FINAL REPORT
TO THE
DEPARTMENT OF ENERGY
BY THE
GEOHERMAL RESOURCES COUNCIL
ON
AN INDUSTRY SURVEY
OF THE NEED FOR A FEDERAL GRANT-ASSISTED
GEOHERMAL DEMONSTRATION POWER PLANT

MASTER

DOE CONTRACT NO. EW-78-X-03-0389

Prepared by the
GEOHERMAL RESOURCES COUNCIL

P.O. BOX 98
DAVIS, CALIFORNIA 95616

JUNE, 1978

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Statement of Problem

In 1974, Congress passed legislation authorizing geothermal demonstration plants and subsequently authorized funds for a 50 MWe plant. At that time very little private sector interest in developing hot-water reservoirs and subsequent power plants was evident. Therefore, a government-supported facility was felt to be necessary in order to demonstrate commercial viability and to provide general access to development and operating data.

To date, however, a contractor has not been selected from the several responses to a DOE Program Opportunity Notice (PON), primarily because numerous geothermal developers, utilities, and engineering firms have recently announced the development of agreements for the design of geothermal power plants independent of government funding.

Due to the recent increase in geothermal power plant design announcements, DOE understandably felt that it would be appropriate to re-examine the objectives of the demonstration project to determine if they are still

valid and/or whether they can be met by projects now in the planning phase in the private sector. If the private sector was indeed addressing the same objectives, then the federal funds might be better spent elsewhere or not at all.

The following are the key objectives of demonstration plant projects:

1. To demonstrate the environmental and institutional (i.e., licensing, etc.) acceptability of geothermal energy;
2. To demonstrate the commercial readiness or state-of-the-art of geothermal technology;
3. To demonstrate geothermal electric conversion technology on a commercial scale;
4. To provide a basis for investor estimates of the risks and benefits of geothermal energy;
5. To demonstrate reservoir performance characteristics.

The recent activity in the private sector raised serious questions concerning these key demonstration plant objectives. For example, objective number 2, above, concerning commercial readiness might not be a relevant objective if the industry was proceeding with commercial plants on its own.

It was to resolve questions such as these that the present survey was commissioned.

Background

On June 6, 1978, the Geothermal Resources Council (GRC) entered into a contract with the Department of Energy (DOE) to design, conduct and analyze a survey of the geothermal industry to determine if a need still exists for a federal grant-assisted geothermal demonstration power plant. The

agreement stipulated that the survey would be made independently by the Geothermal Resources Council without DOE involvement.

A preliminary report of this study was scheduled to be made available June 30, 1978. Due to time constraints it was decided to conduct two separate studies: a preliminary study of leaders of the geothermal industry and a second study of a ten percent representative sample of other firms. This final report presents the findings from both of these studies.

This report addresses the following: selection of the survey samples from the population comprising the 'geothermal industry'; the development of the survey instrument; the collection and analysis of the results; and a summary. Appendix 1 presents the survey instrument. Appendix 2 includes a summary of the responses. Appendix 3 presents a discussion of the responses of financial firms.

Selection of the Samples

The preliminary study sample, consisting of 99 firms, was selected from the Geothermal Resources Council's list of companies involved in geothermal resource development. From the 776 companies on this list, 99 were selected for preliminary study. Of the firms selected, 21 were engineering, 13 were financial institutions, 36 were operators (field developers), and 29 were utilities.

The criteria used to select these firms were as follows:

- Engineering firms: those with the capability of designing and bringing to completion a commercial-scale geothermal electric power plant;

- Financial institutions: banks and other firms with the in-house ability to evaluate and make loans to geothermal developers;
- Operators: resource developers with an ability to develop a commercial-scale geothermal field.
- Utilities: those utilities now involved in geothermal development.

The preliminary study sample included members of the geothermal industry most directly affected by a government decision for or against demonstration plant funding. The project committee and GRC staff members judged the 99 firms on this list to be industry leaders. Thus, the sample for the preliminary study was composed of leading firms in the geothermal industry. These firms would be most knowledgeable of developments in the industry. Firms were further divided into those who were heavily committed and those who were not as heavily committed in the development of geothermal energy. Of the firms in the sample, 33 were heavily committed, the remaining 28 were less heavily committed.

The method used in selecting the preliminary study sample, a judgemental selection process, was employed in order to secure the opinions of those who were most knowledgeable and most involved in the development of geothermal resources. This sample selection method, since it did not involve random selection procedures, leads to later problems in data analysis in that the sample involved does not strictly conform to the required prerequisites for certain statistical tests, i.e. chi-square.

A second study was therefore undertaken in which sampling procedures were designed to select a more representative sample. This representative study sample was selected from among the remaining firms (677) on the Geothermal Resources Council's list. A ten percent representative sample

was selected by taking every tenth firm on this list. By virtue of their inclusion in the preliminary study sample the 99 leading firms were excluded from consideration in the selection procedure of the second study. This means that the leading firms in the industry are not represented in the opinions recorded for this second sample. Therefore, results from the second study should be interpreted with this fact in mind. The sample size for the second study was 66 firms. The firms in the second study were not categorized by type of firm nor by level of commitment--although their commitment presumably is lower than all of the leading firms.

Development of the Survey Instrument, Data Collection, and Data Analysis

A questionnaire was developed by the GRC staff with the aid of a special assistant brought in for this specific purpose. It was then presented to the special committee for concurrence and/or amendment and augmentation. A copy of the questionnaire is attached (see Appendix 1).

The questionnaire was mailed to one select individual, by name, in each of the firms in the study samples. As DOE requested a report by June 30, 1978, the respondents were asked to submit their answers and comments as soon as possible. For the sake of compiling the preliminary report, a cut-off date of 5:00 p.m. on June 26, 1978, was used. Responses received after this date are included in this final report.

In completing the questionnaire, respondents were instructed to keep in mind the following points:

1. It was stipulated in the PON that the federal grant-assisted geothermal demonstration power plant is to operate on moderate to low-salinity resources. High salinity resources were explicitly excluded from the scope of the demonstration program now under re-evaluation by DOE.

