U.S. Department of Energy

Idaho Operations Office • Idaho National Engineering Laboratory

Technical-Assistance Report on a Geothermal Heating Utility for Lemmon, South Dakota

Dunham Associates, Inc.

February 1982

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EG&G Idaho

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TECHNICAL-ASSISTANCE REPORT ON A GEOTHERMAL HEATING UTILITY FOR LEMMON, SOUTH DAKOTA

Published February 1982

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Dunham Associates, Inc.

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PREFACE

This report was prepared for EG&G Idaho by Dunham Associates, Inc., on Subcontract No. K-7651 under the Department of Energy's Outreach Program. It is now being reissued

without modification as an EG&G Formal report in order to make it available to others that may be interested in this geothermal application.

FOREWORD

The Geothermal Technical Assistance Program was developed under the premise that the majority of groups or individuals with available geothermal resources do not have the experience or manpower necessary to do a preliminary engineering and economic feasibility evaluation for geothermal energy projects. In order to disseminate technical information and to facilitate expanded use of geothermal energy resources, assistance was provided through FY-1981 in a consulting format on a first-come, staff-and-funds-available basis. Technical assistance can relate to conceptualization; engineering; economics; water chemistry implications for environmental, disposal, and material selection considerations; and planning and development strategies. This report is one of a series adapted from consultation provided to requestors either through in-house efforts or through limited efforts subcontracted to local engineering firms. The Geothermal Technical Assistance (GTA) Reports in this series, which are listed below, will be available early in 1982 to those with interest in specific geothermal applications.

<u>GTA Report Number</u>	<u>EG&G Report Number</u>	<u>Title</u>
1.	EGG-GTH-5512	<i>Aquaculture Facility Potential at Boulder Hot Springs, Boulder, Montana</i>
2.	EGG-GTH-5521	<i>Preliminary Geothermal Disposal Considerations, State Health Laboratory, Boise, Idaho</i>
3.	EGG-GTH-5573	<i>Geothermal Conversion at Veterans Hospital, Boise, Idaho</i>
4.	EGG-GTH-5574	<i>Geothermal Applications for Highway Rest Areas</i>
5.	EGG-GTH-5575	<i>Geothermal Applications for a Tannery</i>
6.	EGG-GTH-5599	<i>Preliminary Conceptual Design for Geothermal Space Heating Conversion of School District 50 Joint Facilities at Pagosa Springs, Colorado</i>
7.	EGG-GTH-5617	<i>Selected Geothermal Technical Assistance Efforts (comprising short descriptions of ten space heating projects, five district heating projects, and three heat exchanger projects)</i>
8.	EGG-2137	<i>Geothermal Source Potential and Utilization for Methane Generation and Alcohol Production (subcontractor report)</i>
9.	EGG-2138	<i>Geothermal Source Potential and Utilization for Alcohol Production (subcontractor report)</i>
10.	EGG-2139	<i>Potential Geothermal Energy Applications for Idaho Elks Rehabilitation Hospital (subcontractor report)</i>
11.	EGG-2144	<i>Technical Assistance Report on a Geothermal Heating Utility for Lemmon, South Dakota (subcontractor report)</i>
12.	EGG-2145	<i>Economic Analysis for Utilization of Geothermal Energy by North Dakota Concrete Products Company (subcontractor report)</i>

<u>GTA Report Number</u>	<u>EG&G Report Number</u>	<u>Title</u>
13.	EGG-2146	<i>Geothermal Feasibility Analysis for Polo School District No. 29-2, South Dakota (subcontractor report)</i>
14.	EGG-2147	<i>Preliminary Feasibility Study of Heating and Cooling Alternatives for Nebraska Western College, Scottsbluff, Nebraska (contractor report)</i>
15.	EGG-2148	<i>Inventory of Thermal Springs and Wells Within a One-Mile Radius of Yucca Lodge, Truth or Consequences, New Mexico (subcontractor report)</i>
16.	EGG-2149	<i>Space Heating for Spa Facilities at Ojo Caliente, New Mexico (subcontractor report)</i>
17.	EGG-2150	<i>Space Heating for Office Building at Glenwood Springs, Colorado (subcontractor report)</i>
18.	EGG-2151	<i>District Heating for Subdivision in Dickinson, North Dakota (subcontractor report)</i>
19.	EGG-2152	<i>Space Heating for Subdivision in Truth or Consequences, New Mexico (subcontractor report)</i>
20.	EGG-2153	<i>Space Heating for Veterans Administration Medical Center, Marlin, Texas (subcontractor report)</i>
21.	EGG-2154	<i>District Heating for Subdivision in Castle Rock, Colorado (subcontractor report)</i>
22.	EGG-2155	<i>Space Heating for Twin Lakes School Near Gallup, New Mexico (subcontractor report)</i>
23.	EGG-2156	<i>Pumping Tests at Well Campbell Et Al. No. 2, Gila Hot Springs, Grant County, New Mexico (subcontractor report)</i>
24.	EGG-GTH-5739	<i>Geothermal Deicing of Bridge Structures</i>
25.	EGG-GTH-5740	<i>Assessment of a Geothermal Application at Tucson, Arizona</i>
26.	EGG-GTH-5741	<i>Heat Pump Systems for Spring Creek, Montana</i>

ABSTRACT

The purpose of this effort was to review work already done toward establishing a geothermal heating utility in Lemmon, South Dakota; to redefine the goals for such a project; and to recommend how the project might proceed to completion. The minimum size Phase I suggested would provide heat for up to 62 buildings in a 9-block area. Total cost is estimated at \$1,800,000 to 1,950,000. The geothermal source is expected to be 100 to 400 gpm of 160°F water pumped from 500 feet deep. Proposed energy savings and energy cost savings are presented. Analysis indicates that the major geothermal development effort in Lemmon should be directed toward the Madison aquifer. The minimum project dictates simple

reinjection of the water after primary thermal extraction, although other uses are attractive and may be promoted if this resource is developed. A wide range of funding sources was investigated. Most promising avenues appear to be some form of local bond financing, and loans from the Farmer's Home Administration or the HUD Urban Development action grant program. The report suggests that a municipally-owned geothermal district heating utility be established, and a bond issue approved to pay for the initial well drilling, which is the major risk in the whole venture. A UDAG grant for 25% of the well cost may be obtainable. If the well proves successful, then the rest of the project can go forward.

TECHNICAL ASSISTANCE REPORT
ON A
GEOTHERMAL HEATING UTILITY
FOR
LEMMON, SOUTH DAKOTA

Prepared for
Lemmon, South Dakota

Prepared under
A Technical Assistance Grant
by the Department of Energy

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Prepared by
DUNHAM ASSOCIATES, INC.
Consulting Engineers
528 Kansas City Street
Rapid City, South Dakota 57701

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LEMMON GEOTHERMAL HEATING UTILITY
TECHNICAL ASSISTANCE REPORT
Lemmon, South Dakota

Much work has been done by Lemmon, South Dakota in the past several years to work toward the goal of establishing a geothermal utility for the community. Efforts have been thwarted by various economic and institutional problems. The purpose of this work effort and report is to try to put the "hoped for" project into perspective. During the investigation certain underlying conditions have been set to guide and condition any recommendations which may result from the work effort. The conditions which have been set include the following items:

1. Past efforts have been too large and grandiose. They were structured to provide an optimum completion and optimum economics. The current efforts have used a revised goal. That goal being, "What is the minimum size project that could produce a viable geothermal utility?"

2. Past efforts have been directed toward full utilization of the geothermal resource. Such utilization included a multiple tiered utilization as well as year around utilization. Scaling down the project has caused us to anticipate that a minimum water use will be accepted as the final water disposal. We anticipate that use will probably be irrigation or waste into a drainage way.

A review of past expressions of interest from the City and its residents and an analysis of the needs of the City have crystallized a set of goals which, we believe, will provide a working base for the project. The goals are as follows:

1. To discover the minimum size project which may be economically feasible.

2. To obtain an estimate of project cost which is as reliable as can be established at this time.
3. To refine knowledge of the Madison formation at Lemmon to help refine well drilling costs and to answer some questions on probable water quality, quantity and temperature.
4. To investigate and suggest possible end uses for the water once the thermal energy is used.
5. To survey possible funding sources and refine several funding options if they exist.
6. To outline a scenario whereby a geothermal utility could become a reality for Lemmon, South Dakota.

Our efforts in the technical assistance work have been directed toward accomplishing the above goals.

The report discusses the efforts which have been exerted toward that end.

1. Project minimum size.

The project has been scaled down to a minimum phase I construction effort. The phase I envisioned at this time comprises one well located at the central city park site and enough basic distribution piping to utilize a significant fraction of the energy available from the well.

Based on the 1979 energy cost survey accomplished by Lemmon, we have selected a downtown area of basically 9 blocks as a probable first phase of the project. The buildings in that area, for which we have survey data, see Appendix D, will use the probable energy from a well for heating purposes in the winter time. A first phase preliminary distribution system has been configured as can be seen in Appendix A. The utility district will provide essentially all the heating energy for up to 62 buildings in the phase I area. We believe that the distribution grid proposed is a minimum practical because that size is required to effectively use the energy resource from the first well for at least part of the year.

2. Probable Distribution System Cost.

The overall project cost have been divided into two groups. The first is the cost of the proposed distribution system. The second is the cost associated directly with the well.

The distribution system cost assumes that the distribution system is run through the alley network thereby minimizing the amount of street repair work required. The system includes valved taps for the 62 buildings which may connect in the network area. The available energy has been allocated to the various buildings and the piping network was sized based on that allocation.

Because of possible water quality problems, the cost estimates have been based on a fiberglass wrapped epoxy piping material. That material is the same that is currently being used in Philip, South Dakota. The prices are based on the unit prices from the Philip project.

Cost projections for the project include only the valved connection taps. The condition was set that all work between the taps and the various buildings would either be done by the building owner or would be assessed to the building owner.

The estimated probable distribution system cost is \$ 483,980. Detail on that estimate can be found in Appendix B. The estimate is based on the best current cost data available including recent pricing from the Philip, South Dakota system.

Several of the costs in the estimate are variable depending on subscribed users. Some sixty two piping taps are planned. Each of those valved taps is estimated between \$600 and \$800. Should several anticipated users decide not to subscribe, then their corresponding taps can be eliminated.

The second cost factor is the cost of the completed wells. Based on the best geological data available, the wells would have a completed depth of 6,800 to 7,000 feet. The well drilled at Philip, South Dakota, about a year ago had an ultimate cost including pump and pump setting of just under \$ 90 per foot. Because the Lemmon well will be deeper and because of the elapsed time, that cost should be upgraded to about \$ 100 per foot for Lemmon in 1981. We have also compared that price with other drilling costs in the Williston Basin and believe \$ 100 per foot to be a reasonable estimate. A completed well would therefore have a probable cost of \$ 650,000 to \$ 750,000. That estimate includes no instrumentation or monitoring cost and includes no engineering or well logging costs.

Total estimated project cost then will therefore be in a range of \$1,800,000 to \$1,950,000 for the supply well, the disposal well, and the distribution piping.

3. Well Expectations.

Data on the Madison formation in the Lemmon area are sketchy at best. North Dakota geologists have done a great deal of emperical work; trying to extrapolate sketchy data into Hettinger County, North Dakota. Hettinger County is immediately north of Lemmon. Correspondingly there is little actual South Dakota data available as far north in South Dakota as Lemmon. The available South Dakota data must be extrapolated to the north and the available North Dakota data must be extrapolated to the south. When the two sets of data are extrapolated for Lemmon, a gross anomaly becomes apparent. Water quantities which may be expected vary

from as low as 100 gpm to as high as 700 gpm. Water temperatures expected vary from a low of 160°F to as high as 200°F. Water quality varies from the expectation of having water with total dissolved solids as low as 1500 ppm to as high as 150,000 ppm.

In an effort to provide as reliable data as is possible for our technical assistance, we contacted Dr. Paul Gries, a consulting geologist with particular knowledge of the Madison aquifer. Dr. Gries' best estimate is that the top of the Madison will be at about 5800 feet and the formation will be 1225 feet thick. He expects the static water level to be within 100 feet of the ground surface. He recommends setting the pump at 500 feet. Water temperature should be at least 160°F.

The question of well flow and water quality are somewhat more vague. Dr. Gries expects the well to be capable of somewhere between 100 and 400 gpm. He suggests that the water will range somewhere between 5,000 and 50,000 ppm total dissolved solids. Dr. Gries' memorandum can be found as Appendix C.

4. Aquifer Source.

The Fox Hills and Lakota Aquifers, as well as the Madison, have been investigated as possible sources of hydrothermal energy. Appendix F compares the three aquifers and summarizes information Dr. Gries and Mr. Burt Jones of the South Dakota Department Natural Resources have communicated in recent memoranda. (See Appendix C)

The Lakota water is the least attractive source of hydrothermal energy of the three aquifers investigated. The water temperature is low enough that heat pumps are required. The low projected flow rate would

require the drilling of a large number of wells and the predicted TDS is high enough that the water would have to be returned to the aquifer to remain within the scope of this project. The uncertainty of the Lakota conditions is equal to the uncertainty of Madison conditions. The potential savings of drilling costs by drilling to the shallower Lakota rather than the Madison are more than offset by the greater number of wells that would be required.

Existing wells into the Fox Hills aquifer at Lemmon have reduced some of the uncertainty associated with the Lakota and Madison aquifers. The water quality is known and the lower TDS would make the waste water much more suitable for other purposes. It is quite likely, however, that the Fox Hills formation's capacity is not adequate to supply the 1100 gallons per minute of cooler water required from a confined well field. Mr. Burt Jones has indicated that a Fox Hills well field supplying this much water may have to cover a section or more. Tests would have to be made to determine the proper spacing of the wells.

