GL01166

PROPOSAL

GEOTHERMAL RESERVOIR ASSESSMENT

CASE STUDY, NORTHERN BASIN AND RANGE PROVINCE

RFP NO. ET-78-R-08-0003

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Introduction:

The following proposal is presented as a cooperative venture between Southland Royalty Company of Fort Worth, Texas, Millican Oil Company of Houston, Texas, and the Minerals Research Institute of the Mackay School of Mines, University of Nevada-Reno. Integration of industrial and academic expertise provided in the proposed venture, will result in the development of a case study of a northern Basin and Range geothermal system in support of a comprehensive geothermal reservoir assessment of the central portion of Dixie Valley.

The proposal is presented in a multi-phase format, with each phase encompassing specific tasks. This format inherently includes major decision-points both within each phase and between phases to allow for redesign or modification of each of the following tasks or phases based upon evaluation of previous results. In addition, it provides DOE with the option of selecting the proposal as an entire program leading to reservoir assessment, or as a multi-phase program in which each phase can be sequentially selected and negotiated.

The contractual posture which is proposed herein will have the Southland-Millican cooperative venture as Prime Contractor, with the University of Nevada group as a pre-arranged sub-contractor. For purpose of this proposal however, the University has participated in its structuring to facilitiate its preparation of an overall case study. All phases of task accomplishment and reporting will be achieved with the cooperative assistance of University personnel coordinated through the Prime Contractor's representative and under the direction of the Project Administrator.

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B. 1. Investigation Site or Area

Map 1, page 2A, illustrates the general location of Dixie Valley, Nevada. Map 2, page 3A, outlines the areas covered by this proposal.

a. Legal description:

That portion of Dixie Valley Nevada in the following townships and ranges, comprising approximately 60,000 contiguous acres, and lying generally along the western side of Dixie Valley as it abuts the Stillwater Mountain Range.

T22N, R34-37E

T23N, R35-38E

T24N, R35-38E

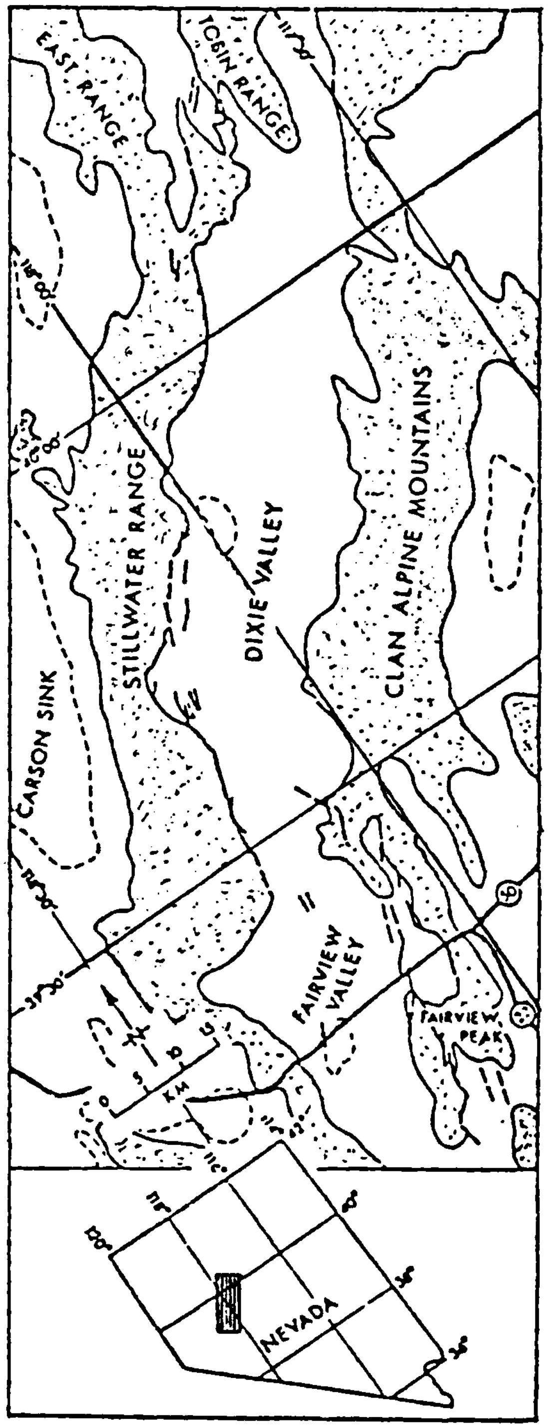
T25N, R36-38E

A graphic portrayal of this acreage is shown in yellow and red on lease map 3, page 2B .

b. Status of ownership/accessibility:

Except for a few very small tracts, mineral ownership rests with the U. S. Government, administered by the Bureau of Land Management. Geothermal leases are held by at least 12 parties, ranging from individuals to major energy companies. Parties cooperating in this proposal have a dominant lease position in the valley. (See Lease Map, page 2B .) The acreage committed to this cooperative proposal, although not formally unitized, consists, in part, of undivided interests, designated "red" on the referenced ownership map. The owners of the entire red colored acreage have executed and filed Designation of Operator Forms 9-1123 naming Millican Oil Company as operator and agent to be the responsible party and represent the entire ownership group which also consists of W. M. Hughes, Jerry H. Clay, and James W. Knowles, all residents of Tyler, Texas. In

MAP 1



Location map of the Dixie Valley region. Fault scarps formed or reactivated 1903, 1915, and 1954 are shown.

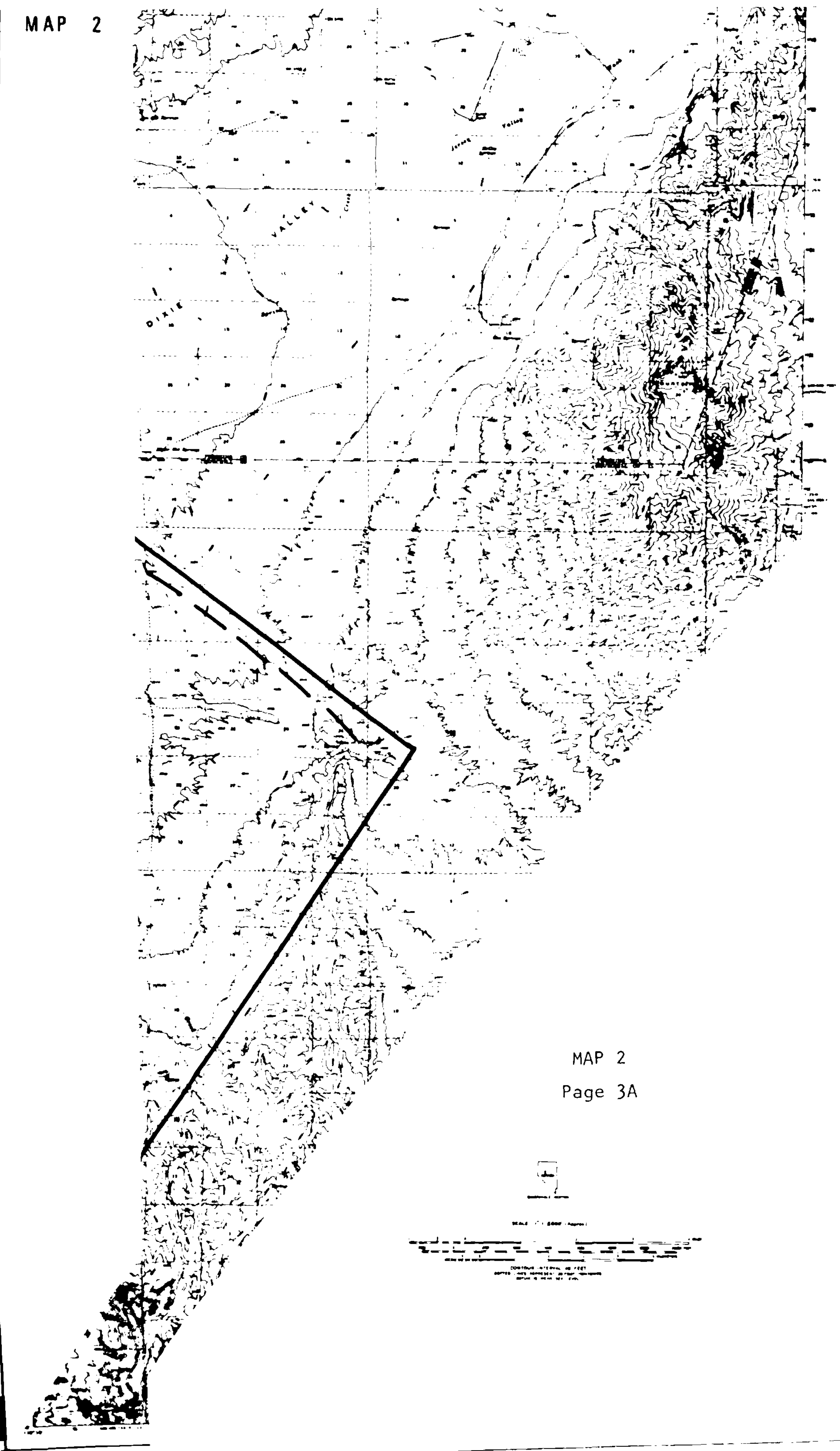
this connection, Millican Oil Company and Southland Royalty Company have agreed to cooperate in the exploration endeavors undertaken to date within the Dixie Valley area and it is this cooperative agreement which allows the inclusion of the complete acreage represented by the two companies for purposes of this proposal.

Accessibility to the area is possible from two directions: 1) Dirt and gravel roads from the north, with access from Lovelock and Winnemucca, and 2) From the south via a paved road which extends into the valley for 15 miles from Frenchman's Station, with an additional 15 miles currently being paved to the north of Dixie Settlement. An additional 10 miles of all-weather gravel road extends to the prospect area, and continues along the west side of the valley to meet the Lovelock-Winnemucca roads.

c. Geologic description:

Dixie Valley is a complex graben bounded by two main large-displacement faults on the west and by many sub-parallel, smaller displacement faults on the east. (See Map, Prospect Outline and Boundaries of the Gabbro, Page 3A .) Faulting was accompanied by westward tilting of the major fault block (i.e., horsts and grabens). A middle Jurassic gabbroic complex or lopolith intrudes the graben. The thickness of alluvial and lacustrine valley fill reportedly may exceed 5000 feet in places. Tertiary and Jurassic andesite and basalt flows, tuffs, carbonates and gabbro are extensively exposed in the Stillwater Range and Clan Alpine Mountains, and are presumed to underly the valley fill. However, data acquired by the Southland-Millican venture over the past year suggests that previous interpretations of the structural relationships within the valley may not be correct. (See "Program Data Offered" and Section 3. A. of this proposal for a brief description of this problem.)

MAP 2



MAP 2
Page 3A

The Dixie Valley area is defined by the intersection of the northeast-trending "northern Nevada lineament" and a north-trending belt of intense historic faulting and seismicity (including the 1954 Dixie Valley earthquake, magnitude 6.8) extending from Owens Valley, California, to Pleasant Valley, Nevada (i.e., northern segment of the Ventura-Winnemucca Seismic Zone). From an analysis of displacements on the late Cenozoic faults and of Pleistocene lake shorelines, Thompson and Burke (1974) concluded that the crustal spreading in Dixie Valley had an average rate of 0.4 mm/yr over the last 15 m.y., and 1 mm/yr over the last 12,000 years. In addition, their seismic refraction data indicate a 24 km thick crust near Fallon, Nevada, which is the thinnest value reported for the Basin and Range. This fits with the concept that Dixie Valley is part of the area of very active mantle spreading and crustal rifting in northern Nevada -- i.e., an area of high geothermal potential. Surface geothermal features include Dixie Hot Springs with a previously reported temperature of 72° C, and the "Senator" fumaroles which discharge warm air, water vapor, and some H_2S and sulfur. Intense heat and hot water have been reported in workings of the Dixie Comstock Mine at depths of greater than 75 feet (Vanderburg - 1940).

Thus, Dixie Valley is presently an area of high seismicity, active extensional faulting, high-temperature geothermal manifestations, and relatively intense late Tertiary silicic volcanism.

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d. Technical reasons for site selection:

Work done for the United States Air Force, Stanford University Cambridge Report (1954) indicated that a gabbroic intrusion (or lopolith) occupies a central part of Dixie Valley. The southern limit of the gabbro is near Dixie Hot Springs, and it extends northward at least to Township 25N, or Sou and Seven Devils Hot Springs. Between these limits hot spring water does not reach the surface, but the western valley edge is marked by areas of hot ground and steam fumaroles extending over a distance of approximately 20 miles. In this zone, as mentioned previously, mining operations at the Dixie Comstock mine were forced to halt when high temperatures were encountered. In addition, a mineral project hole at another nearby mine site encountered temperatures substantially higher than would have been expected from geothermometer water-analysis from springs outside the gabbro-covered area (see Chart 1, page 5A). This strongly indicates that these springs are not true indicators of sub-surface temperatures to be expected in that part of the valley intruded by the gabbroic lopolith.

The surface manifestations focused attention on the central Dixie Valley area, and led to geophysical investigation. During the course of these investigations, which extended over a four year period, almost all known geothermal exploration procedures were investigated. Many of these techniques were found to be ineffective (at least in this area), while others have been proven to be very useful in establishing a geothermal model for Dixie Valley. From this work it appears clearly possible that a major geothermal province exists in Dixie Valley. There appear

CHART 1

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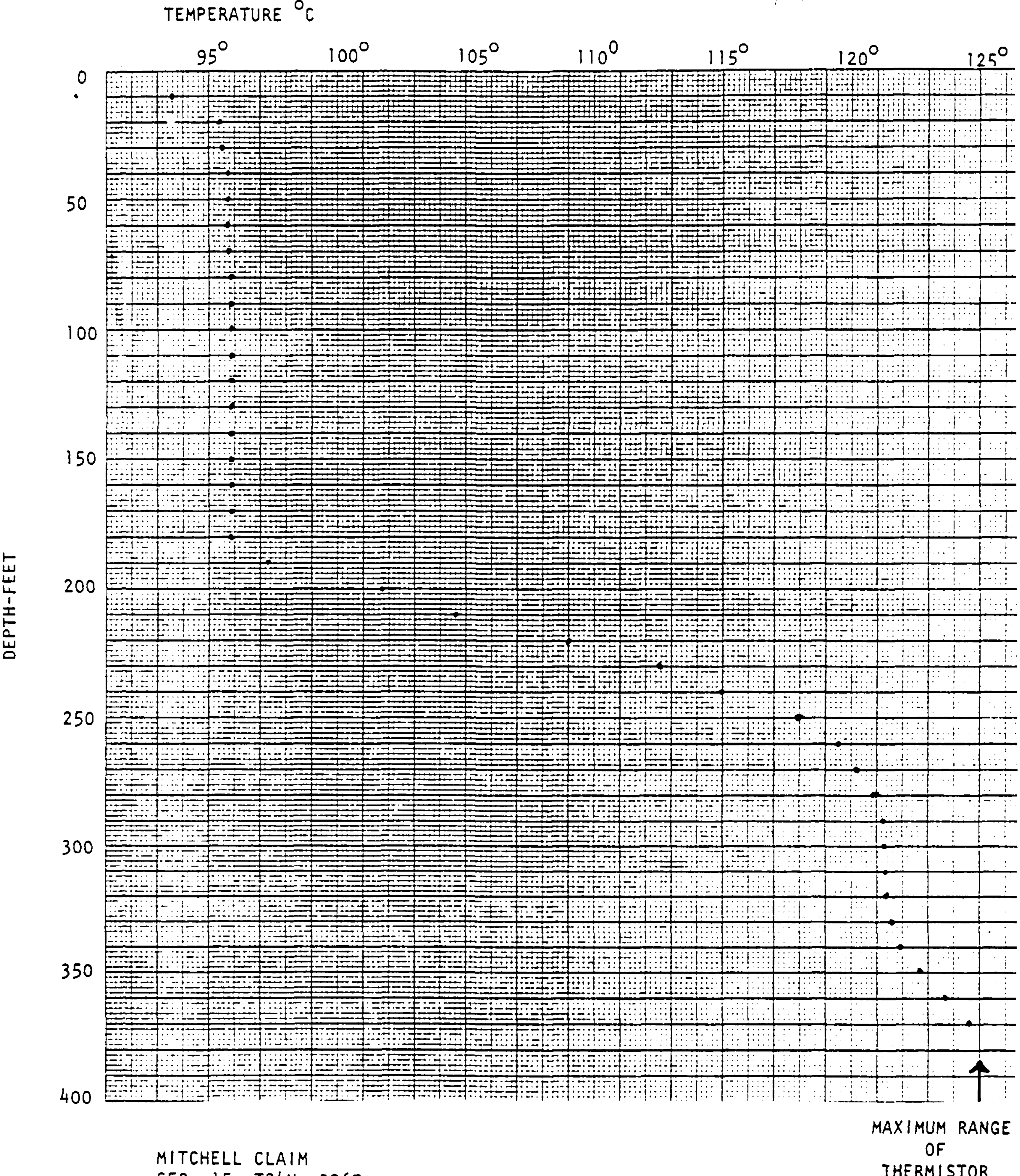

MITCHELL CLAIM
SEC. 15, T24N, R36E

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GEOTHERMEX C. KLEIN

to be miltiple heat sources, which on the basis of initial evaluation may be relatively shallow magma chambers. It seems likely that these heat source areas may coalesce forming an extremely large geothermal field. These concepts appear to be supported by thermal gradient studies now being completed by proposers and offered hereunder.

Specifically, the Dixie Valley area was selected for this proposal because:

1. Surface and near surface criteria, (intermediate depth thermal gradient holes) indicate very high temperatures may exist at depth. Temperatures exceeding 125° C have been encountered at depths of less than 400 feet, (See chart 1, page 5A). The present thermal gradient drilling program indicates significant thermal gradients continue to depths of 1500 feet.
2. Geophysical exploration techniques such as aeromagnetics, magnetotellurics, etc. also indicate high temperatures at moderate depth and point to possible heat sources. If preliminary models can be substantiated, a a major geothermal province is indicated which can be of significant geologic and commercial value due to the potentially vast area involved.
3. Geophysical techniques used are not those commonly utilized in geothermal exploration and substantiating these techniques may lead to significant improvement in geothermal exploration.
4. Tentative geothermal models proposed for Dixie Valley differ markedly from the popularly held views on basin and range thermal development. If these models are substantiated, they would substantially change basin and range exploration objectives and estimates of geothermal energy resources in the Basin and Range Province.

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B. 2.

I. REPORT: GEOTHERMAL POTENTIAL OF DIXIE VALLEY, NEVADA: An evaluation of Dixie Valley was conducted by GeothermEx in December 1976. It is an overview of published data, drawing on the United States Air Force, Stanford University Cambridge Report, (1966). Ther interpretations were made on the basis of geophysical and thermal gradient studies which were conducted on the most favorable part of the Dixie Valley. Specific studies completed in 1976 include:

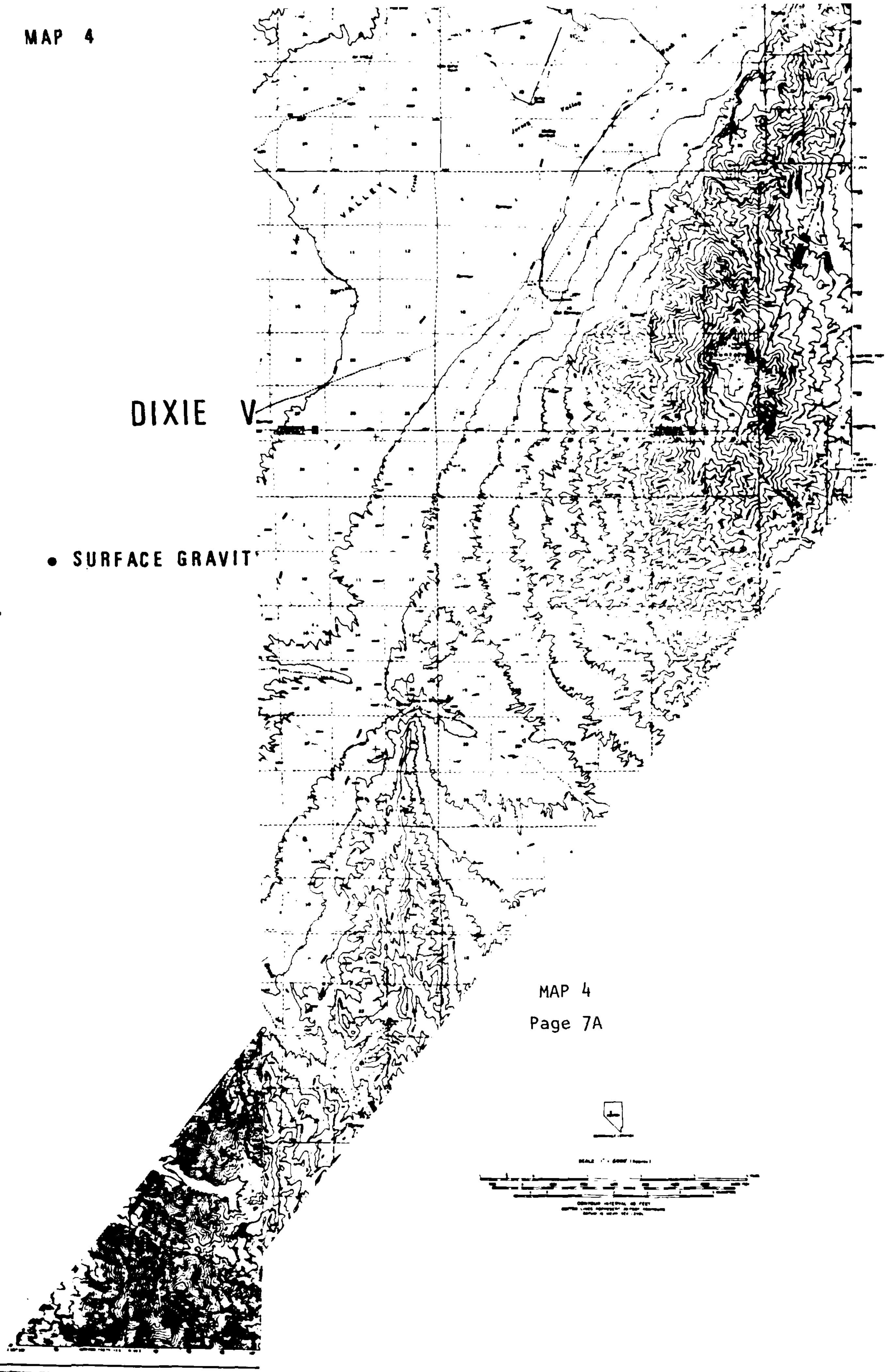
1. Seismicity Report on the Dixie Valley Prospect by Micro Geophysics Corporation. This work consists of a microearthquake survey of 200 sq. km north of Dixie Hot Springs, and an interpretation of 216 events recorded in the area.
2. Gravity and Magnetic Survey over the Humboldt Salt Marsh, Dixie Valley, Nevada by Exploration Data Consultants, Inc. Two hundred eleven (211) gravity and magnetic stations were acquired, and these data were used to construct maps and profiles of the basement configuration and fault system of the valley. Map 4, page 7A, shows the locations of the gravity and magnetic stations.
3. Shallow Thermal Gradient Wells. GeothermEx, Inc. drilled fourteen thermal gradient wells and prepared temperature gradient logs and lithologic logs on the wells. These shallow holes are approximately 300 feet in depth. In addition, two pre-existing wells were logged. Temperatures encountered in this study were as high as 18° F/100 feet. Locations of these wells are platted on Map 7, page 11A.

II. REPORT: PRELIMINARY EVALUATION OF GEOLOGIC AND ECONOMIC POTENTIAL:

A geological and economic evaluation was conducted by Keplinger and associates, Inc., Houston, under the direction of Michael D. Campbell during May through September, 1977. The evaluation consisted of three phases:

(1) Geothermetric Survey

MAP 4



MAP 4
Page 7A

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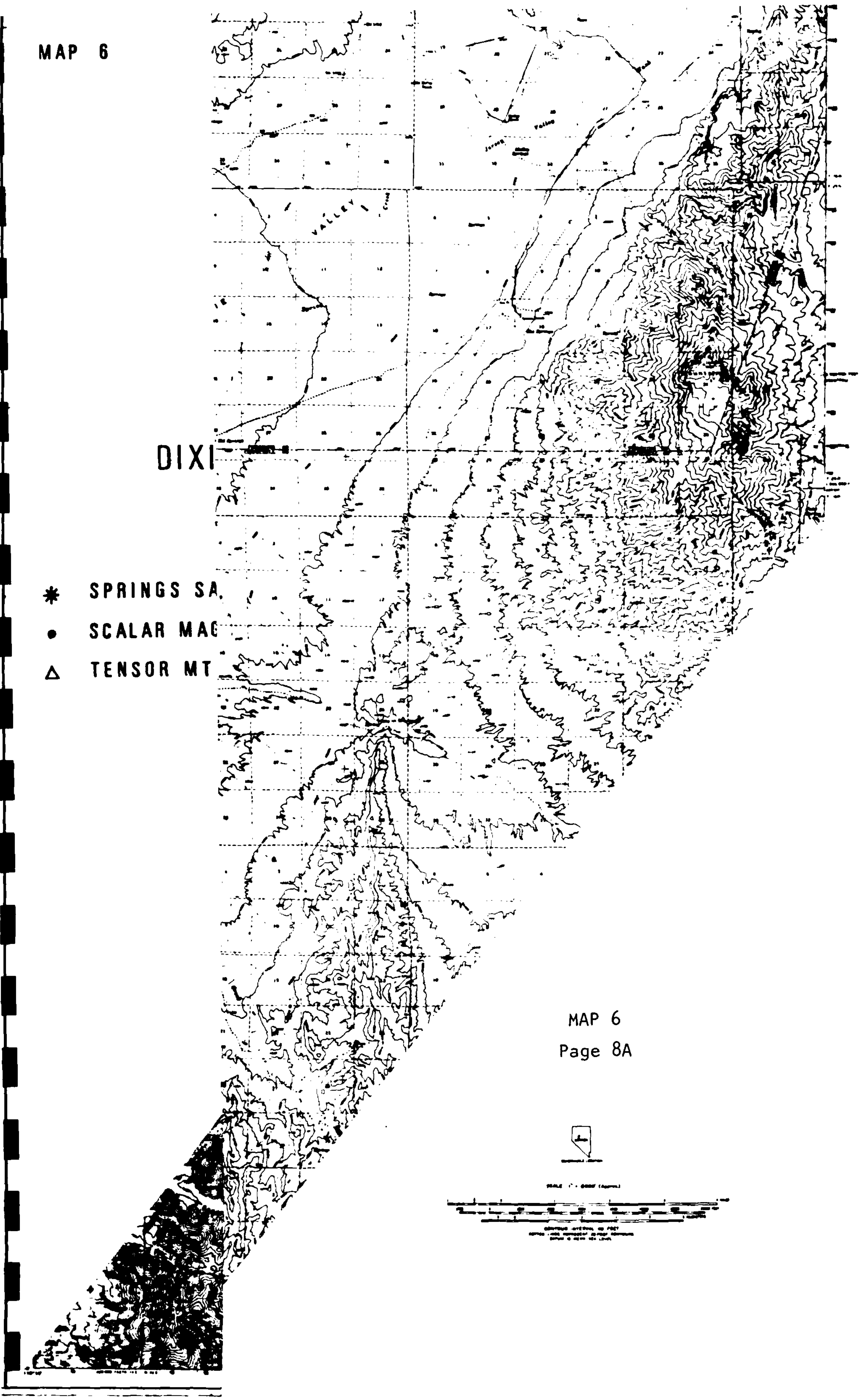
(2) Preliminary Structural Analysis

(3). Preliminary Economic Analysis

A ground water geochemical survey was conducted of selected springs in the immediate area, (See Map 6, page 8A). The springs were sampled on an individual basis over a seven day period and intermittently since that period to the present. Seventeen chemical and physical parameters were analyzed or recorded. Duplicate samples were taken perodically for tests on precision and analytical error. Approximately 60 samples have been taken to date. Standard geothermetric calculations were made using the silica and calcium-sodium potassium methods. The silica method indicates a minimum of 175° C reservoir temperature with considerable mixing of meteoric water. Mineralogical disequilibrium is also apparent. Because of mixing this minimum temperature is not believed to be a limiting factor in the development of the area, especially in that part of the valley below the gabbroic complex.

The second phase of the evaluation consisted of a structural analysis of the Stillwater and Clan Alpine Ranges and the Dixie Valley. Three geothermally-significant structural features (geothermal fairways) have been tentatively inferred within Dixie Valley. Type I: Western normal range-front fault zones and fairways; Type II: East-West graben-like structures and fairways; and Type III: normal fault zones or fairways parallel to but basinward of Type I Structures. Two types of reservoirs were postulated (an upper hot-water reservoir and a lower steam reservoir).

The third phase consisted of an economic evaluation of minimum reservoir temperature, minimum well-flow rate and a preliminary analysis of possible producer cost of explore and develop a geothermal reservoir under a range of subsurface and economic conditions.



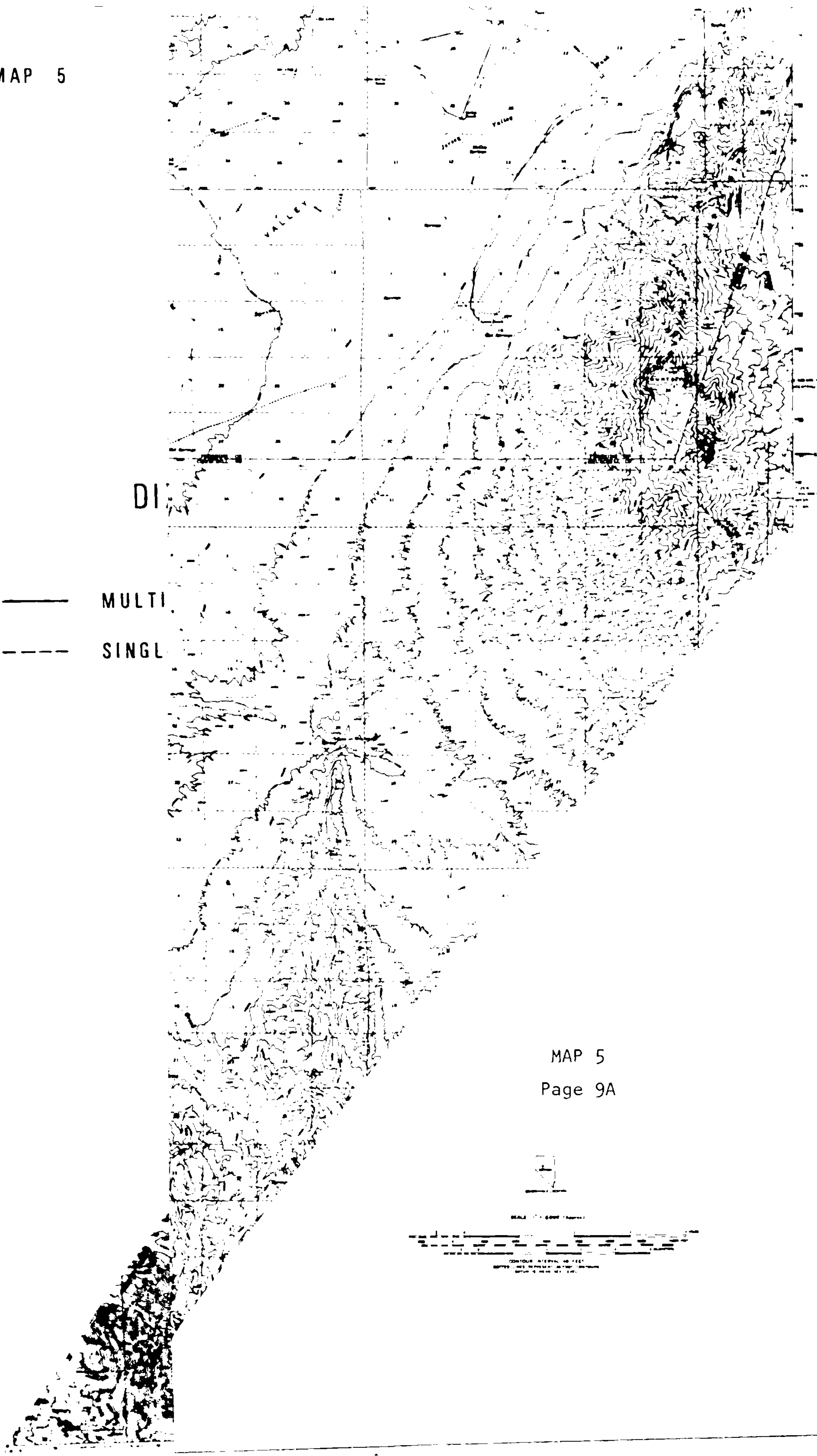
MAP 6
Page 8A

III. MULTI-LEVEL AEROMAGNETIC SURVEY: "Disclosure subject to ...... restrictions on title page i."

This relatively new geophysical technique has had only limited exposure to geothermal exploration, and this is perhaps its first thorough testing. Although the method produces non-unique solutions, this method of exploration can be used to locate magnetic discontinuities (faults and lithologic contacts) and their dip, determine depth to basement and to intrusions, and determine depth to Curie point. Data is acquired at the rate of 18 stations per mile using an optically-pumped helium magnetometer. A precise Doppler navigation system allows a series (4 to 5) of flights to follow exactly the same flight path, recording magnetic data at a progression of elevations. In the case of this Dixie Valley survey, elevations of 5,000, 5,500, 6,000, 6,500 and 7,500 feet were flown. Average surface elevations ranged from 3,500 feet to 4,500 feet MSL. Reduction of this multi-level data allows a precision of interpretation not possible by other magnetic techniques. An evaluation of this tool may make possible a distinct step forward in geothermal exploration. The Dixie Valley survey covers approximately 150 square miles and consists of 5 flight lines flown diagonally across the valley, and 2 flight lines parallel to the sides of the valley. The area covered and flight line paths are shown on Map 5, page 9A. In addition, single-level lines are used to tie in the profiles. The work was done by Senturion Sciences, Inc., Tulsa, Oklahoma in late 1977 and early 1978, under contract to proposers. This survey indicates an area of high thermal gradients in the area.

Data acquired in this survey indicate excellent quality, and the initial interpretation by Senturion Sciences, Inc. appears to be geophysically sound. However, this interpretation is in direct conflict with the commonly accepted concepts of basin and range structure, which was reconfirmed by the preliminary study conducted by proposers. (See "II" of Program Data Offered.) This interpretation is significantly different, is critical to the construction of a geothermal model of Dixie Valley,

MAP 5



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MAP 5

Page 9A

and is important to the geological understanding of the Basin and Range Province. Therefore, Proposer considers that a complete independent re-interpretation of the multi-level aeromagnetic data are necessary, and such is proposed herein. (See Section 3. A. for further comment).

IV. MAGNETOTELLURIC SURVEY:

As a follow-up to the above multi-level aeromagnetic survey, a scalar and tensor magnetotelluric survey was conducted by Senturion Sciences, Inc., Tulsa, during November, 1977 through the present date on behalf of the Southland-Millican cooperative venture.

Twenty-eight scalar stations and 3 tensor stations were located in the central Dixie Valley area on centers of less than 1-mile along the western margin of the Valley, (T23N, R23E; T24N, R36E). The scalar stations (SMT) recorded one component of the telluric field. However, one magnetic and orthogonal telluric field was recorded at the scalar base station.(Map 6) The tensor stations (TMT) recorded three components of the magnetic field and two components of the telluric field.

Scalar stations were deployed to record at an azimuth of 22 degrees east of north or the E-parallel of telluirc field. Local geologic structure suggested a NNE strike direction. However, after reduction of scalar base station data, it became apparent that the base station was at some angle other than 22 degrees azimuth to the E-parallel orientation on the conductive side of a major lateral discontinuity. In order to make the necessary adjustments, Senturion's TMT system with a three-component, superconducting quantum interference device (SQUID) was deployed to determine true E-parallel and calculate the tensor impedence along the major axis of anisotropy. Normalized power spectra at the field station were then multiplied by this sounding curve to yield the apparent resistivity versus period relationships for each station.

