387,529 after expenses of $12,471. In connection with this offering, the Company had borrowed $25,000 from its financial advisor in April 1976. Such indebtedness was subsequently cancelled and, in consideration of the cancellation of such indebtedness and of other consulting services, the financial advisor was issued 12,200 shares of the Company's common stock at $2.50 per share. Subsequently, the consultant purchased 50,000 shares of the Company's common stock at $.60 per share from other stockholders and sold 30,000 of such shares back to the Company at a price of $1 per share.

8. FEDERAL INCOME TAXES

The Company is in the development stage, is without earnings, and has no liability for Federal income taxes. At April 30, 1977 it had net operating loss carryforwards approximating $290,000 which expire as follows: 1978, $34,000; 1979, $70,000; 1980, $67,000; 1981, $61,000; and 1982, $58,000.

EXCERPT FROM JIM KOENIG'S REPORT

A shallow hole was drilled one-quarter mile to the north of Kelly Hot Springs. It reached 241 feet and recorded temperatures of 160°F. This suggests that the thermal fracture system that supports the hot springs (about 200°F at the surface) extends northerly. This same fracture may be warm or hot farther to the north. We still do not know the deep configuration of this system. Summers recommends a deep test at the location of the shallow hole. I do not, as the resistivity data were not as encouraging as elsewhere. We must continue to remind ourselves to distinguish between near-surface plumbing and deep reservoirs.

It is probably wretched of me to recall that I warned against repeating the 3,200-feet test of GRI, that I urged that a hole be drilled initially to 6,000 feet, casing off everything above 3,300 feet, and that I predicted a 350° to 400°F temperature at 6,000 feet. I am pleased that others now support my view; and I hope that we will be right about conditions at that greater depth.

I do not know what the reservoir rock is likely to be (see above). I assume that mildly chlorided hot water will be found. Brimhall reported conductances of aquifers, with one exception, to average about 1,300 μmhos, which is quite mild. I am concerned to further review Furgerson's resistivity data for this area at the 2 km depth; I hope that his data are adequate.

A test to 6,000 to 6,500 feet seems warranted. Otherwise, the geothermal potential of this area will never be known. The 2-mile known extent of the thermal aquifer at 3,000 feet is encouraging: there may be a very large quantity of fluid in storage, and this reservoir may be fed from a deeper source at higher temperature.

Probably a full-scale review of the geology and geophysics should be held before another foot is drilled. It may be advisable to carry out still more geoelectrical surveying. Or, a series of shallow holes (200 feet) may be helpful in delineating the thermal zone more fully. In any case, I prefer to see the deeper hole drilled into the most encouraging electrical anomaly. For this leasehold, it appears to be the present site of Kelly Hot Springs #1.

With best regards,

Very truly,

James B. Koenig

JBK:ab

RECOMMENDATION: This well should be cased with 7 5/8 inch casing to 3395. The casing should be cemented in place and a series of temperature logs should be intiated to determine the temperature distribution thereafter. These temperature logs should be obtained over a period of 4 weeks. If the temperatures show no change in the bottom hole temperature or a substantive increase over all, the well should be deepened to at least 6000 feet by drilling with air.

COST: I estimate the cost of this program as follows:

Mobilization:	$10,000.00
Case and cement:	50,000.00
Temperature logs:	20,000.00
Drill and test 3000 feet:	200,000.00
Contingencies:	20,000.00
Total	$300,000.00

Other recommendations

Because Kelly Hot Springs #2 encountered temperatures of 160 ^{o}F at only 241 feet. A deep test is warranted near that location. The exact location to be determined as the basis of the supplementary ground noise surveys and the reinterpreted resistivity data.

The test hole should be (1) deep enough to test the fracture system adequately i.e. at least 3000 feet, (2) drilled with air, and (2) cased throughout after thorough logging.

I estimate the cost of future test in the area at $200,000.

WILLIAMS BROTHERS ENGINEERING COMPANY
A RESOURCE SCIENCES COMPANY

RESOURCE SCIENCES CENTER | TULSA, OKLAHOMA 74103 | (918) 585-2261

EXCERPT FROM WILLIAMS BROTHERS ENGINEERING REPORT

August 16, 1974

Mr. Frank G. Metcalfe
President
Geothermal Power Corporation
160 Sansome Street, Suite 1201
San Francisco, California 94104

Mr. W. K. Summers
Consulting Geologist
P. O. Box 684
Socorro, New Mexico 87801

Gentlemen:

The enclosed report is submitted in accordance with your request for interpretations of electric logs and temperature surveys of Geothermal Power Corporation's Kelly Hot Springs No. 1. The interpretations reported here are based on the geophysical records supplied by Geothermal Power as recorded by Schlumberger Well Services of Sacramento, California on July 13 and 14, 1974. Copies of these records are not supplied with the report but they are available from Schlumberger Well Services.

The purposes for which interpretations of geophysical data are done are to determine the maximum temperature of the subsurface environment in the well and to attain some understanding of the physical nature of the rocks drilled. The interpretations reported here cover the interval of well depth from 544 feet to 3,372 feet.

The predicted temperature to which the wellbore will recover after a long period of nondisturbance will be 228°F at a depth near 3,395 feet. The well was not drilled to a depth sufficient to penetrate a commercial source of geothermal energy. The temperature at a depth of about 5,500 feet is anticipated to be 350°F.

LAFAYETTE INVESTMENT RESEARCH
985 MORAGA ROAD
P.O. BOX 628
LAFAYETTE, CALIFORNIA 94549
(415) 284-2717

May 26, 1978

Board of Directors of
Kelly Hot Springs, Inc.
1959 Novato Blvd.
Novato, Ca. 94947

Gentlemen:

In regards to the capital required for the exploration and development program on the Kelly Hot Springs leasehold, Lafayette Investment Research is in a position to raise the capital required for our portion of the equity (namely $125,000.00 of the $375,000.00 total to be raised by Kelly Hot Springs, Inc.).

Furthermore, should the first drilling be successful and a second drilling desirable, we would be in a position to handle our equity requirements for the additional drilling as well.

We are all anxious to get started, so please proceed with our support.

Sincerely,

John Papini
General Partner
Lafayette Investment Research

Department of Energy
Nevada Operations Office
P.O. Box 14100
Las Vegas, NV 89114

JUN 13 1978

Dr. J. W. Salisbury, Chairman
Technical Committee for
RFP NO. ET-78-R-08-0003

LATE PROPOSAL, RFP NO. ET-78-R-08-0003

Enclosed is a proposal from Chilton Engineering Company received by the Source Evaluation Panel (SEP) on June 12, 1978. In accordance with the late proposal provisions in effect for this procurement (see Amendment No. 1 to subject RFP), a late proposal may be considered "if it offers significant cost or technical advantages to the Government, and it is received before a determination of the competitive range has been made." Since the proposal does not offer cost sharing, "significant cost advantage" is not apparent. The SEP, therefore, requests that the Technical Committee advise it regarding any "significant technical advantage(s)" which such late proposal may offer.

Please so advise us in conjunction with the scheduled June 27, 1978, report from the Technical Committee which will preceed the determination of the competitive range of all proposals received.

Joseph N. Fiore

J. N. Fiore, Chairman
Source Evaluation Panel

E&EAD:JNF-678

Enclosure:
As stated

cc w/encl: C. Nichols, DGE, HQ
S. H. Ward, Univ. of Utah,
Salt Lake City, UT
H. P. Ross, Univ. of Utah,
Salt Lake City, UT
H. Wollenberg, LBL, Berkeley, CA
H. Goldstein, LBL, Berkeley, CA
D. Mabey, USGS, Denver, CO

cc w/o encl:
C. Nedrow, Finance Div.
L. Demers, Finance Div.
B. Bourn, C&P Div.
R. Amick, OCC
J. Zamora, OCC
J. Cotter, E&EAD
F. J. Marriott, C&P Div.

CHILTON ENGINEERING

MARK CHILTON, P.E., R.L.S.
MICHAEL W. LATTIN, P.E., R.L.S.
WILLIAM F. MUELLER, R.L.S.
WILLIAM A. NISBET, R.L.S.
IRA S. RACKLEY, P.E.

1 June, 1978

Mr. Joseph N. Fiore
United States Department of Energy
Nevada Operations Center
2753 South Highland Drive
Las Vegas, Nevada 89114

Re: Proposal Regarding Geothermal Reservoir Assessment in Elko, Nevada

Dear Mr. Fiore:

We are pleased to respond to your 31 March request for proposals regarding the assessment of geothermal resources in the northern basis and range province. We apologize for the late delivery of our proposal and hope that the source evaluation panel will be able to consider our submittal for selection.

The City of Elko has expressed an interest in the direct utilization of the geothermal resource represented by the surface phenomenon known as the Elko Hot Hole. The resource investigation proposed under this RFP would provide the information needed to submit under the DOE Direct Utilization of Geothermal Resources Program for a pilot project in the city of Elko.

It is our hope that the immediate use of the results of this program to carry out the DOE mandate for implementation of direct utilization systems will make this proposal of interest to the source evaluation panel.

Sincerely,

CHILTON ENGINEERING

Sheldon S. Gordon

Sheldon S. Gordon
Project Engineer

SSG:sbb

1570 LINDA WAY SPARKS, NEVADA 89431 AREA 702-331-2277

ASSESSMENT OF THE GEOTHERMAL RESERVOIR SYSTEM LOCATED NEAR ELKO, NEVADA

TECHNICAL AND MANAGEMENT PROPOSALS

Submitted by

Chilton Engineering Company
Geothermal Surveys, Inc.
Cyprus Georesearch Company

May 1978

TABLE OF CONTENTS

A. PROPOSING ORGANIZATIONS

1. Prime Contractor:

Chilton Engineering Company
421 Court Street
Elko, Nevada 89801
Telephone: (702)738-3108
Attn: Mark Chilton, President

2. Subcontractor:

Geothermal Surveys, Inc.
99 Pasadena Avenue
South Pasadena, California
Telephone: (213)255-4511
Attn: Dr. Joseph H. Birman, President

3. Subcontractor:

Cyprus Georesearch Company
555 South Flower Street/Suite 3200
Los Angeles, California 90071
Telephone: (213)628-0891
Attn: Mark A. Liggett, Director, Research & Development

Additional information on the business structures, experience, and capabilities of these organizations is included in Section D. Business and Management of this proposal.

B. TECHNICAL PROPOSAL

1. INVESTIGATION AREA:

a. The proposed investigation will be conducted in and adjacent to the City of Elko, Elko County, Nevada. The investigation area will be located within the following geographical coordinates.

40°40' - 41°00' North Latitude
115°35' - 116°00' West Longitude

b. The proposed program is intended to evaluate the geothermal reservoir system located near the City of Elko for the purpose of direct applications to space heating and industrial process heating. If the evaluation program is successful, the City of Elko has expressed the intent to support the formation of a public utility to develop and distribute geothermal energy.

Land ownership to be considered in the proposed program is as follows:

1. Surface and mineral lands - City of Elko

2. Surface and mineral lands - privately owned

3. Mineral lands - Southern Pacific Railroad Co.

4. Elko Hot Springs known geothermal resource area (KGRA) - U.S. Bureau of Land Management.

5. Open federal land - U.S. Bureau of Land Management.

6. Surface and mineral lands - State of Nevada

c. (Geological description of Elko area and hot springs). The investigation area is located within the northern Basin and Range province. The physiography of the province is characterized by systems of northerly trending mountain ranges separated by deep alluvial valleys. This physiography developed in late Cenozoic time as a result of regional normal faulting which was locally accompanied by the eruption of large volumes of volcanic tuffs and flows and the emplacement of shallow intrusives of generally silicic to intermediate composition. Most of this igneous activity occurred during late Cenozoic time and was both spatially and temperally controlled by Basin Range faulting. Many of the known geothermal areas within the study area are genetically related to silicic volcanic centers and associated structures.

Although the causes and mechanisms of Basin Range deformation are not clearly understood, most current theories presume the existence of east-west crustal extension within the province during late Cenozoic time (Hamilton and Myers, 1966; Cook, 1966; Roberts, 1968; Stewart, 1971; Liggett and Childs, 1974). The seismicity of the province suggests that crustal extension is presently active.

d. The City of Elko is located on and along the floodplain of the Humboldt River. In this area, the river flows toward the southwest between two mountain ranges, the River Range to the northwest and the Elko Range to the southeast.

The Humboldt valley appears to divide the area into two structurally different terranes. To the north, the topography is represented by a series of parallel northwest trending ridges, gently rising northwest from the Humboldt Valley toward the front of the River Range. However, to the south, the Elko Range rises abruptly from the floor of the Humboldt valley along a northeast trend. Within the Elko Range, the topographic elements trend north-south.

While an in-depth study of the geologic structure in this area has not been done, it is apparent that the gentle (10° to 15°) and uniform southeast dip of sediments comprising the ridges northwest of the Humboldt is interrupted southwest of the river. Steeply dipping sediments can be easily seen in some outcrops along the river and indicate at least local deformation.

As mapped by Fredericks and Loelts (1947), a fault zone trending north-northeast intersects the south side of the Humboldt River floodplain in the vicinity of Hot Hole. In this area, hot water from depth ascends to the surfact along the fracture zone. The steepness of the northern front of the Elko Range suggests that it is uplifted by faulting (not yet mapped) along its base. This faulting, if it exists, may also affect the local occurrence and movement of ground water and hot water from depth. Significant faulting along this segment of the Humboldt River valley is also suggested by the sharp difference between the orientation of bedrock units in the River Range to the north and in the Elko Range to the south.

According to Fredericks and Loelts (1947, p.8) three general groups of rocks occur in the vicinity of Elko. These are: (1) Paleozoic limestones and quartzite exposed in the adjacent mountain ranges; (2) the Humboldt Formation, consisting of Tertiary alluvial and lacustrine sediments with interbedded pyroclastic materials and lava flows, which comprise the majority of basin fill; and (3) surficial Quaternary alluvium forming much of the present Humboldt River floodplain.

e. On June 12, 1977, a thermal exploration program for the City of Elko was initiated by Geothermal Surveys, Inc. of Los Angeles, California under contract to the City of Elko. The purpose of this thermal exploration was to gain a better understanding of the local ground water movement in order to locate favorable sites for municipal water wells. This study included a review of the geohydrologic setting, and of records of well drilling and production in the Elko area, and a study of the Hot Hole thermal system southwest of the city.

The survey area was centered approximately over the city and extended about 1.5 miles northeast and southwest from Elko along the Humboldt River floodplain. From June 12 to June 15, fifty-three thermal probes were installed in ten foot holes drilled at ppre-selected sites throughout the survey area. A first set of temperature measurements of the probes was made on June 16. Following the preliminary interpretation of these data, seven additional probes were installed in thermally interesting areas. On July 8, a second set of temperature measurements for all sixty probes was obtained. Two isotherm contour maps of temperatures at ten feet depth for the June 16 and the July 8 thermal readings were prepared from the data. An analysis was also made of the drift, the change in temperature between the two sets of readings at each probe location.