Obtaining permits for the 11 wells into the Fox Hills aquifer may be difficult because a majority of wells in the area are to the Fox Hills. Because the major source of ground water in the Lemmon area is from this aquifer, a general lowering of the head in the Fox Hills formation would have serious consequences.

Another unknown factor associated with the use of the cooler Fox Hills water is the willingness and ability of building owners to revise their present heating systems at a cost of 2.5 to 3 times greater than the \$1,000 to \$3,000 cost estimated on the Community GIE Survey. The

response to utilizing hydrothermal energy was very positive at the lower cost but the response at the higher cost is unknown.

Estimated well costs are summarized in Appendix H. The number of wells from each aquifer was determined from peak load requirements. The peak load was determined by summing the rated capacity of the existing heating units in each of the buildings to be served and multiplying by an efficiency factor.

The cost of the distribution systems for Lakota and Fox Hills water was not determined because the required well spacing information was not available.

Comparison of costs and risks of development of the aquifers is revealing. Development of the Lakota rather than the Madison would result in higher total well costs because of the greater number of wells required. The water quality of the Lakota, while projected to be better than the Madison water, is not suited to surface disposal without treatment. Similar disposal problems are encountered with water from either aquifer and Lakota development offers no advantages in the area of disposal. Heating equipment costs for the individual buildings would be higher for the Lakota water than the Madison water and the energy savings realized from the Lakota are less. There is little to recommend development of the Lakota rather than the Madison aquifer.

Development of the Fox Hills formation rather than the Madison offers the potential of reduced energy consumption for seasonal cooling and a lower TDS water for secondary use. The disadvantages of Fox Hills development as an alternative to development of the Madison are less energy savings for heating, higher heating equipment cost, and the

development of a large well field. As Mr. Burt Jones has indicated in his letter of April 22, 1981, in Appendix C, obtaining a permit to remove the required quantity of water from the Fox Hills aquifer may be difficult.

Because of the disadvantages associated with use of the Fox Hills water and because of the potential offered by the Madison, we feel that the major effort for geothermal development in Lemmon should be directed toward the Madison aquifer.

No building can be considered typical for purposes of estimating heating equipment costs; however, an example of costs for a building can be informative. Table #1 shows the comparative cost estimates for heating equipment for a building such as described in the questionnaire for building 1031. It is a 2500 sq. ft. building with a ceiling height of 8 feet. The rated capacity of the present forced air, oil furnace is 151,000 BTU/hr.

Table #1
Heating Equipment Cost Comparison

<u>Water Temp.</u>	<u>Heating System</u>	<u>Connection Costs</u>	<u>Equipment First Costs</u>	<u>Est. Annual Electric Consumption</u>
160°F	Heat Exchanger	\$ 500	\$ 2,500	550 KWH
110°F	Water to Air Heat Pump	\$ 500	\$ 4,000	4200 KWH
55°F	Water to Air Heat Pump	\$ 600	\$ 7,500	10800 KWH

5. Operating Energy Savings.

Annual heating cost information was obtained from the Community Survey question #3. From the heating cost information, the fuel type information, and the unit fuel cost information, the total BTU's purchased was computed for each fuel. The conversion efficiency assumed for the various fuels is:

Propane	65%
Fuel Oil	65%
Coal	65%
Electric	100%

Efficiency of the proposed hydrothermal system was assumed as follows:

Heat Pump (Water T = 110°F)	COP = 4
Heat Pump (Water T = 55°F)	COP = 3
All water pumps	70%
Heat Pump motors	95%

Appendix G contains the estimated operating energy savings and operating energy cost savings based on January 1981 prices. Table #2 below compares the energy and energy cost savings for the proposed systems utilizing each of the three aquifers.

Table #2
Heating Energy Savings

<u>Water Source</u>	<u>Annual Energy Savings BTU x 10⁶</u>	<u>Annual Energy Cost Savings (\$1000) 1981 Pricing</u>
Madison	20903	126.4
Lakota	17100	93.6
Fox Hills	15950	75.8

*Distribution pumping costs are based on wells being placed in the same region. Widely spaced wells would require higher distribution pumping costs.

There are large energy savings to be realized by tapping any of the three hydrothermal sources; however, the potential savings must be weighed along with the capital investment and the risks involved.

6. Water Uses.

Although many uses still suggest themselves, the minimum project which is being suggested does not accommodate any use after primary thermal extraction. For economic reasons the project is proposed and structured at this time to simply inject water to the aquifer from which it was taken.

We believe that the water has a higher final use, at least for irrigation or some other agricultural use. Many commercial and industrial opportunities are also apparent. These uses will, in our opinion, be promoted if and when the waste water and energy become available.

7. Possible Funding Sources.

A wide range of funding sources have been investigated to try to suggest a magical combination which will allow the project to proceed

quickly. We were greatly assisted in the funding research by Mr. Phil Lidel of the South Dakota Office of Energy Policy and Mr. Jerry Miller of the Fifth Planning District Office. A copy of a recent letter from Mr. Lidel is attached as Appendix E.

A first possible source which must be investigated further is local bond financing. Such financing could take either of general obligation bonds, or revenue bonds or a combination of both. Revenue bonds might be issued by a unit of the local government operating as a heating utility or by a private enterprise which is franchised by the City as a heating utility.

The project can be economically practical as a private or municipal venture without government grant funds. The group of buildings which would comprise the Phase I grouping reported an annual heating energy cost in 1979 of \$101,383. Appendix D shows a listing of the building surveys for the Phase I area. Upgrading that cost to 1981 costs would be \$131,250. If a utility would offer to supply hydrothermal energy at a price that would never exceed 90% of what the heating cost would be with the fuel now heating that building, then the debt created by revenue bonds for \$1,880,000 would be returned in 20 years. The retirement schedule assumes a revenue bond sale at 8-1/2%, utility operating costs of \$16,000/year, and conventional energy cost increases of 7%. If most experts' predictions of even larger energy rate increases of 11% to 12% are correct, the return of the debt created by the project would be in 14 to 15 years.

Any expansion of the distribution system after Phase I would greatly accelerate the repayment schedule. Rather than inject the 100°F water back into the Madison, a lower temperature distribution system could be constructed with no further investment in wells.

A variation of financing by city bonding, other than revenue bonds, may be considered. Because the drilling of a well into the Madison may be considered as proving a city resource, it may be feasible for the voters to pass a general obligation bond issue. A proven source of hydrothermal energy would induce industrial development and the general economic growth of Lemmon.

One major risk, however, is present. That is the risk associated with the well in the first place. The utility, whether public or private, must risk the cost of the well at the outset. If the well meets or exceeds the technical basis, then the project can be an economical success. However, if the well is unsuccessful then there is no resource to use to recover the investment made in the well.

A second possible source of funds is from the State. All investigations in this direction netted nothing. Apparently the State has no money nor do people in State government believe that there will be money for such ventures, either on a grant or loan basis.

A third possible source which was investigated is the Department of Energy. Contacts were made to not only the San Francisco Regional office, but also the geothermal operations office in Idaho Falls and DOE headquarters in Washington. All contacts with the Department of Energy met with the same negative response. Status of some programs are as follows:

a. The user coupled drilling program is filled for FY80 and 81. No new funds are available in 1981 and no funds are anticipated in FY82.

b. No new grant program for new wells is anticipated either in FY81 or 82.

c. The district heating solicitation is closed and no new solicitation is anticipated.

d. The loan guaranty program is closed and no new funds or new program is expected.

e. No unsolicited proposals are being considered.

The Department of Housing and Urban Development was contacted, both in Denver and Washington. Status of the several programs which they have which might apply is as follows:

a. HUD Block Grant Program
Ms. Mary Sutton
Denver Regional Office
303/837-4666

Ms. Sutton said the grants for the fiscal 1981 year have already been awarded and applications for the 1982 year will be accepted until October of 1981, when they will be reviewed and accepted and awarded. However, there is a possibility that funding for the 1982 year will not be approved by the new administration. She said she would send the application form and guide and also suggested we contact the HUD Innovative Grant Program.

b. HUD Innovative Grant Program
Mr. Dennis Hanson
Denver Regional Office
303/837-5121

Mr. Hanson said that the innovative grant program for the 1981 year was for energy related projects but that the program is over now. The program for next year has not been determined as of yet, and as of May 1981, he did not know when it would be announced. Mr. Hanson said that it is not sure if the new administration will approve funding for the 1982 fiscal year. Mr. Hanson said that we should continue to contact them for more information of the 1982 fiscal year programs.

c. HUD Urban Development Action Grant Program
Denver Regional Office
Howard Buchalter
303/873-5121

Mr. Buchalter said that UDAG will loan money to qualifying programs. To qualify as a needy group the group must provide proof of eligibility to the action grant program. First, they must then show that they can raise 75% of the total cost of the project and show why they cannot raise 100% of the money. UDAG will then determine whether to fund the project or not. Application to UDAG must be made by the City of Lemmon for consideration as a possible grant.

The Farmer's Home Administration was contacted and is a prospect as a lender. Following is a brief recapitulation of our contact:

Farmer's Home Administration
Mr. David Dulitz
Bison District Office
605/244-5224

Mr. Dulitz said that the Farmer's Home Administration is loaning money for this type of project. The required forms for application have been sent to Mr. Dale Rogers of the First Bank of Lemmon.

8. Utility Scenario.

After having progressed through the process of analysis described in the foregoing, we have concluded that one possible scenario seems viable at this point in time. We have a conviction that a geothermal district heating utility is a desirable and technically practical project for Lemmon, South Dakota. The preliminary estimates show that, discounting the initial well drilling risk, the project can stand alone economically. And the present government attitude toward federal grant support for such ventures offers no hope of support for the project. We therefore offer the following project scenario as one which may allow the project to proceed.

We suggest that a municipally owned, geothermal district heating utility be set up by the City of Lemmon. The City should obtain the sanction of the voters to establish the utility and at the same time should consider issuing general obligation bonds for the first well. We believe that a UDAG grant might be secured for 25% of the cost, see page 12. The bond issue would therefore only need to be for 75% of the well cost. The risk in the whole venture is the risk associated with successfully completing the first well. The public should be made aware of the risks and advantages and should be asked to support the bond issue as a start for the project.

Assuming the bond issue is successful, the well should be drilled. If the well delivers the anticipated quality, quantity, and temperature water then the distribution piping funding and disposal well funding can be arranged. The utility group should then obtain

subscriptions from the building owners for the heating service. Such subscriptions would guarantee revenue and allow discussions with lenders. Three possibilities are apparent as viable alternatives at this time for funding to complete the project. One is a Farmer's Home Administration loan, the second is a revenue bond issue. A third is private debt placement through a bank, savings and loan, or insurance company. In any case, all or part of the original general obligation bond issue could be repaid once financing was arranged.

Also, once a water source is confirmed, an end user, either a farm irrigation or an industrial user, could be found. Such a user and the revenue therefrom would enhance the economics of the project.

APPENDIX A
DISTRIBUTION MAPS

GEOHERMAL WATER
DISTRIBUTION PLAN FOR
LEMMON, SOUTH DAKOTA

DUNHAM ASSOCIATES, INC
CONSULTING ENGINEERS
RAPID CITY, SOUTH DAKOTA

GEO THERMAL WATER DISTRIBUTION PLAN FOR LEMMON, SOUTH DAKOTA

DUNHAM ASSOCIATES, INC
CONSULTING ENGINEERS
RAPID CITY, SOUTH DAKOTA

SCALE 1" = 200'

GEOTHERMAL WATER
DISTRIBUTION PLAN FOR
LEMMON, SOUTH DAKOTA

DUNHAM ASSOCIATES, INC
CONSULTING ENGINEERS
RAPID CITY, SOUTH DAKOTA

APPENDIX B
COST ESTIMATE

LEMMON GEOTHERMAL CONSTRUCTION ESTIMATE

February 25, 1981

	Quantity	Material Unit Price	Per	Labor Amount
6" pipe	2,300	\$ 40.00	Ft.	\$ 101,200
4" pipe	1,040	38.00	Ft.	39,520
3" pipe	2,600	26.00	Ft.	67,600
2" pipe	5,240	24.00	Ft.	125,760
6" taps	2	800.00	Tap	1,600
4" taps	25	700.00	Tap	17,500
3" taps	53	600.00	Tap	31,800
2" taps	40	600.00	Tap	<u>24,000</u>
		Subtotal		\$ 408,980
		Mobilizing	LS	25,000
		Contingency	LS	<u>50,000</u>
		TOTAL COST		<u>\$ 483,980</u>

APPENDIX C

DR. GRIES APPRAISAL

JOHN PAUL GRIES

Consulting Geologist
238 ST. CHARLES STREET
RAPID CITY, SOUTH DAKOTA

February 19, 1981

Memorandum

To: George Dunham

From: J. P. Gries

Re: Potential of the Madison Formation at Lemmon, S. D.

Depth to top of Madison

5,800 feet

Thickness of Madison

1,225 feet

Water level

Water quality, TDS

Probably within 100 feet of surface;
small flow possible but unlikely
Projecting South Dakota data into
the Williston Basin, the TDS can
be no less than 5,000 ppm. Extrapo-
lating down from north Dakota, it
may possibly be as high as 50,000
ppm.

Temperature

160°F

Capacity

Unknown. The well may need to be
acid treated to increase the yield.
Estimate from 100 to 400 gpm with
a pump setting at 500 feet.