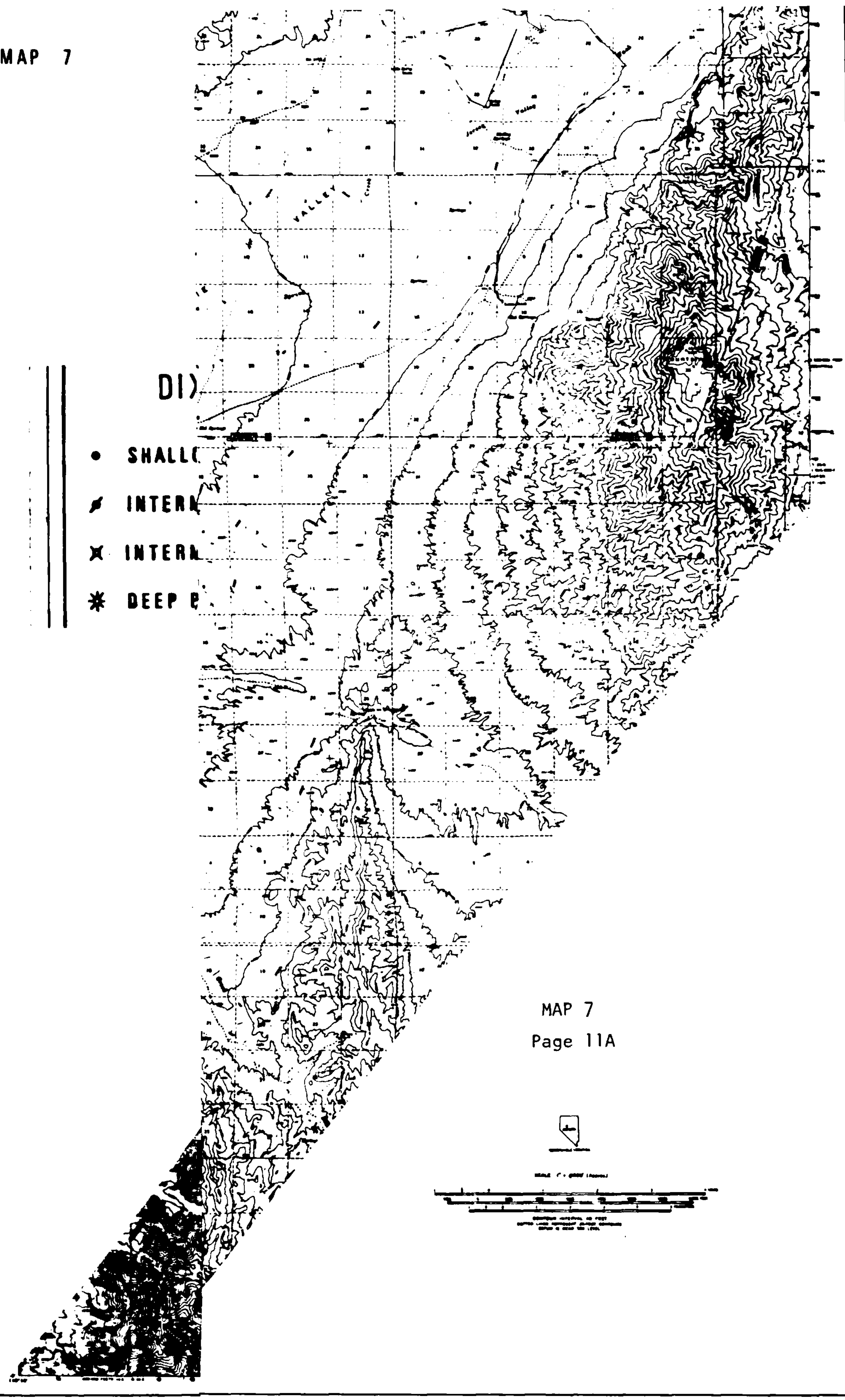
The apparent resistivity contour at five ohmeters was chosen to correlate with the 1-Hertz apparent resistivity of this survey with the audio-magnetotelluric data acquired by Senterfit, et al (1976). Excellent agreement exists between the two surveys as indicated by an overlapping conductive anomaly (50 ohmeters) in T24N, R36E.

The survey has located three heat sources at a depth of six to eight km with anomalously low resistivity (1 to 5 ohmeters), along the western margin of Dixie Valley. This confirms related anomalies indicated by the aeromagnetic survey. In addition three conductive anomalies have been identified in the same area on the basis of apparent resistivities of equal to or less than 20 ohmeters at the 30-second period. (Plots are also available of the one, ten and 100 second periods.) Additional tensor stations are planned.

V. INTERMEDIATE DEPTH THERMAL GRADIENT DRILLING:

Drilling is presently in progress on an intermediate depth thermal gradient drilling program by Southland Royalty Company. The program, when completed, will consist of five wells approximately 1,500 feet in depth and two wells scheduled to 500 feet total depth. The locations of these wells are plotted on Map 7, page 11A. The shallow wells will be drilled on or near the basin edge-bounding faults, primarily to check conductance of the basement rocks and fault dips. The deep holes are located further into the basin to evaluate thermal gradients in the alluvium and underlying units. These wells will be temperature logged at regular time intervals until temperature stabilization is apparent. This project is expected to be completed by the time of contracting under this proposal. To date, two 1500 foot wells are complete and in process of being logged, and a third is underway.

MAP 7



MAP 7
Page 11A

VI. INSTRUMENTATION FOR MEASURING THERMAL GRADIENTS:

At present, inexpensive and accurate methods are not readily available to measure thermal gradients at temperatures above 110° C. Presently available commercial thermistors do not have a sufficient range to measure from ambient temperatures to those found in highly prospective geothermal areas. Enviro-Labs, Inc. has developed a practical system utilizing a platinum thermistor which is able to measure temperatures from below zero to near 200° C. Cooperative engineering and test work is being conducted in Dixie Valley by Enviro-Labs and the Southland-Millican venture to make this system practical for one-man well logging operations. Continuous logging through one inch pipe will be possible. Results of the engineering development work and test result of the system will be of value to the industry, especially in logging high temperature thermal gradient wells. Thermistor designs are proprietary, but engineering designs for geothermal well logging use, logging equipment designs, and test applications will be available for release. (see Appendix A, Page 101 for technical analysis and resume.)

B. 3. PROGRAM DESCRIPTION

a. Subsurface

The primary objective of the proposed program is to assess the potential of the geothermal reservoir of Dixie Valley by drilling three selected geothermal test wells to depths of 8,500 feet. To insure however, that such an assessment will include the necessary geological foundation, this drilling will be included in a comprehensive program required to appropriately evaluate the Valley's geothermal potential. Because of the high costs involved in drilling relatively deep geothermal wells, well-site selections should only be made on the basis of the best available, although economically cognizant, geological information. To meet this requirement, the academic industrial program in this proposal is felt to be extremely valuable.

In order to optimize the potential impact of all pertinent geological information on well site selection, and subsequently the prudent development of a commercially viable geothermal reservoir, if shown to be present, a multi-disciplinary geological analysis is to be conducted in concert with the three-well drilling program. (See Surface Investigations, Section B. 3. b., page 32 .)

Considering that the transmittal of the data obtained to date by Proposer is Phase I of the proposed program, a brief pre-drilling evaluation (early Phase II period) by the staff of the Univeraity of Nevada at Reno, in cooperation with the staff and consultants of the Southland-Millican cooperative venture will be undertaken to optimize the selection of the first and subsequent well sites and to originate pertinent detailed evaluations of the geological factors that impact the potential geothermal reservoir of Dixie Valley. Phase II evaluations will then proceed as Phase III initial drilling is begun. The data derived from each well drilled as tested will be incorporated in the well selection process for each subsequent well drilled as well as in the final assessment of the Dixie Valley geothermal reservoir

In order to expedite drilling, eleven applications to drill were filed with the United States Geological Survey in early May (Map 7, page 11A, approximate locations). It is expected that drilling can commence at one of these locations as early as January, 1979. The United States Geological Survey has advised that if all regulatory requirements are in order, permits could be issued by September, 1978. As indicated previously the plan is for the University of Nevada to review and reinterpret existing data before final selection of the first well-site so that all existing information may be integrated into the overall case study. The schedule for development of the hydrologic, seismologic, geologic and geophysical investigations should allow much of the data developed to be further integrated with the data obtained from the first well before sites are selected for the second and subsequent wells. Data from the second well will then be integrated with the final results of the proposed hydrologic, seismologic, geologic and geophysical investigations before sites are selected for the third well. In determining well site selection, it will be considered that the previous geological evaluations conducted by the Southland-Millican cooperative venture have suggested that two types of reservoirs may exist in Dixie Valley: 1) a hot water, or vapor dominated (more than 200° C) fracture controlled reservoir along the western margin of Dixie Valley below the base of the gabbroic complex, and 2) a hot water dominated (more than 200° C) porous media-fault controlled reservoir at depth in the central region of Dixie Valley, at or below the base of the thick alluviumlucustrine sequence.

On the premise that the area along the western margin of the Valley appears at this time to offer the most attractive economic and geologic conditions necessary for industrial geothermal development, the proposed Dixie Valley assessment program intends to focus initially on the western areas of the Valley. Subsequently, and depending upon the geological information generated from the proposed evaluations and associated drilling program, the central basin area would then be drilled and tested, but such an expanded program is beyond the scope of this proposal.

DETAILED DRILLING AND COMPLETION PROCEDURE

The permits which have been filed and the drilling plan and diagrams (page 25) call for 8,500 foot wells. The depth necessary will vary depending on the proximity to the valley sides as there is likely to be step faulting of the basement rock. A detailed drilling and completion procedure follows; including reference to logging in sequence:

1. Move in and rig up rotary tools. Drill 24" hole to 50' using a fresh water gel mud. Run 20" 94# H-40 casing to 50' and cement with 96 sacks. If cement fails to circulate or falls down the annulus after cementing, wait on cement 8 hours, run 1" pipe into the annulus to top of cement and recement through the 1" pipe, bringing the top of cement to ground level. Wait on cement 12 hours.

In as much as the Southland - Millican Cooperative Venture has drilled a number of geothermal test wells in this immediate area to depths below 1300' without encountering, steam, oil or gas flows, it will be requested that the requirement of a blowout preventer on this string of casing be waived and surface casing set before installing a blowout preventer.

2. Drill 18 5/8" hole to 1300' using a fresh water gel mud. Run electric logs from 50' to 1300'. Run 16" 75# K-55 casing to 1300' and cement with 1225 sacks. If cement fails to circulate or falls down the annulus after cementing, wait on cement 8 hours, run 1" pipe into the annulus to top of cement and recement through the 1" pipe, bringing the top of cement to ground level. Wait on cement 12 hours.

Install a 16" 2000 psi working pressure casing head with 2 - 2" side outlets on the 16" casing at ground level. Install a 2" 2000 psi working pressure valve on one casing head outlet, then connect the valve to the mud pump and use this opening as a kill line if needed. Install 2 - 2" 2000 psi working pressure valves in series on the other casing head outlet, then connect these valves to the mud pits for use as a blowdown line if needed. Install a 16" 2000 psi working pressure drilling spool with 2 - 2" side outlets on the 16" casing head.

Install a 2" 2000 psi working pressure valve on one drilling spool outlet, then connect the valve to the mud pump and use this opening as a fillup line. Install a 2" 2000 psi working pressure valve to the other drilling spool outlet, this valve will be retained for reserve use. Install a manual and remotely controlled hydraulically operated double ram blowout preventer rated at 2000 psi working pressure on the 16" drilling spool. Install an expansion-type blowout preventer rated at 2000 psi working pressure on the 16" double ram blowout preventer. All of this well head equipment will have a bore larger than 14" in order to allow passage of 13 3/4" drilling tools. After nippling up this equipment, test the blowout preventers, valves and casing to 2000 psi. The blowout preventers will be pressure tested not less than once each week, alternating the control stations. The blowout preventers will be tested for operating ability not less than once each day. Prior to drilling out cement, the drill string will be equipped with a kelly cock installed between the kelly and the swivel. A full opening drill string safety valve will be kept on the rig floor and ready for use at all times.

3. Drill 10 5/8" hole to 3000' or through volcanic beds using a 9.5 pound per gallon fresh water based gel-chemical mud. If no lost circulation zones have been encountered, continue drilling 10 5/8" hole to 5000'. If severe lost circulation occurs while drilling the 1300' - 3000' interval, ream the hole to 13 3/4", run electric logs, run 11-3/4" 54# K-55 casing to 3000' and cement with 1700 sacks. If cement fails to circulate or falls down the annulus after cementing wait on cement 8 hours, run 1" pipe into the annulus to top of cement and recement through the 1" pipe, bringing the top of cement to ground level. Wait on cement 12 hours.

Install 11 3/4" x 16" casing slips and packing in the 16" casing head. Install a 16" x 16" 2000 psi working pressure casing spool with 2" side outlets on the 16" casing head. Install a 2" 2000 psi working pressure valve on one casing spool outlet, then connect the valve to the mud pump and use this opening as a kill line if needed.

Install 2 - 2" 2000 psi working pressure valves in series in the other casing spool outlet, then connect these valves to the mud pits for use on a blowdown line if needed. Install a 16" 2000 psi working pressure drilling spool with 2 - 2" side outlets on the 16" casing spool. Install a 2" 2000 psi working pressure valve on one drilling spool outlet, then connect the valve to the mud pump and use this opening as a fillup line. Install a 2" 2000 psi working pressure valve on the other drilling spool outlet; this valve will be retained for reserve use. Install a manual and remotely controlled hydraullically - operated double ram blowout preventer rated at 2000 psi working pressure on the 16" drilling spool. Install an expansion - type blowout preventer rated at 2000 psi working pressure on the 16" double ram blowout preventer. All of this equipment will have a bore larger than 10 3/4" in order to allow passage of 10 5/8" drilling tools.

After nippling up this equipment, test the blowout preventers, valves and casing to 2000 psi. The blowout preventer will be pressure tested not less than once each week, alternating the control stations. The blowout preventer will be tested for operating ability not less than once each day. Prior to drilling out cement, the drill string will be equipped with a kelly cock installed between the kelly and the swivel. A full opening drill string safety valve will be kept on the rig floor and ready for use at all time.

4. Drill 10 5/8" hole to 8000' using a 9.5 pound per gallon fresh water based gel-chemical mud. Run electric logs. Run 8 5/8" 36# Buttress casing to 8000' and cement with 2100 sacks of a high temperature admix cement. This casing string will be composed of 6000' of 36# K-55 casing (top portion) and 2000 ' of 36# N-80 casing (bottom portion). Cementing will be accomplished by running drill pipe inside the casing to a stab-in float collar positioned one joint above the casing guide shoe and pumping cement through the drill pipe and up the annulus outside the 8 5/8" casing to the surface.

A wiper plug will then be pumped through the drill pipe. In the event circulation is lost while cementing and cement does not reach ground level, a wiper plug will be pumped through the drill pipe, the drill pipe pulled, a temperature survey will be run to locate the cement top (if possible), the casing will be perforated at the cement top, a cement retainer will be placed above the perforations and the casing will be again cemented. If necessary, this process will be repeated until a continuous column of cement exists from ground level to the casing shoe. After waiting on cement 12 hours, all retainers placed in the casing will be drilled out and the perforations tested to 2000 psi to assure the perforations are well cemented.

Install an 8 5/8" x 16" expansion unit and a 16" x 10" 2000 psi working pressure expansion spool with 2" side outlets on the 16" casing spool. Install a 2" 2000 psi working pressure valve on one expansion spool outlet, then connect this valve to the mud pump and use this opening as a kill line if needed. Install two 2000 psi working pressure valves in series in the other expansion spool outlet, then connect these valves to the mud pits for use as a blowdown line if needed.

Install a 10" 2000 psi working pressure master valve on the expansion spool. Install a 10" x 10" 2000 psi working pressure drilling spool on the master valve. Install a 2" 2000 psi working pressure pump and use this opening as a fillup line. Install a 2" 2000 psi working pressure valve in the other drilling spool outlet; this valve will be retained for reserve use.

Install a manual and remotely controlled, hydraulically-operated double ram blowout preventer rated at 2000 psi working pressure on the 10" spool. Install an expansion-type blowout preventer rated at 2000 psi working pressure on the double ram blowout preventer. Install a 2000 psi working pressure rotating head on the expansion-type blowout preventer. All of this equipment will have a bore larger than 7 3/4" in order to allow passage of 7 5/8" drilling tools.

After nippling up this equipment, test the blowout preventers, valves and casing to 2000 psi. The blowout preventers will be pressure tested no less than once each week, alternating the control stations. The blowout preventers will be tested for operating ability not less than once each day. Prior to drilling and cement, the drill string will be equipped with a kelly cock installed between the kelly and the swivel. A full opening drill string safety valve will be kept on the rig floor and ready for use at all times.

5. Drill 7 5/8" hole to 8500' using a 9.5 pound per gallon fresh water based chemical mud. Run electric logs. Run a drill stem test if feasible, setting packers in 8 5/8" casing. Displace mud in hole with fresh water. Lay down drill pipe. Shut in well at 10" master valve. Remove rotating head, expansion type blowout preventer, double ram blowout preventer, drilling spool and all mud lines. Install a second 10" 2000 psi working pressure valve to be used as a production valve. Move off the rotary drilling rig. Allow well to flow fresh water to pits. Begin production testing for pressure, volume, temperature, water quality, and other hydrogeological characteristics.

6. In the event severe lost circulation occurs while drilling the hole section 3000' to 8000' and it is necessary to case off these lost circulation zones, an 8 5/8" 36# N-80 Buttress casing will be run and cemented, using the techniques described in step 4 above. The hole section 8000' - 8500' will then be drilled with a 6" bit and the completion technique described in step 5 above will be applied.

In addition to drilling and completion procedure:

1. Condition hole and mud before pulling drill pipe to change bits, log or run casing.

2. Keep hole full while pulling drill pipe.

3. Check mud qualities daily, keep mud testing equipment on location at all times.

4. Equip pits with a high-low level indicator but both visual and audio warning devices.

5. Equip mud system with a degasser and desilter.

6. Equip mud system with temperature monitors to read and record mud temperatures going into and coming out of hole at intervals of 30' or less.

7. A hydrogen sulfide indicator and alarm will be installed on the rig floor while drilling from 1300' to T.D.

8. A member of the rig crew or the tool pusher will monitor activity on the rig floor at all times while drilling and completing this well.

9. Weight material of quantity needed to raise the weight of the mud system 2 pounds per gallon will be maintained at the well site while drilling the interval 1300' - 8500'.

10. Deviation surveys will be made at intervals of 500 feet or less.

11. In addition to blowout preventer specifications listed in the drilling procedure, the following procedures will be observed:

A. Packing elements and ram rubbers will be of high temperature resistant materials.

B. The hydraulic actuators for opening and closing the ram type and expansion type blowout preventers will be located at the drillers station and at a point on ground level 50' or more form the well bore.

C. The blowdown line connecting the well head and the mud pits will be equipped with steel or ceramic chokes and valves. The line will be anchored at all bends and at the end.

D. A blowout prevention drill will be conducted weekly for each drilling crew. During this drill, the expansion-type blowout preventer and pipe rams will be operated, using both control station actuators. All crew personnel will participate in these drills. The result of these drills will be entered in the drillers log book. Flange bolts will be inspected for tightness as a part of this drill.

E. Blind rams in blowout preventers will be checked for operation or each trip.

F. The expansion-type blowout preventer and pipe ram elements of ram type blowout preventers will be checked daily for operation.

Casing Design Safety Factors:

20" 94#, set at 50', using 9.5# maximum mud weight

Collapse REQ = 25	Rating = 520	SF = 20.8
Tension REQ = 4700	Rating = 487,000	SF = 103.6
Burst REQ = 25	Rating = 1400	SF = 56.0

16" 75#, set at 1300', using 9.5# maximum mud weight

Collapse REQ = 642	Rating = 1020	SF = 1.6
Tension REQ = 97,500	Rating = 662,000	SF = 6.8
Burst REQ = 642	Rating = 2400	SF = 3.7

11 3/4" 54#, set at 3000', using 9.5# maximum mud weight

Collapse REQ = 1482	Rating = 2280	SF = 1.5
Tension REQ = 162,000	Rating = 593,000	SF = 3.7
Burst REQ = 1482	Rating = 3300	SF = 2.2

8 5/8" 36# N-80 Buttress 6000' to 8000', using 9.5# maximum mud weight

Collapse REQ = 3952	Rating = 4270	SF 1.08
Tension REQ = 72,000	Rating = 1,034,000	SF 14.36
Burst REQ = 3952	Rating = 5900	SF 1.49

8 5/8" 36# K-55 Buttress 0' - 6000', using 9.5 # maximum mud weight

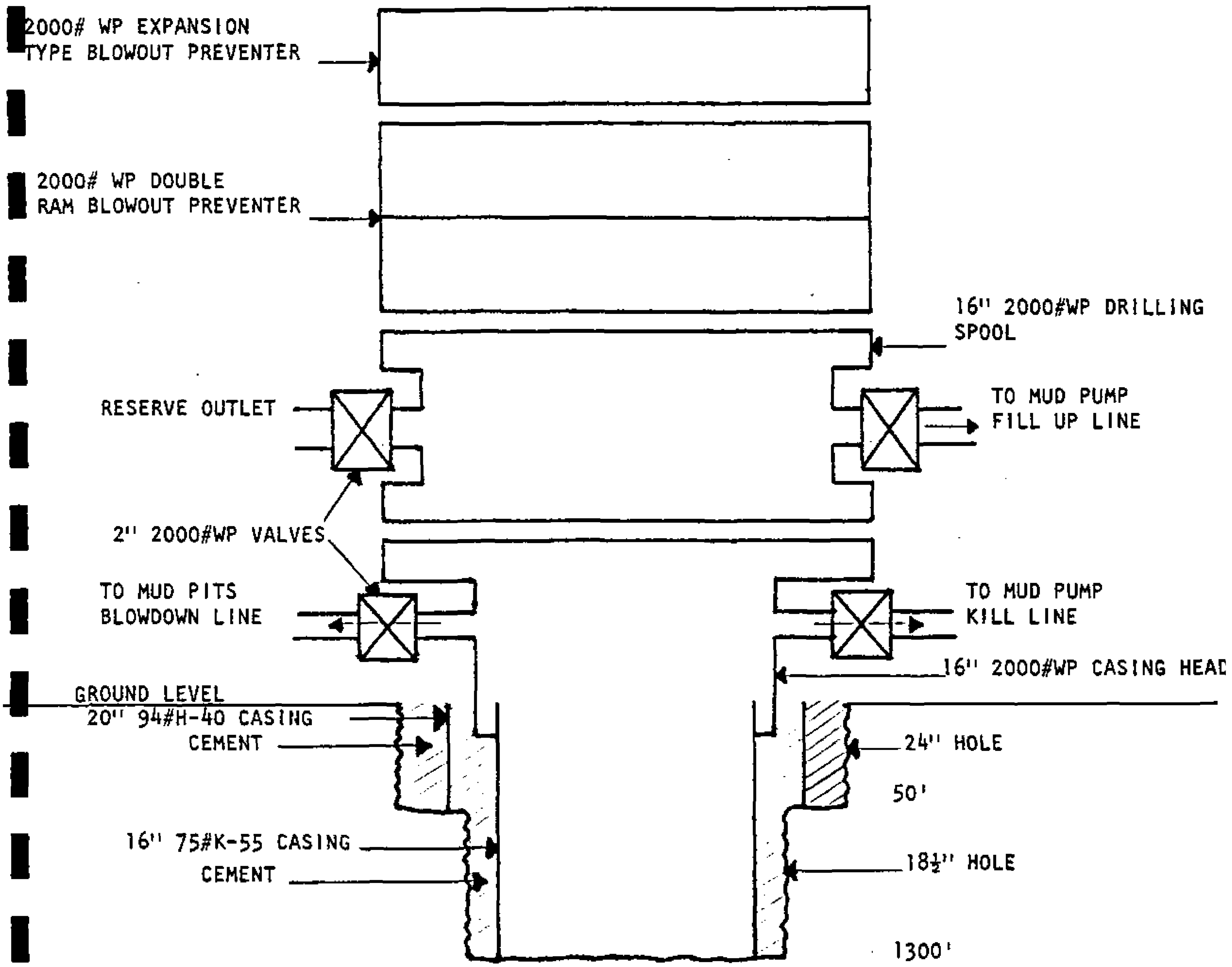
Collapse REQ = 2964	Rating = 3420	SF = 1.15
Tension REQ = 288,000	Rating = 981,000	SF = 3.40
Burst REQ = 2964	Rating = 4100	SF = 1.38

7" 23# N-80 Buttress 0' - 8000', using 9.5# maximum mud weight

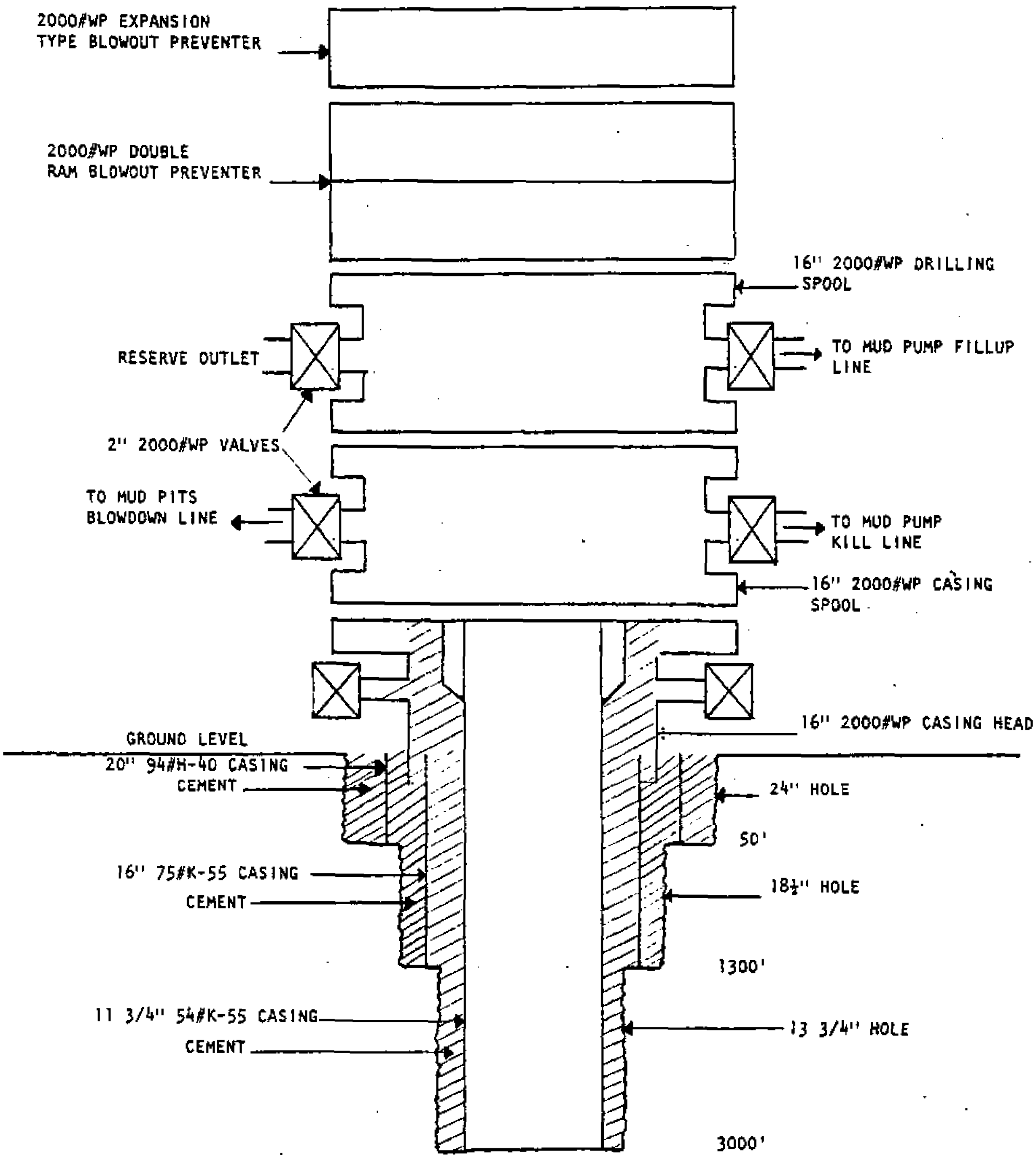
Collapse REQ = 3952	Rating = 4070	SF = 1.03
Tension REQ = 184,000	Rating = 666,000	SF = 3.62
Burst REQ = 3952	Rating = 5800	SF = 1.46

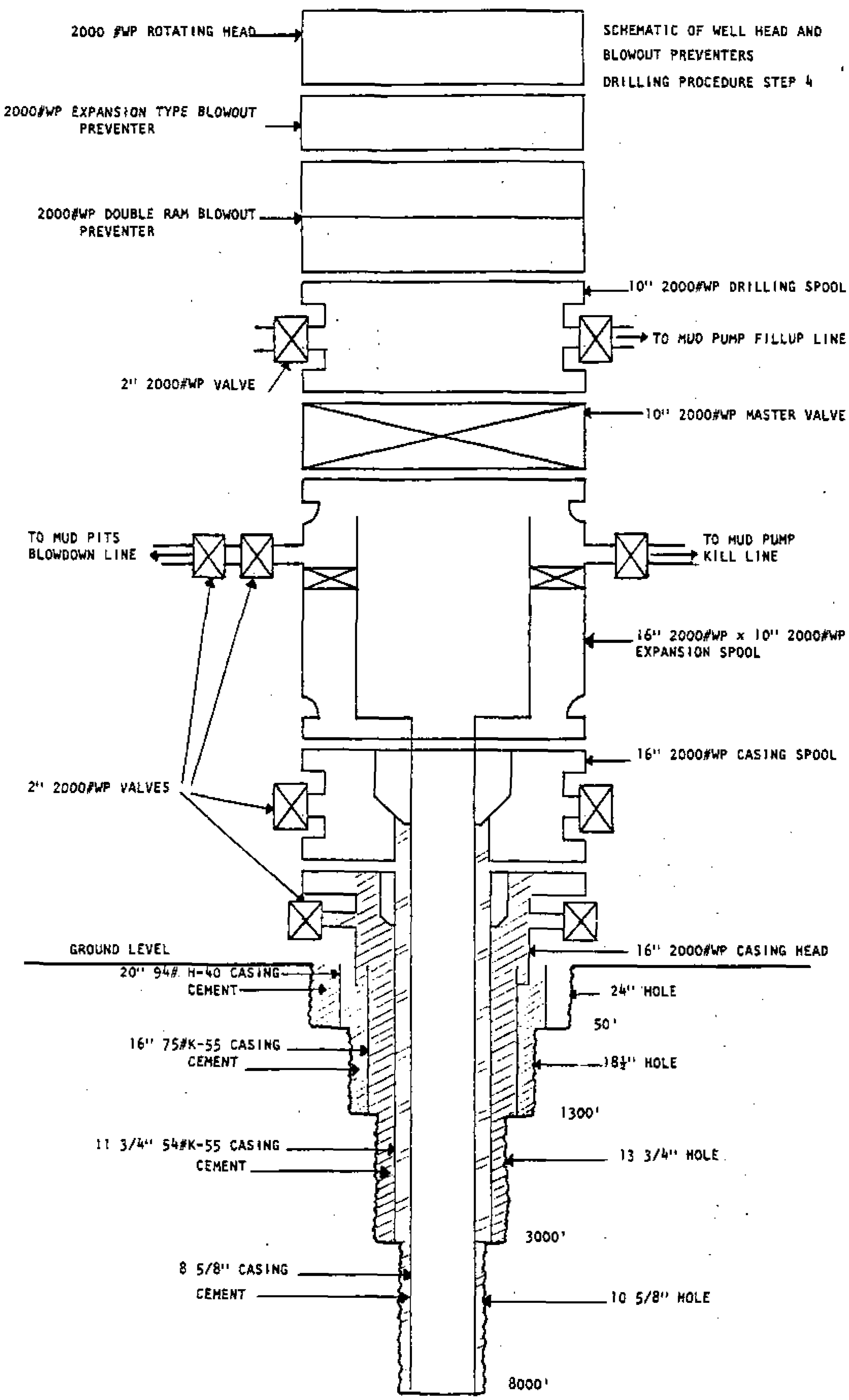
SCHEMATIC OF WELL HEAD AND BLOWOUT PREVENTERS

DRILLING PROCEDURE STEP 2

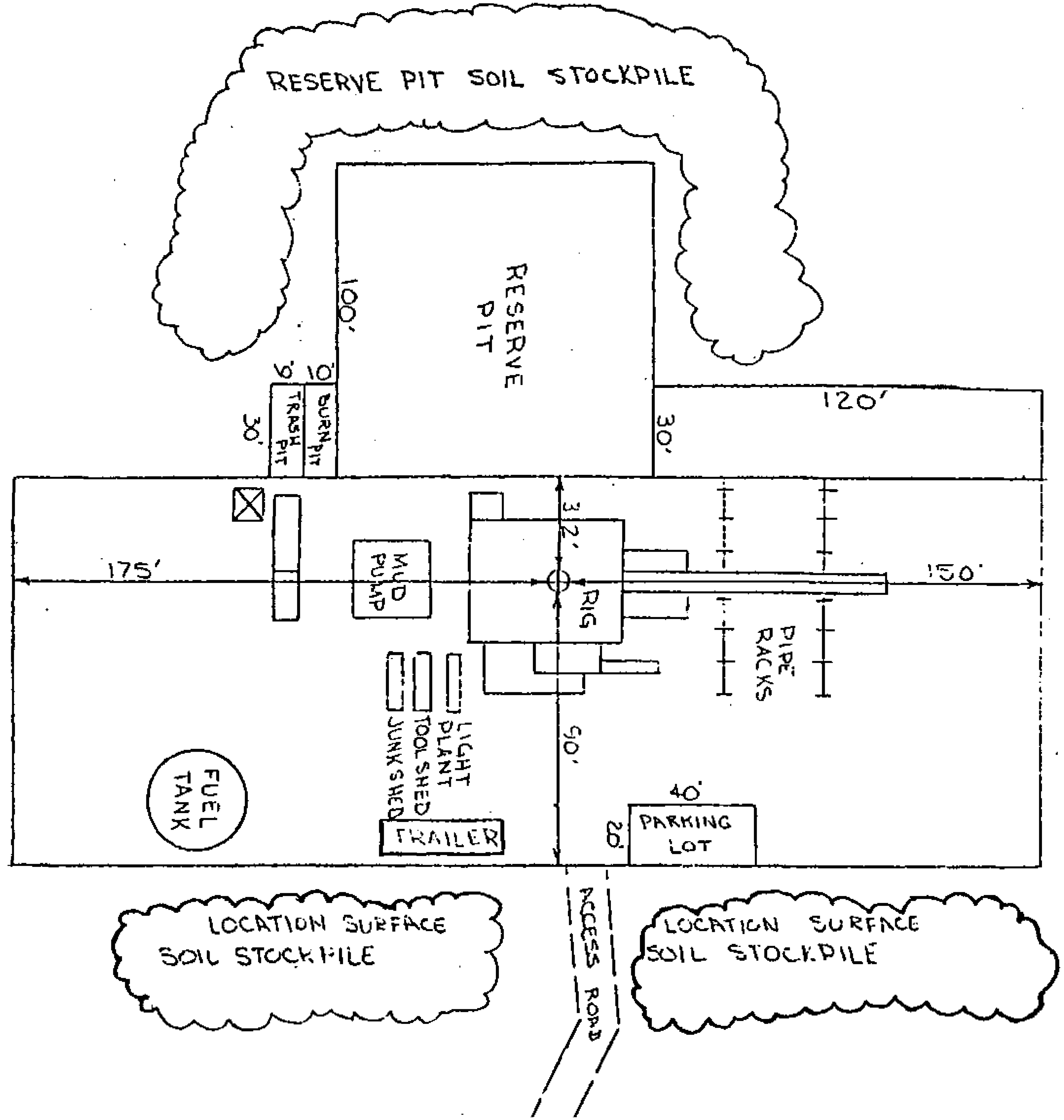


SCHEMATIC OF WELL HEAD AND BLOWOUT PREVENTERS
DRILLING PROCEDURE STEP 3(If Necessary)





2000 #WP ROTATING HEAD
SCHEMATIC OF WELL HEAD AND
BLOWOUT PREVENTERS
DRILLING PROCEDURE STEP 4
2000#WP EXPANSION TYPE BLOWOUT PREVENTER
2000#WP DOUBLE RAM BLOWOUT PREVENTER
10" 2000#WP DRILLING SPOOL
TO MUD PUMP FILLUP LINE
2" 2000#WP VALVE
10" 2000#WP MASTER VALVE
TO MUD PITS BLOWDOWN LINE
TO MUD PUMP KILL LINE
16" 2000#WP x 10" 2000#WP EXPANSION SPOOL
16" 2000#WP CASING SPOOL
2" 2000#WP VALVES
GROUND LEVEL
16" 2000#WP CASING HEAD
20" 94# H-40 CASING
CEMENT
24" HOLE
50'
16" 75#K-55 CASING
CEMENT
18½" HOLE
1300'
11 3/4" 54#K-55 CASING
CEMENT
13 3/4" HOLE
3000'
8 5/8" CASING
CEMENT
10 5/8" HOLE
8000'


RESERVE PIT SOIL STOCKPILE
RESERVE PIT
100'
9'
10'
TRASH PIT
BURN PIT
30'
30'
120'
175'
MUD PUMP
32'
RIG
150'
PIPE RACKS
LIGHT PLANT
TOOL SHED
JUNK SHED
50'
FUEL TANK
TRAILER
40'
PARKING LOT
20'
LOCATION SURFACE SOIL STOCKPILE
ACCESS ROAD
LOCATION SURFACE SOIL STOCKPILE

BLOWOUT PREVENTION PROGRAM

As detailed in the "Drilling and Completion Procedure" the blowout prevention program consists of three phases: blowout prevention containment devices (blowout preventers, rotating head and master gate), blowout warning devices (pit level alarm, degasser, temperature monitor), and blowout control drills for crew members.