2. The federally funded plant or plants under consideration here are separate from any plant or plants that may be supported through a loan guarantee by the federal government under the Geothermal Loan Guaranty Program. For purposes of responding to the survey, a project financed in part through a Federal Loan Guaranty is to be viewed as a privately funded plant. Such a plant is not considered a federal grant-assisted demonstration power plant.
3. For the purposes of responding to the survey, a power plant of 50 MWe, which was stipulated in the PON, should be considered the mean unless otherwise stipulated.
4. In order to be able to properly evaluate the survey, we asked that each firm be identified on the response to the questionnaire. It was specified that this information was to be held confidential by the Council; and would not appear in the report to DOE.

Sixty-seven firms in the first study sample responded to the questionnaire, a response rate of 68%. Of the engineering firms, 13 responded (62%). The corresponding figures for the remaining types of firms were: financial institutions--6 responses (46%); operators--25 responses (69%); and utilities--23 responses (79%).

The response rate and the absolute number of responses of the financial institutions make results from this category statistically misleading, therefore, they will be excluded from most of the analyses covered in this report. For purposes of completeness a separate discussion of the responses of financial institutions can be found in Appendix 3. Of the sixty-seven firms responding to the questionnaire thirty-three were heavily committed while 28 were not as heavily committed.

For the second study 66 firms were contacted and twenty firms responded to the questionnaire, a response rate of 30%.

The data were analyzed using methods of frequency distributions, cross tabular analysis, and discriminant analysis. The data from the first study were analyzed by comparing the responses of the four categories of firms to each question. In addition, analysis was done comparing heavily committed firms with not as heavily committed firms. The data from both studies were further analyzed by geographic area comparing responses of firms located in western states (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming) with responses of firms located in non western states.

In our analysis we used the chi-square test of statistical significance. Relationships between variables in which the chi-square reached the $p < .05$ level of significance were accepted as indicating the existence of significant differences between these variables. A chi-square test in which the level of significance is $p < .05$ indicates that the observed relationships or differences would not occur, in other samples, by chance in only 5 cases out of 100.

The 28 questions were divided into two categories depending on the directionality of the wording of the question. The first category - Category A - included 11 questions in which an answer of "Agree" indicated an affirmative response to a federally-funded geothermal demonstration power plant project. The second category - Category B - was worded such that a "Disagree" answer indicated an affirmative response to a federal grant-assisted geothermal demonstration power plant project (10 questions). For a complete listing of the "Agree" and "Disagree" geothermal demonstration

power plant program affirming questions see Appendix 2. A third category included questions which were primarily qualifying questions (7 questions).

Cross tabular analysis was performed on all 28 questions. For purposes of the final report ten key questions were selected for a more in-depth analysis. The ten questions selected were chosen on the basis of their perceived relative importance to the basic issue in favor of or against the development of a federal grant-assisted geothermal demonstration plant.

Findings

The findings from the preliminary study of leaders indicate a highly favorable response on the part of the leaders to a federal grant-assisted geothermal demonstration power plant. The ten key questions thought to be most indicative of the opinion of the four categories of firms selected for the preliminary study survey were analyzed in greater detail. Category A (questions in which an agree response indicated an affirmative answer) included questions 2, 14, 19 and 28. Overall, 56% indicated an "Agree" response to question 2. The figures for questions 14, 19 and 28 are 74%, 48%, and 75%, respectively. On the other hand, 34% of the respondents indicated a "Disagree" response to question 2. The "Disagree" percentages for questions 14, 19 and 28 are respectively 21%, 26%, and 15%. The average of the "Agree" responses constituted 63%. The average of the "Disagree" responses for this category was 24%. A clear consensus emerges in favor of the demonstration plant program from all of these responses.

In order to achieve a more in-depth picture, responses to these questions were further disaggregated by category of firm and were analyzed separately. An analysis of the data by type of firm (with financial firms

excluded) revealed no significant differences in the response to any of the 28 questions by type of firm. The complete distribution of responses by type of firm is shown in Table A in Appendix 2. Responses by type of firm to the 4 key questions of the Category A type are shown in Table 1.

Responses to these questions range from a moderately high affirmative response (Question 19) to the very high affirmative responses found in questions 14 and 28.

Of these four questions the only one which does not have a majority affirmative response is question number 19. This question elicited a relatively high unsure response by all three types of firms.

Among the several types of firms, engineers range from a low of 38.5% affirmative response in question 19 to a high of 76.9% affirmative response in question 28. Operator responses range from a low of 44% in question 19 to highs of 72% affirmative response in questions 2 and 28. The utilities range from a low of 52.2% in question 2 to a high of 82.6% affirmative response in question 14.

The overall average agree response to all 4 questions is 61.5% for engineers, 60% for operators, and 67.4% for utilities. The overall average disagree response percentage for all 4 questions is 21.2% for engineers, 28% for operators, and 21.8% for utilities.

Category B included questions 1, 4, 9, 12, 17 and 23. In these questions, a "Disagree" response indicated a position favorable to the development of a federal grant-assisted geothermal energy demonstration plant. Overall, 62% in the preliminary study indicated a "Disagree" response to question 1. The "Disagree" figures from the remaining questions are: question 4 (73%); question 9 (71%); question 12 (43%); question 17 (71%);

TABLE 1 KEY CATEGORY A QUESTIONS BY TYPE
OF FIRM (Figures in percents)

Question ^a Responses	Type of Firm		
	Operators (N=25)	Engineers (N=13)	Utilities (N=23)
Question 2			
Agree	52.0	69.2	52.2
Unsure	8.0	7.7	13.0
Disagree	<u>40.0</u>	<u>23.1</u>	<u>34.8</u>
Total	100.0	100.0	100.0
Question 14			
Agree	72.0	61.5	82.6
Unsure	8.0	7.7	0.0
Disagree	<u>20.0</u>	<u>30.8</u>	<u>17.4</u>
Total	100.0	100.0	100.0
Question 19			
Agree	44.0	38.5	56.5
Unsure	20.0	38.5	26.1
Disagree	<u>36.0</u>	<u>23.1</u>	<u>17.4</u>
Total	100.0	100.1 ^b	100.0
Question 28			
Agree	72.0	76.9	78.3
Unsure	12.0	15.4	4.3
Disagree	<u>16.0</u>	<u>7.7</u>	<u>17.4</u>
Total	100.0	100.0	100.0

^a For exact wording of questions see Appendix 1.

