GL01687

at New Mexico State University

NEW MEXICO COOPERATIVE LOW TEMPERATURE RESOURCE ASSESSMENT PROGRAM

PROPOSAL NO. NMSU-80-20-251

Submitted to the

U.S. Department of Energy

Idaho Falls, Idaho

by the

New Mexico Energy Institute

at

New Mexico State University

Las Cruces, New Mexico

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NEW MEXICO ENERGY INSTITUTE

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Endorsements:

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Transmitted by Office of Grants and Contracts

February, 1980

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1.0 INTRODUCTION

After two years participation in the of DOE-DGE/New Mexico Low Temperature Geothermal Reservoir Assessment Program, the initial goal of Phase I, the publishing of public and technical geothermal maps is nearing completion by NOAA. The NMEI/NMSU effort (with first year funding) has involved the collection, tabulation, and presentation of geological, geochemical, and geophysical data pertaining to low temperature geothermal anomalies in the state. While there are still valuable data to be obtained, such as bottom hole well temperatures throughout the state, the information which has been compiled to date will soon be in a map series that will aid individuals, companies, or government agencies in evaluating the possibility of geothermal development in a particular area. The public map showing key low temperature resource areas and key well and spring data will be publish early in 1980. The technical map showing where there are concurrences of geothermal indicators, and associated references keyed to the maps will enable people interested in a particular site to efficiently compile all relevant data. This map will be published later in 1980. Developers will then be able to determine the next logical step in the sequence of resource exploration, assessment, and development for the site of interest.

Phase II, which involves new work aimed at area resource confirmation, was initially (in the first year) concentrated at the Las Alturas anomaly in Las Cruces. These efforts have resulted in the drilling of a production well to heat the University Center and President's Residence on the New Mexico State University Campus, and the drilling of a deeper production/test well

for hot water heating on the campus and for testing of greater depths in later DOE programs. Additional Phase II work, much of which is presently nearing completion, is directed toward background data acquisition (thermal logging of existing wells, age dating of young basalts, well flow tests and hydrologic studies) in selected areas throughout the State, and initial area assessment studies at Socorro, Truth or Consequences, Chamberino, and Mesquite.

The broadly based effort to date has revealed numerous areas within the State which may prove to be viable geothermal prospects. The extent of knowledge about each of these prospect varies widely, with some requiring reconnaissance-level investigations, and others warranting detailed area specific surveys and/or gradient drilling to confirm a resource area. Area assessment must be completed where there is sufficient initial information and a potential geothermal user; assessment of less well understood prospects must continue so that some of these can be developed in the next few years, and broad-based reconnaissance is essential to locate new resources.

2.0 PROJECT PLAN

There are numerous low temperature resource areas worthy of exploration, and there is an urgency to develop geothermal energy sources in the state. New Programs currently under consideration by Congress would provide funding for Phase III, site specific exploration and feasibility studies, and Phase IV, commercialization of geothermal facilities. In view of this, the suggested budget available to the DOE-DGE/New Mexico Geothermal Low Temperature Reservoir Assessment Program for Phase II, area assessment, is relatively small. This necessitates three shifts in the emphasis of the Phase II program, area assessment, as proposed below. (1) A significant portion of this effort is concentrated in areas where there is substantial demand for alternative energy sources, and where there is the likelihood of economic geothermal development coupled with a potential user of the geothermal energy. To choose these locations, extensive use has been made of analyses conducted by the NMEI/NMSU Operations Research Group under the DOE Geothermal Regional Operations Program. (2) The exploration/assessment program at each of these areas has been planned as a coordinated and phased effort. As new data are acquired they will be interpreted in light of existing information to determine the type and extent of subsequent surveys, with the goal of either siting an exploratory test well with defined depth and temperature objectives, or abandoning the prospect area. Some surveys in this plan are proposed conditionally, depending upon the outcome of work performed earlier in the program. The research staff involved in the evaluation of the particular assessment area, in conjunction with the New Mexico Energy Institute geothermal staff, will determine whether or not these surveys should be performed.

To obtain the necessary data for assessment of a particular area private companies may be contracted with or fulltime staff may be hired to carry out certain surveys with predetermined technical specifications. Interpretations of data thus gained will be performed by the research personnel who are coordinating the area assessments.

A third shift in emphasis involves the increasingly important role of the New Mexico Energy Institute in coordinating the area-specific surveys, and in correlating and disseminating the data which have been obtained.

2.1 Project Administration

In 1974, the New Mexico State Legislature passed the Energy Research and Development Act, establishing an annual $2,000,000 program for energy research within the State for the past six years. This research program is administered by the New Mexico Institutes at New Mexico State University, the University of New Mexico, and the New Mexico Institute of Mining and Technology. The New Mexico Energy Institute at New Mexico State University (NMEI/NMSU) was charged with the ressponsibility for energy research in geothermal, solar, wind and waste conversion.

As the DOE/DGE Low Temperature Geothermal Reservoir Assessment Program has grown, two growing responsibilities have naturally fallen upon NMEI/NMSU:

(1) As extensive exploration and assessment activities have become concentrated at several promising areas, it has become increasingly important to coordinate the efforts of the researchers involved in both DOE and state-funded investigations to maximize area-specific knowledge of geothermal resources in the state. NMEI/NMSU, which has dealt directly with the research personnel of three universities in developing the exploration programs, must

be in a position to insure that there is ample communication among the researchers in a specific area, and that an exploration/area assessment sequence with clearly defined objectives is maintained for each resource area.

(2) As data have been acquired and technical reports written, it has become the function of the Energy Institute to transfer this information to the public. The Phase I geothermal maps will provide interested parties with an indication of geothermal potential in a particular area, and the associated references will list the site-specific reports. NMEI/NMSU will have to keep these reference lists current, and will have to provide many of the actual technical reports. Appropriate data will be catalogued in the GEOTHERM file, and geothermal data not accepted in the GEOTHERM file will have to be stored and/or printed, and disseminated by the Energy Institute upon request. Additionally, if geothermal development is to be stimulated, the Energy Institute geothermal staff will have to be able to evaluate the area-specific data on behalf of a potential developer/user, and to make recommendations to the potential user as to the next steps for phased site-specific development.

In order to maximize the amount of useful data obtained per assessment area, to carry out the function of area-specific survey coordination, to publicize the abundant geothermal potential of New Mexico, to disseminate technical data, and to provide guidance in the transfer of the technical information to potential users, NMEI/NMSU requests DOE/DGE support of a central program unit. This unit's personnel will consist of a Low Temperature Program Director (90% to be funded by EMD for 1980), a drilling and data collection technician (100% funded by DOE) and a graduate student for information dissemination (50% during academic year and 100% during summer). In order to expedite the collection of thermal gradient data of a variety of assessment areas, the NMEI/NMSU will either equip a NMSU truck with a

Giddings or Wesdrill trailer-mountain drill rig, mud pump and water tank and provide operating personnel from the program unit for its operation, or contract with commercial drillers for gradient holes, whichever proves the most cost-effective. Researchers at the universities will continue to analyse and interpret such data in either case.

2.2 Site-Specific Low Temperature Geothermal Reservoir Confirmation

2.2.1 Las Alturas

The Las Alturas hydrothermal anomaly is the best understood of the geothermal systems studied as part of the DOE/State funded low temperature reservoir assessment program. Temperature gradient holes, drilled to a depth of 30 meters, have been highly successful in locating a peak in the thermal anomaly, and electrical resistivity surveys have defined the depth extent and some lateral bounds of the hot water reservoir. Gravity, magnetic, and seismic profiles across the feature have revealed a basement fault which may be serving as a conduit for upwelling hot water.

Two temperature gradient test wells, drilled to depths of 300 and 360 meters, have clearly defined a hydrothermal convection system. The easternmost well, located at the peak of the near-surface temperature gradient, encounters continously increasing temperature to a maximum of 62.5°C at total depth. Resistivity, compensated densilog, and compensated neutron logs suggest a porous horizon between about 230 and 260 meters depth.

A production/test well has been drilled into this horizon with the anticipation of producing 200-300 gpm of 60°C water. This temperature and flow rate will be sufficient for heating hot water for the NMSU campus,

thereby eliminating one-sixth of the university demand for natural gas. A 150-meter well has already been completed to produce at least 8 gpm of 48°C water to be used to heat the new NMSU University Center and President's Residence.