The containment devices will be equipped with high temperature resistant packing elements and ram rubbers. All of the containment devices used will be rated and tested to 2000 psi. All of the containment devices will be installed and used above ground level so that any leaks will be visible and accessible for repair. As outlined in "Drilling Procedure", blowout preventers will be pressure tested when installed; then pressure tested not less than once each week; and again pressure tested if any of the equipment is removed or if any seals are broken for any reason. The equipment will be tested for operating ability not less than once each day.

The warning device in use on this well will consist of a pit level alarm rigged to actuate both an audio and visual warning in event the level of fluids in the mud pits increases or decreases. The warning device will be located on the rig floor near the drillers station. In addition to mud level monitoring, mud temperatures will be monitored and recorded, which will also serve as a warning device as temperatures increase.

Blowout control drills for crew members will be conducted not less than once each week and will consist of two phases: acquainting every crew member with blowout prevention equipment and controls; and schooling drillers and tool pushers with kick control techniques and calculations. Kick control procedures and worksheets for calculations will be maintained on the rig floor at all times after drilling surface hole.

A blowout contingency plan in detail will also be placed in a conspicuous place near the rig floor and will concern actions to be taken after kick control procedures are begun. This plan will consist of three main thrusts; containment of well fluids, insulation of the public from danger and cleanup measures.

The reserve pit built on the well site will at all times be capable of handling several thousand barrels of well fluids in addition to drilling fluids discarded as normal operating procedure. If this pit should prove to be indadequate for fluid containment, additional earthen pits will be made to hold well fluids.

The access road to the well site will be equipped with signs warning the general public of possible danger and advising unauthorized personnel to stay away form the well site at all times. In the event a well kick occurs of high temperatures are encountered, the access road will be blockaded to further restrict visitors. If any fluids are being produced by the well, either water, steam or gas, the road will be blockaded and manned to prevent entry by the general public. In the event gas, oil or corrosive waters are produced by the well and are being airborne away from the well site and access road to other public roadways, these roadways will be blockaded and manned to warn the general public of danger.

In the even oil or corrosive water should be produced by this well, these fluids will be confined to the drill site and either transported to a disposal site or buried at the well site when the well site is restored.

Plugging and Abandonment Procedure

In the event this well does not produce high temperature water or steam, the following procedure will be followed:

1. Run drill pipe with 7 5/8" bit and clean out to 8500'

2. Run drill pipe with retainer, set retainer at 7900', fill hole section 7900' to 8500' with 190 sacks cement, pull out of retainer, spot 32 sacks cement in casing, filling casing from 7900' to 7800'. Wait on cement 8 hours, test plug by setting drill pipe weight of 15,000 pounds on top of plug.

3. Fill hole from 7800' to ground level with 9.5 pounds drilling mud.

4. Set 14 sack cement plug at 6' to 50'

5. Cut off 20", 16", and 8 5/8" casing 6' below ground level, weld on a steel plate 20" in diameter and fill cellar.

6. Restore the well site to the satisfactions of the Bureau of Land Management personnel.

B. 3. a. 1. iv. CONTINGENCY INJECTION WELLS

In the event proposer is successful in negotiating a contract for the drilling of three geothermal test wells, proposer will of necessity need to drill one or more injection wells in conjunction with provisions outlined in Section B. 3. b. 2. Proposer desires, during preliminary well testing, to dispose the produced geothermal fluids into earthen pits until such time as data assimilated under Section B. 3. b. 2 will ascertain the proper location and method to reinject the produced fluids. Any surface disposal will be done in a manner whereby minimal effects to the environment will be made.

Subject to the requirements as dictated by the above data, proposer would expect to renegotiate at that time for assistance in drilling any wells required to complete the testing and case study data under this proposal.

II. Sampling and Logging

Samples will be collected at least every 10 feet while drilling is in progress. Density and gamma-ray-neutron logs will be run. Acoustic, velocity, and resitivity logs may be done if the state-of-the-art indicates they are appropriate at that time. Standard drill stem testing, flow testing, and fluid chemistry will be done by University of Nevada personnel in conjunction with industry representatives as will lithologic logging.

A more detailed analysis of this work is presented in Sections B.3. b and c.

B. 3. b. Surface - Subsurface Investigations

The following described work to be performed under this section shall be done primarily by personnel of the University of Nevada-Reno in conjunction with and coordinated through industry representatives and consultants of the Southland-Millican venture.

Since an entire case study is proposed herein including drilling of test wells, the data to be acquired in this section extends to both surface and subsurface programs.

A multi-discipline approach will be utilized for the surface investigations related to the Dixie Valley geothermal reservoir assessment. The first stage of collection and evaluation of all available existing data will allow for the development of a dynamic model of the Dixie Valley system and will provide a frame-work for obtaining and integrating new data.

The second stage surface investigations will include: 1) re-evaluation of available aeromagnetic and magnetotelluric data, 2) Hydrology and hydrogeochemistry, 3) structural and tectonic analysis, 4) petrologic studies, 5) microseismicity studies, and 6) shallow-depth temperature surveys (less than five feet). Task descriptions for each of these evaluations are presented below, with time schedules presented in Section B. 4., and cost schedules presented in Section C. The purposes of the second stage of the surface investigations are to 1) refine the model of the Dixie Valley system in order to prove the optimum sites for the subsurface investigations (i.e., drilling) and 2) to evaluate the effectiveness of each surface investigative technique.

B. 3. b. 1. Aeromagnetic and Magnetotelluric Data

In the previous Section of "Program Data Offered" the need for a re-interpretation of the multi-level aeromagnetic data was outlined. Because of the critical nature of the interpretation it is proposed that the following program be conducted.

a) Re-interpretation of the aeromagnetic data by an independent source. It is proposed that this be done via the cooperative efforts of the staff of the University of Nevada and Mr. Noel Rasmussen, Consulting Geophysicist, Tulsa, Oklahoma. Mr. Rasmussen is highly qualified in this field, having spent many years with AMOCO Research as a geophysicist. (See Resume in Appendix)

b) Re-evaluation of the magnetotelluric data and alternative aeromagnetic interpretations, surface and subsurface geology to produce a tectonic model of Dixie Valley. This work would be done by a group composed of geologists and geophysicists from the Mackay Minerals Research Institute-UNR and the technical consultants to Southland Royalty Company and Millican Oil Company (Richard L. Jodry and Michael D. Campbell, respectively), with consultation with Senturion Sciences, Inc., Mr. Rasmussen, and selected staff members of the United States Geological Survey.

B. 3. b. 2.

This portion of the study will evaluate the hydrologic and hydrogeochemical parameters of Dixie Valley as they relate to the geothermal reservoir in the Valley. The first portion of the hydrologic study will focus on the western half of the Valley with the ultimate goal of supporting well-site selection and testing one or more geothermal wells. However, because of the nature of hydrogeologic systems, it will be necessary to study the entire hydrologic regime of Dixie Valley, although work will be designed to maximize information regarding the study area. The study may be expanded at a later date to include the eastern half of the Valley. Since the hydrology is intimately related to other aspects of the subsurface and surface environments, a substantial amount of interaction will occur with other concurrent investigations (seismology, geophysics and geology). Such close interaction will optimize the results of the study with concomitant drilling to ensure the development of a rational conceptual model of the geothermal resource.

(A good overview of the hydrology of Dixie Valley was provided by Cohen and Everett (1963)). One of the interesting features of Dixie Valley is its role as a major ground-water sink. It receives ground-water inflow from the six surrounding valleys (Fairview, Jersey, Pleasant, Eastgate, Cowkick and Stingaree Valleys). The seven valleys form a closed hydrologic unit, and it thus will be necessary to include a review of existing data on these valleys in hydrologic study of Dixie Valley.

Relevance:

The hydrologic and hydrogeochemical portion of this study will be directed toward understanding the hydrology of the study area as it relates to the geothermal reservoir. On a local scale, this portion will also serve to support well-site selection and testing, which, in turn, will provide additional data for the overall hydrologic-hydrochemical study and future well-site selection. The hydrology of the area is extremely important to the overall evaluation of the geothermal resources of the area. Healy (in Pearl, 1976) stated that the hydrologic conditions of a geothermal reservoir constitute the limiting factor governing the ultimate extraction of heat energy from the reservoir and the success of a proposed geothermal development. When the results of the hydrologic study are integrated with those of the seismic, geophysical and geological studies, and combined with drilling test data, a state-of-the art assessment of the extent and potential life of the geothermal reservoir will result.

The following hydrologic parameters will be considered in the proposed program of geothermal reservoir assessment: recharge rates and areas; storage and transmissive properties of the reservoir; ground-water flow rates and flow paths; ground-water chemistry; and the nature and locations of reservoir boundaries.

In evaluating recharge rates, the following factors will be considered: 1) the amount of fluid withdrawal, as excessive withdrawals could shorten the useful life of the system; 2) a wet-steam field could change to a dry-steam field; 3) declining temperatures and pressures could cause sealing (Bolton, 1972; Garrison, 1972); 4) if excessive withdrawals caused increased recharge, the cooler recharge water might diminish the heat content of the goethermal fluid (Pearl, 1976); 5) locations of subsurface recharge areas are locally important to determine flow paths of water from the recharge areas to points of discharge and the resultant changes in heat and dissolved material content as the water flows to the discharge area.

Storage and transmissive properties will also play a significant role in determining the rate and amount of fluid withdrawal, project lifetime and project size. Knowledge of ground-water flow directions and rates will be required to assess the extent of heat dilution and dispersal in the reservoir. Water chemistry and isotropic composition will provide a wealth of information regarding reservoir temperatures, extent of mixing and leakage in the system, fluid residence times and recharge rates and areas. The geo-chemistry of the ground-water will also be critical in evaluating the extent of plugging with changes in pressure and temperature as the reservoir is developed and the potential problems associated with fluid disposal. Estimates of the location and nature of reservoir boundaries will be required to aid in determining geothermal project size and lifetime as well as boundary effects during exploitation.

In addition, the hydrologic-hydrogeochemical study will identify some of the potential environmental problems associated with geothermal development. For example, the study will seek to identify regions where reinjection of spent geothermal fluids may be feasible. The hydrogeochemistry of the goethermal fluids obtained during well testing will also aid in assessing chemical problems arising from fluid reinjection. Knowledge of reservoir parameters will also be used to provide an evaluation of potential land subsidence problems which may be associated with extensive fluid withdrawals.

Objectives:

The hydrologic and hydrogeochemical portion of this study will be conducted in three overlapping phases (II through IV) although most of the work will be accomplished in Phase II (surface investigations). During this phase, work will involve the examination of existing data and the collection of additional information. The synthesis of Phase II hydrologic data along with the seismic, geophysical and geological data will support well-site selection and drilling (Phase III) and reservoir assessment and testing (Phase IV). Since these three phases overlap to some extent, data collected during each phase will provide support for the other two phases. Such an approach will produce a synergistic effect which will result in a more detailed assessment of the geothermal reservoir.

Some hydrologic and hydrogeochemical investigations will be conducted in Phases III and IV. These will consist largely of providing support for these phases and assisting in the interpretation and analyses of data. Close contact will be maintained with the well drilling (Phase III) and the reservoir assessment and testing (Phase IV) groups, since the tasks of these two groups are intimately related to the hydrology and hydrogeochemistry. For example, a substantial amount of work during Phase IV will consist of conducting and interpreting chemical and isotopic analyses of the goethermal fluid produced during the reservoir tests. These analyses will aid in determining the nature of the reservoir and potential development problems (e.g., sealing and encrustation).

Specific objectives of the hydrology-hydrogeochemical program for each phase are listed below.

Phase II: Surface Investigations (Estimated time frame 10/1/78 - 6/30/79)

1.) Determination of recharge rates and areas;
2.) Approximation of storage and transmissive properties of the valley alluvium;
3.) Delineation of ground-water flow rates and directions;
4.) Estimation of reservoir geometry (thickness, areal extent and nature of boundaries);
5.) Reservoir temperatures and water chemistry;
6.) Integration of data obtained from items 1.) through 5.) above with the results of other Phase II investigations and available Phase III and IV results to provide verification of future well sites, assess the geothermal resources of the study area, and briefly evaluate the environmental impact of geothermal development.

Phase III: Support for Well Drilling (Estimated time frame 1/1/79 - 8/31/79)

1.) Assist in the interpretation of geologic and geophysical logs with respect to the hydrologic and hydrogeochemical properties of the geothermal reservoir;

2.) Collection and analysis (where feasible) of fluid samples;

3.) Assist with drill-stem testing (if feasible) and analysis;

4.) Synthesis of drilling data with those of Phase II to verify future well sites.

Phase IV: Support for Reservoir Assessment and Testing
(Estimated time frame 4/1/79 - 3/31/80)

1.) Assist reservoir assessment group with testing of geothermal wells, data collection and analysis (determination of hydraulic conductivities, storage/leakage parameters, boundary effects, etc.);

2.) Collection and analysis of fluid chemistry data;

3.) Synthesis of data obtained in items 1.) and 2.) with existing Phase II and III data.

Research Procedures:

Phase II

Initial efforts will consist of examining existing hydrological and hydrogeochemical data on file with the Nevada Bureau of Mines and Geology, Desert Research Institute, U.S. Geological Survey, Nevada State Engineer's Office, other agencies and from literature. Field work will consist of measuring and sampling existing wells and springs. Vapor samples will be collected from fumaroles. On certain samples, selected trace element and isotopic analyses (H^2, H^3, C^{14}, C^{13}, O^{18}) will be performed. Temperature data will be collected from existing wells and springs and integrated with similar data from the ongoing spring monitoring project being conducted by Southland/Millican venture, and from the existing gradient holes in the study area. Aquifer test data (i.e., storage coefficients and transmissitivities) will be obtained from existing wells, where feasible. Quantitative estimates of aquifer properties will also be made from existing well-log and specific-capacity data. Sufficient data may also exist for flow-net analysis, which may provide some indication of aquifer parameters.

Substantial use will be made of the chemical and isotopic analyses of the water. Stable isotope data can provide information on recharge rates and areas, as can the radioisotope data. The latter will also assist in placing age limits on the ground-water samples, and the entire suite of isotope data may prove useful in constructing a simple aquifer flow model (Campana, 1975 and 1976). If such a model proves feasible, it can yield information on recharge rates and areas, flow paths and reservoir size and mixing properties. In addition, temperature and temperature gradient data may prove useful in ascertaining mixing properties of the reservoir. New and existing chemical data will be useful in developing the aforementioned flow models. (See Program Data Offered, Part II.) Chemical geothermometers such as the Ca-Na-K method and the silica method (Fournier and Truesdell, 1974 and 1975; Truesdell and Fournier, 1975) and any recent developments in these approaches will be applied to all suitable data. However, the validity of the results must be critically evaluated in light of the other temperature data and theoretical aspects of the subsurface conditions within this particular geological environment. It may be possible to derive independent mixing models with geothermometry and isotope data. If so, the two models should be cross-checked for validity.

Since test well drilling will commence three months after the start of Phase II, the first several months of Phase II will consist primarily of verifications of the site for the first well. Data from the first well will aid in site verification for the second well, and so on.

The last portion will consist of integrating all the new and existing hydrologic and hydrogeochemical data, and conducting some limited re-sampling. The results of the other studies will be assessed and based upon the entire assemblage of hydrologic, hydrogeochemical, seismic, geophysical, geological and test drilling information, additional drilling sites within Phase III will be verified and/or selected.

Phase III:

During the drilling of test wells, the hydrology-hydrogeochemistry group will assist in the interpretation of geologic and geophysical logs. The logs will provide estimates of the lithology and porosity of the material penetrated. If feasible, drill-stem tests will be conducted. These will provide information on hydraulic conductivities and vertical head (pressure) gradients. If possible, fluid samples will be collected and analyzed to provide further information on reservoir parameters and hydrogeochemistry and to assist in selecting additional well sites.

Phase IV:

Well and reservoir testing and assessment will occupy this phase of the study. Each of the wells drilled during Phase III will be tested. The hydrology-hydrogeochemistry group will assist the reservoir assessment and testing group with the conduction of the tests and analysis of the test data. Such close interaction will assure the development of a rational, coherent conceptual model consistent with information collected in earlier phases. In addition, fluid samples will be collected during the tests and analyzed for chemical and isotopic compositions. These analyses, and their interpretation, will provide further information on mixing effects and reservoir temperatures and configuration. They will also be useful in assessing potential difficulties arising from geothermal development (reservoir sealing, well corrosion/encrustation, reinjection problems, etc.).

Work Plan:

Phase II

Months 1 - 3

Examine existing data and begin field reconnaisance and data collection. Commence preliminary data analysis with immediate objective of verifying site for the first test well.

Months 4 - 6

Continue field investigations and data collection. Integrate data from drilling of first test well as it becomes available. Continue with data analysis. Verify site for second test well.

Months 7 - 8

Work up entire data assemblage and perform computer simulations as necessary. Integrate data from second test well as it becomes available. Conduct quick field checks and limited re-sampling (if required) to check for variations in water chemistry. Verify site for third test well.

Month 9

Interact with other project investigators to produce a coherent conceptual model of the geothermal reservoir in the study area, indicate favorable areas for additional wells, and provide a brief environmental impact assessment.

Phase III

Months 1 - 8

Monitor drilling progress on test wells 1, 2 and 3 (to be drilled sequentially). Assist in drill-stem test and log interpretations. If feasible, collect and analyze fluid samples. Assist in preliminary design of well tests.

Phase IV

Months 1 - 12

Assist in conducting well tests (to be done sequentially) on wells 1, 2 and 3. Collection and analysis of fluid samples from each test. Assist in the analysis of test results and determination of reservoir parameters.

References:

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Cohen, P., and D. E. Everett, 1963. A Brief Appraisal of the Ground-Water Hydrology of the Dixie-Fairview Valley Area, Nevada, State of Nevada Dept. of Conservation and Natural Resources, Ground-Water Resources and Reconnaissance Series Rpt. 23, 40 p.

Fournier, R. O., and A. H. Truesdell, 1973. An Empirical Na-K-Ca Geothermometer for Natural Waters, Geochim. Cosmochim. Acta, V. 37, pp. 1255 - 1275.

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Garrison, L. E., 1972. Geothermal Steam in the Geysers in Clear Lake Region, California, Geol. Soc. Amer. Bull., V. 83, N. 5, pp. 1449 - 1468.

Pearl, R. H., 1976. Hydrological Problems Associated with Developing Geothermal Energy Systems, Ground Water, V. 14, N. 3, pp. 128 - 137.

Truesdell, A. H., and R. O. Fournier, 1975. Calculation of Deep Reservoir Temperatures from Chemistry of Boiling Hot Springs of Mixed Origin, Proc. 2nd U. N. Sym. on Devel. of Geothermal Resources, San Francisco, California, 837 p.

B. 3. b. 3. Structural and Tectonic Analysis

The structural and tectonic analysis will be subdivided into two stages. The results of these studies will be integrated to develop a geologic model of Dixie Valley that incorporates the structural and tectonic data with respect to a geothermal system. The analysis is also designed to resolve the apparent conflict in interpretations between the multi-level aeromagnetic data and previous structural interpretations.

Stage 1, about three months duration, will involve collecting and evaluating all available existing geologic and geophysical data to determine the location and apparent nature of major faults and lineaments within the study area (Map 2, page 3A.) These data include existing fault and lineament maps, available landsat and manned-space imagery, and available high-altitude and detailed photography. Stage 1 studies will provide an independent evaluation of the tectonic setting and major structures of the Dixie Valley geothermal area, and will serve as a base for directing the detailed work of stage 2.

Stage 2, about six months duration, will involve the collection and evaluation of new data. Specific tasks will include completing low-sun angle aerial photographic coverage to provide a clear and detailed record of all topographic domains and enhance small-scale structural features, particularly fault scarps (Slemmons, 1969; Cluff and Slemmons, 1972; Clark, 1972; Walker and Trexler, 1977). This photography will provide a base for detailed (1:12,000 scale) field mapping of faults and deformed areas.

Surface thermal effects will be measured by time-lapse aerial photography of snow melting following winter snowfalls. This "snow-lapse" photography is not significiantly influenced by the interferences that strongly influence thermal infrared or near-infrared imagery.

Field mapping will emphasize delineation, determination of type and attitude of faults and a record of past slip directions. The frontal fault zone of the Stillwater Range will be mapped in detail to determine the nature and location of all Tertiary and late Cenozoic faults in the bedrock and adjoining alluvial areas. The bedrock areas will be studied in special detail to determine the character of the Bernice fault and to establish whether or not it has surface extensions in the alluviated areas to the east, as indicated by previous investigations (See Program Data Offered, Parts II and III).

The following is a detailed outline of the tasks to be completed in each stage of the structural and tectonic analysis.

Task 1: Evaluate existing imagery and remote sensing data and coordinate ordering of any additional, available imagery. Determine additional imagery and remote sensing data required and direct program for obtaining these data. Conduct aerial reconnaissance. Organize and direct any training necessary for research assistants.

Task 2: Organize and direct appropriate low-sun angle aerial missions for detailed black and white 1:12,000 scale aerial photographs of the valley floor to provide the base for detailed mapping of Quaternary surficial deposits and for detailed mapping of active faults.

Direct and assist in interpreting the results of basement fault mapping near the front of the Stillwater Range and along the basement exposures of the Bernice fault.

Assist in organizing and conducting field studies of the main sedimentary units of alluviated areas and field studies for mapping, determining the age, number and type of surface fault offsets along the main faults of Dixie Valley.

Task 3: Conduct preliminary field study of the basement rocks along the front of the range and across the Bernice fault. Study and compile all available literature and unpublished data on the basement rocks of the area.

Task 4: Map in detail and evaluate the structural mechanics for faulting in late Cenozoic time of faults near the eastern base of the Stillwater Range, and along the Bernice fault. Assist in determining the parameters that would assist in interpreting the various geophysical studies within the area. Prepare reports on results.

Task 5: Conduct a preliminary field study of the faults and stratigraphic units of the valley fill sediments. Review all imagery studies and prepare new analyses of available imagery on the area.

Task 6: Interpret the low-sun angle photographs, conduct detailed field studies of the faults within or projecting toward the field area. Prepare a detailed report on the stratigraphic units exposed on the valley floor. Assist in correlating the structural interpretations with the geophysical data. Prepare reports. Direct and assist in developing a model consistent with the structural and tectonic data as well as the petrologic alteration data. Prepare interim and final reports.

B. 3. b. 4. Petrologic Alteration Studies

The petrologic alteration studies will be completed in a two stage process. The first stage will involve the analysis of all subsurface samples available from thermal gradient drilling and representative samples of surface sediments. Stage 2 will involve detailed analyses of the subsurface samples, completing detailed mapping of and analysis of samples of the main stratigraphic units of the basin fill.

The available cuttings of all previously drilled holes within the study area will be examined mineralogically in order to determine the type of variation in mineralogy and lithology as a function of depth and to determine the nature and vertical and lateral extent of any alteration. The lithologic and mineralogic changes will be compared with the sediments presently being transported by and deposited along all major streams and in the playa sediments. The studies will include size analysis, light and heavy mineral separations, and x-ray diffraction and thermal analysis of the clay-size particles.

Integration of the petrologic-alteration studies with the structural and tectonic analysis will be focussed on determining the relative importance and character of the major faults and determining the lithologic and alteration variations as a function of location and depth of drilling and of the sedimentary source areas. A model will be generated that incorporates all petrologic-alteration data with the structural and tectonic analysis data.

The following is a detailed outline of the work to be completed during each stage of the petrologic-alteration study.

Task 1: Assemble a collection of drill cuttings for all drill holes on or near the study area. Prepare a detailed set of procedures for the study of subsurface samples. Conduct preliminary size analyses, binocular analyses, petrographic analyses and x-ray diffraction and differential thermal analyses of representative sample types. Investigate other possible methods of analyzing the samples in the most effective and efficient manner.

Task 2: Complete detailed analyses of size, textural, mineralogical and petrological variation in the samples from the drill holes. Prepare progress and final reports on the studies.

Task 3: Collect representative samples of surface sediments that show the lithologic and mineralogic character of the present sedimentary processes of the area. Review all existing data on the lithologic and mineralogic character of the present sedimentary processes of the area. Review all existing data on the lithologic character of the source areas.

Task 4: Complete a detailed mapping of the main stratigraphic units of the valley fill sediments and determine the main parameters of their petrologic and mineralogic variation.

Task 5: Assemble cuttings and samples for petrologic, mineralogic and alteration studies. Initiate studies of most appropriate x-ray diffraction, size analysis, and optical methods of evaluating the samples.

Organize and arrange for any necessary training of research assistants.

Task 6: Review the mineralogic and petrologic studies of the surface sediments derived from the Stillwater Range, and from the Spring Creek and Jersey Valley areas.

Assist in developing methods of analyzing the drill cuttings with emphasis on evaluating vertical changes and on determination of alteration effects on the original mineralogy. Special emphasis will be given to study of the most reactive original minerals (including the clay minerals and micas).

5. Microearthquake Survey

Microearthquake activity will be monitored in central Dixie Valley in the vicinity of the underlying gabbroic complex for a period of 90 days. This area lies between the 2 October 1915 Pleasant Valley M = 7.8 earthquake to the north and the M = 6.9, 16 December 1954 Dixie Valley earthquake to the south; both had extensive faulting. The seismic energy release in the area of interest is comparable to that of much of central Nevada (Ryall, 1977) and the suspected low seismicity in the area may be more illusory than real.

A trailer-mounted six-station array of vertical seismometers will be developed and will be recorded on magnetic tape and played back in the Seismological Laboratory for analysis which will include epicenters, depths, and focal mechanisms. These data will be correlated with existing geologic and geophysical data.

The primary purpose of the microearthquake studies is to provide the following:

1. Define fault zones in the project area that are seismically active. Previous studies in geothermal areas commonly define faults that define the geothermal structures. Microearthquake studies commonly define faults that are concealed by surface alluvial cones.
2. Provide the focal mechanisms and source; this is part of the earthquake activity, important in interpreting the regional stress orientation and the type of conjugate faulting at a site or area.
3. Determine any special seismic character to earthquake activity; some geothermal areas have characteristic seismic activity. The microearthquake studies will monitor any such characteristics.
4. Provide base line data on any local seismic activity in order to compare any possible deviations from future geothermal resource development activities.

B. 3. b. 6. Shallow-depth Temperature Survey

The purposes for utilizing a shallow-depth (1 meter) temperature survey in the Dixie Valley geothermal area are: 1) to delineate the near-surface hydrothermal discharge system, 2) to compare the near-surface hydrothermal discharge system with sub-surface data derived from temperature gradient holes, and 3) to test the validity of the shallow-depth temperature survey as a rapid and inexpensive geothermal exploration technique (Olmsted, 1977).

The absence of widely varying conditions, including geology, topography, depth to water and land use, and the presence of high temperature near-surface and surface heat flow areas, including fumaroles, hot springs and steam vents, indicate large lateral variations in temperature with "hot spots" having near-surface heat flows thousand of times greater than background levels. In addition, preliminary shallow depth (1 - 3 m) temperature profiles across faults have shown 3^{o} C, and as much as 18^{o} C, temperature differences across the fault. This suggests that the shallow depth temperature survey may be used to delineate faults and also fault bounded blocks which act as preferential heat flow conductors.

An estimated survey net of 200 stations will be used. Probe sites will be hand augered to a depth of 1 meter, cased with PVC pipe and capped to allow for repeated temperature surveys at the same stations over a six-month period. Surveys will be conducted at monthly intervals to determine the average annual temperature by synoptic measurements. This should minimize the effects of variations in convective heat transport by water vapor and air and by variations in the solar-air-earth heat budget.

The equilibrated temperature measured by a thermistor, the lithologic character and the moisture content of the soil will be recorded for each station at monthly intervals. The average annual temperature and fluctuations will be computed. These data will then be compared by computerized statistical reduction with temperatures at depth as recorded in temperature gradient holes. Results of the entire study will be compared with individual monthly surveys to evaluate the reliability of single survey data.

B. 3. c.

Reservoir Engineering Studies:

The budget for reservoir assessment has not been specifically contracted, however a proposed analysis with cost estimates has been received from the California State Lands Commission (CSLC). Due to the short time for proper evaluation between receipt of the CSLC proposal and the closing date of the RFP, the Proposer has not made a decision with regard to the CSLC as the sub-contractor to conduct the reservoir assessment program. However, Proposer feels the program described by CSLC is the type of program necessary for evaluation of a geothermal reservoir and the personnel of the Desert Research Institute's Water Resources Center of the University of Nevada also feel that such a program is compatable with their work on hydrology and hydrogeochemistry. Proposer is therefore including the CSLC proposal outline and experience for DOE consideration and discussion if it is determined that the Southland-Millican-University of Nevada Proposal is in the competitive range. It should be recognized, however, that the modifications of or additions to this proposal may be made before the time of contract negotiation.

As with the remainder of the proposed case study program, the industry representatives would work on an associated basis with the California Agency in the event a sub-contract is negotiated. The proposed cost figures for this analysis as outlined, and its reporting, are felt to be within a reasonable range based upon the estimates submitted by CSLC for accomplishing the studies contained in the following outline.

Outline of Proposed Reservoir Assessment Plan

By: California State Lands Commission

The economics of a geothermal operation depends on the type and nature of the resource (liquid dominated vs. vapor dominated), depth, reservoir deliverability, original reservoir pressure, location and type of the recharge system, salinity of the liquid, fracture pattern, and most importantly, the reservoir temperature. The above parameters should be determined in a systematic approach to minimize exploration cost and maximize reservoir description.

Wells should be logged at successive drilled intervals. The well logs should include a Dual-Induction Laterolog with SP, Gamma Ray-Neutron, FDC, Saraband, and a temperature survey. Additional logs such as conventional sonic as well as Micro-Seismograms (fracture finder) may be run if available and offered by the service company.

Carefully designed drill-stem tests at selected intervals (as determined by the well logs) should be conducted. Such test data is of vital importance in future planning of additional drill sites, identification of the resource type, and properties of the fluid.

While the drilling is in progress, the well logs should be interpreted and combined with results obtained from the DST. A plan for additional well tests upon the termination of drilling will be formulated. Specific well tests designed at this stage will include short and long term flow tests, pressure buildup and fall-off tests, and reservoir limit tests.

The above plan, when carefully designed and monitored, should and normally will enable one to estimate reserves, deliverability and productivity indices, and the possible existence of a natural recharge system. Because of the nature of geothermal reservoirs, however, the results obtained from one well should not be extrapolated to the entire field, especially if the hydraulic transmissivity is mainly controlled by fractures. Thus, it is recommended that the initial exploration plan include at least two more wells in carefully selected areas of the reservoir.

Well logs and tests similar to the ones described for the initial well should be run for subsequent wells. In addition, the existence of the three wells will enable us to conduct pulse and interference tests to evaluate an inter-well communication path for possible fluid injection programs. Pressure transient and interference test data on three wells will suffice to determine a relatively good estimate of reservoir extent and even perhaps reservoir shape, fracture orientation and impermeable barriers. Vertical pulse tests to estimate vertical permeability will also be considered.

Various exploitation schemes will be modeled using our 3-D geothermal simulator and the economics of each process will be determined.

California State Lands Commission
Geothermal Reservoir Experience

A- East Mesa

No. of Wells: 5

Objective: Reserves Evaluation and Deliverability Forecast

Data Available: Well Logs
DST on Most Wells
Flow Test on Two Wells
Temperature Surveys
Heat Flow Map

Methodology and Conclusions:

1. DST data were interpreted to estimate reservoir static pressure and formation transmissibility. Transmissibilities were compared to results obtained from Saraband logs. The validity of Saraband derived permeabilities were ruled out.

2. Net sand thicknesses for individual wells were obtained and contoured. The pore volume of the reservoir in the area of interest was determined using the isopach map, the heat flow map, and the porosity values from the Saraband log.

3. Based on a material balance study it was demonstrated that for straight production and with no pressure maintenance (by reinjection of the produced fluid) the producing life of the reservoir would be less than two years. It was demonstrated, however, that by water injection the economic life may be extended to more than thirty years. In this computation, based on in-situ heat capacity of the reservoir, it was shown that up to two pore volume of the fluid in place may be injected before the reservoir temperature would drop to unacceptable levels.

4. Salinities computed from resistivity logs and the analysis of produced water indicated that the concept of sudden pressure drop to create a vapor dominated system may not be a wise decision for the East Mesa field. Although our hypothetical model studies using

one and two dimensional systems indicate the heat recovery may be maximized by the above process.

5. Economic utilization of a geothermal resource depends heavily on the available temperature level, and the existing technology. At the time the study was done, temperatures in the range of 310° - 330° F were not economical. Therefore, no further action was taken at that time. Recently, however, both TRW and Republic Geothermal are both reconsidering the East Mesa reservoir.

   Lawrence Berkeley Laboratory has conducted many pressure transient tests to determine inter-well transmissibilities. Their results have confirmed our initial estimates from the DST analysis.

B - The Geysers Area, California

*(Because of the sensitive nature of the litigation and the fact that the decision made by Superior Court is still subject to appeal, and the confidentiality of the data, only some of the technical aspects of the reservoir study will be discussed here with no reference to specifics of conclusions.)

Objectives: Reservoir and Reserve Evaluation and Deliverability Forecast

Data Available: Pressure transient and some Flow Test; Static Pressure and temperature Surveys; Considerable Past Production Data; No Well Logs.

Methodology:

1. The well head recorded pressure transient test data were converted to bottomhole data by using a computer program utilizing static wellbore temperature surveys.

2. From the bottomhole data, and applying the conventional Horner plots (assuming radial flow), the pressure data were analyzed. It was noticed that the radial flow model may not be suitable for such data. Evidence from drilling and geological information led us to consider the flow regime to be of a semi-spherical rather

than radial system. The behavior of a semi-spherical flow system for a naturally fractured reservoir using the double-porosity model originally proposed by Warren and Root was mathematically modelled and solved both analytically and numerically.

3. From the sperical flow model, we were able to derive improved estimates of reservoir static pressure, fracture capacity, and an average spherical permeability.

4. Also, from the past production data, plots of P/Z vs. cumulative production were made. This information plus a limited amount of back pressure test data on few selected wells enabled us to make deliverability forecast on three distinct portions of the reservoir. A computer program to make the deliverability forecast was developed for this purpose.

   In the absence of well logs, the location of steam entry points compiled from drilling data were used to construct a 3-D peg model illustrating fracture pattern and distribution. Currently, this concept is being considered for modelling on our digital computer. The objective is to generate three dimensional description of fracture orientation and use the information for extrapolation to areas surrounding The Geysers.

5. The shut-in pressure data as they become available are continuously being received by our geothermal operations staff on the Geysers wells and used for updating the P/Z curves and monitoring the reservoir pressure.