JOHN PAUL GRIES

Consulting Geologist

238 ST. CHARLES STREET
RAPID CITY, SOUTH DAKOTA

March 30, 1981

Geothermal water potential of the Fall River-Lakota sandstones at Lemmon

The following estimates are based on logs and drill stem tests made on oil and gas tests in Perkins and Corson counties, SD and Adams county North Dakota.

Depth to top of Fall River sandstone at Lemmon: 4175 feet

Depth to base of Lakota sandstone: 4325 feet

The Fall River sand will probably be poorly developed, but examination of electric logs of oil tests in the vicinity, the Lakota may include 40 to 75 feet of clean, fairly porous sandstone. No data are available as to rate of fillup during drill stem tests, so no conclusions can be drawn as to permeability or drawdown.

Shut-in pressures on two drill stem tests, both several miles from Lemmon but with the Fall River-Lakota at about the same depth, suggest that the static level may lie 800 feet below the surface at Lemmon.

Based on bottom hole temperatures obtained during logging of 4000-foot oil tests in the Lemmon area, the water temperature may be in the range of 105 to 110 degrees Fahrenheit.

Water quality in the Lakota sandstone, based on samples collected on drill stem tests from wells of comparable depth and within 30 miles of Lemmon indicate that the total dissolved solids may be as low as 3,600 ppm but will likely be nearer 4,600 pp.

JPG/me

J. P. Gries
Certified Professor
No. 791

Department of
Water & Natural Resources
Foss Building Water Rights Division (605) 773-3352
Pierre, South Dakota 57501

1189-2

April 22, 1981

Chuck Mize
Dunham Associates
528 Kansas City Street
Rapid City, SD 57701

Dear Mr. Mize:

Reference is made to your phone call regarding the City of Lemmon using either the Fox Hills Formation or the Dakota/Lakota formations in lieu of using water from the Madison Formation for geothermal heating.

You indicate that you estimate that it would take approximately 1100 gpm for the Fox Hills Formation to produce the heat required. In this area, it is doubtful if the Fox Hills will produce more than 100 gpm per well, so you are probably looking at at least 11 wells. Spacing of this many wells to prevent interference with existing city wells and domestic wells using this formation, may create a public interest problem. The secondary use qualification would also be a part of consideration of use of this formation.

You estimate that you would need 300 gpm from the Dakota/Lakota formation. We do not have sufficient data on the formation in this area to forecast what yield you would get from wells. Our feelings are that you may run into as poor quality water from this formation as from the Madison, and may have to go to reinjection with this formation also. Both of the above systems would be operated by use of heat pumps.

The permit as issued calls for up to three wells into the Madison Formation, with a diversion rate of up to 2000 gpm. It is our understanding that about 400 gpm of water from this formation would provide the same amount of heat as the alternate sources listed above without the use of heat pumps.

From a water rights stand point, we believe the permit as issued using the Madison Formation is the best source of water. In the event either of the other two formations are to be used, a permit for such use will be required. You should be aware the Water Management Board may not approve a change of water sources.

Should you have further questions, feel free to contact this office.

Sincerely,

BURTON F JONES
Water Rights Specialist

BFJ/gy
cc: Phil Lidel, Energy Policy

Equal Opportunity Employer

APPENDIX D
BUILDING SURVEYS

100
100 MAIN
COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System.

With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal Electricity Fuel Oil Propane Wood

b. Forced air hot water steam baseboard radiant

2. What is your approximate square footage? 960 Ceiling height? 8

3. What is your approximate annual heating bill? 430.72 1978

4. What is the current size of your heating plant in BTU's? 100,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?
yes.

Approximate casts are between \$1000-\$3000 depending on the system you now own..

The anticipated savings through the use of geothermal heating are in the area of 20% of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than fluctuat with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal enenery even more effective and economical?

Vestibule entrances,
Double pane insulating glass,
Add insulation.

possible.

100 ~
Name WHEELER - EVANSON BLDG
Address 101-107 MAIN, LEMMON, S.D.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
b. Forced Air ☐ Hot Water ☐ Steam ☒ Baseboard Radiant ☐
c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other UNIT HEATERS
2. What is your approximate square footage? 14000 Ceiling height? 12'6" - 8' - 88' - 12'

3. What is your approximate annual heating bill? 2600⁰⁰ ✓

4. What is the current size of your heating plant in BTU's? UNKNOWN
MAX 7 G.P.H #1 FUEL OIL

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical? ONLY AS ECONOMICALLY ADVISABLE

- ☐ Vestibule entrances
☐ Double pane insulating glass
☐ Add insulation

Date 4-23-79

Signature

1007

Name Dr. NinosAddress 109 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐b. Forced Air ☐ Hot Water ☐ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☐ Floor Finances ☐ Other ☐2. What is your approximate square footage? 1,000 Ceiling height? 9 ft3. What is your approximate annual heating bill? unknown4. What is the current size of your heating plant in BTU's? unknown

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☐ No ☒

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

No

- ☒ Vestibule entrances
☒ Double pane Insulating glass
☐ Add Insulation

Date

12/18/79Patricia J. Ninos

Signature

1006

200 Main

Name

Coop Ford Store

Address

Lemmon, 5th St 57638

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☒ Floor Furnaces ☐ Other ☐2. What is your approximate square footage? 11,000 Ceiling height? 15 ft.3. What is your approximate annual heating bill? \$5000 to \$60004. What is the current size of your heating plant in BTU's? ?

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

- ☒ Vestibule entrances
☐ Double pane insulating glass
☐ Add insulation

Date

4/18/79

Charles Fabe, Mgr.

Signature

1007

Name First National Bank in LemmonAddress Lemmon, S.D. 212 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐2. What is your approximate square footage? 4200 Ceiling height? 20'

We utilize full basement so effective square
footage of 8,400 square feet

3. What is your approximate annual heating bill? \$3,500.004. What is the current size of your heating plant in BTU's? 450,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

have Vestibule entranceshave Double pane Insulating glass Add insulationDate 4-20-79

Bob Rogers, Vice President
Signature

1008
Name ED's TOGGERY
Address 207 Main Lemmon

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
b. Forced Air ☐ Hot Water ☒ Steam ☐ Baseboard Radiant ☐
c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 7500 Ceiling height? 8 ft.

3. What is your approximate annual heating bill? 1200⁰⁰
4. What is the current size of your heating plant in BTU's? 239,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☒ Vestibule entrances
☐ Double pane insulating glass
☐ Add insulation

Date 4/18/79

Signature

1009

Name Kohn's Sport ShopAddress Lemmon, So. Dak. 213 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☒2. What is your approximate square footage? 4500 Ceiling height? 12'also 24x60 Shop Basementwith 8' ceiling3. What is your approximate annual heating bill? \$30004. What is the current size of your heating plant in BTU's? 335,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances☐ Double pane Insulating glass☒ Add InsulationDate 4/18/79William Kohn

Signature

1610
Name MYRON WHITE, P.A.

Address 217 MAIN LEMMON, SD

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 1000 Ceiling height? 8'

3. What is your approximate annual heating bill? 600⁰⁰

4. What is the current size of your heating plant in BTU's? 2

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances

☐ Double pane insulating glass

☐ Add Insulation

Date _____

Signature

1011

Name

LAO LASSIE SHOPPE

Address

218 MAIN

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ___ Electricity ___ Fuel Oil ___ Propane ☒ Wood ___

b. Forced Air ☒ Hot Water ___ Steam ___ Baseboard Radiant ___

c. Heat Pump ___ Space Heater ___ Floor Furnaces ☒ Other ___

2. What is your approximate square footage? 2,400 Ceiling height? 8-9 1/2"

3. What is your approximate annual heating bill? \$ 450.00

4. What is the current size of your heating plant in BTU's? 100,000 input 125,000 BTU'S

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ___

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☒ Vestibule entrances

☒ Double pane Insulating glass

☒ Add Insulation

Date

4-18-79

Lauren Peterson

Signature

1012
Name Ken Bartell

Address 919 MAIN

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☒ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 624 Ceiling height? 10

3. What is your approximate annual heating bill? 350⁰⁰

4. What is the current size of your heating plant in BTU's? _____

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐ Thanks Geo.

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☒ Vestibule entrances
☒ Double pane insulating glass
☒ Add insulation

Date 4-19-79

Ken Bartell

Signature

1013

Name Lemmon ClinicAddress 223 Main
Lemmon, SD. 57638

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 a. Coal ☐ Electricity ☒ Fuel Oil ☐ Propane ☐ Wood ☐
 b. Forced Air ☐ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
 c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
 2. What is your approximate square footage? 1800 Ceiling height? 8-10'

3. What is your approximate annual heating bill? \$2,436.70 ^{MARCH-78 - MARCH 79}

4. What is the current size of your heating plant in BTU's? each one indiv. (w/3) heater a floor

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances
☐ Double pane Insulating glass
☒ Add Insulation

Date Apr. 19/79

Robert J. Bohul
Signature

1014

Name Thompson Drug (Andy Ploeg - owners landlord)
 Address 300 main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 - a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
 - b. Forced Air ☐ Hot Water ☐ Steam ☒ Baseboard Radiant ☐
 - c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 1800 Ceiling height? 10 1/2 ft

3. What is your approximate annual heating bill? difficult to estimate - apartments
uptake, take majority of heating costs
total for the building is approximately \$2500
4. What is the current size of your heating plant in BTU's? ?? old steam boiler

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

- ☒ Vestibule entrances
☐ Double pane insulating glass
☐ Add insulation

Date 12-11-79

James Beuchle Manager
 Signature

1015
Name SMITH'S DRUG INC.

Address 301 MAIN AVENUE, LEMMON, S. DAK. 57638

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐

b. Forced Air ☐ Hot Water ☒ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☒ Other ☐

2. What is your approximate square footage? 2500 Ceiling height? 11 ft.

3. What is your approximate annual heating bill? \$2500.00

4. What is the current size of your heating plant in BTU's? 160,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☒ Vestibule entrances
☒ Double pane Insulating glass
☒ Add Insulation

Date 4-18-79

Signature

1016

Name

Address

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☒ Other ☐

2. What is your approximate square footage? 2,500 Ceiling height? 10'

3. What is your approximate annual heating bill? 1000

4. What is the current size of your heating plant in BTU's? do not know

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

NA Vestibule entrances

NA Double pane insulating glass

yes Add insulation

Date

4-26-79

Signature

1017
Name BEN FRANKLIN

Address 305 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☐ Hot Water ☒ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other Ceiling

2. What is your approximate square footage? 8600 Ceiling height? avg. 11 ft.

3. What is your approximate annual heating bill? \$2400

4. What is the current size of your heating plant in BTU's? 400,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances

☐ Double pane Insulating glass

☒ Add Insulation

Date 4-18-79

Kenneth Heier
Signature

1018

Name Jerry Hardware

Address 306 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☒ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☒ Other ☐

2. What is your approximate square footage? 3500 Ceiling height? 10'

3. What is your approximate annual heating bill? 1200⁰⁰

4. What is the current size of your heating plant in BTU's? Does not know

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

NA Vestibule entrances
have this Double pane Insulating glass
yes Add insulation

Date 4-20-79

Gerald H. Heier
 Signature

1019
Name Montgomery Ward
Address 308 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☐ Hot Water ☒ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other Furnace

2. What is your approximate square footage? 1100 Ceiling height? 8'

3. What is your approximate annual heating bill? \$ 700.00

4. What is the current size of your heating plant in BTU's? 120,000"

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances
☒ Double pane Insulating glass
☒ Add Insulation

Date 4-20-79

James Dennis
Signature

1020

Name J.C. Penney Co.
Address 309 Main St.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 - a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
 - b. Forced Air ☐ Hot Water ☒ Steam ☒ Baseboard Radiant ☐
 - c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 2900 sq ft Ceiling height? 25'

3. What is your approximate annual heating bill? \$ 4400.00

4. What is the current size of your heating plant in BTU's? _____

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Owner showed an interest and I feel he would OK the project

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

- ☒ Vestibule entrances
☒ Double pane Insulating glass
☒ Add Insulation

} the landlord & I met to discuss these issues this May 1979
ap

Date 4/20/79

John B. Peck
Signature

1021
Name Johnson & Kelley

Address 310 Maine

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 - a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
 - b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
 - c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☒ Other ☐
2. What is your approximate square footage? 1825 Ceiling height? 8'

3. What is your approximate annual heating bill? 750⁰⁰

4. What is the current size of your heating plant in BTU's? does not know

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

yes Vestibule entrances
yes Double pane Insulating glass
yes Add Insulation

Date 4-20-79

Bonell Johnson Btr
Signature

1022
Name Sewing Shoppe

Address 312 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☒ Other ☐

2. What is your approximate square footage? 3750 Ceiling height? 9

3. What is your approximate annual heating bill? \$1250.00

4. What is the current size of your heating plant in BTU's? Don't Know

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances
☐ Double pane Insulating glass
☐ Add insulation

Don't Know

Date 12-18-78

Gerald J. Thuermer

Signature

1023

Name Riddle's Jewelry

Address 315 MAIN

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

- a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐
 b. Forced Air ☐ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
 c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☒ Other ☐

2. What is your approximate square footage? 2000 Ceiling height? 10'

3. What is your approximate annual heating bill? about \$500.00

4. What is the current size of your heating plant in BTU's? _____

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☐ No ☒

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

- ☐ Vestibule entrances
☐ Double pane Insulating glass we have thermos-pane glass
☐ Add Insulation