While the Las Alturas anomaly appears at this time to be closer to producing a significant demonstration project than any other low temperature geothermal system in New Mexico, there is still a great deal that needs to be learned about the area, specifically it's north, east and south limits. The production well will have to undergo an extensive testing, the final step in reservoir confirmation, before plans can proceed with the costly installation required to use the geothermal fluids for hot water heating on the campus ($125,000 has been funded by the State of New Mexico and $250,000 by DOE for this purpose and initial engineering design of the NMSU system). Also, the hottest portion of the anomaly may not yet have been located, and the extent of the feature to the north and south along the controlling fault has not been ascertained. Two recent city-owned wells of 1000' indicate that the anomaly lies at least six miles north and approximately one mile east of the NMSU land. The anomaly extends into areas where there would be users other than the NMSU campus. The bipole-dipole resistivity survey which has been performed shows the conductive anomaly to be open-ended to the south. To the north the data indicate increased resistivities, but these coincide with a major arroyo which may be masking deeper thermal waters with shallow fresh cold water.

With the Las Alturas anomaly lying immediately adjacent to the City of Las Cruces, private companies have expressed considerable interest in ascertaining the geothermal potential of areas both to the north and south of the known hydrothermal system.

Scope of work. Approximately 25-100 30-meter temperature gradient holes will be drilled. Temperature gradient holes will be arranged along profile lines to determine if possible the N-S and E-W boundaries on the anomaly and the position of the controlling fault to trace the extent of the thermal anomaly.

The flow test of the production well will involve the temporary installation of a downhole pump capable of producing 300 gpm. The well will be pumped for approximately one week while temperature and draw-down are monitored in this and adjacent wells. Baseline data will be acquired for several days before pumping commences to ascertain barometric effects, and recovery will be monitored for up to two weeks after production is terminated. The analysis of these hydrology data will be the basis for development of the Las Alturas geothermal reservoir. This portion of the work is state-funded, and requires no DOE funds.

2.2.2 Socorro

The existence of a major geothermal anomaly at Socorro and the volatility of natural gas prices make the possibility of geothermal heating of the New Mexico Institute of Mining and Technology an attractive alternative. However, development must be planned carefully so as to avoid contamination of the City's fresh water supply, and to avoid inducing earthquakes in this, the most seismically active region in the State.

In the vicinity of the proposed NMIMT test drill site, between the campus and Socorro Mountain, it is essential to understand the regional groundwater circulation patterns, the thickness of a near-surface cold water aquifer, and the thickness of Tertiary sediments. A drilling target in the sediments

beneath the cold aquifer must be clearly defined in order to draw up design specifications for the well.

DOE funding for FY79 is presently supporting a detailed seismic reflection survey at the proposed drill site to determine the thickness of the Tertiary sediments, and an initial groundwater survey to include the sampling of springs and wells, analysis for tritium, and the compilation of water well and water quality data. FY79 funds will complete the present hydrology studies.

Hydrologic work to date has focused on the thermal springs which are the main water supply for the city of Socorro, other non-thermal springs in the Socorro Mountains, windmills in the Snake Ranch Flats alluvial basin west of the Socorro Mountains, and springs and surface water in the Magdalena Mountains west of Snake Ranch Flats which are supposed to be the source of the water further east. Tritium measurements have evidenced the existance of three groundwater zones: springs issuing from the Magdalena Mountains show "high" tritium contents ($\geq$ 40 TU), indicating "young" water; the groundwater from windmills in the Snake Ranch Flats is "old", based upon "low" tritium content ($\leq$3 TU); springwater from the Socorro Mountains is "intermediate" (10 to 20 TU). The preliminary conclusion is that the Snake Ranch Flat water circulates very slowly and that Socorro springs are made up of a mixture of this "old" water with recent recharge.

Water chemistry studies have shown that the water in the Magdalena Mountains is of the calcium-bicarbonate type while springs and groundwater in the Socorro area are of the sodium-calcium-bicarbonate type. This could be due to ion exchange as the water from the west flows through the volcanic Socorro Mountain complex, or could result from mixing of two different sources (e.g., surface water and water of volcanic origin). The former explanation seems more likely at this point.

Based on water level measurements in wells a preliminary water level map for the Snake-Ranch Flats basin has been constructed. This map is to be a starting point for model studies and mapping of groundwater flow patterns.

Scope of work. Expanded isotope and geochemical studies will be performed to aid in the analysis of geologic and hydrologic conditions in the vicinity of the drill site. If after analysis of all the data, a drilling target is not defined, a commercial seismic reflection survey could be highly advantageous in resolving ambiguities. This survey, however, is not currently proposed.

Details of the hydrologic investigation are as follows: (1) Tritium measurements are to continue in order to detect systematic time variations in the tritium content of the springs. This is needed to gain a quantitative understanding of the recharge mechanism. (2) Tritium measurements are to be supplemented with measurement of the stable isotopes oxygen-18 and deuterium. These are a useful complement to water quality studies to ascertain water sources and rock/water interactions. For example, geothermal waters can be identified because their isotope composition is usually quite different from surface or ordinary groundwater. (3) Water level data will be subjected to a novel statistical analysis called Kriging. This establishes confidence limits on contours and computes alternative contour configurations. Groundwater contour maps are usually non-unique, so that conclusions based on a specific contour map are not unique. Kriging allows confidence limits to be established for alternative conclusions. (4) An attempt will be made to connect the water level pattern in the Socorro Mountain-Snake Ranch Flats area with that in the Rio Grande valley. The purpose of this is to determine the relation and connections between these two aquifer systems. A shallow thermal gradient grid of approximately 8-100 30m holes will be planned to locate a prime site or sites for deep test well drilling.

Once the surveys discussed have been interpreted it is hoped that the production well decision can be made in conjunction with developing geothermal energy for use on the NMIMT campus (under Phases III and IV of the proposed DOE program) unless the Socorro citizens legally block this development.

2.2.3 Truth or Consequences

Investigations continue in the Truth or Consequences area as funded under the FY79 program. Data concerning gravity studies to better define the faults and possible hot water recharge zones and the geometry of the basins and possible geothermal reservoirs are being interpreted. Field mapping of all late Cenozoic faults in the area has being completed. Temperature logging of all available wells has been completed, and this information along with the data from the geological and geophysical studies will be used to plan a program of shallow gradient drilling. Since this work is not complete at this time, no FY80 funding is sought for this area.

2.2.4 Albuquerque

Several factors contributed to selection of a prime geothermal target area in the vicinity of Albuquerque on the West Mesa. The target area is approximately 15 km by 15 km and includes the city's western limits. The area is centered about 15 km from the University of New Mexico campus and includes the site of the proposed new airport for Albuquerque. Positive geothermal indicators include: (1) the young Albuquerque volcanoes age dated at 190,000 years; (2) shallow swarm earthquakes monitored by the U. S. Geological Survey beginning in October, 1978 and peaking with a magnitude 2-2.5 earthquake on March

30, 1979 (personal communication with the U.S.G.S. on September 5, 1979 confirms the continuation of seismicity in the target area but to a lesser extent.); (3) reports of warm municipal water wells (∿32°C); (4) temperature gradient measurements in municipal and private wells yielding gradients exceeding 50°C/km in the targe area versus gradients of less than 30°C/km in other portions of the city; and (5) large gravity anomally (at least 5 mGal residual) flanking the target area and indications of associated magnetic anomalies from U.S.G.S. aeromagnetic maps. This combination of geological and geophysical data confirmed the target area to be active geologically and geothermally anomalous.

During 1979, 50 shallow gradient holes (<25/m) were drilled based on electrical resistivity reconnaissance and gravity/magnetic anomalies. Resistivity measurements included both sounding and mapping.

Three deep electrical soundings show that the resistive basement (≥100 ohm-m) is over 3 km deep over much of the target area. Shallower water-saturated zones are clearly correlated with the resistivity soundings, especially when the zones are of lower water quality (<10 ohm-m). Such confirmations result from comparison with electric logs to depths of approximately 500 m run in the Albuquerque city wells in the area. A correlation between resistivity and temperature in the wells has not yet been confirmed owing to a masking by pronounced lithologic variations.

Resistivity reconnaissance mapping in the area has allowed the sounding information to be extended to more than 60 km^2 area. Although this is only about one-fourth of the target area, the results have revealed a pronounced lateral resistivity contrast where gravity and magnetic anomalies were dectected earlier. Following the preliminary interpretation that such a feature (or series of features) represents buried elevated structures with associated

hidden volcanics, shallow temperature gradients were drilled in a grid over the anomalous area. Of the holes drilled, one yielded the maximum geothermal gradient ($\sim$80°C/km), measured below the depth of the annual temperature variation, approximately 15 m.