6. Our past economic studies on the Geysers area mostly have consisted of estimates of future royalty income from the field and determination of risk weighted optimum bid bonuses on new areas offered for leasing. Computer program to conduct economic evaluation and forecasting and a specific statistical model to digest

past history of the field and make risk-weighted forecasts about the reserves of the unleased areas have been developed by our staff.

C - The Cerro Prieto Field, Baja, California

Objective: Well Log Interpretation

Data Available: The following logs are available on most wells:

a. IES for shallow depths

b. Dual-Induction Laterolog

c. Density Log

d. Neutron

e. Saraband

f. Micrology

In addition, static temperature surveys on some wells are available.

Methodology:

The interpretation of the well logs by our staff has just been started. Based on some preliminary work the following observations have been made:

1. Conventional empirical correlations used in the interpretation of well logs at low temperatures (such as those used in petroleum industry) may have shortcomings at temperature ranges existing in the Cerro Prieto area.

2. The logs indicate the presence of sand-shale series in the producing section of the reservoir. Salinity data are being interpreted to determine the flow path in vertical cross sections of the reservoir.

3. From the physical property measurements currently being made at elevated temperatures (under a separate contract with the U.S. D.O.E.) attempts are underway to interpret the log derived values using the newly developed correlation.

4. Using a novel technique developed by one of our staff members, the permeability profile in individual wells are being determined from well logs. The objective is to compare the results to transmissibility values available from well test data.

B. 4. Schedule

The proposed program is based on a multi-phase format, with the sequence and relationships between the various phases depicted on Project Flow Chart (See Chart 2, page 59A), and Estimated Timetable of Phases, (See Chart 3, page 59B). It is the intention of Proposers to make data available for release as soon as it is reasonably conceivable to gather, assimilate and report it, as concerns new data to be acquired. As stated previously in this proposal, all existing data is available for immediate release.

Chart 4, at page 59C shows the detail breakdown of the tasks to be undertaken by the University of Nevada in its case study with time sequence and decision points indicated.

Chart 5, at page 59D, shows a breakdown of the drilling phase indicating time sequence of three wells proposed and the contingent injection well and/or wells.

ESTIMATED TIMETABLE OF PHASES FROM CONTRACT DATE

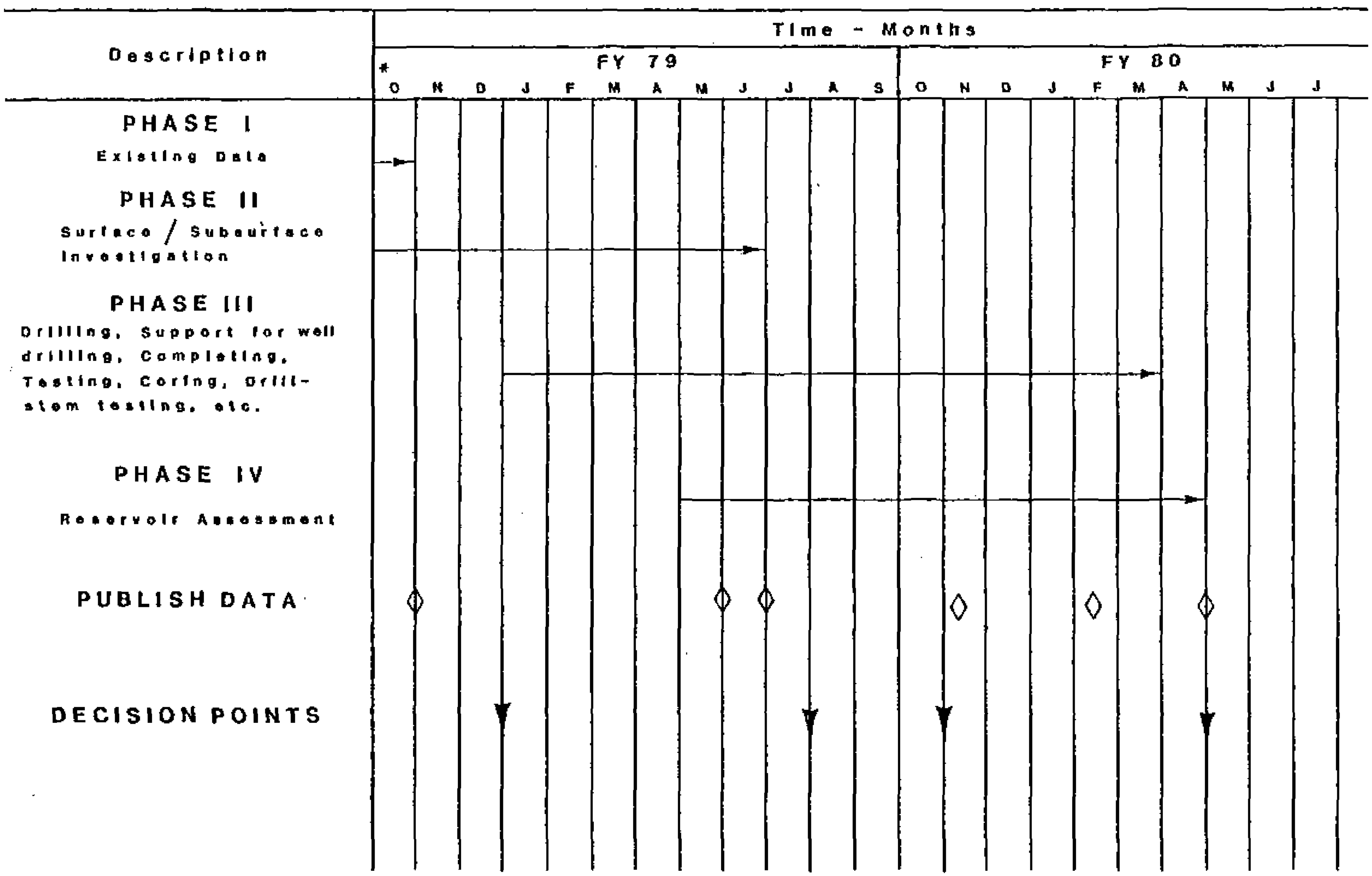


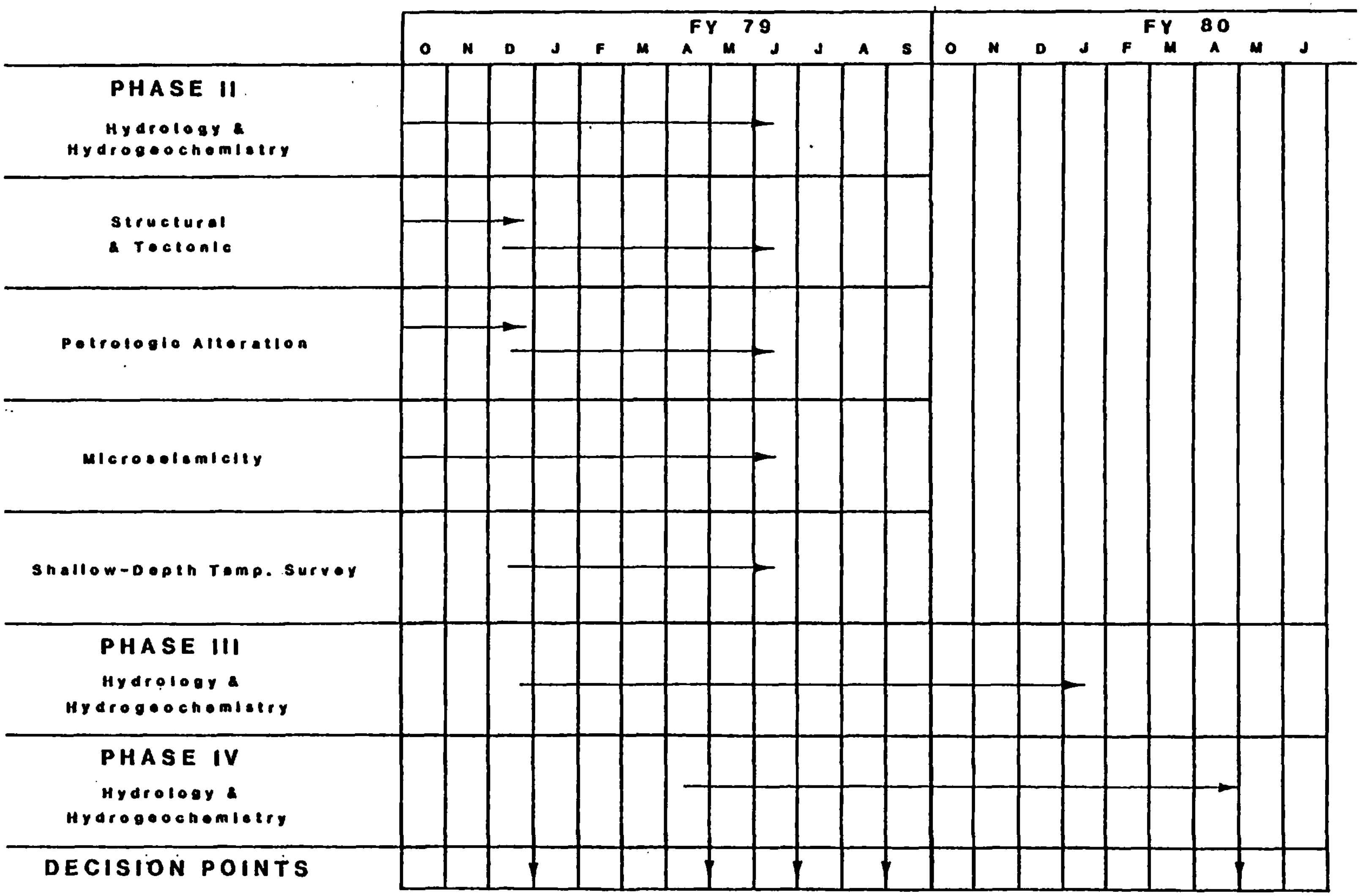
CHART 3

* Timetable Compiled on assumption of contract date of 1 Oct. 78

CHART 4

DETAIL SURFACE/SUBSURFACE INVESTIGATIONS

TIMETABLE (UNR CASE STUDY) PHASES II, III, IV



DETAIL DRILLING TIMETABLE (PHASE III)

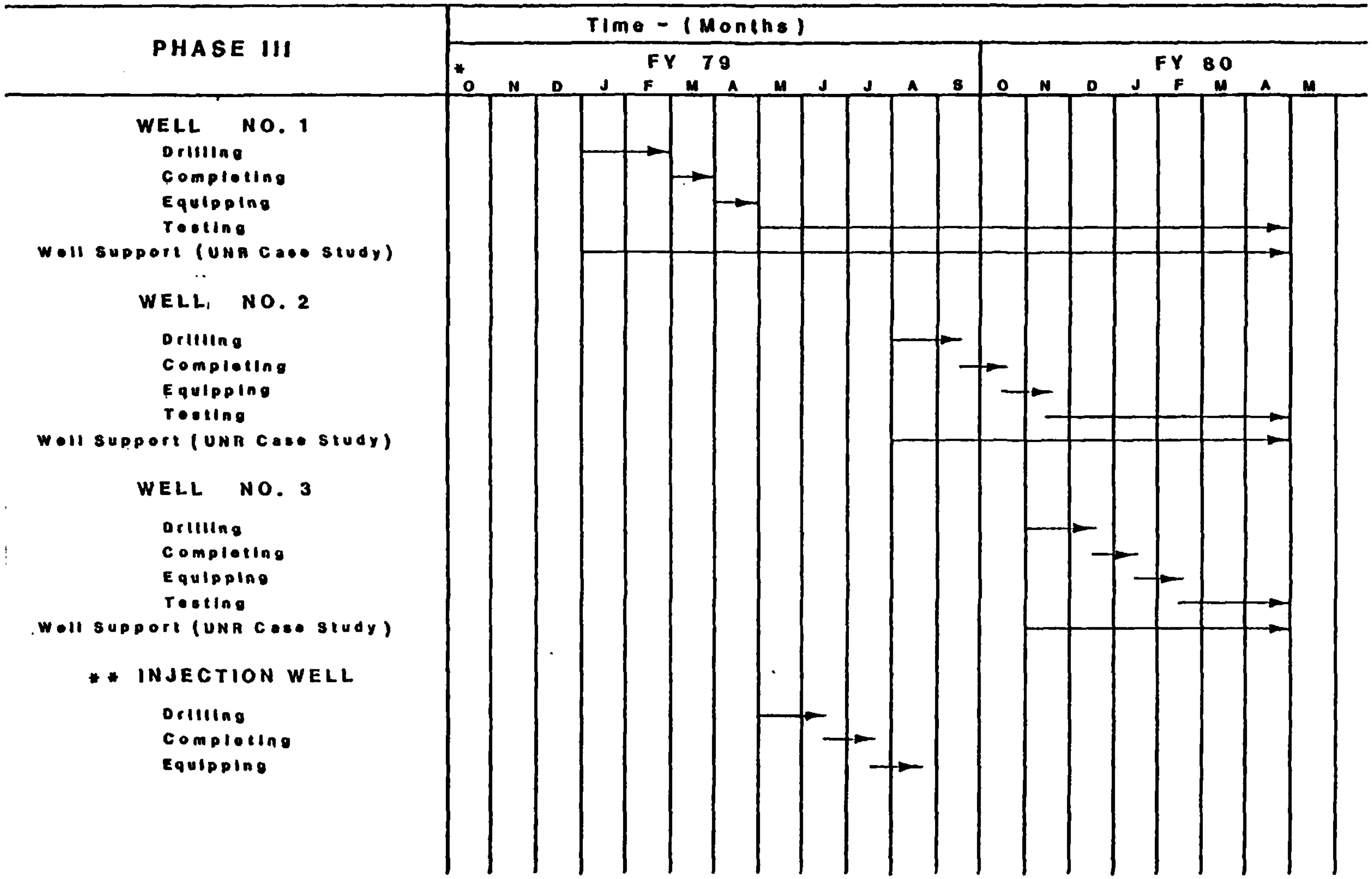


CHART 5

* Timetable Compiled on Assumption of Contract Date of 1 Oct.78

** Contingency See page 30, this Proposal

B. 5. ENVIRONMENTAL

Statement: The area of interest involved is located on Federal lands in an isolated, virtually uninhabited area of Nevada. There are no obvious affects environmentally on humans, wildlife, or vegetation. The activities proposed herein are accepted, non-environmentally significant procedures for exploration and any drilling of wells which is undertaken will be done in strict accordance with applicable permitting requirements of the Department of Interior. To date, the activity required to acquire the data offered in Section B-2 of this proposal, including actual drilling of wells up to a depth of 1500 ft., has been so approved and permits obtained.

Proposer will continue to comply with all applicable Federal, State and local standards with respect to control of all environmental consequences of any action undertaken pursuant to this proposal.

In specific response to the formal request herein by DOE in its Request for Proposal, Proposer states that there are no known or expected conflicts affecting environment which are apt to result from any endeavor hereunder. More detailed environmental impact statements will be filed as required before each proposed activity is undertaken. To date, there have been no adverse effects from Proposer's activities, with reference to areas outside the leasehold which are not covered by permits heretofore granted. Any surface data gathering and sampling occassioned by the persuit of activities proposed will be conducted by vehicle travel restricted as nearly as practicable to existing roads and trails with any disruption of surface terrain to be restored to its natural state.

C. COST

As stated in prior sections of this proposal it is submitted in phases so that each can be reflected as a separate cost item. Table 1, following page, shows the summary of all costs and the relative shares to be borne by government and industry. There then follows detailed Forms 60 which portray the work cost for each phase, along with summary Forms to facilitate cross-referencing to Table 1.

The total government cost proposed is $ 2,320,052., of which, $ 240,706. would be expended initially for acquisition of existing data, with the balance to be required in fiscal years 1979 and 1980.

Proposer believes it is significant to note that the drilling program represents 68.7% of the total amount of requested government participation, while another 13.4% would directly fund the overall case study program proposed by the University of Nevada.

SUMMARY OF

TOTAL PROGRAM COST

	ITEM COST AT 100%	GOVERNMENT PORTION $	%	%/TOTAL PROJECT
PHASE I. EXISTING DATA:				
A. MULTI-LEVEL AEROMAGNETIC SURVEY	$ 30,200	$ 20,113	66.6	
B. MAGNETOTELLURICS	12,200	6,100	50.0	
C. TEMPERATURE GRADIENT HOLES	214,224	142,673	66.6	
D. GEOTHERMEX REPORT	88,473	44,236	50.0	
E. KEPLINGER REPORT (INCLUDING MAPS)	62,918	12,584	20.0	
F. INSTRUMENTATION FOR MEASURING THERMAL GRADIENTS	15,000	15,000	100	
SUB-TOTAL, PHASE I	$ 423,015	$ 240,706	56.9	10.4
PHASE II. DATA TO BE GENERATED (UNR CASE STUDY):				
A. ADMINISTRATION	$ 31,373	$ 31,373	100	
B. HYDROLOGY AND HYDROGEOCHEMISTRY*	134,075	134,075	100	
C. STRUCTURE AND TECTONICS	42,404	42,404	100	
D. PETROLOGIC ALTERATION	31,794	31,794	100	
E. MICROSEISMICITY	58,913	58,913	100	
F. SHALLOW TEMPERATURE SURVEY	12,755	12,755	100	
SUB-TOTAL, PHASE II	$ 311,314	$ 311,314	100	13.4
PHASE III. DRILLING PROGRAM:				
~~THREE~~ TWO WELLS PROPOSED TO A DEPTH OF 8,500 FEET	$3,187,500	$1,593,750	50	
SUB-TOTAL, PHASE III	$3,187,500	$1,593,750	50	68.7
PHASE IV. WELL TESTING AND RESERVOIR EVALUATION:				
A. ESTIMATED SERVICES	$ 123,659	$ 123,659	100	
B. ESTIMATED EQUIPMENT	225,000	50,625	22.5	
SUB-TOTAL PHASE IV	$ 348,659	$ 174,282	49.9	7.5
TOTAL PROJECT PROPOSED	$4,270,486	$2,320,052		100%

*The University of Nevada case study extends through all Phases. However, for summarization purposes, total costs as proposed by the University are reflected here as Phase II, which is the time period during which a majority of the work will be done. The Forms 60 following, show the allocation of costs of the University Hydrology study to each phase.

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
1	2

NAME OF OFFEROR: Southland-Millican Cooperative Venture	SUPPLIES AND/OR SERVICES TO BE FURNISHED: Summary of Total Proposal Costs (Details by Project are Contained on Attached Forms.)
HOME OFFICE ADDRESS: 1000 Fort Worth Club Tower, Fort Worth, Texas 76102	
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED: N/A	TOTAL AMOUNT OF PROPOSAL: $ 2,320,052. — GOV'T SOLICITATION NO.: ET-78-R-08-0003

DETAIL DESCRIPTION OF COST ELEMENTS

	ESTIMATED HOURS	RATE/HOUR	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)*					
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 ($)		
a. TRANSPORTATION					
b. PER DIEM OR SUBSISTENCE					
TOTAL TRAVEL					
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
TOTAL CONSULTANTS					
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*				$2,320,052.	
10. *TOTAL DIRECT COST AND OVERHEAD*				$2,320,052.	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate % of cost element Nos.)*[3]				-0-	
12. ROYALTIES[4]				-0-	
13. *TOTAL ESTIMATED COST*				$2,320,052.	
14. FEE OR PROFIT				-0-	
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*				$2,320,052.	

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

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

RFP No. ET-78-R-08-0003 Summary of Total Proposal Costs (Details, by Project, are Contained on attached Forms.)

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
J. Jon Brumley President and C.E.O.	[signature]

NAME OF FIRM	DATE OF SUBMISSION
Southland Royalty Company	5-30-78

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST *($)*
9	A four-phase program is submitted. Attached as exhibits are the detailed breakdowns of actual costs and estimates. For purpose of facilitating government review, the attachments are furnished on Forms 60 by category. The "per phase" costs proposed are as follows:	
	Phase I: Existing Data Offered (2 schedules) $ 240,706	
	Phase II: University of Nevada Case Study (6 schedules) 311,314	
	Phase III: Drilling Program (1 schedule) 1,593,750	
	Phase IV: Well Testing and Reservoir Evaluation (1 schedule) 174,282	
	TOTAL	$ 2,320,052.

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)

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 2

NAME OF OFFEROR: Southland-Millican Cooperative Venture	SUPPLIES AND/OR SERVICES TO BE FURNISHED: Existing Geological and Geophysical Data
HOME OFFICE ADDRESS: 1000 Fort Worth Club Tower, Fort Worth, Texas 76102	
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED: N/A	TOTAL AMOUNT OF PROPOSAL: $225,706. — GOV'T SOLICITATION NO.: ET-78-R-08-0003

DETAIL DESCRIPTION OF COST ELEMENTS

1. DIRECT MATERIAL *(Itemize on Exhibit A)*			EST COST ($)	TOTAL EST COST[1]	REFERENCE[2]
a. PURCHASED PARTS					
b. SUBCONTRACTED ITEMS					
c. OTHER—(1) RAW MATERIAL					
(2) YOUR STANDARD COMMERCIAL ITEMS					
(3) INTERDIVISIONAL TRANSFERS *(At other than cost)*					
TOTAL DIRECT MATERIAL				-0-	
2. MATERIAL OVERHEAD[3] *(Rate %X$ base=)*					
3. DIRECT LABOR *(Specify)*	ESTIMATED HOURS	RATE/HOUR	EST COST ($)		
TOTAL DIRECT LABOR				-0-	
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)		
TOTAL LABOR OVERHEAD				-0-	
5. SPECIAL TESTING *(Including field work at Government installations)*			EST COST ($)		
TOTAL SPECIAL TESTING				-0-	
6. SPECIAL EQUIPMENT *(If direct charge) (Itemize on Exhibit A)*				-0-	
7. TRAVEL *(If direct charge) (Give details on attached Schedule)*			EST COST ($)		
a. TRANSPORTATION					
b. PER DIEM OR SUBSISTENCE					
TOTAL TRAVEL				-0-	
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
TOTAL CONSULTANTS				-0-	
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*			$	225,706.	
10. *TOTAL DIRECT COST AND OVERHEAD*			$	225,706.	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate % of cost element Nos.)*[3]				-0-	
12. ROYALTIES[4]				-0-	
13. *TOTAL ESTIMATED COST*			$	225,706.	
14. FEE OR PROFIT				-0-	
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*			$	225,706.	

1

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

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

RFP No. ET-78-R-08-0003: Geothermal Reservoir Assessment Case Study
Northern Basin and Range Province

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
Jere Denton Project Administrator	

NAME OF FIRM	DATE OF SUBMISSION
Southland Royalty Company	5-30-78

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST ($)
9	Based upon actual costs already incurred:	
	Multi-level Aeromagnetic Survey ($30,200 x66.6%)	20,113
	Magnetotellurics ($12,200 x 50%)	6,100
	GeothermEx Report ($88,473 x 50%)	44,236
	Keplinger Report ($62,918 x 20%)	12,584
	Estimated, based upon cost of drilling to date:	
	Temperature Gradient Holes	
	1500' = 5 @ $36,798 = $183,990	
	500' = 2 @ $15,117 = 30,234	
	$214,244 x 66.6%	142,673
	TOTAL	225,706

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)

2

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 2

NAME OF OFFEROR: Southland-Millican Cooperative Venture

HOME OFFICE ADDRESS: 1000 Fort Worth Club Tower, Fort Worth, Texas 76102

SUPPLIES AND/OR SERVICES TO BE FURNISHED: Geothermal Well Temperature Logging Instrument System (Prototype)

DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED: Enviro-Labs, Inc. Glendale, California

TOTAL AMOUNT OF PROPOSAL: $ 15,000

GOV'T SOLICITATION NO.: ET-78-R-08-0003

DETAIL DESCRIPTION OF COST ELEMENTS

	EST COST ($)	TOTAL EST COST[1]	REFERENCE[2]
1. DIRECT MATERIAL *(Itemize on Exhibit A)*			
a. PURCHASED PARTS			
b. SUBCONTRACTED ITEMS	15,000		
c. OTHER—(1) RAW MATERIAL			
(2) YOUR STANDARD COMMERCIAL ITEMS			
(3) INTERDIVISIONAL TRANSFERS *(At other than cost)*			
TOTAL DIRECT MATERIAL		15,000	
2. MATERIAL OVERHEAD[3] *(Rate %X$ base =)*			

3. DIRECT LABOR *(Specify)*	ESTIMATED HOURS	RATE/HOUR	EST COST ($)	TOTAL EST COST	REFERENCE
TOTAL DIRECT LABOR				-0-	

4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)	TOTAL EST COST	REFERENCE
TOTAL LABOR OVERHEAD				-0-	

	EST COST ($)	TOTAL EST COST	REFERENCE
5. SPECIAL TESTING *(Including field work at Government installations)*			
TOTAL SPECIAL TESTING		-0-	
6. SPECIAL EQUIPMENT *(If direct charge) (Itemize on Exhibit A)*		-0-	
7. TRAVEL *(If direct charge) (Give details on attached Schedule)*			
a. TRANSPORTATION			
b. PER DIEM OR SUBSISTENCE			
TOTAL TRAVEL		-0-	
8. CONSULTANTS *(Identify—purpose—rate)*			
TOTAL CONSULTANTS		-0-	
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*		-0-	
10. *TOTAL DIRECT COST AND OVERHEAD*		15,000	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate % of cost element Nos.)*[3]		-0-	
12. ROYALTIES[4]		-0-	
13. *TOTAL ESTIMATED COST*		15,000	
14. FEE OR PROFIT		-0-	
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*		15,000	

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

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

RFP No. ET-78-R-08-0003: Geothermal Well Temperature Logging Instrument System (Prototype)

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
Jere Denton Project Administrator	

NAME OF FIRM	DATE OF SUBMISSION
Southland Royalty Company	5-30-78

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST *($)*
1 b.	If a contract is entered, Proposer has negotiated with Enviro-Labs, Inc. to complete testing of a system design for gradient logging. A written proposal has been received from Enviro-Labs who would install the device and test it on a sub-contract basis. The estimated costs are:	
	Engineering $ 10,000	
	Field Testing 5,000	
	TOTAL	$15,000

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)

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 2

NAME OF OFFEROR Southland-Millican Cooperative Venture	SUPPLIES AND/OR SERVICES TO BE FURNISHED Summary: Geothermal Reservoir Assessment Case Study by Mackay School of Mines, Mineral Research Institute, University of Nevada	
HOME OFFICE ADDRESS 1000 Fort Worth Club Tower Fort Worth, Texas 76102		
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED N/A	TOTAL AMOUNT OF PROPOSAL $ 311,314	GOV'T SOLICITATION NO. 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=)*				-0-	
3. DIRECT LABOR *(Specify)*	ESTIMATED HOURS	RATE/HOUR	EST COST ($)		
TOTAL DIRECT LABOR				-0-	
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)		
TOTAL LABOR OVERHEAD				-0-	
5. SPECIAL TESTING *(Including field work at Government installations)*			EST COST ($)		
TOTAL SPECIAL TESTING				-0-	
6. SPECIAL EQUIPMENT *(If direct charge) (Itemize on Exhibit A)*					
7. TRAVEL *(If direct charge) (Give details on attached Schedule)*			EST COST ($)		
a. TRANSPORTATION					
b. PER DIEM OR SUBSISTENCE					
TOTAL TRAVEL				-0-	
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
TOTAL CONSULTANTS				-0-	
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*				311,314	
10. *TOTAL DIRECT COST AND OVERHEAD*				311,314	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate % of cost element Nos.)*[3]				-0-	
12. ROYALTIES[4]				-0-	
13. *TOTAL ESTIMATED COST*				311,314	
14. FEE OR PROFIT				-0-	
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*				311,314	

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

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

RFP NO: ET-78-R-08-0003: Summary: Geothermal Reservoir Assessment Case Study by Mackay School of Mines, Mineral Research Institute, U. of NV

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
Jere Denton Project Administrator	

NAME OF FIRM	DATE OF SUBMISSION
Southland Royalty Company	5-30-78

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST ($)
9	Proposer has associated the University of Nevada to perform a complete case study in conjunction with the drilling program also proposed herein. Detailed Forms 60 have been received from the University personnel and are attached for explanation.	
	As indicated on this Form 60, no profit or fee is included to Proposer from any of these funds, therefore the total request from the University, by category is:	
	Administrator $ 31,373	
	Hydrology and Hydrochemistry 134,075	
	Structure and Tectonics 42,404	
	Petrologic Alteration 31,794	
	Microseismicity 58,913	
	Shall Temperature Survey 12,755	
	TOTAL	$311,314

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)

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 1

NAME OF OFFEROR: Mackay Minerals Research Institute

HOME OFFICE ADDRESS:

SUPPLIES AND/OR SERVICES TO BE FURNISHED: Administration

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

TOTAL AMOUNT OF PROPOSAL: $ 31,373

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 ($)		
Program Administrator -L.T. Larson	348	19.79	6,886		
Program Administrator - E. J. Bell	174	10.38	1,806		
Secretary - TBN	1044	4.15	4,333		
Graduate Research Asst. - TBN	1044	6.00	6,264		
TOTAL DIRECT LABOR				19,289	
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)		
All of 3 less GRA	12%	13,025	1,563		
Graduate Research Assistant	1%	6,264	63		
TOTAL LABOR OVERHEAD				1,626	
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)*					
10. *TOTAL DIRECT COST AND OVERHEAD*				20,915	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate 50 % of cost element Nos. 3 & 4)*[3]				10,458	
12. ROYALTIES[4]					
13. *TOTAL ESTIMATED COST*				31,373	
14. FEE OR PROFIT					
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*				31,373	

1

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

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 2

NAME OF OFFEROR: Desert Research Institute	SUPPLIES AND/OR SERVICES TO BE FURNISHED: Phase II - Surface Investigation Hydrology and Hydrogeochemistry (10/1/78 - 6/30/79)
HOME OFFICE ADDRESS: P. O. Box 60220 Reno, Nevada 89506	
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED: Water REsources Center	TOTAL AMOUNT OF PROPOSAL: $ 63,210 — GOV'T SOLICITATION NO.:

DETAIL DESCRIPTION OF COST ELEMENTS

Item			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 ($)		
Hydrogeologist, M. Campana	540	10.10	5454		
Hydrogeochemist, R. Jacobson	550	11.00	6050		
Graduate Research Fellow, TBN	865	4.55	3936		
Clerical, TBN	350	4.75	1733		
TOTAL DIRECT LABOR				17,173	
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)		
All of 3 Less Graduate Research Fellow	22.1%	13,237	2925		
Graduate Research Fellow	1.0%	3,936	39		
TOTAL LABOR OVERHEAD				2,964	
5. SPECIAL TESTING *(Including field work at Government installations)*			EST COST ($)		
TOTAL SPECIAL TESTING				-0-	
6. SPECIAL EQUIPMENT *(If direct charge) (Itemize on Exhibit A)*				3,000	
7. TRAVEL *(If direct charge) (Give details on attached Schedule)*			EST COST ($)		
a. TRANSPORTATION			1,250		
b. PER DIEM OR SUBSISTENCE			2,400		
TOTAL TRAVEL				3,650	
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
TOTAL CONSULTANTS				-0-	
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*				23,740	
10. *TOTAL DIRECT COST AND OVERHEAD*				50,527	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate 63 % of cost element Nos. 3 & 4)*				12,683	
12. ROYALTIES[4]				-0-	
13. *TOTAL ESTIMATED COST*				63,210	
14. FEE OR PROFIT				-0-	
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*				63,210	

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

This proposal is submitted for use in connection with and in response to *(Describe RFP, etc.)*
Hydrology and Hydrogeochemistry-Phase II-Surface Investigations

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

NAME OF FIRM	DATE OF SUBMISSION
Water Resources Center - DRI	

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST ($)
7a	Project Mileage, 5000 mi. @ .25/mi.	1250
7b	Per Diem, 80 days @ $30/day	2400
6	Conductivity Bridge and Probes	
	(Beckman RC-19 or equivalent)	3000
9	ADP, CDC 6400 (8 hrs @ $360/hr.)	3240
9	Tritium Analyses, 100 @ $20/each	2000
9	Deuterium Analyses, 30 @ $100/each	3000
9	Oxygen-18, 30 @ $50/each	1500
9	Carbon-14 and C^{13}/C^{12}, 30 @ $200/each	6000
9	Selected Trace Elements, 30 @ $50/each	1500
9	Expendable Materials and Supplies	2500
9	Xerox and Communications	400
9	Chemical Analyses, 100 @ $36/each	3600

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)

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 2

NAME OF OFFEROR: Desert Research Institute	SUPPLIES AND/OR SERVICES TO BE FURNISHED: Phase III - Hydrologic and Hydrogeochemical Support for Well Drilling (1/1/79 - 8/31/79)
HOME OFFICE ADDRESS: P. O. Box 60220, Reno, Nevada 89506	
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED: Water Resources Center	TOTAL AMOUNT OF PROPOSAL: $ 9,153 — GOV'T SOLICITATION NO.:

DETAIL DESCRIPTION OF COST ELEMENTS

1. DIRECT MATERIAL *(Itemize on Exhibit A)*			EST COST ($)	TOTAL EST COST[1]	REFERENCE[2]
a. PURCHASED PARTS					
b. SUBCONTRACTED ITEMS					
c. OTHER—(1) RAW MATERIAL					
(2) YOUR STANDARD COMMERCIAL ITEMS					
(3) INTERDIVISIONAL TRANSFERS *(At other than cost)*					
TOTAL DIRECT MATERIAL					
2. MATERIAL OVERHEAD[3] *(Rate %X$ base=)*					
3. DIRECT LABOR *(Specify)*	ESTIMATED HOURS	RATE/HOUR	EST COST ($)		
Hydrogeologist, M. Campana	160	11.18	1,789		
Hydrogeochemist, R. Jacobson	160	12.18	1,949		
Clerical, TBN	40	5.30	220		
TOTAL DIRECT LABOR				3,958	
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE=	EST COST ($)		
All of 3	22.1%	3,958	875		
TOTAL LABOR OVERHEAD				875	
5. SPECIAL TESTING *(Including field work at Government installations)*			EST COST ($)		
TOTAL SPECIAL TESTING				-0-	
6. SPECIAL EQUIPMENT *(If direct charge) (Itemize on Exhibit A)*				-0-	
7. TRAVEL *(If direct charge) (Give details on attached Schedule)*			EST COST ($)		
a. TRANSPORTATION			375		
b. PER DIEM OR SUBSISTENCE			300		
TOTAL TRAVEL				675	
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
TOTAL CONSULTANTS				-0-	
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*				600	
10. *TOTAL DIRECT COST AND OVERHEAD*				6,108	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate 63 % of cost element Nos. 3 & 4)*[3]				3,045	
12. ROYALTIES[4]				-0-	
13. *TOTAL ESTIMATED COST*				9,153	
14. FEE OR PROFIT				-0-	
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*				9,153	

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.)*

Hydrologic and Hydrogeochemical Support for Phase III

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

NAME OF FIRM	DATE OF SUBMISSION
DRI-Water Resources Center	

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST *($)*
7a	Project Mileage, 1500 mi. @ 0.25/mi.	375
7b	Per Diem, 10 days @ $30/day	300
9	Xerox and Communications	100
9	Expendable Materials and Supplies	500

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)

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 2

NAME OF OFFEROR	SUPPLIES AND/OR SERVICES TO BE FURNISHED
Desert Research Institute	Hydrology and Hydrogeochemistry Support for Phase IV (4/1/79 - 3/31/80)
HOME OFFICE ADDRESS: P. O. Box 60220, Reno, Nevada 89506	
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED: Water Resources Center	TOTAL AMOUNT OF PROPOSAL: $ 61,712 — GOV'T SOLICITATION NO.:

DETAIL DESCRIPTION OF COST ELEMENTS

	ESTIMATED HOURS	RATE/HOUR	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)					
Hydrogeologist, M. Campana	540	11.18	6,037		
Hydrogeochemist, R. Jacobson	530	12.18	6,455		
Graduate Research Fellow, TBN	865	5.06	4,377		
Clerical, TBN	320	5.50	1,760		
TOTAL DIRECT LABOR				18,629	
4. LABOR OVERHEAD (Specify Department or Cost Center)[3]	O.H. RATE	X BASE =	EST COST ($)		
All of 3 less Grad. Research Fellow	22.1%	14,252	3,150		
Graduate Research Fellow	1.0%	4,377	44		
TOTAL LABOR OVERHEAD				3,194	
5. SPECIAL TESTING (Including field work at Government installations)			EST COST ($)		
TOTAL SPECIAL TESTING				-0-	
6. SPECIAL EQUIPMENT (If direct charge) (Itemize on Exhibit A)				-0-	
7. TRAVEL (If direct charge) (Give details on attached Schedule)			EST COST ($)		
a. TRANSPORTATION			1,500		
b. PER DIEM OR SUBSISTENCE			3,000		
TOTAL TRAVEL				4,500	
8. CONSULTANTS (Identify—purpose—rate)			EST COST ($)		
TOTAL CONSULTANTS				-0-	
9. OTHER DIRECT COSTS (Itemize on Exhibit A)				21,640	
10. TOTAL DIRECT COST AND OVERHEAD				47,963	
11. GENERAL AND ADMINISTRATIVE EXPENSE (Rate 63% of cost element Nos. 3 & 4)[3]				13,749	
12. ROYALTIES[4]				-0-	
13. TOTAL ESTIMATED COST				61,712	
14. FEE OR PROFIT				-0-	
15. TOTAL ESTIMATED COST AND FEE OR PROFIT				61,712	

1

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

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

Phase IV - Hydrologic and Hydrogeochemical Support

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

NAME OF FIRM	DATE OF SUBMISSION
WRC-DRI	

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST ($)
7a	Project Mileage, 6000 mi. @ .25/mi.	1500
7b	Per Diem, 100 days @ $30/day	3000
9	ADP, 6 hrs. CDC 6400 @ $360/hr.	2160
9	Chemical Analyses, 80 @ $36/each	2880
9	Tritum Analyses, 80 @ $20/each	1600
9	Deuterium Analyses, 30 @ $100/each	3000
9	Oxygen-18 Analyses, 30 @ $50/each	1500
9	Selected Trace Elements, 30 @ $50/each	1500
9	Carbon-14 and C^{13}/C^{12}, 30 @ $200/each	6000
9	Expendable Materials and Supplies	2500
9	Xerox and Communications	500

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)

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 2

NAME OF OFFEROR	SUPPLIES AND/OR SERVICES TO BE FURNISHED
Mackay Minerals Research Institute	Structural and Tectonic Analysis
HOME OFFICE ADDRESS	
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED	TOTAL AMOUNT OF PROPOSAL $ 42,404
	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 ($)		
Geologist - E. J. Bell	348	10.38	3,612		
Geologist - D. B. Slemmons	174	22.47	3,910		
Graduate Research Asst. (I) - TBN	520	6.00	3,120		
Graduate Research Asst. (II) - TBN	520	6.00	3,120		
TOTAL DIRECT LABOR				13,762	
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)		
All of 3 less GRA	12%	7,522	903		
Graduate Research Asst.	1%	6,240	62		
TOTAL LABOR OVERHEAD				965	
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			5,625		
b. PER DIEM OR SUBSISTENCE			2,858		
TOTAL TRAVEL				8,483	
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
TOTAL CONSULTANTS					
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*				11,830	
10. *TOTAL DIRECT COST AND OVERHEAD*				35,040	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate 50 % of cost element Nos. 3 & 4)*[3]				7,364	
12. ROYALTIES[4]					
13. *TOTAL ESTIMATED COST*				42,404	
14. FEE OR PROFIT					
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*				42,404	

1

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

NAME OF FIRM	DATE OF SUBMISSION

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST ($)
7a	Rental Cessna 206 for Aerial Reconnaissance 25 hrs. @ $65/hr.	1625
7a	4 WD for field work - 60 days @ $10/day & .20/mi. for 200	
	mi./day	3000
7a	Air transportation to attend regional & national meeting	
	to present papers	1000
7b	90 man-days per diem for field work @ $30 per day	2700
7b	5 days per diem to attend meetings at $31.50/day	158
9	Landsat imagery & computer enhancement	2000
9	Low-sun-angle photography (1:12,000)-300 photos @ $15/each	4500
9	Snow-lapse photography (1:24,000)-150 photos @ $15/each	2250
9	Xerox, Graphic arts	1000
9	Communications	500
9	Expendable Materials and Supplies	500
9	3 hrs. CDC 6400 @ $360/hr.	1080

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)

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 2

NAME OF OFFEROR: Mackay Minerals Research Institute	SUPPLIES AND/OR SERVICES TO BE FURNISHED: Petrologic Alteration Studies
HOME OFFICE ADDRESS:	
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED:	TOTAL AMOUNT OF PROPOSAL: $ 31,794 — 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 ($)		
Geologist - D. B. Slemmons	174	22.47	3,910		
Geologist - E. J. Bell	174	10.38	1,800		
Graduate Research Asst. - TBN	520	6.00	3,120		
Graduate Research Asst. - TBN	520	6.00	3,120		
TOTAL DIRECT LABOR				11,956	
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)		
All of 3 less Graduate Research Asst.	12%	5,716	686		
Graduate Research Asst.	1%	6,240	62		
TOTAL LABOR OVERHEAD				748	
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			2,500		
b. PER DIEM OR SUBSISTENCE			1,358		
TOTAL TRAVEL				3,858	
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
TOTAL CONSULTANTS					
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*				8,880	
10. *TOTAL DIRECT COST AND OVERHEAD*				25,442	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate 50 % of cost element Nos. 3 & 4)*[3]				6,352	
12. ROYALTIES[4]					
13. *TOTAL ESTIMATED COST*				31,794	
14. FEE OR PROFIT					
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*				31,794	

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

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

Petrologic Alteration Studies

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

NAME OF FIRM	DATE OF SUBMISSION

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST ($)
7a	4 WD vehicle for field work for 30 days @ $10/day and	
	.20/mi. for 200 mi./day	1500
7a	Air transportation to attend regional and national meetings	
	to present papers	1000
7b	40 man-days field work at $30/day	1200
7b	5 days @ $31.50/day for attending meetings	158
9	600 thin sections at $3/each	1800
9	K-Ar dating, 5 @ $300/each	1500
9	C-14 dating, 10 @ $150/each	1500
9	Expendable Materials and Supplies	500
9	Communications	500
9	Xerox, Graphic Arts	1000
9	X-ray diffraction 100 hours @ $10/hour	1000
9	3 hours CDC 6400 @ $360/hour	1080

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)

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 2

NAME OF OFFEROR: Mackay Minerals Research Institute

HOME OFFICE ADDRESS:

SUPPLIES AND/OR SERVICES TO BE FURNISHED: Microseismic Study

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

TOTAL AMOUNT OF PROPOSAL: $ 58,913

GOV'T SOLICITATION NO.:

DETAIL DESCRIPTION OF COST ELEMENTS

Item			EST COST ($)	TOTAL EST COST[1]	REFERENCE[2]
1. DIRECT MATERIAL *(Itemize on Exhibit A)*					
a. PURCHASED PARTS					
b. SUBCONTRACTED ITEMS					
c. OTHER—(1) RAW MATERIAL					
(2) YOUR STANDARD COMMERCIAL ITEMS					
(3) INTERDIVISIONAL TRANSFERS *(At other than cost)*					
TOTAL DIRECT MATERIAL					
2. MATERIAL OVERHEAD[1] *(Rate %X$ base=)*					
3. DIRECT LABOR *(Specify)*	ESTIMATED HOURS	RATE/HOUR	EST COST ($)		
Seismologist, J. D. VanWormer	348	11.20	3,898		
Technician, A. Wilson	696	6.67	4,642		
Programmer, L. Butcher	348	7.49	2,607		
Design Technician, W. Nicks	174	10.55	1,836		
Record Analyst, G. Smith	174	6.37	1,108		
Graduate Research Fellow - TBN	1305	6.00	7,830		
TOTAL DIRECT LABOR				21,921	
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[1]	O.H. RATE	X BASE =	EST COST ($)		
All of 3 less GRF	12%	13,771	1,691		
Graduate Research Fellow	1%	7,830	78		
TOTAL LABOR OVERHEAD				1,769	
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			1,970		
b. PER DIEM OR SUBSISTENCE			1,358		
TOTAL TRAVEL				3,328	
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
TOTAL CONSULTANTS					
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*				20,050	
10. *TOTAL DIRECT COST AND OVERHEAD*				47,068	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate 50 % of cost element Nos. 3 & 4)*[1]				11,845	
12. ROYALTIES[4]					
13. *TOTAL ESTIMATED COST*				58,913	
14. FEE OR PROFIT					
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*				58,913	

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.)*

Microseismic Study

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

NAME OF FIRM	DATE OF SUBMISSION

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST ($)
7a	To install, maintain and remove stations - 4 WD vehicle -	
	8000 mi. @ $.20/mi. and $80/ month	1920
7a	To Fall AGU meeting (San Francisco) to present paper on	
	study - $50 for University car	50
7b	40 man-days per diem field work @ $30/day	1200
7b	5 days per diem for AGU meeting @ $31.50/day	158
9	2 hours CDC 6400 @ $360/hour	720
9	Key punching and plotting	280
9	6 component trailer field system - 3 mo. @ $4000/mo.	12000
9	Laboratory playback facilities - 3 mo. @ $1000/mo.	3000
9	40 Air cell batteries @ $35/each	1400
9	24 Lead acid @ $50/each	1200
9	9 magnetic field tapes @ $50/each	450
9	10 digital computer tapes @ $50/each	500
9	Expendable materials and supplies	200
9	Xerox and Communications	300

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)

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 2

NAME OF OFFEROR: Mackay Minerals Research Institute

SUPPLIES AND/OR SERVICES TO BE FURNISHED: Shallow-Temperature Survey

HOME OFFICE ADDRESS: University of Nevada-Reno, Reno, Nevada 89557

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

TOTAL AMOUNT OF PROPOSAL: $ 12,755

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 ($)		
Geologist, Elaine J. Bell	174	10.38	1,806		
Graduate Research Assistant-TBN	520	6.00	3,120		
TOTAL DIRECT LABOR				4,926	
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)		
All of 3, less GRA	12%	1,806	217		
Graduate Research Asst.	1%	3,120	31		
TOTAL LABOR OVERHEAD				248	
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			1,500		
b. PER DIEM OR SUBSISTENCE			1,050		
TOTAL TRAVEL				2,550	
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
TOTAL CONSULTANTS					
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*				2,444	
10. *TOTAL DIRECT COST AND OVERHEAD*				10,168	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate 50 % of cost element Nos. 3 & 4)*[3]				2,587	
12. ROYALTIES[4]					
13. *TOTAL ESTIMATED COST*				12,755	
14. FEE OR PROFIT					
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*				12,755	

1

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.)*

DOE RFP NO. ET-78-R-08-0003 Shallow Temperature Survey

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

NAME OF FIRM	DATE OF SUBMISSION

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST ($)
7a	4 WD vehicle @ $10/day and .20/mi for 30 days and 200 mi./day	1500
7b	35 days @ $30/day	1050
9	Auger rental 15 days @ $35/day	525
9	708 ft. PVC 2" diameter casing @ .17/ft.	119
9	Thermistor rental 20 days @ $20/day	400
9	Key punching, plotting	280
9	2 hrs. CDC 6400 @ $360/hour	720
9	Expendable materials and supplies	100
9	Communications	150
9	Xerox, Graphic Arts	150

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)

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 2

NAME OF OFFEROR: Southland-Millican Cooperative Venture

HOME OFFICE ADDRESS: 1000 Fort Worth Club Tower, Fort Worth, Texas 76102

SUPPLIES AND/OR SERVICES TO BE FURNISHED: Drilling of Geothermal Wells

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

TOTAL AMOUNT OF PROPOSAL: $ 1,593,750

GOV'T SOLICITATION NO.: ET-78-R-08-0003

DETAIL DESCRIPTION OF COST ELEMENTS

1. DIRECT MATERIAL *(Itemize on Exhibit A)*	EST COST ($)	TOTAL EST COST[1]	REFERENCE[2]
a. PURCHASED PARTS			
b. SUBCONTRACTED ITEMS	1,593,750		
c. OTHER—(1) RAW MATERIAL			
(2) YOUR STANDARD COMMERCIAL ITEMS			
(3) INTERDIVISIONAL TRANSFERS *(At other than cost)*			
TOTAL DIRECT MATERIAL		1,593,750	
2. MATERIAL OVERHEAD[3] *(Rate %X$ base=)*			

3. DIRECT LABOR *(Specify)*	ESTIMATED HOURS	RATE/HOUR	EST COST ($)	TOTAL EST COST	REFERENCE
TOTAL DIRECT LABOR				-0-	
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)		
TOTAL LABOR OVERHEAD				-0-	

	EST COST ($)	TOTAL EST COST	REFERENCE
5. SPECIAL TESTING *(Including field work at Government installations)*			
TOTAL SPECIAL TESTING		-0-	
6. SPECIAL EQUIPMENT *(If direct charge) (Itemize on Exhibit A)*		-0-	
7. TRAVEL *(If direct charge) (Give details on attached Schedule)*			
a. TRANSPORTATION			
b. PER DIEM OR SUBSISTENCE			
TOTAL TRAVEL		-0-	
8. CONSULTANTS *(Identify—purpose—rate)*			
TOTAL CONSULTANTS		-0-	
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*			
10. *TOTAL DIRECT COST AND OVERHEAD*		1,593,750	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate % of cost element Nos.)*[3]		-0-	
12. ROYALTIES[4]		-0-	
13. *TOTAL ESTIMATED COST*		1,593,750	
14. FEE OR PROFIT		-0-	
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*		1,593,750	

1

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 No. ET-89-R-08-0003 Geothermal Reservoir Assessment Case Study
Northern Basin and Range Province

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
Jere Denton, Project Administrator	

NAME OF FIRM	DATE OF SUBMISSION
Southland Royalty Company	5-30-78

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST *($)*
1 b.	The entire cost of drilling the proposed three geothermal wells will be sub-contracted by Proposer to the best available rig company on a footage basis. The fixed cost proposal to the Government is a cost-sharing on the basis of estimated total drilling costs of $125/foot as follows:	
	3 x 8,500' Maximum Depth x $125/ft. x 50% =	1,593,750
	Under this proposal all costs necessary to the completion of drilling in excess of $62.50 per foot will be underwritten by the Proposer.	
	There is no profit nor consulting fee accruing to Proposer.	

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)

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 2

NAME OF OFFEROR: Southland-Millican Cooperative Venture	SUPPLIES AND/OR SERVICES TO BE FURNISHED: Well Testing and Reservoir Evaluation
HOME OFFICE ADDRESS: 1000 Fort Worth Club Tower Fort Worth, Texas 76102	
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED: Geothermal Exploration	TOTAL AMOUNT OF PROPOSAL: $ 174,282 — GOV'T SOLICITATION NO.: ET-78-R-08-0003

DETAIL DESCRIPTION OF COST ELEMENTS

			EST COST ($)	TOTAL EST COST[1]	REFERENCE[2]
1. DIRECT MATERIAL *(Itemize on Exhibit A)*					
a. PURCHASED PARTS					
b. SUBCONTRACTED ITEMS					
c. OTHER—(1) RAW MATERIAL					
(2) YOUR STANDARD COMMERCIAL ITEMS					
(3) INTERDIVISIONAL TRANSFERS *(At other than cost)*					
TOTAL DIRECT MATERIAL				-0-	
2. MATERIAL OVERHEAD[3] *(Rate %X$ base=)*					
3. DIRECT LABOR *(Specify)*	ESTIMATED HOURS	RATE/HOUR	EST COST ($)		
TOTAL DIRECT LABOR				-0-	
4. LABOR OVERHEAD *(Specify Department or Cost Center)*[3]	O.H. RATE	X BASE =	EST COST ($)		
TOTAL LABOR OVERHEAD				-0-	
5. SPECIAL TESTING *(Including field work at Government installations)*			EST COST ($)		
TOTAL SPECIAL TESTING				-0-	
6. SPECIAL EQUIPMENT *(If direct charge) (Itemize on Exhibit A)*				-0-	
7. TRAVEL *(If direct charge) (Give details on attached Schedule)*			EST COST ($)		
a. TRANSPORTATION					
b. PER DIEM OR SUBSISTENCE					
TOTAL TRAVEL				-0-	
8. CONSULTANTS *(Identify—purpose—rate)*			EST COST ($)		
TOTAL CONSULTANTS				-0-	
9. OTHER DIRECT COSTS *(Itemize on Exhibit A)*				174,282	
10. *TOTAL DIRECT COST AND OVERHEAD*				174,282	
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate % of cost element Nos.)*[3]				-0-	
12. ROYALTIES[4]					
13. *TOTAL ESTIMATED COST*				174,282	
14. FEE OR PROFIT				-0-	
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*				174,282	

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

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

RFP No. ET-78-R-08-0003 Well Testing and Reservoir Evaluation

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
Jere Denton Project Administrator	

NAME OF FIRM	DATE OF SUBMISSION
Southland Royalty Company	5-30-78

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

COST EL NO.	ITEM DESCRIPTION *(See footnote 5)*	EST COST ($)
9	Estimate based upon total costs of $116,319 per well for testing and reservoir evaluation.	
	3 wells @ $116,319 = $348,657	
	Since this work will be sub-contracted and performed in conjunction with the Univ. of Nevada Case Study, the detailed cost figures are not yet available. The above per well estimate is based upon a proposed detailed budget submitted to Proposer by the California State Land Commission in the amount of $41,219 for partial testing and reservoir engineering with the balance of $75,000 being estimated as the costs of equipment necessary for conducting the tests. It is expected that equipment costs will vary depending upon the exact reservoir type encountered and other drilling variables.	
	Proposed cost to Government:	
	Reservoir test and Engineering 3 @ $41,219 = $123,657	
	Equipment Estimate 3 @ $75,000 = $225,000	
	x 22.5% = 50,625 =	$174,282
	The net effect of this computation produces a cost share to Government of approximately 50% of total, with the intention of Proposer bearing substantially all equipment costs and the Government to bear 100% of reservoir evaluation services.	

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)

1. As the proposers are relatively new to the geothermal business, their geothermal experience is limited. For specific geothermal experience, the proposers will be relying upon their ability to contract a reputable geothermal well drilling company. Insofar as property and project management, drilling supervision, and financial control experience is concerned, the ongoing busines of Southland and Millican -- as evidenced particularly in Southland's annual report -- has well equipped the Cooperative Venture to handle these aspects of the proposal. Both companies are experienced in oil and gas exploration, with Southland alone having participated in the drilling of 245 oil and gas wells in 1977 with an average 40% working interest. In 1977, Southland supervised drilling operations on 112 wells in eight states and Canada. It is intended that Southland will act as Operator of the Cooperative Venture in the event a contract is awarded.

2. Key Personnel (in brief) - See Appendix B for Complete Resumes.

Dr. Lawrence T. Larson - Chairman and Professor of Geology,
Mackay School of Mines, University of Nevada

Dr. David B. Slemmons - Former Chairman, Geology Department,
Mackay School of Mines, University of Nevada

Dr. Michael D. Campana, Assistant Research Professor,
Water Resources Center, Desert Research Institute

Dr. Roger L. Jacobsen, Assistant Research Professor,
Water Resources Center, Desert Research Institute

James D. VanWormer, M. S., Research Assistant in Seismology,
University of Nevada

Elaine J. Bell, M. S., Consulting Geologist,
University of Nevada

Richard L. Jodry, M. S., President,
Energy and Natural Resource Consultants-Geothermal Consulting

Michael D. Campbell, M. A., Consulting Geologist,
Keplinger and Associates

George Oliver, Petroleum Engineer, Manager of Drilling
Southland Royalty Company

Jere Denton, Natural Resources Manager,
Southland Royalty Company

Noel J. Rasmussen, Consulting Geologist and Geophysicist, Gravity and Magnetic Interpretation

Duane A. Landine, Engineering Physicist, President, Enviro-Labs

Herbert L. Eggleston, Industrial Engineer, Chairman, Enviro-Labs

3. Co-administrators of the work to be conducted by the Mackay Minerals Research Institute are Dr. Larson and Mrs. Bell. Their organizational structure and administrative budget are attached. The efforts of the University and the Southland-Millican Cooperative Venture will be administered by Mr. Denton, using the financial control system and computerized reports available within the Southland management reporting and control system. He will coordinate all efforts between Southland, Millican and their respective consultants. He will coordinate all drilling activities in cooperation with Mr. Oliver, who is Southland's Drilling Manager. (See chart 6, page 90A.) Drilling will be contracted for on the basis of geothermal experience and rig availability.

Reports will be issued monthly by Mr. Denton and final reports will be prepared by all sub-contractors and consultants and integrated by him. Distribution of data obtained under this proposal may be made under any arrangements agreeable to the DOE.

Considering the extensive federal and state permitting procedures and their lack of predictability, it does not appear advisable to the proposers to set fixed deadlines for many phases of the work. As no deep tests have been drilled in Dixie Valley, the drilling time is also problematical. Under these circumstances, the management of the program must remain flexible with regard to time. However, it should be noted the vested interests of the prime contractor make the timely completion of the program at least as important to it as to the DOE. The proposer's best current estimate of the timing of the program is shown in chart 3, page 59B.

4. Jere Denton - Program Manager
1000 Fort Worth Club Tower
Fort Worth, Texas 76102
Phone - (817) 390-9200

George Oliver - Drilling Adviser
1000 Fort Worth Club Tower
Fort Worth, Texas 76102
Phone - (817) 390-9200

Dr. Lawrence Larson - University Program Administrator
Department of Geology
Mackay School of Mines
University of Nevada
Reno, Nevada
Phone - (702) 784-6050

Elaine Bell - University Program Administrator
Department of Geology
Mackay School of Mines
University of Nevada
Reno, Nevada
Phone - (702)-784-6050

Richard L. Jodry - Geothermal Consultant to Southland
President
Energy and Natural Resource Consultants
Dallas, Texas
Phone - (214) 238-9554 or (512) 349-1426

Michael D. Campbell - Geothermal Consultant to Millican
Keplinger & Associates
Houston, Texas
Phone - (713) 651-3127

5. The draft contract is an acceptable starting point for negotiations, however, for ease of administration, and because the proposal is on a fixed price basis and conducted under federal lease restrictions, the proposers will seek to eliminate all of the standard provisions that are not germane to delivery of data or the timely completion of the project.

This is especially true with respect to the provisions regarding subcontracts as the University of Nevada is a co-proposer and is only being considered a sub-contractor for administrative purposes. In addition, the proposers intend to find the best drilling contractor possible within the constraint of rig availability and feel that cost should not be a primary consideration.

Proposer will request at negotiations, a contract clause providing for mutual termination of the project if, in the opinion of the industry consultants and company representatives, the drilling program has suffered failures or reversals such as to make further pursuit of commercial geothermal development of the project area economically infeasible.

In general the proposers feel that a contract can be negotiated based upon the standard contract provisions, even though it is felt that most of them are not relevant due to the nature of the work contemplated by the RFP and the proposal. The proposers hope the DOE has the room to be flexible on the contract, but such flexibility is not a necessary condition of this proposal.

6. The "program technical scope" set forth in the RFP has been reviewed and all of the data which will be furnished pursuant to a contract may be published immediately upon submission to the DOE.

7. See attached annual reports for Southland Royalty Company and Millican Oil Company. (Appendix C)

8. This proposal will remain in effect for 120 days after May 30, 1978, unless modified at the request of the DOE within that period of time.

9. The person(s) signing the proposal has the authority to commit the proposer to all the provisions of the proposal.

10. Representations and Certificates

GSA Form 198, copies attached.

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)*
SOUTHLAND - MILLICAN COOPERATIVE VENTURE
Jere Denton - Program Administrator
1000 Fort Worth Club Tower
Fort Worth, Texas 76102

DATE OF BID
5/27/78

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 - (Millican is, Southland is not)

He [X] is, [X] 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, [X] 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, [X] 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, [X] 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, [X] corporation, incorporated in State of Texas (Millican) Delaware (Southland

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
	75-0572527 (Southland) ~~75-1301584 (Milligan)~~	

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 certifications from proposed subcontractors prior to the award of subcontracts 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:1977-0-241-530/3164

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:

Southland

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 Millican he (b) [X] 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:

Millican Millican

The bidder does [ ], does not [X] employ more than 50 employees and has [ ], has not [X] 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:

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

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).

[X] 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, [X] 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: MILLICAN OIL COMPANY
Thomas W. Clay

Name: *[signature]*

Date: 5/27/78

Title: President

Firm: SOUTHLAND ROYALTY COMPANY
I. Jon Brumley

Name: *[signature]*

Date: 5/27/78

Title: President & CEO

Appendix A

ENVIRO-LABS, INC.
727 SOUTH MAIN STREET BURBANK, CALIFORNIA 91506
TELEPHONE (213) 846-9920
OUR NEW ADDRESS: 626 SONORA AVE., GLENDALE, CA 91201, (213) 240-2666

PROSPOSED GEOTHERMAL WELL TEMPERATURE
LOGGING INSTRUMENT SYSTEM

A proposed Temperature Logging Instrument System for Geothermal Wells will be composed of the following items:

1. Digital Thermometer
2. Cable Reel-motor driven with slip rings
3. High Temperature Cable
4. Platinum Resistance Element Sensor
5. Alternate Integrated Circuit Sensor
6. Cable Counter
7. Tripod with Cable Sheave
8. Portable Enclosure for entire System

A battery powered Digital Thermometer with 'liquid crystal'display has been developed by Enviro-Labs, Inc. for temperature logging and will be used in this system. Range of the present unit is -100 to +200° Celsius. This unit could be calibrated in degrees Fahrenheit, if required. Rechargable nickel-cadmium batteries are used in this small, portable thermometer which measures 1½" x 4½" x 6.

The Cable Reel proposed for this system is a rugged, portable reel with die-cast aluminum frame fitted with 4 conductor silver - silver graphite slip ring assembly driven by a 12 volt DC motor. The reel capacity is 2500 ft. of cable with maximum outside diameter .187". This reel without motor drive has been used successfully in field logging operations for three years with very good results and has proven capability to withstand field service.

The cable proposed for the system is made with Kynar insulation (Polyvinylidene Fluoride) for sustained testing at 150°C and short term exposure to 180°C. An additional attribute of Kynar insulation is its resistance to abrasion and cut-through, a very important factor in deep well logging.

Platinum Resistance Sensor was selected for the standard sensor because of its ruggedness and stability. These probes have been well proven over years of industrial use. Methods of attachment to the cable and appropriate sealing and encapsulation compounds must be investigated for the most effective seal that can be applied. A special integrated circuit temperature sensor is being investigated now that may perform as well or better than the Platinum Probe up to 150°C. It is expected that greater linearity can be achieved with the IC sensor but final tests will determine which probe is used in the system.

A cable counter reading in feet and tenths of feet to 9999 feet will be employed. The counter will have the capability of having the cable removed from the counter jaws during rewind, if required. The counter will be manually resettable to zero.

A tripod and cable sheave assembly will be provided in the system for ease of lowering cable in the well. This assembly will assure the cable entering the well vertically so as to keep the cable from being scraped on the well pipe edges. A cable clamp assembly will be attached to the tripod to clamp the cable at any desired depth in order that readings can be taken without holding the cable by hand.

A portable carrying case will be provided to properly house all the equipment of the system for transport by car or plane. The case will be hinged so that the system can be operated without complete removal from the case, giving a platform base for operation in uneven, rocky of muddy ground. It is expected that this entire system can be operated by one man in the field.

RESUME

May 1971

Duane A. Ladine

Date of Birth:	November 26, 1928
Place of Birth:	Sidney, Nebraska
Residence, Glendale	Lives with wife, Gina, Daughters Linda 21, Sherry 18, and son Jay 15
Education:	University of Colorado-Bachelor of Science in Engineering Physics
	Graduate Studies:
	North Texas State College-Denton, Texas
	Southern Methodist University-Dallas, Texas
	UCLA-Los Angeles, California
	Graduate courses in advanced electronics, transistor electronics, digital computers, servomechanisms, control system synthesis, and computer logic.

Patents: (Issued and applied for)

- Punched Tape Reader (2 patents)
- Punched Tape Drive Mechanism
- Boring Bit Locator (2 patents)

Magnetically Gated Transistor Amplifi

Transistor Amplifier Circuit

Direct Drive Servo for Data Conversio

Quadrature Rejector Circuit for
Servo Amplifier

Transistorized Solenois Amplifier

Publications and Papers:

Magnetically Gated Transistor Servo Amplifier, Technical paper delivered to various chapters of American Institute of Electrical Engineers, and Institute of Radio Engineers

'Design for Miniaturization', Ladine, Spencer, and Ohlson, Electromechanical Design, August 1960

"A Non-Linear Servo for Direct Applications" Librascope Technical Review 1960

Affiliations:

Sigma Pi Sigma - National Physics Society - Institute of Electrical & Electronic Engineers - American Institute of Electrical Engineers

Instrument Society of America

American Association for Advancement of Sciences

1971- Enviro-Labs President and Director of Engineering
Presently responsible for general operations of company with primary emphasis on final product development, product testing, and manufacture. Formerly, for six years as partner in Industrial Dynamics he was responsible for design and development of product line of peripheral data monitoring equipment for water pollution control.

1968- 1971 Goldak Co.,Inc. Director of Engineering
Responsibilities include guidance of an engineering group for research and development of electronic and electromechanical instruments for detection and tracing of metallic pipes, cables, and for product engineering of these instruments for production.

1964- 1968 Ocean Technology, Inc. Supervisor, Electronics
As supervisor of the Electronics Group and Laboratory, he managed a product development group in design and development of electronic equipment for Naval Submarine Fire Control and Anti-Submarine Warfare computers. Other equipment types developed included Data Monitoring Units for Navy requirements, Infra Red Detection Systems for Navy Airborne Equipment, and Navy Underwater Retrieval and Observation instruments.

1962- 1964 Hufco Industries Chief Engineer

As chief engineer and part owner, he was responsible for developing electromechanical and solid state relays and related switching equipment and aided in developing manufacturing processes for these items.

1960- 1962 Imm Industries Director, Commercial Development

As Director, Mr. Ladine was responsible for the direction and engineering management of the Commercial Division including overall supervision of design and development groups, final evaluation of component designs, coordination of development activities, and direction of advanced component and equipment research and development efforts.

1954- 1960 Librascope, Inc. Project Manager, Aerospace Branch

For three years Mr. Ladine was responsible for the design and development of analog computers, servo-mechanism, and analog computer components. His responsibilities included evaluation of equipment requirements, formulation of design concepts, and direction and supervision of design and development efforts. For three years previous, as Senior Engineer at Librascope, Mr. Ladine was engaged in the research and development of transistor and magnetic amplifier systems and servomechanism systems employing these units, and the design and development of AC analog computer systems and related components.

1951- 1954 Chance Vought Aircraft Corporation, Dallas, Texas Engineer

As an Engineer at Chance Vought Aircraft Corporation Mr. Ladine engaged in the design and development of electronic equipment for high performance aircraft and guided missiles. His activities included development of servomechanisms for guidance and control, missile terminal guidance equipment design and transistor and magnetic amplifier design and development.

Herbert L. Eggleston, Jr.

Born in Los Angeles February 4, 1923

Attended grade school and high school in Glendale, California through January 1941.

1941 - 1942 attended Glendale Junior College with major emphasis on engineering subjects.

1942 - 1943 Undergraduate engineering work at Stanford University.

1943 - 1945 U.S. Air Force. Flew as a fighter pilot with the 9th Air Force in Belgium and Germany.

1945 - 1948 attened Stanford and graduated with a bachelor of science degree in Industrial Engineering. Member of the Sigma Nu Fraternity.

1948 - 1949 employed by the GOLDAK Company in the production and sales departments.

1949 - 1952 Sales Manager at GOLDAK

1952 - 1954 Vice President - Sales

1954 - 1970 Vice President and General Manager

1970 - 1971 President and General Manager

Concurrent employment:

1964-1970 partner in Industrial Dynamics, Glendale, California

1971 Chairman of Board, Vice President ENVIRO-LABS, Inc.

Lives in Glendale with wife Dana, son Robert D (18) and daughter Amy C (15). Has a son Herbert L III (19) in his second year at Northern Arizona University, Flagstaff, Arizona.

Appendix B

RESUME

NAME: Lawrence T. Larson

DATE AND PLACE OF BIRTH: December 3, 1930, Waukegan, Illinois

MARITAL STATUS: Married (Elizabeth R.), three children

PHYSICAL CONDITION: Good. Height 6'3", Weight 250 lbs.

PRESENT ADDRESS:

Office: Department of Geology
Mackay School of Mines
University of Nevada-Reno
Reno, Nevada 89507
Phone 702-784-4002

Home: 340 Sparrow Way
Carson City, NV 89701
Phone 702-849-0587

PRESENT POSITION: Chairman and Professor of Geology (Economic).

EDUCATION:

University of Illinois 9/54-9/57 B.S. (with highest honors) - Geology
Urbana, Illinois

University of Wisconsin 9/57-6/59 M.S. Geology
Madison, Wisconsin

University of Wisconsin 9/59-6/61 Ph.D. Geology (6/62)
Madison, Wisconsin

PUBLICATIONS:

See listing appended.

SCHOLASTIC HONORS, FELLOWSHIPS, ETC.

B.S. with highest honors; University Honors; Bronze Tablet-Univ. Ill.
Wisconsin Alumni Fellow 1957/58 and 1958/59
Union Carbide Ore Company Fellow 1959/60 and 1960/61
Phi Kappa Phi
Participant-NSF-AGI summer field trip, Brazil, 1966.
Participant-NSF Institute in Sulphide Phase Equilibria, 1967

GRANTS AND CONTRACTS
NSF GY-6216, 1969-1970.
BFEC GJO 76-020-E, 1976-78 - Principal Investigator

PROFESSIONAL EXPERIENCE:

3/75 - Present: Chairman and Professor of Geology (Economic); Mackay School of Mines, Univ. of Nevada-Reno, Reno, NV 89507.
Responsibilities include direction and administration of the Department, teaching of graduate and undergraduate courses in the fields of geochemistry and mineral deposits, and direction of M.S. and PH.D. research in the general field of Economic Geology. Personal publishable research and various types of public service are alos part of my responsibilities.

1/72 - Present: Partner, Applied Exploration Concepts a firm involved in the formulation and implementation of exploration programs for various clients in the mineral industry. Programs to date have included geologic, geochemical and geophysical searches for 'porphyry' copper, massive sulphides in volcanic terrains, and uraninum in both coastal plain and precambrian environments.

9/61 - 3/75: Assistant (1961-66) then Associate (1966-71) then Professor of Geology (1971-75), University of Tennessee, Knoxville, Tn.
Responsibilities included teaching, research and graduate research supervision. Courses designed and taught included Principles of Economic Geology; Metallic Mineral Deposits; Non-metallic Mineral deposits; Geology of Fuels, Ore Petrology, Regional Studies in Economic Geology; and various seminars in Sulphide Phase Equilibria, Massive Sulphide Deposits, Mississippi Valley Deposits, Geochemistry of Ore Forming Solutions, Metallogenetic Provinces, etc.
Graduate student (M.S. and Ph.D.) research directed included geologic mapping, clay mineralogic studies, fluid inclusion thermometry, fission track dating, ore microscopy, sedimentary and metamorphic petrology as related to ore deposits; trace element geochemistry as an exploration tool; ore beneficiation studies, etc.

Summer, 1971: Consultant to International Minerals and Chemicals Corp., Exploration program in Wyoming, Utah and Colorado.

Summer, 1970: Consultant with Lindgren Exploration Company. Conducted mineral exploration program in northern Maine for Cu-Ni sulphides. (Client - Alcoa)

Summer, 1969: Consultant with Lindgren Exploration Company. Directed part of a program searching for Cu-Ni deposits in Montana and Idaho. (Client - Duval & Amex)

1963-69: Consultant (available time) to Union Carbide Nuclear Corp., at Oak Ridge National Laboratory. Most of the work involved determination of optical properties and relations of these properties to corrosion resistance and other fabrication properties of reactor-important metals and alloys.

Summer, 1968: Participant, NSF sponsored course in Sulphide Phase equilibria and their applications to ores.

Summer, 1967: Consultant, Tennessee Division of Geology, Nashville, Tn. Study and mapping of mineral deposits scattered throughout the state. See publication listings.

Summer, 1966: Participant, NSF-AGI sponsored field studies in Brazil. Visits and tours through mining districts from which there is major production of iron, manganese, gold, phosphate, lead and zinc.

Summer, 1962-1965: Consultant (full-time) to Oak Ridge National Laboratory. See last item on preceding page. Also with Tenn. Div. Geol.

Summer, 1961: Worked with G. P. Woolard gathering data for correction of gravity data throughout the U.S.