Date 12/17/79

Margaret Riddle
 Signature

1024
Name Miller Co. 313 Main
Address Lemmon, S.D.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 - a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
 - b. Forced Air ☐ Hot Water ☒ Steam ☐ Baseboard Radiant ☐
 - c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 3100 Ceiling height? 10 ft

3. What is your approximate annual heating bill? 700.00

4. What is the current size of your heating plant in BTU's? ?

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

- ☐ Vestibule entrances
- ☐ Double pane insulating glass
- ☐ Add insulation

Date 4-18-79

Tim Miller
Signature

1025
Name Town & Country Cafe

Address 316 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 - a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☒ Wood ☐
 - b. Forced Air ☒ Hot Water ☒ Steam ☐ Baseboard Radiant ☐
 - c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 3000 Ceiling height? 9'

- Propane - 728.48
3. What is your approximate annual heating bill? Fuel oil \$775.00
Fuel oil Forced Air 15000 BTU
 4. What is the current size of your heating plant in BTU's? Propane Hot Water 15000 BTU

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances
☐ Double pane Insulating glass
☒ Add Insulation

Date 4-23-79

Harlan Buchholz
Signature

1026
Name

Address

Stoch Electric, Inc.317 Main, Lemmon, S.D.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 1000 Ceiling height? 8 ft

3. What is your approximate annual heating bill? \$ 400.00

4. What is the current size of your heating plant in BTU's? 80,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances

☐ Double pane insulating glass

☒ Add insulation

Date

4-20-79Ernest Kroghsted
Signature

1027

Name Coast to Coast

Address 319 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

- a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
b. Forced Air ☐ Hot Water ☒ Steam ☐ Baseboard Radiant ☐
c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 3000 Ceiling height? 10 ft

3. What is your approximate annual heating bill? 750.00

4. What is the current size of your heating plant in BTU's? 153800

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

- ☐ Vestibule entrances
☐ Double pane insulating glass
☒ Add insulation

Date 4/20/79

Joe M...
Signature

1028
Name Bank of Lemmon

Address 321 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☐ Hot Water ☒ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 700 Ceiling height? 12

3. What is your approximate annual heating bill? \$500

4. What is the current size of your heating plant in BTU's? 388,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances
☐ Double pane insulating glass
☐ Add insulation

Date 4-20-

Nan Baumgardner
Signature

1029
Name Lynn's Sugar Valley

Address Lemmon, South Dakota
4th & Main 403 MAIN

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 - a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
 - b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
 - c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 10000 Ceiling height? 10'

3. What is your approximate annual heating bill? \$ 1530.00

4. What is the current size of your heating plant in BTU's? _____

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

- ☒ Vestibule entrances
☐ Double pane Insulating glass
☐ Add Insulation

Date 4/25/79

[Signature]
Signature

1030

Name Northern Contract Service Inc.
Address 408 Main Lemmon S. Dak

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 - a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐
 - b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
 - c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 1680 Ceiling height? 8'

3. What is your approximate annual heating bill? 1400⁰⁰
4. What is the current size of your heating plant in BTU's? 72⁰⁰⁰
5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?
Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☒ Vestibule entrances
☒ Double pane insulating glass
☒ Add insulation

Date 4-17-79

[Signature]
Signature

1031
Name Professional Building

Address 415 MAIN

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 2500 Ceiling height? 8 feet

3. What is your approximate annual heating bill? \$1200.00

4. What is the current size of your heating plant in BTU's? 151000 per hour

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

None Vestibule entrances
None Double pane insulating glass
O.K. Add insulation - None further can be added

Date 4-18-79

D. H. J. Chonster
Signature

1032
Name Andy's Mail
Address Lemmon 417 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 - a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
 - b. Forced Air ☐ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
 - c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 1150 Ceiling height?

3. What is your approximate annual heating bill? \$ 4100.00

4. What is the current size of your heating plant in BTU's? Do not know

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

- ☐ Vestibule entrances
- ☐ Double pane Insulating glass
- ☐ Add insulation

Date 4-18-79

Andy Fayeth
Signature

1033
Name Christen Studios
Address Lemmon - 420 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐
b. Forced Air ☐ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☒ Other Space heater
2. What is your approximate square footage? 3150 Ceiling height? 9'
Main Floor - 2240
Basement 720 Up stairs 200
3. What is your approximate annual heating bill? \$500.00
4. What is the current size of your heating plant in BTU's? _____
5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?
Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☒ Vestibule entrances
☐ Double pane insulating glass
☒ Add insulation

Date 4/17/79

Margorie Christen - Christen Studios
Signature

1034
Name C. V. Penfield

Address 500 Main

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 2000 Ceiling height? 8

3. What is your approximate annual heating bill? 350.00

4. What is the current size of your heating plant in BTU's? 80,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances
☐ Double pane Insulating glass
☐ Add insulation

Date 4-18-79

C. V. Penfield
Signature

1035
Name Chamber of Commerce

Address 500-A- Main St. Lemmon SD

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☒ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 200 Ceiling height? 8 ft.

3. What is your approximate annual heating bill? 500.-

4. What is the current size of your heating plant in BTU's? 1-48,000 BTU and 1-25,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances
☒ Double pane Insulating glass
☒ Add insulation

Date 12-8-79

Tom Hedrick Pres.
Signature

1036

Name

Style Beauty Shop

Address

501 Main St.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐2. What is your approximate square footage? 1300 Ceiling height? 8'3. What is your approximate annual heating bill? ?4. What is the current size of your heating plant in BTU's? 112 000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances☐ Double pane insulating glass☒ Add Insulation

Date

4-17-79Oliver Schroeder

Signature

3361
36
216
108
1296

5491

1031

503 main

Name Kal Machine Shop

Address _____

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?—

a. Coal _____ Electricity _____ Fuel Oil _____ Propane _____ Wood _____

b. Forced Air _____ Hot Water ☒ Steam _____ Baseboard Radiant _____

c. Heat Pump _____ Space Heater _____ Floor Furnaces _____ Other _____

2. What is your approximate square footage? 2700 Ceiling height? 9'

3. What is your approximate annual heating bill? 650⁰⁰

4. What is the current size of your heating plant in BTU's? 350⁰⁰⁰

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No _____

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☒ Vestibule entrances
☒ Double pane insulating glass
☒ Add insulation

Date 4-18-79

Vern Kalb

Signature

1038

Name Gamble Store
Address 515 Main
Lemmon, S.D., 57638

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 - a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
 - b. Forced Air ☐ Hot Water ☒ Steam ☐ Baseboard Radiant ☐
 - c. Heat Pump ☐ Space Heater ☒ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 5500 Ceiling height? 15 ft.
(5500 Main floor 5000' basement)

3. What is your approximate annual heating bill? 3000⁰⁰
4. What is the current size of your heating plant in BTU's? 300,000
5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?
Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances
☒ Double pane insulating glass
☒ Add insulation

Date 4/18/79

Robert C. Schmitz (owner)
Signature

1639
Name Northwest South Dakota Production Credit Association

Address 519 Main - Lemmon, S D

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☒ Fuel Oil ☐ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☒ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 6000 Ceiling height? 9'

3. What is your approximate annual heating bill? \$1800.00 includes 12 months also
air conditioning - summer time

4. What is the current size of your heating plant in BTU's? ?

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances

☐ Double pane insulating glass

☐ Add insulation

Building built 1976

Date April 17, 1979

Signature

1047

Name Lemmon Dealer

Address 11 3rd St. W.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

- a. Coal ☐ Electricity ☒ Fuel Oil ☐ Propane ☐ Wood ☐
b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 2000 Ceiling height? 10 & 8'

3. What is your approximate annual heating bill? \$600 - \$700

4. What is the current size of your heating plant in BTU's? 134,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

- ☐ Vestibule entrances
☐ Double pane insulating glass
☒ Add insulation

Date _____

Bruce Brown
Signature

1048
17 3 SW

Name George B. Smith

Address Lemmon, S.D.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 1375 Ceiling height? 9'

3. What is your approximate annual heating bill? _____

4. What is the current size of your heating plant in BTU's? _____

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances

☒ Double pane Insulating glass

☐ Add Insulation

Date April 18, 1979

George B. Smith
Signature

Name

Lemmon Bldg & Loan.

Address

17 3rd St. West.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 1375 Ceiling height? 9

3. What is your approximate annual heating bill? 450.00

4. What is the current size of your heating plant in BTU's? _____

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances

☐ Double pane Insulating glass

☒ Add insulation

Date

Apr. 18 1979

Thelma Clauer

Signature

Name Raney's GarageAddress 18 3 S W

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How Is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐2. What Is your approximate square footage? 15,000 Ceiling height? 12'3. What Is your approximate annual heating bill? 5000

4. What is the current size of your heating plant in BTU's? _____

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

yes Vestibule entrances
yes Double pane Insulating glass
yes Add Insulation

Date _____

A. L. Raney
 Signature

1052

Name SPENCER MEMORIAL CHURCHAddress 511 W 3RD STREET

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐2. What is your approximate square footage? 2425 Ceiling height? 173. What is your approximate annual heating bill? \$ 2500.004. What is the current size of your heating plant in BTU's? 1. 250,000
2. 250,000
3. 250,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances☐ Double pane insulating glass☐ Add insulationDate 4/21/79Signature Dr. C. A. Kelly, Jr.

Name Northwestern Bell telephone CoAddress 12 4th Street west Lemmon, S.D.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐b. Forced Air ☐ Hot Water ☒ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐2. What is your approximate square footage? 3000 Ceiling height? 9' feet
12 ft near in Equip Room3. What is your approximate annual heating bill? \$1200.004. What is the current size of your heating plant in BTU's? 324 m Btu/h

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

Power Vestibule entrancesPower Double pane Insulating glassPower Add insulationDate 4-18-79

E. H. Jensen
Signature

1054

Name N.W. Area Alcohol, Drug & Mental Health Center, Inc.Address 14 West 4th St. - Lemmon, S.D. 57638

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☒ Ceiling2. What is your approximate square footage? 1400 Ceiling height? 8 ft.3. What is your approximate annual heating bill? \$ 910.024. What is the current size of your heating plant in BTU's? ?

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

done Vestibule entrances
done Double pane insulating glass
done Add insulation

Date 4/17/79

Signature

14 4 SW 1055

Name Lemmon Processing Plant

Address Lemmon S DAK

405 West 1st Street Avenue

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☐ Hot Water ☐ Steam ☒ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 2500 Ceiling height? 9'

3. What is your approximate annual heating bill? \$1548.00

4. What is the current size of your heating plant in BTU's? _____

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☒ Vestibule entrances

☐ Double pane Insulating glass

☐ Add Insulation

Date 4/25/79

Jim Ford
Signature

Name Nodak SupplyAddress 1145 E

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☒ Floor Furnaces ☐ Other ☐2. What is your approximate square footage? 6000 Ceiling height? 12'3. What is your approximate annual heating bill? \$27004. What is the current size of your heating plant in BTU's? 480,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances☐ Double pane Insulating glass☐ Add insulationDate 4-20-79

Randolph Jahner
Signature

Name

State line Electronics

Address

20 East 4th Street

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ___ Electricity ___ Fuel Oil ___ Propane ☒ Wood ___b. Forced Air ☒ Hot Water ___ Steam ___ Baseboard Radiant ___

c. Heat Pump ___ Space Heater ___ Floor Furnaces ___ Other ___

2. What is your approximate square footage? 720 Ceiling height? 8'

3. What is your approximate annual heating bill?

450.00

4. What is the current size of your heating plant in BTUs?

?

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ___

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☒ ☒ ☒

Vestibule entrances

Double pane insulating glass

Add insulation

Date

4-20-79

Signature

1067
12 2 SE
Name Great Plains Supply Co.

Address Lemmon, S.D.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☒ Fuel Oil ☐ Propane ☐ Wood ☒

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☒ Other ☐

2. What is your approximate square footage? 1600 Ceiling height? 9 FT

3. What is your approximate annual heating bill? 77000

4. What is the current size of your heating plant in BTU's? 125000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances

☐ Double pane insulating glass

☐ Add Insulation

Date 18 April 79

Philip D. [Signature]
Signature

1066

Name Mike's Auto ElectricAddress 17 2nd ST E

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☒ Floor Furnaces ☐ Other ☐2. What is your approximate square footage? 3600 Ceiling height? 11'3. What is your approximate annual heating bill? \$1600.004. What is the current size of your heating plant in BTU's? 200,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances☐ Double pane insulating glass☒ Add insulationDate 4-25-79

Raymond Michael
Signature

1078

Name WHEELER MFG CO., INC - BLDG 2Address 101-105 - 1ST AV W, LEMMON, S.D.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☒ Electricity ☐ Fuel Oil ☐ Propane ☐ Wood ☐b. Forced Air ☐ Hot Water ☐ Steam ☒ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other CENTRAL FORCED AIR2. What is your approximate square footage? 7,000 Ceiling height? 12'WE HAVE CONSIDERABLE OUTSIDE AIREXCHANGE IN THIS BLDG FOR MFG'S PURPOSEFROM 3,000 TO 8,000 C.F.M. ⁰⁰ ✓3. What is your approximate annual heating bill? 3800

4. What is the current size of your heating plant in BTU's? _____

MAX COAL FEED - 75[#] P.H. BOILER CAPACITY APPROX 50[#] pi

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

AS ECONOMICALLY ADVISABLE☐ Vestibule entrances☐ Double pane Insulating glass☐ Add insulationDate 4-23-79R. B. Wheeler, Pres.