During the survey, down-hole temperature profiles were obtained from several wells throughout the survey area. These thermal logs were made to assist the interpretation of the areal thermal survey data, and to identify water bearing strata intersected by the well bore.

The study showed that a zone of anomalous warm temperature extends from the vicinity of a well known hot spring southwest of the city and passes to and beneath the city. Downhole temperature gradient measurements in existint wells indicate that a significant thermal source is present. Good quality of the near-surface thermal water and the location close to and beneath the city make this an unusually attractive possibility for direct utilization.

The recognition and analysis of the thermal anomaly was made within the framework of the geologic and hydrologic setting. Recommendations both for development of potable water and for further exploration of the thermal resource have been made to the City of Elko, (Birman, J. and Butterfield, F., 1977, p.9-15).

f. The proposed investigation site was selected in order to facilitate development and utilization of geothermal energy. The City of Elko is in close proximity to a known geothermal anomaly, and the municipal government has expressed serious intent to support the proposed program.

An area of approximately 400 square miles surrounding the City of Elko will be studied by geological reconnaissance in order to acquire a broad overview of the tectonic, volcanogenic and geohydrologic setting of the Elko geothermal anomaly. This investigation area is illustrated in the index map of Figure 1.

2. PROGRAM DATA PRODUCTS

a. Subsurface

(1) Water well data

- Temperature logs and gradient measurements
- Geochemistry
- Drilling logs
- Aquifer data

(2) Intermediate depth drilling

- Temperature logs and gradient measurements
- Geochemistry

- Petrographic analyses
- Fluid inclusion analyses of selected hydrothermal vein systems
- Radiometric age dating

(3) Intermediate depth geophysical surveys

- Electrical resistivity profiling and sounding
- Seismic refraction surveying

(4) Ground Temperature surveys

- Repeated measurements at 10 ft. depths in selected profile and grid patterns

b. Surface

(1) Reconnaissance geologic mapping of investigation site

(2) Detailed geologic mapping of key areas

(3) Geohydrological investigations

(4) Geochemical and petrographic sampling and analyses

- Geothermometric analysis of thermal springs and wells
- Petrographic analysis
- Radiometric analyses
- Fluid inclusion analyses of selected hydrothermal vein systems
- Geochemical analysis of hydrothermal alteration anomalies

c. Reservoir engineering studies

(1) Reservoir modeling

(2) Test pumping

(3) Engineering feasibility studies

3. TECHNICAL BASIS FOR PROPOSED PROGRAM

a. Introduction

To date, most geothermal resource exploration has been done in areas which contain direct evidence for subsurface geothermal activity. Such direct evidence of subsurface geothermal activity may include geologically young volcanic cneters, springs, and wells which are thermally and chemically anomalous; siliceous sinter deposits, hydrothermal alteration, and other expressions of surface venting from geothermal systems.

The program outlined in this proposal will focus on acquisition and evaluation of direct evidence for subsurface geothermal activity. In addition, however, it is designed to explore for geothermal resources that are not indicated by direct surface evidence. Because of the scarcity of direct surface expression of geothermal activity, the evaluation of the Elko geothermal anomaly must be based on a variety of geologic, geophysical, and geochemical models, which follow in part, from the assumptions and criteria summarized below.

b. Geological Models

(1) Surface Expression of Geothermal Systems

Geothermal heat reaches the surface by conductive transfer, convective transfer, or a combination of both. Near-surface processes such as the movement of ground water and the reach of the ambient surface temperature waves obscure or eliminate the surface expression of geothermal systems. These factors, must be taken into account, as well as the thermal parameters of the materials through which the heat is transferred.

In a purely conductive model within a thermally isotropic medium and not affected by other processes, the highest near-surface temperatures will be directly over the source (shortest path to the surface). In a purely convective model, heat is transferred to the surface by fluids moving along control structures such as faults, joints, or permeable formations. In such models the highest near-surface temperatures are not likely to be directly over the source except in very special circumstances.

Any exploration must take into account the characteristics of both models, the likelihood that both are present, and the modifying effects of the non-geothermal near-surface processes. The obscuring effects of the ambient temperature waves can be avoided by exploring at sufficient depth below the surface or by analyzing the heat transfer resulting from amplitude and period of each ambient cycle and the thermal diffusivity of the materials. To properly interpret the geothermal evidence as modified by moving ground water requires a clear understanding of ground water hydrology and sufficient knowledge of the hydrologic setting.

Geothermal Surveys, Inc., has already completed a first phase program within and around the city both for ground water and to further explore the Elko geothermal resource. In the Elko area, the local system is at least partly convective, and a detailed program for further exploration and development has been formulated for the City, (Birman, J. and Butterfield, F., 1977).

This assumption has been supported by the study of high-temperature water-dominated geothermal systems in which vapor pressure is exceeded by confining hydrostatic and lithostatic pressures. Such water-dominated geothermal systems do not require surface vents which might be indicated by such features as springs, geysers, or fumaroles (White and Williams, 1975).

Geothemal convection systems have a tendency to seal existing surface vents by the deposition of silica, calcium carbonate, and other substances in response to the lowering of temperature and pressure in the ascending hydrothermal fluids. This mechanism tends to prevent the rapid dissipation of geothermal fluid and heat in the absence of ongoing structural activity, and can minimize the surface expression of an active geothermal system.

(2) Igneous Associations of Geothermal Systems.

Most known high-temperature geothermal systems are spatially and temporally associated with silicic igneous rocks of Pliocene age or younger. The silica-rich magmas are believed to have formed within the lower crust or upper mantle as a result of such processes as magmatic differentiation or partial melting of crustal rocks. Geophysical evidence indicates that silicic magmas often form reservoirs at shallow depths in the crust, beneath volcanic centers. This phenomenon may be controlled by the high viscosity and low density of silicic magma. Basaltic magmas are believed to originate in the upper mantle. The low viscosity of basaltic magmas permits their rapid ascent to the surface through fissures and pipes from which the heat of the magma is quickly dissipated.

Although silicic magma bodies are clearly the most favorable heat sources for potential geothermal convection systems, the frequent bi-modal association of coeval basaltic and silicic eruptive sequences in the Basic and Range Province indicates that basaltic volcanic cneters must not be automatically rejected from consideration. For this reason, evaluation of an igneous center must consider the eruptive history of the center, and its regional geologic and tectonic setting (Liggett and Childs, 1977).

(3) Hydrology of Geothermal Systems

Isotopic and geochemical evidence indicate that the water involved in known geothermal convection systems is predominately of meteoric origin. In order to be considered a viable energy source, a geothermal reservoir must posses favorable hydrologic recharge and permeability such that fluids in reasonable quantity may be [illegible] reservoir [illegible] bound pr[illegible] of sed[illegible] fractured crystalline basement rocks.

In many geothermal systems, cold surface water percolates to a depth of several kilometers through fractured crystalline rocks or permeable sedimentary formations. The lower density of the heated surface water produces a convection system in which the upward percolating fluid selectively follows routes of highest permeability.

Under special conditons, such fluids can spread laterally along faults or permeable strata, thus displacing the surface or near-surface thermal expression of the geothermal system from the actual source at depth. Consequently, an exploration program must consider the regional structural and geological setting of thermal springs or wells, alteration anomalies, or near-surface temperatures or gradient data.

(4) Similarities of Hydrothermal and Geothermal Processes

Recent geologic, geochemical, and isotopic studies have demonstrated genetic sililarities between thermal spring deposition and alteration, and the hydrothermal alteration and mineralization typical of epithermal precious and base metal deposits. In the western United States this similarity often includes associations of such ore deposits with the favorable volcanogenic, hydrologic, and structural settings of geothermal systems as described above (Liggett and Childs, 1975). The occurrence of hydrothermal alteration in association with rocks or structures of late Cenozoic age is believed to be sufficient evidence to warrant testing and evaluation for possible related geothermal activity.

(5) Relationship between Late Cenozoic Structure and Volcanism

Regional geologic investigations in the western United States have demonstrated a spatial and temporal relationship between certain late Cenozoic tectonic patterns and the localization and composition of volcanic activity. The volumetrically important volcanism in the western United States is closely associated with the structural deformation of the Basin and Range Province, which is characterized by northerly striking systems of low-angle normal faults believed to represent crustal extension. Within this province, volcanic centers which have erupted magmas of silicic to intermediate composition are frequently localized within areas dominated by major dip-slip fault systems. Such localized areas of crustal extension are frequently bordered by strike-slip fault systems which have mechanically compensated for differential rates and amounts of crustal extension (Liggett and Research Staff, 1974).

The mapping of regional patterns of late Cenozoic structural deformation provides a basis for predicting areas of potential volcanic and related geothermal activity which may lack direct surface expression.

(6) Geophysical Models

Several geophysical techniques are of proven value in reconnaissance exploration for geothermal resources. Three of the more important involve the observations of temperature, seismic noise, and electrical and magnetic properties.

Since the ultimate target of geothermal exploration is a high-temperature source, it is reasonable to search for anomalous near-surface temperatures which may indicate that a high-temperature source occurs at depth. Seismic noise studies are based on the assumption that a high-temperature geothermal source may be more active seismically than its surroundings, and if so, the increased activity should be detectable at the surface. Electrical resistivity telluric, and magnetotelluric surveys are used to test for the presence of geothermal fluid which, because of its high temperature and its higher-than-normal content of dissolved constituents, can have lower electrical resistivity than its surroundings.

Within the scope of this project, it is not expected that the use of electrical and magnetic geophysical techniques would be extensive. Except in special instances, where one or more of these techniques can be applied efficiently to acquire generalized data, their use would be deferred to a later phase where intensive exploration will be applied to limited areas chosen because of favorable geological-geophysical and economic settings. Also, it is expected that the use of electrical, telluric, and magnetotelluric methods will be minimal, because many of the basins contain large deposits of saline evaporites, or ground water with higher than normal content of dissolved constituents, which reduce the effectiveness of these methods in geothermal exploration.

The thermal technique has been selected for the proposed program for the following reasons: (1) theparameter being measured is intrinsic to the objective, since a geothermal source will have a high temperature; (2) it can be done rapidly and economically throughout a large area with minimum disturbance to the environment; (3) it can make use of existing wells and drillholes; (4) it permits the use of several thermal parameters; and (5) far more thermal information is currently available for the Elko area than seismic or resistivity data. The following paragraphs summarize some aspects of thermal techniques applied to exploration for geothermal sources.

(1) Methods of Thermal Analysis

In making thermal observations, it is possible to measure the temperature at any time, the rate of change of temperature with time, the temperature at any depth, and the rate of change of temperature with depth. Observations of temperature change iwth time are necessary when making observations within a zone affected by a source of changing temperature such as that due to daily or seasonal temperature effects. This complication can be avoided by making nearly simultaneous observations at depths of 10 feet or greater, and observations which are not time-dependent at depths exceeding 50 feet. The diurnal temperature effect is eliminated at 3 to 4 feet below the surface and almost all seasonal effects are nonexistent below 40 feet.

(2) Geothermal Gradient Measurements

The rate of temperature change with depth, or the thermal gradient, is a useful criterion for estimating temperatures at any depth. Such gradient measurements must be used with caution, however, because of three factors which can obscure their meaning. These are (1) changes due to differences in thermal diffusivity of earth materials; (2) convective overturn of air or water in the drillhole or in the surroundings; and (3) advective heat transfer.

Thermal gradients are present where heat flows by conduction. When heat flow does not change with time, differences in the thermal gradient along the same verical profile will result from differences in thermal conductivity. For this reason, it is more reliable to measure heat flow values, which are the product of thermal gradient and thermal conductivity, rather than either of these parameters alone. To do so, however, would require the measurement of thermal conductivity at many different depths in each observed drillhole. For a reconnaissance exploration program, this would require much unnecessary time and expense. Since the values of thermal conductivity are reasonably similar for most of the alluvial rock types found in the study area, gradients can be

considered a reasonably reliable indicator of heat flow conditions. The presence of water, however, changes the thermal conductivity, and this is one important reason that an understanding of ground water distribution in the basin alluvium is extremely important.

Convective transfer of heat typically masks conductive heat flow by causing overturn in a mobile fluid such as air or water. Convection is normally recognizable in a drillhole by a constant temperature within an interval of depth. In many instances, a reasonable value for the undisturbed gradient can still be obtained if sufficient temperature change occurs above and below the disturbed depth interval.

Advective heat transfer is usually due to moving ground water. This is the most serious cause of disturbance of the thermal gradient and the most difficult to resolve for interpretation (Birman, 1969, see Appendix B of this proposal; Cartwright, 1968; Stallman, 1963, Bredehoeft and Papadopulos, 1965). Depending on the thermal regimen at its source, moving water can act either as a heat sink or a heat source. It is , therefore, of prime importance that the geologic and hydrologic setting of the measurement site be well understood in the interpretation of the acquired gradient data.

(3) Ground Temperature Measurements

In addition to measurements of the temperature gradients, other meaningful parameters are: (1) the temperatures at a constant depth below the surface: (2) the change of temperature with time; and (3) the temperature of ground water in wells which are not suitable for thermal logging.

The temperature distribution at constant depth below the surface can be used to outline areas that are unusually warm or unusually cold compared with their surroundings. Unusually cold areas may indicate active flow of unconfined ground water along zones of high transmissivity. The temperature values and configurations of a cool or warm anomaly in relation to its relation to its geologic or geohydrologic setting are important in the interpretation of their meaning. Warm areas may indicate shallow concealed bedrock, which because of higher conductivity, increases the temperature of its surroundings. Abrupt changes in the background temperatures along a linear zone may indicate displaced basement along a concealed fault or the edge of a pediment. Asymmetry across an elliptical warm anomaly may indicate a dipping fault along which warm fluids are rising into the alluvium. Interpretation of ground temperature surveys must consider not only the absolute temperature values, but also the depth of measurement, elevation, time of year, and geologic setting.

d. Geochemical Models

Deep percolating geothermal fluids are known to establish complex chemical and isotopic equilibria with the host rocks for the specific temperature and pressure conditions of the resevoir environment. Where equilibrium reactions have had sufficient time to reach completion, and the ascent of geothermal fluid to the surface is rapid enough that re-equilibration reactions have not had time to occur, geo-chemical analysis of thermal spring or well samples can provide a valuable guide to the geothermal reservoir temperatures.

For this reason, a variety of geochemical analytical methods are applicable to exploration and evaluation of geothermal anomalies. Examples are summarized below.