^b Figure does not add to 100% due to rounding.

and question 23 (53%). The average of the responses on these 6 key questions favorable to the demonstration plant concept was 62%. The average of the responses opposed to the demonstration plant concept was 22%. Again, a solid consensus emerges in favor of the federally-funded geothermal power plant program.

The responses by type of firm to the 6 key questions of the Category B type are shown on Table 2.

Overall the figures show a rather high affirmative response to this set of questions with the exception of question 12 and the engineers on question 23. Engineering firms had a rather high proportion indicating unsure in response to question 23. On question 12 all 3 types of firms seem to be rather divided on this question.

The overall average affirmative (disagree) response to all 6 questions is engineers (50%), operators (60%), and utilities (70.9%). The overall average negative (agree) response to all 6 questions is engineers (24.4%), operators (25.3%), and utilities (17.5%).

In examining the relationship between level of commitment and response to the 28 questions (as shown in Appendix 2, Table 2) a significant difference was found on only one question, question number 7. Question 7 is a qualifying type question (Category C) and therefore neither response necessarily reflects an attitude about a federal grant-assisted geothermal demonstration power plant. Responses indicated 66.7% of the heavily committed firms agreed with this statement while 53.6% of the not heavily committed firms disagreed with the statement.

The overall average affirmative percentage for the ten key questions was 65% affirmative response for the heavily committed and 59% affirmative

TABLE 2 KEY CATEGORY B QUESTIONS BY TYPE
OF FIRM (Figures in percents)

Question ^a Responses	Type of Firm		
	Operators (N=25)	Engineers (N=13)	Utilities (N=23)
Question 1			
Agree	28.0	15.4	26.1
Unsure	12.0	30.8	4.3
Disagree	<u>60.0</u>	<u>53.8</u>	<u>69.6</u>
Total	100.0	100.0	100.0
Question 4 ^c			
Agree	20.0	15.4	9.1
Unsure	12.0	23.1	4.5
Disagree	<u>68.0</u>	<u>61.5</u>	<u>86.4</u>
Total	100.0	100.0	100.0
Question 9			
Agree	20.0	15.4	13.0
Unsure	12.0	23.1	8.7
Disagree	<u>68.0</u>	<u>61.5</u>	<u>78.3</u>
Total	100.0	100.0	100.0
Question 12			
Agree	40.0	46.2	30.4
Unsure	24.0	23.1	13.0
Disagree	<u>36.0</u>	<u>30.8</u>	<u>56.5</u>
Total	100.0	100.1 ^b	99.9 ^b
Question 17			
Agree	20.0	23.1	8.7
Unsure	12.0	7.7	17.4
Disagree	<u>68.0</u>	<u>69.2</u>	<u>73.9</u>
Total	100.0	100.0	100.0
Question 23			
Agree	24.0	30.8	17.4
Unsure	16.0	46.2	21.7
Disagree	<u>60.0</u>	<u>23.1</u>	<u>60.9</u>
Total	100.0	100.1 ^b	100.0

^aFor exact wording of questions see Appendix 1.

^bFigures do not add to 100% due to rounding.

^cOne case missing data due to non response by utility firm to this question.

response by the not so heavily committed average negative responses for the 2 categories were 24% heavily committed and 21% not heavily committed.

The data from the second study serves as an additional indicator of industry opinion. A comparison of the responses to both studies is shown in its complete tabular form in Appendix 2, Table B.

In comparing data from the two studies it was found that there were significant differences on responses to eleven questions (4, 6, 7, 8, 10, 13, 17, 18, 20, 25, 27). Two of the questions on which significant differences were found are among the ten key questions (question number 4 and 17). Four of the questions (7, 8, 10, 18) are Category C type questions (qualifying questions) and will not be explored more fully in this report.

The distribution of responses to the questions on which significant differences were found by sample is shown in Table 3. There is a rather large difference between the two samples in the percentage of unsure responses to each question. In all seven questions the second sample (nonleaders) shows a higher percentage of unsure responses. Overall leaders show an average unsure response of 11% (ranging from a low of 1.7% in question 6 to a high of 19.7% in question 20) whereas the second sample of nonleaders has an average unsure response of 28% (ranging from a low of 15% in question 6 to a high of 45% in question 27). Some differences found between the two samples are undoubtedly due to the higher proportion of unsure responses in sample 2. In three of the questions (4, 6, and 25) the difference is primarily in the magnitude of the affirmative response rather than differences in the direction of the response. In questions 20 and 27 the two samples differ in the directionality of responses, however

TABLE 3 SIGNIFICANTLY DIFFERENT RESPONSES BY SAMPLE
BY CATEGORY (Figures in percents)

Question Responses	I (N=61)	Sample II (N=20)
<u>Category A</u>		
Question 6 ^{*,c}		
Agree	71.7	55.0
Unsure	1.7	15.0
Disagree	<u>26.7</u>	<u>30.0</u>
Total	100.1 ^b	100.0
Question 13 [*]		
Agree	57.4	20.0
Unsure	9.8	20.0
Disagree	<u>32.8</u>	<u>60.0</u>
Total	100.0	100.0
<u>Category B</u>		
Question 4 ^{*,c}		
Agree	15.0	15.0
Unsure	11.7	35.0
Disagree	<u>73.3</u>	<u>50.0</u>
Total	100.0	100.0
Question 17 ^{*,d}		
Agree	16.4	52.6
Unsure	13.1	15.8
Disagree	<u>70.5</u>	<u>31.6</u>
Total	100.0	100.0
Question 20 ^{*,d}		
Agree	21.3	36.8
Unsure	19.7	36.8
Disagree	<u>59.0</u>	<u>26.3</u>
Total	100.0	99.9 ^b
Question 25 [*]		
Agree	23.0	25.0
Unsure	6.6	30.0
Disagree	<u>70.5</u>	<u>45.0</u>
Total	100.1 ^b	100.0

TABLE 3 (continued)

Question Responses	Sample	
	I (N=61)	II (N=20)
Question 27 [*]		
Agree	27.9	30.0
Unsure	14.8	45.0
Disagree	<u>57.4</u>	<u>25.0</u>
Total	100.1 ^b	100.0

* Chi-square significant at $p < .05$ level.