The shallow grid will be followed by deeper holes before mid-1980 (perhaps 3 or about 100m depth or one of 300 m depth).

Scope of Work. It is proposed to drill additional evaluation holes, to expand the resistivity and surface magnetic mapping, and to do detailed resistivity profiling where deemed appropriate in the present assessment area. Such surveying and drilling would be most cost effective prior to any proposal to drill deeper holes.

Initial geological, geochemical, and geophysical reconnaissance will also be initiated in other promising assessment areas near Albuquerque. These include the area of the Jemez reservoir and Santa Ana Mesa about 35 km north of Albuquerque, the Puerco fault zone 35 km west of the city, and the Cat Hills volcanoes, 30 km to the southwest. The area of the Jemez reservoir is one of the deepest portions of the Albuquerque basin as attested by a large negative gravity anomaly; thus, a vast potential reservoir exists. This location also has been measured by Swanberg (personal communications, 1978-79) as having high geochemcial temperatures (SiO_2-120°C, Na K Ca-150°C). The Puerco fault has exhibited heat flow values as high as 3.1 as measured by Reiter (personal communication, 1978) and extensive faulting may provide deep circulation zones. The Cat Hills volcanoes represent some thirty cinder cones and basalt flows; the latest eruption is dated to be 140,000 years (Kudo, personal communications, 1978). These young volcanoes, associated faults, and deep basin fill provide positive geothermal indicators.

To aid in the electrical investigations, it is proposed to purchase a 500 watt resistivity transmitter to be initially located at UNM. This will result in more efficient, more rapid electrical resistivity evaluation of the Albuquerque geothermal prospect. Its addition will provide researchers with a light-weight, highly mobile, high powered transmitting unit to complement their present 15 kilowatt unit. Three on-hand receivers would be used with both transmitted units.

2.2.5 Columbus

This is located in Luna County about 30 miles south of Deming near the border cities of Columbus, New Mexico, and Palomas, Chihuahua, Republic of Mexico. An industrial park and new border facilities have been planned for this area. Geothermal energy may play a significant role in making these proposed facilities energy self-sufficient, in addition to providing the opportunity for international cooperation in developing resources which may well straddle the international boundary.

The present assessment program requires a total of $88,854 to conduct area-specific electrical resistivity and geothermal gradient studies in the area. The bulk of money ($75,000) including funds for test drilling has been funded by the State of New Mexico. The remaining funds ($13,854) are being requested as part of the DOE state coupled geothermal program to help support key personnel involved in the investigation.

The geothermal potential of the Columbus area has been discussed by Swanberg (1978). Geologic evidence of enhanced geothermal potential includes late Pliocene and Quaternary basaltic volcanoes, deep sedimentary basins of the Rio Grande Rift, and faults active in the late Quaternary (Seager and Morgan,

1979). In addition, the chemistry of warm water wells (>30°C) in the area suggest that subsurface temperatures may be as high as 150°C (Swanberg, 1978).

The above information is reconnaissance in nature and can be used only to demonstrate that a detailed search for a geothermal prospect has a resonable chance for success. The present studies are designed to search for and evaluate any geothermal sites that might be located in this geologically favorable area.

2.2.6 Tularosa Basin

This is the largest tract of land in the contiguous United States that has excellent geothermal potential, but has not been studied in that regard. Investigators at the University of Texas at El Paso have traced the Hueco Tanks geothermal anomaly as far north as the New Mexico border near the southern end of the Tularosa Basin.

White Sands Missile Range, which covers most of the Tularosa Basin and is faced with a mandate to locate alternative energy sources, has provided $10,000 seed money for assessment of existing geological and geophysical data in the immediate vicinity of the Range headquarters. The Department of Defense has recently become involved in geothermal studies at Williams Air Force Base in Arizona and Hill Air Force Base in Utah, and is likely to provide future support for the Tularosa Basin.

Scope of work. A representative selection of drill holes from all parts of the military land will be logged to obtain temperature gradient data, and chemical analyses will be performed on selected groundwaters. The new and existing data will be interpreted to locate new assessment areas for further exploration.

2.2.7 Chamberino and Mesquite

Water temperature, geochemical thermometer temperatures, and two resistivity soundings indicate a probable low temperature geothermal resource east of Interstate 10 near Chamberino and Mesquite, New Mexico. This area lies about halfway between Las Cruces, New Mexico, and El Paso, Texas, in a rapidly growing portion of the Rio Grande River Valley.

The geothermal assessment area lies along the same trend (the Valley Fault) as the Las Alturas geothermal anomaly near Las Cruces, and bears significant similarities with it. Both appear to be bounded by north-south trending faults, uplift to the east, which may be serving as conduits for upwelling hot water.

FY 1979 funds have already supported performance of electrical resistivity surveys (Schlumberger, bipole-dipole and magnetotelluric) to determine the extent and thickness of the low resistivity zone, which may be associated with hot water.

Conditional scope of work. If the electrical investigations locate a low resistivity anomaly of significant size, then temperature gradient data will be obtained to define the thermal characteristics of the anomaly. Available free holes will be located and temperature logged, and approximately 15-100 new shallow temperature gradient holes will be drilled. At this point, sufficient data will have been obtained to site the optimum location for the intermediate depth test well if it is warranted by the previous investigations.

2.3 Preliminary Investigations of Additional Geothermal Sites in New Mexico

2.3.1 Northwest and Northeast New Mexico Counties

Northwest New Mexico is the fastest growing area of the State, with increasing activity in the mining of coal and uranium, and drilling for oil, gas, and, of course, use of groundwater necessary for all these activities. The explosion in population in Farmington, Gallup, and Grants dictates a current and near future need for replacement of the conventional fuel energy consumption in the area.

Past work has shown several isolated localities in the northwestern New Mexico counties which possess geothermal potential: several high temperatures, above 150°C, have been interpreted from geochemistry (Swanberg, unpublished); a partial analyis of bottom hole temperature data from deep wells has revealed some temperature gradients 1.5 times normal (USGS Circular 790); recent temperature measurements in water wells in the Zuni Mountains near Gallup have proven to be anomalously high (Levitte, LASL).

DOE/DGE FY 1979 funds are presently supporting a study to isolate potential geothermal sites in the five northwestern counties (San Juan, McKinley, Rio Arriba, Sandoval, and Valencia), primarily on the Colorado Plateau. Bottom hole temperature data have been collected from approximately 10,000 wells. Additional well data will be collected, along with information on the geohydrology, structure, and stratigraphy. These data are to be assessed, with a view ultimately to prepare a map of potential sites in the New Mexico portion of the Colorado Plateau.

Scope of work. The present funding will support the efforts in the Northwest counties through May 1, 1980. Additional funding will continue the

work in the Northwest counties through completion in 1980 and extend the collection of bottomhole data into Taos, Colfax, Mora, San Miguel and Santa Fe counties.

3.0 ORGANIZATIONAL AND MANAGEMENT PLAN

3.1 The New Mexico Energy Institute at New Mexico State University

The New Mexico Energy Institute at NMSU has been designated at the lead institution for geothermal research within the New Mexico Research and Development Program by the New Mexico Energy and Mnerals Department. As such, it administrates state research projects and coordinates these with federal geothermal programs.

3.2 Interfacing Organizations

Researchers at the State's three primary universities, the University of New Mexico, the New Mexico Institute of Mining and Technology and the New Mexico State University, contribute their unique expertise to the State's benefit in this and other programs through a combination of subcontracts and memoranda of agreements. NMEI/NMSU will continue to support the integrated research efforts within the university system, as well as interfacing with it's state agency, the EMD, and its technical advisors within the national laboratories in New Mexico.