(1) Assumptions in the Use of Chemical Geothermometry

The Na-K-Ca geothermometer (Fournier and Truesdell. 1973), and the silica geothermometer (Fournier and Rowe, 1966), are empirically-derived methods for estimating geothermal reservoir temperatures based on the chemical constituents of thermal spring water. Several assumptions are involved in the interpretation of the geochemical data, and these can lead to inaccuracies in the indicated temperatures. The most important assumptions are (Fournier and others, 1974):

a. Water-rock chemical reactions which are temperature-dependent occur in the resevoir at depth.

b. All constituents involved in a temperature-dependent reaction are sufficiently abundant (i.e., supply is not a limiting factor).

c. Water-rock equilibration is established at the resevoir temperature.

d. Little or no re-equilibration or change in composition occurs at lower temperatures as the water flows from the resevoir to the surface.

e. The hot water coming from deep in the system does not mix with cooler shallow ground water.

The Na-K-Ca Geothermometer

The Na-K-Ca geothermometer makes use of the ratios of these three ions in solution based on empirical evidence that the function log (Na/K) versus temperature approximates a straight line. Fournier and Truesdell (1973) have increased the accuracy of this function by adding a correction factor of log ($\sqrt{Ca}$/Na). The formula for determining reservoir temperatures is as follows:

$$T\ (°C) = \frac{1674}{2.24+F(T)} - 273.15$$

Where $F(T) = \log (Na/K) + B \log (\sqrt{Ca}/Na)$

and B=4/3 or 1/3, depending upon whether equilibrium in the resevoir took place below or above 100°C (212°F). Ionic concentrations are in moles/100g H_2O. The calculation is performed by first assuming that B = 4/3. If the calculated temperature is below 100°C, then this temperature is used. However, if the calculated temperature is above 100°C, then the calculation must be repeated using B = 1/3.

(2) The Silica Geothermometer

The silica geothermometer (Fournier and Rowe, 1966), is based on the increasing solubility of various forms of silica in water with increasing temperature at depth in hydrothermal systems. Hot springs sampled at the surface are often found to be supersatureated with respect to silica due to the rapid ascent of solutions from depth combined with the relatively slow rate of deposition of the dissolved silica. When corrections to the silica content

are made to allow for the formation of steam during the ascent, the silica content may be used as an approximate measure of resevoir temperature. These corrections have been calculated on a thermodynamic basis (Fournier and Truesdell, 1974, Reed, 1975).

(3) Reliability of Geothermometric Data

As indicated above, the accuracy of the calculated resevoir temperature is dependent on the degree to which the working assumptions fit the subsurface geology. A partial test of the assumptions is provided by the concordance of the Na-K-Ca and silica temperatures. The Na-K-Ca geothermometer is not critically sensitive to concentration or dilution of the hydrothermal fluids, as it is based on the ratios of the dissolved constituents. In contrast, the silica geothermometer, which is based upon the absolute concentrations of silica in the water, is extremely sensitive to such effects. The Na-K-Ca geothermometer is sensitive to the precipitation of Ca as calcium carbonate. If Ca precipitates out during the ascent of the solution, or at some time subsequent to the collection of the sample, the estimated reservoir temperature will be too high. However, it is possible to prevent the precipitation of calcium carbonate in the sampling bottle by acidifying the water sample to about pH 2.5 immediately after collection of the sample.

(4) Fluid Inclusion Geothermometry

During the formation of hydrothermal veins, small inclusions of saline solutions gases, or other hydrothermal fluids are frequently trapped within small cavities in the vein-forming minerals. Typical host minerals include quartz, calcite, fluorite, and other low-temperature minerals typical of geothermal systems.

Primary fluid inclusions ideally represeent microscopic samples of the fluid which surrounded the host crystal at the time of its formation. Secondary fluid inclusions are those which form at any time subsequent to the formation of the host crystal; they are usually caused by fracturing and rehealing of the host crystal.

When primary fluid inclusions are formed, the fluid is at the elevated temperature and pressure of crystal formation. As the fluid cools and contracts,a vapor bubble is generally formed within the inclusion. During analysis, a chip of the crystal is heated in a special microscope stage, where the fluid inclusions can be observed and the temperature precisely monitored. During heating, the liquid phase of the inclusion expands at the expense of the vapor phase; the temperature at which the vapor bubble disappears (the homogenization point) is the temperature of formation of the inclusion, and hence of the crystal. This analytical technique is valuable for estimating the temperature of a geothermal system at the time when the analyzed vein minerals were formed.

4. PROGRAM DESCRIPTION

The proposed program will coordinate the application of a variety of remote sensing data, geologic map and literature research, and geological, geophysical, and geochemical reconnaissance studies. These tasks will be undertaken with the objective of obtaining an overview of the study area as quickly and economically as possible, so that maximum effort can be concentrated in areas having the highest geothermal potential. The following paragraphs summarize the data and analytical techniques to be employed in the proposed program.

a. Remote Sensing Data Acquisition and Processing

LANDSAT 1 and 2 MSS imagery and SKYLAB S-190B and U-2 aircraft photography will be selected and acquired having minimum cloud and snow cover and low sun elevation favorable for structural interpretation. Preliminary analysis of the LANDSAT 1 and 2 MSS imagery will employ an additive color viewer for determining the optimum MSS band/filter combination to be used in high-resolution false-color compositing. Following preliminary additive color analysis of the LANDSAT imagery, high-resolution false-color composites will be produced in the laboratory uisng the technique developed by MacGalliard and Liggett (1973). This procedure will result in precise control of image color balance and contrast range.

High resolution prints of selected U-2 photographs will be prepared to support geological field investigations.

Data products resulting from this task will include:

(1) 1:500,000 scale LANDSAT MSS false-color composites (multiple coverage where analysis is benefited by seasonal variations in snow, vegetation cover, or sun elevation).

(2) Geographic overlays for the above images.

(3) Index maps of available NASA U-2 aircraft photography.

Time duration: _____months

Personnel: _____man-months

b. Literature and Map Research

In support of the proposed program, a working library will be updated to include the most recent data applicable to the investigation area. A partial list of reference sources includes:

Chilton Engineering Company research files
Cyprus Georesearch Company research files
Geothermal Surveys, Inc. research files
U.S. Geological Survey Publications and Open-File Reports
U.S. Department of Energy, Division of Geothermal Energy
U.S. Department of Commerce - National Technical Information Service
U.S. Bureau of Reclamation
U.S. Bureau of Mines
U.S. Department of Agriculture
Nevada Bureau of Mines
University of Nevada Agriculture Experimental Station Bulletins
Desert Research Institute, University of Nevada
Nevada Department of Conservation and Natural Resources
Nevada State Engineer, Water Resources Bulletins
Published literature in geologic, hydrologic, and geophysical journals
University theses

Index maps will be complied at appropriate scales to show the locations of the following:

(1) Geothermal wells and springs

(2) Water wells and other accessible drill holes in selected areas

(3) Regional geophysical survey data

(4) Sources of geological data

Time duration: _____months

Personnel: _____man-months

c. Data Analysis and Geological Field Reconnaissance

Analysis of available geologic, geophysical, hydrologic, and tectonic data will be directed toward selection of preliminary areas in which geologic and geophysical field surveys can be most economically concentrated. This program task is designed to accomplish the following objectives:

(1) Recognition of regional tectonic controls of volcanism, plutonism, and related geothermal activity.

(2) Identification of volcanic centers, their shallow plutonic equivalents, and related features such as caldera structures.

(3) Interpretation of the local structural settings of known or potential areas of geothermal activity.

(4) Identification of possible hot spring deposits or associated hydrothermal alteration.

Following the exploration criteria outlined in Section 3A of this proposal, preliminary exploration anomalies will be selected for geologic field reconnaissance and applicable geochemical sampling and geophysical studies. Geological field studies will focus on evaluating the age and compositional range of igneous centers, the structural setting of these igneous centers, and evaluation of alteration color anomalies and structural patterns interpreted from the U-2 aircraft imagery. Laboratory petrographic and geochemical analyses will be conducted as required to support the field reconnaissance surveys. Specific attention will be directed toward studying the structural settings and lithologic associations of known ghermal springs and wells in the study area.

Time duration: _____months

Personnel: _____man-months

d. Geochemical Sampling and Analysis

Water samples from springs and flowing wells will be collected during the reconnaissance program in order to provide supplementary information concerning subsurface conditions in selected areas. Samples will be analysed for sodium, potassium, calcium, and silica, and the results will be interpreted using geothermometric techniques as referenced in Section_____of this proposal.

Identified thermal springs will be checked for discharge, temperature, extraordinary gases, and approximate pH. The water samples to be analysed for sodium, calcium, and potassium will be collected in 500 mi glass bottles. Glass is used because polyetheyne bottles leak gases which can affect the concentration of the above ions. In order to prevent the precipitation of the ions, the samples will be acidified to approximately pH 2.5 by the addition of hydrochloric acid (HCl).

The water samples intended for silica analysis will be collected in 950 ml polyethylene bottles, used to minimize contamination by silica from glass. Each sample will consist of 90 ml of hot spring water added to 810 ml of distilled and de-ioized water. This method is intended to prevent the precipitation of silica gel in response to the decrease in sample temperature after collection.

The results of this program task will be tabulated and plotted on base maps to facilitate analysis of regional trends in indicated reservoir temperatures and salinities.

Time duration: _____months

Personnel: _____man-months

e. Reconnaissance Geophysical Studies

Geophysical field work as part of the proposed program will be conducted within areas believed to have high geothermal potential on the basis of geological studies. The geophysical program will consist of measuring temperatures, temperature gradients, and water levels in existing wells throughout the selected areas. The objective is to locate areas that are thermally anomalous and to do this without incurring the high cost and environmental risks of drilling new observation holes. Because water wells are irregularly distributed, vary in depth, and may be in operation, a unifrom distribution of measurements may not be achieved.

Temperature logging of selected wells and drill holes will be done using cable-mounted thermistor probes, individually calibrated to $\pm 0.01^{\circ}C$ ($0.018^{\circ}F$). The reels which hold the cables are equipped with odometers, accurate to 0.1 ft., so that depths can be efficiently measured. Temperature measurements will be made at specified intervals selected for each well to ensure sufficient data points so that significant changes in vertical distribution of temperature can be observed.

The temperatures are measured at each point by allowing the probe to achieve thermal equilibrium and then reading the resistance of the thermistor with a Wheatstone bridge and null detector. Resistance values for the thermistors are converted to temperatures by means of individual calibration curves. The depth to water in a well or drill hole will be measured with standard electric water level indicator. This is generally done before the thermal log is run, so that temperatures near or at the static water level can be measured.

Wells which are pumping or which can not be idled for more than a few days are not suitable for gradient logging, but can provide useful water temperature data. In actively pumping wells, the temperature of the water must be obtained at or near the point of discharge at the well head. However, if the pump can be temporarily idled, the temperature midway in the water column is generally chosen because it can be assumed that during pumping, the entire

[illegible] discharging [illegible] through the vertical column. Inaccuracies involved in the use of water temperatures derive from the following: the wells are of varying depth; the depth interval of the water column is unknown; the production rate is not the same from the individual aquifers throughout the saturated column; and some wells may be artesian, in which event the water temperatures would not be representative of the water temperatures at similar depths in unconfined, or water table wells.

The data for the third thermal parameter - the temperature values at 100 ft. depth - will be obtained in the normal course of logging. It is expected that many wells will be too shallow (less than 100 feet) to provide reliable gradients. Because ground temperatures at 100 ft. are below the reach of the annual temperature wave they provide a useful standard for local comparisons with data measured at shallower depths. These 100 ft. temperatures are subject to variations due to ground water movement, varying thermal conductivities of the host rock, and evaluation factors as discussed in Section 3.3.0 of this proposal.

The results of this program task will be tabulated, statistically analysed, and plotted on base maps to facilitate analysis of regional trends.

Time duration: _____months

Personnel: _____man-months

The following paragraphs describe the analytical techniques to be employed in the Phase II portion of the investigation:

f. Advanced Geologic Studies

Advanced geological investigations will be performed within the geothermally anomalous areas identified as a result of the reconnaissance program. [illegible] work with the objective of [illegible] structural associations of the identified geothermal anomalies. Techniques to be employed include the following:

(1) Compilation of reconnaissance geologic and structural maps at appropriate scales of the temperature range [illegible]

(2) Sampling and radiometric dating of key igneous rock units or hydrothermal vein material.

(3) Sampling and fluid inclusion analysis of relevant hydrothermal vein material.

(4) Petrographic and mineralogical analysis of hydrothermally altered rocks.

(5) Geothermometric analysis of additional water samples to supplement analyses made during the Phase I program.

This program task will utilize the analytical facilities of the Cyprus Research Laboratory (Management Proposal) and will be coordinated with analysis of available geological, hydrological and geophysical data. This coordination of methods will permit maximum efficiency in the planning, execution, and interpretation of advanced geophysical investigations of the identified geothermal anomalies.

Time duration: _____months

Personnel: _____man-months

g. Advanced Geophysical Studies

Within the geothermal anomalies selected as a result of the Phase I program, a variety of specialized geophysical survey methods will be employed for estimating the configurations and depths or the thermal anomalies, and the characteristics of any associated ground water reservoirs. The following methods will be employed:

(1) Thermal Probe Surveys:

Thermal probes which utilize thermistors with sensitivities of 0.01°C will be placed in perdetermined arrays at a depth of 10 feet and spacings of one to two miles. The probes are inserted by drilling six-inch holes with a power auger, and then backfilling the hole after the probe is in place. The ten foot depth is below the reach of the diurnal temperature wave and within the reach of the annual wave.

After allowing the thermistors to come to equilibrium with their surroundings, the probes

calibration tables which have been

As applied by Geothermal Surveys, Inc., the thermal technique has no lasting impact on the enfironment. Holes for the thermal sensors are shallow and slim. Trees and shrubs

are not cut down or removed, because the sensors must be located away from such vegetation. Heavey rigs such as those used for drilling water wells, shot holes, or intermediate depth temperature gradient holes are not used. No drilling mud or other fluids are used, and the holes are backfilled with the material from the hole. It is standard practice by GSI personnel to prevent theft of the probes by making the probe locations virtually undistinguishable in the environment. When the survey is finished, the probes are removed, the holes are refilled, and the surface is restored by smoothing any irregularities.

Depending on the general geologic setting in each area, temperatures will first be measured along profiles and then expanded into a grid distribution to cover areas where anomalous conditions are indicated by the profile data. Probes will be read twice, with a minimum interval between readings of one week, after which they will be removed.

The temperatures and temperature drift (variation with time) will be plotted on base maps and contoured to show the configuration and variation of temperature and drift data. Anomalous temperatures, both warm and cold, will be identified by comparison with background temperature, statistical analysis, interpretation with respect to the local geographic-climatic-hydrologic setting, and comparison with the range of temperature and drift data obtained by GSI in the southwestern United States over the past sixteen years. In certain instances, derivative and downward continuation analysis of the thermal data may be made.