1959-61: Graduate student, University of Wisconsin. Summers spent in field at Philipsburg, Montana in the mines of Taylor-Knapp Corp. gathering field data of Ph.D. dissertion.

1957-59: Graduate student, University of Wisconsin working toward M.S. in Geology.

Summer, 1958: Geologist, Northern Pacific Railroad. Summer spent mapping and geochemically surveying the Hog Heaven mining district in western Montana

Summer, 1957: Junior geologist, Sohio Petroleum Corp., Casper, Wyoming. Summer spent surface mapping structures and stratigraphic sections in _olorado, Wyoming and Montana.

1954-57: Student, University of Illinois. Part-time employee of the Illinois Geological Survey (Stratigraphy Branch).

Miscellaneous: A considerable number of short (1 week to 1 month) Consulting jobs for glass sand producers, road material producers, zinc companies, U. S. Borax and Chemical, and Alcoa.

PROFESSIONAL ORGANIZATIONS

Fellow - Geological Society of America
Member - Society of Economic Geologists
American Institute of Mining, Metallurgical and Petroleum Eng.
Canadian Institute of Mining and Metallurgy
Mineralogical Society of America
North West Mining Association
AGID - Assoc. Geologists interested in International Dev.
IAGOD - International Assoc. on the Genesis of Ore Deposits
Registered Professional Geologist #418 - State of Georgia

PUBLICATIONS:

Rotation Properties of Certain Anisotropic Ore Minerals: Econ. Geol. v. 56, pp. 569-583, 1961 (with others)

Geology and Mineralogy of Certain Manganese Oxide Deposits, Philipsburg, Montana: (Abs), GSA Special Paper 68, 1961, page 215.

Zinc-bearing Todorokite from Philipsburg, Montana: Amer. Mineralogist, v. 47, pp. 59-66, 1962

Geology and Mineralogy of Certain Manganese Oxide Deposits, Philipsburg, Montana: Econ. Geol. v. 59, pp. 54-78, 1964.

Field-trip guide to Corundum Hill, North Carolina: in Field trip Guidebook, Joint ACA-MSA meeting, Gatlinburg, Tennessee, July 1965 (with F.S. Lesure).

Mineral Resources Summary of the Waverly Quadrangle, Tennessee: Tenn. Div. of Geology, Geologic Map and Mineral Resources Summary (MRS) 30-SE, 1965, 7 pages.

Mineral Resources Summary of the Standing Rock Quadrangle, Tennessee: Tenn. Div. of Geology, GM and MRS 29-NW, 1965, 15 pages (with R. H. Barnes)

Mineral Resources Summary of the Bumpas Mills Quadrangle, Tennessee: Tenn. Div. of Geology, GM and MRS 28-SE, 1965, 17 pages.

Mineral Resources Summary of the Dover Quadrangle, Tennessee: Tenn. Div. of Geology, GM and MRS 29-NE, 1965, 12 pages (with R. H. Barnes).

Mineral Resources Summary of the Hurricane Mills Quadrangle, Tennessee: Tenn. Div. of Geology, GM and MRS 31-NE, 1965, 4 pages.

Mineral Resources Summary of the Kimmins Quadrangle, Tennessee: Tenn. Div. Geology, GM and MRS 41-NE, 1965, 17 pages.

Mineral Resources Summary of the Cumberland Furnace Quadrangle, Tennessee: Tennessee Div. of Geology, GM and MRS 302-SE, 1966, 15 pages.

Mineral Resources Summary of the McEwen Quadrangle, Tennessee: Tenn. Div. of Geology, GM and MRS 39-SW, 1966, 6 pages.

Mineral Resources Summary of the Purdy Quadrangle, Tennessee: Tenn. Div. of Geology, GM and MRS 4-NE, 1966, 5 pages

Mineral Resources Summary of the Tharpe Quadrangle, Tennessee: Tenn. Div. of Geology, GM and MRS 28-SW, 1967, 17 pages (with others)

Mineral Resources Summary of the Ashland City Quadrangle, Tennessee: Tenn- Div. of Geology, GM and MRS 304-SE, 6 pages, 1967.

Mineral Resources Summary of the Cheatham Dam Quadrangle, Tennessee: Tenn. Div. of Geology, GM and MRS 304=SW, 1967, 4 pages.

PUBLICATIONS (continued)

Determination of the Basal-Pole Orientation in Zirconium by Polarized light Microscopy: Trans. Met. Soc. of AIME. v. 236,pp. 1104-1106, 1966.

Equipment for the quantitative measurement of reflectivity: Journ. of Scientific Instruments, v. 40, No. 8, pp 1088-1092, 1969.

Reflectivity measurements on zirconium: Trans. Met. Soc. of AIME, v. 245, pp. 2047-2049, 1969.

Cobalt and Nickel-bearing manganese oxides from the Fort Payne Formation, Tennessee: Econ. Geol. v. 65, pp. 952-962, 1970.

Two sources of error in low temperature inclusion homogenization determination, and corrections on published temperatures for the East Tennessee and Laisvall Deposits: Econ. Geol. v. 68, pp. 113-116, 1973 (with others)

Textural Study of Polycrystalline Pyrrhotite by Reflectance Measurements and X-ray Pole Figures: Econ. Geol. v. 68, pp 671-680, 1973.

A short course on Opaque Minerals: a text published for the 1973 S. E. Geol. Soc. of Amer. Meeting. (with R. H. Carpenter).

Geochemistry - A Review, 1976. Mining Engineering, Feb. 1977, 6 pages.

The Great Basin Geologic Framework and Uranium Favorability. A Report to Bendix Corp. 3 volumes (Text and bibliography) 226 pages text, 696 pages biblio. plus Geologic Geochemical, Geochronologic Map Folio 211 pages (189 maps + 22 stratigraphic columns) open filed, April, 1978.

ABSTRACTS (partial listing)

The Stratigraphic and Petrologic Controls of the Economics of a Pottsville Sandstone, Caryville, Tn: GSA Special Paper, 1966 (with T. Freeman)

Preliminary Electron Microscope Studies of West Tennessee Ceramic Clays: Prog. for the 1967 annual meeting of S.E. Section of GSA.

Mineralogy of Certain West Tennessee Ceramic Clays: Prog. for the 1967 meeting of the S.E. Section of GSA (with D. E. Merschat).

Geochemistry of Co and Ni in Southern Appalachian Massive Suophide Ores: Prog. for the 1968 annual meeting, S.E. Section of G.S.A. p. 51.

Cobalt and Nickel-bearing Manganese Oxides from the Fort Payne Formation, Tennessee: Prog. for the 1969 Annual Meeting, S.E. Section of GSA

Textural Study of Polycrystalline Pyrrhotite by Reflectance Measurements and X-ray Pole Figures: Prog. for the 1970 National GSA Meeting.

Disseminated sulphides in Late Precambrian Metamorphic Rocks: Prog. of the S.E. Section of GSA, 1972 (with G. E. Merschat).

ABSTRACTS (continued)

Basin evolution and Mississippi Valley Ore Deposits. Manuscripts in Preparation and research in progress.

Microscopic Deformation textures in massive sulphide ores from the Southeastern U.S.

Basin evolution and Ore Deposits -- with emphasis on Mississippi Valley Ores.

Ore Microscopy -- a text with R. H. Carpenter. Revision and addition to Short Course text will be made for another Short Course to be held in 1975 in Washington D.C., after which submission will be made to a publisher.

The occurrence, abundance and partitioning of minor elements in ore minerals and associated gnague in massive sulphide deposits.

DAVID B. SLEMMONS
865 Ryan Lane
Reno, Nevada 89503
702-747-4871

EDUCATION

Univ. of Calif., Berkeley; B. S. Economic Geology, 1947
Univ. of Calif., Berkeley; Ph. D. Geology, 1953

PROFESSIONAL HISTORY

Univ. of Calif., Berkeley, Teaching Assist., 1948-51. Univ. of Nev., Reno, Assist. Prof. to Prof. of Geology and Geophysics, 1951-present. Univ. of Calif., Berkeley, Visiting Assist. Prof. to Prof. Geology, Summer Sessions, 1952 to 1961. Univ. of Nev., Reno, Director of the Univ. Nev. Seismographic Stations, 1952-1964. Univ. of Nev., Reno, Principal Investigator or Co-Principal Investigator on Atomic Energy Comm., Air Force Office of Sci. Res., Energy Res. Devel. Adm., L.A. Water and Power, Nat. Sci. Found., NASA and other research projects relating to seismology, active faulting, seismic regionalization and timing and compositional variation of late Cenozoic volcanism in western Nev. and eastern Calif. Univ. of Nev., Reno, Chairman, Dept. of Geology-Geography, Mackay School of Mines, 1966-1970. National Science Foundation, Program Director for Geophysics, 1970-71. Engineering Foundation, Conference on Earthquakes and Lifelines, Co-Chairman, December 1974.

CONSULTING EXPERIENCE: Numerous consulting projects in geology, engineering geology, seismology, geothermal energy, earthquake hazard analyses and mining geology for Alyeska Pipeline Services, AMEX, Atomic Energy Comm., Bear Creek Min. Co., Duval Corp., Fugro Cons. Eng. and Geol., Homestake Min. Co., Lawrence Livermore Lab., Los Alamos Sci. Lab., Skyline Oil. Co., Union Pacific, Utah Constr. and Min. Co., U. S. Corps of Eng., Woodward-Clyde Cons., Wash. Publ. Power Supply System and many shorter-term, individual or minor consulting services.

REGISTRATION

Registered in California as Geologist and Nevada as Engineering Geologist

HONORS AND AWARDS

Listed in World Who's Who in Science, Who's Who in America, Who's Who in the West, and American Men of Science
Delegate to Second and Third U. S.-Japan Conferences on Earthquake Prediction, 1966 and 1969

OFFICES AND APPOINTMENTS

Board of Directors, Seis. Soc. of America, 1969-1970
Chairman, Cordilleran Sect. Geol. Soc. of America, 1971-1972
Associate Editor, Geol. Soc. of America, 1971-1973
Member, Committee on Safety of Dams, Assembly of Engineering, National Research Council, 1977-present
Member, Los Alamos Sci. Lab. (LASL), Geosciences Adv. Panel, 1972-1975.
Secretary, Geophysics Division, Geological Society of America, 1977-1979

PROFESSIONAL AFFILIATIONS

American Assoc. Adv. Sci., American Geophys. Union, American Inst. Min. Metall. and Petrol. Eng., Earthquake Engin. Res. Inst., Geol. Soc. America, Geol. Soc. Nevada, Phi Kappa Phi, Seism. Soc. America, Theta Tau, Tau Beta Pi

PUBLICATIONS

Slemmons, D. B., 1953, Geology of the Sonora Pass Region: unpublished Ph.D. thesis, Univ. of Calif., Berkeley, 201 p.

Slemmons, D. B., 1956, Geological setting for the Fallon-Stillwater earthquake of 1954: Seismol. Soc. America Bull., v. 46, p. 4-9.

Slemmons, D. B., 1957, Geological effects of the Dixie Valley-Fairview Peak, Nevada, earthquakes of December 16, 1954: Seismol. Soc. America Bull., v. 47, p. 353-375.

Slemmons, D. B., Steinbrugge, K. V., Tocher, D., Oakeshott, G. B., and Gianella, V. P., 1959, Wonder, Nevada, earthquake of 1903: Seismol. Soc. America Bull., v. 49, p. 251-265.

Slemmons, D. B., 1962, Determination of volcanic and plutonic plagioclases using a three- or four-axis universal stage: Geol. Soc. America Sp. Paper 69, 64 p.

Slemmons, D. B. 1962 The Dixie Valley-Fairview Peak earthquakes of December 16 1954: Auxiliary Road Log -- earthquake features in Dixie Valley: Guidebook Ann. field trip, Sacramento Sect., Calif. Assoc. Engr. Geol., p. 81-86.

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Slemmons, D. B., and Eisinger, J. V., 1962, Observations on order-disorder relations of natural plagioclase, Part II: Order-disorder relations in metavolcanic and plutonic rocks of the Prison Hill area, Carson City, Nevada: Norsk Geologisk Tidsskrift, Bind 42, p. 555-566.

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Slemmons, D. B., and Jones, A. E., 1966, Field Guide for the Annual field trip: Geol. Soc. Sacramento and Sacramento Sect. Calif. Assoc. Engr. Geol., June 18 and 19, 1966.

Oliver, J., Ryall, A. S., Brune, J. N., and Slemmons, D. B., 1966, Microearthquake activity recorder by portable seismographs of high sensitivity; Seismol. Soc. America, v. 56, p. 899-924.

Slemmons, D. B., 1967, Pliocene and Quaternary crustal movements of the Basin-and-Range province, U.S.A., in Sea level changes and crustal movements of the Pacific, Pac. Sci. Cong., 11th, Tokyo, 1966, symp. 19: Osaka City Univ. Jour. of Geoscience, v. 10, art. 1-11, p. 91-103.

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Cluff, L. S., and Slemmons, D. B., 1970, Active fault zone hazards and related problems of siting works of man: in Fourth International Symp. on Earthquake Engin. Proc.: Roorkee Univ., Indian Soc. Earthquake Tech. Bull., v. 1, p. 401-410.

Slemmons, D. B., 1972, Microzonation for surface faulting: International Conf. on Microzonation for Safer Construction Research and Application, v. 1, p. 347-361.

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Noble, D. C., Slemmons, D. B., Korringa, M. K., and Dickinson, W. R., 1974, Eureka Valley Tuff, East-Central California and adjacent Nevada: Geology (Boulder), v. 2, no. 3, p. 139-142.

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Slemmons, D. B., 1975, Fault activity and seismicity near the Los Alamos Scientific Laboratory geothermal test site, Jemez Mountains, New Mexico: Los Alamos Scientific Laboratory Informal Report LA-5911-MS, 26 p.

Brogan, G. E., Cluff, L. S., Korringa, M. K., and Slemmons, D. B., 1975, Active faults of Alaska: Tectonyphysics, V. 29, p. 73-85.

Slemmons, D. B., 1977, State-of-the-Art for Assessing Earthquake Hazards in the United States (Series): Faults and Earthquake Magnitude: Report b; Misc. Paper 5-73-1: U. S. Army Engineer Waterways Experiment Station, Vicksburg, MS, 166 p.

Slemmons, D. B., and McKinney, R., 1977, Definitions of the Term "Active Fault": U. S. Army Engineer Waterways Experiment Station, Vicksburg, MS, 17 p.

ABSTRACTS

Publications

Slemmons, D. B., 1955, Structural and geomorphic effects of the Dixie Valley-Fairview Peak earthquakes of December 16, 1954, Churchill County, Nevada (abstr.): Geol. Soc. America Bull., v. 66, p. 1618.

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Lohr, L. S., and Slemmons, D. B., 1961, Structural state of plagioclase from hydrothermally altered rock from Pyramid Butte, Washoe County, Nevada (abstr.): Geol. Soc. America Sp. Paper 68, p. 38-39.

Gimlett, J. I., Slemmons, D. B., and Jones, A. E., 1963, Catalog of Nevada earthquakes, Part I (abstr.): Geol. Soc. America Sp. Paper 76, p. 202-203.

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Bonham, H. F., and Slemmons, D. B., 1968, Faulting associated with the northern part of the Walker Lane, Nevada (abstr.): Geol. Soc. America Sp. Paper 101, p. 290.

Slemmons, D. B., 1969, Surface faulting from the December 26, 1969 Olinghouse, Nevada earthquake (abstr.): Seismol. Soc. America Earthquake Notes, v. 40, p. 23.

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Carver, G. A., Slemmons, D. B., and Glass, C. E., 1969, Surface faulting patterns in Owens Valley, California (abstr.): Geol. Soc. America Abstr. 1969, pt. 3 (Cordilleran Sect.), p. 9-10.

Glass, C. E., and Slemmons, D. B., 1969, Restudy of surface faulting from the October 2, 1915, Pleasant Valley area earthquake, Nevada (abstr.): Geol. Soc. America Abstr. 1969, pt. 5, (Rocky Mtn. Sect.), p. 28.

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Slemmons, D. B., 1971, Details of Cenozoic high-angle faulting in space and time (abstr.): Geol. Soc. America Abstr., v. 3, p. 195.

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Slemmons, D. B., 1977, New Earthquake Magnitude-Fault Length-Maximum Displacement/Relationships: Geological Society of America, Abstracts with Programs, v. 9, n. 4, p. 501.

Slemmons, D. B., 1977, Criteria for Detection, Delineation and Evaluation of Active Faults for Siting of Vital Engineering Structures: Geological Society of America, Abstracts with Programs Cordilleran Sect., v. 9, n. 4.

Slemmons, D. B. and Bell, E.J., 1977, Recent Crustal Movements in the Central Sierra Nevada-Walker Lane Region of California-Nevada: Part I, Rate, Style, and Historical Record of Deformation: Abstracts, 1977 International Symposium on Recent Crustal Movements.

Bell, E. J., and Slemmons, D. B., 1977, Recent Crustal Movements in the Central Sierra Nevada-Walker Lane Region of California-Nevada: Part II, The Pyramid Lake Right-Slip Fault Zone Segment of the Walker Lake: Abstracts, 1977 International Symposium on Recent Crustal Movements.

Sanders, C. O., and Slemmons, D. B., 1977, Recent Crustal Movements in The Central Sierra Nevada-Walker Lane Region of California-Nevada: Part III, The Olinghouse Fault Zone: Abstracts, 1977 International Symposium on Recent Crustal Movements.

Slemmons, D. B., 1977, Definitions of Fault Activity and Non-Activity: Geological Society of America, Abstracts with Programs, v. 9, n. 7, p. 1179-1180.

RÉSUMÉ

Michael E. Campana

EDUCATION

B.S., College of William and Mary - 1970
Major: Geology

M.S., University of Arizona - 1973
Major: Hydrology

Ph.D., University of Arizona - 1975
Major: Hydrology Minor: Mathematics

EXPERIENCE

7/76 - present	Assistant Research Professor, Water Resources Center, Desert Research Institute, Reno, Nevada 89507
8/75 - 5/76	Associate Faculty Member (Earth Sciences), Pima Community College, Tucson, Arizona 85709
7/74 - 6/75	Graduate Research Associate, Dept. of Hydrology and Water Resources, Univ. of Arizona, Tucson, Arizona 85721
8/73 - 5/74	Associate Faculty Member, (Earth Sciences), Pima Community College
8/73 - 6/74	Graduate Teaching Associate, Dept. of Hydrology and Water Resources, Univ. of Arizona

ACADEMIC HONORS

NDEA Title IV Fellowship, NSF summer research grant, University of Arizona tuition scholarship

PROFESSIONAL SOCIETIES

Sigma Xi, American Geophysical Union, National Water Well Assn., Geological Society of America, International Assn. for Mathematical Geology, American Assn. Advancement Science, American Water Resources Assn.

PROFESSIONAL RECOGNITION

Attended Penrose Conference on "Mass and energy transport in porous and fractured media", Aspen, Colorado, Fall 1974

"Jointing and foliation in the Petersburg Granite near Richmond, Virginia", B.S. Thesis.

"Determination of hydraulic parameters in a fractured rock aquifer", M.S. Thesis.

"Finite-state models of transport phenomena in hydrologic systems", Ph.D. Dissertation.

PROCEEDINGS ARTICLES

Campana, Michael E., 1976, Application of carbon-14 ground-water ages in calibrating a flow model of the Tucson Basin Aquifer, Arizona, Hydrology and Water Resources in Arizona and the Southwest, v. 6, pp. 197-202.

Roger L. Jacobson

Age: 32

Health: Excellent

Marital Status: Married with two dependents

Education:

B.A. - University of Minnesota - Duluth, Geology (1965)
M.A. - University of Missouri, Geology (1968)
Ph.D.- Pennsylvania State University, Geochemistry (1973)

Professional Experience:

1975-Present	Assistant Research Professor, Water Resources Center, Desert Research Institute, Reno, Nevada Research on trace minerals in carbonate systems and chemistry of geothermal systems.
1973-1975	Wissenschaftlicher Assistant, Sedimentpetrographisches Institut der Universitaet Goettingen, W. Germany Trace element partitioning in minerals, primarily carbonates, as a function of temperature.
1969-1973	Graduate Research Fellow, Pennsylvania State University Water chemistry investigations in carbonate terrain.
1965-1968	Teaching Assistant, University of Missouri
1966	Exploration Geologist, Chevron Oil Company, Lafayette, Louisiana

Publications:

Jacobson, R. L. and Langmuir, D., 1970, The chemical history of some spring waters in carbonate rocks: Ground Water, V. 8, p. 5-9.

Langmuir, D. and Jacobson, R. L., 1970, Specific-ion electrode determination of nitrate in some fresh waters and sewage effluents: Environmental Science and Technology, V. 10, p. 834-838.

Publications (Continued):

Jacobson, R. L., Langmuir, D., and O'Brien, P. J., 1971, Factor analysis of carbonate ground water chemistry: Caves and Karst, Cave Res. Meeting, Hamilton, Ontario, Oct. 14-16, 1971.

Harmon, R. S., Hess, J. W., Jacobson, R. L., Shuster, E. T., Haygood, C., and White, W. S., 1972, Chemistry of carbonate denudation in North America: Trans. Cave Research Group of Great Britain, V. 14, p. 96-103.

Jacobson, R. L. and Langmuir, D., 1972, An accurate method for calculating saturation levels of ground water with respect to calcite and dolomite: Trans. Cave Research Group of Great Britain, V. 14, p. 104-108.

Jacobson, R. L. and Langmuir, D., 1974, Dissociation constants of calcite and $CaHCO_3^+$ from 0° to 50°C: Geochemica et Cosmo. Acta, V. 38, p. 301-318.

Jacobson, R. L. and Langmuir, D., 1974, Controls on the quality variations of some carbonate spring waters: Jour. of Hydrol., V. 23, p. 247-265.

Jacobson, R. L. and Usdowski, E., 1975, Geochemical controls on a calcite precipitating spring: Contributions to Mineralogy and Petrology, in press.

Jacobson, R. L. and Langmuir, D., 1975, A statistical treatment of carbonate well water chemistry, in press.

Jacobson, R. L. and Usdowski, E., 1975, Strontium partitioning in calcite and dolomite, in preparation.

PERSONAL DATA

NAME: James Douglas VanWormer

DATE OF BIRTH: March 14, 1943

PLACE OF BIRTH: Klamath Falls, Oregon

EDUCATION:

B.S. Geology, University of Oregon, 1965
M.S. Geophysics, University of Nevada, 1967

POSITIONS HELD AND EXPERIENCE:

Research Assistant in Seismology, University of Nevada, Reno, Nevada.
Geophysicist with the Earthquake Mechanism Laboratory, ESSA, San Francisco, California, 1967-1970.
Assistant Geophysicist, Geophysical Institute, University of Alaska, 1970-1974.
Assistant Research Seismologist, Seismological Laboratory, University of Nevada, 1975-Present.

PROFESSIONAL ORGANIZATIONS:

American Association for the Advancement of Science
American Geophysical Union
Seismological Society of America
Sigma Xi

PUBLICATIONS:

Published Articles

Ryall, A., A. E. Jones, J. D. VanWormer, Triggering of micro-earthquakes by earth tides and other features of the Truckee California earthquake sequence of September, 1966, Bull. Seism. Soc. of Amer., 58, No. 1, 215-248, 1968.

VanWormer, D. and E. Berg, Seismic evidence for glacier motion, J. of Glaciology, 12, No. 65, pp. 259-265, 1973.

Gedney, Larry and James D. VanWormer, Tectonic mapping in Alaska with ERTS-1 imagery, Photo Interpretation, Feb. 1974.

Gedney, Larry and James D. VanWormer, In Alaska: Remote Sensing of Seismic Hazards, Geotimes, 19(2), 15-17, Feb. 1974.

Published Articles (Cont'd)

Gedney, Larry and James D. VanWormer, Tectonic lineaments and Plate Tectonics in southcentral Alaska, Proceedings of the First International Symposium on the New Basement Tectonics, Utah Geological Association Publication No. 5, 1974, p. 27-35.

Gedney, Larry and James D. VanWormer, ERTS-1, Earthquakes and tectonic evolution in Alaska, Proceedings of the 3rd ERTS-1 Symposium, 1974 (in press).

VanWormer, James D., John Davies and Larry Gedney, Seismicity and plate tectonics in south-central Alaska, in Bull. Seism. Soc. Amer., Vol. 64, No. 5, pp. 1467-1475, October 1974.

VanWormer, J. D., L. D. Gedney, J. N. Davies, and N. Condal, "V_p/V_s and b-Values: A test of the dilatancy model for earthquake precursors", Geophysical Research Letters, v. 2, No. 11, p. 514-516, November 1975.

Ryall, A. and J. D. VanWormer (1975). Field-Seismic Investigations of the Oroville, California, earthquakes of August, 1975, in: Oroville, California, Earthquake, 1 August 1975, Special Report 124, Calif. Div. Mines & Geology, 1975.

Ryall, A., W. A. Peppin and J. D. VanWormer, Field-Seismic Investigation of the August 1975 Oroville, California, Earthquake Sequence, Engineering Geology, 10, p. 353-369, 1976.

Slemmons, D. B., Van Wormer, D., Bell, E. J. Silberman, M. L. (1977). Recent Crustal Movements in the Central Sierra Nevada-Walker Lane Region of California-Nevada: Part 1, Rate and Style of Deformation, (in press, Tectonophysics).

Reports

VanWormer, J. D., Solid earth tides as a triggering mechanism for earthquakes, Technical Report No. 5, AFOSR, 1967, Mackay School of Mines, University of Nevada, Reno, Nevada.

VanWormer, J. D., Solid earthtides as a triggering mechanism for earthquakes, M. S. Thisis, 1967, Mackay School of Mines, University of Nevada, Reno, Nevada.

Murdock, J. N., J. D. VanWormer, et al., Microseisms and teleseisms recorded in Australia, ESSA Technical Report ERL66-ESL4 Boulder, Colorado, February, 1968.

Romig, P. R., J. D. VanWormer, et al., Residual strains associated with JORUM, Report to the Atomic Energy Commission, Las Vegas, Nevada, 11 December, 1969 (unpublished).

Bufe, C. J., J. D. VanWormer, et al., Observations at Stone Canyon, in Earthquake Research in ESSA 1696-1970, ESSA Technical Report-ERL182-ESL11, Boulder, Colorado, July, 1970, ed. L. R. Alldredge.

Wideman, C. J., J. D. VanWormer, Residual strains from BENHAM, MILROW and JORUM, in Earthquake Research in ESSA 1969-1970, ESSA Technical Report ERL182-ESL11, Boulder, Colorado, July, 1970 21-25, ed. L. R. Alldredge.

Gedney, L., L. Shapiro, D. VanWormer, F. Weber, Earthquake epicenters in interior Alaska, 1968-1971, and their correlation with mapped faults, Geophysical Institute, University of Alaska, Scientific Report UAG R-218, 1972.

Gedney, L., L. Shapiro, D. VanWormer, F. Weber, Correlation of epicenters with mapped faults, east-central Alaska, 1968-1971, U. S. Geological Survey, Open-file report, 1972.

Gedney, Larry and James VanWormer, Tectonic mapping in Alaska with ERTS-1 imagery, interim scientific report, NASA Contract NAS 5-218833, 25 May 1973.

VanWormer, J., J. Davies and L. D. Gedney, Central Alaska earthquakes during 1972, Scientific report UAGR-224, Geophysical Institute, University of Alaska, September 1973.

Gedney, Larry and James D. VanWormer, Seismically active structural lineaments in south-central Alaska as seen on ERTS-1 imagery, Interim Scientific Report, NASA Contract NAS 5-21833, November 1973.

Gedney, Larry and James D. VanWormer, Tectonic lineaments and Plate tectonics in south-central Alaska, Scientific Report, NASA Contract NAS 5-21833, 1974.

J. C. Rogers, W. D. Harrison, L. H. Shapiro, T. E. Osterkamp, L. D. Gedney, and J. D. VanWormer, "Nearshore permafrost studies in the vicinity of Point Barrow, Alaska", Geophysical Institute Scientific Report UAG R-237, University of Alaska, Fairbanks, Alaska, May 1975, 71 pp.

Reports (Cont'd)

R. B. Forbes, L. Gedney, D. VanWormer, and J. Hook, "A geophysical reconnaissance of Pilgrim Springs, Alaska", Geophysical Institute Scientific Report UAG R-231, University of Alaksa, Fairbanks, Alaska, February 1975, 26 pp.

Papers

Gedney, Larry and J. D. VanWormer, Some aspects of active tectonism in Alaska as seen in ERTS-1 imagery, Symposium on significant results obtained from ERTS-1, NASA/Goddard Space Flight Center, abstracts, paper G-23, p. 49, March, 1973.

VanWormer, J. D., L. Gedney, J. Davies and L. H. Shapiro, Central Alaska Seismicity, Program with abstracts, 69th Annual Meeting of the Seismological Society of America, Golden, Colorado, p. 49, May 1973.

Gedney, Larry and James D. VanWormer, Earthquake forecasting in Alaska with b-slopes, Joint U.S.-Japan symposium in earthquake prediction, Boulder, Colorado, August, 1973.

Gedney, Larry and James D. VanWormer, ERTS-L, earthquakes, and tectonic evolution in Alaska, abstracts, 3rd ERTS symposium, paper G-10, p. 46, Wash., D.C., December 1973.

VanWormer, James D., John Davies and Larry Gedney, Some characteristics of the subduction zone in south-central Alaska, Program with abstracts, 70th Annual Meeting Cordilleran Section, Geol. Soc. Amer., vol. 6, No. 3, p. 270, March 1974.

Gedney, Larry and James D. VanWormer, Tectonic lineaments and plate tectonics in south-central Alaska, First International Symposium on the new Basement tectonics, Salt Lake City, Utah, June 1974, (invited paper).

A. A. Ryall, W. A. Peppin, and J. D. VanWormer, "Preliminary Study of the August, 1975, Oroville, California, Earthquake Aftershock Sequence", First International Symposium on Induced Seismicity, Banff, Alberta, Canada, 16 September 1975.

A. S. Ryall and J. D. VanWormer, "Field Study of the August, 1975, Oroville, California Earthquake Sequence", December, 1975 Fall Annual Meeting, American Geophysical Union.

Stauber, Douglas A., and Boore, David M., Ryall, Alan and Doug, Van Wormer, "Crustal thickness in the region of the Battle Mountain heat flow high in Nevada", December, 1976 Fall Annual Meeting American Geophysical Union.

R E S U M E

ELAINE J. BELL

Born: December 19, 1948
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Education:

1976-Present	University of Nevada-Reno, Reno, Nevada 89557 Selected courses in Earthquake Engineering, Environmental Geology and Engineering Geology. Currently enrolled in PhD program. Proposed dissertation: Late Cenozoic faulting and earthquake hazard assessment of the Walker Lane in western Nevada.
1971-1974	Arizona State University, Tempe, Arizona 85281 M.S. in Geology, May 1974. Thesis: Origin of the Auriferous Clays in the Fairbanks area, Alaska.
1967-1971	University of Wisconsin-Whitewater, Whitewater, Wisconsin 53190 B.S. cum laude, May 1971. Major: Geography. Minor: Geology.

Experience:

March 1977-Present	David B. Slemmons, Consulting Geologist under contract to Washington Public Power Supply System. Title: Consulting Geologist/Project Coordinator (March 1977 - September 1977). Responsible for directing and conducting regional and site-specific lineament analysis utilizing remote sensing data and conventional aerial photography for evaluation of nuclear power plant sites in the state of Washington. Title: Consulting geologist/Project Reviewer (September 1977 - Present). Responsible for reviewing and conducting interpretation of low-sun-angle aerial photography for evaluation of faulting for nuclear power plant sites in the state of Washington.
Sept. 1977-Present	Mackay School of Mines, Nevada Bureau of Mines and Geology, University of Nevada-Reno, Reno, Nevada 89557. Title: Research Assistant. Research Grant: Evaluation of Lineament Analysis as an Exploration Technique for Geothermal Energy. Research involves analysis of remote sensing data and low-sun-angle aerial photography for detection and evaluation of lineaments and faults in relation to geothermal potential.
May 1978	Pezonella-Bryan Associates, Sparks, Nevada 89431. Consultant on evaluating geologic hazards associated with a proposed housing subdivision near Fernley, Nevada.
Jan. 1978-Feb. 1978	Earth Science Consultants Associated, Sparks, Nevada 89431. Consultant on seismic hazard evaluation of Pyramid Lake Indian Housing, Washoe County, Nevada.

Resume: Elaine J. Bell

Experience:

July 1977- Jan. 1978	Mackay School of Mines, Department of Geology, University of Nevada-Reno, Reno, Nevada 89557. Technical and editorial reviewer -- Great Basin Geologic Framework and Uranium Feasibility, for DOE-Bendix Field Engineering Corporation, Grand Junction, Colorado, Contract BFEC-GJO Subcontract 76-020-E.
Aug. 1976- Aug. 1977	Mackay School of Mines, Nevada Bureau of Mines and Geology, University of Nevada-Reno, Reno, Nevada 89557. Title: Research Assistant. Research Grant: Computer-Simulated Earthquake Hazard Model for the Reno Area. Research involved collection and evaluation of geologic and engineering data for the Reno area as a data base for computer-generated model of seismic risk.
June 1974- June 1976	Fugro, Inc., Consulting Engineers and Geologists, Long Beach, California 90804. Title: Staff Geologist. Investigations included regional and site analysis for evaluation of aggregate deposits in south-central Alaska; Geologic and geomorphic investigations of faulting for nuclear power plant siting in south-eastern California; Interpretation of off-shore geophysical data for launch and towing corridors, Santa Barbara Channel, California; Regional hydrologic analysis and regional environmental assessment for land-based ICBM MX Program in Arizona, southern Nevada, New Mexico and Texas; Regional and site investigations for siting of land-based ICBM MX Program in Arizona, southeastern California and Nevada.
Sept. 1971- June 1973	Arizona State University, Tempe, Arizona 85281. Title: Graduate Teaching Assistant. Responsible for organizing and teaching laboratories in physical geology, petrology-petrography, and structural geology.
Sept. 1969- June 1971	University of Wisconsin-Whitewater, Whitewater, Wisconsin 53190. Title: Laboratory Assistant. Assisted teaching physical geology and mineralogy laboratories.

Professional Memberships:

Association of Engineering Geologists - Member
Geological Society of America - Member
International Glaciological Society
Sigma Gamma Epsilon - Member
Sigma Xi - Member
Phi Kappa Phi - Member

Resume: Elaine J. Bell

Publications:

Bell, E.J., Trexler, D.T., and Bell, J.W., 1978, Computer-simulated composite earthquake hazard model for the Reno, Nevada, area: International Conference on Microzonation, San Francisco, California, November 1978.

Bell, E.J., Pease, R.C., Sanders, C.O., and Slemmons, D.B., 1978, Western Basin and Range active faulting: Fieldtrip guidebook for the Seventy-third Annual Meeting, Seismological Society of America, Sparks, Nevada, March 1978, 19 p. plus appendices.

Bell, E.J., Sanders, C.O., and Slemmons, D.B., 1978, Geologic and geometric analysis of conjugate strike-slip faults and regional strain in the western Basin and Range Province: Geological Society of America Abstracts, v. 10, no. 3, p. 95.

Slemmons, D.B., VanWormer, D., Bell, E.J., and Silberman, M.L., 1977. Recent crustal movements in the Sierra Nevada-Walker Lane region of California-Nevada: Part I, Rate and style of deformation: Tectonophysics (in press), 13 p.

Bell, E.J., and Slemmons, D.B., 1977, Recent crustal movements in the central Sierra Nevada-Walker Lane region of California-Nevada: Part II, The Pyramid Lake right-slip fault zone segment of the Walker Lane: Tectonophysics (in press), 21 p.

Slemmons, D.B., VanWormer, D., and Bell, E.J., 1977, Recent crustal movements in the central Sierra Nevada-Walker Lane region of California-Nevada: Part I, Rate, style and historical record of deformation: International Symposium on Recent Crustal Movements, Stanford University, July, 1977 (abstract).

Bell, E.J., and Slemmons, D.B., 1977, Recent crustal movements in the central Sierra Nevada-Walker Lane region of California-Nevada: Part II, The Pyramid Lake right-slip fault zone segment of the Walker Lane: International Symposium on Recent Crustal Movements, Stanford University, July, 1977 (abstract).