4.0 PROPOSED BUDGET

	DOE	UNIVERSITY COST SHARING
1. Salaries, Wages and Fringe Benefits		
Faculty/Staff Salaries:		
EI Program Unit-Project Manager (90%)		$22,750(1)
EI Program Unit-Technician (100%)	$15,000	
Las Alturas	1,114	(3)
Socorro (thermal gradient analyses)	1,114	
Columbus		(2)
Tularosa Basin	3,591	
Chamberino-Mesquite	3,591	
NW/NE New Mexico Counties	2,000	
TOTAL FACULTY/STAFF SALARIES	$26,410	
Student Salaries:		
EI Program Unit-Graduate Assistant	$ 7,500	
Las Alturas	464	
Socorro (thermal gradients analyses)	464	
Columbus	9,361	
Tularosa Basin	9,361	
Chamberino-Mesquite	2,436	
NW/NE New Mexico Counties	4,270	
TOTAL STUDENT SALARIES	$33,856	

Fringe Benefits:		
Faculty/Staff F.B. (15.13% of $26,410)	$ 3,996	$ 3,443(1)
Student F.B. (2% of $33,856)	678	
TOTAL FRINGE BENEFITS	$ 4,674	
TOTAL S,W AND F.B.	$64,940	
2. Travel		
EI Program Unit	$ 5,005	$ 1,000(1)
Las Alturas		(3)
Columbus		(2)
Tularosa Basin	2,020	
Chamberino-Mesquite	2,020	
NW New Mexico Counties	2,424	
TOTAL TRAVEL	$11,449	
3. Permanent Equipment		
EI Program Unit	$10,000	
Truck-mounted water tank @ $2,000; Giddings or Wesdrill, trailer-mounted drill rig, drill pipe, mud pump @ $8,000		
In UNM Subcontract	-0-	
1 - Scintrex TSQ-2E, 500 W Resistivity Equipment @ $7,089		
TOTAL EQUIPMENT	$10,000	

4. Expendable Supplies:		
EI Program Unit	$10,900	$ 1,000(1)
General @ $1,000		
Drilling Supplies @ $9,900		
(300 holes)		
Columbus		(2)
Tularosa Basin	$ 500	
Chamberino-Mesquite	300	
NW New Mexico Counties	200	
TOTAL SUPPLIES	$11,900	
5. Computing Costs		
EI Program Unit	$5,000	
Columbus		(2)
Tularosa Basin	200	
Chamberino-Mesquite	200	
NW New Mexico Counties	500	
TOTAL COMPUTING COSTS	$ 5,900	
6. Other Direct Costs		
EI Program Unit: Publications	$ 1,390	$ 1,000(1)
Columbus: Publications		(2)
Gradient Drilling		
Tularosa Basin: Publications	900	
Chemical Analyses	1,000	
Chamberino-Mesquite: Publications	300	
NW New Mexico Counties: Publi-	354	
cations		
TOTAL OTHER DIRECT COSTS	$ 3,944	

7. Subcontracting		
Socorro-NMIMT	$ 9,350	
Albuquerque-UNM	103,770	
TOTAL SUBCONTRACTING	$113,120	
8. Indirect Costs		
At NMSU-48% of total modified on-campus direct costs ($108,153)	$51 914	
*At NMIMT-40% of Salaries, Wages ($4,850)	1,940	
*At UNM-53% of Salaries, Wages ($46,929)	24,873	
TOTAL INDIRECT COSTS	$78.727	
TOTAL CONTRACT COSTS	$300,000	$230,000

*Not included in subcontracting figures.

1. EMD 78-2238
2. 68R-2204 ($75,000 total; budget being negotiated)
3. 68R-2207 ($125,000 total; budget being negotiated)
4. NMSU Arts & Sciences Research Unit

References

Swanberg, C.A., 1978, Chemistry, origin and potential of geothermal resources in southwestern New Mexico and southeastern Arizona; New Mexico Geol. Soc. Guidebook, 29th Field Conference, Land of Cochise, p. 349-351.

Seager, W.R., and Morgan, P., 1979, Rio Grande Rift in southern New Mexico, west Texas, and northern Chihuahua; Rio Grande Rift: Tectonics and Magnetism: American Geophysical Union, Washington, D. C.; p. 87-106.

GL011647

NEW MEXICO COOPERATIVE LOW TEMPERATURE RESOURCE

ASSESSMENT PROGRAM

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Submitted to the
U.S. Department of Energy
Idaho Falls, Idaho

by the

New Mexico Energy Institute
at
New Mexico State University
Las Cruces, New Mexico

March 31, 1980

NEW MEXICO COOPERATIVE LOW TEMPERATURE RESOURCE

ASSESSMENT PROGRAM

?'s:
Task 3
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PROPOSAL NO. NMSU-80-20-251 REVISED

Submitted to the

U.S. Department of Energy

Idaho Falls, Idaho

by the

New Mexico Energy Institute

at

New Mexico State University

Las Cruces, New Mexico

March 31, 1980

NEW MEXICO ENERGY INSTITUTE

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NEW MEXICO COOPERATIVE LOW TEMPERATURE RESOURCE ASSESSMENT PROGRAM

PROPOSAL NO. NMSU 80-20-251R

Submitted to the

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New Mexico State University
Las Cruces, New Mexico

Endorsements:

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Transmitted by Office of Grants and Contracts

March 31, 1980

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1.0 INTRODUCTION

After two years participation in the DOE-DGE/New Mexico Low Temperature Geothermal Reservoir Assessment Program the initial goal of publishing public and technical geothermal maps is nearing completion. The NMEI/NMSU effort has involved the collection, tabulation, and presentation of geological, geochemical, and geophysical data pertaining to low temperature geothermal resources in the state. While there are still valuable data to be obtained, the information which has been compiled to date will soon be published as a map series that will aid individuals, industries, or government agencies in evaluating the possibility of geothermal development in a particular area. A public map showing well and spring data and delineated low temperature resource areas will be published in mid-1980. A technical map showing basic data related to geothermal resources and an accompanying publication of associated references will enable people interested in a particular site to efficiently compile all relevant data. These basic data include the distribution and temperatures of thermal wells and springs; abnormally high water, oil and gas well bottom hole temperatures; estimated temperatures by SiO_2 and Na-K-Ca geothermometers; salinity of groundwater; heat flow; deep sedimentary basins; seismicity; late Tertiary and Quaternary faults, Quaternary volcanic rocks and major volcanic centers; and electrical resistivity. This map will be published near the end of 1980 or Spring, 1981. With these two maps potential developers and users of geothermal energy will have a highly useful basic resource for undertaking a complete geothermal assessment and development of any site.

The broadly based research effort to date has revealed numerous areas within New Mexico which may prove to be viable geothermal prospects. The extent of knowledge about each of these prospects varies widely, with some requiring additional reconnaissance-level investigations, and others warranting detailed local surveys, possibly including gradient drilling to confirm the resources. Area assessment should be completed first in those areas where there is sufficient information to suggest some geothermal resource and where there is one or more potential geothermal users; assessment of less well known prospects should continue so that the data on these areas may be upgraded in the next few years. A continuing broad-based reconnaissance program is also needed in order to locate new resources, in particular, those which do not have any apparent surface manifestations.

Other work, aimed at area resource confirmation, was done at the Las Alturas geothermal anomaly near Las Cruces. State funds were used to drill a production well to heat the University Center and President's Residence on the New Mexico State University campus. A deeper production/test well has been drilled (50% DOE and 50% state funds) for hot water heating on the campus and for determining aquifer characteristics for reservoir assessment. Additional assessment work, has been directed toward acquiring background data on the West Mesa of Albuquerque (state funded) and in Sierra, Dona Ana, Luna, Otero, San Juan, McKinley, Rio Arriba, Sandoval, Valencia and Socorro Counties (DOE funded).

2.0 PROJECT PLAN

The program is divided into two parts: Phase I (state wide assessment tasks) and Phase II (area resource assessment tasks). Phase I deals with certain tasks which need to be performed or completed in order to more fully assess the low temperature geothermal potential of New Mexico. These Phase I activities also help to delineate new geothermal resources throughout the state. Phase II deals with tasks which are needed to refine the assessment of certain local geothermal resources. Current targets have been selected from an analysis of the existing data that will be presented on the public and technical geothermal maps. Extensive use was also made of analyses conducted by the NMEI/NMSU Operations Research Group under the DOE Geothermal Regional Operations Program in locating the targets. These analyses helped to determine where there is a likelihood of having economic geothermal development coupled with potential users of the geothermal energy. In order to accomplish the tasks proposed herein, university researchers and private companies or consultants will be subcontracted to carry out certain investigations with predetermined technical specifications and deliverables. The subcontractors named in the task budget (section 4.1) have been selected on the basis of preliminary program discussions. If any determine they cannot participate under the proposed task budgets when the subcontracts are negotiated, NMEI/NMSU will find other subcontractors to carry out the program. An ongoing analysis and synthesis of incoming monthly results will be performed by the Low Temperature Program staff in order that current data and information are available to the public.

i.e. George!

2.1 Project Administration

In 1974, the New Mexico State Legislature passed the Energy Research and Development Act, establishing an annual $2,000,000 program for energy research within the State. This research program is administered by the New Mexico Institutes at New Mexico State University, the University of New Mexico, and the New Mexico Institute of Mining and Technology. The New Mexico Energy Institute at New Mexico State University (NMEI/NMSU) was charged with the responsibility for energy research in geothermal, solar, wind and waste conversion. On the average, the annual geothermal investment from the New Mexico Research and Development Program has been $296,909.