^a For exact wording of questions see Appendix 1.

^b Figures do not add to 100% due to rounding.

^c One case missing data due to non response by sample I firm to question.

^d One case missing data due to non response by sample II firm to question.

in both cases the direction of the nonleader's responses is based on a small percentage difference between the agree and disagree percents; both have a very high percent of unsure responses. The remaining two questions, 13 and 17, appear to reflect differences in opinion between the leaders of the industry and the remainder of the industry. Question 13 states that there is a need for a federal grant-assisted geothermal demonstration power plant to provide the projected power costs for private sector plants. Leaders tended to agree with this statement (57.4%) while nonleaders tended to disagree (60%). Question 17 states that it is a better use of federal funds to conduct full-scale reservoir tests rather than to build an equivalent size federal grant-assisted geothermal demonstration power plant. Leaders highly disagreed with this statement (70.5%) while nonleaders tended to agree with it (52.6%).

In sum, we found that on the majority of questions in the study the two samples did not differ significantly in their opinions. Where significant differences were found in some cases they appeared to be due to differences in qualifying or specifying type questions or in the magnitude of the affirmative responses rather than in divergent opinions. In addition some of the differences found may be attributable to a much higher percentage of unsure responses on the part of the nonleaders sample.

Combining the two samples we analyzed the relationship between geographical location of the responding firm and response to the 28 questions (shown in Table D, Appendix 2). Significant differences exist between western and nonwestern states on 4 questions (1, 7, 13, and 28). Of these, question 7 is a Category C type question (qualifying) and will not be discussed further. Two of the questions (28 and 1) do not differ

in direction but in the magnitude of the response (see Table 4). In both cases the unsure response percentage is quite high for the nonwestern state category. There appears to be a definite difference in the opinion of western and nonwestern states on question 13. Question 13 states that there is a need for a federal grant-assisted geothermal demonstration power plant to provide the projected power costs for private sector plants. Western firms tended to agree with this statement (56.3%) while nonwestern firms tended to disagree with it (58.8%).

Conclusions

In response to a perceived need by the Federal government concerning the relevance of the geothermal demonstration power plant program, the Geothermal Resources Council conducted an opinion survey of the geothermal industry. A preliminary survey questionnaire, consisting of 28 questions, was developed and sent to two distinct study populations, a sample of 99 leading firms in the geothermal community and a representative sample of the remaining firms interested in geothermal development. A response rate of 68% was achieved for the leaders and 30% for the nonleaders. Overall the general responses ran 62% (leaders) and 45% (nonleaders) in favor of a geothermal demonstration plant program, with 24% (leaders) and 31% (nonleaders) opposed, with the balance unsure. For a set of 10 key questions the affirmative responses were 62% (leaders) and 46% (nonleaders), the opposed were 23% (leaders) and 32% (nonleaders).

Data analysis revealed no significant differences among the opinions of the various types of firms with the exception of financial firms (where a low overall number of responses due to a small sample size and low response rate makes analysis of their responses somewhat questionable).

TABLE 4 SIGNIFICANTLY DIFFERENT RESPONSES BY GEOGRAPHIC
LOCATION BY CATEGORY (Figures in percents)

Question ^a Responses	Geographic Location	
	Western State (N=64)	Non Western State (N=17)
<u>Category A</u>		
Question 13 [*]		
Agree	56.3	17.6
Unsure	9.4	23.5
Disagree	<u>34.4</u>	<u>58.8</u>
Total	100.1 ^b	100.1 ^b
<u>Category B</u>		
Question 28 [*]		
Agree	78.1	47.1
Unsure	4.7	35.3
Disagree	<u>17.2</u>	<u>17.6</u>
Total	100.0	100.0
Question 1 [*]		
Agree	25.0	17.6
Unsure	9.4	41.2
Disagree	<u>65.6</u>	<u>41.2</u>
Total	100.0	100.0

* Chi-square significant at $p < .05$ level.

^a For exact wording of questions see Appendix 1.

^b Figures do not add to 100% due to rounding.

The only significant difference found by level of commitment was in reference to a qualifying question. A number of significant differences were found between results from the leader and nonleader studies. Some of these differences may be attributable to a higher percentage of unsure responses in the nonleader study. A lower response rate in the nonleader study, and quite possibly some differences in the opinions of leading firms as opposed to other types of firms (the leader study included only leading firms while the other study was exclusively of nonleaders).

In general, a clear consensus has emerged from the leaders favoring a federal grant-assisted geothermal power plant demonstration program. The nonleader study confirms the overall favorable opinion of the geothermal community toward a federal grant-assisted geothermal power plant demonstration program but to a lesser extent than did the leading firms.

AN INDUSTRY SURVEY
OF THE NEED FOR A FEDERAL GRANT-ASSISTED
GEOTHERMAL DEMONSTRATION POWER PLANT

Please make only one answer per question, answer all of the questions, and check your answers.

DO YOU AGREE OR DISAGREE WITH THE FOLLOWING?