Signature

204 1A W 1079

Name Northwestern Cleaning

Address Lemmon

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☐ Hot Water ☐ Steam ☒ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 2500 Ceiling height? 12

3. What is your approximate annual heating bill? \$ 800.00

4. What is the current size of your heating plant in BTU's? 15 HP Boiler

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances

☐ Double pane Insulating glass

☒ Add Insulation

Date 4-18-79

Fred Short, Jr.
Signature

Name Hershel Implement Number in Household Business
Address 211 1st Ave West 1080

COMMUNITY SURVEY GTE 1979-Residential Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal heating system. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How do you heat your home now? Both
a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☒ Wood ☐
b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☒ [Radiation]
c. Heat Pump ☐ Floor Furnace ☐ Space Heater ☐ Other ☐
2. What is your approximate square footage heated? 16,000 sq feet
3. What is your approximate annual heating bill? \$10,000
4. Are you on a fixed income? Business
5. Should geothermal heat become available for all residents of Lemmon, would you be interested in investing in your heating system so that you could connect?
Yes ☐ No ☐ Not sure

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Should the first buildings to be connected to the geothermal heat be schools, hospital, and other public buildings? Yes ☒ No ☐
 7. Do you then favor the city of Lemmon attempting to develop and utilize geothermal energy? Yes ☒ No ☐
 8. Would you support a bond issue for the repair of streets and alleys after the system of piping was laid throughout the city? Yes ☒ No ☐
 9. What is the age of your home? 69 yrs
business
 10. Have you insulated or installed other energy saving materials in your home? Yes Recently? Feb of this year
- Type: Land

4/25/79

Clark B. Johnson

303 1 A W

1081

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System.

With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal Electricity Fuel Oil Propane Wood

b. Forced air hot water steam baseboard radiant (Electric)

2. What is your approximate square footage? 4800 Ceiling height? 9

3. What is your approximate annual heating bill? 2432.70 1978

4. What is the current size of your heating plant in BTU's? Very old furnace.

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect? yes

Approximate costs are between \$1000-\$3000 depending on the system you now own..

The anticipated savings through the use of geothermal heating are in the area of 20% of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than fluctuate with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

Vestibule entrances,
Double pane insulating glass,
Add insulation.

Possibly.

311 1 A W

1082

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System.

With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal Electricity Fuel Oil Propane Wood

b. Forced air hot water steam baseboard radiant

2. What is your approximate square footage? 2200 Ceiling height? 12

3. What is your approximate annual heating bill? 2489.40 1977

4. What is the current size of your heating plant in BTU's? 220,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect? yes

Approximate costs are between \$1000-\$3000 depending on the system you now own..

The anticipated savings through the use of geothermal heating are in the area of 20% of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than fluctuate with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

Vestibule entrances,
Double pane insulating glass,
Add insulation.

Possibly.

404 1 A W

1083

Name Peterson Imp + Auto Sales Inc.

Address Lemmon S.D.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

- a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐
b. ~~Forced Air~~ ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other Hanging Furnace

2. What is your approximate square footage? 6000 Ceiling height? 14'

3. What is your approximate annual heating bill? 4500.00

4. What is the current size of your heating plant in BTU's? 170,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

- ☒ Vestibule entrances
☒ Double pane Insulating glass
☒ Add Insulation

Date 4-19-79

Signature

405 1 A W

1084

Name

American Legion

Address

Lemmon SD

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐2. What is your approximate square footage? 4500 Ceiling height? 83. What is your approximate annual heating bill? \$ 800.004. What is the current size of your heating plant in BTU's? 125,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☐ No ☐ Undecided

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☒ Vestibule entrances
☒ Double pane insulating glass
☒ Add insulation

Date

4-18-79

Signature

1085

Name THE REFORMED PRESBYTERIAN Church
Address REFORMED PRESBYTERIAN CHURCH
500 First Ave. West, Lemmon, S.D.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 - a. Coal ☒ Electricity ☐ Fuel Oil ☐ Propane ☐ Wood ☐
 - b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
 - c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 2500 Ceiling height? 10 ft.

Ceiling height varies between 8' and 10'

3. What is your approximate annual heating bill? \$300.00
4. What is the current size of your heating plant in BTU's? 150,000
5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?
Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances
☐ Double pane Insulating glass
☐ Add Insulation

Date 4/20/79

Jim Lemmon
Signature

1088

Name Church of God

Address 212 - 2nd Ave., W.

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
 - a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
 - b. Forced Air ☐ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
 - c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 10,000 Ceiling height? 20 ft.

3. What is your approximate annual heating bill? \$ 4,800

4. What is the current size of your heating plant in BTU's? 300,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

- ☒ Vestibule entrances
- ☒ Double pane insulating glass
- ☒ Add insulation

Date 4-20-79

CHURCH OF GOD
214 - 2nd Ave. W.
P.O. Box 336
LEMMON, SD 57638

Pastor A. W. Petty
Signature

Name ST. MARY'S CATHOLIC CHURCH } RECTORY CHURCH
 Address 410 2ND AVE W LEMMON SD 57638

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

- How is your business heated now?
 a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐
 b. Forced Air ☐ Hot Water ☒ Steam ☒ Baseboard Radiant ☐
 c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
- What is your approximate square footage? RECTORY - 4,375 sq. ft. Ceiling height? 8'
CHURCH - 10,000 sq. ft. HEIGHT - 19' - CHURCH
8' - BASEMENT
\$2,300.00
- What is your approximate annual heating bill? ?
- What is the current size of your heating plant in BTU's? ?
- Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?
 Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.
 The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

- Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical? IMPROVEMENTS ALREADY MADE.
☐ Vestibule entrances
☐ Double pane Insulating glass
☐ Add Insulation

Date 4/20/79 Andrew Norway
 Signature

1100

Name FULLERTON LEMBER

Address 102 1ST AVE E

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?

a. Coal ☐ Electricity ☐ Fuel Oil ☒ Propane ☐ Wood ☐

b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐

c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐

2. What is your approximate square footage? 1056 Ceiling height? 10

Shop 1000 SF - 10 Ceiling

3. What is your approximate annual heating bill? 700⁰⁰

4. What is the current size of your heating plant in BTU's? 120⁰⁰⁰ + 75⁰⁰⁰

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☒ Vestibule entrances
☒ Double pane Insulating glass
☒ Add Insulation

Date 4-23-79

Bueh-Bauer
Signature

Name Barber Transportation
Address ~~125~~ 1st Ave East.
403

COMMUNITY SURVEY GTE 1979-Commercial

As you have probably heard, Lemmon is being considered for a community wide Geothermal Heating System. With that in mind, would you please answer the following questions to help us with our Federal Grant Application?

1. How is your business heated now?
a. Coal ☐ Electricity ☐ Fuel Oil ☐ Propane ☒ Wood ☐
b. Forced Air ☒ Hot Water ☐ Steam ☐ Baseboard Radiant ☐
c. Heat Pump ☐ Space Heater ☐ Floor Furnaces ☐ Other ☐
2. What is your approximate square footage? 250 Ceiling height? 8'

3. What is your approximate annual heating bill? paid out of Rapid City

4. What is the current size of your heating plant in BTU's? 80,000

5. Should geothermal heat become available for your business, would you be interested in investing in your heating system so that you could connect?

Yes ☒ No ☐

Approximate costs are between \$1,000—\$3,000 depending on the system you now own.

The anticipated savings through the use of geothermal heating are in the area of 20 percent of your present heating costs. This can vary, but the cost of geothermal once installed would be constant, rather than escalating with fuel costs.

6. Would you be willing to make other capital improvements to make the geothermal energy even more effective and economical?

☐ Vestibule entrances
☐ Double pane insulating glass
☒ Add insulation

Date 4-19-79

Signature

APPENDIX E

SOUTH DAKOTA OFFICE OF ENERGY POLICY

LETTER DATED FEBRUARY 25, 1981

SOUTH DAKOTA
OFFICE OF ENERGY POLICY
Capitol Lake Plaza
Pierre, SD 57501
605/773-3603

February 25, 1981

George Dunham
Dunham Associates
528 Kansas City Street
Rapid City, SD 57701

Dear George:

At the recent State-Federal Geothermal Conference, officials of the Division of Geothermal Energy, U.S. Department of Energy, presented an overview of the proposed FY 1982 geothermal budget. These officials noted that the Federal Government's involvement in the assessment and development of geothermal resources in the United States will be greatly diminished in FY 1982. It was pointed out that the proposed Carter Administration budget called for drastic cuts in almost all phases of the national geothermal program and that the Reagan Administration is recommending still further budget reductions. Such programs as the User Coupled Drilling Program and the Geothermal Loan Guarantee Program will be severely reduced if not entirely eliminated. It is also proposed that the Resource Assessment and Commercialization Programs be eliminated.

I will keep trying to find geothermal programs that have funding available. In the meantime I am sending you the information we talked about on the phone February 24th.

Sincerely,

Phil Lidel
Director, Geothermal Program

PL:ba

ENC.

APPENDIX F
COMPARISON OF AQUIFERS

APPENDIX F

	<u>Aquifer</u>		
	<u>Madison</u>	<u>Lakota</u>	<u>Fox Hills</u>
Depth	6800 feet	4200 feet	1000 feet
Temperature	160°F	110°F	55°F
Flow rate/well	400 gpm	50 gpm	100 gpm
Required total flow	398 gpm	298 gpm	1050 gpm
Supply wells	1	6	11
Disposal wells	1	6	7*
TDS	7500 ppm	4000 ppm	1100 ppm
Static level	-100 feet	-800 feet	-500 feet
Estimated cost for supply & disposal wells	\$1,400,000	\$3,600,000	\$1,080,000

*Assumes existing, inactive wells could be used for disposal.

APPENDIX G
ENERGY REQUIREMENTS

APPENDIX G

Madison
Purchased BTU x 10⁶/Yr.

	<u>Existing</u>	<u>Proposed</u>	<u>Save</u>
Propane	6630	0	6630
Fuel Oil	8340	0	8340
Coal	5810	0	5810
Electric	595	0	595
Electric (pump Dist.)	0	102	(102)
Electric (well pump)	<u>0</u>	<u>370</u>	<u>(370)</u>
Total	21375	472	20903

Madison
1981 Annual Fuel Cost (\$1000's)

	<u>Existing</u>	<u>Proposed</u>	<u>Save</u>
Propane @ \$.59/gal	44.05	0	44.05
Fuel Oil @ \$1.10/gal	70.60	0	70.60
Coal @ \$30/ton	10.50	0	10.50
Electric @ \$.035/KWH	<u>6.10</u>	<u>4.84</u>	<u>1.26</u>
Total	131.25	4.84	126.41

Lakota Formation
Purchased BTU x 10⁶/Yr

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane	6630	0	6630
Fuel Oil	8340	0	8340
Coal	5810	0	5810
Electric (existing)	595	0	595
Electric (heat pumps)	0	3710	(3710)
Electric (pump dist.)*	0	70	(70)
Electric (well pump)	<u>0</u>	<u>495</u>	<u>(495)</u>
Total	21375	4275	17100

Lakota Formation
1981 Annual Fuel Costs (\$1000's)

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane @ \$.59/gal	44.05	0	44.05
Fuel Oil @ \$1.10/gal	70.60	0	70.60
Coal @ \$30/ton	10.50	0	10.50
Electric @ \$.035/KWH	<u>6.10</u>	<u>43.80</u>	<u>(37.7)</u>
Total	131.25	43.8	93.55

*Dependent upon well placement

Heating Fox Hills Wells

BTU x 10⁶/Yr

	<u>Existing</u>	<u>Proposed</u>	<u>Save</u>
Propane	6630	0	6630
Fuel Oil	8340	0	8340
Coal	5810	0	5810
Electric (existing)	595	0	595
Electric (heat pump)	0	4950	(4950)
Electric (pump dist.)*	0	200	(200)
Electric (well pump)	<u>0</u>	<u>270</u>	<u>(270)</u>
Total	21375	5420	15955

Fox Hills Wells

1981 Annual Fuel Costs (\$1000's)

	<u>Existing</u>	<u>Proposed</u>	<u>Save</u>
Propane @ \$.59/gal	44.05	0	44.05
Fuel Oil @ \$1.10/gal	70.60	0	70.60
Coal @ \$30/ton	10.50	0	10.50
Electric @ \$.035/KWH	<u>6.1</u>	<u>55.5</u>	<u>(49.4)</u>
Total	131.25	55.5	75.75

*Dependent upon well placement

APPENDIX H
PRESENTATION

PRESENTATION

On May 19, 1981, a presentation of the work performed under Subcontract K-7651 was given to representatives of the Lemmon, South Dakota, community. Those in attendance were enthusiastic and were supportive of geothermal development in Lemmon.

Initial discussion included questions of specific buildings to be served, corrosion problems, and the absence of the need for a back-up heat source. The discussion then addressed the problems of financing in view of the risk associated with the geothermal well development.

Financing attempts at this time include a loan application to the Farm Home Administration and plans to apply for assistance through the HUD Urban Development Action Grant Program. Because the risk in the whole venture is the risk associated with successfully completing the first well, the possibility of leasing municipal land for oil exploration in exchange for a test hole to the Madison was discussed. Financing of a test well by private individuals was also discussed and more information on possible tax incentives for private investors was to be gathered.

The citizens of Lemmon are anxious to utilize geothermal energy. The funding of the project with the present financial climate is a major obstacle because of the risk associated with development of the first well. The people of Lemmon are actively seeking funding for the all-important test well.

Respectfully submitted,

DUNHAM ASSOCIATES, INC.