The presence of ground water in basin alluvium may complicate the interpretation of thermal survey data. As a result, it is important to the interpretation of the thermal data to have a thorough knowledge of the ground water hydrology of the basin areas within which the thermal surveys are conducted. Thus, the data gathered during the thermal surveys and supporting ground water studies will be valuable not only in locating geothermal anomalies, but also in assessing the basin areas for potential ground water supplies.

(2) Intermediate-Depth Gradient Drilling

In situations where a geothermal source is overlain by actively moving ground water, its near-surface thermal expression may be partially or completely masked. On selected geothermal anomalies, identified as a result of advanced geologic and geophysical investigations, intermediate depth drilling (300-500 feet or deeper) may be required in order to provide temperature gradients below the zone of active ground water influence. Coordinated with thermal probe surveys and appropriate subsidiary geophysical methods, the application of gradient drilling well provide critical data for estimating the depth and temperature of the associated geothermal reservoir or heat source. The use of shallow thermal probe surveys, however, will greatly reduce the number of drillholes required to provide gradients, and allow best choices to be made for their locations. By drilling the deeper holes only where shallow probes prove ineffective, both costs and environmental impacts will be kept to a minimum. Gradient data obtained from these drillholes will supplement the gradient data obtained earlier from existing wells and drillholes.

Given the sizes of the areas and the complexity of conditions, the chance of missing significant geothermal possibilities would be high if gradient holes were drilled without first using shallow temperature surveys. However, by combining both types of thermal surveying techniques - shallow areal coverage followed by selected gradient drilling - the objectives of the program will be reached with minimum cost and optimum enviornmental safety.

It is anticipated that approximately _____thermal gradient drillholes might be required as part of the proposed program. If these drillholes appear to be warranted based on the results of shallow survey methods, the drilling would be contracted to capable companies with anticipated costs as follows:

Holes of 500 ft. at $7,500/hole
Holes of 300 ft. at $4,500/hole

(3) Other Geophysical Methods

Depending upon specific geological characteristics of the investigation sites, a variety of additional geophysical exploration methods may be employed. These may include magnetic, gravity, seismic refraction, telluric, magnetotelluric, and electrical resistivity surveys. In

specific instances, electric or radioactivity logging may be done in holes drilled for thermal gradients, and in some area, seismic noise surveys may be made. In addition, there already exists a considerable body of magnetic and gravity data. These will provide much information regarding size, distribution, and depth of formations that can function as geothermal reservoir systems. Similarly, any other deep geophysical work, such as electrical and seismic studies, the results of which are available to the public, will be utilized in the program.

In general, the use of gravity, magnetic, and seismic refraction methods would be needed to determine the depth to crystalline basement, to trace distinctive units, and to identify buried structural discontinuities. The electrical and telluric methods would be used to search for high temperature fluids having low electrical resistance. Seismic noise surveys have been used to search for active movement of fluids within a geothermal system. Special drillhole logging techniques may be used to determine in-situ characteristics of rock units, from which, combined with the gradient data, estimates of heat flow can be made.

Time duration: _____months

Personnel: _____man-months

h. Reservoir Assessment

Comprehensive analysis of the diverse geologic, hydrologic, geophysical, and geochemical information to be acquired in the proposed program will be performed for the purpose of estimating the following parameters:

(1) Size and principal characteristics of identified geothermal reservoirs

(2) Probable temperature range and chemistry of geothermal reservoir fluids

(3) Structural and lithologic associations or controls of the geothermal reservoirs

(4) Origin and characteristics of reservoir heat source

(5) Potential geologic hazards relating to seismicity and/or subsidence.

To the extent that sufficient evidence can be obtained, estimates of heat content (in units of 10^{18} calories) will be derived utilizing the assumptions and criteria cited by White and Williams (1975). Subsidiary parameters

relating to physical constraints in reservoir development will be identified and evaluated as feasible utilizing available data.

Although the scope of this program task is necessarily limited, it is expected to provide an important basis for planning advanced engineering assessment and feasibility studies.

Time duration: _____months

Personnel: _____man-months

i. Preparation of Reports

The following reports will be compiled and submitted in conformance with contract specifications:

(1) Management Plan - A plan to be updated upon contract award. The management will contain management methodologies, control procedures to be used and include milestone charts and other planning schedules, organizational identification and descriptions, and special critical plans such as test plans. Working breakdown structures, key personnel identification, and methods for monitoring progress toward objectives shall be included.

(2) Cost Plan - A plan submitted upon contract execution. It shall be the baseline for incurring costs on the contract and used to measure progress in terms of cost.

(3) Cost Management Report - A monthly report of the status of costs compared to the Cost Plan. It will show estimated, acutal, and projected costs.

(4) Program Status Report - A quarterly report to communicate to DOE management an assessment of contract status and explain variances, achievements, and identify actual or potential problems.

(5) Technical Progress Report - A monthly report summarizing the activities during the past month, planned activities for the succeeding month, and identifying significant problems and solutions encountered or expected.

(6) Final Technical Report - A report submitted at program completion summarizing the results of the program including well drilling and completion histories if applicable.

(7) Informal Reports - Telephone communications on a weekly or daily basis depending on the status of the program may be required.

5. PROGRAM SCHEDULE

6. ENVIRONMENTAL EVALUATION

No portion of the proposed program is expected to have significant environmental effects on plant life, water quality, or terrane damage.

Reconnaissance geological and geochemical studies will be performed with no environmental impact, as will logging of existing water wells and exploration holes. The ground temperature surveys described in Section____of this proposal have only minor transient expression, and it is anticipated that 80% of the probe sites may be located along existing road systems.

Intermediate depth gradient drilling or test well drilling will be performed in accordance with state requirements. Well sites will be evaluated with consideration to possible environmental influence.

C. COST

(Include GSA optional form 60)

CONTRACT PRICING PROPOSAL
(RESEARCH AND DEVELOPMENT)

Office of Management and Budget Approval No. 29-RO184

This form is for use when *(i)* submission of cost or pricing data (see FPR 1-3.807-3) is required and *(ii)* substitution for the Optional Form 59 is authorized by the contracting officer.

PAGE NO. | NO. OF PAGES

NAME OF OFFEROR: CHILTON ENGINEERING

HOME OFFICE ADDRESS: 421 Court Street, Elko, Nevada 89801

SUPPLIES AND/OR SERVICES TO BE FURNISHED

DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED

TOTAL AMOUNT OF PROPOSAL: $

GOV'T SOLICITATION NO.

DETAIL DESCRIPTION OF COST ELEMENTS

			EST COST ($)	TOTAL EST COST[1]	REFERENCE[2]
1. DIRECT MATERIAL *(Itemize on Exhibit A)*					
a. PURCHASED PARTS					
b. SUBCONTRACTED ITEMS					
c. OTHER—(1) RAW MATERIAL					
(2) YOUR STANDARD COMMERCIAL ITEMS					
(3) INTERDIVISIONAL TRANSFERS *(At other than cost)*					
TOTAL DIRECT MATERIAL					
2. MATERIAL OVERHEAD[3] *(Rate % X $ base =)*					
3. DIRECT LABOR *(Specify)*	ESTIMATED HOURS	RATE/ HOUR	EST COST ($)		
Management	400	13.78	5,512.00		
Professional I	400	15.74	6,296.00		
Professional II	1520	11.07	16,826.40		
Technician	1920	7.88	15,129.60		
TOTAL DIRECT LABOR			43,764.00		
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)		
	.28	43,764.	12,253.92		
TOTAL LABOR OVERHEAD			12,253.92		
5. SPECIAL TESTING *(Including field work at Government installations)*			EST COST ($)		
TOTAL SPECIAL TESTING					
6. SPECIAL EQUIPMENT *(If direct charge) (Itemize on Exhibit A)*					
7. TRAVEL *(If direct charge) (Give details on attached Schedule)*			EST COST ($)		
a. TRANSPORTATION					
b. PER DIEM OR SUBSISTENCE					
TOTAL TRAVEL					
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
TOTAL CONSULTANTS					
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*			22,962.50		
10. TOTAL DIRECT COST AND OVERHEAD					
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate 88 % of cost element Nos.)*[4]			38,512.32		
12. ROYALTIES[4]					
13. TOTAL ESTIMATED COST				117,492.74	
14. FEE OR PROFIT			14,180.00		
15. TOTAL ESTIMATED COST AND FEE OR PROFIT				131,672.74	

OPTIONAL FORM 60
October 1971
General Services Administration
FPR 1-16.806
5060-101

This proposal is submitted for use in connection with and in response to *(Describe RFP, etc.)*

and reflects our best estimates as of this date, in accordance with the Instructions to Offerors and the Footnotes which follow.

TYPED NAME AND TITLE	SIGNATURE
Sheldon S. Gordon, Project Engineer	Sheldon S Gordon

NAME OF FIRM	DATE OF SUBMISSION
CHILTON ENGINEERING	

EXHIBIT A—SUPPORTING SCHEDULE *(Specify. If more space is needed, use reverse)*

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*			EST COST *(5)*
	DIRECT LABOR:			
	Management	50	110.24/ Day	5,512.00
	Professional I	50	125.92/ Day	6,296.00
	Professional II	190	88.56/ Day	16,826.40
	Technician	240	63.04/ Day	15,129.60
	OTHER DIRECT COSTS			
	Field Vehicle	5500 miles @ $.35/Mile		1,925.00
	Transportation	14 trips @ $175.00/trip		2,450.00
	Per Diem	250 days @ $35.00/day		8,750.00
	Geochemical + Petrograph Analysis			3,000.00
	Radiometric Age Dating	2 @ $300.00		600.00
	Photographic Data Processing			1,250.00
	Graphics + Reproduction			1,250.00
	Computer			500.00
	Field Supplies			500.00
	Miscellaneous			650.00
	Other Direct Cost Subtotal $20,875.00 + 10% Handling Fee	2,087.00	TOTAL	22,962.50

I. HAS ANY EXECUTIVE AGENCY OF THE UNITED STATES GOVERNMENT PERFORMED ANY REVIEW OF YOUR ACCOUNTS OR RECORDS IN CONNECTION WITH ANY OTHER GOVERNMENT PRIME CONTRACT OR SUBCONTRACT WITHIN THE PAST TWELVE MONTHS?

☐ YES ☒ NO *(If yes, identify below.)*

NAME AND ADDRESS OF REVIEWING OFFICE AND INDIVIDUAL	TELEPHONE NUMBER/EXTENSION

II. WILL YOU REQUIRE THE USE OF ANY GOVERNMENT PROPERTY IN THE PERFORMANCE OF THIS PROPOSED CONTRACT?

☐ YES ☒ NO *(If yes, identify on reverse or separate page)*

III. DO YOU REQUIRE GOVERNMENT CONTRACT FINANCING TO PERFORM THIS PROPOSED CONTRACT?

☒ YES ☐ NO *(If yes, identify.):* ☐ ADVANCE PAYMENTS ☒ PROGRESS PAYMENTS OR ☐ GUARANTEED LOANS

IV. DO YOU NOW HOLD ANY CONTRACT *(Or, do you have any independently financed (IR&D) projects)* FOR THE SAME OR SIMILAR WORK CALLED FOR BY THIS PROPOSED CONTRACT?

☐ YES ☒ NO *(If yes, identify.):*

V. DOES THIS COST SUMMARY CONFORM WITH THE COST PRINCIPLES SET FORTH IN AGENCY REGULATIONS?

☒ YES ☐ NO *(If no, explain on reverse or separate page)*

See Reverse for Instructions and Footnotes

OPTIONAL FORM 60 (10-71)

D. BUSINESS AND MANAGEMENT

1. BUSINESS MANAGEMENT ORGANIZATION

This proposal has been prepared by Chilton Engineering Company, Geothermal Surveys, Inc., and Cyprus Georesearch Company in response to Solicitation No. ET-78-R-08-0003 released by the United States Department of Energy.

In conducting the investigation outlined in this proposal, it is intended that Chilton Engineering Company will function as the prime contractor to the U.S. Department of Energy. Technical assistance in the proposed program will be provided by Geothermal Surveys, Inc., and Cyprus Geosearch Company under a subconsultant agreement in conformance with the regulations of the U.S. Department of Energy.

(a) Decision Making Authority

Responsibility and authority for conducting the proposed investigation, for decisions relating to utilization of personnel, and for controlling resources will be vested in Mr. Ira S. Rackley, P.E., Partner, Chilton Engineering, as Program Director.

Investigation progress and financial accounting will be reviewed by the manager of Chilton Engineering who will resolve any confilcts with respect to priorities, and will make any decisions that are judged to be beyond the authority of the Program Director. Periodic reviews of the progress in the investigation will also be made by the principals of Geothermal Surveys, Inc., and Cyprus Georesearch Company.

(b) Program Accounting

Financial Accounting for the proposed program will be conducted in conformance with the standard accounting principles of the Chilton Engineering Company.

2. BACKGROUND INFORMATION

CHILTON ENGINEERING

Chilton Engineering is a consulting engineering firm involved in the areas of Municipal Engineering, Program Management, Transportation Engineering, General Land and Mining Surveying, General Civil Engineering, Solar design and energy systems evaluations for domestic and commercial applications, and State Water Rights Engineering. Chilton Engineering was founded in 1966 by Mr. Mark Chilton acquiring the interests of Mr. W.H. Settlemeyer. The firm has been active in the northern Nevada area through succesive ownerships since 1906.

Chilton Engineering has extensive expertise in water right mapping and applications. The firm's clientele are widely spread throughout the State of Nevada. The firm has six registered water right engineers on staff well versed in the requirements of the state and federal government in developments in the subject area.

Chilton Engineering has developed a project management team that has managed projects of all degrees of complexity. These range from multimodal transportation projects to the management of several local and county governmental programs. The firm represents several of the northern Nevada counties and municipalities as their manager/ engineer.

Presently, Mr Ira S. Rackley, P.E., is the manager of a federal demonstration project in Elko for the relocation of the railroads from the ceneral area of the community and the development of the central business district and adjoining industrial areas. Mr. Rackley has been appointed to a special task force to the Department of Transportation, Federal Highway Adminstration, for the development of evaluation guidelines for a future national program for the Urban Railroad Programe. His involvement with this and other federal programs has utilized the Federal Procurement Regulations and project systems management techniques which will be necessary to properly manage and account for this proposal.

Additional background information of Chilton Engineering personnel are summarized in the following resume's.