1. The geothermal industry is adequately addressing the question of the validity of hot water commercial power plants independent of federal funding of a geothermal demonstration power plant.
A. Agree B. Unsure C. Disagree
2. A federally-funded geothermal demonstration power plant should be undertaken because the private sector has not made a solid commitment to design and construct hot water geothermal power plants on their own.
A. Agree B. Unsure C. Disagree
3. There is a need for a federally-funded geothermal demonstration power plant of 50 MWe or larger to assess reservoir characteristics including injection.
A. Agree B. Unsure C. Disagree
4. A federally-funded geothermal demonstration power plant is no longer needed because options available to western utilities are so few that commercial hot water geothermal power plants will be operational by 1983.
A. Agree B. Unsure C. Disagree
5. There is a need for a federally-funded demonstration power plant to assess the reliability and economic effectiveness of a flash steam energy conversion system.
A. Agree B. Unsure C. Disagree
6. There is a need for a federally-funded geothermal demonstration power plant to assess the reliability and economic effectiveness of the binary cycle energy conversion system.
A. Agree B. Unsure C. Disagree

7. It is better to build a large federally-funded demonstration power plant (50 MWe or greater) than a series of smaller federally-funded plants in various areas, under a variety of conditions.
A. Agree B. Unsure C. Disagree
8. It is better to build a series of small federally-funded geothermal demonstration power plants in various areas and under a variety of conditions than one large power plant.
A. Agree B. Unsure C. Disagree
9. Building a federally-funded geothermal demonstration power plant is a waste of taxpayers' funds because the private sector will build them anyway.
A. Agree B. Unsure C. Disagree
10. There is a need for a federally-funded geothermal demonstration power plant in the higher temperature ranges (400° F and above).
A. Agree B. Unsure C. Disagree
11. There is a need for a federally-funded geothermal demonstration power plant in the lower temperature ranges (400° F and below).
A. Agree B. Unsure C. Disagree
12. There are vital program needs for geothermal development other than a federally-funded demonstration power plant on which demonstration funds should be spent.
A. Agree B. Unsure C. Disagree
13. There is a need for a federally-funded geothermal demonstration power plant of 50 MWe or larger to provide the projected power costs for private sector plants.
A. Agree B. Unsure C. Disagree
14. A federally-funded geothermal demonstration power plant will provide the geothermal community with needed information regarding reservoir performance characteristics.
A. Agree B. Unsure C. Disagree
15. A federally-funded geothermal demonstration power plant will serve as a useful pathfinder for the regulatory procedures to power plant permitting.
A. Agree B. Unsure C. Disagree
16. A successful federally-funded binary cycle geothermal demonstration power plant is needed to stimulate the private sector to fund and construct binary cycle plants in the 1980's.
A. Agree B. Unsure C. Disagree

17. It is a better use of federal funds to conduct full-scale reservoir tests than to build an equivalent size federally-funded geothermal demonstration power plant.
- A. Agree B. Unsure C. Disagree
18. A federally-funded geothermal demonstration power plant would be useful because it would provide data to the public that would normally be withheld by the private sector.
- A. Agree B. Unsure C. Disagree
19. A federally-funded geothermal demonstration power plant under operation will spur large-scale development of the energy.
- A. Agree B. Unsure C. Disagree
20. The federally-funded geothermal demonstration power plant program does not directly address important risks such as reservoir performance.
- A. Agree B. Unsure C. Disagree
21. If a federally-funded geothermal demonstration power plant has high costs, investment in geothermal power plants by the private sector will be discouraged.
- A. Agree B. Unsure C. Disagree
22. If a federally-funded geothermal demonstration power plant were less economic than a contemporary privately-funded power plant it would still serve a useful purpose by providing needed information to the geothermal community.
- A. Agree B. Unsure C. Disagree
23. If the federal government funds a 50 MWe geothermal demonstration power plant, the private sector will not pursue geothermal development as aggressively on their own until the results are known.
- A. Agree B. Unsure C. Disagree
24. Considering the status of the financing, construction, permitting, resource assessment and commitment to construct other possible power plants, it is very probable that at least one 50 MWe hot water geothermal power plant will be in operation by 1983 apart from any federally-funded geothermal demonstration power plant.
- A. Agree B. Unsure C. Disagree
25. One such hot water geothermal power plant as mentioned in question 24, above, is enough to make the federally-funded geothermal demonstration power plant unnecessary.
- A. Agree B. Unsure C. Disagree

26. Considering the status of the financing, construction, permitting, resource assessment and commitment to construct other possible power plants, it is very probable that at least two 50 MWe hot water geothermal power plants will be operating by 1983 apart from any federally-funded geothermal demonstration power plant.

A. Agree B. Unsure C. Disagree

27. Two such hot water geothermal power plants as mentioned in question 26, above, are enough to make the federally-funded geothermal demonstration power plant unnecessary.

A. Agree B. Unsure C. Disagree

28. If a federally-financed demonstration plant were sited in the same reservoir where a privately-financed power plant with a vastly different power conversion cycle is planned or under construction, the federally-funded demonstration power plant would still provide valuable data to the geothermal community.

A. Agree B. Unsure C. Disagree

TABLE A OPINION OF INDUSTRIAL LEADERS BY TYPE OF FIRM (Excluding Financial)
(Figures given in percents)