Charles J. Mize, P.E.
Director of Industrial
Projects Division

CJM:pr

APPENDIX I

Reference has been made throughout this report that there is not general agreement on the well expectations in the Lemmon area. E G & G Idaho, Inc., through modification No. 4 of Subcontract No. K-7651, requested an evaluation of several heating systems incorporating the geothermal source described in Mr. Engen's correspondence (Page I-23 & 24). The area to be served is the same group of buildings described earlier in this report.

SYSTEMS

Three distinct systems for utilizing 110°F geothermal water were investigated. A schematic diagram of system #1 is shown in figure I-1. This system would utilize geothermal energy under low demand conditions. As demand increased electric heating would be employed to increase the temperature of the water entering the coil. The quantity of electric energy that can be used for a specific geothermal water flow is limited by the heating coil size. If too much electrical heating is required to maintain building temperature, water leaving a building could have a higher temperature than the geothermal source. In order to maintain reasonable coil size, auxiliary heat sources were assumed to prevent conditions that would require the return of water warmer than 110°F to the distribution system.

The second system, shown in figure I-2, extracts hydrothermal energy by means of a duct coil. As demand exceeds the capacity of the geothermal source an auxiliary heat source is required to maintain building temperature.

Individual water to air heat pumps for each building comprise the third system. This system is similar to the method of utilizing the 110°F water from the Lakota proposed previously in this report.

MODEL METHODS

Calculation of energy requirements and energy costs in systems employing multiple energy sources requires techniques to estimate average demand-time relationships. A computer program, GEOBIN, was prepared to assist with the equation of the contribution by each energy source.

GEOBIN is a simulation program which utilizes single measure weather data and load adjustment parameters to simulate the annual performance of two types of geothermal heating systems. These system types are schematically depicted in figures I-1 and I-2. With system type 1, the elevation of the water temperature by the boiler must be limited to avoid elevating the return water temperature above that of the geothermal source temperature.

The basic GEOBIN building load model calculates steady state heat losses as a direct function of outside air temperature. The basic GEOBIN system model calculates geothermal system performance for a constant space temperature. Since experience has shown that the accuracy of the simple models is less than desirable, GEOBIN employs user supplied load modification parameters to more nearly achieve the level of accuracy that would be expected with more sophisticated simulation programs.

Following is a simple statement of the basic algorithm employed by GEOBIN.

Building Losses:

Peak Unoccupied Hour Loss = $UA \times (\text{Space Temp.} - \text{Outside Temp.})$

Peak Occupied Hour Loss = $UA \times (\text{Space Temp.} - \text{Outside Temp.}) - \text{internal gains}$

where: UA is a composite heat transfer coefficient

Annual losses = Peak losses X hours of occurrence X Adjustment factor

Geothermal System Performance:

Output = $(\text{Supply water temperature} - \text{Room Temp.}) \times \text{Coil performance factor}$

GEOBIN was chosen as the analysis tool because the data base was not sufficient to perform detailed modeling of the subject buildings.

Were such a data base available, any number of state-of-the-art simulation programs could be employed that would dynamically simulate the effects of

1) Multiple weather parameters on an hourly basis. In addition to outside air temperature, those parameters could include wind speed, wind direction, and solar radiation.

2) Dynamic performance of the building envelope.

3) Internal loads and utilization schedules.

4) Floating space temperatures.

COSTS

Well Cost

A disposal well will be required for the water leaving the geothermal system. The projected TDS of 4000 ppm and the declining level of the Lakota aquifer in the Lemmon area will make necessary the return of the spent water.

Two completed wells would have a probable cost of \$ 600,000. That estimate includes no instrumentation or monitoring cost and includes no engineering or well logging costs.

Distribution System Cost

Economic pipe size for the specified flow rates is the same as the pipe size for the 398 gpm flow from the Madison. Estimated distribution system costs are therefore the same, \$ 483,980.

Individual Building System Costs

Comparative cost estimates for the heating equipment for a building such as described in the Community Survey GTE for building 1031 is shown in Table I-1.

Table I-1

<u>Heating System</u>	<u>Retrofit Cost</u>
System #1 Electric Temp. Increase	\$ 4,400
System #2 Auxiliary Fuel-Duct Coil	2,900
System #3 Heat Pump	4,000

OPERATING COSTS

The operating costs were estimated with the efficiency assumptions and conditions stated on page 9 in the main body of this report. GEOBIN runs were made assuming a 300 gpm flow rate and a 500 gpm flow rate. The output from these runs are on pages I-17 through I-22. At 300 gpm system #1 obtains 35% of the annual heating load from the geothermal source. At 500 gpm system #1 obtains 70.5% of the annual load from the geothermal source. System #2 is more efficient than system #1 at both flow rates, utilizing 62.4% geothermal energy at 300 gpm and 85.1% at 500 gpm. The percentages are based on delivered Btu's, not purchased Btu's.

FIGURE I-1. CUSTOMER SYSTEM TYPE #1

FIGURE I-2. CUSTOMER SYSTEM TYPE #2

ANNUAL SAVINGS
SYSTEM #1 300 GPM
PURCHASED Btu X 10⁶

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane	6,630	653	5,977
Fuel Oil	8,340	837	7,503
Coal	5,810	583	5,227
Electric (existing)	595	60	535
Electric (pump distribution)	0	70	(70)
Electric (well pump)	0	495	(495)
Electric (water heating)	0	7,621	(7,621)
	<u>21,375</u>	<u>10,319</u>	<u>11,056</u>

1981 ANNUAL FUEL COSTS
(\$ 1,000's)

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane @ \$.59/gal.	44.05	4.34	39.71
Fuel Oil @ \$1.10/gal.	70.60	7.09	63.51
Coal @ \$30 ton	10.50	1.05	9.45
Electric @ \$.035/KWH	6.10	84.54	(78.44)
	<u>131.25</u>	<u>97.02</u>	<u>34.23</u>

* 300 gpm flow rate

Table I-2

ANNUAL SAVINGS
SYSTEM #2 300 GPM
PURCHASED Btu X 10⁶

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane	6,630	2,457	4,173
Fuel Oil	8,340	3,089	5,251
Coal	5,810	2,153	3,657
Electric (existing)	595	220	375
Electric (pump distribution)	0	70	(70)
Electric (well pump)	0	495	(495)
	<u>21,375</u>	<u>8,484</u>	<u>12,891</u>

1981 ANNUAL FUEL COSTS \$ (1,000's)

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane @ \$.59/gal.	44.05	16.32	27.73
Fuel Oil @ \$1.10/gal.	70.60	26.15	44.45
Coal @ \$30/ton	10.50	3.89	6.61
Electric @ \$.035/KWH	<u>6.10</u>	<u>8.05</u>	<u>(1.95)</u>
	131.25	54.41	76.84

* 300 gpm flow rate

Table I-3

ANNUAL SAVINGS
SYSTEM #3 - HEAT PUMP
PURCHASED Btu X 10⁶

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane	6,630	0	6,630
Fuel Oil	8,340	0	8,340
Coil	5,810	0	5,810
Electric (existing)	595	0	595
Electric (heat pumps)	0	3,710	(3,710)
Electric (pump distribution)	0	70	(70)
Electric (well pump)	0	495	(495)
	<u>21,375</u>	<u>4,275</u>	<u>17,100</u>

1981 ANNUAL COST (\$ 1000's)

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane @ \$.59/gal.	44.05	0	44.05
Fuel Oil @ \$1.10/gal.	70.60	0	70.60
Coal @ \$30 ton	10.50	0	10.50
Electric @ \$.035/KWH	6.10	43.8	(37.7)
	<u>131.25</u>	<u>43.8</u>	<u>93.55</u>

Table I-4

ANNUAL SAVINGS

SYSTEM #1

PURCHASED Btu X 10⁶

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane	6,630	19.4	6,610.6
Fuel Oil	8,340	24.4	8,315.6
Coil	5,810	17.0	5,793.0
Electric (existing)	595	1.7	593.3
Electric (pump distribution)	0	117	(117)
Electric (well pump)	0	825	(825)
Electric (water heating)	<u>0</u>	<u>4,052.0</u>	<u>(4,052.0)</u>
	21,375	5,056.5	16,318.5

1981 ANNUAL SAVINGS (\$ 1,000's)

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane @ \$.59/gal.	44.05	.10	43.95
Fuel Oil @ \$1.10/gal.	70.60	.20	70.40
Coal @ \$30 ton	10.5	.03	10.47
Electric @ \$.035/KWH	<u>6.1</u>	<u>51.22</u>	<u>(45.12)</u>
	131.25	51.55	79.70

* 500 gpm flow rate

Table I-5

ANNUAL SAVINGS

SYSTEM #1

PURCHASED Btu X 10⁶

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane	6,630	971.8	5,658.2
Fuel Oil	8,340	1,222.1	7,117.9
Coil	5,810	851.6	4,958.4
Electric (existing)	595	87.2	507.8
Electric (pump distribution)	0	117	(117)
Electric (well pump)	0	825	(825)
	<u>21,375</u>	<u>4,074.7</u>	<u>17,300.3</u>

1981 ANNUAL SAVINGS (\$ 1,000's)

	<u>Existing</u>	<u>Proposed</u>	<u>Savings</u>
Propane @ \$.59/gal.	44.05	6.46	37.59
Fuel Oil @ \$1.10/gal.	70.60	10.35	60.25
Coal @ \$30 ton	10.50	1.54	8.96
Electric @ \$.035/KWH	<u>6.10</u>	<u>10.55</u>	<u>(4.45)</u>
	131.25	28.90	102.35

* 500 gpm flow rate

Table I-6

Tables I-2 through I-4 summarize the estimated savings, both in Btu's and dollars for the three systems at a projected flow rate of 300 gallons per minute. The water to air heat pump system is projected to result in the largest fuel savings of the three systems. System #2 without electrical energy input to boost water temperature is second to the heat pump system.

If projected water flows were 500 gallons per minute at 110°F a greater energy savings would be realized. GEOBIN computer runs with 500 gpm of geothermal water available were made. The energy saving is substantially greater than if only 300 gpm is available.

SYSTEM COMPARISON

Table I-7 shows a comparison of the three systems and the system employing the Madison aquifer as a geothermal source. Project economics are sensitive to finance costs, rate of increase of fuel costs and rate of increase of operating costs over the life of the project. Table I-7 does not include estimates of increasing operating costs which would significantly reduce the payback period for all systems.

The heat pump system, system #3 and the system employing water from the Madison are quite comparable if a well into the Lakota formation will yield 300 gpm at 110°F. Interest rates and the expected rate of increase of fuel prices will have a significant effect on the economic choice of systems. High interest rates will favor a heat pump system utilizing Lakota formation geothermal water. Highly increasing rates of fuel costs would tend to favor the greater initial cost of developing the Madison source.

If the Lakota formation will yield 110°F water at 300 gpm from one well, development of a system utilizing Lakota water would present less risk than development of the Madison. The lower risk is a result of the lower initial investment.

ECONOMIC COMPARISON

	<u>*Total Project Cost</u>	<u>**Annual Operating Cost</u>	<u>***Annual Fuel Savings 1981</u>	<u>Simple Payback (Years)</u>
System #1	\$ 1,726,000	\$ 16,000	\$ 34,230	94.7
System #2	1,633,000	16,000	78,840	26.8
System #3	1,702,000	16,000	93,550	21.9
Madison Source	2,409,000	16,000	126,410	21.8

* Includes wells, distribution system, building retrofit, project administration costs.

** Includes maintenance and utility administration but does not include finance costs.

*** Assumes fuel costs constant.

**GEOBIN
Version 1.0**

**A Simulation Program That Simultaneously Models The Performance
Of Two Types Of Customer Systems Connected To A Geothermal Utility**

This Simulation Was Performed For 62 Buildings For Connection To A Proposed Utility In LEMMON, SOUTH DAKOTA

**Customer System Type 1 Would Utilize An Electric Boiler To Boost The Geothermal Fluid Temperature Prior To Its Use
By A Water To Air Heat Exchanger. Customer System Type 2 Would Utilize The Geothermal Fluid At Its Source Temperature.**

Requirements For Auxiliary Systems To Supplement The Geothermal System Requirements Were Also Simulated.