INTRODUCTION

CHILTON ENGINEERING, an organization of consulting engineers and surveyors, has been serving the people of Nevada and the Intermountain West for over 60 years. As the firm has grown in size, it has broadened its scope of activities. We are pleased with this opportunity to acquaint you with our capabilities and experience in the following fields:

Civil Engineering

- Municipal Works
  - Water Supply and Treatment Systems
  - Sewage Collection, Treatment, and Disposal Systems
  - Storm Drains
  - Streets
- Traffic and Transportation
  - Railroads
  - Highways
  - Airports
  - Traffic Systems and Parking
- Community Planning and Development
- Subdivisions
- Industrial Parks
- Environmental Studies
- Earthfill Dams
- Economic Studies
- Construction Inspection and Management

Surveying

- Land Surveys
- Mineral Location Surveys
- Mineral Patent Surveys
- Water Right Surveys
- Topographic Mapping
- Construction Surveys

Energy Studies

- Solar Energy Systems
- Geothermal Energy Systems
- General Energy Policies/Conservation

IRA S. RACKLEY, P.E.

EDUCATION
University of Nevada, B.S.C.E.

LICENSES
Registered Professional Civil Engineer Nevada and California

PROFESSIONAL MEMBERSHIPS AND ORGANIZATIONS
National Society of Professional Engineers
American Society of Civil Engineers

EXPERIENCE

From	To	
1973	Present	Responsible as chief engineer for Chilton Engineering. In charge of administering and development of many municipal water and sanitary improvements, earthfill dam projects, and direct responsibility as Project Manager for the Elko Demonstration Railroad Relocation Project for the City of Elko.
1970	1973	Employed by the Nevada State Highway Department as a construction resident engineer in charge of major highway construction projects including: Construction supervision and inspection of seventeen major concrete and steel structures on the Interstate 80-US 395 Interchange in Reno, Nevada. This included a major railroad-highway overcrossing on US 395. Construction resident engineer in charge of major highway extensions and widenings including supervision of earthwork, asphalt paving, concrete and major drainage structures. Construction resident engineer on landscaping of freeway systems within the Sparks-Reno area.
1968	1970	Participated in the [illegible] planning and right-of-way [illegible] involved very close coordination and work with all state policies and Federal Highway Administration Policy and Procedure Memorandums.

[illegible], 1968

SHELDON S. GORDON

EDUCATION
Stanford University, B.S. Human Biology, M.S. Mechanical Engineering
1976 co-terminal

PROFESSIONAL MEMBERSHIPS AND ORGANIZATIONS
American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
American Society of Mechanical Engineers (ASME)
Solar Energy Industries Association (SEIA)
International Solar Energy Society (ISES)

EXPERIENCE

From	To	
1976	Present	Chief design engineer for energy related projects at Chilton Engineering. Responsible for the design and specification of solar and geothermal (low temperature) energy systems for service hot water, space heating, and space cooling. Feasibility work for process heat applications has also been completed.
1975	1976 (Part Time)	Employed by City of Palo Alto to prepare a feasibility report on the application of solar heating to the Rinconada Pools in Palo Alto, California. Project is now in final design stages. Also carried out design study and performance testing for John Brooks Boyd Associates in regard to a flat plate collector for manufacture and sale through their Western Energy Division.
1974	1975 (Summer)	Production engineer for Fafco, Inc. in Menlo Park, California. Involved in perfecting manufacturing process for plastic flat plate collectors used for pool heating.

RICHARD D. BARTHOLET

EDUCATION
University of Nevada, Reno, Masters of Business Administration, 1975
Montana State University, B.S. Business Administration, 1973

EXPERIENCE

From	To	
1976	Present	Employed by Chilton Engineering as business, economic, and financial analyst. Responsibilities include management of energy studies, preparation of life-cycle economic analyses, and development of accounting informtion systems.
1975	1976	Lecturer in Accounting and Finance, California State College, Bakersfield, California. Small Business Institute Advisor on two studies, one involving marketing problems and another concerned primarily with accounting information systems.
1973	1974	Graduate Teaching Assistant, University of Nevada, Reno. Assistant Research Consultant for the City of Elko, COMMUNITY SURVEY for "Project Lifesaver."

VICTOR J. OTT

EDUCATION
Masters of Business and Administration, Santa Clara University, 1977.
Bachelor of Science Mechanical Engineering, University of Nevada, Reno, 1973.

PROFESSIONAL AFFILIATION
Beta Gamma Sigma, Honorary Business and Commerce

EXPERIENCE

From	To	
1977	Present	General Manager and principal engineer, Solar Industrial, Inc. of Newport Beach, California. Responsible for solar system design, preparation of federal demonstration proposals, and marketing of solar equipment in the greater Southern California area.
1974	1976	Bechtel Corporation, San Francisco, California Mechanical Engineering responsible for system design, cost forecasts, subcontract administration, and field installation of chemical process, combustion control, and material process equipment related to electrolytic refining and ore processing industry. Experience includes responsibilities as Field Mechanical/ Piping Engineer for Bechtel Corporation on ASARCO, Amarillo Copper Refinery. Responsible for installation of piping, mechanical equipment, and craft oversight on boiler plant and electrolytic refining process. Also in steam systems including design review, installation, punch list and start-up proceedures. 2/74 - 4/75 Bechtel Corporation - Design Engineer, San Francisco, California 4/75 - 3/76 Bechtel Corporation - Field Piping Engineer, Amarillo, Texas 3/76 - 6/76 Bechtel Corporation - Field Mechanical Engineer, Virginia, Minnesota

THOMAS H. GALLAGHER, P.E., R.L.S.

EDUCATION
University of Nevada, Reno, B.S. Civil Engineering, 1974

LICENSES
Registered Professional Engineer, Nevada and California
Registered Land Surveyor, Nevada
State Water Rights Surveyor, Nevada

EXPERIENCE

From	To	
August 1977	Present	Chilton Engineering, Sparks Office, Staff Engineer - Design and project coordination of Eastland Hills Subdivision, Elko, Nevada inlcuding layout, preliminary design and final design - Design of single story masonry and wood structure for City of Ely, Nevada - Design of proposed modifications to the Gem Club, Reno, Nevada - Inspection and coordination of construction of water system for Wadsworth Industrial Park, Wadsworth, Nevada
May 1974	August 1977	The Spink Corporation, Reno, Nevada - Project Engineer on four lane divided and undivided roadway in Lemmon Valley. Responsibilities included preliminary and final design of roadway and major drainage canal and structures as well as project coordination, inspection and surveying. - Project Engineer on 114 unit subdivision in Sacramento, California including preliminary and final design. Other subdivision work included layout and grading design on 530 lots in Sacramento, California. - Structural design of five wood framed, concrete tilt up warehouses, a 2-story medical facility for Sacramento Plastic Surgeons, the Owyhee Hospital, a 2-story steel framed structure with concrete walls and various 1 and 2-story residential units in Reno and Sacramento. - Structural design of 40 foot high concrete support towers for a bulk storage facility at the Port of Sacramento. - Structural design and detailing of two floating docks for Garcia Bend and Miller Park Marinas in Sacramento, California. - Structural design, pump and pipe sizing and detailing of 2.2 mgd underground sewage lift station for South Pocket Road Sewer Assessment District, Sacramento, California. - Preliminary structural design on 7-story steel framed court addition in Stockton, California.
May 1973	May 1974	Desert Research Institute Center for Water Resources Research, University of Nevada, Reno, Nevada. - As a Student Research Assistant was responsible for hydraulic studies of the Truckee River from Lake Tahoe to Pyramid Lake including surveys, sampling, gaging and computer analysis of various hydraulic elements.

May 1973 (Continued)	May 1974	- Computer Analysis of the performance of various waste water treatment facilities in Nevada. - Installation of pipeline and submersible pump at depth of 40' in Pyramid Lake for fish harvesting studies.
June 1971	August 1971	Chilton Engineering - Experience in various phases of surveying including photogrammetry and all aspects of field work.

TABLE 7A

EXPERIENCE AND BACKGROUND OF CHILTON ENGINEERING

Brief Description of Project and the Work Performed	Start	Completion	Client's Namd and Individual to Contact	Location Where Work was Performed	Type of Contract
"Elko Railroad Relocation Project" The relocation of two primary rail corridors in the City of Elko, Nevada	May '73	1981 (est.)	City of Elko Charles C. Armuth, City Manager	Elko, Nevada	Cost Plus Fixed Fee
"Lander County Airport - Master Plan"	Mar. '76	1980 (est.)	Lander County, Lander County Commissioners, Courthouse Austin, Nevada	Battle Mountain, Nevada	Negotiated
"Solar Feasibility Study" Enlisted men's barracks - Nellis Air Force Base	Jul. '77	Aug. '77	Army Corp of Engineers Kingston Peng Sacramento, California	Nellis Air Force Base Las Vegas, Nevada	Fixed Fee
"Detailed Design - Solar Service Hot Water System" Enlisted men's barracks, Nellis Air Force Base	Oct. '77	Dec. '77	" " "	" " "	Fixed Fee
"Study of Alternatives to City Owned Electrical Utility"	Nov. '76	Jan. '77	City of Carlin Wanda Borden, Mayor	Carlin, Nevada	Fixed Fee
"The Chateau" - Solar Feasibility Study	Aug. '77	Sept '77	Incline Village Planning Commission Bill Curtis - Architect	Incline Village, Nevada	Fixed Fee
"Solar Feasibility Study - Beale Air Force Base" Cafeteria facility - Service Hot Water	Mar. '77	Mar. '77	Peters Engineering Sacramento, California Mr. Leroy Peters	Sacramento, California	Fixed Fee
"Solar Feasibility Study - Mather Air Force Base" Space Heating + Domestic Hot Water	May '77	May '77	Samford, Alessi & Rios Sacramento, California Mr. Ed Rios	Sacramento, California	Fixed Fee
"Design of Nye Hall Solar Service Hot Water System"- University of Nevada, Reno	Jan. '78	(est.) Dec. '78	University of Nevada - Reno Richard Sasek, Plant Serv.	Reno, Nevada	Fixed Fee

TABLE 7A (CONT.)

EXPERIENCE AND BACKGROUND OF CHILTON ENGINEERING (Continued)

Brief Description of Project and the Work Performed	D A T E S Start	Completion	Client's Name and Individual to Contact	Location Where Work was Performed	Type of Contract
"Preparation of Technical Portion - ERDA PON for North Tahoe Public Utility District" Solar space heating and service hot water system	Nov. '77	Dec. '77	North Tahoe Public Utilities District Tahoe Vista, California Mr. Doyle Puckett	Reno, Nevada	Fixed Fee

Geothermal Surveys, Inc.

Geothermal Surveys, Inc. (GSI) is a geological-geophysical company specializing in exploration and assessment of ground water and geothermal resources. The company was founded in 1961 by J. H. Birman, Professor of Geology at Occidental College. Since its founding, the company has pioneered in the development and extensive use of ground temperature as an exploration tool. Other methods of exploration and assessment performed by the company include geologic mapping, seismic refraction surveying (compressional wave and shear wave), and electrical resistivity surveying.

The thermal techniques utilized by GSI include downhole temperature logging to measure vertical temperature gradients, and areal temperature measurements at constant depth or at several selected depths throughout a survey area. Using precisely calibrated sensors, temperatures are normally measured to the nearest 0.01°C. Survey depths are chosen with respect to the objectives of the survey and the thermal regimen of the area in which the survey is being made. Details of the thermal technique are discussed in Section 3.3.0.

As originally developed, the primary application of thermal probe surveys was in the exploration and assessment of ground water flow systems (Birman, 1969). Later applications were made in detecting and monitoring leakage through dams (Birman, Esmilla, and Indreland, 1971), and in monitoring and tracing pollution fluids in the vicinity of mine tailings ponds and other waste discharge systems (Birman, 1973). In hydrological investigations, thermal surveys detect and map zones of maximum transmissibility and recharge of ground water. The method has proven effective in selecting drilling sites for high-production wells and provides essential data for water resource management. GSI has conducted hydrological projects in most of the western states and in Mexico, Iran, and Africa.

In 1963, GSI began using its thermal techniques in exploration for geothermal resources. Applications include measurement of vertical temperature gradients in wells and drillholes, and surveys of shallow ground temperature anomalies. GSI has engaged in geothermal resource exploration projects in California, Nevada, Oregon, Arizona, New Mexico, and Baja California.

From its own field work since 1961, GSI has developed a large collection of shallow and deep temperature data from areas in the United States and abroad, within a variety of climatic and geologic settings. These projects have involved both ground water and geothermal resource investigations.

From his academic work at Occidental College and other professional activities, Dr. Birman has acquired broad geological experience in the Basin and Range Province of Arizona, California, and Nevada. Birman's doctoral research was in California glacial geology. Closely related research has involved Pleistocene and Holocene geomorphology, evaporite mineralogy, and ground water recharge and storage in

the alluvial fan and playa complexes.

Additional background information on GSI personnel, publications, and equipment is included in the Management Proposal.

Put in Roger's resume + Qualifications

Business Address

Geothermal Surveys, Inc.
99 Pasadena Avenue
South Pasadena, California 91030

Telephone: (213) 255-4511

Principal Contact: Dr. Joseph H. Birman, President

GSI Personnel

Directors	Dr. Joseph H. Birman -	President, Geothermal Surveys, Inc.
Directors (continued)	Mr. Robert L. Parker -	Partner, Christie, Parker & Hale, Attorneys
	Mr. George E. Moss -	Vice President, Roscoe Moss Company
Officers and Program Personnel	Dr. Joseph H. Birman -	President
	~~Mr. Jack B. Indreland -~~	~~Vice President~~
	Dr. George P. Rigsby -	Senior Geologist
	~~Mr. Adonis B. Esmilla -~~	~~Senior Geologist~~
	~~Mr. Richard W. Prine -~~	~~Physicist~~
	Mr. Jeffrey T. Schick -	Geologist
	Ms. Barbara E. Birman -	Economist
	MR. ROGER A. NORRIS -	SENIOR GEOPHYSIST
	MR. GLEN E. TINSLEY -	OPERATIONS SUPERVISOR
Associates	Mr. Robert C. Fox -	Hydrologist, Engineering Geologist
	Dr. James F. Conel -	Geophysicist, Mathematical Analyst
Retained	Mr. Robert L. Parker -	Attorney, Christie, Parker & Hale, Attorneys
	Mr. Edward S. Tomaso -	President, Edward S. Tomaso Accountants, Inc.

Operations Supervisor

GSI Patents

Country	Title	Patent No.	Issue Date
Australia	Geothermal prospecting	269,270	12/15/66
Canada	Geothermal prospecting	746,236	11/15/66
Egypt	Geothermal prospecting	5,493	11/29/65
Mexico	Geothermal prospecting	80,933	5/17/67
United States	Geothermal prospecting	3,217,550	11/16/65
United States	Leak Detection Method	3,375,702	4/02/68
Iran	Geothermal prospecting	13,547	9/15/75

Resume

JOSEPH H. BIRMAN
President
Geothermal Surveys, Inc.