In 1978, the NMEI/NMSU received its first DOE-DGE funds for low temperature geothermal resource assessment. As the DOE-DGE Low Temperature Geothermal Reservoir Assessment Program has grown, two responsibilities of NMEI/NMSU have increased in importance:

(1) As extensive exploration and assessment activities have become concentrated at several promising areas in the state, it has become essential to coordinate the efforts of the subcontractors involved in either DOE and state-funded investigations to maximize knowledge of geothermal resource areas in the state. NMEI/NMSU must insure that there is ample communication among the subcontractors about specific resource areas, and that an exploration/area assessment sequence with clearly defined objectives is developed for each area.

(2) As data have been acquired and task technical reports written, it has become the function of the Energy Institute to transfer this information to the public and to DOE. The initial public and technical geothermal maps to be published by NOAA will provide interested parties with an indication of

geothermal potential in a particular area, and the associated references will list the specific technical reports already published. NMEI/NMSU will need to keep these maps and reference lists current, to publish interim maps with new data, and to provide potential users with published technical reports. Appropriate new data will be catalogued in the GEOTHERM file. Raw geothermal data will be maintained in NMEI/NMSU computer files or possibly the New Mexico Heritage file for dissemination by the Energy Institute upon request. The data will be retrievable in both longitude and latitude and township and range format. As geothermal development is stimulated in the state, the Energy Institute geothermal staff will be able to evaluate the area data on behalf of a potential developer/user, and to make recommendations to the user of the next steps for phased site-specific development.

time limit! ?

2.2 FY 1980 Program

2.2.1 Program Personnel

builds bureaucracy - no one else has this on state teams NMSU should do w/ state $$

NMEI/NMSU requests DOE-DGE funding support for the following personnel: 1) Low Temperature Program Director (100% funded by DOE for FY 1980), 2) a field engineer (100% funded by DOE for FY 1980) and 3) a graduate student for information dissemination (50% time during academic year and 100% time during summer funded 100% by DOE).

this comes from a suggestion that a lot of resource data exist, but they are unavailable to the public -

These personnel will enable the institute to maximize the amount of useful data obtained per assessment area, carry out the coordination of regional surveys, publicize the abundant geothermal potential of New Mexico, disseminate technical data, and provide guidance in the transfer of the technical information to potential users.

2.2.2 Project Tasks

The following are applicable to all project tasks: Subcontractors will submit monthly reports with collected data and a summary of the work accomplished. These reports will include estimates of the percentage of work completed and the percentage of budget spent. The NMEI/NMSU will provide DOE, LASL, USGS AND URRI with monthly summaries of the interim reports for all project tasks and detailed semi-annual and final reports on these tasks.

Phase I (State-Wide Tasks)

TASK 1. Completion of public and technical maps currently under production. The subcontractor shall complete the public and technical maps of New Mexico. Final review and revision is needed for the public geothermal map prior to the final printing by NOAA. The initial draft of the technical map is scheduled to be sent to NOAA by June 30, 1980. Further reviews and updates of the technical map will be required prior to publication in 1981. The publication of these maps will represent the state of geothermal knowledge to date. The deliverables will consist of: 1) mylar overlays (scale 1/500,000) of each data set shown on the two maps to the NMEI/NMSU and 2) draft copies of each map as specified by NOAA.

TASK 2. Completion of the collection of oil and gas well data. The subcontractor shall complete the collection of oil and gas well data for New Mexico. The data will include bottom hole temperatures and depths, latitude-longitude and township-range of well locations, and, where available, the bottom hole geological formations and their ages. The deliverables will

Lallstrat. would be helpful

consist of: 1) tabulated data and 2) a map and a mylar overlay (scale 1/500,000) showing well depth, bottom hole temperature and formation name and age, if known.

TASK 3: Updating of NOAA maps. The NMEI and subcontractors shall collect necessary data from on-going DOE and non-DOE funded research for updating the NOAA maps. Work is to include the plotting and drafting of new data on mylar overlays which will serve as up-to-date addenda to final draft mylar overlays for each data set from which the initial public and technical geothermal maps were constructed. The following maps may be updated: seismic, water quality, electrical surveys, and thermal gradients. This will give NMEI the ability to generate blue line addenda maps at any particular time for prospective users and be in a position to give an accurate and current assessment of potential geothermal resources throughout the state. The deliverables will be 1) the tabulated new data in the same format as the original data set and 2) mylar map (scale 1/500,000) overlays with new data.

TASK 4. Construction of a lineament map. The subcontractor shall construct a lineament map of the state. LANDSAT photos of the appropriate scale will be used to generate the lineament map. The deliverables shall consist of 1) the lineament map and mylar overlay (scale 1/500,000), 2) a written report and 3) the photographs used.

TASK 5. Collection of existing water well data. Collection of existing water well data in the southern Rio Grande Rift and the southwestern part of the state is to be accomplished by the NMEI/NMSU field engineer. The data collected will include, where possible, temperature logs of abandoned water

wells, lithologies and drill cuttings. The deliverables will include 1) a temperature gradient map and mylar overlay (scale 1/500,000), 2) a heat flow map and mylar overlay (scale 1/500,000) if enough lithologic data are available to establish thermal conductivities, 3) county maps (scale 1/250,000) will also be prepared in areas of high data density, 4) data utilized and 5) a short interpretive report.

Phase II (Area Resource Assessment Task)

TASK 6. West Mesa of Albuquerque. The subcontractor shall complete a magnetic survey on Albuquerque's West Mesa and drill and temperature log 5 shallow ($\sim$50m) thermal gradient wells. A dipole-dipole resistivity survey will be conducted on the West Mesa area to detect lateral variations in resistivity at depth in order to attempt to locate fault controlled geothermal sources within the ground water reservoirs. The deliverables will include 1) magnetic, electrical resistivity and thermal gradient data obtained, 2) an interpretive report and 3) appropriately scaled maps of each of the three data sets.

TASK 7. Dona Ana and Luna Counties. This task deals with the Dona Ana-Luna county area which is suspected of having significant geothermal potential. The subcontractors shall drill 20 shallow ($\sim$30m) temperature gradient holes, measure the thermal gradients of these holes, and conduct regional resistivity work in Dona Ana County. The deliverables will include 1) the data produced, 2) an interpretive report, 3) a resistivity map (scale 1/250,000) and 4) a temperature gradient map (scale 1/250,000).

Task 8. Hydrologic Study of the Animas Valley Lightning Dock KGRA Area. The subcontractor shall use hydraulic data to conduct a preliminary computer simulated model for calibration of hydraulic properties of the ground water reservoirs. Quarterly water quality samples and temperature measurements will be obtained from wells in the area for use in calculating the chemical and thermal dispersive properties of the reservoirs. The deliverables will include the results of the ground water computer simulation; compilations and interpretive report; and, appropriately scaled maps of water quality analysis, ground water temperature data and ground water flow patterns including ground water divides and barriers.

maybe OK, but needs justification
pvt lease situation (?)
user coupled realm (?)
hi T a direct use

3.0 ORGANIZATIONAL AND MANAGEMENT PLAN

3.1 The New Mexico Energy Institute at New Mexico State University

The New Mexico Energy Institute at NMSU has been designated the lead institution for geothermal research within the New Mexico Research and Development Program by the New Mexico Energy and Minerals Department. As such, it administrates state research projects and coordinates these with federal geothermal programs.

3.2 Interfacing Organizations

Researchers at the State's universities contribute their unique expertise to the State's benefit in this and other programs through a combination of subcontracts and memoranda of agreements. NMEI/NMSU will continue to support the integrated research efforts within the university system, as well as interfacing with it's state agency, the Energy and Minerals Department, and it's technical advisors at the Los Alamos Scientific Laboratory.