Input Parameters Used In This Simulation Were:

Composite Building Heat Loss Coefficient	:	114000.0 BTUH/Deg F.
Geothermal Source Temperature	:	110.0 Deg F.
Geothermal Fluid Flow Rate	:	300.0 Gal/Min.
Geothermal Heat Exchanger Capacity Coefficient	:	75000.0 BTUH/Deg F
Internal Heat Gains vs. OAT Balance	:	35.0 Deg F
Occupied/Unoccupied Load Coefficients	:	.575/ .001
Building Loss Adjustment Coefficients	:	.650, .350
Occupied Room Temperature	:	70.0 F

**Simulation Was Performed Using Average Year Weather Data As Reported For BISMARCK, NORTH DAKOTA
For The Periods When The Outside Air Temperature Is Below 65.0 Degrees F.**

Outside Temp.	Bin Hours	Peak Loss KBTUH	Sys. Type	Peak Hourly Data				Annual Data				Geofluid Fraction Pct	
				Water Temp (F) Supply Return	Geofluid Electric KBTUH	Auxiliary	Loss	Geofluid	Electric	Auxiliary			
64/ 63	234	740	1	110.0	105.1	740	0	0	65715	65715	0	0	100.0
			2	110.0	105.1	740	0	0		65715	0	0	100.0
62/ 61	237	968	1	110.0	103.5	968	0	0	87088	87088	0	0	100.0
			2	110.0	103.5	968	0	0		87088	0	0	100.0
60/ 59	267	1197	1	110.0	102.0	1197	0	0	121856	121856	0	0	100.0
			2	110.0	102.0	1197	0	0		121856	0	0	100.0
58/ 57	248	1425	1	110.0	100.5	1425	0	0	135141	135141	0	0	100.0
			2	110.0	100.5	1425	0	0		135141	0	0	100.0
56/ 55	266	1653	1	110.0	99.0	1653	0	0	168443	168443	0	0	100.0
			2	110.0	99.0	1653	0	0		168443	0	0	100.0
54/ 53	236	1881	1	110.0	97.5	1881	0	0	170891	170891	0	0	100.0
			2	110.0	97.5	1881	0	0		170891	0	0	100.0
52/ 51	227	2109	1	110.0	95.9	2109	0	0	184531	184531	0	0	100.0
			2	110.0	95.9	2109	0	0		184531	0	0	100.0
50/ 49	230	2337	1	110.0	94.4	2337	0	0	208283	208283	0	0	100.0
			2	110.0	94.4	2337	0	0		208283	0	0	100.0
48/ 47	221	2565	1	110.0	92.9	2565	0	0	220137	220137	0	0	100.0
			2	110.0	92.9	2565	0	0		220137	0	0	100.0
46/ 45	230	2793	1	110.0	91.4	2793	0	0	250114	250114	0	0	100.0
			2	110.0	91.4	2793	0	0		250114	0	0	100.0
44/ 43	210	3021	1	110.3	90.1	2978	41	0	248749	245291	3458	0	98.6
			2	110.0	90.0	3000	0	20		247020	0	1729	99.3
42/ 41	209	3249	1	113.3	91.7	2750	497	0	266574	225714	40859	0	84.7
			2	110.0	90.0	3000	0	249		246144	0	20429	92.3
40/ 39	229	3477	1	116.4	93.2	2522	953	0	314029	227867	86161	0	72.6
			2	110.0	90.0	3000	0	476		270948	0	43080	86.3
38/ 37	236	3705	1	119.4	94.7	2294	1409	0	345635	214098	131537	0	61.9
			2	110.0	90.0	3000	0	704		279867	0	65768	81.0
36/ 35	260	3933	1	122.4	96.2	2066	1865	0	405392	213055	192337	0	52.6
			2	110.0	90.0	3000	0	932		309224	0	96168	76.3
34/ 33	267	4160	1	125.5	97.7	1838	2321	0	452305	205365	246939	0	45.4
			2	110.0	90.0	3000	0	1161		328835	0	123469	72.7
32/ 31	250	4388	1	128.5	99.3	1610	2777	0	460027	182442	277583	0	39.7
			2	110.0	90.0	3000	0	1389		321234	0	138792	69.8
30/ 29	257	4616	1	131.6	100.8	1382	3233	0	510666	177341	333324	0	34.7
			2	110.0	90.0	3000	0	1617		344003	0	166662	67.4
28/ 27	221	4844	1	134.6	102.3	1154	3689	0	472236	143786	328449	0	30.4
			2	110.0	90.0	3000	0	1845		308011	0	164224	65.2
26/ 25	209	5072	1	137.6	103.8	926	4145	0	477528	127496	350031	0	26.7
			2	110.0	90.0	3000	0	2073		302512	0	175015	63.3
24/ 23	191	5300	1	140.7	105.3	698	4601	0	463250	108346	354903	0	23.4
			2	110.0	90.0	3000	0	2301		285798	0	177451	61.7
22/ 21	168	5528	1	143.7	106.9	470	5057	0	432952	88507	344444	0	20.4
			2	110.0	90.0	3000	0	2529		260730	0	172222	60.2
20/ 19	167	5756	1	146.0	108.0	299	5399	56	455883	85045	366965	0	18.7
			2	110.0	90.0	3000	0	2757		268527	0	187356	58.9
18/ 17	145	5984	1	146.0	108.0	299	5399	284	419720	81707	321067	0	19.5
			2	110.0	90.0	3000	0	2985		242241	0	177479	57.7
16/ 15	140	6212	1	146.0	108.0	299	5399	512	425823	86026	310316	0	20.2
			2	110.0	90.0	3000	0	3213		241185	0	184638	56.6
14/ 13	128	6440	1	146.0	108.0	299	5399	740	409732	85516	285094	0	20.9
			2	110.0	90.0	3000	0	3441		228063	0	181668	55.7
12/ 11	128	6668	1	146.0	108.0	299	5399	968	429794	92329	286121	0	21.5
			2	110.0	90.0	3000	0	3669		235390	0	194404	54.8

Outside Temp.	Bin Hours	Peak Loss KBTUH	Sys. Type	Water Temp (F)		Peak Hourly Data			Annual Data				Geofluid Fraction Pct	
				Supply	Return	Geofluid	Electric	Auxiliary	Loss KBTUH	Geofluid	Electric	Auxiliary		
10/	9	132	6896	1	146.0	108.0	299	5399	1197	463768	102226	295941	65600	22.0
				2	110.0	90.0	3000	0	3897		250197	0	213571	53.9
8/	7	118	7124	1	146.0	108.0	299	5399	1425	430588	90029	270935	69622	20.9
				2	110.0	90.0	3000	0	4124		225497	0	205090	52.4
6/	5	115	7352	1	146.0	108.0	299	5399	1653	439827	82549	277940	79337	18.8
				2	110.0	90.0	3000	0	4352		221519	0	218307	50.4
4/	3	112	7580	1	146.0	108.0	299	5399	1881	444878	74678	282248	87950	16.8
				2	110.0	90.0	3000	0	4580		215803	0	229075	48.5
2/	1	100	7808	1	146.0	108.0	299	5399	2109	415301	62066	264452	88782	14.9
				2	110.0	90.0	3000	0	4808		194293	0	221008	46.8
0/	-1	104	8036	1	146.0	108.0	299	5399	2337	446158	59027	285069	102061	13.2
				2	110.0	90.0	3000	0	5036		201562	0	244595	45.2
-2/	-3	88	8264	1	146.0	108.0	299	5399	2565	392052	45592	251293	95166	11.6
				2	110.0	90.0	3000	0	5264		171239	0	220812	43.7
-4/	-5	86	8492	1	146.0	108.0	299	5399	2793	399665	40490	256931	102243	10.1
				2	110.0	90.0	3000	0	5492		168956	0	230709	42.3
-6/	-7	62	8720	1	146.0	108.0	299	5399	3021	297220	25936	191601	79682	8.7
				2	110.0	90.0	3000	0	5720		121736	0	175483	41.0
-8/	-9	57	8948	1	146.0	108.0	299	5399	3249	282481	20920	182572	78988	7.4
				2	110.0	90.0	3000	0	5948		112207	0	170274	39.7
-10/-11	51	9176	1	146.0	108.0	299	5399	3477	261889	16141	169675	76072	76072	6.2
				2	110.0	90.0	3000	0	6176		100979	0	160910	38.6
-12/-13	41	9404	1	146.0	108.0	299	5399	3705	216017	10782	140275	64958	64958	5.0
				2	110.0	90.0	3000	0	6404		80920	0	135096	37.5
-14/-15	35	9632	1	146.0	108.0	299	5399	3933	192387	7473	125200	59713	59713	3.9
				2	110.0	90.0	3000	0	6632		70073	0	122313	36.4
-16/-17	27	9860	1	146.0	108.0	299	5399	4160	152620	5409	97365	49845	49845	3.5
				2	110.0	90.0	3000	0	6860		54091	0	98528	35.4
-18/-19	19	10089	1	146.0	108.0	299	5399	4388	112060	3867	69614	38578	38578	3.5
				2	110.0	90.0	3000	0	7088		38674	0	73385	34.5
-20/-21	17	10317	1	146.0	108.0	299	5399	4616	105789	3557	64039	38192	38192	3.4
				2	110.0	90.0	3000	0	7316		35577	0	70212	33.6
-22/-23	13	10545	1	146.0	108.0	299	5399	4844	81699	2679	48224	30796	30796	3.3
				2	110.0	90.0	3000	0	7544		26791	0	54908	32.8
-24/-25	8	10773	1	146.0	108.0	299	5399	5072	51576	1650	29703	20223	20223	3.2
				2	110.0	90.0	3000	0	7772		16501	0	35074	32.0
-26/-27	5	11001	1	146.0	108.0	299	5399	5300	35087	1095	19727	14264	14264	3.1
				2	110.0	90.0	3000	0	8000		10959	0	24127	31.2
-28/-29	3	11229	1	146.0	108.0	299	5399	5528	23528	717	12921	9888	9888	3.1
				2	110.0	90.0	3000	0	8228		7178	0	16349	30.5
-30/-31	3	11457	1	146.0	108.0	299	5399	5756	21127	629	11339	9157	9157	3.0
				2	110.0	90.0	3000	0	8456		6299	0	14827	29.8
-32/-33	2	11685	1	146.0	108.0	299	5399	5984	15091	440	7920	6730	6730	2.9
				2	110.0	90.0	3000	0	8684		4400	0	10691	29.2
-34/-35	1	11913	1	146.0	108.0	299	5399	6212	7934	226	4073	3633	3633	2.9
				2	110.0	90.0	3000	0	8912		2263	0	5670	28.5
-36/-37	0	12141	1	146.0	108.0	299	5399	6440	6097	170	3064	2862	2862	2.8
				2	110.0	90.0	3000	0	9140		1702	0	4395	27.9

--- Annual Summary ---

Customer System Type: 1
Customer System Type: 2

13897280	4860452	7621676	1415113	35.0
8671305	0	5225946	62.4	

GEORIN
Version 1.0

A Simulation Program That Simultaneously Models The Performance
Of Two Types Of Customer Systems Connected To A Geothermal Utility

This Simulation Was Performed For 62 Buildings For Connection To A Proposed Utility In LEMMON, SOUTH DAKOTA

Customer System Type 1 Would Utilize An Electric Boiler To Boost The Geothermal Fluid Temperature Prior To Its Use
By A Water To Air Heat Exchanger. Customer System Type 2 Would Utilize The Geothermal Fluid At Its Source Temperature.

Requirements For Auxiliary Systems To Supplement The Geothermal System Requirements Were Also Simulated.

Input Parameters Used In This Simulation Were:

Composite Building Heat Loss Coefficient	:	114000.0 BTUH/Deg F.
Geothermal Source Temperature	:	110.0 Deg F.
Geothermal Fluid Flow Rate	:	500.0 Gal/Min.
Geothermal Heat Exchanger Capacity Coefficient	:	125000.0 BTUH/Deg F
Internal Heat Gains vs. OAT Balance	:	35.0 Deg F
Occupied/Unoccupied Load Coefficients	:	.575/ .001
Building Loss Adjustment Coefficients	:	.650, .350
Occupied Room Temperature	:	70.0 F

Simulation Was Performed Using Average Year Weather Data As Reported For BISMARK, NORTH DAKOTA
For The Periods When The Outside Air Temperature Is Below 65.0 Degrees F.

Outside Temp.	Bin Hours	Peak Loss KBTUH	Sys. Type	Water Temp (F)		Peak Hourly Data			Annual Data				Geofluid Fraction Pct
				Supply	Return	Geofluid	Electric	Auxiliary	Loss	Geofluid	Electric	Auxiliary	
							KBTUH				KBTUH		
64/ 63	234	740	1	110.0	107.0	740	0	0	65715	65715	0	0	100.0
			2	110.0	107.0	740	0	0		65715	0	0	100.0
62/ 61	237	968	1	110.0	106.1	968	0	0	87088	87088	0	0	100.0
			2	110.0	106.1	968	0	0		87088	0	0	100.0
60/ 59	267	1197	1	110.0	105.2	1197	0	0	121856	121856	0	0	100.0
			2	110.0	105.2	1197	0	0		121856	0	0	100.0
58/ 57	248	1425	1	110.0	104.3	1425	0	0	135141	135141	0	0	100.0
			2	110.0	104.3	1425	0	0		135141	0	0	100.0
56/ 55	266	1653	1	110.0	103.4	1653	0	0	168443	168443	0	0	100.0
			2	110.0	103.4	1653	0	0		168443	0	0	100.0
54/ 53	236	1881	1	110.0	102.5	1881	0	0	170891	170891	0	0	100.0
			2	110.0	102.5	1881	0	0		170891	0	0	100.0
52/ 51	227	2109	1	110.0	101.6	2109	0	0	184531	184531	0	0	100.0
			2	110.0	101.6	2109	0	0		184531	0	0	100.0
50/ 49	230	2337	1	110.0	100.7	2337	0	0	208283	208283	0	0	100.0
			2	110.0	100.7	2337	0	0		208283	0	0	100.0
48/ 47	221	2565	1	110.0	99.7	2565	0	0	220137	220137	0	0	100.0
			2	110.0	99.7	2565	0	0		220137	0	0	100.0
46/ 45	230	2793	1	110.0	98.8	2793	0	0	250114	250114	0	0	100.0
			2	110.0	98.8	2793	0	0		250114	0	0	100.0
44/ 43	210	3021	1	110.0	97.9	3021	0	0	248749	248749	0	0	100.0
			2	110.0	97.9	3021	0	0		248749	0	0	100.0
42/ 41	209	3249	1	110.0	97.0	3249	0	0	266574	266574	0	0	100.0
			2	110.0	97.0	3249	0	0		266574	0	0	100.0
40/ 39	229	3477	1	110.0	96.1	3477	0	0	314029	314029	0	0	100.0
			2	110.0	96.1	3477	0	0		314029	0	0	100.0
38/ 37	236	3705	1	110.0	95.2	3705	0	0	345635	345635	0	0	100.0
			2	110.0	95.2	3705	0	0		345635	0	0	100.0
36/ 35	260	3933	1	110.0	94.3	3933	0	0	405392	405392	0	0	100.0
			2	110.0	94.3	3933	0	0		405392	0	0	100.0
34/ 33	267	4160	1	110.0	93.4	4160	0	0	452305	452305	0	0	100.0
			2	110.0	93.4	4160	0	0		452305	0	0	100.0
32/ 31	250	4388	1	110.0	92.4	4388	0	0	460027	460027	0	0	100.0
			2	110.0	92.4	4388	0	0		460027	0	0	100.0
30/ 29	257	4616	1	110.0	91.5	4616	0	0	510666	510666	0	0	100.0
			2	110.0	91.5	4616	0	0		510666	0	0	100.0
28/ 27	221	4844	1	110.0	90.6	4844	0	0	472236	472236	0	0	100.0
			2	110.0	90.6	4844	0	0		472236	0	0	100.0
26/ 25	209	5072	1	110.6	90.3	4926	145	0	477528	465202	12326	0	97.4
			2	110.0	90.0	4999	0	72		471365	0	6163	98.7
24/ 23	191	5300	1	112.4	91.2	4698	601	0	463250	416824	46425	0	90.0
			2	110.0	90.0	4999	0	300		440037	0	23212	95.0
22/ 21	168	5528	1	114.2	92.1	4470	1057	0	432952	360903	72048	0	83.4
			2	110.0	90.0	4999	0	528		396928	0	36024	91.7
20/ 19	167	5756	1	116.1	93.0	4242	1513	0	455883	352997	102886	0	77.4
			2	110.0	90.0	4999	0	756		404440	0	51443	88.7
18/ 17	145	5984	1	117.9	93.9	4014	1969	0	419720	302589	117130	0	72.1
			2	110.0	90.0	4999	0	984		361155	0	58565	86.0
16/ 15	140	6212	1	119.7	94.9	3786	2425	0	425823	286410	139412	0	67.3
			2	110.0	90.0	4999	0	1213		356117	0	69706	83.6
14/ 13	128	6440	1	121.5	95.8	3558	2881	0	409732	257576	152156	0	62.9
			2	110.0	90.0	4999	0	1441		333654	0	76078	81.4
12/ 11	128	6668	1	123.4	96.7	3330	3337	0	429794	252928	176865	0	58.8
			2	110.0	90.0	4999	0	1669		341361	0	88432	79.4

