CHAPTER I

OVERVIEW

A. INTRODUCTION

Development of the geothermal resource, like the development of any other resource, depends upon the responses to a number of key issues. Those key issues, in capsule form, are:

(1) Resource extent and producibility.

(2) Maturity of the associated technology of production and utilization.

(3) Economics and energetics of production and utilization.

(4) Environmental acceptability.

(5) The marketplace and potential market penetration.

Discussion of these key issues is important at all stages of a development project, but especially during the early stages when recommendations for commitment of considerable technical, economic, and non-renewable resources are being proposed.

The objective of the overall study, of which this report volume composes a part, is to identify the important issues confronting the development of geopressured geothermal resources for electric power generation. However, identification and enumeration of important issues is not sufficient; the identified issues must be assessed and activities necessary for resolving or mitigating identified problems proposed. The work reported in this volume focusses primarily on the key issues associated with utilizing geopressured geothermal resources for electricity generation; however, a brief discussion of industrial utilization is also included. The utilization issues are identified, are assessed, and are placed in perspective with one another and with the total project. Activities, necessary for resolving or mitigating identified key issues (for specific problems associated with key issues), are proposed. Finally, conclusions are drawn from the issue assessment; recommendations for future activity are formulated in view of the

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assessment conclusions and the increased magnitude of expenditure of technical and economic resources required to proceed with the next meaningful step in the development process.

The major emphases of this volume are the scope and maturity of technology for resource utilization, the energetics and economics of utilization, and certain aspects of the environmental loads expected from utilization. Again, most of the interest focusses on utilization for electric power generation, but some attention is given to industrial utilization.

The utilization investigation was subdivided into six technical studies and one technology development study. The approach adopted in the technical studies was to define the expected resource based upon the best resource data available at the beginning of the project. Then, the specific technology required for geothermal fluids processing in a fuel plant was identified and a fuel plant preliminary conceptual design produced. Next power conversion technology was assessed and preliminary conceptual designs for power plants were produced. Cost factors developed from the preliminary conceptual designs were used to generate net energetics and economic analyses. The former are used to rank the geopressured geothermal resource with respect to other fuels and plants for electric power generation. Finally, the technical tasks were completed with an enumeration of the technological issues which need to be addressed in later research and development. Laboratory facilities and a phased program for investigating identified problems are recommended. The following is a capsule presentation of the succeeding chapters and represents a general summary of results of the above program.

B. SCOPE

1. COMMERCIAL ELECTRICITY GENERATION PLANTS

Chapter II presents the results of studies by two subcontractors--Brown and Root, Inc., and Dow Chemical, USA--which result in preliminary conceptual designs of electricity generation plants using a model geopressured geothermal resource. The cycle and process studies lead to preliminary cycle and process selection and to conceptualization of design and costs for plants in the 25 MW(e) [net] class. This size seems consistent

with the resource assessment data reviewed at the beginning of the project and, later, at the end of the project.

2. FUEL PLANTS FOR COMMERCIAL ELECTRICITY GENERATION PLANT

Knowing the model resource and the power plants' fluid flow requirements allowed the preliminary conceptual design of fuel plants. Chapter III notes the production and reinjection well characteristics necessary to produce and dispose of the geothermal fluids. Assumptions were made for well spacing in both the production and reinjection wellfields and then gathering and disposal systems were designed to deliver the required flow of fluids. Processes developed for methane processing and brine processing were translated into fuel processing plant preliminary conceptual designs and costs by Dow Chemical, USA, acting as a subcontractor.

3. NET ENERGETICS ANALYSIS

Net energy analysis of the fuel and power plants was used to evaluate the attractiveness of geopressured geothermal power generation alternatives in relation to western hydrothermal resource generation, western low-sulfur coal-fired power generation, and briefly, nuclear fission power generation. Chapter IV presents the concepts of net energetics analysis, the assumptions and details of the analyses, and the results and conclusions.

4. ECONOMIC ANALYSIS

The estimated capital costs of Chapter III, estimated operations and maintenance costs, and estimated revenues are used in Chapter V to prepare economic analyses. Both present worth and the more traditional levelized consolidated balance sheet are used to evaluate and compare geopressured goethermal generation and western low-sulfur coal-fired generation.

5. WATER RESOURCES ANALYSIS

The efficiency of geothermal electric generation plants is known to be low while water resources in most geothermal regions are known to be fully committed. Presented in Chapter VI is a survey of the water resources of the Texas Gulf Coast. The impact of meaningful amounts of geothermal

generation on the water resources are assessed in terms of subregion and county water resources. Necessary resources are identified.

6. GEOTHERMAL EFFLUENT DISPOSAL

The quantities of geothermal brines required for meaningful electric power generation is enormous. The work reported in Chapter VII represents a preliminary investigation of this serious problem; the alternatives currently available are discussed and some implications of each choice are presented.

7. INDUSTRIAL UTILIZATION

Chapter VIII presents the results of a brief survey of the potential utilization of geopressured geothermal fluids in other Texas industry than electric power generation. The character of most Texas industry limits the impact that use of these fluids can have on industry. This result obtains because petroleum, petrochemical, and chemical industry predominates. Consequently, Chapter VIII also presents the results of a brief technical, energetics, and economics study of a potential process for tailoring geothermal fluids for suitable use in these important Texas industries.

8. TECHNOLOGY DEVELOPMENT

All of the foregoing analysis and design effectively focussed research attention on the important economic and technical problems associated with the geopressured geothermal resource and its utilization. Chapter IX presents the identified problems and formulates a research and development plan aimed at evaluating, mitigating, and/or eliminating these problems. Programs and physical facilities to execute the required research and development are suggested and discussed.

9. SUMMARY AND RECOMMENDATIONS

This final, brief chapter highlights the conclusions developed and presents recommendations for future work.