3.3 Work Schedule

1980-81

TASK	Summer 1980	FALL	SPRING	Summer 1981
PROJECT ADMINISTRATION	← monthly reports due →	semi-annual report due	← monthly reports due →	annual report due
(1)	publication of public geothermal map; first draft of technical geothermal map	revision of technical geothermal map	second draft of technical geothermal map	final revision and publication of technical geothermal map
(2)	completion of field work necessary for collection of data	data reduction and preliminary report	final revision and drafting	final reports, maps, and other deliverables due
(3)	← ongoing analysis and synthesis of incoming data for the updating of the NOAA maps →		"	"
(4)	← construction of lineament map →		"	"
(5)	← ongoing aquisition and reduction of temperature and lithologic data →		"	"
(6)	Electrical and magnetic field work complete. Temperature gradient holes drilled and logged.	data reduction and preliminary interpretations	"	"
(7)	Temperature gradient holes located, drilled and measured. Resistivity field work completed.	data reduction and preliminary interpretations	"	"
(8)	existing data and new field data collected	preliminary computer simulation conducted	chemical and thermal dispersive properties of reservoir calculated from quaterly measured data	"	"

4.0 FY 1980 BUDGET

4.1 Program Personnel and Task Budgets

DESCRIPTION: Program Personnel

	DOE	University Cost Sharing
1. Salaries, Wages and Fringe Benefits		
Faculty/Staff Salaries:		
Project Director-to be employed		
100% for 1½ months SFY*, 1980	$ 2,995	
100% for 10½ months SFY, 1981	$23,481	
TOTAL FACULTY/STAFF SALARIES	$26,476	
Student Salaries:		
Graduate Student		
100% for 3 months Summer, 1980	$ 2,226	
50% for 9 months AY Fall-Spring, 1981	$ 4,930	
TOTAL STUDENT SALARIES	$ 7,156	
Fringe Benefits:		
Faculty/Staff (15.13% of $26,476)	$ 4,006	
Student (2.0% of $7,156)	$ 143	
TOTAL FRINGE BENEFITS	$ 4,149	
TOTAL SALARIES, WAGES, BENEFITS	$37,781	-0-
2. Travel		
Organizational Meetings		
3000 miles @ 25¢/mile	$ 750	
Per diem @ $32/day in-state, 20 days	$ 640	
To scientific meetings	$ 500	
TOTAL TRAVEL	$ 1,890	-0-
3. Permanent Equipment		
Specific description of research equipment:		
TOTAL PERMANENT EQUIPMENT	-0-	-0-

*SFY-New Mexico State Fiscal Year July 1-June 30.

	DOE	University Cost Sharing
4. Expendable Supplies		
TOTAL EXPENDABLE SUPPLIES	-0-	-0-
5. Computing Costs		
C.P.U.	$ 5,000	
TOTAL COMPUTING COSTS	$ 5,000	-0-
6. Other Direct Costs		
Equipment Rental		
Terminal Lease @ $100/mo.	$ 1,200	
Other Report Costs	$ 500	
Publication of DOE Reports	$ 2,600	
TOTAL OTHER DIRECT COSTS	$ 4,300	-0-
7. Subcontracting (list)		
TOTAL SUBCONTRACTING	-0-	-0-
8. Indirect Costs		
At 48% of modified total on-campus direct costs ($48,971)		
TOTAL INDIRECT COSTS	$12,010	$11,496
TOTAL TASK COST	$60,681	$11,496

DESCRIPTION: Task 1. Completion of public and technical maps currently under production.

	DOE	University Cost Sharing
1. Salaries, Wages and Fringe Benefits		
Faculty/Staff Salaries:		
Dr. Chandler Swanberg		
33% for 3 months Summer, 1980	$ 2,440	
15% for 9 months AY Fall-Spring 1981	$ 3,689	
Research Aide		
75% for 1½ months SFY*, 1980	$ 825	
75% for 10½ months SFY, 1981	$ 8,620	
TOTAL FACULTY/STAFF SALARIES	$15,574	
Student Salaries:		
500 hrs. @ $3.50/hr.	$ 1,750	
TOTAL STUDENT SALARIES	$ 1,750	
Fringe Benefits:		
Faculty/Staff (15.13% of $15,574)	$ 2,356	
Student (2.0% of $1,750)	$ 35	
TOTAL FRINGE BENEFITS	$ 2,391	
TOTAL SALARIES, WAGES, BENEFITS	$19,715	-0-
2. Travel		
Organizational Meetings		
4000 miles @ 25¢/mile	$ 1,000	
Per diem @ $32/day in-state, 20 days	$ 640	
To scientific meetings	$ 500	
TOTAL TRAVEL	$ 2,140	-0-
3. Permanent Equipment		
Specific description of research equipment:		
TOTAL PERMANENT EQUIPMENT	-0-	-0-

*SFY-New Mexico State Fiscal Year July 1-June 30.

	DOE	University Cost Sharing
4. Expendable Supplies	$ 250	
TOTAL EXPENDABLE SUPPLIES	$ 250	-0-
5. Computing Costs		
TOTAL COMPUTING COSTS	-0-	-0-
6. Other Direct Costs		
Drafting Services	$ 600	
Other Report Costs	$ 400	
TOTAL OTHER DIRECT COSTS	$ 1,000	-0-
7. Subcontracting (list)		
TOTAL SUBCONTRACTING	-0-	-0-
8. Indirect Costs		
At 48% of modified total on-campus direct costs ($23,105)	$11,091	
TOTAL INDIRECT COSTS	$11,091	-0-
TOTAL TASK COST	$34,196	-0-

DESCRIPTION: Task 2. Completion of the collection of oil and gas well data.

	DOE	University Cost Sharing
1. Salaries, Wages and Fringe Benefits		
Faculty/Staff Salaries:		
Dr. Lokesh Chaturvedi		
100% for 1 months Summer, 1980	$ 1,810	
10% for 9 months AY Fall-Spring 1981	$ 2,432	
TOTAL FACULTY/STAFF SALARIES	$ 4,242	
Student Salaries:		
Graduate Assistant		
100% for 3 months Summer, 1980	$ 2,226	
50% for 9 months AY Fall-Spring, 1981	$ 4,930	
TOTAL STUDENT SALARIES	$ 7,156	
Fringe Benefits:		
Faculty/Staff (15.13% of $4,242)	$ 642	
Student (2.0% of $7,156)	$ 143	
TOTAL FRINGE BENEFITS	$ 785	
TOTAL SALARIES, WAGES, BENEFITS	$12,183	-0-
2. Travel		
To field: 4000 miles @ 25¢/mile	$ 1,000	
Per diem @ $32/day in-state, 30 days	$ 960	
To scientific meetings	$ 500	
TOTAL TRAVEL	$ 2,460	-0-
3. Permanent Equipment		
Specific description of research equipment:		
TOTAL PERMANENT EQUIPMENT	-0-	-0-

*SFY-New Mexico State Fiscal Year July 1-June 30.

	DOE	University Cost Sharing
4. Expendable Supplies	$ 250	
TOTAL EXPENDABLE SUPPLIES	$ 250	-0-
5. Computing Costs		
File space, programming and preparation for job running	$ 1,000	
TOTAL COMPUTING COSTS	$ 1,000	-0-
6. Other Direct Costs		
Drafting Services	$ 600	
Other Report Costs	$ 400	
TOTAL OTHER DIRECT COSTS	$ 1,000	-0-
7. Subcontracting (list)		
TOTAL SUBCONTRACTING	-0-	-0-
8. Indirect Costs		
At 48% of modified total on-campus direct costs ($16,893)	$ 8,109	
TOTAL INDIRECT COSTS	$ 8,109	-0-
TOTAL TASK COST	$25,002	-0-

DESCRIPTION: Task 3. Updating of NOAA maps.

	DOE	University Cost Sharing
1. Salaries, Wages and Fringe Benefits		
Faculty/Staff Salaries:		
Richard Lohse, Field Engineer		
20% for 1½ months SFY*, 1980	$ 500	
20% for 10½ months SFY, 1981	$ 3,920	
TOTAL FACULTY/STAFF SALARIES	$ 4,420	
Fringe Benefits:		
Faculty/Staff (15.13% of $4,420)	$ 669	
TOTAL FRINGE BENEFITS	$ 669	
TOTAL SALARIES, WAGES, BENEFITS	$ 5,089	-0-
2. Travel		
Organizational Conferences		
2000 miles @ 25¢/mile	$ 500	
Per diem @ $32/day in-state, 10 days	$ 320	
TOTAL TRAVEL	$ 820	-0-
3. Permanent Equipment		
Specific description of research equipment:		
TOTAL PERMANENT EQUIPMENT	-0-	-0-
4. Expendable Supplies		
TOTAL EXPENDABLE SUPPLIES	-0-	-0-
5. Computing Costs		
TOTAL COMPUTING COSTS	-0-	-0-
6. Other Direct Costs		
Drafting Services	$ 2,000	
Other Report Costs-Reproduction of blue line addenda maps	$ 750	
TOTAL OTHER DIRECT COSTS	$2,750	-0-

*SFY-New Mexico State Fiscal Year July 1-June 30.