Question ^a Number	Type of Firm								
	Operator (N=25)			Engineer (N=13)			Utility (N=23)		
	Agree	Unsure	Disagree	Agree	Unsure	Disagree	Agree	Unsure	Disagree
1	28.0	12.0	60.0	15.4	30.8	53.8	26.1	4.3	69.6
2	52.0	8.0	40.0	69.2	7.7	23.1	52.2	13.0	34.8
3	64.0	8.0	28.0	69.2	0.0	30.8	82.6	4.3	13.0
4 ^b	20.0	12.0	68.0	15.4	23.1	61.5	9.1	4.5	86.4
5	52.0	4.0	44.0	46.2	0.0	53.8	47.8	13.0	39.1
6 ^c	66.7	4.2	29.2	69.2	0.0	30.8	78.3	0.0	21.7
7	36.0	12.0	52.0	38.5	15.4	46.2	73.9	4.3	21.7
8 ^b	44.0	16.0	40.0	46.2	7.7	46.2	22.7	4.5	72.7
9	20.0	12.0	68.0	15.4	23.1	61.5	13.0	8.7	78.3
10	36.0	8.0	56.0	15.4	15.4	69.2	39.1	13.0	47.8
11	68.0	12.0	20.0	69.2	0.0	30.8	82.6	4.3	13.0
12	40.0	24.0	36.0	46.2	23.1	30.8	30.4	13.0	56.5
13	44.0	12.0	44.0	53.8	15.4	30.8	73.9	4.3	21.7
14	72.0	8.0	20.0	61.5	7.7	30.8	82.6	0.0	17.4
15	52.0	8.0	40.0	53.8	15.4	30.8	60.9	17.4	21.7
16	56.0	8.0	36.0	69.2	0.0	30.8	78.3	8.7	13.0
17	20.0	12.0	68.0	23.1	7.7	69.2	8.7	17.4	73.9
18	64.0	4.0	32.0	61.5	0.0	38.5	52.2	4.3	43.5
19	44.0	20.0	36.0	38.5	38.5	23.1	56.5	26.1	17.4
20	28.0	4.0	68.0	23.1	30.8	46.2	13.0	30.4	56.5
21	44.0	20.0	36.0	61.5	7.7	30.8	30.4	39.1	30.4
22	80.0	8.0	12.0	69.2	7.7	23.1	78.3	8.7	13.0
23	24.0	16.0	60.0	30.8	46.2	23.1	17.4	21.7	60.9
24	56.0	24.0	20.0	38.5	53.8	7.7	26.1	39.1	34.8

TABLE A (continued)

Question Number	Type of Firm								
	Operator (N=25)			Engineer (N=13)			Utility (N=23)		
	Agree	Unsure	Disagree	Agree	Unsure	Disagree	Agree	Unsure	Disagree
25	24.0	0.0	76.0	23.1	15.4	61.5	21.7	8.7	69.6
26	20.0	44.0	36.0	15.4	46.2	38.5	13.0	30.4	56.5
27	32.0	12.0	56.0	23.1	23.1	53.8	26.1	13.0	60.9
28	72.0	12.0	16.0	76.9	15.4	7.7	78.3	4.3	17.4

^a For exact wording of each question see Appendix 1.

^b One case missing data due to non response by utility firm to this question.

^c One case missing data due to non response by operator firm to this question.

TABLE B OPINION OF GEOTHERMAL INDUSTRY FIRMS BY LEVEL OF COMMITMENT TO
GEOTHERMAL RESOURCE DEVELOPMENT (excluding financial)

Question ^a Number	Level of Commitment					
	Heavily Committed (N=33)			Not Heavily Committed (N=28)		
	Agree	Unsure	Disagree	Agree	Unsure	Disagree
1	24.2	6.1	69.7	25.0	21.4	53.6
2	63.6	3.0	33.3	46.4	17.9	35.7
3	72.7	3.0	24.2	71.4	7.1	21.4
4 ^b	21.2	9.1	69.7	7.4	14.8	77.8
5	45.5	12.1	42.4	53.6	0.0	46.4
6 ^c	71.9	0.0	28.1	71.4	3.6	25.0
7*	66.7	6.1	27.3	32.1	14.3	53.6
8 ^c	25.0	9.4	65.6	50.0	10.7	39.3
9	24.2	9.1	66.7	7.1	17.9	75.0
10	27.3	12.1	60.6	39.3	10.7	50.0
11	72.7	6.1	21.2	75.0	7.1	17.9
12	36.4	15.2	48.5	39.3	25.0	35.7
13	66.7	3.0	30.3	46.4	17.9	35.7
14	75.8	3.0	21.2	71.4	7.1	21.4
15	63.6	12.1	24.2	46.4	14.3	39.3
16	63.6	6.1	30.3	71.4	7.1	21.4
17	18.2	15.2	66.7	14.3	10.7	75.0
18	66.7	6.1	27.3	50.0	0.0	50.0
19	57.6	15.2	27.3	35.7	39.3	25.0
20	27.3	12.1	60.6	14.3	28.6	57.1
21	39.4	24.2	36.4	46.4	25.0	28.6
22	75.8	6.1	18.2	78.6	10.7	10.7
23	18.2	18.2	63.6	28.6	32.1	39.3
24	45.5	27.3	27.3	35.7	46.4	17.9
25	24.2	9.1	66.7	21.4	3.6	75.0
26	24.2	33.3	42.4	7.1	46.4	46.4
27	27.3	24.2	48.5	28.6	3.6	67.9
28	69.7	12.1	18.2	82.1	7.1	10.7

TABLE B (continued)

* Chi-square significant at $p < .05$ level.

^a For exact wording of each question see Appendix 1.

^b One case missing data due to non response by not heavily committed firm to question.

^c One case missing data due to non response by heavily committed firm to question.

TABLE C RESPONSE TO QUESTIONNAIRE BY SAMPLE (excluding financial)
(Figures given in percents)