Bell, E.J., Broadbent, R., and Szumigala, A., 1977, Analysis and effects of the 1948 earthquake at Verdi, Nevada: Geological Society of America Abstracts, v. 9, no. 4, p. 387.

Bell, E.J., 1975, Origin of the gold-bearing clays in the Fairbanks area, Alaska: Geological Society of America Abstracts, v. 7, no. 3, p. 297.

Bell, E.J., 1974, Origin of the auriferous clays in the Fairbanks area, Alaska: Arizona State University, M.S. thesis, 61 p.

RICHARD L. JODRY

Energy and Natural Resource Consultants, Inc.
Post Office Box 941
Richardson, Texas 75080

Education

Michigan State University, BS Cum Laude, Geology, 1945
Michigan State University, MS Geology, 1954
University of Michigan, MS Minor, Conservation of National Resources
Michigan State University and Southern Methodist University, two years additional graduate work in Geology and Business Administration

Positions Held

Energy and Natural Resource Consultants, Inc., President 1977-Present
Suntech, Inc. (Division of Sun Oil Co.)
Manager, Geothermal Services, 1976-1977, Retired
Sun Oil Company
Scientist 1955-1976
Rex Oil and Gas Company
Chief Geologist 1950-1955
Ohio Oil Company
Geologist 1947-1950
Magnolia Petroleum Company
Geologist 1945-1946

Experience

Energy and Natural Resource Consultants, Inc.

1977 - Full consulting services in exploration for geothermal energy, oil, gas and coal; and management of exploration and development programs.

Sun Oil Company

1976-1977 - Manager, Geothermal Services. Managed geothermal research activities and consulting services in geothermal exploration to Sun companies and outside clients. Consulting in fossil fuel and mineral fields. Took voluntary early retirement in 1977.

1972-1975 - Chief Geologist for Geothermal Energy. Managed all geothermal exploration activity for company, evaluated exploration results, developed exploration technologies, selected areas for land acquisition and supervised all geothermal energy functions.

1962-1972 - Senior Research Scientist. Manager projects in oil and gas, coal, oil shale and geothermal energy exploration and evaluation. Project leader for worldwide unexplored basin evaluation, habitat of oil and giant oil field studies, regional geologic studies, petrophysics of carbonate rocks, modern reef studies, carbonate rock specialist.

1955-1962 - Manager, Billings Research Office. Supervised research projects in Rocky Mountain, Canadian and Eastern United States areas.

Professional Activities

Board on Mineral Resources, National Research Council
National Academy of Sciences

Professional Affiliations

Phi Kappa Phi - Honor Scholastic Society
American Association of Petroleum Geologists - Member
Dstinguished Lecturer 1966-1967
Geological Society of America - Fellow
Geothermal Research Council - Vice President and Director
Dallas Geological Society - President
Lecturer: Heidelberg University, Institute du Petrole (Paris) Institute of Petroleum (London), University of Louvain, CFP (Paris), SNPA (Pau)

Publications

Numerous company reports and professional papers, including:

Oil and Gas Production from Carbonate Reservoirs, American Elsevier, 1972
The Andros Reef Tract, Sun Company Richardson Library, film (one hour)
"Growth and Dolomitization of Silurian Reefs, St. Clair Co., Michigan", in Silurian Reefs of Great Lakes Region of North America, AAPG, 1975.
Natural Gas From Unconventional Geologic Sources (Chairman) National Research Council, 1976.

RESUME

OF

MICHAEL D. CAMPBELL

SCHOLASTIC ACHIEVEMENTS:

1966	Ohio State University, Bachelor of Arts Degree in Geology (German Minor)
1976	Rice University, Master of Arts Degree in Geology with 31 semester hours toward Ph.D.

PROFESSIONAL EXPERIENCE:

1971 to Present	Senior Consulting Geologist for Keplinger and Associates, Inc. General Crude Oil Company, Texas Eastern Nuclear, Inc., Pioneer Nuclear, Inc., U. S. Environmental Protection Agency, U. S. Office of Water Resources Research, National Water Well Association and numerous private companies. Domestic and International projects on alternate energy resource exploration, planning and evaluation, e.g. frontier and trend exploration and developmentof uranium, coal-lignite, geothermal energy; industrial and precious minerals and environmental projects, the latter with special emphasis on project grants and contracts on ground-water development/pollution control, geochemistry and subsurface water injection systems (see references).
1969 to 1971	United Nuclear Corporation - Teton Exploration Division, Casper, Wyoming. District Geologist. Responsible for field operations and exploration drilling. Research and development of exploration criteria in frontier areas. Under R.I. Rackley.
1966 to 1969	Continental Oil Company of Australia, Ltd., Sydney, Australia. Staff Geologist, Minerals Exploration Division. Responsible for field operations and drilling and evaluations in Australia and parts of Southeast Asia and South Pacific for phosphate, potash, sulfur and uranium. Under R.N. Arrington.

PROFESSIONAL AFFILIATIONS: Certified Professional Geological Scientist #3330 (formerly AIPG), Society of Mining Engineers (AIME), American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists, Geological Society of America, American Society of Testing Materials, National Water Well Association, American Water Resources Association, Houston Geological Society.

PUBLICATIONS AND MAJOR REPORTS:

1. Campbell, M. D., 1968, "Discovery of New Phosphate Deposits: Interim Phosphate Report No. 1: Northern Territory, Australia," Continental Oil Company of Australia, Minerals Exploration Division, 22 pp., 3 tabs., 3 plates (unpubl.).

2. Campbell, M. D., 1969, "Report on Preliminary Beneficiation Results: Undilla Basin, Queensland, Australia," Continental Oil Company of Australia, Minerals Exploration Division, 13 pp., 6 figs., 3 tabs., (unpubl.).

3. Campbell, M. D., 1969, "Report on Potash Potential, Carnarvon Basin, Western Australia," Continental Oil Company of Australia, Minerals Exploration Division, 13 pp., 6 figs., 3 tabs.(unpubl.).

4. Campbell, M. D., 1969, "Analysis of Transportation, Water Resources, Multiple Product Recovery and Mining in Australia," Interim Phosphate Report No. 2, Australian Phosphate PRoject, Continental Oil Company of Australia, Mineral Exploration Division, 25 pp., 15 figs. (unpubl.).

5. Campbell, M. D., 1969, "Final Report on Undilla Basin Phosphate, Queensland, Australia," Continental Oil Company of Australia, Minerals Exploration Division, 65 pp., 1 fig., 5 tabs., 4 plates, 3 appen. (unpubl.).

6. Campbell, M. D., 1969, "An Evaluation for Uranium of the Pidinga Lakes Area, South Australia," Consulting Report for Minoil, 8 refs. (unpubl.).

7. Campbell, M. D., 1970, "Final Reconnaissance Report on the Uranium Potential of Ohio," Ohio Report No. 2, United Nuclear Corporation, 42 pp., 8 figs., 7 tabs., 1 plate (unpubl.).

8. Campbell, M. D., 1970, "Preliminary Recommendation Report on the Uranium and Other Mineral Potential of Pennsylvania," Pa. Report No. 2, Stage II Evaluation, United Nuclear Corporation, 80 pp., 19 figs., 3 plates, 2 tabs., 37 refs. (unpubl.).

9. Campbell, M. D., 1971, "A Preliminary Evaluation for Uranium of the Green River Utah Project," Consulting Report: United Resources, 44 pp., 20 figs., 10 refs. (unpubl.).

10. Campbell, M. D., 1960 through 1966, all abstracts of papers bearing on hydrology and geohydrology in Ground Water, Vols. 4, 5, 6, 7, and 8. Abstract Editor.

11. Campbell, M.D., 1971, "Geophysics and Ground Water: Applied Use of Geophysics," Water Well Journal, Vol. 25, No. 8, pp. 39-50, 14 figs, 3 tabs., 23 refs.

12. Campbell, M. D., 1971, "Terradynamics," Water Well Journal, Vol. 25, No. 10, pp. 42-44, 5 figs.

13. Campbell, M. D., 1971, Progress Through Research," Water Well Journal, Vol. 25, No. 11, pp. 48-49.

14. Campbell, M. D., 1972, "Water Well Construction Technology: An Introduction," Water Well Journal, Vol. 26, No. 3, pp. 42-45, 9 refs.

15. Campbell, M. D., 1972, "Rock Drillability," Water Well Journal, Vol. 26 No. 4, pp. 55-58, 7 refs., 4 figs.

16. Campbell, M. D., 1972, "Cable Tool Drilling," Water Well Journal, Vol. 26, No. 5, pp. 58-61, 15 refs.

17. Campbell, M. D., 1972, "Introduction to Rotary Drilling Systems and Mud Drilling Fluids," Water Well Journal, Vol. 26, No. 6, pp. 42-25, 17 refs.

18. Campbell, M. D., 1972, "Rotary Drilling: Drilling Rate and Optimization," Water Well Journal, Vol. 26, No. 7, pp. 48-51, 11 refs.

19. Campbell, M. D., 1972, "Variations on Rotary Drilling and Other Common Drilling Systems," Water Well Journal, Vol. 26, No. 8, pp. 39-43, 23 refs.

20. Campbell, M. D., 1972, "Novel Drilling Systems: the Turbodrill," Water Well Journal, Vol. 26, No. 9, pp. 48-52, 11 refs., 3 figs., 3 tabs.

21. Campbell, M. D., 1972, "Future Drilling Systems," Water Well Journal, Vol. 26, No. 11, pp. 46-51.

22. Campbell, M. D., 1972, "Course Outlines for Ground Water Specialist Certificate," for Indiana Vocational Technical College, South Bend, Indiana.

23. Campbell, M. D., and J. H. Lehr, 1973, Water Well Technology, subtitled: Field Principles of Exploration Drilling for Ground Water and Selected Minerals, a textbook, McGraw-Hill, 697 pp., 165 figs., 120 tabs., 68 eqs., 674 refs. (4th printing - 1977).

24. Campbell, M. D., 1973, "Industrial Progress Through Practical Research," Ground Water, Vol. 11, No. 1, pp. 204, Guest Editorial.

25. Campbell, M. D., 1973, Rural Water Systems Planning and Engineering Guide, a text, Commission on Rural Water, Washington, D. C., 180 pp., 62 figs., 22 tabs., 73 refs.

26. Campbell, M. D., 1973, "Well Cost Analysis," Water Well Journal, Vol. 25, No. 5.

27. Campbell, M. D., 1973, "Spray Effluent Irrigation: An Editorial," Irrigation Journal, Vol. 23, No. 3, May/June.

28. Campbell, M. D. and S. N. Goldstein, 1974, "Engineering Economics of Rural Water and Wastewater Systems," Presented at the Conference on Rural Environmental Engineering, Warren, Vermont, September 22; in Water Pollution Control in Low Density Areas, as Chapter 13, pp. 145-180, University Press of New England (1975).

29. Campbell, M. D. and W. A. Hunt , 1973, "Engineering Economics of Rural Water Systems: A New American Approach," presented at the International Groundwater Symposium, Macquarie University, Sydney, Australia, November 20-22.

30. Campbell, M. D. and W. A. Hunt, 1973, "The Place for Private Water Supplies: the Challenge of Environmental Protection and Industrial Development," presented at the International Ground Water Symposium, Macquarie University, Sydney, Australia, November 20-22.

31. Campbell, M. D., 1973, "Practical Ground Water Research: A University-Industry Solution," An Editorial, Ground Water, Vol. 11, No. 6, pp. 2-3.

32. Campbell, M. D., 1974, Rural Water Systems Operation and Maintenance: A Guide for the Engineer and Operator, a text, Commission on Rural Water, Washington, D. C., 500 pp.

33. Campbell, M. D., 1974, "Rural Water Systems: Ground Water Quality Control and Testing," Rural Water News Technical Note, June, Commission on Rural Water, Washington, D. C.

34. Campbell, M. D., 1974, "Rural Water Systems Automation and Telemetry: An Economic Advantage," Rural Water News Technical Note, August, Commission on Rural Water, Washington, D. C.

35. Campbell, M. D., 1974, Uranium Potential of the United States: StageI, Frontier Exploration, United Resources Consulting Report for Pioneer Nuclear, Inc. and Texas Eastern Nuclear, Inc. (Copyrighted), 218 pp., 21 plates, 46 figs., 7 tabs., 1,389 refs. (Houston).

36. Campbell, M. D. and J. H. Lehr, 1975, "Engineering Economics of Rural Water Systems: A New American Approach," Journal AWWA, May, pp. 225-331.

37. Campbell, M. D. and R. H. Schwartzer, 1975, "Critical Energy Resource Areas: Subsurface Information From Ground-water Exploration and Other Shallow Exploration Activities," a paper presented at the Symposium on Subsurface Geo- Science Records and Materials. Sponsored by the Federal Energy Administration, Dallas, April 10.

38. Campbell, M. D. and G. R. Gray, 1975, "Mobility of Well-Drilling Additives in the Ground-Water System," EPA Conference on Environmental Aspects of Chemical Use in Well-Drilling Operations, May 21-23, Houston, U. S. Office of Toxic Substances, EPA-560-1-75-004.

39. Campbell, M. D., 1975, Manual of Recommended Water Well Construction Standards, U. S. EPA Contract 68-01-92, Office of Research and Development, 177 pp.

40. Campbell, M. D., 1975, "Glossary of Sedimentary Structures in Carbonate Rocks," in Carbonate Facies in Geologic History, by J. L. Wilson, Springer-Verlag, pp. 75-86.

41. Campbell, M. D., 1976, "Alternate Energy and Mineral Development: General Outlook and Comparative Economics," a paper presented at the 1976 Keplinger Energy Seminar, University Club, New York City, November 23, 30 pp.

42. Campbell, M. D., 1976, Paleoenvironmental and Diagenetic Implications of Selected Siderite Zones and Associated Sediments in the Upper Atoka Formation, Arkoma Basin, Oklahoma-Arkansas, unpub., Master's Thesis, Rice University.

43. Warner, D. L., M. D. Campbell, and J. H. Lehr, 1977, Manual for Deep-Well Waste Injection Systems, U. S. Environmental Protection Agency, Kerr Water Research Center, Ada, Oklahoma.

44. Campbell, M. D., 1977, Editor, Geology of Alternate Energy Sources of the South Central United States, Houston Geological Society, 364 pp.

45. Campbell, M. D. and K. T. Biddle, 1977, "Frontier Uranium Exploration in the South Central United States," in Geology of Alternate Energy Sources of the South Central United States, Houston Geological Society, Houston, Texas, Chapter1; pp. 3-44.

46. Campbell, M. D., 1977, "Water Well Technology for Ground-Water Development and Production in Igneous and Metamorphic Rocks," United Nations International Seminar on Ground Water in Hard Rocks, Stockholm-Sardinia, September 22 - October 7, 61 pp.

47. Campbell, M. D., 1977, "Phase II Preliminary Evaluation of Dixie Valley, Nevada: Geothermal Potential and Associated Economics," Consulting Report for Millican Oil Company, 45 pp. (unpub.).

48. Campbell, M. D., 1978 (in prep.), "Ground-Water Geochemistry of the Black Hand Sandstone in South Central Ohio."

49. Wielchowsky, C. C. and M. D. Campbell, (in prep.),"Structural Development of a Part of the Stillwater Range, Churchill County, Nevada."

CAREER HIGHLIGHTS:

1975	Received "Ohioana Book Award: Science & Technology" for Water Well Technology, published by McGraw-Hill, New York.
1971-Present	Appointed to Editorial Board of the technical journal, Ground Water.
1976	Appointed as United Nations Technical Expert to review overseas ground-water and mineral exploration programs.
1976	Biography in American Men & Women of Science (13th Edition)
1968	Visiting Lecturer, University of Townsville, Queensland, Australia, on "An Introduction to Geohydrology."
1971	Lecturer, Indiana Vocational Technical College, South Bend, Indiana, on "Hydrology for Well Drilling Contractors."
1974	Lecturer, U. S. Environmental Protection Agency, Short Course 1974, "Ground-Water Hydrodynamics," St. Louis, Missouri.
1975	Lecturer, Department of Geology, Rice University, "Ground-Water Geochemistry and Economic Geology."
1971-1973	Appointment as Technical Consultant to Water Well Journal.

OVERSEAS ACTIVITIES:

1966-1969	While working for Continental Oil Company of Australia Ltd. in Sydney, Australia, Mr. Campbell traveled extensively in Southeast Asia and Micronesia actively engaged in geological exploration and mining development of phosphate, potash, sulphur and uranium, including ground water supply investigation for potential mining operations. Negotiation work also took him to Japan and other areas of the Pacific region.

1977	Presented 12 lecture hours to United Nations Seminar on Ground Water Development and Production in Igneous and Metamorphic Rocks, Stockholm and Sardinia, September 20-October 7.

REFERENCES:

1) Mr. R. N. Arrington, Vice President, Texas Eastern Nuclear, Inc. 921 Main Street, P. O. Box 2521, Houston, Texas 77001.(713) 651-7961.

2) Dr. Ted Foss, Director, Minerals Exploration, General Crude Oil, P. O. Box 2252, Houston, Texas 77001. (713) 651-9261.

3) Mr. Ruffin I. Rackley, Consulting Geologist, 2651 South Chase Lane, Denver, Colorado 80227. (303) 989-4104.

4) Mr. Gene Pendry, Manager, Nuclear Dynamics, Inc., 633 17th Street, Suite 1290, Denver, Colorado 80202. (303) 892-2025.

5) Mr. Tom Clay, President, Millican Oil Company, 908 Town and Country Blvd., Suite 400, Houston, Texas 77024.(713)461-4904

6) Dr. H. C. Clark, Professor, Dept. of Geology, Rice University, Houston Texas 77005. (713) 527-8101.

Additional references supplied upon request.

PERSONAL

Phone: (713) 666-4355
Birthdate and Location: August 8, 1941
Lancaster, Ohio
Marital Status: Married - 3 children
Health: Excellent
Citizenship: U.S.A.

RESUME OF

G. E. OLIVER

EDUCATION: B.S. in Petroleum Engineering, Texas Technological College, 1953

EMPLOYMENT HISTORY:

1974 - Present: Manager of Drilling, Southland Royalty Company, Fort Worth, Texas. Subordinate to Vice President-Production. On equal level with Managers of Production and Reservoir Engineering. Supervisor to five District Production Managers (Gulf Coast, West Texas, Four Corners, Mid-Continent, and Rocky Mountain) in drilling matters.

I analyze drilling proposals for feasibility, cost estimate accuracy and safety, and consult daily with District Managers on drilling problems.

Work area is all of central United States plus Alberta.

Work load is 200 wells per year.

1970 - 1974: District Engineer, Southland Royalty Company, Denver, Colorado. Subordinate to Vice President-Production. On equal level with District Geologist and District Landman. Supervisor to Drilling and Production Foremen, Lease Pumpers, and to Drilling and Production Contractors. Work included preparation of drilling, production equipment, and workover AFE's, supervision of production, drilling, and workover activity and purchase of well equipment. I devoted considerable time to unitization work, serving as company representative on both Operators and Engineering Committees of Rogers, Gas Draw, Grady Hilight, and Goose Lake Units. Specialized work included presentations to State and Provincial Conservation Commissions.

Work area included Utah, Colorado, Montana, Wyoming, Nebraska, and Alberta.

Work load consisted of 50 to 150 producing wells and 25 drilling wells per year.

1967 - 1970:	Drilling Engineer, Southland Royalty Company, Midland, Texas. Subordinate to District Superintendent. On equal level with Drilling and Production Foremen. Supervisor to Drilling Contractors. Work here included preparation of drilling and workover AFE's, cost estimates for geologists' use and field supervision of drilling and completion activity in Louisiana, Texas Gulf Coast (some offshore), West Texas, New Mexico, Oklahoma, Colorado, and Wyoming. Work load consisted of 20 drilling wells per year.
1964-1967:	Production Superintendent, Seco Production Company, Midland, Texas. Subordinate to President of Company. Supervisor to Lease Pumpers and to Drilling and Production Contractors' Personnel. Work included preparation of AFE's, supervision of production and negotiating drilling contracts, dealing with land and royalty owners. I also designed and installed water flood equipment. Work area was West Texas and New Mexico. Work load consisted of 100 producing wells and 5 drilling wells per year.
1961 - 1964:	District Superintendent, Texas Pacific Coal and Oil Company, Sundown, Texas. Subordinate to Division Superintendent, supervisor to District Engineers, Drilling and Production Foremen, Lease Pumpers, Roustabouts, and Clerks. My work was strictly supervisory, all at field level, 95% of time and effort devoted to production, 5% to drilling and workovers. Work included handling large volumes of paper work. Work area consisted of Hockley and Yoakum Counties, Texas. Work load consisted of 400 producing wells and 5 drilling wells per year.
1953 - 1961:	Roustabout, Lease Pumper, Well Tester, Engineer, and District Engineer, Texas Pacific Coal and Oil Company. Subordinate to Production Foremen, District Engineers, Gang Pushers, Pulling Unit Operators, and District Superintendents. Work included connection gang, pumping, gas, oil, and water testing, high and low pressure gas measurement, design and construction of gas injection and water injection equipment, working on unitization

1953 - 1961 Continued

engineering committees, supervision of rotary and cable tool rigs, installation of production equipment and production clerical work including material inventories, production calculations, and allowable and proration schedules. Work areas were Odessa, Royalty, and Sundown, Texas.

RESUME OF

JERE DENTON

SOUTHLAND ROYALTY COMPANY - FORT WORTH, TEXAS (7/76 - Present)

1/78 - Present:	District Manager-Natural Resources Work to evaluate opportunities for the Company in geothermal, coal, and forest products. Manage the Company's geothermal business.
5/77 - 12/77:	Manager of Planning Work on corporate-wide communication of Company goals. Performed extensive analysis of potential impact of proposed legislation on Company
7/76 - 4/77:	Manager of Special Projects Spent most of this time working on long-term refinancing of $180,000,000 loan used to acquire Aztec Oil and Gas, expecially as related to value of Aztec gas properties.

AZTEC OIL AND GAS COMPANY - DALLAS, TEXAS (11/73 - 6/76)

3/76 - 6/76:	Acting CFO Managed treasury and accounting functions during transition to ownership by Southland Royalty Company
5/75 - 3/76:	Assistant Treasurer Performed Company planning, personnel, office administration and cash management functions.
11/73 - 4/75:	Manager of Planning Introduced formal planning techniques to the Company. Designed composite capital budget system.

SAMSONITE CORPORATION - DENVER, COLORADO (11/79 - 3/71)

9/72 - 9/73:	Senior Financial Analyst Developed financial section of annual and five year plans. Made monthly forecasts and analyzed sales.
4/72 - 9/72:	Cost Accountant-Luggage Division Wrote Cost Accounting Manual.

(SAMSONITE CORPORATION - DENVER, COLORADO CONTINUED)

3/71 - 3/72: Financial Analyst-Luggage Division
Reviewed 123 departmental budgets for two manufacturing facilities, performed variance-analysis and did overhead allocations

11/69 - 3/71: Budget Analyst-Toy Division
Developed annual and five-year departmental budgets, wrote annual capital budget and financial section of business plan.

EDUCATION

B.S. Finance and International Business - University of Colorado

Graduate work in International Monetary Theory - University of Texas at Dallas

PROFESSIONAL ORGANIZATION

Association for Corporate Growth

Professional Resume

Noel F. Rasmussen
Consulting Geologist and Geophysicist
7966 E. 41st Street (918) 622-6160
Tulsa, Oklahoma 74145

April 1974 to Present Consultant

My activities as a consultant have been related to the interpretation of geology using gravity and magnetic geophysics. Most of this work concerns the use of computers and I have written programs to assist me in making interpretations. About one-half of my work includes some seismic interpretation.

I have a special interest in borehole gravimetry and have developed a research program to produce an instrument of advanced design. This program as well as my consulting work is carried out through my corporation, Borehole Exploration Corporation. I own an interest in four producing wells in northern Michigan. This production was obtained directly and indirectly from borehole gravimetry.

My clients include both major oil companies and independent operators. I have also worked for several geophysical contractors.

March 1965 to April 1974 Senior Research Scientist, Geophysical Research Department, Amoco Production Co. (Std. Oil Indiana) Tulsa, Oklahoma

My work at Amoco concerned developing new interpretive techniques for gravity and magnetic geophysics. I wrote a portion of the computer program system for gravity and magnetics and was responsible for establishing and maintaining this system.

My work also included data processing and interpretation as a technical service to the exploration department of Amoco, Amoco International Oil Co., and Amoco Canada.

I was part of the team which developed the successful operating and interpretation methods for borehole gravimetry. I wrote the operations manual for conducting borehole gravity surveys.

February 1957 to March 1965 Geologist and Geophysicist, The California Company (Std. Oil California), New Orleans, La.

This work included geophysical and geological duties in the Gulf Coast province of Louisiana. This included the following positions:

1. Development Geologist, Production Dept.
This included the on-site evaluation of exploration and production wells;

reservoir mapping; and reservoir structure interpretation. Most of this concerned the use of well logs and cores.

2. Exploration Geologist, Exploration Dept.
This included the development of prospects, the economic evaluation of prospects, and the recommendation to lease and conduct geophysical programs. Some gravity and seismic interpretation was included.

3. Division Stratigrapher, Exploration Dept.
This included stratigraphic studies of the Gulf Coast, stratigraphic mapping, and interpretation. This work was aimed at evaluating the reservoir stratigraphy and predicting conditions in undrilled areas.

4. Seismologist, Exploration Dept.
This work included computing, reprocessing and interpreting seismic data. I also acted as client representative on a seismic party. This work was aimed at making accurate structural interpretations of objective horizons.

5. Geophysicist, Exploration Dept.
This work was aimed at assisting other geologists and geophysicists in making their interpretations. It was oriented to the use of gravity and magnetics. The work also included the development of prospects through the coordinated use of geological and geophysical methods.

September 1955 to February 1957	Graduate Assistant, Dept. of Geology, University of Nebraska. Degree: M.S. Geology
October 1953 to August 1955	Army of the United States - Korea.
June 1953 to October 1953	Roughneck and Geologist, Omaha Drilling Corp.

This work included the supervision of wellsite operations, logging, and permitting at the Northern Natural Gas underground gas storage project at Redfield, Iowa.

September 1944 to June 1953	University of Nebraska. Degree: B.S. Geology

Professional Societies

AAPG	American Association of Petroleum Geologists
SEG	Society of Exploration Geophysicists
TGS	Tulsa Geologic Society
GST	Geophysical Society of Tulsa
SPWLA	Society of Professional Well Log Analysts.

Publications

1. "The Mississippian, Devonian, and Silurian Systems in the Subsurface of Dallas County, Iowa". A thesis submitted to the University of Nebraska in partial fulfillment of the requirements for the M.S. degree: 1957.

2. "A Method of Gravity Modeling Using Precalculated Component Models". A paper presented at the 38th Annual International Meeting of the Society of Exploration Geophysicists, Sept. 29-Oct. 3, 1968, Denver, Colorado.

3. "Borehole Gravity Survey Planning and Operations" SPWLA Fourteenth Annual Logging Symposium Transactions, 1973.

4. "The Successful Use of the Borehole Gravity Meter in Northern Michigan". Canadian Well Logging Society Fifth Formation Evaluation Symposium, 1975. Reprinted in the Sept-Oct. 1975 issue of Log Analyst, a publication of SPWLA.

5. "Borehole Gravimeter Finds Bypassed Oil, Gas". The Oil and Gas Journal, September 29, 1975.

6. "Some Criteria For Judging Gravity and Magnetic Map Quality". A paper presented at the 45th International Meeting of the Society of Exploration Geophysicists, Denver, Colorado, October, 1975.

7. "Gravity Logs Promise New Applications". Petroleum Engineer International, July, 1977.

SERVICES RENDERED

1. Subsurface Geologic Interpretation

2. Seismic Interpretation

3. Gravity Geophysics

    a. Interpretation

        1) Computer Model Studies

            a) Two Dimensional

            b) Three Dimensional

        2) Integration of Surface and Subsurface Geological Data.

        3) Integration of Seismic Data.

    b. Data Processing

        1) Map Digiting

        2) Calculation of Residuals

        3) Vector Gradient

        4) Three Dimensional Computer Modeling Results Subtracted from Gravity Maps.

4. Magnetic Geophysics

    a. Interpretation

    b. Interpretation using three Dimensional Magnetic Modeling (Computer)

Appendix C

RFP No. ET-78-R-08-0003

TUSCARORA, NEVADA PROPOSAL

AMAX Exploration, Inc.

14 H (2)

A. Proposers Name and Address

AMAX Exploration, Inc.
4704 Harlan Street
Denver, Colorado 80212
(303) 433-6151

a wholly owned subsidiary of:

AMAX, INC.
AMAX Center
Greenwich, Connecticut 06830

B. Technical Proposal

AMAX Exploration, Inc., proposes to define the recently discovered heat flow anomaly at the north end of the Independence Valley by surface and subsurface methods and if warranted to drill for discovery of potential geothermal resources. Total estimated cost of the proposed exploration program is $1,996,000. Estimated cost to the DOE is $1,002,000 during the period FY 1978, FY 1979, and FY 1980. Estimated cost to the DOE for FY 1978 is $35,000, for FY 1979 is $82,000 and for FY 1980 is $885,000.

1. Investigation Site or Area

The investigation site comprises about five townships at the north end of the Independence Valley approximately 82 km northwest of Elko in Elko County, Nevada (see Figure 1).

a. The proposal area is currently defined by Townships 41, 42, North, Ranges 50, 51 East, and the N 1/2 of Township 40 North, Range 50, 51 East, MDM , (see Plate 1). Exploration results may cause the area of interest to be slightly enlarged or contracted

b. AMAX Exploration, Inc., controls approximately 19,280 acres of fee geothermal leases and priority federal geothermal lease applications which comprise the majority of the central portion of the proposal area. Supron Energy Corporation also holds leases in the central portion of the proposal area.

   The acreage controlled by AMAX is not fixed, and during the course of the proposed exploration program leases may be either added or dropped depending upon exploration results and/or lease chargeability limitations. AMAX also may elect at any point during the proposal to seek joint venture participation in the exploration program from other individuals or business concerns.

   Legal descriptions of leases and lease applications, which are subject to change, are given in Appendix I. The current lease application block is shown on Plate I.

   No unitization arrangements exist in the proposal area.

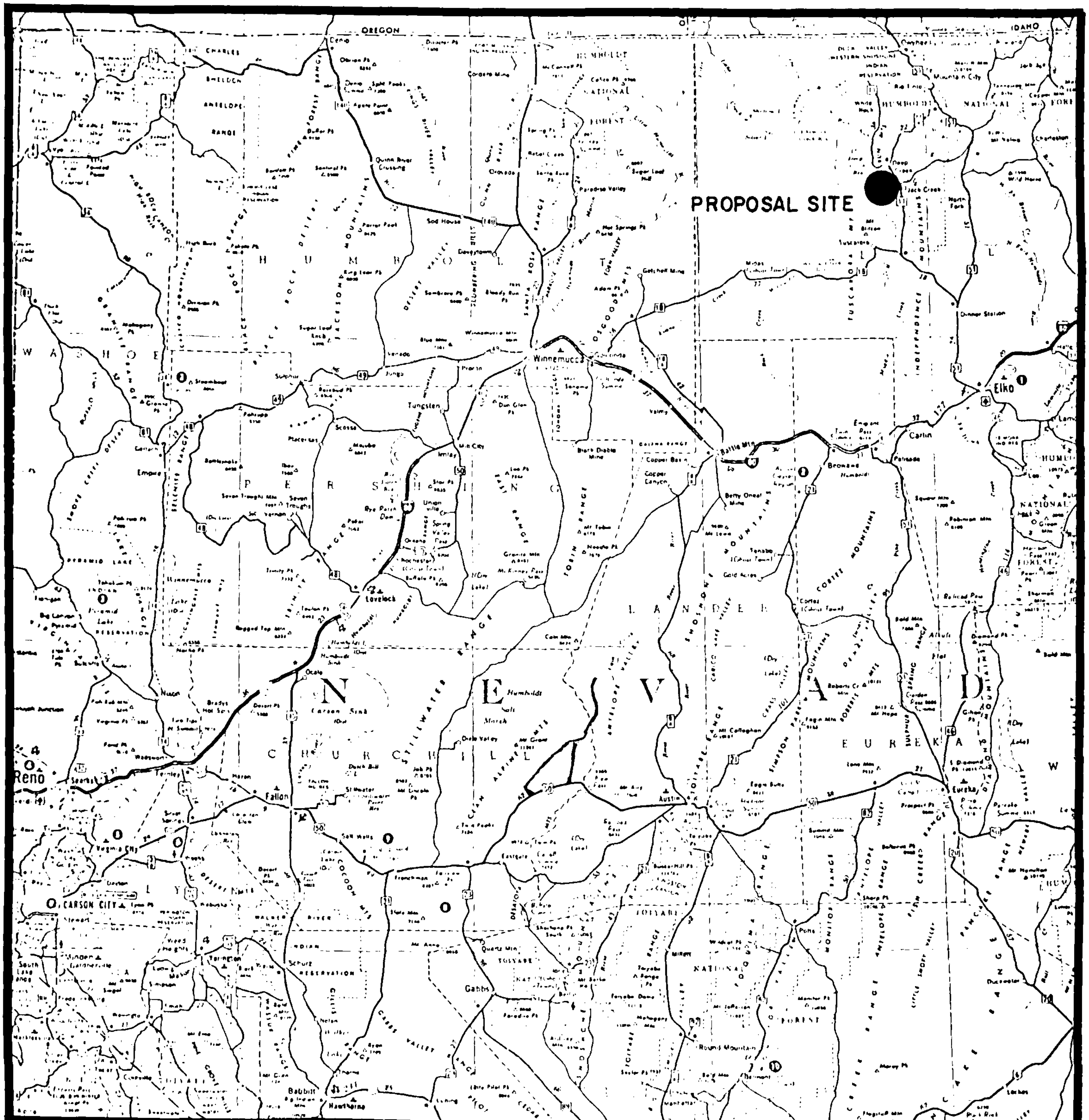


Figure I

INDEX MAP

CONFIDENTIAL

The proposal area can be reached by driving north along State Highway 51 from Elko, Nevada, 43 kilometers to the junction of State Highway 11, and from there approximately 44 kilometers to an unimproved ranch road. Hot Sulphur Springs, which marks the center of the proposal site is about 7 kilometers northwesterly along this road.

c. The proposal area has not been geologically mapped in detail, but the general setting is fairly well known. The site is characterized by a thick assemblage of Tertiary intermediate to acidic volcanic rocks overlying siliceous Paleozoic eugeosynclinal deposits of the Nevada western facies. These rocks are extensively broken by Basin and Range faulting. Several hot springs, giving minimum geochemical reservoir temperatures of greater than 200°C, are depositing siliceous sinter along Hot Creek.

d. The site is well located for the discovery and development of potential geothermal resources.

1) It is within the Battle Mountain "heatflow high".

2) Landsat imagery shows a circular structure indicative of a volcanic center and possible caldera subsidence.

3) The Cl-SiO_2-enthalpy (boiling water) geochemical mixing model with a 54% cold water fraction gives minimum reservoir temperatures of 216°C. This is in close agreement with the Na-K-Ca geothermometer which gives subsurface temperatures of 209°C.

4) Several springs along Hot Creek are currently depositing siliceous sinter.

5) Mercury, tungsten, and silver mineralization and local hydrothermal bleaching are conspicuous features within the area.

6) Portions of the central part of the proposal area exhibits heatflow in excess of 5.3 HFU as determined by 4 shallow thermal gradient measurements. Heat flow values of 24.3 HFU and 34.3 HFU have been measured. Temperatures were measured to depths of 50 to 60 meters. The highest direct measurement is 54.8°C at 50 meters.

2. Program Data Offered

The proposed exploration program is divided into three phases each contingent upon the successful completion of the previous phase and/or the results of previous surveys. The program is designed to provide maximum flexibility in the search for a geothermal resource whose existence, location, and characteristics are not known and are only suggested or inferred at present.

The following data are offered contingent on the applicability and completion of the associated surveys. These are only briefly outlined in this section but are more fully described in the subsequent section entitled "Program Description".

a. Subsurface Data

Approximately 24 shallow (less than 150 meters) thermal gradient (temperature) and lithologic logs. Four of these holes have already been drilled and approximately 20 are proposed to be drilled.

Three deep (600 meter maximum) thermal gradient and lithologic logs.

Two deep (2300 $\pm$ meter) geothermal production test wells with all associated temperature, lithologic, and other logs and measurements.

b. Surface Data

Self potential profiles-approximately 180 line-kilometers with measurements at 100 to 200 meter intervals.