	DOE	University Cost Sharing
7. Subcontracting (list)		
NMIMT-Dr. Allan Sanford		
1. Salaries, Wages and Fringe Benefits		
Faculty/Staff Salaries:		
Allan Sanford		
4% for 9 months AY Fall-Spring, 1981	$ 1,000	
TOTAL FACULTY/STAFF BENEFITS	$ 1,000	
Fringe Benefits:		
Faculty/Staff (15.13% of $1,000)	$ 151	
TOTAL FRINGE BENEFITS	$ 151	
TOTAL SALARIES, WAGES, BENEFTIS	$ 1,151	
2. Travel		
Organizational Meetings		
2000 miles @ 25¢/mile	$ 500	
Per diem @ $32/day in-state, 10 days	$ 320	
TOTAL TRAVEL	$ 820	
3. Permanent Equipment		
Specific description of research equipment:		
TOTAL PERMANENT EQUIPMENT	-0-	
4. Expendable Supplies	$ 129	
TOTAL EXPENDABLE SUPPLIES	$ 129	
5. Computing Costs		
TOTAL COMPUTING COSTS	-0-	
6. Other Direct Costs		
Drafting Services	$ 300	
Other Report Costs	$ 200	
TOTAL OTHER DIRECT COSTS	$ 500	

	DOE	University Cost Sharing
7. Subcontracting (list		
TOTAL SUBCONTRACTING	-0-	
8. Indirect Costs At NMIMT-40% of Salaries, Wages ($1,000)	$ 400	
TOTAL INDIRECT COSTS	$ 400	
TOTAL SUBCONTRACTING	$ 3,000	-0-
8. Indirect Costs At 48% of modified total on-campus direct costs ($11,659)	$ 4,156	$ 1,440
TOTAL INDIRECT COSTS	$ 4,156	$ 1,440
TOTAL TASK COST	$15,815	$ 1,440

DESCRIPTION: Task 4. Construction of a lineament map.

	DOE	University Cost Sharing
1. Salaries, Wages and Fringe Benefits		
Faculty/Staff Salaries:		
Richard Lohse, Field Engineer		
20% for 1½ months SFY*, 1980	$ 500	
20% for 10½ months SFY, 1981	$ 3,920	
TOTAL FACULTY/STAFF SALARIES	$ 4,420	
Fringe Benefits:		
Faculty/Staff (15.13% of $4,420)	$ 669	
TOTAL FRINGE BENEFITS	$ 669	
TOTAL SALARIES, WAGES, BENEFITS	$ 5,089	-0-
2. Travel		
Organizational Meetings		
1000 miles @ 25¢/mile	$ 250	
Per diem @ $44/day out-of-state, 4 days	$ 176	
TOTAL TRAVEL	$ 426	-0-
3. Permanent Equipment		
Specific description of research equipment:		
TOTAL PERMANENT EQUIPMENT	-0-	-0-
4. Expendable Supplies		
TOTAL EXPENDABLE SUPPLIES	-0-	-0-
5. Computing Costs		
TOTAL COMPUTING COSTS	-0-	-0-
6. Other Direct Costs		
TOTAL OTHER DIRECT COSTS	-0-	-0-

*SFY-New Mexico State Fiscal Year July 1-June 30.

	DOE	University Cost Sharing
7. Subcontracting (list)		
Dr. Larry Lepley, Consultant LANDSAT photos, map, and report	$15,000	
TOTAL SUBCONTRACTING	$15,000	
8. Indirect Costs		
At 48% of modified total on-campus direct costs ($20,515)	$ 2,647	$ 7,200
TOTAL INDIRECT COSTS	$ 2,647	$ 7,200
TOTAL TASK COST	$23,162	$ 7,200

DESCRIPTION: Task 5. Collection of existing water well data.

	DOE	University Cost Sharing
1. Salaries, Wages and Fringe Benefits		
Faculty/Staff Salaries:		
Richard Lohse, Field Engineer		
60% for 1½ months SFY*, 1980	$ 1,500	
60% for 10½ months SFY, 1981	$11,760	
TOTAL FACULTY/STAFF SALARIES	$13,260	
Fringe Benefits:		
Faculty/Staff (15.13% of $13,260)	$ 2,006	
TOTAL FRINGE BENEFITS	$ 2,006	
TOTAL SALARIES, WAGES, BENEFITS	$15,266	-0-
2. Travel		
To field: 6000 miles @ 25¢/mile	$ 1,500	
Per diem @ $32/day in-state, 30 days	$ 960	
To scientific meetings	$ 500	
TOTAL TRAVEL	$ 2,960	-0-
3. Permanent Equipment		
Specific description of research equipment:		
TOTAL PERMANENT EQUIPMENT	-0-	-0-
4. Expendable Supplies		
Maps, tools, miscellaneous supplies	$ 300	
TOTAL EXPENDABLE SUPPLIES	$ 300	-0-
5. Computing Costs		
Preparation and job running	$ 500	
TOTAL COMPUTING COSTS	$ 500	-0-

*SFY-New Mexico State Fiscal Year July 1-June 30.

	DOE	University Cost Sharing
6. Other Direct Costs		
Equipment Rental, leasing of temperature logging equipment	$ 4,000	
Drafting Services	$ 600	
Other Report Costs	$ 400	
TOTAL OTHER DIRECT COSTS	$ 5,000	-0-
7. Subcontracting (list)		
TOTAL SUBCONTRACTING	-0-	-0-
8. Indirect Costs		
At 48% of modified total on-campus direct costs ($24,026)	$11,532	
TOTAL INDIRECT COSTS	$11,532	-0-
TOTAL TASK COST	$35,558	-0-

DESCRIPTION: Task 6. West Mesa of Albuquerque.

	DOE	University Cost Sharing
1. Salaries, Wages and Fringe Benefits		
Faculty/Staff Salaries:		
Dr. George Jiracek		
54% for 3 months Summer, 1980 (UNM)	$ 4,846	
Dr. George Jiracek		
15 days @ $140/day, AY Fall-Spring, 1981 (SDS)	$ 2,100	
Electrical Technician (UNM)		
80 hrs. @ $7.50/hr.	$ 600	
Drafting Technician (SDS)		
100 hrs. @ $6.00/hr.	$ 600	
TOTAL FACULTY/STAFF SALARIES	$ 8,146	
Student Salaries:		
Graduate Assistant		
384 hrs. @ $6.00/hr. (UNM)	$ 2,304	
Undergraduate Students		
384 hrs. @ $3.75/hr. (UNM)	$ 1,440	
384 hrs. @ $3.50/hr. (UNM)	$ 1,344	
Undergraduate Student (SDS)		
150 hrs. @ $3.70/hr.	$ 555	
TOTAL STUDENT SALARIES	$ 5,643	
Fringe Benefits at UNM		
12.7% of $4,846	$ 615	
17.6% of $600	$ 106	
0.4% of $5,088	$ 21	
TOTAL FRINGE BENEFITS AT UNM	$ 742	
Fringe Benefits at SDS		
32% of $2,100	$ 672	
12% of $600	$ 72	
5% of $555	$ 28	
TOTAL FRINGE BENEFITS AT SDS	$ 772	
TOTAL FRINGE BENEFITS	$ 1,514	
TOTAL SALARIES, WAGES, BENEFITS	$15,303	-0-

*SFY-New Mexico State Fiscal Year July 1-June 30.

	DOE	University Cost Sharing
2. Travel		
At UNM		
To field: 2000 miles @ 20¢/mile	$ 400	
At SDS		
Organizational Meetings		
2000 miles @ 20¢/mile	$ 400	
Per diem @ $40/day out-of-state, 5 days	$ 200	
To scientific meetings	$ 250	
TOTAL TRAVEL	$ 1,250	-0-
3. Permanent Equipment		
Specific description of research equipment:		
TOTAL PERMANENT EQUIPMENT	-0-	-0-
4. Expendable Supplies		
At UNM-electrical supplies, gas for generator, etc.	$ 450	
At SDS-drafting equipment, etc.	$ 150	
TOTAL EXPENDABLE SUPPLIES	$ 600	-0-
5. Computing Costs		
At UNM- 1 hr. @ $250/hr.	$ 250	
At SDS	$ 250	
TOTAL COMPUTING COSTS	$ 500	-0-
6. Other Direct Costs		
Other Report Costs @ SDS	$ 300	
TOTAL OTHER DIRECT COSTS	$ 300	-0-
7. Subcontracting (list)		
Drilling of 5 shallow (∿50m) temperature gradient holes @ $820 each	$ 4,100	
TOTAL SUBCONTRACTING	$ 4,100	-0-

	DOE	University Cost Sharing
8. Indirect Costs		
At 48% of modified total on-campus direct costs (NMSU) ($22,165) @ UNM		$10,640
At 48% of modified total on-campus direct costs (NMSU) ($7,864) @ SDS		$ 3,775
At 54% of UNM Salaries and Wages ($10,534)	$ 5,689	
At 41% of SDS ($5,577)	$ 2,287	
TOTAL INDIRECT COSTS	$ 7,976	$14,415
TOTAL TASK COST	$30,029	$14,415

DESCRIPTION: Task 7. Dona Ana and Luna Counties.