Born	2 June 1924		
Education	Ph.D.	University of California at Los Angeles	1957
	MS	California Institute of Technology	1950
	AB	Brown University	1948

Licenses and certifications

California Registered Geologist, Number 994
California Registered Geophysicist, Number 513
California Certified Engineering Geologist, Number 396
Arizona Registered Geologist, Number 8710

Professional affiliations

Fellow, Geological Society of America
Member, American Institute of Mining, Metallurgical, and Petroleum Engineers
Charter Member, American Institute of Professional Geologists
Member, National Water Well Association
Member, WATERCARE
Member, Geothermal Resources Council

Honors and grants

Member, Sigma Xi honorary scientific society
Outstanding Educators of America Award, 1972
Research grants from: National Science Foundation, Southern California Edison Company, Sequoia Natural History Association, Geological Society of America

Areas of research and publication

Thermal exploration: Theory, technique, and applications in geohydrology, geothermal resource investigations, and marine surveys.

Pleistocene and glacial geology in United States, Middle East, and Chile.

Pleistocene and Holocene development of the Persian Gulf; climatic effects on early civilization in the Persian Gulf region.

Experience

Dr. Birman's geological experience includes work throughout much of the United States and in Mexico, and in South America, Africa, and the Middle East. Throughout his career he has combined research and teaching with applied geology.

In 1950 he joined the faculty at Occidental College and was chairman of the Department of Geology for many years. He is internationally known for research in Pleistocene geology, and this has important applications in hydrology, geothermal exploration, and engineering geology.

In 1957 Dr. Birman began research on the use of shallow temperatures in exploration for water and related problems, and from this was founded Geothermal Surveys, Inc. with the first field application in 1961. Since that time, as the company developed, Birman has continued with both research in Pleistocene geology and with new applications of the thermal technique. He has served on a number of special assignments including accreditation surveys of a number of colleges and universities in California; assessment of the Geology Department of the University of Tunis (for U.S. Aid to International Development); glacial geological studies throughout Turkey; evaluation of the Pleistocene setting for a large dam in Chile; and field examination of ground water possibilities in Eritrea, Ethiopia.

Resume

GEORGE P. RIGSBY
Geology and Operations
Geothermal Surveys, Inc.

Born	19 November 1915		
Education	Ph.D.	California Institute of Technology	1953
	MS	California Institute of Technology	1950
	BS	California Institute of Technology	1948

Licenses and certifications

California Registered Geologist
Commercial Pilot License
- Airplane single and multi-engine land
- Airplane single and multi-engine sea
- Flight Instructor
- Glider

Professional affiliations	Fellow, Geological Society of America Fellow, American Geophysical Union Fellow, Arctic Institute of North America Mineralogical Society of America International Glaciological Society
Honors and grants	Tau Beta Pi (Engineering equivalent of Phi Beta Kappa) Sigma Xi (Science honor society) Kappa Mu Epsilon (Mathematics honor society)
Areas of research and publication	Glaciology, Arctic Glaciology, Antarctic Crystal Fabric Ice Deformation
Experience	Dr. Rigsby has held faculty positions in geology and mathematics at California Institute of Technology, Occidental College, and U.S. International University. He has done research in ice physics for Snow, Ice, and Permafrost Research Establishment (SIPRE), and in sea ice for U.S. Naval Electronics Laboratory (NEL) in San Diego. He has been a member of 11 expeditions to the Arctic, Sub-Arctic, and Antarctic regions, including the following examples. In 1958 he was sent to Antarctica to investigate the effectiveness of glacier research projects of International Geophysical Year. In 1960 he was chief scientist and leader of an expedition to Ward Hunt Ice Shelf, Ellesmere Islands, Canada to investigate origin and growth of ice shelves. In 1967 he was Scientist in Charge of research on Fox Glacier, Yukon Territory, to investigate glacial surges. During the years 1954-1966 he served as a member of the Technical Panel and Representative of the U.S. National Committee for the International Geophysical Year. As Representative he was sent to annual meetings in Rome, Brussels, Toronto, and Moscow. In 1966 he was U.S. Representative to Ice Conference in Sapporo, Japan.

Included in his work for Geothermal Surveys, Inc. are supervision of geological, thermal, and drilling programs for ground water in Hawaii, thermal and resistivity exploration for ground water in Mexico, and supervision of a program of geothermal power exploration in Oregon.

Dr. Rigsby has been a commercial pilot for Pan American Air Ferries, and was a Commissioned Pilot, U.S. Navy, during World War II. He remains active in flying, gliding, and glider towing. He is also an experienced deep water sailor.

Resume

JAMES E. CONEL
Associate
Mathematical Modeling, Geology, Geophysics
Geothermal Surveys, Inc.

Born	4 December 1934		
Education	Ph.D.	California Institute of Technology	1962
	MS	California Institute of Technology	1957
	BA	Occidental College	1955

Professional affiliations

American Geophysical Union
Sigma Xi

Honors and grants

Several scholarships and fellowships at California Institute of Technology
Fulbright fellowship to University of Innsbruck, Austria, 1959-1960
Participant NASA Lunar Science Institute, post-Apollo Lunar Science Study, 1972
NASA New Technology Award, 1974

Areas of research and publication

Lunar Thermal History and Heat Flow
Earth Thermal History and Heat Flow
Thermoelasticity, Seismicity, Tidal Deformation, and Structure of the Moon

Areas of research and publication (continued)

Gravitational Fields of Moon and Mars
Planetary Deformation as Indicator of Internal Thermal State
Exploration for Geothermal Resources by Subsurface Temperature
Exploration for Geothermal Resources by Microwave Techniques
Visible and Near-Infrared Investigations
Spectroscopic Studies, using Methane and Ammonia, of Outer Planet Atmospheres and Satellite Surfaces

Experience

Dr. Conel specializes in the development, mathematical modeling and analytical studies of geophysical systems, both theoretical and applied. He has had many years of experience with terrestrial and extraterrestrial research during his work as Scientist and Senior Scientist with Jet Propulsion Laboratory in Pasadena.

In addition to his own work, Dr. Conel has supervised high level research projects for NASA, including all technical, administrative, and budgetary aspects. His field work includes western United States, Alaska, Canada, and Greenland.

Publications by GSI Personnel

Birman, J.H., (in progress) Climatic and geomorphic development of the Persian Gulf in late Pleistocene and Holocene time.

Fox, R.C., and Cummings, J., (in progress) Sea-water intrusion: Pismo Beach-Guadalupe, San Luis Obispo County: State of California, Department of Water Resources, Bulletin no. 63-3.

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Blinn, J.C., Conel, J.E., and Quade, J.G., 1972, Microwave Emission from Geological Materials: Observations of Interference Effects: J. Geophys. Res., v. 77 (23), p. 4366-4378.

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Wahrhaftig, C., and Birman, J.H., 1965, The Quaternary of the Pacific Mountain System in California: in The Quaternary of the United States; a review for the VII Congress of the International Association for Quaternary Research (INQUA), Princeton Univ. Press, p. 299-340.

Birman, J.H., 1964, Glacial geology across the crest of the Sierra Nevada, California: Geol. Soc. Am. Spec. Paper 75, p. 1-80.

Fox, R.C., Werner, S., and Richardson, N., 1964, Ground water occurrence and quality, Lahontan Region: State of California, Department of Water Resources, Bull. no. 106-1.

Fox, R. C., 1962, Recommended well construction and sealing standards for protection of ground water quality in West Coast Basin, Los Angeles County: State of California, Department of Water Resources, Bull. no. 107.

Rigsby, G. P., 1960, Crystal orientation in glacier and experimentally deformed ice: Jour. Glaciology, v. 3, no. 27, p. 589-606.

Fox, R. C., 1958, Sea-water intrusion in California: Appendix A-Status of sea-water intrusion, State of California, Department of Water Resources, Bull. no. 63 (unpublished).

Hansen, R., and Fox., R. C., 1958, Investigation of the water quality in Mission Basin, San Luis Rey Valley, San Diego County: A report to San Diego Regional Water Pollution Control Board (no. 9): State of California, Department of Water Resources.

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Fox, R. C., Callison, J., and Roth, J., 1956, Santa Margarita River Investigation: State of California, Department of Water Resources, Bull. no. 57.

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Rigsby, G.P., 1951, Crystal fabric studies on Emmons Glacier, Mount Rainier, Washington: Journal of Geology, v. 59, p. 590-598.

Office and Technical Equipment

Geothermal Surveys, Inc. has 3,000 square feet of office and work shop space at the address noted above. All standard office equipment including desks, files, drafting equipment, copier, typewriters, calculators and housekeeping service will be provided to the program under general and administrative overhead.

Project equipment presently owned by Geothermal Surveys, Inc. include the following:

a. B-38 Mobil Drill mounted on 12-foot flat-bed Ford truck
b. Little Beaver portable drill
c. Four-wheel drive Chevyvan with custom mountings for geophysical equipment
~~d. Four-wheel drive Jeep Wagoneer~~
e. 400 thermal probes with individually computerized calibration tables
f. Three reel-mounted thermal probes for down-hole temperature gradient measurements
g. Three Wheatstone bridges with null detectors
h. S.I.E. RS-~~44~~ Seismic Refraction Unit with assorted cables equipped with compressional and shear wave geophones; twelve recording channels
i. Dynametrics Model 117B Seismic Unit and custom made weight release
j. Electrical Resistivity Unit
k. Sedimentary Analysis Laboratory
l. Three reel-mounted water level indicators for measuring water depth in wells
m. Research and Map Library

4. BACKGROUND INFORMATION

Cyprus Georesearch Company

Cyprus Georesearch Company is a wholly-owned research subsidiary of Cyprus Mines Corporation, organized in 1970 to investigate applications of new technology to natural resource exploration and management. As a result of its early experience with remote sensing technology, Cyprus was awarded a two-year research contract by the National Aeronautics and Space Administration to evaluate geologic applications of the first LANDSAT-1 (Earth Resources Technology Satellite) imagery to be recorded over a 75,000 square mile test site in the Basin and Range Province of parts of Nevada, California, Utah and Arizona.

In the course of research for its parent corporation, governmental agencies and industrial clients, Cyprus has developed a variety of specialized image enhancement and analysis techniques which have supported practical applications of satellite data to systematic exploration and development programs. Coordinated with in-house geophysical, geochemical, and geologic mapping capabilities, this technology has been successfully employed in regional mineral, geothermal energy and ground water exploration programs, and in reconnaissance mapping of potential seismic hazards. Cyprus has conducted programs in the diverse geologic and climatic terranes of the Middle East, Australia, South America and Canada in addition to many areas in the continental United States.

Cyprus Georesearch Company is currently managing and executing geothermal exploration programs in a total area of over 150,000 square miles in parts of Nevada, Arizona, New Mexico, California, Utah and Oregon. Still in progress, these programs have been successful in discovering evidence for active geothermal systems located outside of lands presently classified by the U.S. Geological Survey as "Known Geothermal Resource Areas".

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Bredehoeft, J.D., and Papadopulos, I.S., 1965, Rates of vertical ground water movement estimated from the earth's thermal profile: Water Resources Research, v. 1, p. 325-328.

Cartwright, K., 1968, Temperature prospecting for shallow glacial and alluvial aquifers: Illinois State Geol. Survey Circ. 433, p. 1-41.

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Hamilton, W., and Myers, W.B., 1966, Cenozoic tectonics of the western United States: Rev. Geophysics, v. 4, no. 4, p. 509-549.

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Fredericks, J. C., and Loelts, O.J., 1947, Ground Water in the Vicinity of Elko, Nevada; State of Nevada, Office of the State Engineer; prepared in cooperation with the U.S. Geological Survey.

ior natural waters: Geochimica et Cosmochimica Acta, v. 37, p. 1255-1275.

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Liggett, M.A., and Childs, J.F., July 1973, Evidence of a major fault zone along the California-Nevada State Line. 35°30' to 36°30' N. Latitude: NASA Rept. of Inv., NASA-CR-133140, E73-10773, 10 p.

Liggett, M.A., and Childs, J.F., 1974, Crustal extension and transform faulting in the southern Basin Range Province: Argus Exploration Company, NASA Rept. Inv., NASA-CR-137256, E74-10411, 54 p.

Liggett, M.A., and Childs, J.F., 1977, An application of satellite imagery to mineral exploration: in Proceedings of the First Annual William T. Pecora Memorial Symposium, 1975, P.W. Woll and W.A. Fisher, editors: U.S. Geological Survey Professional Paper 1015, pp. 253-270.

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Stallman, R.W., 1963, Computation of ground water velocity from temperature data: in Methods of collecting and interpreting ground water data: U.S. Geological Survey Water Supply Paper 1544-1, p. 1436-1446.

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White, D.E., and Williams, D.L., (eds.), 1975, Assessment of geothermal resources of the United States--1975: U.S. Geol. Survey Circ. 726, 155 p.

CYPRUS GEORESEARCH COMPANY

Business Address

Cyprus Georesearch Company
555 South Flower Street
Suite 3200
Los Angeles, California 90071

Telephone (213) 628-0891

Principal Contact: Mark A. Liggett, Director, Research & Development

Cyprus Georesearch Company Personnel

Directors	G.L. Furth -	Executive Vice President Cyprus Mines Corporation
	P.J. McLean -	Senior Vice President & Comptroller Cyprus Mines Corporation
	G.G. Kelly -	Partner Musick, Peeler & Garrett-attorneys
Officers	A.A. Bakewell, Jr. -	President- Vice President Cyprus Mines Corporation
	C.A. Mark -	Vice President- Chief Geologist & Manager of Exploration Cyprus Mines Corporation
	G.L. Furth -	Vice President & Treasurer- Executive Vice President Cyprus Mines Corporation
	G.G. Kelly -	Secretary- Secretary & General Counsel Cyprus Mines Corporation
	B. Fleming -	Assistant Secretary & Assistant Treasurer
	Larry Hoke -	Assistant Secretary
Program Personnel	M.A. Liggett -	Director, Research & Development
	J.F. Childs -	Research Geologist
	B.H. Burton -	Research Geologist
Associates	Dr. D.L. Harris -	Senior Research Chemist Cyprus Research Company
	Dr. Oskar Kortan -	Senior Geologist Technical Services Division Cyprus Mines Corporation
	Dr. E.A. Schmidt -	Senior Geologist Cyprus Exploration Company

Resume

MARK A. LIGGETT
Director, Research and Development
Cyprus Georesearch Company

Born	1 August 1947		
Education	MS	University of California at Santa Cruz	1970
	BA	Pomona College Claremont, California	1969
Licenses and certifications	California Registered Geologist, Number 3275		
Professional affiliations	Member, Geological Society of America The American Society of Photogrammetry Geothermal Resources Council American Geological Institute		
Honors and grants	Richard E. Strehle Memorial Award in Geology, 1968 James A. Lyman Prize in Chemistry-Geology, 1969 Regent's Fellowship, University of California, 1969-70		
Areas of research and publication	Remote Sensing: Satellite and aircraft image enhancement and analysis techniques; applications to mineral, geothermal and ground water exploration. Tectonics: Interpretation of regional structural patterns and structural control of hydrothermal alteration and mineralization. History of Science: Evolution of major concepts in the earth sciences.		
Experience 1971-present	Responsibilities with Cyprus Georesearch Company have included planning and management of applied research for divisions and subsidiaries of Cyprus Mines Corporation and for outside clients. This research		

Experience (continued)	has focused on geologic applications of remote sensing technology, including a variety of orbital and high altitude imaging systems, side looking aerial radar, multispectral imaging systems, and geophysics. This technology has been applied to practical programs for mineral, geothermal energy and ground water exploration, and mapping of seismic hazards. Liggett was the principal investigator of a two-year investigation funded by NASA to evaluate geologic applications of the first data from the Earth Resources Technology Satellite (LANDSAT-1) to be recorded over a 70,000 square mile test site in the southwestern United States.
1966-70	Geological experience acquired while in school included consulting and summer employment in analytical research, geologic mapping and hard rock mining. This experience included work for both NASA and the U. S. Geological Survey.