Magnetotelluric Soundings-approximately 30 stations with measurements recorded between 10 and 0.01 Hz.

Aeromagnetic Survey-approximately 600 line-kilometers flown E-W at 1.6 kilometer intervals with N-S tie lines at a constant barometric altitude providing 305 meter (1000 foot) minimum terrain clearance.

Gravity Measurements-approximately 150 stations, terrain corrected to produce a complete Bouguer gravity anomaly map.

Passive Seismic Survey-approximately 50 stations designed to map and interpret microearthquake hypocenters and determine possible Poisson's ratio, and P and S-wave travel time and attenuation anomalies.

Reflection Seismic Survey-approximately 32 line-kilometers, designed to identify structure and acoustic impedance effects associated with possible reservoir materials.

c. Reservoir Engineering Studies

Flow Testing to establish reservoir characteristics and fluid composition.

3. Program Description

For the purpose of this proposal all data collected after 31 May 1978 are considered "new" and data collected previously are considered "existing". Data collected under this proposal are designed to discover, define, and delineate the potential geothermal reservoir indicated by the Tuscarora thermal anomaly and to provide sufficient information to construct an informative case-history.

Existing Data - Fiscal Year 1978

Four (4) thermal gradient and lithology logs to depths of betweem 50 and 62 meters will be delivered to the DOE at the time of the award of a contract concerning this proposal. These data will include:

1) A map showing well locations,

2) Temperature measurements in °C at 1/2 meter intervals from the surface to 10 meters, at one meter intervals to 20 meters, and at 2 meter intervals thereafter, as conditions permit,

3) Lithology mapped from drill cuttings by a geologist,

4) Computer output of thermal data showing

   a) Graph of gradient divided into segments,

   b) Gradients in °C per kilometer, and standard deviations,

   c) Extrapolated depth to the 200°C isotherm,

   d) Calculated HF at estimated conductivity (k) values,

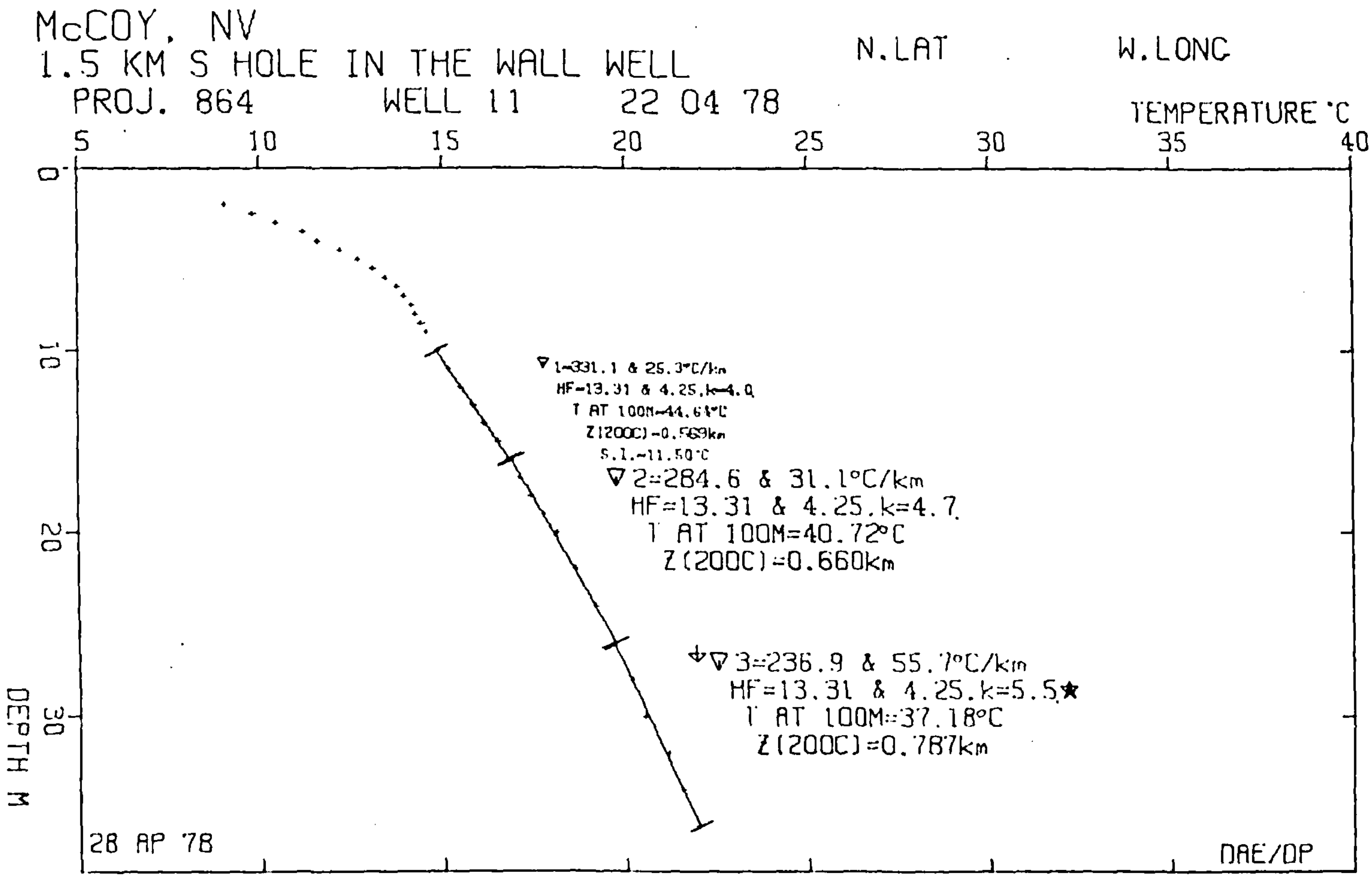
   e) Actual or projected temperature in °C at 100 meter depth,

   f) Printout of above data. An example of a thermal log and computer printout are shown on Figure 2a, b, c, d.

New Data

Approximately twenty (20) thermal gradient and lithology logs to average depths between 50 and 100 meters. This survey is designed to define and delineate the thermal anomaly in the proposal area.

Gradient wells will be rotary drilled with 4 1/2 inch or larger bits. Air will be used whenever possible. Foam or mud will be used otherwise depending upon drilling conditions. A PVC pipe approximately one inch in diameter, capped at the bottom and filled with water will be inserted into the hole to the total depth possible. The hole will be backfilled with drill cuttings and completed as specified in the geothermal regulations.



McCOY, NV
1.5 KM S HOLE IN THE WALL WELL
PROJ. 864 WELL 11 22 04 78
N.LAT
W.LONG
TEMPERATURE °C
5 10 15 20 25 30 35 40
0 10 20 30
DEPTH M
∇1=331.1 & 25.3°C/km
HF=13.31 & 4.25,k=4.0
T AT 100M=44.64°C
Z(200C)=0.569km
S.I.=11.50°C
∇2=284.6 & 31.1°C/km
HF=13.31 & 4.25,k=4.7
T AT 100M=40.72°C
Z(200C)=0.660km
∇3=236.9 & 55.7°C/km
HF=13.31 & 4.25,k=5.5★
T AT 100M=37.18°C
Z(200C)=0.787km
28 AP 78
DAE/DP

Figure 2a.

GEOTHERMAL G, AMAX EXPLORATION, INC., A.L.LANGE
28 AP 78

PROJECT: MCCOY, NV

PROJ	WELL	DA	MO	YR	WELL TITLE	EDITOR	TERRAIN	LF	LI	ISZ	IST
864	11	22	04	78	1.5 KM S HOLE IN THE WALL WELL	DAE/OP	0.0	C	0	1	1

YCM	XCM	N.LAT	W.LONG	ELEV
8.5000	31.2000			1706.9

J	SEG START	SEG END	CONDTVTY & STD DEV.	
1	10.000	16.000	0.000	0.000
2	16.000	26.000	0.000	0.000
3	26.000	36.000	5.500	0.500

PRECEEDING CONDUCTIVITY USED TO COMPUTE OTHERS
*** PREVIOUS SEGMENT USED TO EXTRAPOLATE TO DEPTH ***

PROJ	WELL	DA	MO	YR	DEPTH (M)	DEG C	DEG C/KM	SAMPLE NO.
864	11	22	04	78	2.000	9.060	99999.000	1
					2.500	9.800	1480.000	2
					3.000	10.450	1300.001	3
					3.500	11.180	1459.999	4
					4.000	11.580	800.001	5
					4.500	12.190	1220.000	6
					5.000	12.690	1000.000	7
					5.500	13.080	780.000	8
					6.000	13.430	699.999	9
					6.500	13.770	680.000	10
864	11	22	04	78	7.000	13.970	400.000	11
					7.500	14.130	320.000	12
					8.000	14.270	280.001	13
					8.500	14.420	299.999	14
					9.000	14.570	300.001	15
					10.000	14.850	280.000	16
					11.000	15.150	300.000	17
					12.000	15.450	300.000	18
					13.000	15.780	330.000	19
					14.000	16.120	339.995	20
864	11	22	04	78	15.000	16.480	360.001	21
					16.000	16.830	349.991	22
					17.000	17.120	290.009	23
					18.000	17.420	300.003	24
					19.000	17.750	330.002	25
					20.000	18.080	329.987	26
					22.000	18.620	270.004	27
					24.000	19.140	260.002	28
					26.000	19.660	259.995	29

Figure 2b.

864	11 22 04 78	28.000	20.150	245.003	30
		30.000	20.520	194.998	31
		32.000	21.160	320.000	32
		34.000	21.530	185.005	33
		36.000	22.020	244.995	34

SURFACE INTERCEPT FOR SEGMT 1 = 11.505

SEG	ZSTART	TSTART	ZEND	TEND	COND &	DCON	GRADIENT &	S.D.	HFL &	DHF	T AT 100M	KM
1	10.000	14.850	16.000	16.830	4.019	0.000	331.059	25.323	13.306	4.249	44.639	0.569

SEG	ZSTART	TSTART	ZEND	TEND	COND &	DCON	GRADIENT &	S.D.	HFL &	DHF	T AT 100M	KM
2	16.000	16.830	26.000	19.660	4.675	0.000	284.608	31.119	13.306	4.249	40.721	0.660

SEG	ZSTART	TSTART	ZEND	TEND	COND &	DCON	GRADIENT &	S.D.	HFL &	DHF	T AT 100M	KM
3	26.000	19.660	36.000	22.020	5.500	0.500	236.864	55.730	13.306	4.249	37.179	0.787

PRECEEDING SEGMENT USED FOR EXTRAPOLATION

DATA FOR THIS WELL AND PROJECT # ALREADY ON DISK!!

Figure 2c.

Explanation of Logs

∇ 2 = Gradient of 2d segment based on a least squares analysis of interval gradients.

& = $\pm$ followed by standard deviation

k = Thermal conductivity x 10^3.

HF = Heat flow in H.F.U. computed from gradient and conductivity assigned for starred segment. Heat flows for other segments are set equal and their conductivities deduced.

T at 100 m, as measured or extrapolated from gradient indicated by ↓

Z (200 C) = Depth to 200°C isotherm determined by extrapolating gradient marked ↓

S.I. = Surface intercept temperature (≃ mean annual) determined from uppermost segment.

22 04 78 = 22 April 1978, date logged

22 AP 78 = Date plotted

DAE/DP = Initials of logger/editor.

Figure 2d

A self potential survey of approximately twelve, 15-kilometer lines totaling about 180 line kilometers designed to define and delineate fault and fracture zones and potential zones of heat and thermal fluid flow. Station density along the lines will vary between 100- and 200-meter intervals depending upon the regularity of the data.

A magnetotelluric survey of approximately 30 stations recorded at 10 to .01 Hz. The stations will consist of 10, five component bases and 20 telemetered satellite stations consisting of two orthogonal pairs of electrodes. Analysis of data will yield inversions continuous in depth by the methods of F. X. Bustick, and are designed to provide resistivity depth profiles revealing thermal fluids, alteration products, and possibly magma at depth.

A gravity survey of approximately 150 stations designed to provide structural understanding of the area. Station locations will be situated so as to provide several modelling profiles across the proposal area as well as adequate grid coverage. Data processing will yield a complete Bouguer gravity map and profile models whenever possible.

A microearthquake survey of approximately 50 stations designed to map seismic activity, zones of active faulting, and possible areas of magmatism. Besides the recording and locating of microearthquakes, Poisson's ratios, P- and S-wave attenuations, and travel time anomalies will be determined.

An aeromagnetic survey of approximately 600 line-kilometers flown at a constant barometric altitude providing a minimum 305 meter (1000 foot) terrain clearance. Flight lines will be flown East-West at 1.6 kilometer spacing and will be tied by two North-South lines. The survey will provide deep magnetic and structural data of the proposed area.

Three deep (600 meter maximum) thermal gradient and lithology logs positioned to verify the shallow thermal anomaly and identify potential reservoir rocks and drilling conditions at depth.

Two deep (2300 $\pm$ meter) poduction test wells designed to discover and flow-test the potential geothermal reservoir. If warranted by drilling conditions, innovative drilling techniques will be attempted. All applicable logs and measurements will be made upon successful completion of the well.

Reservoir engineering studies will be made if warranted, and as soon as the necessary wells are available.

4. Schedule

A tentative exploration schedule is shown on Figure 3. Exact timing will depend upon permitting and equipment availability.

The exploration program is divided into three Phases (I, II, and III). Funding for Phase I is scheduled for FY 1978, Phase II, for FY 1979 and Phase III for FY 1980. Completion of the various phases will be contingent upon successful completion of the previous phases and surveys. The completion and performance of individual surveys and drill programs will be contingent upon previous experience and results. AMAX reserves the right to reschedule, substitute, or modify, with DOE concurrence, any of the phases or surveys outlined above to take advantage of new or improved technology, and any exigencies of the exploration or regulatory atmosphere.

Data will be made available according to the following schedule:

Existing Data-

Simultaneously with Phase I New Data

New Data

Phase I - Six months after completion of individual surveys or final logging of gradient wells.

Phase II - Three months after completion of individual surveys or final logging of gradient wells.

Phase III - Three months after completion of individual surveys and the logging of the well.

5. Environmental Evaluation

The 19,280 acre Tuscarora site is located north of Tuscarora, Nevada, on the South Fork of the Owyhee River at the northwest end of Independence Valley, Elevations on the site range from less than 5600 feet msl in the South Fork Owyhee River bottoms to 7000 feet msl east of Chicken Creek Summit in the northern most part of the site. The site is relatively flat in the southeast where it encompasses portions of Independence Valley. To the northwest of this area, site topography changes into dissected ridges, washes, valleys and eroded hilltops. The site is drained by the South Fork of the Owyhee River which flows northwest through the southwest portion. Hot Creek drains the center of the site, and Harrington Creek drains the eastern part of the area. These latter streams flow south into the Owyhee River near the south boundary of the site. The site is typical of the northern Great Basin.

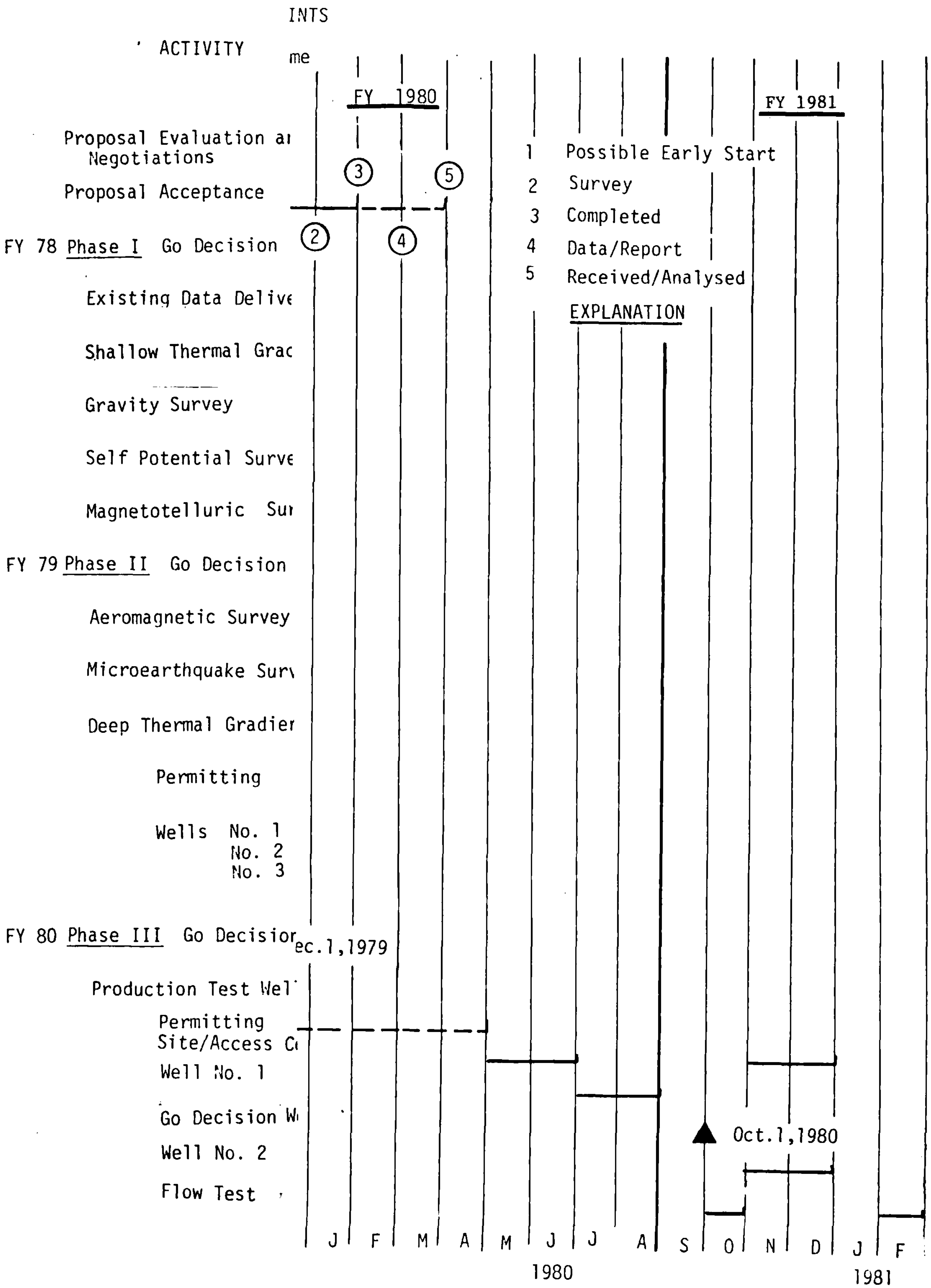

INTS
ACTIVITY
me
FY 1980
FY 1981
Proposal Evaluation ar
Negotiations
Proposal Acceptance
FY 78 Phase I Go Decision
Existing Data Delive
Shallow Thermal Grac
Gravity Survey
Self Potential Surve
Magnetotelluric Sur
FY 79 Phase II Go Decision
Aeromagnetic Survey
Microearthquake Surv
Deep Thermal Gradier
Permitting
Wells No. 1
No. 2
No. 3
FY 80 Phase III Go Decisior
ec.1,1979
Production Test Wel
Permitting
Site/Access C
Well No. 1
Go Decision W
Well No. 2
Flow Test
Oct.1,1980
1 Possible Early Start
2 Survey
3 Completed
4 Data/Report
5 Received/Analysed
EXPLANATION
J F M A M J J A S O N D J F
1980
1981

FIGURE 3

Climate can be classified as "cold desert." Mean monthly temperatures at Tuscarora range from -2°C in January to 20°C in July. Precipitation averages 27.2 cm annually with most falling in November, December, and January.

Major vegetation types include cottonwood-willow riparian in the perennial stream bottomlands, native hay meadows in the Owyhee River bottoms, big sagebrush-grassland in the upper Independence Valley at mid-elevations, and pinon-juniper shrublands at the higher elevations. Pinon pine, juniper, big sagebrush, rabbitbrush, wheatgrasses, bluegrasses and cheatgrass are typical. Mule dear, coyotes, foxes and weasels in the bottoms, blacktail jackrabbits, numerous rodents, and herptiles (particularly saurians) are common.

Approximately 50 percent of the site is privately owned and used for cattle grazing. Primary land use on non-private portions is wildlife habitat and livestock grazing. The proposed drilling would neither alter nor conflict with the current land uses.

Environmental monitoring and control of the proposed action will be explicit, and will adhere to the stipulations and requirements presented in The Geothermal Resources Operations Orders (particularly GRO Order 4) issued under the Geothermal Steam Act of 1970. In addition, the environmental requirements of any other regulating state and/or federal agency shall be followed closely.

C. Cost

A copy of GSA Optional Form 60 is attached in Appendix II.

Estimated costs are outlined below. Estimated cost to the DOE is based on 50% of actual cost of new data billed to AMAX by contractors and consultants including salaries, fringe, and expenses of temporary personnel hired by AMAX to conduct or assist in the surveys. Overhead, salaries, fringe, and expenses of AMAX permanent personnel are not included.

Item	Estimated Cost ($000)	Estimated Cost to DOE ($000)
Phase I		
Existing Data		
Shallow Thermal Gradient and Lithologic Logs		4
New Data		
Shallow Thermal Gradient and Lithologic Logs	26	13
Self Potential Survey	16	8
Magnetotelluric Survey	16	8
Gravity Survey	4	2
Subtotal Phase I (FY78)	62	35
Phase II		
Microearthquake Survey	36	18
Aeromagnetic Survey	8	4
Deep Thermal Gradient and Lithologic Logs	120	60
Subtotal Phase II (FY79)	164	82
Phase III		
Well Site Preparation	80	40
Production Test Wells	1500	750
Logs	40	20
Flow Test	150	75
Subtotal Phase III (FY80)	1770	885
PROPOSAL TOTAL	1996	1002

D. Business and Management

1. Corporate Character and Geothermal Experience

THE CORPORATION

AMAX is a broadly diversified natural resource company. In 1977 the company had sales of $1168 million and net earnings of $69 million.

AMAX explores for, produces, and markets, on a world-wide basis, molybdenum, copper, lead, zinc, iron, nickel, tungsten, aluminum, coal, potash, petroleum, and uranium. AMAX' commodity product line also includes speciality metals and numerous byproducts of the above commodities and metals.

Growth and diversification at AMAX have been accompanied by a concern for environmental matters. AMAX management believes there is no fundamental incompatibility between man's economic progress and the quality of the life he lives. Natural resources exploration and development can exist in complete harmony with conservation and recreation, and AMAX is committed to conducting its activities in a manner which best accommodates both economic and environmental aspirations.

The company frequently has been cited for the success of its environmental programs. In 1969 Business Week magazine presented AMAX with "The first annual Business Citizenship Award for the preservation of our natural environment". In 1970 the Environment Monthly called AMAX "the ecological champion of big mining companies" and recognized the company for its environmental responsibility. The Sports Foundation, Inc., gave AMAX its National Gold Medal Award in 1969 for environmental control programs, and the State of Colorado cited the company for "its outstanding contributions in the prevention of pollution to the waters of the State of Colorado". In 1974 AMAX was chosen as the sole U. S. representative from private industry to participate in an International Symposium on the Environment at Expo 74 in Spokane, Washington. AMAX presented a case study on its "Experiment in Ecology", involving the Henderson Molybdenum Mine in Colorado.

Corporate environmental programs are carried out by operations personnel and by AMAX' Environmental Services Group, whose employees include ecologists, environmental control engineers and other specialists in air and water pollution and solid waste disposal. Leading private consultants also are used by the company when needed on particular projects. This group reports directly to the executive offices of AMAX.

The AMAX Environmental Planning and Protection Committee disseminates environmental information and ideas throughout the company. It is composed of representatives of each group and division of the corporation.

Diversity, growth, and environmental responsibility highlight AMAX' response to forecasted needs for more mineral resources and the need for preservation of our environment. The company is acutely aware of projected energy shortages as well. Our commitment to geothermal resources exploration and development is a response to that need.

AMAX' GEOTHERMAL QUALIFICATIONS

AMAX first began investigating the potential of geothermal energy in the mid-1960's. Those investigations were concentrated on the Imperial Valley of Southern California. Adverse economics and a lack of the requisite technology caused a discontinuance of AMAX' activities at that time.

At the beginning of 1973, AMAX initiated new studies to provide the company with an overview of the emerging geothermal industry. Those studies indicated that opportunities attractive to AMAX were potentially available.

As a result of these studies, AMAX decided to commit some of its resources to the discovery and development of geothermal power sources, and by 1975 had assembled a highly skilled technical exploration team.

To date AMAX has conducted regional geothermal exploration programs in the western and eastern United States, and has evaluated 35 major and numerous smaller geothermal prospects. Of these, 15 have been dropped, and the remainder are in various stages of evaluation.

Since 1973 AMAX has drilled over 300 shallow thermal gradient wells, three deep thermal gradient wells, one production test well, and has been involved in the drilling of seven other production test wells. AMAX has conducted or supervised various aeromagnetic, gravity, resistivity, geochemistry, microearthquake, groundnoise, self potential and helium soil gas surveys. In addition AMAX has conducted pioneering research in surface and shallow - subsurface direct heat flow measurement, and telluric-magnetotelluric instrumentation.

AMAX' geothermal staff is well rounded in the various aspects of geothermal exploration and have all been involved in the planning, execution, and analysis of the programs and projects to which they have been assigned.

AMAX GEOTHERMAL STAFF

Technical

William M. Dolan - Manager, Geothermal Exploration
M.S., Geophysics, Graduate Stanford Executive Program: Twenty-one years' world-wide experience in geophysical, mineral, and geothermal exploration. Past President Geothermal Resources Council.

Harry J. Olson - Managing Geologist, Geothermal Exploration
Ph.D., Geology: Eighteen years' experience in mineral and geothermal exploration, and mining geology. Board of Directors, Geothermal Resources Council, Vice President, Rocky Mountain Section Geothermal Resources Council.

H. Dean Pilkington - District Geologist
Ph.D., Geology: Eighteen years' world-wide experience in mineral and geothermal exploration, and university teaching and research.

Arthur L. Lange - Geophysicist
B.S., Physics: Twenty-two years' experience in geophysical exploration and research. Performed pioneering research in correlation of microearthquake activity with geothermal phenomena and in application of computer graphics to magnetic and gravity interpretation.

William P. Long - Business Manager, Geothermal
Ph.D., Mineral Economics, B.S., Chemical Engineering: Two years' experience in geothermal development, production economics, and financing.

Frank Dellechaie - Geochemist
M.S., Geology with major work in geochemistry: Five years' experience in geothermal geochemical exploration.

John E. Deymonaz - Geologist
B.S., Geology: Three years' experience in geothermal exploration.

Larry R. Hall - Land Manager
Seven years' experience as oil engineer, oil well logger, and land surveyor. Two years' experience as land specialist.

Support

Andrea S. Aragon - Land Draftsman
Cheryl L. Caywood - Secretary/Files
D. Darline Dalman - Secretary
Virginia L. Handley - Draftsman
Jane S. Muller - Draftsman
Mark W. Sherbring - Accountant

AMAX Internal Consultation

Gerald J. Kitchen - Attorney
E. Dale Trower - Attorney
A. Percy Wicklund - Superintendent of Drilling
Jeffrey W. Todd - Staff Ecologist
William O. Lockman - Environmental Analyst
James A. Sturgess - Aquatic Biologist
Jack K. Letts - Land Manager
Mark H. Alldredge - Assistant Land Manager

Consultants

Terraphysics
815 South 10th Street, 11A
Richmond, CA 94804

Aldo T. Mazzella: Resistivity, tellurics, magnetotellurics, self potential EM soundings

GeothermEx
1760 Solano, Room 209
Berkeley, California 94707

James B. Koenig; Geothermal Geology

Elliot Zais - Reservoir Engineering
7915 N.W. Siskin Drive
Corvallis, Oregon 97330
(503) 757-9795

3. AMAX Management Plan

AMAX technical personnel will supervise and where applicable conduct the various surveys. Trained temporary personnel will be hired as field assistants and will assist in supervising the drilling and logging operations. AMAX personnel will conduct the gravity survey, and will log the thermal gradient wells with AMAX equipment. Consultants or independent contractors will be retained to advise and to provide all other technical surveys. Independent contractors also will be retained to perform road, site, and test construction; drilling programs, and the various production test logging surveys. Technical service groups will be used in computor data reduction and plotting.

AMAX personnel will be responsible for all data analysis and for exploration planning, scheduling, and budgeting. General responsibilities are as follows:

W. M. Dolan - overall performance of the proposed exploration program

H. J. Olson - operations planning, scheduling, and budgets

H. D. Pilkington - field operations and data analysis

A. L. Lange - geophysical surveys and data analysis

F. Dellechaie - project supervision

J. E. Deymonaz - project supervision

A. P. Wicklund - drilling techniques and performance.

4. AMAX technical personnel available for discussions relating to this proposal are:

Harry J. Olson, Managing Geologist, Geothermal Exploration

William M. Dolan, Manager, Geothermal Exploration

Arthur L. Lange, Geophysicist

H. Dean Pilkington, District Geologist

A. Percy Wicklund, Drilling Superintendent

AMAX Exploration, Inc.
4704 Harlan Street
Denver, Colorado 80212
(303) 433-6151

5. AMAX is willing to negotiate any provisions in the draft contract as illustrated in Enclosure 8 "Request for Proposal No. ET-78-R-08-0003 Geothermal Reservoir Assessment Cost Study, Northern Basin and Range Province".

6. The Program Technical Scope" as set forth in RFP No. ET-78-R-08-0003 has been reviewed and all data which will be furnished pursuant to a contract may be published.

7. A copy of the AMAX 1977 Annual Report is enclosed.

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

9. This proposal is signed by a vice president of AMAX Exploration, Inc. The by-laws of that corporation authorize the president and any vice president to bind the corporation through execution of contracts.

10. One complete copy of GSA Form 19B "Representations and Certifications" is attached.

AMAX EXPLORATION, INC.

Gerald Kitchen
Vice President

APPENDIX I

APPENDIX I

Federal Lease Applicationscontrolled by AMAX Exploration, Inc.

MDM, Nevada

Township 41 North, Range 51 East

Section 1 - Lots 1,2,3,4, S½N½, S½ (All)
Section 12 - E½, E½NW¼, W½SW¼, SE¼SW¼
Section 13 - N½, SE¼SW¼, N½SW¼, SE¼
Section 24 - NE¼NE¼, S½NW¼, SW¼, S½SE¼
Section 25 - N½NE¼, NW¼, SW¼SW¼, E½SW¼, SW¼SE¼, E½SE¼
Section 36 - SW¼NE¼, NW¼NW¼, SE¼NW¼, NW¼SW¼, SE¼SW¼, W½SE¼, NE¼SE¼

Township 41 North, Range 52 East

Section 3 - Lots 1,2,3, S½NE¼, SE¼NW¼, W½SW¼, NE¼SW¼, SE¼
Section 6 - Lots 3,4,5,6,7, SW¼NE¼, SE¼NW¼, E½SW¼, SE¼
Section 7 - Lots 1,2,3,4, E½W½, E½ (All)
Section 10 - W½NE¼, SE¼NW¼, NE¼SW¼
Section 18 - Lots 1,2,3,4, E½W½, E½ (All)
Section 19 - Lots 1,2, E½NW¼, W½NE¼, NE¼NE¼

Township 42 North, Range 52 East

Section 21 - SE¼NE¼, W½NE¼, E½NW¼
Section 22 - NW¼NE¼, N½SW¼, SW¼SW¼, E½SE¼ (Minerals Only - E½SE¼)
Section 23 - W½ (Minerals Only)
Section 26 - W½NW¼, NW¼SW¼ (Minerals Only)
Section 27 - E½NE¼, W½W½, SW¼SE¼, NE¼SE¼ (Minerals Only - E½E½)
Section 31 - Lots 1,2,3,4, E½W½, E½ (All)
Section 34 - E½, E½SW¼
Section 35 - SE¼NE¼, SE¼SW¼, SE¼

Fee Leases controlled by AMAX Exploration, Inc.

MDM, Nevada

Township 41 North, Range 51 East, M.D.B. & M.

Section 13 - SW¼SW¼
Section 24 - N½NW¼, W½NE¼, SE¼NE¼, N½SE¼
Section 25 - S½NE¼, NW¼SE¼, NW¼SW¼
Section 36 - N½NE¼, SE¼NE¼, NE¼NW¼, SW¼NW¼, NE¼SW¼, SW¼SW¼

Township 41 North, Range 52 East

Section 3 - Lot 4, SW¼NW¼, SE¼SW¼
Section 4 - S½NW¼, NW¼SW¼
Section 5 - Lots 2,3,4, S½N½, S½
Section 6 - Lots 1,2, SE¼NE¼
Section 8 - NE¼NE¼, W½E½, E½W½
Section 9 - S½NE¼, SE¼
Section 10 - E½NE¼, NE¼NW¼, W½W½, SE¼SW¼, SE¼
Section 15 - NE¼, W½, S½SE¼
Section 16 - E½, S½SW¼
Section 17 - E½W½, SE¼SE¼
Section 19 - Lots 3,4, SE¼NE¼, E½SW¼, SE¼
Section 20 - All
Section 21 - All
Section 29 - All
Section 30 - Lots 1,2,3,4, E½W½, E½
Section 31 - Lot 1, E½W½, E½
Section 32 - All

Township 42 North, Range 52 East

Section 25 - W½NW¼, NW¼SW¼ Portion
Section 26 - NE¼, E½NW¼, NE¼SW¼, SW¼SW¼, SE¼SE¼, Portions of N½SE¼, SW¼SE¼, SE¼SW¼
Section 27 - SW¼NE¼, E½W½, NW¼SE¼, SE¼SE¼ Portion
Section 28 - S½S½
Section 29 - S½S½
Section 32 - All
Section 33 - All
Section 34 - NW¼, W½SW¼
Section 35 - W½NE¼, NW¼NW¼, S½NW¼, N½SW¼, SW¼SW¼, less two parcels; NE¼NW¼ Portion

APPENDIX II

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 AMAX Exploration, Inc.	SUPPLIES AND/OR SERVICES TO BE FURNISHED Geothermal Exploration Logging Well Testing
HOME OFFICE ADDRESS 4704 Harlan Street Denver, Colorado 80212	
DIVISION(S) AND LOCATION(S) WHERE WORK IS TO BE PERFORMED Geothermal Group - Nevada	TOTAL AMOUNT OF PROPOSAL: $1,002,000 — GOV'T SOLICITATION NO.: ET-78-R-08-0003

DETAIL DESCRIPTION OF COST ELEMENTS ($000) ($000)

			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 ($)		
see Exhibit A			1002		
TOTAL SPECIAL TESTING				1002	
6. SPECIAL EQUIPMENT *(If direct charge) (Itemize on Exhibit A)*					
7. TRAVEL *(If direct charge) (Give details on attached Schedule)*			EST COST ($)		
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)*					
10. *TOTAL DIRECT COST AND OVERHEAD*					
11. GENERAL AND ADMINISTRATIVE EXPENSE *(Rate % of cost element Nos.)*[3]					
12. ROYALTIES[4]					
13. *TOTAL ESTIMATED COST*				1002	
14. FEE OR PROFIT					
15. *TOTAL ESTIMATED COST AND FEE OR PROFIT*				1002	

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

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

RFP No. ET-78-R-08-0003 Geothermal Reservoir Assessment Case Study, Northern Basin and Range Province

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

Harry J. Olson
Managing Geologist, Geothermal Exploration

SIGNATURE

Harry J. Olson

NAME OF FIRM

AMAX Exploration, Inc.

DATE OF SUBMISSION

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 ($)
	FY 1978	
	Phase I - Existing Data	
	Shallow Thermal Gradient and Lithologic Logs	4
	New Data	
	Shallow Thermal Gradient and Lithologic Logs	13
	Self Potential Survey	8
	Magnetotelluric Survey	8
	Gravity Survey	2
	FY 1979	
	Phase II	
	Microearthquake Survey	18
	Aeromagnetic Survey	4
	Deep Thermal Gradient and Lithologic Logs	60
	FY 1980	
	Phase III	
	Well Site Preparation	40
	Production Test Wells	750
	Logs	20
	Flow Test	75
	TOTAL	1002

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) (to the best of my knowledge

See Reverse for Instructions and Footnotes

OPTIONAL FORM 60 (10-71)

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.