Question ^a Number	Preliminary Leader Sample (N=61)			Representative Sample (N=20)		
	Agree	Unsure	Disagree	Agree	Unsure	Disagree
1	24.6	13.1	62.3	20.0	25.0	55.0
2	55.7	9.8	34.4	40.0	25.0	35.0
3	72.1	4.9	23.0	60.0	15.0	25.0
4*,b	15.0	11.7	73.3	15.0	35.0	50.0
5	49.2	6.6	44.3	45.0	20.0	35.0
6*,b	71.7	1.7	26.7	55.0	15.0	30.0
7*	50.8	9.8	39.3	10.0	15.0	75.0
8*,b	36.7	10.0	53.3	65.0	15.0	20.0
9	16.4	13.1	70.5	30.0	10.0	60.0
10*	32.8	11.5	55.7	15.0	40.0	45.0
11	73.8	6.6	19.7	65.0	10.0	25.0
12	37.7	19.7	42.6	60.0	20.0	20.0
13*	57.4	9.8	32.8	20.0	20.0	60.0
14 ^c	73.8	4.9	21.3	68.4	15.8	15.8
15	55.7	13.1	31.1	65.0	10.0	25.0
16	67.2	6.6	26.2	60.0	15.0	25.0
17*,c	16.4	13.1	70.5	52.6	15.8	31.6
18*	59.0	3.3	37.7	40.0	25.0	35.0
19 ^c	47.5	26.2	26.2	26.3	42.1	31.6
20*,c	21.3	19.7	59.0	36.8	36.8	26.3
21	42.6	24.6	32.8	60.0	20.0	20.0
22	77.0	8.2	14.8	65.0	20.0	15.0
23	23.0	24.6	52.5	40.0	10.0	50.0
24	41.0	36.1	23.0	40.0	45.0	15.0
25*	23.0	6.6	70.5	25.0	30.0	45.0
26	16.4	39.3	44.3	20.0	60.0	20.0
27*	27.9	14.8	57.4	30.0	45.0	25.0
28	75.4	9.8	14.8	60.0	15.0	25.0

TABLE C (continued)

* Chi-square significant at $p < .05$ level.

^a For exact wording of each question see Appendix 1.

^b One case missing data due to non response by preliminary sample firm to question.

^c One case missing data due to non response by representative sample firm to question.

TABLE D OPINION OF GEOTHERMAL INDUSTRY FIRMS BY GEOGRAPHIC AREA
(excluding financial)^a (Figures given in percents)

Question ^b Number	Western State (N=64)			Non Western State (N=17)		
	Agree	Unsure	Disagree	Agree	Unsure	Disagree
1*	25.0	9.4	65.6	17.6	41.2	41.2
2	54.7	12.5	32.8	41.2	17.6	41.2
3	70.3	7.8	21.9	64.7	5.9	29.4
4 ^c	14.3	14.3	71.4	17.6	29.4	52.9
5	46.9	10.9	42.2	52.9	5.9	41.2
6 ^d	70.3	3.1	26.6	56.3	12.5	31.3
7*	48.4	9.4	42.2	11.8	17.6	70.6
8 ^c	38.1	11.1	50.8	64.7	11.8	23.5
9	20.3	10.9	68.8	17.6	17.6	64.7
10	26.6	21.9	51.6	35.3	5.9	58.8
11	75.0	7.8	17.2	58.8	5.9	35.3
12	45.3	18.8	35.9	35.3	23.5	41.2
13*	56.3	9.4	34.4	17.6	23.5	58.8
14 ^c	76.2	4.8	19.0	58.8	17.6	23.5
15	57.8	12.5	29.7	58.8	11.8	29.4
16	67.2	7.8	25.0	58.8	11.8	29.4
17 ^c	23.8	12.7	63.5	29.4	17.6	52.9
18	51.6	10.9	37.5	64.7	0.0	35.3
19 ^c	46.0	28.6	25.4	29.4	35.3	35.3
20 ^c	22.2	25.4	52.4	35.3	17.6	47.1
21	43.8	25.0	31.3	58.8	17.6	23.5
22	76.6	9.4	14.1	64.7	17.6	17.6
23	25.0	21.9	53.1	35.3	17.6	47.1
24	37.5	39.1	23.4	52.9	35.3	11.8
25	21.9	14.1	64.1	29.4	5.9	64.7
26	15.6	45.3	39.1	23.5	41.2	35.3
27	26.6	23.4	50.0	35.3	17.6	47.1
28*	78.1	4.7	17.2	47.1	35.3	17.6

TABLE D (continued)

* Chi-square significant at $p < .05$ level.

^a Western states include the following: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

^b For exact wording of each question see Appendix 1.

^c One case missing data due to non response by western state firm to this question.

^d One case missing data due to non response by non western state firm to this question.

TABLE E COMPILATION OF ANSWERS SHOWING AFFIRMATION OF THE GEOTHERMAL
DEMONSTRATION POWER PLANT PROGRAM (Figures in percents)

CATEGORY A: Questions showing affirmation by an answer of "Agree"					CATEGORY B: Questions showing affirmation by an answer of "Disagree"				
Sample 1		Sample 2		No.	Sample 1		Sample 2		No.
Agree	Disagree	Agree	Disagree		Agree	Disagree	Agree	Disagree	
2	56	34	40	35	1	25	62	20	55
3	72	23	60	25	4	15	73	15	50
5	49	44	45	35	9	16	71	30	60
6	72	27	55	30	12	38	43	60	20
13	57	33	20	60	17	16	71	53	32
14	74	21	68	16	20	21	59	37	26
15	58	31	65	25	23	23	53	40	50
16	67	26	60	25	25	23	71	25	45
19	48	26	26	32	26	16	44	20	20
22	77	15	65	15	27	28	57	30	25
28	75	15	60	25					
Averages	64	27	51	29	Averages	21	60	33	38

Qualifying questions (questions that neither affirmed nor denied the geothermal demonstration power plant program): Nos. 7, 8, 10, 11, 18, 21 & 24.

In the preliminary study four types of firms were distinguished: Engineers, Financial, Operators, and Utilities. The low number of financial firms included in the sample (13) and the low response rate of financial firms (46% or 6 firms) made it statistically misleading to include financial firms in the analyses reported on in this final report. Financial firms were therefore excluded from all tables discussed. However, for purposes of completeness we have included responses of financial firms in this Appendix (Table F). A comparison of financial firms (Table G) with the other 3 types of firms on the ten key questions (see Tables 1 and 2) indicates a high percentage of unsure responses on the part of financial firms (i.e. in question 12 50% of the financial firm responses were unsure). In addition, in questions 1, 2, 4, 9, 17, 19, and 23 the direction of the responses of financial firms was the reverse of the other 3 firms. On questions 14 and 28 the financial firms were equally divided among all 3 response categories whereas the other three types of firms exhibited quite high affirmative responses.