Resume

JOHN F. CHILDS
Research Geologist
Cyprus Georesearch Company

Born	2 December 1944		
Education	Ph.D.	University of California at Santa Cruz	Expected 197X
	MS	University of British Columbia Vancouver, B.C.	1969
	BS	Syracuse University Syracuse, New York	1966

Professional affiliations

Member, Geological Society of America
American Geological Institute

Honors and grants

New York State Regents Scholarships, 1962-66
Syracuse University Scholarships, 1962-66
National Science Foundation Undergraduate Research Grant, 1965-66
Chancellor's Patent Fund of the University of California, Research Grant, 1970-71

Honors and grants (continued)	Geological Society of America, Penrose Research Grant, 1971 Sigma Xi Research Grant, 1971
Areas of research and publication	Structural geology and petrology: Multiple deformation in relation to metamorphic recrystallization; origin of foliation and lineation; processes of igneous intrusion. Economic geology: Structural control of ore emplacement. Remote sensing: Use of satellite and aircraft imagery in regional geologic investigations including the search for mineral deposits.
Experience 1972-present	During his employment with Cyprus Georesearch Company, Childs has been involved in a variety of applied research and resource exploration programs involving both spacecraft and aircraft remote sensing techniques. Childs participated as a senior member of the research staff in a two-year investigation funded by NASA on applications of LANDSAT-1 imagery to regional tectonic mapping and resource exploration. Childs has been responsible for several applied research projects supporting mineral and geothermal exploration in the western United States. Childs' duties have included coordination of imagery enhancement and analysis, geologic field and laboratory work, geochemical surveys, and aircraft reconnaissance.
1965-72	Work experience while in school included teaching, analytical research, and field mapping in the Azores, Alaska, British Columbia, Idaho and Maine. Experience included summer employment by the U.S. Geological Survey and the Geological Survey of Canada.

Resume

BRUCE H. BURTON
Research Geologist
Cyprus Georesearch Company

Born 11 June 1952

Education	MS	University of Minnesota Minneapolis, Minnesota	1975
	BS	Oregon State University Corvallis, Oregon	1973

Professional affiliations

Society of Mining Engineers of A.I.M.E.

Areas of research and publication

Economic geology and petrology: Paragenetic relationships of ore formation; geothermometry.

Experience 1975-present

Since his employment with Cyprus Georesearch Company, Burton has participated in several geothermal resource exploration programs in the southwestern United States. These programs have involved both spacecraft and aircraft remote sensing techniques coordinated with geologic mapping and geophysical surveying. Burton's duties have included imagery analysis, geological field work, and interpretation of geophysical and geochemical data.

1973-75

Experience while in school included work as a research assistant with the Minnesota Geological Survey. Burton was involved in estimating the mineral resources of northern Minnesota, with emphasis on the copper-nickel deposits of the Duluth Gabbro Complex. Field investigations were conducted in central Mexico for Burton's Master's thesis project, which included extensive geochemical and geothermometric research.

Publications by Cyprus Georesearch Company Personnel

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Burton, Bruce H., July 1975, Paragenetic study of the San Martin mine, near Sombrerete, Mexico: M.S. thesis, Dept. of Geol. & Geophys., Univ. of Minnesota, Minneapolis, 98 p., 2 maps.

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Liggett, M.A., and Childs, J.F., March 1974, Crustal extension and transform faulting in the southern Basin Range Province: NASA Rept. of Inv., NASA-CR-137256, E74-10411, 28 p., 2 maps.

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Liggett, M.A., and Ehrenspeck, H.E., January 1974, Pahranagat shear system, Lincoln County, Nevada: NASA Rept. of Inv., NASA-CR-136388, E74-10206, 10 p.

Childs, J.F., January 1974, Fault pattern at the northern end of the Death Valley-Furnace Creek Fault Zone, California and Nevada: NASA Rept. of Inv., NASA-CR-136387, E74-10205, 8 p.

Childs, J.F., November 1973, A major normal fault in Esmeralda County, Nevada (ABS): NASA Rept. of Inv., NASA-CR-135859, E74-10018, 6 p.

MacGalliard, Wally, and Liggett, M.A., November 1973, False-color compositing of ERTS-1 MSS imagery: NASA Rept. of Inv., NASA-CR-135859, E74-10018, 5 p.

Bechtold, I.C., Liggett, M.A., and Childs, J.F., October 1973, Remote sensing reconnaissance of faulting in alluvium, Lake Mead to Lake Havasu, California, Nevada and Arizona in Moran, D.E., Slosson, J.E., Stone, R.O., and Yelverton, L.A., eds., Geology, seismicity, and environmental impact: Assoc. of Engineering Geologists Spec. Pub., p. 157-161.

Liggett, M.A., and Childs, J.F., July 1973, Evidence of a major fault zone along the California-Nevada State Line, 35°30' to 36°30' N. Latitude: NASA Rept. of Inv., NASA-CR-133140, E73-10773, 10 p.

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Bechtold, I.C., Liggett, M.A., and Childs, J.F., March 1973, Regional tectonic control of Tertiary mineralization and Recent faulting in the southern Basin Range Province: An application of ERTS-1 data: in Freden, S.C., Mercanti, E.P., and Becker, M.A., eds., Symposium of significant results obtained from the Earth Resources Technology Satellite-1: New Carrollton, Maryland, v. 1, sect. A, paper G21, NASA-SP-327, E73-10824, p. 425-432.

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Liggett, M.A., July 1972, Applications of ERTS-A imagery to structural geology: Presentation, ERTS Users News Briefing, NASA Headquarters, Washington, D.C.

Bechtold, I.C., and Liggett, M.A., August 1971, Space sensing of crustal structure: Presented at the Fourth Annual International Remote Sensing Institute Symposium in joint conference with the Legislative Council of Photogrammetry, San Francisco, California.

Childs, J.F., 1968, The contact relationships of the Mount Carlyle stock, Slocan, B.C. (ABS): Ann. Meeting Geol. Soc. Canada (Cordilleran Sect.), Vancouver, B.C., Canada.

Childs, J.F., and Boone, G.M., 1966, Metamorphism of Pre-Silurian Chloritic Phyllite to Sillimanite Granofels, West-central Maine (ABS): Ann. Meeting of Geol. Soc. Amer. (N.E. Sect.), Philadelphia, Penn.

Office and Research Equipment

Cyprus Georesearch Company has 2,000 square feet of fully equipped office space at the address noted above. All standard office equipment including desks, files, drafting equipment, xerox, typewriters, and housekeeping facilities will be provided to the program under general and administrative overhead.

Scientific research equipment presently owned by Cyprus Georesearch Company include the following:

a. Spectral Data Corp. Model 61-4 channel additive color viewer
b. Richards Light Table/Stereoscope/Film Transport
c. Nikon Petrographic Microscope and accessories
d. Miscellaneous photographic image enhancement and analysis equipment
e. Two four-wheel drive field vehicles and related field equipment
f. Research library

Equipment and services available through Cyprus Research Company include the following:

a. Wet chemical analysis
b. Fire assay analysis
c. Atomic absorption spectrophotometry
d. Visible light spectrophotometry
e. Infra-red spectrophotometry
f. X-ray diffraction analysis
g. X-ray fluorescence spectrometry
h. Differential thermal analysis
i. Thermogravimetric analysis
j. Scanning electron microscopy
k. Transmission electron microscopy

5. Contractual Requirements

a. The draft contract provided with the subject solicitation is acceptable as a basis for contract negotiations.

b. The "Program Technical Scope" set forth in the subject solicitation has been reviewed and it is understood that all data which will be furnished pursuant to a contract may be published.

c. This proposal shall terminate automatically one hundred and twenty (120) days from the date hereof unless Chilton Engineering Company shall elect to extend the proposal by written notice to the U.S. Department of Energy.

6. "Representations and Certifications" (GSA form 19B).

7. Certified annual report for Chilton Engineering Company.

REPRESENTATIONS AND CERTIFICATIONS

(Construction and Architect-Engineer Contract)

(For use with Standard Forms 19, 21 and 252)

REFERENCE *(Enter same No.(s) as on SF 19, 21 and 252)*

NAME AND ADDRESS OF BIDDER (*No., Street, City, State, and ZIP Code*)

DATE OF BID

In negotiated procurements, "bid" and "bidder" shall be construed to mean "offer" and "offeror."

The bidder makes the following representations and certifications as a part of the bid identified above. *(Check appropriate boxes.)*

1. SMALL BUSINESS

He ☑ is, ☐ is not, a small business concern. (A small business concern for the purpose of Government procurement is a concern, including its affiliates, which is independently owned and operated, is not dominant in the field of operations in which it is bidding on Government contracts, and can further qualify under the criteria concerning number of employees, average annual receipts, or other criteria as prescribed by the Small Business Administration. For additional information see governing regulations of the Small Business Administration (13 CFR Part 121)).

2. MINORITY BUSINESS ENTERPRISE

He ☐ is, ☑ is not a minority business enterprise. A minority business enterprise is defined as a "business, at least 50 percent of which is owned by minority group members or, in case of publicly owned businesses, at least 51 percent of the stock of which is owned by minority group members." For the purpose of this definition, minority group members are Negroes, Spanish-speaking American persons, American-Orientals, American-Indians, American-Eskimos, and American-Aleuts."

3. CONTINGENT FEE

(a) He ☐ has, ☑ has not, employed or retained any company or person (other than a full-time bona fide employee working solely for the bidder) to solicit or secure this contract, and *(b)* he ☐ has, ☑ has not, paid or agreed to pay any company or person (other than a full-time bona fide employee working solely for the bidder) any fee, commission, percentage or brokerage fee, contingent upon or resulting from the award of this contract; and agrees to furnish information relating to *(a)* and *(b)* above as requested by the Contracting Officer. *(For interpretation of the representation, including the term "bona fide employee," see Code of Federal Regulations, Title 41, Subpart 1-1.5.)*

4. TYPE OF ORGANIZATION

He operates as an ☐ individual, ☑ partnership, ☐ joint venture, ☐ corporation, incorporated in State of .....

5. INDEPENDENT PRICE DETERMINATION

(a) By submission of this bid, each bidder certifies, and in the case of a joint bid each party thereto certifies as to his own organization, that in connection with this procurement:

(1) The prices in this bid have been arrived at independently, without consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor;

(2) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, in the case of a bid, or prior to award, in the case of a proposal, directly or indirectly to any other bidder or to any competitor; and

(3) No attempt has been made or will be made by the bidder to induce any other person or firm to submit or not to submit a bid for the purpose of restricting competition.

(b) Each person signing this bid certifies that:

(1) He is the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein and that he has not participated, and will not participate, in any action contrary to (*a*)(1) through (*a*)(3) above; or

(2) (i) He is not the person in the bidder's organization responsible within that organization for the decision as to the prices being bid herein but that he has been authorized in writing to act as agent for the persons responsible for such decision in certifying that such persons have not participated, and will not participate, in any action contrary to (*a*)(1) through (*a*) (3) above, and as their agent does hereby so certify; and (ii) he has not participated, and will not participate, in any action contrary to (*a*)(1) through (*a*)(3) above.

(c) This certification is not applicable to a foreign bidder submitting a bid for a contract which requires performance or delivery outside the United States, its possessions, and Puerto Rico.

(d) A bid will not be considered for award where (*a*)(1), (*a*)(3), or (*b*) above, has been deleted or modified. Where (*a*)(2) above, has been deleted or modified, the bid will not be considered for award unless the bidder furnishes with the bid a signed statement which sets forth in detail the circumstances of the disclosure and the head of the agency, or his designee, determines that such disclosure was not made for the purpose of restricting competition.

NOTE.—Bids must set forth full, accurate, and complete information as required by this invitation for bids (including attachments). The penalty for making false statements in bids is prescribed in 18 U.S.C. 1001.

THE FOLLOWING NEED BE CHECKED ONLY IF BID EXCEEDS $10,000 IN AMOUNT.

6. EQUAL OPPORTUNITY

He ☑ has, ☐ has not, participated in a previous contract or subcontract subject to the Equal Opportunity Clause herein, the clause originally contained in Section 301 of Executive Order No. 10925, or the clause contained in Section 201 of Executive Order No. 11114; he ☐ has, ☑ has not, filed all required compliance reports; and representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained prior to subcontract awards.

(The above representations need not be submitted in connection with contracts or subcontracts which are exempt from the equal opportunity clause.)

7. PARENT COMPANY AND EMPLOYER IDENTIFICATION NUMBER

Each bidder shall furnish the following information by filling in the appropriate blocks:

(a) Is the bidder owned or controlled by a parent company as described below? ☐ Yes ☑ No. *(For the purpose of this bid, a parent company is defined as one which either owns or controls the activities and basic business policies of the bidder. To own another company means the parent company must own at least a majority (more than 50 percent) of the voting rights in that company. To control another company, such ownership is not required; if another company is able to formulate, determine, or veto basic business policy decisions of the bidder, such other company is considered the parent company of the bidder. This control may be exercised through the use of dominant minority voting rights, use of proxy voting, contractual arrangements, or otherwise.)*

(b) If the answer to *(a)* above is "Yes," bidder shall insert in the space below the name and main office address of the parent company.

NAME OF PARENT COMPANY	MAIN OFFICE ADDRESS *(No., Street, City, State, and ZIP Code)*

(c) Bidder shall insert in the applicable space below, if he has no parent company, his own Employer's Identification Number (E.I. No.) *(Federal Social Security Number used on Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941)*, or, if he has a parent company, the E.I. No. of his parent company.