	DOE	University Cost Sharing
1. Salaries, Wages and Fringe Benefits		
Faculty/Staff Salaries:		
Dr. Paul Morgan		
100% for 1 months Summer, 1980	$ 2,165	
10% for 9 months AY Fall-Spring 1981	$ 2,183	
Dr. Charles Young		
100% for 1 month, Summer, 1980	$ 1,889	
10% for 9 months, AY Fall-Spring, 1981	$ 1,904	
Research Aide		
100% for 1 month SFY, 1980	$ 733	
TOTAL FACULTY/STAFF SALARIES	$ 8,874	
Student Salaries:		
Graduate Assistant (Morgan)		
100% for 3 months Summer, 1980	$ 2,226	
50% for 9 months AY Fall-Spring, 1981	$ 4,930	
Undergraduate Students (Young)		
320 hrs. @ $3.50/hr	$ 1,120	
TOTAL STUDENT SALARIES	$ 8,276	
Fringe Benefits:		
Faculty/Staff (15.13% of $8,874)	$ 1,343	
Student (2.0% of $8,276)	$ 166	
TOTAL FRINGE BENEFITS	$ 1,509	
TOTAL SALARIES, WAGES, BENEFITS	$18,659	-0-
2. Travel		
Dr. Paul Morgan		
To field: 1000 miles @ 25¢/mile	$ 250	
Per diem @ $32/day in-state, 10 days	$ 320	
To scientific meetings	$ 500	
Dr. Charles Young		
To field: 1000 miles @ 25¢/mile	$ 250	
Per diem @ $32/day in-state, 10 days	$ 320	
To scientific meetings	$ 500	
TOTAL TRAVEL	$ 2,140	-0-

*SFY-New Mexico State Fiscal Year July 1-June 30.

	DOE	University Cost Sharing
3. Permanent Equipment Specific description of research equipment:		
TOTAL PERMANENT EQUIPMENT	-0-	-0-
4. Expendable Supplies Dr. Paul Morgan Maps, tools, miscellaneous supplies, and maintenance of temperature logging and thermal conductivity equipment	$ 500	
Dr. Charles Young Maps and miscellaneous supplies	$ 300	
TOTAL EXPENDABLE SUPPLIES	$ 800	-0-
5. Computing Costs Dr. Paul Morgan Preparation and job running	$ 500	
Dr. Charles Young Preparation and job running	$ 500	
TOTAL COMPUTING COSTS	$ 1,000	-0-
6. Other Direct Costs Dr. Paul Morgan Drafting Services	$ 600	
Other Report Costs	$ 400	
Dr. Charles Young Drafting Services	$ 600	
Other Report Costs	$ 400	
TOTAL OTHER DIRECT COSTS	$ 2,000	-0-
7. Subcontracting (list) Drilling 20 shallow ($\sim$30m) temperature gradient holes @ $7/ft.	$14,000	
TOTAL SUBCONTRACTING	$14,000	-0-

	DOE	University Cost Sharing
8. Indirect Costs At 48% of modified total on-campus direct costs ($38,599)	$18,528	
TOTAL INDIRECT COSTS	$18,528	-0-
TOTAL TASK COST	$57,127	-0-

DESCRIPTION: Task 8. Hydrologic Study of the Animas Valley

	DOE	University Cost Sharing
1. Salaries, Wages and Fringe Benefits		
Faculty/Staff Salaries:		
Dan Stevenson		
50% for 1 months Summer, 1980	$ 1,100	
6% for 9 months AY Fall-Spring, 1981	$ 1,100	
Draftmen		
50% for 1 month	$ 800	
TOTAL FACULTY/STAFF SALARIES	$ 3,000	
Student Salaries:		
Research Assistant		
50% for 3 months Summer, 1980 and 50% for 9 months AY Fall-Spring, 1981	$ 5,500	
TOTAL STUDENT SALARIES	$ 5,500	
Fringe Benefits:		
Faculty/Staff (15.0% of $3,000)	$ 450	
TOTAL FRINGE BENEFITS	$ 450	
TOTAL SALARIES, WAGES, BENEFITS	$ 8,950	-0-
2. Travel		
To field: 4000 miles @ 25¢/mile	$ 1,000	
Per diem @ $32/day in-state, 15 days	$ 480	
To scientific meetings	$ 500	
TOTAL TRAVEL	$ 1,980	-0-
3. Permanent Equipment		
Specific description of research equipment:		
TOTAL PERMANENT EQUIPMENT	-0-	-0-

*SFY-New Mexico State Fiscal Year July 1-June 30.

	DOE	University Cost Sharing
4. Expendable Supplies		
Drafting material, xerox, etc.	$ 300	
TOTAL EXPENDABLE SUPPLIES	$ 300	-0-
5. Computing Costs	$ 2,000	
TOTAL COMPUTING COSTS	$ 2,000	-0-
6. Other Direct Costs		
Chemical analysis 60 samples @ $20/sample	$ 1,200	
Other Report Costs	$ 300	
TOTAL OTHER DIRECT COSTS	$ 1,500	-0-
7. Subcontracting (list)		
TOTAL SUBCONTRACTING	-0-	-0-
8. Indirect Costs		
At NMSU-48% of modified total on-campus direct costs ($18,130)		$ 8,703
At NMIMT-40% of Salaries, Wages, ($8,500)	$ 3,400	
TOTAL INDIRECT COSTS	$ 3,400	$ 8,703
TOTAL TASK COST	$18,130	$ 8,703

4.2 Summary Budget

		DOE	NMSU COST SHARING
1.	TOTAL SALARIES, WAGES AND FRINGE BENEFITS	$113,782	
	NMSU Faculty and Staff	$ 77,266	
	NMSU Students	$ 24,338	
	Fringe Benefits		
	NMSU Faculty and Staff (@ 15.13% of $77,266)	$ 11,691	
	NMSU Students (@ 2.0% of $(24,338)	$ 487	
2.	TOTAL NMSU TRAVEL	$ 12,836	
3.	TOTAL NMSU EQUIPMENT	-0-	
4.	TOTAL NMSU EXPENDIBLE SUPPLIES	$ 1,600	
5.	TOTAL NMSU COMPUTING COSTS	$ 7,500	
6.	TOTAL OTHER DIRECT COSTS	$ 16,050	
	TOTAL CONTRACT DIRECT COSTS	$151,768	
7.	TOTAL SUBCONTRACTING	$ 80,159	
	SDS - Task 6	$ 7,864	
	UNM - Task 6	$ 22,165	
	NMIMT - Task 3	$ 3,000	
	Consultant - Task 4	$ 15,000	
	Drilling - Task 7	$ 14,000	
	NMIMT - Task 8	$ 18,130	
8.	TOTAL NMSU INDIRECT COSTS	$ 68,073	$43,254
	48% of modified total on campus costs ($165,768) Program Personnel and Tasks 1, 2, 3, 4, 5, 7	$ 68,073	$11,496
	48% of UNM subcontract ($22,165)-Task 6		$10,640
	48% of SDS subcontract $$7,864)-Task 6		$ 3,775
	48% of NMIMT subcontract ($3,000)-Task 3		$ 1,440

	DOE	NMSU COST SHARING
48% of off-campus costs ($15,000)-Task 4		$ 7,200
48% of NMIMT subcontract ($18,130)-Task 8		$ 8,703
TOTAL PROJECT DIRECT AND INDIRECT COSTS	$300,000	$43,254

CERTIFICATE OF CURRENT COST OR PRICING DATA

This is to certify that, to the best of my knowledge and belief, cost or pricing data as defined in FPR 3-807 submitted, either actually or by specific identification in writing to the Contracting Officer or his representative in support of NMSU Proposal No. 80-20-251R (revised scope of work and budget of $300,000) are accurate, complete, and current as of April 1, 1980.

This certification includes the cost or pricing data supporting any advance agreement(s) and forward pricing rate agreements between the offeror and the Government which are part of the proposal.

Firm New Mexico Energy Institute

Name Dr. Harold A. Daw

Title Acting Director

Date of Execution April 1, 1980