Outside Temp.	Bin Hours	Peak Loss KBTUH	Sys. Type	Water Temp (F)		Peak Hourly Data			Annual Data				Geofluid Fraction ---Pct---
				Supply	Return	Geofluid	Electric	Auxiliary	Loss	Geofluid	Electric	Auxiliary	
							KBTUH				KBTUH		
10/ 9	132	6896	1	125.2	97.6	3102	3793	0	463768	255841	207926	0	55.2
			2	110.0	90.0	4999	0	1897		359804	0	103963	77.6
8/ 7	118	7124	1	127.0	98.5	2875	4249	0	430588	222942	207645	0	51.8
			2	110.0	90.0	4999	0	2125		326765	0	103822	75.9
6/ 5	115	7352	1	128.8	99.4	2646	4705	0	439827	213958	225868	0	48.6
			2	110.0	90.0	4999	0	2353		326893	0	112934	74.3
4/ 3	112	7580	1	130.6	100.3	2418	5161	0	444878	203516	241361	0	45.7
			2	110.0	90.0	4999	0	2581		324197	0	120680	72.9
2/ 1	100	7808	1	132.5	101.2	2190	5617	0	415301	178801	236499	0	43.1
			2	110.0	90.0	4999	0	2809		297051	0	118249	71.5
0/ -1	104	8036	1	134.3	102.1	1962	6073	0	446158	180895	265262	0	40.5
			2	110.0	90.0	4999	0	3037		313526	0	132631	70.3
-2/ -3	88	8264	1	136.1	103.1	1734	6529	0	392052	149777	242274	0	38.2
			2	110.0	90.0	4999	0	3265		270914	0	121137	69.1
-4/ -5	86	8492	1	137.9	104.0	1506	6985	0	399665	143928	255737	0	36.0
			2	110.0	90.0	4999	0	3493		271796	0	127868	68.0
-6/ -7	62	8720	1	139.8	104.9	1278	7441	0	297220	100928	196292	0	34.0
			2	110.0	90.0	4999	0	3721		199074	0	98146	67.0
-8/ -9	57	8948	1	141.6	105.8	1050	7897	0	282481	90468	192012	0	32.0
			2	110.0	90.0	4999	0	3949		186475	0	96006	66.0
-10/-11	51	9176	1	143.4	106.7	822	8353	0	261889	74707	187181	0	28.5
			2	110.0	90.0	4999	0	4176		168298	0	93590	64.3
-12/-13	41	9404	1	145.2	107.6	594	8809	0	216017	53717	162299	0	24.9
			2	110.0	90.0	4999	0	4404		134867	0	81149	62.4
-14/-15	35	9632	1	146.0	108.0	499	8999	133	192387	43210	147156	0	2019
			2	110.0	90.0	4999	0	4632		116789	0	75597	60.7
-16/-17	27	9860	1	146.0	108.0	499	8999	360	152620	31916	116472	0	4230
			2	110.0	90.0	4999	0	4860		90153	0	62467	59.1
-18/-19	19	10089	1	146.0	108.0	499	8999	588	112060	21791	85333	0	4935
			2	110.0	90.0	4999	0	5088		64458	0	47602	57.5
-20/-21	17	10317	1	146.0	108.0	499	8999	816	105789	19099	80392	0	6297
			2	110.0	90.0	4999	0	5316		59295	0	46493	56.1
-22/-23	13	10545	1	146.0	108.0	499	8999	1045	81699	13670	61963	0	6065
			2	110.0	90.0	4999	0	5544		44651	0	37047	54.7
-24/-25	8	10773	1	146.0	108.0	499	8999	1273	51576	7981	39044	0	4551
			2	110.0	90.0	4999	0	5772		27503	0	24073	53.3
-26/-27	5	11001	1	146.0	108.0	499	8999	1501	35087	5009	26513	0	3564
			2	110.0	90.0	4999	0	6000		18266	0	16821	52.1
-28/-29	3	11229	1	146.0	108.0	499	8999	1729	23528	3090	17748	0	2689
			2	110.0	90.0	4999	0	6228		11964	0	11563	50.9
-30/-31	3	11457	1	146.0	108.0	499	8999	1957	21127	2544	15911	0	2671
			2	110.0	90.0	4999	0	6456		10499	0	10627	49.7
-32/-33	2	11685	1	146.0	108.0	499	8999	2185	15091	1660	11348	0	2083
			2	110.0	90.0	4999	0	6684		7334	0	7757	48.6
-34/-35	1	11913	1	146.0	108.0	499	8999	2413	7934	793	5957	0	1183
			2	110.0	90.0	4999	0	6912		3772	0	4161	47.5
-36/-37	0	12141	1	146.0	108.0	499	8999	2641	6097	551	4571	0	974
			2	110.0	90.0	4999	0	7140		2837	0	3260	46.5

--- Annual Summary ---
 Customer System Type: 1
 Customer System Type: 2
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13897280	9803988	4052024	41267	70.5
	11830010	0	2067279	85.1

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P.O. BOX 1625, IDAHO FALLS, IDAHO 83415

G✓	
cm	

August 27, 1981

Mr. Charles Mize
Dunham Associates
528 Kansas Street
Rapid City, SD 57701

GEOHERMAL WELL INFORMATION - IAE-98-81

Dear Chuck:

Well data for use in the additional evaluation of potential geothermal development at Lemmon, SD are as follow:

Well Depth	4,200 ft.
Static Water Level	-800 ft.
Water Temperature	110 - 115°F
Flow Rate/Well	300 gpm or more, as needed
Drawdown Basis	8 - 9 gpm/ft. drawdown
TDS	4,000 ppm

Production rate per well is the major deviation from earlier data. This change is compatible with our understanding of resource interpretation/estimates by Ray Butler; the contrast with earlier data represents differences of opinion within the technical community.

This is the resource data to consider in comparing use of heat pump technology and an appropriate peaking system such as an electric or fossil fired conventional system or a hot-water-coil/electric resistance system. The source temperature may be too low to seriously consider the hot water coil with resistance peaking.

Our understanding of Ray Butler's interpretation of the Dakota formation, near Lemmon, SD, is as follows:

	Depth	Thickness	Permeability	Lithology
Fall River	4,200	30	7-19'/day	Fine sandstone
Fuson	4,230	100	7-19'/day	Fine sandstone
Lakota	4,330	50	3-9'/day	Very fine sandstone

(Clean, well sorted, coastal marine sandstone; 40-60 ft. sands, 120-140 ft. of sandstone with gradual thinning toward SD.)

An estimate of the transmissivity, based on thickness of 120 ft. and of 20 ft./day, is 2,400 ft²/day or 18,000 gal/ft per day; resulting in estimated well yields of 8 and 9 gpm per ft. of drawdown for 6 and 12 inch wells, respectively.

Mr. Charles Mize
August 27, 1981
IAE-98-81
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Based on a sea level referenced head of 1,900 - 2,000 ft. at Lemmon, a pump setting of 500 - 1,000 ft. is suggested.

Butler suggests the three layers act as one with respect to quality - 4,000 - 8,000 ppm TDS in Inyan Kara, with 4,000 ppm probable in Lemmon area.

The temperature is estimated to be 110°F - 120°F at depths ranging from 3,800 to 4,600 feet.

It is also suggested that the Madison formation in this area is less uniform in its characteristics.

The foregoing can be compared to the enclosed information obtained from USGS, by Phil Lidel.

If you have any questions on the foregoing, please call this office at (208) 526-1836.

Sincerely,

I. A. Engen
Hydrothermal Branch

dfw

Enclosures:
As stated

cc: Phil Lidel w/o enclosure

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Rm. 237-515 9th St.

Rapid City, South Dakota 57701

August 5, 1981

Phil Lidel
Geothermal Director
ND Office of Energy Policy
Capitol Lake Plaza
Pierre, South Dakota 57501

Dear Mr. Lidel:

Deep geophysical data is unfortunately lacking in the Lemmon area. Rough estimates for formation and sand thicknesses for the Inyan Kara Group can be made based on the closest nearby data from oil and gas tests. These data are listed below:

Location	Depth to Fall River	Fall River	Sand	Fuson	Sand	Lakota	Sand
20N-18E-13	3,862	30	15	63	0	25	13
21N-12E-11	4,435	55	10	100	59	100	86
21N-14E-26	4,152	16	8	92	65	66	42
131N-86W-9	3,240	33	13	9	0	111	81

Based on this data, formation and sand thicknesses at Lemmon may be roughly estimated.

	<u>Formation thickness</u>	<u>Sand thickness</u>
Fall River	35	10
Fuson	65	35
Lakota	50	40
Total	150 ft.	85 ft.

The top of the Fall River Formation may be reached at a depth of approximately 4,200 ft. in the Lemmon area.

I believe Ray Butler's sand estimates are too high. A more realistic permeability would be about 10 ft/day, resulting in a transmissivity of about 850 ft.²/day (about 6,400 gal. per foot per day).

Only one water analysis is available in the area from well 20N-12E-13 in Perkins County. The analysis is from the Fall River Formation in the Inyan Kara Group and is enclosed.

Page 2
Phil Lidel

Due to the lack of available data in the Lemmon area, I would strongly recommend drilling a test hole. This is the only way you will be able to determine the actual potential of the area and resolve differences in data interpretation.

Sincerely,

Carol L. Loskot

Carol L. Loskot
Hydrologist
Subdistrict Office

Enclosure

SCHEDULE

U.S. DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISIONShell #1 Home
PLUGGED CANNON

45414010.234 1001

Shell Oil Co.

Analyses by ~~Geological Survey, United States Department of the Interior~~

9-268q

(parts per million)

Sample number ^m Water Log #4.....	877a		b
	Fall R.		Fall R.
Date of collection.....	"D. L. F. F. F."		8/27/51
Temperature (°F).....			
DST interval	422-4305		422-4305
5117ca2 (3102).....	Fluid	Retained 3000' ft.	24.20 ft.
	2200-2300		100-200
Iron (Fe).....			
Manganese (Mn).....			
Calcium (Ca).....	12		7
Magnesium (Mg).....	2		1
Sodium (Na).....			
Potassium (K).....	1,470		1,170
Bicarbonate (HCO ₃).....	1,130		880
Carbonate (CO ₃).....			
Sulfate (SO ₄).....	95		110
Chloride (Cl).....	1,480		1,140
Fluoride (F).....	—		—
Nitrate (NO ₃).....	—		—
Boron (B).....	—		—
Dissolved solids			
Calculated.....			
Residue on evaporation at 180°C.	4,260		3,660
Hardness as CaCO ₃	89		25
Noncarbonate hardness as CaCO ₃			
Alkalinity as CaCO ₃			
Specific conductance			
(micromhos at 25°C).....			
pH.....	8.2		8.7
Color.....			
Percent sodium.....	91		99
Sodium-adsorption ratio.....			

Owner: Shell Oil Co.

Log #1 J.T. Hammel

Point of collection:

Well type: Oil Test

Water level (ft.):

Date drilled: 7/24, 11/1/51

Yield (gpm):

Depth (ft.): 7248

Use: Home

Diameter (in.):

Appearance:

Cased to (ft.):

Collected by: Shell Oil

Water-bearing formation: low sand, s, & clay, q, micaceous in s.s.

Remarks: Source - USGS "Saline Water Rept. #6"