Earlier analysis showed that when responses to questions were compared by type of firm (excluding financial) there were no significant differences found by type of firm. Performing the same kind of analysis including financial firms revealed the following questions as ones on which significant differences are found by type of firm: 3, 6, 9, 11, 16, 20, and 25.

Again, we must caution that the low number of responses on the part of financial firms makes inferences drawn from these responses somewhat statistically misleading. However, it would appear that financial firms do have somewhat divergent opinions from those of other types of firms in the geothermal industry.

TABLE F OPINION OF INDUSTRY LEADERS BY TYPE OF FIRM (including financial)
(Figures given in percents)

Question ^a Number	Operators (N=25)			Engineer (N=13)			Utility (N=23)			Financial (N=6)		
	Agree	Unsure	Disagree	Agree	Unsure	Disagree	Agree	Unsure	Disagree	Agree	Unsure	Disagree
1	28.0	12.0	60.0	15.4	30.8	53.8	26.1	4.3	69.6	50.0	33.3	16.7
2	52.0	8.0	40.0	69.2	7.7	23.1	52.2	13.0	34.8	0.0	16.7	83.3
3*	64.0	8.0	28.0	69.2	0.0	30.8	82.6	4.3	13.0	16.7	0.0	83.3
4	20.0	12.0	68.0	15.4	23.1	61.5	9.1	4.5	86.4	50.0	33.3	16.7
5	52.0	4.0	44.0	46.2	0.0	53.8	47.8	13.0	39.1	16.7	0.0	83.3
6*	66.7	4.2	29.2	69.2	0.0	30.8	78.3	0.0	21.7	0.0	16.7	83.3
7	36.0	12.0	52.0	38.5	15.4	46.2	73.9	4.3	21.7	16.7	16.7	66.7
8	44.0	16.0	40.0	46.2	7.7	46.2	22.7	4.5	72.7	40.0	20.0	40.0
9*	20.0	12.0	68.0	15.4	23.1	61.5	13.0	8.7	78.3	83.3	0.0	16.7
10	36.0	8.0	56.0	15.4	15.4	69.2	39.1	13.0	47.8	16.7	0.0	83.3
11*	68.0	12.0	20.0	69.2	0.0	30.8	82.6	4.3	13.0	0.0	50.0	50.0
12	40.0	24.0	36.0	46.2	23.1	30.8	30.4	13.0	56.5	33.3	50.0	16.7
13	44.0	12.0	44.0	53.8	15.4	30.8	73.9	4.3	21.7	16.7	0.0	83.3
14	72.0	8.0	20.0	61.5	7.7	30.8	82.6	0.0	17.4	33.3	33.3	33.3
15	52.0	8.0	40.0	53.8	15.4	30.8	60.9	17.4	21.7	33.3	16.7	50.0
16*	56.0	8.0	36.0	69.2	0.0	30.8	78.3	8.7	13.0	16.7	0.0	83.3
17	20.0	12.0	68.0	23.1	7.7	69.2	8.7	17.4	73.9	40.0	40.0	20.0
18	64.0	4.0	32.0	61.5	0.0	38.5	52.2	4.3	43.5	16.7	16.7	66.7
19	44.0	20.0	36.0	38.5	38.5	23.1	56.5	26.1	17.4	0.0	33.3	66.7
20*	28.0	4.0	68.0	23.1	30.8	46.2	13.0	30.4	56.5	66.7	33.3	0.0
21	44.0	20.0	36.0	61.5	7.7	30.8	30.4	39.1	30.4	66.7	33.3	0.0
22	80.0	8.0	12.0	69.2	7.7	23.1	78.3	8.7	13.0	33.3	50.0	16.7
23	24.0	16.0	60.0	30.8	46.2	23.1	17.4	21.7	60.9	66.7	16.7	16.7
24	56.0	24.0	20.0	38.5	53.8	7.7	26.1	39.1	34.8	66.7	33.3	0.0
25*	24.0	0.0	76.0	23.1	15.4	61.5	21.7	8.7	69.6	83.3	16.7	0.0
26	20.0	44.0	36.0	15.4	46.2	38.5	13.0	30.4	56.5	50.0	50.0	0.0
27	32.0	12.0	56.0	23.1	23.1	53.8	26.1	13.0	60.9	83.3	16.7	0.0
28	72.0	12.0	16.0	76.9	15.4	7.7	78.3	4.3	17.4	33.3	33.3	33.3

* Chi-square significant at $p < .05$ level.

^a For exact wording of each question see Appendix 1.

TABLE G RESPONSES TO KEY QUESTIONS BY FINANCIAL FIRMS
(Figures in percents)

Question Responses	Financial Firms (N=6)
<u>Category A</u>	
Question 2	
Agree	0.0
Unsure	16.7
Disagree	<u>83.3</u>
Total	100.0
Question 14	
Agree	33.3
Unsure	33.3
Disagree	<u>33.3</u>
Total	99.9 ^b
Question 19	
Agree	0.0
Unsure	33.3
Disagree	<u>67.7</u>
Total	100.0
Question 28	
Agree	33.3
Unsure	33.3
Disagree	<u>33.3</u>
Total	99.9 ^b
<u>Category B</u>	
Question 1	
Agree	50.0
Unsure	33.3
Disagree	<u>16.7</u>
Total	100.0
Question 4	
Agree	50.0
Unsure	33.3
Disagree	<u>16.7</u>
Total	100.0
Question 9*	
Agree	83.3
Unsure	0.0
Disagree	<u>16.7</u>
Total	100.0

TABLE G (continued)

Question Responses	Financial Firms (N=6)
Question 12	
Agree	33.3
Unsure	50.0
Disagree	<u>16.7</u>
Total	100.0
Question 17	
Agree	40.0
Unsure	40.0
Disagree	<u>20.0</u>
Total	100.0
Question 23	
Agree	66.7
Unsure	33.3
Disagree	<u>0.0</u>
Total	100.0

* Chi-square significant at $p < .05$ level.

^a For exact wording of questions see Appendix 1.

^b Figures do not add to 100% due to rounding.