EMPLOYER IDENTIFICATION NUMBER OF	PARENT COMPANY	BIDDER
➤		88-0123-949

8. CERTIFICATION OF NONSEGREGATED FACILITIES

(Applicable to (1) contracts, (2) subcontracts, and (3) agreements with applicants who are themselves performing federally assisted construction contracts, exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause.)

By the submission of this bid, the bidder, offeror, applicant, or subcontractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. He certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The bidder, offeror, applicant, or subcontractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, or national origin, because of habit, local custom, or otherwise. He further agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certificatons from proposed subcontractors prior to the award of subcontractors exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity clause; that he will retain such certifications in his files; and that he will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods):

NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENT FOR CERTIFICATIONS OF NONSEGREGATED FACILITIES

A Certification of Nonsegregated Facilities must be submitted prior to the award of a subcontract exceeding $10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually).

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

9. CLEAN AIR AND WATER

(Applicable if the bid or offer exceeds $100,000, or the contracting officer has determined that orders under an indefinite quantity contract in any year will exceed $100,000, or a facility to be used has been the subject of a conviction under the Clean Air Act (42 U.S.C. 1857c-8(c)(1)) or the Federal Water Pollution Control Act (33 U.S.C. 1319(c)) and is listed by EPA, or is not otherwise exempt.)

The bidder or offeror certifies as follows:

(a) Any facility to be utilized in the performance of this proposed contract has ☐, has not ☑, been listed on the Environmental Protection Agency List of Violating Facilities.

(b) He will promptly notify the contracting officer, prior to award, of the receipt of any communication from the Director, Office of Federal Activities, Environmental Protection Agency, indicating that any facility which he proposes to use for the performance of the contract is under consideration to be listed on the EPA List of Violating Facilities.

(c) He will include substantially this certification, including this paragraph (c), in every nonexempt subcontract.

☆U.S.GPO:1977-0-241-530/3964

SUPPLEMENT TO REPRESENTATIONS AND CERTIFICATIONS

10. BUY AMERICAN CERTIFICATE

The bidder or offeror hereby certifies that each end product, except the end products listed below, is a domestic source end product (as defined in the clause entitled "Buy American Act"); and that components of unknown origin have been considered to have been mined, produced, or manufactured outside the United States.

Excluded end products (show country of origin for each excluded end product):

11. AFFIRMATIVE ACTION PROGRAM

The following paragraphs are added:

a. The bidder or proposer represents that he (a) [ ] 1. has developed and has on file, [✓] 2. has not developed and does not have on file at each establishment an affirmative action program as required by the rules and regulations of the Secretary of Labor (41 CFR Part 60-1 and 60-2), or that he (b) [ ] has not previously had contracts subject to the written Affirmative Action Program requirement of the Secretary of Labor.

If such a program has not been developed, the bidder will complete the following:

The bidder does [ ], does not [✓] employ more than 50 employees and has [ ], has not [ ] been awarded a contract subject to Executive Order 11246 in the amount of $50,000 or more since July 1, 1968. If such a contract has been awarded since July 1, 1968, give the date of such contract, but do not list contracts awarded within the last 120 days prior to the date of this representation.

b. The bidder or proposer represents (a) that a full compliance review of the bidder's employment practices [✓] has, [ ] has not been conducted by an agency of the Federal Government; that such compliance review [ ] has, [✓] has not been conducted for the bidder's known first-tier subcontractors with a subcontract of $50,000 or more and having 50 or more employees and (b) that the most recent compliance reviews were conducted as follows:

NAME OF CONTRACTOR	DATE	FEDERAL AGENCY
(include known first-tier sub-contractors)		

c. The bidder or proposer represents that if the bidder has 50 or more employees and if this Contract is for $50,000 or more, and that for each subcontractor having 50 or more employees and a subcontract for $50,000 or more, and if he has not developed one, a written affirmative action plan will be developed for each of its establishments within 120 days from commencement of the Contract. A copy of the establishment's plan shall also be maintained at the establishment within 120 days from the date of commencement of the Contract.

The Affirmative Action Compliance Program will cover the items specifically set out in 41 CFR Part 60-2 and shall be signed by an executive of the Contractor.

d. Where the bid of the apparent low responsible bidder is in the amount of $1 million or more, the bidder and his known first-tier subcontractors which will be awarded subcontracts of $1 million or more will be subject to full, preaward equal opportunity compliance reviews before the award of the Subcontract for the purpose of determining whether the bidder and his subcontractors are able to comply with the provisions of the equal opportunity clause.

e. The bidder or proposer, if he has 100 or more employees, and all subcontractors having 100 or more employees are required to submit the Government Employer Information Report SF 100 (EEO-1), within 30 days after award, unless such report has been filed within 12 months preceding award. The EEO-1 report is due annually on or before March 31.

12. COST ACCOUNTING STANDARDS--EXEMPTION FOR CONTRACTS OF $500,000 OR LESS--CERTIFICATION

If this proposal is expected to result in the award of a contract of $500,000 or less and the offeror is otherwise eligible for an exemption, he shall indicate by checking the box below that the exemption to the Cost Accounting Standards clause (FPR 1-3.1204) under the provisions of 4 CFR 331.30(b)(8) (see FPR 1-3.1203(h)) is claimed. Where the offeror fails to check the box, he shall be given the opportunity to make an election in writing to the Contracting Officer prior to award. Failure to check the box below or make such an election shall mean that the offeror cannot claim the exemption to the Cost Accounting Standards clause or that the offeror elects to comply with such clause.

[✓] Certificate of Exemption for Contracts of $500,000 or Less.

The offeror hereby claims an exemption from the Cost Accounting Standards clause under the provisions of 4 CFR 331.30(b)(8) and certifies that he has received notification of final acceptance of all items of work on (i) any prime contract or subcontract in excess of $500,000 which contains the Cost Accounting Standards clause, and (ii) any prime contract or subcontract of $500,000 or less awarded after January 1, 1975, which contains the Cost Accounting Standards clause. The offeror further certifies he will immediately notify the Contracting Officer in writing in the event he is awarded any other contract or subcontract containing the Cost Accounting Standards clause subsequent to the date of this certificate but prior to the date of any award resulting from this proposal.

13. DISCLOSURE STATEMENT--COST ACCOUNTING PRACTICES AND CERTIFICATION

Any contract in excess of $100,000 resulting from this solicitation except (i) when the price negotiated is based on: (A) established catalog or market prices of commercial items sold in substantial quantities to the general public, or (B) prices set by law or regulation, or (ii) contracts which are otherwise exempt (see 4 CFR 331.30(b) and FPR 1-3.1203(a)(2)) shall be subject to the requirements of the Cost Accounting Standards Board. Any offeror submitting a proposal which, if accepted, will result in a contract subject to the requirements of the Cost Accounting Standards Board must, as a condition of contracting, submit a Disclosure Statement as required by regulations of the Board. The Disclosure Statement must be submitted as a part of the offeror's proposal under this solicitaion (see I. below) unless (i) the offeror, together with all divisions, subsidiaries, and affiliates under common control, did not exceed the monetary exemption for disclosure as established by the Cost Accounting Standards Board (see II. below); (ii) the offeror exceeded the monetary exemption in the Federal Fiscal Year immediately preceding the year in which this proposal was submitted but, in accordance with the regulations of the Cost Accounting Standards Board, is not yet required to submit a Disclosure Statement (see III. below); (iii) the offeror has already submitted a Disclosure Statement disclosing the practices used in connection with the pricing of this proposal (see IV. below); or (iv) postaward submission has been authorized by the Contracting Officer. See 4 CFR 351.70 for submission of copy of Disclosure Statement to the Cost Accounting Standards Board.

CAUTION: A practice disclosed in a Disclosure Statement shall not, by virtue of such disclosure, be deemed to be a proper, approved, or agreed to practice for pricing proposals or accumulating and reporting contract performance cost data.

Check the appropriate box below:

[ ] I. CERTIFICATE OF CONCURRENT SUBMISSION OF DISCLOSURE STATEMENT(S)

The offeror hereby certifies that he has submitted, as a part of his proposal under this solicitation, copies of the Disclosure Statement(s) as follows: (i) original and one copy to the cognizant Contracting Officer; and (ii) one copy to the cognizant contract auditor.

Date of Disclosure Statement(s):_____

Name(s) and Address(es) of Cognizant Contracting Officer(s) where filed:_____

The offeror further certifies that practices used in estimating costs in pricing this proposal are consistent with the cost accounting practices disclosed in the Disclosure Statement(s).

[ ] II. CERTIFICATE OF MONETARY EXEMPTION

The offeror hereby certifies that he, together with all divisions, subsidiaries, and affiliates under common control, did not receive net awards of negotiated national defense prime contracts subject to Cost Accounting Standards totaling more than $10,000,000 in either Federal Fiscal Year 1974 or 1975 or net awards of negotiated national defense prime contracts and subcontracts subject to cost accounting standards totaling more than $10,000,000 in Federal Fiscal Year 1976 or in any subsequent Federal Fiscal Year preceding the year in which this proposal was submitted.

CAUTION: Offerors who submitted or who currently are obligated to submit a Disclosure Statement under the filing requirements previously established by the Cost Accounting Standards Board are not eligible to claim this exemption unless they have received notification of final acceptance of all deliverable items on all of their prime contracts and subcontracts containing the Cost Accounting Standards clause.

[ ] III. CERTIFICATE OF INTERIM EXEMPTION

The offeror hereby certifies that (i) he first exceeded the monetary exemption for disclosure, as defined in II. above, in the Federal Fiscal Year immediately preceding the year in which this proposal was submitted, and (ii) in accordance with the regulations of the Cost Accounting Standards Board (4 CFR 351.40(f)), he is not yet required to submit a Disclosure Statement. The offeror further certifies that if an award resulting from this proposal has not been made by March 31 of the current Federal Fiscal Year, he will immediately submit a revised certificate to the Contracting Officer, in the form specified

under I. above or IV. below, as appropriate, to verify his submission of a completed Disclosure Statement.

CAUTION: Offerors may not claim this exemption if they are currently required to disclose because they exceeded monetary thresholds in Federal Fiscal Years prior to Fiscal Year 1976. Further, the exemption applies only in connection with proposals submitted prior to March 31 of the year immediately following the Federal Fiscal Year in which the monetary exemption was exceeded.

[ ] IV. CERTIFICATE OF PREVIOUSLY SUBMITTED DISCLOSURE STATEMENT(S)

The offeror hereby certifies that the Disclosure Statement(s) were filed as follows:

Date of Disclosure Statement(s):_____

Name(s) and Address(es) of Cognizant Contracting Officer(s) where filed:_____

The offeror further certifies that practices used in estimating costs in pricing this proposal are consistent with the cost accounting practices disclosed in the Disclosure Statement(s).

14. ADDITIONAL COST ACCOUNTING STANDARDS APPLICABLE TO EXISTING CONTRACTS--CERTIFICATION

(a) Cost accounting standards will be applicable and effective as promulgated by the Cost Accounting Standards Board to any award as provided in the Federal Procurement Regulations Subpart 1-3.12. If the offeror presently has contracts or subcontracts containing the Cost Accounting Standards clause, a new standard becomes applicable to such existing contracts prospectively when a new contract or subcontract containing such clause is awarded on or after the effective date of such new standard. Such new standard may require a change in the offeror's established cost accounting practices, whether or not disclosed. The offeror shall specify, by an appropriate entry below, the effect on his cost accounting practice.

(b) The offeror hereby certifies that an award under this solicitation [ ] would, [√] would not, in accordance with paragraph (a)(3) of the Cost Accounting Standards clause, require a change in his established cost accounting practices affecting existing contracts and subcontracts.

NOTE: If the offeror has checked "would" above, and is awarded the contemplated contract, he will also be required to comply with the clause entitled Administration of Cost Accounting Standards.

Firm: CHILTON ENGINEERING

Name: Grant L. Bastian

Date: 5/31/78

Title: Partner

Chilton Engineering
Elko, Nevada

BALANCE SHEET
as of December 31, 1977
UNAUDITED

ASSETS

Current Assets			
Note Receivable-Ira Rackley		2,500.00	
Note Receivable-Bill Nisbet		2,500.00	
Note Receivable-Bill Mueller		1,250.00	
Note Receivable-Mike Lattin		820.00	
Accounts Receivable		169,927.33	
Note Receivable-Silver State Flying Service		2,105.11	
Supplies-No Tax Basis		6,591.15	
Prepaid Federal and State Payroll Tax		687.67	
Prepaid Interest		1,487.40	
Prepaid Insurance		2,591.00	
Employee Advances		527.31	
Total Current Assets			190,986.97
Property and Equipment			
Machinery and Equipment-Tax Basis	316,161.41		
Accumulated Depreciation	112,093.43	204,067.98	
Machinery and Equipment-No Tax Basis	25,434.22		
Accumulated Depreciation	21,709.43	3,724.79	
Total Property and Equipment			207,792.77
Other Assets			
Prepaid Interest		943.77	
Deposits		1,000.00	
Investments		600.00	
Note Receivable-Ira Rackley		8,150.27	
Note Receivable-Bill Nisbet		7,979.88	
Note Receivable-Bill Mueller		4,864.94	
Note Receivable-Mike Lattin		6,354.97	
Total Other Assets			29,893.83
Total Assets			428,673.57

"We did not examine the financial statements for the year, years, or periods indicated

Notes to Financial Statements are an integral part of this exhibit.

Exhibit A

LIABILITIES

Current Liabilities		
Overdraft-First National Bank	16,018.37	
Accounts Payable	723.51	
Accrued Payroll and Sales Taxes	4,900.46	
Contract Payable-I.B.M.	2,230.68	
Note Payable-FNB-1976 GMC	1,828.08	
Note Payable-FNB-1977 GMC	1,371.56	
Notes Payable-FNB	48,600.00	
Note Payable-FNB	1,910.24	
Note Payable-Alberta Keppler	1,000.00	
Note Payable-FNB-1977 Cars	6,213.60	
Total Current Liabilities		84,796.30
0,986.97 **Long Term Liabilities**		
Note Payable-FNB-1976 GMC (Payable $152.34 per month)	457.02	
Note Payable-FNB-1977 GMC (Payable $114.28 per month)	685.68	
Note Payable-Alberta Keppler (Payable $1,000.00 per year until 1980 then $19,000.00 balance due)	20,000.00	
7,792.77 Contract Payable-I.B.M. (Payable $185.89 per month)	557.67	
Note Payable-FNB (Payable $193.16 per month including interest)	1,144.53	
Note Payable-FNB-1977 Cars (Payable $519.80 per month)	6,213.60	
Total Long Term Liabilities		29,058.50
Total Liabilities		113,854.80
,893.83 **PARTNERS' EQUITY**		
Partners Capital Accounts as of December 31, 1977-See Exhibit C		314,818.77
,673.57 **Total Liabilities and Partners' Equity**		428,673.57

periods indicated and accordingly do not express an opinion on them."